

B-09 Thematic Poster - Aging

Wednesday, May 27, 2020, 1:00 PM - 3:00 PM
 Room: CC-2007

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

587 **Board #1** **May 27 1:00 PM - 3:00 PM**
Arterial Stiffness And Cardiorespiratory Fitness In Adults With And Without Down Syndrome: An Age-and Sex-matched Study

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INTRODUCTION: There are gaps in our knowledge about differences in arterial stiffness (AS) and cardiorespiratory fitness (CRF) in adults with and without Down syndrome (DS).

PURPOSE: To describe and compare AS and CRF in adults with DS versus adults without DS.

METHODS: Fourteen adults with DS (27±5 yrs) and 14 adults without DS (27±5 yrs) participated in this study. An informed consent and a health screening questionnaire was completed by each participant and/or legal guardian. After familiarization, participants rested lying for 5-10 minutes before the measurements were taken. Brachial and central systolic and diastolic blood pressure (BSP; BDP; CSP; CDP), central augmented pressure (AP), augmentation index (AIx), AIx normalized at 75 beats/min (AIx@75) and AS (carotid-femoral pulse wave velocity (cfPWV)) were measured by using the SphygmoCor Xcel device (SphygmoCor XCEL, AtCor Medical). To assess the CRF, all participants performed a maximal treadmill test. Respiratory gas-exchange was measured breath-by-breath with an automatic gas analysis system (Metasys TR-plus, Brainware SA, La Valette, France).

RESULTS: Non-DS participants were taller and had a lower BMI than the DS group (all $p < .05$). The CRF of the DS group was lower than the non-DS group (VO_2 peak = 29.4±6.3 vs. 51.5±11.3 ml/kg/min; $p < .001$). Non-significant differences were found for BSP/BDP (DS = 116.31 ± 10.9/68.4 ± 9.3 vs. Non-DS = 123.43 ± 8.8/71.6 ± 6.6 mmHg; all $p > .050$); CSP/CDP (DS = 103.6 ± 8.5/61.1 ± 9.3 vs. Non-DS = 107.0 ± 7.6/71.6 ± 6.6 mmHg; all $p > .050$) and cfPWV (DS = 5.5 ± .6 vs. Non-DS = 5.8 ± .7 m/sec; $p = .191$). The AP (DS = 6.4 ± 2.7 vs. Non-DS = 1.8 ± 3.2 mmHg; $p = .002$); AIx (DS = 18.1 ± 6.3 vs. Non-DS = 4.9 ± 10.3; $p = .001$) and the AIx@75 (DS = 12.3 ± 8.8 vs. Non-DS = -1.6 ± 11.7; $p = .002$) were significantly higher in the DS group.

CONCLUSIONS: Despite having lower CRF and higher BMI, adults with DS presented similar values of central and peripheral blood pressure than the Non-DS group. Nevertheless, the DS group showed higher AP, AIx and AIx@75 values, which may be due to a higher aortic wave reflection and arterial stiffness. **Partially supported by:** MINECO (DEP2017-86862-C2-1-R) & FPCEE Blanquerna (APR- FPCEE19/20).

588 **Board #2** **May 27 1:00 PM - 3:00 PM**
Evaluation Of 3D Body Imaging To Estimate Percentage Body Fat In Older Adults

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Aging is often associated with adverse changes in body composition that contribute to the development of age-related cardiometabolic and geriatric disorders. Although Dual Energy X-ray Absorptiometry (DXA) remains the gold-standard for assessing body composition, 3D body imaging is emerging as cost-effective, noninvasive, user-friendly alternative. However, the validity of 3D body imaging to assess percentage body fat in older adults is unknown.

PURPOSE: This study examined the association between percentage body fat estimated by 3D body imaging vs. DXA (criterion) in inactive older adults.

METHODS: The present analyses included data from 17 (12F, 5M and 13 White, 4 Black) older (X±SD; 71±4) adults that were participating in an ongoing exercise

intervention (REALPA). Participants completed a DXA using a Hologic Horizon A and 3D body imaging using a Fit3D to estimate whole-body percentage fat. Paired t-test were performed to assess mean differences between the two methodologies. Linear regression models were used to determine the association between the two methodologies. Finally, Bland-Altman plots were used to assess level of agreement between the two methodologies.

RESULTS: The mean percentage body fat measured by Fit3D was significantly lower than DXA (34±6% vs. 38±8%, $p < 0.01$). There was a strong positive correlation between the percentages body fat measured by the Fit3D and DXA methods ($r = 0.72$, $P = 0.001$). The mean difference (limits of agreement) between the Fit3D vs. DXA for percentage body fat was -3.8% (-14.5%, 6.7%). Finally, the Bland-Altman analysis revealed that the Fit3D over estimates percentage fat at lower percentages and under estimates percentage fat at high percentages.

CONCLUSION: Although the percentage body fat measured by the Fit3D was highly correlated with those measured by DXA (criterion), the Fit3D tended to produce lower percentage body fats than the DXA. The presence of measurement bias also suggests that the Fit3D measurements may not be interchangeable with those obtained from DXA in older adults. Future research is necessary to optimize the validity of the Fit3D to estimates of percentage body fat in older adults.

This study was supported by the NIH 5R21AG058181-02.

589 **Board #3** **May 27 1:00 PM - 3:00 PM**
Relative Intensity-associated Cadence (steps/min) Thresholds In 61-85 Year Olds, The Cadence-adults Study

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A cadence of 100 steps/min has been associated with absolutely-defined moderate intensity (3 metabolic equivalents [METs; where 1 MET = 3.5 mL O₂/kg) in young and middle-aged adults. However, less is known about how cadence corresponds with relative intensity indicators, especially in older adults. **PURPOSE:** To investigate cadence thresholds associated with the lower thresholds of relatively-defined indicators of moderate intensity provided in the 2011 ACSM Position Stand (i.e., 40-59% of heart rate reserve [%HRR], 64-76% of maximum heart rate [%HRmax], and a Borg scale rating of perceived exertion [RPE] of 12-13) in healthy older adults. **METHODS:** Ninety-eight older adults (mean [SD]; age = 72.6 [7.0] years, BMI = 25.9 [3.5] kg/m²) completed a progressive treadmill walking protocol consisting of 5-minute bouts separated by 2-min rests increasing from 0.5 to 6.0 mph in 0.5 mph increments. The protocol concluded following the bout during which the participants naturally selected to jog or run, reached 75% age-predicted HRmax, or reported a Borg scale RPE >13. Cadence was calculated by dividing directly observed step counts by bout duration (5 min). Heart rate (HR) was measured using a chest-worn Polar HR monitor, and HR was averaged over the final 2-min of each bout. HRmax was estimated using the standard equation of 220 - age. Intensity indicators were analyzed using Receiver Operating Characteristic (ROC) curves and optimal cadence thresholds associated with moderate intensity were determined using Youden's Index. **RESULTS:** The cadence threshold associated with 40% HRR was 103 steps/min (sensitivity = 78%, specificity = 75%, area under the ROC curve [AUC] = 0.83), and that associated with 64% HRmax was 104 step/min (sensitivity = 66%, specificity = 75%, AUC = 0.77). Additionally, an RPE ≥12 was associated with a cadence threshold of 101 steps/min (sensitivity = 63%, specificity = 73%, AUC = 0.79). **CONCLUSION:** Cadence thresholds of 100 - 104 steps/min were associated with relative indicators of moderate intensity in ostensibly healthy older adults. These results are consistent with the commonly reported heuristic (i.e., practical, rounded, evidence-based) threshold of 100 steps/min associated with absolutely-defined moderate intensity walking in healthy adults.

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590 Board #4 May 27 1:00 PM - 3:00 PM
Abstract Withdrawn

591 Board #5 May 27 1:00 PM - 3:00 PM
Relationship Between Fitness Age And Face Age Amongst An Older Adult Population
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(No relevant relationships reported)

PURPOSE: To determine the relationship between Fitness Age and Face Age amongst a sample of older adults. **METHODS:** Sixty participants (38 females; 22 males; Age = 82.7 ± 5.7 yrs; Height = 163.3 ± 8.3 cm; Body Mass = 72.4 ± 15.0 kg; Body Fat = 34.2% ± 8.9%) participated in the five-part fitness assessment to obtain a Fitness Age (FITA). Face Age (FACEA) was derived from a single high-resolution digital photograph using a proprietary algorithm based on machine learning to derive a perceived age in years from the face. Pearson product-moment correlation coefficient was used to assess the relationships between FITA and FACEA. **RESULTS:** Data revealed no significant correlation between FITA and FACEA for males ($r = .418, p = .053$). There was a significant positive correlation between FITA and FACEA for females ($r = .531, p = .001$). **CONCLUSIONS:** There was no relationship between FITA and FACEA amongst the male participants. Female participants, however, who had poorer fitness levels (higher FITA) subsequently appeared facially older (higher FACEA) when compared to their chronological age. Despite these mixed findings, more research is deemed necessary in this nascent field of research.

592 Board #6 May 27 1:00 PM - 3:00 PM
Preliminary Investigations Into Muscle Recovery Following Exercise-induced Muscle Damage Between Younger And Older Males
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(No relevant relationships reported)

Unaccustomed resistance exercise is associated with reductions in muscle force output, avoidance of repeated loading, pain and an inflammatory response. Whilst well defined in the literature in healthy younger populations, research into older individuals is lacking. **PURPOSE:** Examine muscle function, recovery and inflammatory response following an unaccustomed exercise-induced muscle damage protocol (EIMD) in younger and older males. **METHODS:** Healthy younger ($n = 7, 27.3 \pm 3.5$ years) and older ($n = 5, 62.6 \pm 2.1$ years) males provided written informed consent, performed a unilateral eccentric exercise protocol (7 sets of 10 repetitions, leg press machine). Venous plasma was collected for creatine kinase (CK), tumour necrosis factor (TNF)- α and interleukin (IL)-6 prior to EIMD, immediately after EIMD, and at 1, 2, 24, 48, and 72 hours post-EIMD. Maximal voluntary isometric contraction (MVIC), peak power and perceived muscle soreness were assessed at all time points except 1 and 2 hours post-EIMD. **RESULTS:** Significant difference in CK was found between younger and older group at 72 hours post-EIMD ($p = 0.042$), with older showing a greater increase in CK (pre- vs 72h post-EIMD) compared to the younger group (165.7% vs 107.3%, respectively). Post EIMD, older group TNF- α concentrations were significantly increased relative to pre-EIMD in comparison to the younger group ($p = 0.042$). IL-6 did not differ between younger and older groups at any time point (each $p < 0.05$). A significant main effect for time was observed for MVIC ($p = 0.005$), with both groups showing a reduction in leg strength immediately post-EIMD. The main effect comparing the two groups MVIC was also significant ($p = 0.005$). The younger group had significantly higher power output than the older group ($p = 0.001$). No difference in perceived muscle soreness was observed at any time point. **CONCLUSIONS:** The older group had greater change in muscle damage and inflammatory response following EIMD, suggesting a blunted resolution relative to the younger group. As older individuals respond to EIMD in a different manner than younger people, prior research into recovery from EIMD in younger, primarily athletic populations, cannot be extrapolated into older populations.

593 Board #7 May 27 1:00 PM - 3:00 PM
Reference Standards For Cardiorespiratory Fitness In Overweight/obese Sedentary Adults 45-69 Years Of Age
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Purpose In order to establish standards for cardiorespiratory fitness (CRF; peak VO_2), peak heart rate (HR) and peak oxygen pulse (O_2 -pulse, a surrogate for stroke volume), we collated percentile data from maximal exercise testing from a sample of sedentary, overweight and obese adults in North Carolina. A second objective was to describe the relative role of declines in peak HR and peak O_2 -pulse in the overall decline in CRF that occurs from ages 45-69 years. **Methods** A total of 669 sedentary adults, ages 45-69, with BMI 25-35 kg/m^2 from the three STRRIDE clinical trial cohorts were included in the analysis. All three cohorts used the same graded maximal treadmill test. Peak VO_2 was determined by the greatest two consecutive 15-sec collection periods. O_2 -pulse was calculated as: peak VO_2 (mL/min) / peak HR (beats per min). Only subject's data with peak RER ≥ 1.00 were included in the registry. Sex-specific percentile data for each half-decade of age are shown in **Table 1** (only VO_2 Peak data shown below) **Results** When assessing trends across the 25 year age range, we observed a 20.6%, 14.3% and 11.6% decrement in peak VO_2 (mL/kg/min), peak HR and peak O_2 -pulse from the youngest to oldest women. In men, the magnitude of these trends across 25 years was slightly less, with 15.1%, 12.6% and 7.2% decrements in peak VO_2 (mL/kg/min), peak HR and peak O_2 -pulse. In both women and men, the age-dependent decrements in peak HR were greater than the decrements in peak O_2 -pulse. The trend for decrement in the weight-independent absolute peak VO_2 (L/min) was 24.1% in women and 19.7% in men across the 25-year period. **Conclusion** This CRF registry represents sedentary, overweight or obese adults in North Carolina. As a majority of Americans are sedentary and have an elevated BMI, these data are also likely representative of the U.S. population. Further, these data suggest that the age-dependent decrements in peak HR play a greater role than the loss of stroke volume in the decrease of CRF with age.

Table 1. STRRIDE Cardiorespiratory Fitness Data Registry by Percentiles of Peak VO_2

Percentiles	10	25	50	75	90
Women Age 45 – 49.9 (N=58)	17.9	19.8	23.6	25.8	27.9
Women Age 50 – 54.9 (N=91)	18.9	20.9	22.5	25.4	27.1
Women Age 55 – 59.9 (N=84)	18.0	20.5	23.0	25.6	27.8
Women Age 60 – 64.9 (N=60)	15.8	18.1	21.0	22.7	24.4
Women Age 65 – 69.9 (N=40)	15.0	16.7	18.8	20.1	21.7
Men Age 45 – 49.9 (N=50)	22.9	27.6	31.0	33.3	37.1
Men Age 50 – 54.9 (N=67)	21.2	24.7	28.6	31.8	36.3
Men Age 55 – 59.9 (N=60)	20.7	24.0	27.3	30.6	33.5
Men Age 60 – 64.9 (N=68)	19.9	23.8	26.1	29.4	31.2
Men Age 65 – 69.9 (N=48)	19.6	22.9	26.2	29.4	30.5

594 Board #8 May 27 1:00 PM - 3:00 PM
Does Carbohydrate Mouth Rinsing Affect Six Minute Walk Test And Blood Glucose Responses In Older Adults?
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(No relevant relationships reported)

Carbohydrate mouth rinsing (MR) prior to exercise can improve performance in endurance and power activities in young physically active populations. Carbohydrate MR may also improve impulse and power during the sit-to-stand maneuver in healthy older adults; however, its effect on functional aerobic endurance and underlying physiological mechanisms are not well established. **PURPOSE:** To determine if carbohydrate MR affects six-minute walk test (6MWT) distance and blood glucose responses in healthy older adults. **METHODS:** 26 participants (12 males, 14 females) age ≥ 70 years completed the 6MWT during two testing sessions under two MR conditions: a 6.4% maltodextrin (MDX) condition and a placebo (PLAC) condition. Participants and researchers were blinded to MR contents, and MR administration was counter-balanced. Prior to testing, participants refrained from food and drink (except water) for 4 hours, as well as exercise, caffeine, and alcohol for 12 hours. Testing

sessions occurred at the same time of day, separated by at least 48 hours. Participants held the MR in their mouth for 20 seconds, returned it to a vial, and immediately completed the 6MWT. Total distance walked and rating of perceived exertion (RPE) during the 6MWT were compared between MR conditions using paired sample t-tests. Blood glucose and lactate levels were compared pre- and post-6MWT and between MR conditions using 2x2 repeated measures ANOVAs. **RESULTS:** Total distance walked and RPE were similar between MR conditions (481 ± 79 m vs. 485 ± 70 m, $p = 0.33$ and 11 ± 3 vs. 11 ± 3 , $p = 0.62$). Blood glucose did not significantly differ according to MR condition or time (100 ± 16 mg/dL and 102 ± 17 mg/dL for the MDX condition pre- and post-6MWT; 105 ± 26 mg/dL and 104 ± 26 mg/dL for the PLAC condition pre- and post-6MWT, $p = 0.16$ - 0.49). Blood lactate significantly increased pre- to post-6MWT, but did not significantly differ according to MR condition (1.4 ± 0.5 mmol/L and 2.7 ± 0.9 mmol/L for the MDX condition pre- and post-6MWT; 1.4 ± 0.4 mmol/L and 2.6 ± 1.1 mmol/L for the PLAC condition pre- and post-6MWT; $p < 0.01$ - $p = 0.99$). **CONCLUSION:** Carbohydrate MR may not significantly impact functional aerobic performance in older adults. Continued research into the clinical relevance of pre-exercise MR in older adults, including the use of other variations of gustatory stimuli, is warranted.

B-10 Thematic Poster - Cardiac

Wednesday, May 27, 2020, 1:00 PM - 3:00 PM
Room: CC-2000

595 **Chair:** Eric J. Stohr. *Cardiff Metropolitan University, Cardiff, United Kingdom.*

(No relevant relationships reported)

596 Board #1 May 27 1:00 PM - 3:00 PM

Differences In Left Ventricular Twist In Elite Short And Long Distance Swimmers

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(No relevant relationships reported)

Exercise-induced cardiac remodeling is influenced by sport-specific exercise characteristics, such as the isometric and isotonic components of the activity. Differences in cardiac dimensions and left ventricular (LV) systolic and diastolic function have been observed between short- (SS) and long-distance (LS) swimmers. Intensity and duration specific adaptations in LV mechanics may help to explain these differences in global function. **PURPOSE:** To examine whether there are event-specific differences in LV twisting mechanics between elite SS and LS athletes. **METHODS:** Data were collected during the 2019 FINA World Championships. SS were identified as competing in pool events ranging from 50-400m; LS were identified as open water swimmers competing in events 5-25 km. Fourteen SS (7 males; 23 ± 4 years; 100% identified as white) and 14 sex, age and ethnicity matched LS were selected for comparison. Echocardiography was performed in the left lateral decubitus position following 10 minutes of rest. Parasternal short axis images at the level of the mitral valve and apex were analyzed using speckle-tracking software and post-processed in custom software to normalize the temporal sequence of heart rate. **RESULTS:** Data are presented as mean \pm SD for LS vs. SS. Athletes had a similar body surface area (1.92 ± 0.15 vs. 1.94 ± 0.18 m², $P=0.76$), resting heart rate (52 ± 10 vs. 54 ± 8 bpm, $P=0.54$), years of event-specific training (11 ± 6 vs. 14 ± 5 years, $P=0.21$), and weekly training duration (25 ± 5 vs. 22 ± 5 hours/week, $P=0.15$). Peak LV twist (13.8 ± 3.5 vs. 12.7 ± 5.0 deg, $P=0.49$) and peak LV twist normalized to LV length (1.7 ± 0.5 vs. 1.6 ± 0.6 deg/cm, $P=0.67$) were similar between groups. Time to peak LV twist (94 ± 4 vs. 98 ± 4 % systole, $P=0.006$) and time to peak LV untwisting rate (9 ± 4 vs. 12 ± 3 % diastole, $P=0.03$), were faster in LS, while time to peak twisting rate was also trending to be faster in LS (56 ± 9 vs. 62 ± 10 % systole, $P=0.06$). **CONCLUSION:** In swimming, event distance appears to influence the temporal sequence of LV mechanics at rest with faster twisting and untwisting rates occurring in swimmers who train and compete in longer-distances. The relationship between these observations and global systolic and diastolic function warrants investigation.

597 Board #2 May 27 1:00 PM - 3:00 PM
Cardiac Remodeling Following High Intensity Exercise Training In A Preclinical HCM Mouse Model

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(No relevant relationships reported)

Participation in high intensity exercise for individuals with hypertrophic cardiomyopathy (HCM) remains controversial. Retrospective data has suggested that HCM patients who participate in lifetime vigorous exercise can have favorable cardiac remodeling that resembles that which occurs in healthy athletes. Cardiac hypertrophy is highly variable in HCM patients and may mask physiologic hypertrophy induced by exercise. **PURPOSE:** Evaluate the effects of high intensity interval training (HIIT) on cardiac hypertrophy in a preclinical transgenic cardiac troponin T delta160E (TG) HCM mouse model. **METHODS:** C57BL/6J non-transgenic (NTG) (n=6 F, n=5 M) and TG (n=4 F, n=8 M) mice (13-16mos) underwent a translationally parallel cardiac rehabilitation HIIT protocol. One treadmill training bout included 4-4 minute high intensity intervals (~80% preVO₂ max speed) interspersed by 5-3 minute recovery intervals (~50% preVO₂ max speed) for 31 total minutes. Exercise compliance was measured as percent of total training time completed. Bouts were repeated 3 times/wk for 10wks. Pre and post HIIT murine echocardiography (ECHO) was recorded and analyzed by a blinded technician. Unpaired and paired t-tests were used for data analysis. **RESULTS:** Training compliance between TG and NTG did not differ ($921.90 \text{ min} \pm 4.24, 99.13\%$ vs $928.95 \text{ min} \pm 1.05, 99.90\%$; $p=0.14$). Pre and post HIIT left ventricular (LV) mass was significantly greater in both NTG (Mean difference & SEM: $23.04 \text{ mg}, 6.23$; $p=0.0042$) and TG (Mean difference & SEM: $17.56 \text{ mg}, 6.31$; $p=0.019$) mice. Body weights measured prior to pre and post HIIT ECHOs did not differ in NTG (Mean difference & SEM: $0.473 \text{ g}, 0.8370$; $p=0.585$) or TG (Mean difference & SEM: $1.354 \text{ g}, 0.819$; $p=0.129$) mice. **CONCLUSION:** In a preclinical HCM mouse model that doesn't demonstrate pathologic hypertrophy, HIIT training resulted in LV hypertrophy in both NTG and TG mice. Our data provides initial evidence that high intensity exercise training may result in physiologic hypertrophy. Biochemical analyses are underway to elucidate the underlying type of cardiac remodeling.

598 Board #3 May 27 1:00 PM - 3:00 PM
Abstract Withdrawn

599 Board #4 May 27 1:00 PM - 3:00 PM
Naltrexone, Opioid Antagonist, Decreases Left Ventricular Function At Rest And Following Acute Exercise In Mice.

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(No relevant relationships reported)

Naltrexone (NTX) is an opioid receptor blocker which can be prescribed for weight loss. To augment the effects of NTX on weight reduction, exercise (EX) is recommended as an adjacent therapy. There is prior evidence that NTX may interfere with the psychological benefits of EX. Despite a working knowledge of how NTX influences the psychological dynamics of EX investigations into how opioid receptor blockade may alter left ventricular function (LVF) following EX is lacking. **PURPOSE:** To determine the effect of NTX on LVF following EX in a rodent model. **METHODS:** Male 8 wk C57-BL6 mice were divided into 4 groups: control (CON), exercise (EX), naltrexone (NTX), exercise with naltrexone (EX+NTX). Mice that underwent EX performed 50 mins of forced swimming following a week of familiarization. NTX or saline was given (i.p., 4 mg/kg), 15 min prior to EX or 65 min prior to echocardiography (ECHO). Mice were anesthetized using isoflurane (4-5% for induction; 0.5-2.0% for maintenance of anesthesia). Fur was removed from the anesthetized animal with nair and echo gel was applied. LVF was assessed by ECHO using a VisualSonics Vevo 2100 ultrasound. LV internal dimensions (LVID) were measured in systole and diastole using Vevo 2100 for calculations. LV systolic function was estimated from LV dimensions by the cubed method. Results were quantified using a one-way ANOVA with a Tukey Post-HOC. **RESULTS:** Heart rate was elevated ($p<0.05$) in the EX group when compared to CON (CON = 275 ± 12 vs. EX = 360 ± 30 bpm; $n=8-9$). This effect was abolished with the addition of NTX (EX vs. EX-NTX = 275 ± 36 BPM). Stroke volume (SV), was reduced in the NTX group compared to CON and EX ($p<0.05$), exercise mediated increase in SV was attenuated with pre-treatment of NTX (CON 128.8 ± 15.0 , EX 147.4 ± 7.5 , EX+NTX 14.3 ± 17.7 , NTX 76.9 ± 19.0 ml; $n=7-8$). Cardiac output was

reduced in NTX group when compared to EX and CON ($p < 0.05$), NTX+EX was also lower ($p < 0.05$) than the EX group (CON 35.4 ± 4.3 , EX 52.5 ± 2.5 , EX+NTX 29.4 ± 6.5 , NTX 19.2 ± 4.5 L/min; $n = 7-8$).

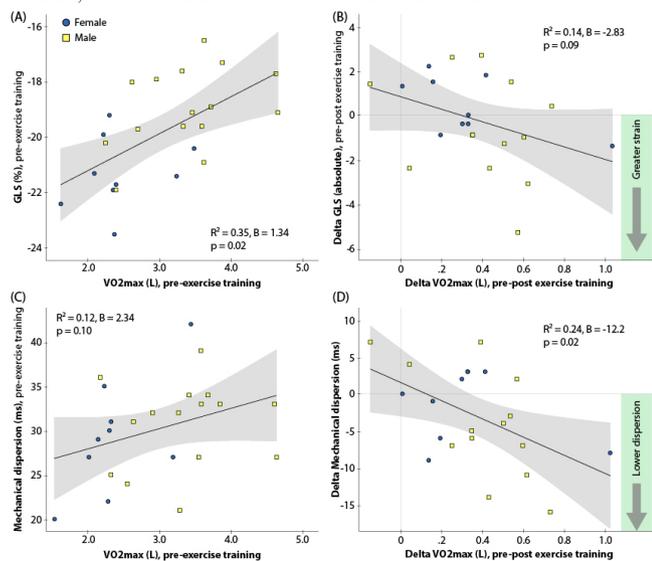
CONCLUSION: To our knowledge, this is the first study to examine the effects of NTX on LVF following acute exercise in a mouse model. These data suggest that NTX diminishes LVF following exercise. Being that exercise is a frontline therapy for weight loss the addition of NTX may alter LVF and ultimately negatively affect exercise recovery.

600 Board #5 May 27 1:00 PM - 3:00 PM

Effects Of Very Low Volume, High-intensity Interval Training On Left Ventricular Volume And Systolic Function

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PURPOSE: It is unknown whether exercise training of extremely low volume and high intensity is enough to elicit measurable changes in cardiac dimensions or function at rest. **METHODS:** Healthy, young subjects not performing regular training were recruited for six weeks of supervised exercise training, three times per week. Each of the 18 sessions consisted of three 30 seconds all-out sprints on a bicycle ergometer (breaking force 7.5% of the subject's body weight), separated by two minutes of low intensity cycling. A maximal cardiopulmonary exercise test (CPX) and an echocardiographic examination (echo) at rest were performed before and the week after the last session. Left ventricular (LV) and left atrial (LA) volumes were determined with 4-D echo. LV systolic function was measured as ejection fraction (LVEF), global systolic longitudinal strain (GLS, 2-D speckle tracking), and mechanical dispersion (MD, standard deviation of time to peak systolic strain in all 17 LV segments). **RESULTS:** Twenty eight subjects (27 ± 5 yrs, 16 male) performed all sessions and pre- and post echo. VO_{2max} , determined in 27 subjects, increased from 3.0 ± 0.8 L/min to 3.4 ± 0.8 L/min post-training (mean +14%, $p < 0.001$). LV end-diastolic volume and LV stroke volume were similar pre-/post training (112 ± 20 vs 115 ± 24 mL, $p = 0.29$; 65 ± 13 vs 66 ± 3 mL, $p = 0.64$), as was LA end-systolic volume (47 ± 9 vs 51 ± 15 mL, $p = 0.26$). LVEF and GLS were similar pre-/post training (58 ± 5 vs 58 ± 6 %, $p = 0.89$; -20 ± 2 vs -20 ± 2 %, $p = 0.60$) while MD decreased from 30 ± 6 to 27 ± 7 ms, $p = 0.042$. There was a significant association between the decrease in MD and increase in VO_{2max} as well as between baseline GLS and VO_{2max} (figure 1). **CONCLUSIONS:** Less than five minutes of high-intensity exercise training per week for six weeks increased VO_{2max} , but not LV or LA volume at rest. Interestingly, LV longitudinal shortening was more synchronous following training, proportional to the increase in VO_{2max} , which could indicate a more efficient LV contraction.



601 Board #6 May 27 1:00 PM - 3:00 PM

Time-frequency Analysis Of The Seismocardiogram

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(No relevant relationships reported)

PURPOSE: The present study compares the features of the seismocardiograph (SCG) resolved in the time-frequency domain to the features of a single-lead electrocardiogram (ECG). **METHOD:** SCG and ECG signals were obtained from the combined measurement of ECG, breathing and seismocardiogram (CEBS) database. Baseline signals (b001 to b020) were selected from the data base and trimmed to include a minimum of ~10 beats (range: 8-12 beats; 50,000 samples). The analyzed data included lead II ECG with a bandwidth between 0.05 Hz and 150 Hz and SCG acquired using a triaxial accelerometer with a bandwidth between 0.5 Hz and 100 Hz, sampled at 5000 Hz. Time values for the peak P- and T-waves and the Q, R, and S of the ECG were identified and recorded. The SCG was subjected to an adaptation of the von Tscharny intensity analysis for accelerometry ($r = 1.959$, $q = 1.45$, scale = 1.0), and total intensity (sum of the intensities over the set of $J = 11$ Cauchy wavelets for each sample in time) was calculated. The peaks (P1 & P2) and valleys (V1 & V2) of the total intensity for each cardiac cycle (10 per sample) were determined and compared to the ECG. Correlation coefficients were determined and P1-P1 and R-R intervals were compared using a paired t-test in R. Statistical significance was set at an alpha-level of 0.05. **RESULTS:** Correlations were consistently strong among the variables (range: 0.971 to 0.999). There were no significant differences between the rate intervals for P1-P1 and R-R ($p = 0.60$). **CONCLUSION:** This preliminary analysis suggests that the SCG intensity analysis may be a suitable alternative when EMG signals are not feasible. Visual analysis and these results suggest that SCG intensity provides reliable heart rate data and may offer further insight into the nature of the cardiac cycle (e.g., pre-ejection period, left ventricular ejection time, etc.), however, the CEBS database lacked data (e.g., heart sounds) that would permit more thorough analyses. Additional study is, therefore, warranted.

602 Board #7 May 27 1:00 PM - 3:00 PM

Importance Of Frequency In Volume Matched Exercise On Heart Rate Variability In Type 2 Diabetes

Charlotte Bjoerk Ingul, Michael Shelver, Norwegian University of Science and Technology, Trondheim, Norway.
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(No relevant relationships reported)

Type 2 diabetes mellitus is associated with a decrease in heart rate variability (HRV), which reflects autonomic nervous system modulation of cardiac activity and is associated with increased mortality. HRV variation is the time interval between consecutive heartbeats. Nighttime HRV provides a more unambiguous measurement of changes in the autonomic nervous systems regulation.

PURPOSE: To compare two volume and intensity matched exercise protocols with different frequencies in individuals with T2D and to investigate the effects on HRV. **METHODS:** 54 subjects with T2D were recruited and randomly assigned to either a high-frequency high-intensity interval training protocol (HF, $n = 29$) (10-minute high frequency, 12 sessions per week) or a low-frequency high-intensity interval training protocol (LF, $n = 25$) (30-minute low frequency, 4 sessions per week). Both groups were matched for volume and intensity, and the study participants exercised for 120 minutes a week for 12 weeks. 24-hour time-domain HRV measurements were selected for analysis. Aerobic capacity (VO_{2peak}) and glycosylated hemoglobin (HbA1c) were also measured. **RESULTS:** HRV improved only in the LF group, with a significant decrease in nighttime heart rate and an increase in nighttime HRV (rMSSD, root mean square of differences between NN intervals) (Table). Both the HF and LF group significantly improved aerobic capacity by 9% (3.0 ml, baseline 33.2 ml/kg/min) and 10% (3.3 ml, baseline 32.1 ml/kg/min), respectively, with no significant difference between groups. A significant decrease of 5% in HbA1c was observed in the LF group only ($p = 0.001$). **CONCLUSION:** Longer, less frequent exercise training seems to be more effective in improving heart rate variability, and glycemic control in type 2 diabetes provided this is at a frequency of at least four times a week. This finding might be associated with enhanced cardiovascular health in a population with an elevated risk of cardiovascular morbidity and mortality.

Nighttime Heart Rate Variability in type 2 diabetes after an exercise intervention						
	Baseline High-frequency training	Post intervention High-frequency training	P-value	Baseline Low-frequency training	Post intervention Low-frequency training	P-value
Night heart rate (beats/minute)	61±10	61±7	0.40	69±11	64±10	0.005
Night HRV rMSSD (ms)	29±13	35±17	0.36	27±13	32±17	0.02

B-11 Thematic Poster - Mitochondrial Metabolism

Wednesday, May 27, 2020, 1:00 PM - 3:00 PM
 Room: CC-2010

603 **Chair:** Robert Jacobs. *University of Colorado at Colorado Springs, Colorado Springs, CO.*
 (No relevant relationships reported)

604 Board #1 May 27 1:00 PM - 3:00 PM
PO₂-dependent Changes In Contractility And Mitochondrial Activation In Single Myofibers From Young And Old Mice

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 (No relevant relationships reported)

Aging shows muscle contractile and mitochondrial dysfunctions, as well as muscle hypoxia. **PURPOSE:** To investigate how aging affects contractile function during fatigue and contraction-induced mitochondrial activation at near-physiological oxygen tensions (PO₂). **METHODS:** Flexor digitorum brevis muscles were dissected from young (4-mo old, YM) and old (21-25 mo-old, OM) C57BL/6J mice. Single myofibers were perfused with Tyrode's solution (22°C), pre-equilibrated with 5% or 1% or 0% O₂, which produced an extracellular PO₂ of ~40, or 10, or 3 Torr, respectively. To measure fatigue resistance, myofibers (n=5 for YM and OM) were repetitively contracted (100 Hz) with progressive increases in train frequency each 2 min until fatigue (30% of initial tension) at 5% O₂. The myofibers rested for 1h, perfused with 1% O₂, and the previous contractile protocol was repeated. To measure NAD(P)H changes during contractions, myofibers (n=4 for YM and OM) were equilibrated at 5% O₂, then at 1% O₂, and then at 0% O₂, with 1h rest between conditions. For each PO₂ condition, myofibers contracted repetitively for 2 min at a fixed train frequency (0.5 trains per second). **RESULTS:** At 5% O₂, time to fatigue was significantly higher in myofibers from OM (509 ± 93 sec) vs YM (207 ± 38 sec, p<0.01). At 1% O₂, time to fatigue was not different to 5% O₂ in YM (4 ± 11% decrease, p=0.87), but showed a trend to be decreased in OM (16 ± 7% decrease, p=0.06). Relaxation time (½RT) at 5% O₂ was higher in OM (122 ± 17 ms) compared to YM (77 ± 4 ms, p<0.05) before fatiguing contractions, but showed a similar slowing in relaxation at fatigue (103 ± 30 vs 117 ± 33% increase, respectively, p>0.05). At 1% O₂, ½RT was further increased at fatigue (154 ± 39%) compared to 5% O₂ (p<0.05) in YM. ½RT changes with fatigue were not different in OM at 1% O₂ (151 ± 31 %) vs 5% O₂ (p>0.05). Contractions produced a transient (for ~30-40 s) increase in NAD(P)H fluorescence in YM at 5% O₂, which was enhanced at 1% and at 0% O₂. However, the increase in fluorescence at 1% O₂ was minimized in OM. **CONCLUSION:** These data suggest that myofibers from old mice have a higher fatigue resistance during repetitive contractions under "near-physiological" PO₂ conditions, although mitochondrial NAD(P)H responses were lower and relaxation was slower in aged myofibers. **FUNDING:** NIAMS AR069577

605 Board #2 May 27 1:00 PM - 3:00 PM
Skeletal Muscle Cells Derived From Old Donors Show Mitochondrial Fragmentation And Decreased Oxygen Consumption Rates

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 (No relevant relationships reported)

With age, skeletal muscles lose their oxidative capacity and have a reduced mitochondrial fusion leading to fragmentation. These phenomena can lead to a reduction in oxygen consumption, atrophy, and an increased risk of developing age-related diseases such as sarcopenia. Skeletal muscle cells derived from humans can be used to investigate these physiological capacities in primary culture. **PURPOSE:** Investigate mitochondrial morphology and maximal oxygen consumption rates (OCR) of skeletal muscle cells derived from healthy young and old men. **METHODS:** Primary skeletal muscle cells derived from the Rectus abdominis muscle of healthy active eighteen and sixty-nine year old men (SKM18M and SKM69M, respectively) were obtained from Cook MyoSite Inc. (Pittsburgh, PA). Cells were stained with MitoTracker Red (Cell Signaling; Danvers, MA) and mitochondria morphology was observed using a Zeiss LSM 710 AxioObserver confocal scanning microscope (Carl Zeiss; White Plains, NY). The mitochondrial network was analyzed using the Mitochondrial Network Analysis tool in ImageJ (MiNA, FIJI) to estimate

mitochondrial footprint from a binarized image. Oxygen consumption rates were measured in intact cells using Seahorse Cell Mito Stress Tests on a XFp extracellular flux analyzer (Agilent Technologies; Santa Clara, CA). **RESULTS:** Primary cells derived from the young donor (SKM18M) had a larger mitochondrial footprint, longer branch length, and a greater number of network branches compared to SKM69M (Footprint: 34.65 ± 25.30 vs. 11.64 ± 9.53 μm²; Branch Length: 20.59 ± 7.23 vs. 12.10 ± 6.84 μm; Network: 17.25 ± 0.16 vs. 7.67 ± 4.97 counts). SKM18M also showed higher Basal and Maximal OCR compared to SKM69M (Basal: 38.78 ± 8.34 vs. 12.82 ± 2.07; Maximal: 60.09 ± 10.84 vs. 20.52 ± 2.36 pmol/min/protein). **CONCLUSIONS:** We observed differences morphologically and metabolically between the primary skeletal muscle cells derived from young and old donors. These preliminary results give us an insight into human skeletal muscle-derived cellular physiological capacity. Technology to observe human muscle mitochondrial fragmentation in vitro will help us elucidate the effects of aging on skeletal muscle mitochondrial fragmentation and loss of metabolic flexibility in aging.

606 Board #3 May 27 1:00 PM - 3:00 PM
The Impairment Of Oxidative Metabolism After 10-day Of Bed Rest Is Upstream Of Skeletal-Muscle Mitochondria

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 (No relevant relationships reported)

PURPOSE: Exposure to microgravity, as simulated by bed rest (BR), leads to an impairment of oxidative metabolism. The sites of this impairment are still debated. Aim of this study was to identify markers of impaired oxidative metabolism along the O₂ pathway, from ambient air to skeletal muscle mitochondria, following 10 days of BR.

METHODS: Measurements were carried out on 10 recreationally active young males (age 23 ± 5 years [mean±SD]) before (PRE) and after (POST) 10 days of horizontal BR. Pulmonary O₂ uptake (V̇O₂) and other respiratory, cardiovascular and skeletal muscle variables were determined during an incremental exercise on a cycle ergometer. Peripheral vascular and endothelial functions were evaluated by the blood flow response (Doppler ultrasound) in the femoral artery during 1-min passive leg movement (PLM). Mitochondrial respiration was evaluated by high-resolution respirometry on permeabilized vastus lateralis fibers obtained by biopsy.

RESULTS: Peak V̇O₂ was lower (P=0.001) in POST (41.5 ± 6.5 ml·kg⁻¹·min⁻¹) vs. PRE (44.5 ± 7.4). The area under the blood flow vs. time curve during PLM was lower (P=0.038) in POST (274 ± 233 mL) vs. PRE (427 ± 291). Skeletal muscle citrate synthase activity, an estimate of mitochondrial mass, was not different (P=0.115) in POST (131.2 ± 15.9 U·mg⁻¹·protein) vs. PRE (137.9 ± 18.8). Maximal ADP-stimulated mitochondrial respiration (66.4 ± 17.5 pmol·s⁻¹·mg⁻¹ wet weight [POST] vs. 72.3 ± 14.0 [PRE], P=0.127) and oxidative phosphorylation coupling efficiency (respiratory control ratio, 4.10 ± 1.19 [PRE] vs. 3.59 ± 1.11 [POST], P=0.443) were not affected by BR. **CONCLUSIONS:** These preliminary data suggest that the whole-body impairment of oxidative metabolism during exercise, following 10 days of horizontal BR, is associated with an impairment of peripheral vascular and endothelial functions, whereas mitochondrial volume and respiratory function are unaffected. Data related to several other markers (pulmonary function, cardiac output, submaximal exercise tolerance, skeletal muscle fractional O₂ extraction, skeletal muscle V̇O₂ recovery kinetics, mitochondrial respiration sensitivity to submaximal [ADP]) are yet to be analyzed. Funding: ASI, MARS-PRE Project, n. DC-VUM-2017-006

607 Board #4 May 27 1:00 PM - 3:00 PM
Effect Of Endurance Exercise On Localization Of Myoglobin In Mitochondria In Muscle

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 (No relevant relationships reported)

Purpose: Mitochondria play a principal role for metabolism and have a primary role in regulating respiration in myocytes. Recently, we have shown that the muscle-specific protein myoglobin (Mb) interacts with complex IV to augment mitochondrial respiratory capacity in skeletal muscles. However, the precise mechanism for the Mb-mediated upregulation remains unclear. The present study has focused on effect of the endurance training (eTR) on Mb within the mitochondria. **Methods:** Wistar male

rats aged 10-week, were subjected to eTR sessions for 4 weeks (25 m/min X 60 min X 5-day/week, n=6). Muscle specimen from the deep portion of m. Gastrocnemius was taken and homogenized. Crude mitochondria were isolated by differential centrifugations and washed with the mitochondrial isolation buffer. The isolated mitochondria were treated with proteinase K (PK), osmotic shock (OS), and SDS (or TrX) in order to digest proteins on the outer membrane and in the intramembrane. The final samples were subjected to SDS-PAGE and immunoblotting using antibodies to localize the proteins in the mitochondria. **Results:** The eTR increased VDAC-I and COX-IV around +80~130% as compared with non-exercise control ($p<0.05$), Mb increased by +50% ($p<0.05$). Western blotting analysis revealed that the PK digested Tom20, and Tom20 band intensity decreased with the amount of PK used. PK treatment, however, did not affect Mb found in the mitochondrial fraction. Combining treatment with PK, OS and SDS (or TrX) allowed immunoblotting detection of the mitochondrial proteins localized in specific regions of the mitochondria. Mb was detected with either PK or OS treatment. But it cannot be detected with a combined PK+OS treatment, suggesting that Mb associated with the inner membrane (intramembrane side, not matrix side) of the mitochondria. The Mb content inside the mitochondria in eTR rat was similar with that in the control muscles (n.s). **Conclusion:** The present results suggest that Mb in muscle cells localizes both in the cytosol and in the mitochondrial intermembrane space. Although eTR elevates mitochondrial volume and Mb content but does not change Mb content in the mitochondria. Therefore, the observation might imply that the dynamic flux of Mb from cytosol to mitochondria has greater importance than just the amount found in the mitochondria

skeletal muscle fat oxidation in healthy humans and to what extent exercise regulates ETF remains largely unknown. **PURPOSE:** To determine the relationship between skeletal muscle ETF protein abundance and mitochondrial fat oxidation capacity in healthy adult humans at rest and after acute aerobic exercise. **METHODS:** Sedentary lean adults (n=14 [10F/4M], age 28 ± 7 years, BMI 22.2 ± 2.1 kg/m²) completed two studies involving 1-hour of cycle ergometry (65% $\dot{V}O_{2max}$) or sedentary rest in a randomized cross-over design. Vastus lateralis muscle biopsies were collected at rest and 15 minutes after exercise. High-resolution respirometry was performed on isolated mitochondria using palmitoyl-carnitine (lipid substrate, ETF-linked) and glutamate-succinate (non-lipid substrate, N and S-linked). ETF protein abundance and methylation status were determined via western blot. **RESULTS:** Exercise did not alter ETF-linked oxidative phosphorylation or leak respiration compared to rest. Acute exercise did not stimulate N or S linked respiration states. Oxidative phosphorylation was lower for ETF substrates ($p<0.0001$), but with greater electron leak to H_2O_2 , than N or S substrates ($p<0.0001$). Acute exercise did not alter protein abundance of ETF-beta subunit or trimethylation ($p=0.41$ and 0.28 , respectively). **CONCLUSION:** Moderate intensity aerobic exercise did not alter mitochondrial respiration for either lipid or non-lipid substrates. ETF proteins did not undergo acute regulation to a single session of aerobic exercise. The lower capacity for lipid oxidation indicates factors upstream to ETF may regulate muscle lipid oxidation to acute exercise.

608 Board #5 May 27 1:00 PM - 3:00 PM
Vastus Lateralis Muscle Oxygenation Measured By Near-infrared Spectroscopy During Voluntary Isometric Leg Extension Muscle Actions
 Marni E. Shoemaker, Zachary M. Gillen, Nicholas A. Bohannon, Sydney M. Gibson, Joel T. Cramer, FACSM. *University of Nebraska-Lincoln, Lincoln, NE.*
(No relevant relationships reported)

Purpose: Examine vastus lateralis muscle tissue oxygenation measured by near-infrared spectroscopy (NIRS) during submaximal (10-90%) and maximal voluntary isometric contractions (MVIC) of the leg extensors.

Methods: Ten healthy, active males (age: 23 ± 1 y, mass: 84.5 ± 4.5 kg, stature: 181.4 ± 2.5 cm) performed three, 5-s MVICs and nine, 5-s submaximal isometric step muscle actions at 10 – 90% of the MVIC in 10% increments (randomly-ordered). Bipolar surface electromyography (EMG) and NIRS were used simultaneously to record muscle activation and muscle tissue oxygenation, respectively, from similar adjacent locations of the vastus lateralis muscle. The following four variables from the NIRS device were quantified for 0.5-s epochs during the isometrics force plateaus: concentration changes ($\Delta \mu M$) in oxygenated hemoglobin (Hb) + myoglobin (Mb) (oxy[heme]), deoxygenated Hb + Mb (deoxy[heme]), total Hb + Mb (total[heme]) and tissue saturation index (StO_2 , %). Difference EMG amplitude values were calculated for the same 0.5-s epochs and normalized to the MVIC. B-mode ultrasound was used to measure muscle and subcutaneous adipose tissue thicknesses.

Results: The sample demonstrated homogenous muscle thickness (range = 3.8 – 5.6 cm) and subcutaneous adipose thickness (0.3 – 0.6 cm). MVIC torque values ranged from 129 – 308 Nm. As expected, EMG amplitude increased incrementally from 10% to 100% MVIC ($p<0.001-0.021$). Oxy[heme] and total[heme] decreased incrementally from 10% to 80% MVIC ($p<0.001-0.05$), while deoxy[heme] did not change ($p=0.897$), from 10% to 100% MVIC. StO_2 remained unchanged from 10% to 60% MVIC ($p=0.406-0.992$), then decreased incrementally from 60 to 100% MVIC ($p=0.001-0.039$).

Conclusions: Despite systematic decreases in vastus lateralis blood diffusion (total[heme]) from 10% to 80% MVIC, muscle perfusion (deoxy[heme]) remained unchanged across the force spectrum. Interestingly, vastus lateralis tissue oxygen saturation remained intact from 10% to 60% MVIC, but then systematically decreased to 100% MVIC from 71% saturation to 64% saturation. These findings suggest that non-fatiguing submaximal isometric leg extension muscle actions from 10% to 60% MVIC may allow for a steady maintenance of oxygen saturation, which is decreased at higher force production.

609 Board #6 May 27 1:00 PM - 3:00 PM
No Change To Muscle Mitochondrial Fat Oxidation Or ETF Abundance Following Exercise In Healthy Adults
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(No relevant relationships reported)

Electron transfer flavoproteins (ETF) serve a critical role in mitochondrial fat oxidation by accepting electrons liberated during beta-oxidation, with mutations in ETF proteins linked with mitochondrial diseases in humans. Yet, the role of ETF as a regulator of

610 Board #7 May 27 1:00 PM - 3:00 PM
Skeletal Muscle Mitochondrial Plasticity Is Reduced In Liver Transplant Recipients

Caroline Elizabeth Echevarria¹, Shu'aib Abdul-Mateen¹, Steve Shen¹, Marnie Blalock¹, Chandra Bhati², Mohammad S. Siddiqui², Danielle Kirkman¹. ¹*Virginia Commonwealth University, Richmond, VA.* ²*Virginia Commonwealth University Health System, Richmond, VA.*
 Email: ceechevarria@gmail.com
(No relevant relationships reported)

Skeletal Muscle Mitochondrial Plasticity is Reduced in Liver Transplant Recipients
 Echevarria CE, Abdul-Mateen S, Shen S, Blalock M, Bhati C, Siddiqui MS, Kirkman DL

PURPOSE Sarcopenic obesity is a hallmark of liver transplant recipients, of which the mechanisms are not yet fully understood. Decline in mitochondrial plasticity could play a mechanistic role in muscle wasting, loss of strength, and increased adiposity via impaired energy substrate utilization. The purpose of this study is to determine if skeletal muscle mitochondrial plasticity is reduced in liver transplant (LT) recipients. **METHODS** In this prospective cohort study, 15 LT patients (Mean \pm SD; Age: 58 ± 10 years; months since transplant: 55 ± 81 months) and 10 age matched healthy controls (Age: 55 ± 4 years), underwent assessment of mitochondrial oxidative capacity of the wrist flexor muscle group. Near infrared spectroscopy coupled with repeated, transient arterial occlusions, measured the recovery kinetics of oxygen consumption following a 10 second bout of hand grip exercise. Post exercise metabolic recovery rate constant was calculated and reported as an index of mitochondrial oxidative capacity. **RESULTS** Post exercise metabolic recovery rates were significantly greater in LT recipients (Mean \pm SEM; Recovery Time Constant: 72 ± 7 s) compared to HC (51 ± 4 s; $p=0.03$) indicative of diminished mitochondrial plasticity in this patient cohort (Figure 1). **CONCLUSION** Skeletal muscle mitochondrial plasticity is reduced in LT patients compared to matched healthy controls. Further investigations are warranted to determine the role of mitochondrial dysfunction in the development of sarcopenic obesity and frailty following LT.

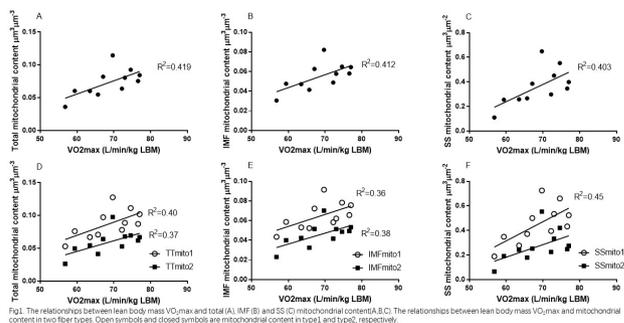
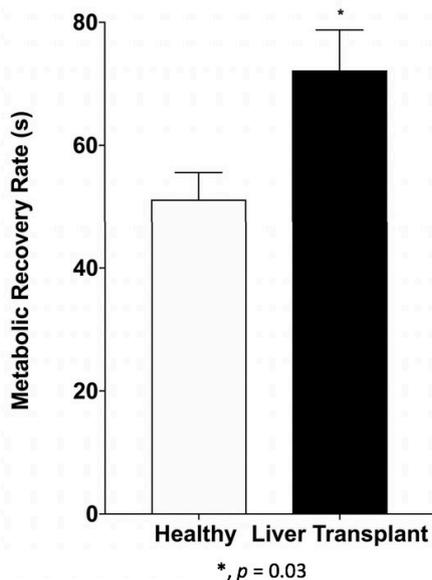


Fig. 1. The relationships between lean body mass VO_{2max} and total (A), IMF (B) and SS (C) mitochondrial content. The relationships between lean body mass VO_{2max} and mitochondrial content in two fiber types. Open symbols and closed symbols are mitochondrial content in type 1 and type 2, respectively.

B-12 Thematic Poster - Muscular Strength, Strength Training and Health

Wednesday, May 27, 2020, 1:00 PM - 3:00 PM
Room: CC-2011

612 Chair: Alpa V. Patel, FACSM. *American Cancer Society, Atlanta, GA.*

(No relevant relationships reported)

611 Board #8 May 27 1:00 PM - 3:00 PM

The Associations Of Mitochondrial Content And Maximal Oxygen Uptake

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(No relevant relationships reported)

Introduction The purpose of this study was to explore the relationship between human fiber type specific mitochondria volume density and VO_{2max}. **Methods** Eleven recreational active subjects (VO_{2max} mean 4.54±0.58 L/min) reported to lab for a progressive ergometer cycle test to estimate VO_{2max}. Ten muscle fibers were obtained in each 9 biopsies in vastus lateralis from each of the 11 subjects. In each fibers, 24 images were obtained in a randomized systematic order, thus 528 fibers and 13968 images were analyzed. Point counting was used to estimate intermyofibrillar (IMF) mitochondrial content as a volume density and subsarcolemmal (SS) mitochondrial content as a volume per fiber surface. Total mitochondrial content were obtained by recalculating the SS subfraction to myofibrillar volume density. Fibre type was determined by z-disk widths. Lean body mass (LBM) was determined by DXA. All data are presented as means ± SD. Associations was evaluated using Pearson's correlation coefficient. **Results** The total, IMF and SS mitochondrial content in type 1 are 0.087±0.021 μm³·μm⁻³, 0.065±0.014 μm³·μm⁻³, 0.451±0.159 μm³·μm⁻², respectively, and in type 2 are 0.059±0.018 μm³·μm⁻³, 0.046±0.012 μm³·μm⁻³, 0.271±0.129 μm³·μm⁻², respectively. Total mitochondrial volume content was a strong predictor of VO_{2max} per LBM. Further, IMF mitochondrial content is a better predictor of a subject's VO_{2max} per LBM than SS mitochondrial content. The fiber type specific correlations revealed that, total, IMF and SS in different fiber types are associated with VO_{2max} per LBM, except SS mitochondrial content in type 2 is not associated (Fig1). **Conclusion** There is a strong correlation between mitochondrial content and VO_{2max} per LBM, however, VO_{2max} and relative VO_{2max} are not associated with mitochondrial content. Also, there is a clear correlation between total and IMF mitochondrial content and VO_{2max} per LBM in both type 1 and type 2 fibers, whole this was only the case for SS in type 1 fibers.

613 Board #1 May 27 1:00 PM - 3:00 PM

Associations Of Muscle Strength And Genetic Predispositions To High Blood Pressure With Mortality And Cardiovascular Disease Outcomes: Findings From The Uk Biobank Project

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(No relevant relationships reported)

PURPOSE: High blood pressure (BP) is a heritable risk factor for cardiovascular diseases (CVD). Whether muscle strength, a modifiable environmental trait, is associated with risk of mortality and CVD independently of genetic risk for high BP is unknown. The purpose was to investigate the associations of genetic risk for high BP and muscle strength with mortality from all causes and CVD, and incidence of myocardial infarction (MI) and stroke. **METHODS:** This study is based on data from UK Biobank, a prospective cohort containing >500,000 adults aged 40-69 years. We included 304,020 individuals of European ancestry without 2nd-degree genetic relatedness and prevalent CVD at baseline. Polygenic risk scores (PRS) for high BP were determined by averaging the standardized calculated risk scores for systolic BP (using 274 single-nucleotide polymorphisms [SNPs]), diastolic BP (278 SNPs) and pulse pressure (231 SNPs). Muscle strength was assessed through grip strength tests. The average grip strength values from both hands were divided by measured fat-free mass. Independent and stratified associations were estimated using Cox regression. **RESULTS:** Compared with the bottom muscle strength tertile, hazard ratios of the top tertile were 0.72 (95% Confidence Interval: 0.69-0.76) for all-cause mortality, 0.66 (0.59-0.75) for CVD mortality, 0.84 (0.78-0.90) for MI, 0.81 (0.74-0.89) for stroke, 0.79 (0.72-0.88) for ischemic stroke and 0.80 (0.67-0.96) for hemorrhagic stroke after adjusting for confounders and PRS. Higher PRS was associated with higher hazards of each disease outcome. At all tertiles of genetic risk for high BP, higher muscle strength was associated with lower hazard of mortality due to all causes and CVD (except at low genetic risk), MI, stroke, ischemic and hemorrhagic stroke (except for high muscle strength at medium genetic risk), compared with low muscle strength: no additive and multiplicative interactions detected. **CONCLUSION:** Individuals with higher levels of muscle strength have lower rates of mortality from all causes and CVD, and incidence of MI and stroke, independent of genetic risk for high BP. Increased muscle strength is, in general, protective against mortality and CVD in the whole population including those at increased genetic risk for high BP.

- 614** Board #2 May 27 1:00 PM - 3:00 PM
Association Of Knee Extensor Strength With Prevalence Of Type 2 Diabetes Among Japanese: A Cross-sectional Study
 Takahisa Ohta¹, Junzo Nagashima², Takeshi Yoshihisa², Yasunori Imagawa², Nobuyoshi Ono², Wataru Fukuda², Susumu S. Sawada, FACSM³, Hiroyuki Sasai⁴, Kazushige Sasaki¹, Naokata Ishii¹. ¹The University of Tokyo, Tokyo, Japan. ²Yokohama Sports Medical Center, Yokohama, Japan. ³Waseda University, Saitama, Japan. ⁴Tokyo Metropolitan Institute of Gerontology, Tokyo, Japan.
 (No relevant relationships reported)

Low hand grip strength is known to be an independent risk factor for developing type 2 diabetes. However, the relationship between the strength of lower limb muscles such as knee extensors and the prevalence of type 2 diabetes remains unclear among Japanese adults. **PURPOSE:** To investigate the relationship between knee extensor strength and prevalence of type 2 diabetes among Japanese adults.

METHODS: This cross-sectional study was conducted in 6227 Japanese male [age: 49.7 (16.0) years, mean (standard deviation)] and 7790 Japanese female [age: 50.4 (14.6) years] who had undergone medical checkup and physical fitness tests voluntarily from 1998 to 2018 at a preventive medical center. Participants completed a maximal voluntary knee extension test, a medical examination, and lifestyle questionnaires. Knee extensor strength, expressed as knee joint torque per body weight (Nm/kg), was measured at 60 degrees/s with an isokinetic dynamometer. Type 2 diabetes was defined as having at least one of the following criteria; fasting plasma glucose ≥ 126 mg/dL, hemoglobin A1c $\geq 6.5\%$ (NGSP) and self-reported physician diagnosis. All participants were divided into quartile according to knee extensor strength. Odds ratios and 95% confidence intervals for having type 2 diabetes were obtained by using logistic regression models. The models were adjusted for age, systolic blood pressure, current smoking status, alcohol intake, and body mass index.

RESULTS: Of the participants who had complete data, 720 males (11.6%) and 505 females (6.5%) had type 2 diabetes. Using the lowest quartile of knee extensor strength as reference, odds ratios and 95% confidence intervals for the highest quartile were 0.71 (0.59-0.86) for overall (p for trend < 0.001), 0.64 (0.51-0.82) for male (p for trend < 0.001), and 0.75 (0.55-1.01) for female (p for trend = 0.036).

CONCLUSIONS: Our results suggest an inverse relationship between knee extensor strength and prevalence of type 2 diabetes among Japanese adults. Further cohort studies are warranted to investigate longitudinal associations between lower limb muscle strength and type 2 diabetes.

- 615** Board #3 May 27 1:00 PM - 3:00 PM
Muscle Strength Moderates The Harmful Relationship Between Abdominal Obesity With Health Variables Among Adults
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 (No relevant relationships reported)

PURPOSE: Clinical variables are usually altered among individuals with abdominal obesity (AO). However, few population-based studies have investigated whether clinical variables are improved according muscle strength (MS) levels in adults with AO or without AO. We investigate whether MS levels moderates the relationship between AO with clinical variables among adults.

METHODS: Cross-sectional population-based study comprising 862 adults (39.3 \pm 11.4 years, 46.4% men) from Florianópolis, Southern Brazil. MS was assessed by handgrip strength. Clinical variables investigated as outcomes were systolic (SBP) and diastolic blood pressure (DBP), carotid intima-media thickness (IMT), high sensitive C-reactive protein (hs-CRP) levels, lipid and glucose metabolism markers. Multiple linear regression adjusted for confounding factors was used.

RESULTS: Higher levels of MS were related to lower levels of IMT, hs-CRP, triglycerides, insulin resistance (HOMA-IR) and higher HDL cholesterol (HDL) among male (p<0.05 in both cases). Among female, to have higher levels of MS was associated with lower levels of SBP, DBP, IMT, hs-PCR, glycated hemoglobin (HbA1c), HOMA-IR and higher HDL (p<0.05). Reduced IMT was observed in male with AO who presented higher MS levels (p<0.05). Among female with AO, lower levels of SBP, HbA1c, HOMA-IR, and higher levels of HDL and IMT were identified in those with higher MS levels (p<0.05).

CONCLUSIONS: MS levels moderated the harmful relationship between AO with clinical variables in male and female.

- 616** Board #4 May 27 1:00 PM - 3:00 PM
The Independent And Combined Effects Of Aerobic Physical Activity And Muscular Strengthening Activity On All-Cause Mortality: An Analysis Of Effect Modification By Race-Ethnicity
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 (No relevant relationships reported)

The relationship between aerobic physical activity (PA) and all-cause mortality risk is well documented. However, the combined effects of sufficient aerobic PA and muscular strengthening activity (MSA) on all-cause mortality risk need further exploration. Moreover, the 2018 PA guidelines committee report suggests that effects of race-ethnicity on this relationship need to be examined. **PURPOSE:** To examine the independent and joint relationship between meeting the current aerobic PA and MSA recommendations and all-cause mortality while considering potential effect modification by race-ethnicity. **METHODS:** This study sample (n=14,384), included adults (20-79 years of age), who participated in the 1999-2006 NHANES. Participants self-reported participation in aerobic PA (leisure-time, transportation, household) and MSA. PA was categorized into 6 categories based around the 2018 PA guidelines: category 1 (no aerobic PA and no MSA), category 2 (insufficiently active and no MSA), category 3 (active and no MSA), category 4 (no PA and meeting the MSA recommendations), category 5 (insufficiently active and meeting the MSA recommendations), and category 6 (meeting both the aerobic and MSA recommendations). All-cause mortality was the dependent variable. Race-ethnic groups examined included non-Hispanic White (NHW), non-Hispanic Black (NHB) and Mexican American (MA). Cox-proportional hazard models were used for the total sample and for individual race-ethnicity estimates. **RESULTS:** A significant interaction was found between aerobic PA and race-ethnicity (p=0.0001) and MSA and race-ethnicity (p=0.0005). Significant risk reductions were found for categories 2, 3 and 6 among NHW (cat 2: HR 0.76, 95% CI 0.64-0.91; cat 3: HR 0.63, 95% CI 0.52-0.74; cat 6: HR 0.58, 95% CI 0.44-0.76) and NHB (cat 2: HR 0.63, 95% CI 0.52-0.74; cat 3: HR 0.51, 95% CI 0.41-0.65; cat 6: HR 0.54, 95% CI 0.38-0.77). Among MA, only those meeting both guidelines had significant reductions in all-cause mortality risk (HR 0.54, 95% CI 0.32-0.92). **CONCLUSIONS:** In support of the most recent PA guidelines, participation in sufficient volumes of both aerobic PA and MSA lead to significant reductions in risk for all-cause mortality across race-ethnic groups. The positive effects of aerobic PA alone seem to be isolated to NHW and NHB.

- 617** Board #5 May 27 1:00 PM - 3:00 PM
Abstract Withdrawn

- 618** Board #6 May 27 1:00 PM - 3:00 PM
Weakness May Cause Mortality In Older Americans: A Matched Cohort Analysis
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 (No relevant relationships reported)

Muscle weakness has been implicated with early mortality; however, quantifying the extent of this association with a carefully matched not weak and strong control will help to better establish the impact of weakness on premature death. **PURPOSE:** We utilized a propensity cohort analysis in a national sample of older Americans for this study to determine if persons who were weak had a higher risk for early mortality compared to a not weak or strong control group. **METHODS:** Data from 19,729 Americans aged at least 50 years from 2006-2014 waves of the Health and Retirement Study were analyzed. Handgrip strength was measured with a hand-grip dynamometer. Men with handgrip strength <26 kilograms were considered weak, ≥ 26 kilograms were considered not weak, and ≥ 32 kilograms were considered strong. Women with handgrip strength <16 kilograms were classified as weak, ≥ 16 kilograms were classified as not weak, and ≥ 20 kilograms were classified as strong. The National Death Index and postmortem interviews determined date of death. The greedy matching algorithm was used to separately match the weak cohort 1:1 to a 1) not weak control cohort, and 2) strong control cohort on several influential covariates. Kaplan-Meier estimators examined survival probabilities and Cox models determined the association between weakness and time to mortality for each of the matched pairs. **RESULTS:** Of the 1,077 weak and not weak matched pairs, 401 weak (37.2%; mortality rate per 1,000 person years: 90.6) and 296 not weak (27.4%; mortality rate per 1,000 person years: 57.8) older Americans died over an average 4.4 \pm 2.5 year follow up. There were 392 weak (37.0%; mortality rate per 1,000 person years: 89.6)

and 243 strong (22.9%; mortality rate per 1,000 person years: 46.7) persons that died over a mean 4.5±2.5 year follow up from the 1,057 weak and strong matched pairs. Those in the weak cohort had a 1.40 (95% confidence interval (CI): 1.19-1.64) and 1.54 (CI: 1.30-1.83) higher hazard for mortality relative to older Americans in the not weak and strong control cohorts, respectively. **CONCLUSION:** Our findings may indicate a causal association between muscle weakness and mortality in older Americans. Healthcare providers should include measures of handgrip strength as part of routine health assessments and discuss the health risks of weakness with their patients.

619 Board #7 May 27 1:00 PM - 3:00 PM

Association Between Silent Lacunar Infarcts And Muscle Strength: The Bunkyo Health Study

Yuki Someya, Yoshifumi Tamura, Hideyoshi Kaga, Satoshi Kadowaki, Daisuke Sugimoto, Ruriko Suzuki, Shigeki Aoki, Nobutaka Hattori, Yumiko Motoi, Kazunori Shimada, Hiroyuki Daida, Shuko Nojiri, Ryuzo Kawamori, Hirotaka Watada. *Juntendo University, Tokyo, Japan.*

(No relevant relationships reported)

Silent lacunar infarcts by definition, lack clinically overt stroke-like symptom, are occasionally found by brain magnetic resonance imaging (MRI) scan in asymptomatic elderly individuals. A previous study revealed that more than 25% of elderly people have silent lacunar infarcts. The main risk factors for lacunar infarcts and stroke were reported as aging, hypertension, and smoking. While a recent study showed that low muscle strength is also a risk factor for cerebrovascular events, it remains unclear whether low muscle strength is a risk factor for silent lacunar infarcts. **PURPOSE:** To investigate the association between muscle strength and silent lacunar infarcts in the elderly people living in urban community. **METHODS:** This study included 1,536 elderly people without past history of cerebral vascular events, aged 65-84 years living in an urban area of Tokyo, Japan (Bunkyo Health Study). All participants underwent brain MRI scan and silent lacunar infarcts were defined as the presence of 1 or more lacunar infarcts. Isokinetic muscle strength of knee extensors was evaluated at angular velocity of 60 degree per seconds using dynamometer. Subjects was categorized tertiles (high, medium, and low) by muscle strength, and compared the prevalence of silent lacunar infarcts. **RESULTS:** Mean age of subjects was 73.0±5.4 years old and 58.9% were female. Two hundred fifty-two (16.4%) subjects were diagnosed as silent lacunar infarcts, and the subjects categorized as lower muscle strength showed higher prevalence of silent lacunar infarcts (high: 12.3%, medium: 17.7%, and low: 19.3%, p for trend 0.003), while skeletal muscle indices among the groups were similar. After multivariate adjustment by age, sex, body mass index, smoking status, physical activity, hypertension, diabetes, and dyslipidemia, the trend was still significant and the odds ratio for having silent lacunar infarcts was significantly higher in the lowest muscle strength tertile compared to the highest tertile [High: 1.00 (reference), medium: 1.42 (95%CI: 0.98-2.04), Low: 1.48 (1.02-2.14), p for trend 0.043]. **CONCLUSIONS:** In the elderly people living in urban community, lower muscle strength of knee extensors was associated with higher prevalence of silent lacunar infarcts independent of other established risk factors.

620 Board #8 May 27 1:00 PM - 3:00 PM

Genetic Risk, Muscle Strength And Stroke Risk

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PURPOSE: Little is known about whether the beneficial impacts of increased muscle strength are consistent across all levels of genetic predispositions to stroke. The purpose was to examine whether the associations between muscle strength and stroke are independent of or vary by genetic risk for stroke.

METHODS: We included 312,398 individuals of European ancestry in UK Biobank (a prospective cohort of >500,000 adults aged 40-69 years) who had no stroke at baseline and genetic relatedness. Genetic risk was assessed using polygenic risk scores, calculated by multiplying the sum of risk-increasing alleles at a given locus by the known effect estimates. Muscle strength was assessed through grip strength tests via a hand dynamometer. Values from both hands were averaged, then divided by fat-free mass. The outcome variables included incidence of overall ($n=3,356$), ischemic ($n=2,632$) and hemorrhagic ($n=861$) stroke over 9-year median follow-up. Overall, stratified and joint associations were estimated using Cox regression. **RESULTS:** Compared with the bottom tertile of muscle strength, hazard ratios [95% confidence interval] of stroke were 0.88 [0.81-0.95] and 0.80 [0.73-0.87] for the middle and top tertiles of muscle strength, respectively, after adjusting for confounders and genetic risk; higher levels of genetic risk were independently associated with higher hazards of stroke. Hazard ratios of stroke for the top muscle strength tertile were 0.82

[0.69-0.96], 0.78 [0.67-0.91] and 0.81 [0.70-0.93] at low, medium and high genetic risk, respectively: no evidence of additive and multiplicative interactions detected. Compared with the reference category of high muscle strength and low genetic risk, there was an increased hazard of stroke for individuals who had medium or high genetic risk combined with low or medium muscle strength, but not for those who had medium genetic risk but high muscle strength. Similar associations were observed for ischemic and hemorrhagic stroke, although for hemorrhagic stroke, confidence intervals were wider and inconclusive for some of the associations.

CONCLUSIONS: Higher muscle strength was associated with lower risk of stroke, independently of genetic risk for stroke. The increased genetic risk of overall and ischemic stroke was partly attenuated through increased muscle strength.

B-13 Thematic Poster - Pediatrics

Wednesday, May 27, 2020, 1:00 PM - 3:00 PM

Room: CC-2009

621 Chair: Karin A. Pfeiffer, FACSM. Michigan State University,

East Lansing, MI.

(No relevant relationships reported)

622 Board #1 May 27 1:00 PM - 3:00 PM

Acute Perceptual Responses To Individual And Group-based High-intensity Interval Exercise In Girls

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(No relevant relationships reported)

Vigorous-intensity physical activity (PA), such as high-intensity interval exercise (HIIE), elicits greater health benefits than moderate-intensity PA. However, predictors of PA adherence such as affect and enjoyment are rarely assessed during HIIE in children. **PURPOSE:** To compare girls' acute perceptual responses to different types of HIIE, treadmill-based (TM) and body-weight resistance exercise circuit (CIRC), and to CIRC performed in a small group setting. **METHODS:** Fifteen active girls (age = 9.2 ± 1.1 years) completed a graded exercise test to determine maximal aerobic speed (MAS). TM and CIRC were performed on separate days (randomized and counterbalanced), and then CIRC was completed in a small group (group CIRC). TM required eight 30s sprints at 100% MAS with 30s of active recovery at 40% MAS; whereas, CIRC consisted of 2 sets of 4 exercises performed 'all out' for 30s with 30s of active recovery. Perceived exertion (RPE 0-10), affective valence (Feeling Scale, -5 to +5), and exercise enjoyment (facial scale, 1-4) were recorded at pre-exercise, 38%, and 75% of protocol completion, and post-exercise. Participants also completed surveys encompassing exercise enjoyment (PACES, 16-80) and positive and negative affect (10-item PANAS) prior to the exercise test and 15 minutes post-exercise.

RESULTS: RPE increased significantly during exercise ($P<0.001$), yet there was no time by protocol interaction ($P=0.12$). Affective valence and enjoyment were unchanged during exercise ($P>0.05$) and similar between protocols ($P>0.05$). Mean affective valence and exercise enjoyment at post-exercise were equal to 3 ± 2 and 3 ± 1 (TM) respectively, 3 ± 2 and 3 ± 1 (CIRC), and 4 ± 2 and 4 ± 1 (group CIRC). Mean exercise enjoyment (PACES) at baseline was equal to 69 ± 10 and did not significantly change post-exercise, and there was no change in positive or negative affect ($P>0.05$). **CONCLUSION:** Despite an exercise-induced increase in RPE, affect and enjoyment were unchanged during all protocols, suggesting that HIIE did not elicit unfavorable perceptual responses in individual and small-group settings. A possible explanation for our findings is our use of relatively brief work intervals and a lower volume exercise protocol compared to previous HIIE studies.

623 Board #2 May 27 1:00 PM - 3:00 PM

JOINT-, CONTRACTION-TYPE, AND CONTRACTION-VELOCITY SPECIFIC DIFFERENCES IN MUSCLE STRENGTH OF LOWER EXTREMITY IN CHILDREN

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PURPOSE: Concentric and eccentric muscle contractions produce dynamic movements requisite for activities of daily living (e.g. walking, running, and jumping). The purpose of this study is to examine joint-, contraction-type, and contraction-velocity specific differences as a function of lower extremity muscle strength in children. Methods: Thirteen children (male = 5, female = 8; age = 11.2 ±

1.1 years) participated in our cross-sectional study. After a familiarization session, participants performed randomized unilateral isometric (ISO), concentric (CON) and eccentric (ECC) muscle strength testing of the non-dominant knee extensors and ankle plantarflexors in a seated position at 120°/s and 180°/s on Biodex. Obtained peak torques were normalized to body mass. Differential muscle strengths were also calculated [D1 = (ECC120-CON120)_{knee}; D2 = (ECC120-CON120)_{ankle}; D3 = (ECC180-CON180)_{knee}; D4 = (ECC180-CON180)_{ankle}]. We used separate within repeated measures ANOVA to calculate muscle strength differences. Paired t-tests were used to compare the differential muscle strength (D1 vs D2; D3 vs D4). Results: No difference was noted between ISO and CON. However, ISO and CON were lower than ECC muscle strength at 120°/s and 180°/s (P < 0.01) at the knee and ankle. No difference was noted between D1 and D2 but D4 was significantly lower than D3 (P = 0.009). Conclusion: Irrespective of contraction velocity and the body sites, children display greatest muscle strength for ECC relative to CON or ISO which is site-dependent. Whether this is dictated by maturation associated site-specific neuromuscular inhibition remains to be investigated.

624 Board #3 May 27 1:00 PM - 3:00 PM
Relationship Between Deep Squat And Joint Range Of Ankle Motion In Young Female Hockey Players

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BACKGROUND: The “Deep Squat” (DS) is a qualitative functional test that integrates muscle strength, neuromuscular control, mobility and joint stability. This test has been frequently used to identify risk of musculoskeletal injury in varied populations. The active joint range of motion (AROM) is the arc of mobility that an individual performs during a voluntary movement, measured objectively by goniometer. **PURPOSE:** Identify the relationship between the DS and the AROM of the ankle measured by goniometer in young female hockey players who belong to *Gimnasia Esgrima Rosario Club*. **METHODS:** Twenty young and healthy female hockey players (age: 16.12 ± 1.16 years; Weight: 57.40 ± 6.32 Kg; Height: 161.42 ± 6.14 cm), participated in this study. Asymptomatic subjects were included, with no history of lumbar spine, hip, knee or ankle injuries. The functional DS test was measured by goniometer in angular degrees of movement for knee flexion, and three bilateral tests for the AROM of dorsiflexion of the ankle (a- Bipedal position with partial load; b- Seated with knee flexed at 90°; and c- Seated with knee at 0° of flexion). The Intraclass Correlation Coefficient (ICC: 0.832-0.993) and the Standard Error of Measurement (SEM: 0.803-0.971) were established by analysis of variance one way for each variable measured. We have applied matched t-test differences to determine statistical differences (SD) between dominant and non-dominant leg at p<0.05. Correlations were calculated through Pearson coefficient (r) between DS and right and left AROM mean values. **RESULTS:** No significant differences (ns) were found for dominant and non-dominant leg. Low correlation was found for dorsiflexion in bipedal position with partial load (r = 0.48; p <0.05) and seated with knee flexed at 90° (r = 0.39; p = 0.09 ns). However, a moderate correlation was found between the goniometric measurement of DS and dorsiflexion in the seat with 0° knee flexion (r = 0.61; p <0.01). **CONCLUSION:** Based on the results, we conclude that the DS measured objectively by goniometer has a moderate r with dorsiflexion seated with knee at 0° of flexion (gastrocnemius muscle length test). Therefore, in this sample, the DS test could be influenced by other determinants factors different from mobility, as they are the muscle strength, neuromuscular control and joint stability.

625 Board #4 May 27 1:00 PM - 3:00 PM
Association Between Strength Fitness And Gross Motor Function In Children: A Us National Study

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Zezhao Chen¹, Jingyuan Zhu¹, Suda Xu² & Weimo Zhu, FACSM¹
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 It was believed that children with better motor function and skills will be likely more physically active. Yet, contribution of fitness, especially muscular strength, to children’s motor function and skill has not been well understood.
Purpose: To examine the relationship between core and upper-body strength and gross motor function in children using a US national sample.
Methods: Three data sets in the 2012 National Youth Fitness Survey (NNYFS) were merged: Test of Gross Motor Development – Second Edition (TGMD-2), modified pull-up, and plank. TGMD-2 total score (TGMD-2 TS) was calculated by adding “Local

motor subtest raw score” and “Object control subtest raw score” together. Descriptive statistics and correlations of TGMD-2 TS, “# of correctly completed modified pull-ups (M-Pull-up)”, and “# of seconds planks position is held (Planks)” were computed using the 2012 NNYFS data.

Result: A total of 6375389 of boys and 6134317 of girls who aged between 3 and 5 yr. old participated in 2012 NNYFS, and their performances (M±SD) in gross motor function and fitness, as well as their correlations (r), are summarized below:

	Boy			Girl		
	3	4	5	3	4	5
TGMD-2 TS	37.8814.79	49.8515.95	60.5515.29	34.259.46	50.5012.60	60.0113.16
M-Pull-up			2.082.75			2.282.92
Plank	10.286.29	15.7014.87	24.6123.52	12.8910.02	21.9419.25	28.5521.38
r, TGMD-T vs. Plank	0.07	0.12	0.38	0.3	0.38	0.56
r, TGMD-T vs. M-Pull-up			0.43			0.25
r, M-Pull-up vs. Plank			0.35			0.30

Conclusion: As children become older, core and upper-body strength seems playing a positive impact on children’s gross motor function in both boys and girls.

626 Board #5 May 27 1:00 PM - 3:00 PM
The Pedi-CHAMP Agility Test: Completion Rates For Typically Developing Children Aged 5 To 17yrs

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 Reported Relationships: K. Tulchin-Francis: Ownership/interest/stock; Maxim Integrated.

The Comprehensive High-Level Activity Mobility Predictor (CHAMP) was developed to assess the rehabilitation and performance in active military service-members who sustained traumatic injury. A pediatric version of this 4-part agility test (the Pedi-CHAMP) has been adapted for use in children aged 5 to 17 years. The Pedi-CHAMP consists of a) 30sec single limb stance (SLS) on each leg, b) a modified Edgren Side-Step Test (Edgren) consisting of 3 continuous repetitions of side-step movements in each direction over a 4m course c) an L-test (10m forward, 10m side-step in each direction, 10m backwards) and d) the Illinois Agility Test (IAT) triple shuttle run with directional weaving on the second pass.

PURPOSE: To assess the completion rate of each portion of the Pedi-CHAMP in typically developing children aged 5 to 17 years.

METHODS: With IRB-approval, 1,093 children (574 females, average age 11.0±3.9yrs (range 5.0-17.9yrs) were tested and included for analysis. Each participant was given two attempts to complete each portion of the test. If one attempt was unsuccessful or disqualified based on performance, a third attempt was offered. Participants were grouped by age (rounded down to the nearest year) and sex (male/female). A complete test was noted if the participant was able to follow directions and did not demonstrate any performance deemed to disqualify the trial (missed end line/ cone, failed to maintain proper body position during side step, etc.)

RESULTS: All participants were able to follow the directions and perform the SLS test. It should be noted, however, that 29% were not able to maintain balance for 30 secs on one or both legs. The SLS rate of completion was higher in girls than boys for children aged 5 to 11 years. The overall completion rates for the modified Edgren and L-test tasks were 93% and 92%, respectively. Similar trends between sexes were seen for both tests, with completion rates improving from 74% (Edgren) and 69% (L-Test) in children aged 5yrs to <90% by 8yrs of age. The Illinois Agility Test (IAT) had an overall completion rate of 99%, with all age-sex groups achieving at least 92% completion.

CONCLUSION: The Pedi-CHAMP is a 4-part agility test that can be successfully administered in typically developing children aged 5 to 17yrs.

WEDNESDAY, MAY 27, 2020

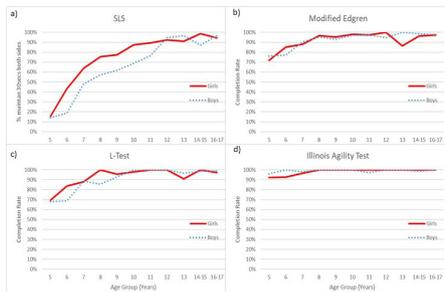


Figure 1. a) Percentage of participants who were able to maintain single limb balance for 30secs on each side; b-d) Completion rates for the modified Edgren, L-Test and Illinois Agility tests. Data for N=1,089 participants grouped by age and gender.

627 Board #6 May 27 1:00 PM - 3:00 PM
Effects Of Aerobic Training With Different RPEs To Double Poling Performance In Adolescent XC Skiers
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 (No relevant relationships reported)

Cross-country (XC) skiers frequently perform low intensity training sessions to improve their endurance capacity or for recovery from hard sessions. It is well known that exercise performed below a certain threshold intensity, adaptational responses will only occur after a certain duration. Rating of perceived exertion (RPE) scale may be helpful to identify reference markers for intensity-duration relationship. Such reference markers, especially during low intensity trainings, could help to improve exercise training in XC skiers' performance.

PURPOSE: To investigate adaptation of low intensity sessions, by means of session RPE (sRPE) in two groups of adolescent XC skiers with different RPEs on double poling performance after 1-week pre-competitive season training camp. **METHODS:** Thirteen national level XC skiers (13.4±1.9 yrs; VO_{2max} 51.2±8.0 ml·min⁻¹·kg⁻¹) participated in a 1-week camp in preparatory period. Pre- and post-camp double poling performance was measured with incremental exercise test on the ski ergometer. All XC skiers trained with the same training program. Based on the athletes' RPE values they were divided into two groups. Group1, who rated their trainings lighter and a Group2 who rated trainings harder compared to the median rating of all trainings. **RESULTS:** After excluding the intensive training session, Group1 average RPE rating was significantly higher compared to Group2 (3.09±0.90 vs 4.94±1.84, respectively) and total sRPE was also higher in Group2 compared to Group1 (4010±765 vs 2499±193 AU, respectively), while total training time was not different (796±41 vs 786±55 min, p<0.05). No significant differences were found in time spent in different HR zones between the two groups. Progression in ski ergometer performance in Group1 was 10.0% (ES=0.18, small), while in Group2 the progression was 12.0% (ES=0.39, moderate). **CONCLUSION:** Despite training with similar training plan, adolescent XC skiers experience training load differently. This leads to differences in performance changes, highlighting the importance of individual volume-intensity description. Supported by NRC Grant no. PUT1395G.

628 Board #7 May 27 1:00 PM - 3:00 PM
The Relationship Between Core Strength And Sportive Performance In Adolescent Female Soccer Players
 Ceyda Sevinc¹, Nevin Ergun, FACSM². ¹Hacettepe University, Ankara, Turkey. ²Sanko University, Gaziantep, Turkey.
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 (No relevant relationships reported)

PURPOSE: The effect of the strength of the core muscles on the sportive performance is still a controversial issue. At the same time, there is very little research on female soccer players on this topic. The aim of this study was to search the relationship between core strength and sportive performance in adolescent female soccer players.

METHODS: Thirty-six (mean age 16.5±1.1 years, BMI: 20.3±2.1 kg/m²) woman soccer players were included in this study. Core strength was evaluated by isokinetic dynamometer at the velocity of 60°/s and front abdominal power test. In the assessment of the sportive performance vertical jump test, 20 m sprint test and T-test were used. Spearman and Pearson correlation tests were used to compare the correlation between core strength and sportive performance.

RESULTS: The correlation between isokinetic flexor muscle strength at 60°/s velocity and vertical jump peak power (r = .643, p<.05); 20 m sprint performance (r = -.629, p<.05); T test performance (r = -.510, p<.05) were determined. The correlation between isokinetic extensor muscle strength at 60°/s velocity and vertical jump peak power (r = .657, p<.05); 20 m sprint performance (r = -.714, p<.05); T test performance (r = -.442,

p<.05) were determined. The correlation between front abdominal power test and vertical jump peak power (r = .737, p<.05); 20 m sprint (r = -.683, p<.05); T test (r = -.574, p<.05) were determined.

CONCLUSIONS: Core strength was correlated with sportive performances of adolescent female soccer players. The relationship between core strength and sportive performance tests reveals the importance of trunk strength in improving sportive performance. For this reason, we recommend that athletes' training programs should include exercises improving trunk strength. In addition to this, athletes should be informed about core strength's importance by physiotherapists or coaches.

629 Board #8 May 27 1:00 PM - 3:00 PM
Us Children Became Heavier And Unfit To Make Another Pull-up Test Failing

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(No relevant relationships reported)

PURPOSE: Since too many children and youth, especially girls, cannot perform a single chin-up, a modified pull-up (M-Pull-Up) test was developed (Pate et al., 1987), in which a test taker only pulls up only partial his/her body weight, and was used in the 2nd National Children and Youth Fitness Study (NCYFS II) in 1987. This study was to determine if M-Pull-Up could still eliminate the "zero score" problem for the current children population.

METHOD: The modified pull-up data of 6-9 yr. old (N = 4678) from the 2012 NHANES National Youth Fitness Survey (NNYFS, N= 494), were compared with the modified pull-up data from NCYFS II. Statistics, including median, interquartile range, cumulative frequency distributions for scores from 0 to 10, and correlations, were used for the analyses.

RESULTS: Between 1987 and 2012, 6-9 yr. children, on average, got slightly shorter (boys = -0.05 cm, girls = -0.2 cm), heavier (Weight: boys = +5.19 kg, girls = + 4.13 kg; BMI: boys = +1.31, girls = +1.14), less # of pull-ups (boys = -4.75, girls = -5). The "zero score" rates (%) in 1987 for 6-, 7-, 8-, 9-yr.-old boys were 7.16, 5.11, 2.60, and 2.61, respectively and for 6-, 7-, 8-, 9-yr.-old girls were 9.41, 6.29, 5.69, and 5.92, respectively; the corresponding "zero scores" rates in 2012 were increased to 22.86, 6.45, 16.67, and 26.92 for boys, respectively and to 19.67, 30.65, 21.43, and 30.00 for girls, respectively.

CONCLUSION: The US children became heavier and less fit, which made another easier pull-up test failing.

B-14 Free Communication/Slide - All in the Wrist: Development and Application of Methods for Wrist-worn Devices

Wednesday, May 27, 2020, 1:00 PM - 3:00 PM
 Room: CC-2022

630 Chair: Tiago V. Barreira. *Syracuse University, Syracuse, NY.*
 (No relevant relationships reported)

631 May 27 1:00 PM - 1:15 PM
Deep Learning Approach To Recognize Physical Activity Type From Wrist-worn Tri-axial Accelerometer
 Mamoun T. Mardini¹, Subhash Nerella¹, Duane B. Corbett¹, Amal Wanigatunga², Todd Manini, FACSM¹. ¹University of Florida, Gainesville, FL. ²Johns Hopkins, Baltimore, MD.
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 (No relevant relationships reported)

PURPOSE: Wrist accelerometers for assessing physical activity type and intensity are rapidly growing with the advent of smartwatch technology in both public and research arenas. There is a necessity to enhance the accuracy of the wrist models in estimating hallmark measures of physical activities. The purpose of this study is to compare the performance of conventional machine learning and deep learning networks in recognizing physical activity type and estimating energy expenditure using raw data from wrist-worn tri-axial accelerometer.

METHODS: Participants (95 women and 46 men, aged 20-89 yrs) performed a battery of 31 typical daily activities in a standardized laboratory setting (e.g. washing dishes, walking) while a tri-axial accelerometer collected data at 100 Hz on the right wrist. A portable metabolic unit was worn to measure metabolic intensity (ml/min of oxygen consumption) that was expressed as a relative metabolic equivalent (MET=(ml/kg/min)/3.5). Deep learning networks comprising of convolutional neural networks

(CNN) and long-short-term memory (LSTM) were used to extract spatial and temporal representations from the raw accelerometry data. These representations were used to estimate energy expenditure and to recognize physical activity type. As a comparison, random forest algorithm was also used to estimate energy expenditure and recognize activity type from seven time and frequency domain features extracted from the raw data.

RESULTS: Deep learning networks resulted in high performance in recognizing physical activity type and estimating energy expenditure. The balanced accuracy was: 88%, 93%, and 92% for recognizing locomotor, lifestyle and sedentary activities, respectively. Random forest resulted in a slightly lower accuracy for the same set of tasks (78%, 91%, and 86%). The root mean square error for estimating energy expenditure using deep learning networks was slightly lower at 0.74 compared to 0.78 using random forest.

CONCLUSIONS: Deep learning models built using raw data from wrist-worn accelerometer data outperformed conventional machine learning algorithms such as random forest. These results show the efficacy of deep learning in extracting representation from the raw data without the need to relying on first creating a feature set that requires domain expertise.

632 May 27 1:15 PM - 1:30 PM
A Novel Method To Estimate Free-living Physical Behaviors From A Wrist-Worn ActiGraph™ Accelerometer

Greg J. Petrucci, Jr., Robert T. Marcotte, Melanna F. Cox, Patty S. Freedson, FACSM, John Staudenmayer, John R. Sirard, FACSM. *University of Massachusetts, Amherst, MA.* (Sponsor: John R. Sirard, PhD., FACSM)
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(No relevant relationships reported)

BACKGROUND: Despite the proliferation of body-worn sensors to assess physical behaviors (e.g. physical activity and sedentary behavior; PBs), processing accelerometer data collected from free-living (FL) individuals remains a challenge. **PURPOSE:** To develop a method to estimate FL PBs from wrist-worn ActiGraph accelerometer count data.

METHODS: Forty-nine participants (X +/- SD age:20.4±1.3 yrs, 45.8% male) wore an ActiGraph wGT3X-BT on their non-dominant wrist during four, 1-hour FL sessions. Sessions were video-recorded and coded using a direct observation (DO) system that provided criterion measures, including intensity category. All steps in the novel method were developed using a subset (n=44) of participants and tested on the remaining (n=5). The first step identifies inactive bouts (e.g. sedentary and standing behaviors) using a vector-magnitude threshold, chosen via a grid-search to maximize the positive predictive value (PPV) of inactive classification. The second step uses statistical features of the count data and bout length (seconds) as inputs to random forest models to estimate active (light, moderate, vigorous) vs inactive periods. Percent agreement between criterion-measured (DO) and method estimated PB was evaluated using second-by-second data. Gini impurity index was used to measure the importance of statistical features used as inputs to the random forest models.

RESULTS: The first step identified a vector magnitude threshold that resulted in a PPV 95.71% for inactive classification. In the holdout sample, steps 1 and 2 correctly classified 84.1% of inactive and active bouts. Gini impurity index revealed that bout length (seconds) was most important among statistical features.

CONCLUSIONS: The new method performed well at estimating FL PBs from wrist-worn ActiGraph accelerometer counts. Future work should investigate how to improve method estimates using PB bout duration and other novel accelerometer statistical features. Supported by NIH NIDDK 1R01DK110148

633 May 27 1:30 PM - 1:45 PM
A Method To Estimate Free-living Behaviors Using High-frequency Wrist Accelerometer Data

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(No relevant relationships reported)

PURPOSE: To develop a novel method to estimate free-living sedentary behavior and activity intensity using high-frequency wrist accelerometer data. **METHODS:** Forty-nine participants (mean ± SD; age: 20.4±1.3 yrs, 45.8% male) completed four, 1-hour sessions of free-living behaviors in home, school, community, and exercise environments. Each session was video-recorded (DO) and participants wore an ActiGraph wGT3X-BT (AG) accelerometer on the non-dominant wrist. Videos were coded for whole body movement, contextual activity type, and activity intensity from the Compendium of Physical Activities (e.g. walking, shopping, 2.8 METs). The novel two-step method (SojWrist) first segments AG data into bouts, or “sojourns”, of inactivity (i.e. sedentary and standing behaviors) or activity using an acceleration

standard deviation threshold and random forest model. The second step estimates the intensity of inactive (sedentary, light) and active (light, moderate, vigorous) sojourns. Separate inactive and active sojourn RF models were fit to estimate intensity using bout duration and time- and frequency-domain AG signal characteristics. A 90-10 sample split was used for SojWrist development (N = 44) and cross-validation (N=5). Percent agreement between DO and SojWrist was evaluated at each step using second-by-second data. **RESULTS:** In the cross-validation sample, 91.8% [95%CI: 87.0%, 96.5%] of inactive and active periods were classified correctly from step 1 of SojWrist. After step 2, overall percent agreement between DO and SojWrist was 86.9% [95%CI: 78.9%, 95.0%] across all intensity categories (Table). **CONCLUSION:** The new SojWrist performed well at estimating free-living activity intensity categories from a wrist worn accelerometer. Future work should strive to improve method performance for predicting activity intensity categories and test validity on a diverse, independent, free-living sample. Supported by NIH NIDDK 1R01DK110148

Table. Confusion matrix for sojourn estimates compared to directly observed criterion time spent in intensity categories (seconds)

		Sojourn Estimate				% Correct
		Sedentary	Light	Moderate	Vigorous	
Direct Observation	Sedentary	36610	2694	109	0	92.9%
	Light	1070	9983	1144	0	81.8%
	Moderate	151	3088	10465	28	76.2%
	Vigorous	0	0	1022	4970	82.9%

634 May 27 1:45 PM - 2:00 PM
Does Heart Rate Improve Prediction Of Oxygen Uptake From Hip Or Wrist Accelerometer Output In Adults With Down Syndrome?

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Heart rate (HR) may improve the prediction of the rate of oxygen uptake (VO₂) from accelerometer output, but this has not been examined in adults with Down syndrome (DS). Addressing this issue may have implications for accelerometer-based measurement of physical activity and sedentary behavior in adults with DS. **PURPOSE:** To examine if HR improves VO₂ prediction from hip- and wrist-accelerometer output in adults with DS. **METHODS:** Sixteen adults with DS (10 men; age 31 ± 15 years) performed 12 tasks including physical activities and sedentary behaviors. VO₂ was measured with portable spirometry (K4b², Cosmed) and accelerometer output (Vector Magnitude [VM] with a hip- and a wrist-worn accelerometer (wGT3X-BT, Actigraph). We used multi-level regression to predict VO₂ from VM alone and VM and HR together. We evaluated prediction accuracy with the absolute percent error and Bland-Altman plots. Analyses were run separately for hip and wrist accelerometer VM. **RESULTS:** Both hip- and wrist-derived VM significantly predicted VO₂ (p <0.001; R² = 0.74 and 0.49 for hip and wrist model, respectively). HR significantly contributed to both models (p <0.001; R² = 0.73 and 0.55 for hip and wrist model, respectively). For hip data, absolute error did not differ significantly between the model with VM alone and the model with VM and HR (24 ± 27 and 26 ± 27%, respectively; p = 0.15). For wrist data, absolute error was higher for the model with VM alone than the model with VM and HR (43 ± 39 and 37 ± 38%, respectively; p = 0.017). Bland-Altman plots indicated zero mean error for all models and limits of agreement were wider for wrist- than hip-models. For hip-models, limits of agreement were similar between VM alone and VM and HR (-5.6 to 5.6 and -5.8 to 5.6 ml kg⁻¹ min⁻¹, respectively). For wrist-models, limits of agreement were somewhat wider for VM alone than VM and HR (-7.9 to 7.6 and -7.4 to 7.1 ml kg⁻¹ min⁻¹, respectively). **CONCLUSION:** Inclusion of HR does not improve prediction of VO₂ from hip-accelerometer VM in adults with DS. HR may slightly improve prediction of VO₂ from wrist-accelerometer VM. Overall, hip-accelerometer VM is better than wrist-accelerometer VM at prediction of VO₂ during physical activities and sedentary behaviors in adults with DS. Supported by NIH Grant R15HD098660

WEDNESDAY, MAY 27, 2020

635 May 27 2:00 PM - 2:15 PM

Sedentary Time And Markers Of Physical Function In Those With Established Type 2 Diabetes

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(No relevant relationships reported)

PURPOSE: An accelerated ageing process places those with type 2 diabetes mellitus (T2DM) at risk of physical functional impairments at a younger age. Although the importance of moderate-to-vigorous physical activity (MVPA) is acknowledged, emerging research suggests that sedentary time may be also important. Therefore, the aim was to examine cross-sectional associations between device-assessed sedentary time and markers of physical function in a population with T2DM and to determine whether associations were modified by the recommended levels of MVPA.

METHODS: Participants with T2DM (>6months), aged 18-75 years were recruited as part of an ongoing, cross-sectional study (CODEC) conducted in the Midlands, UK. Participants were asked to wear an accelerometer (GENEActiv, ActivInsights Ltd, Kimbolton, UK) on their non-dominant wrist for 7 days to quantify habitual levels of sedentary time and MVPA. Generalised linear models examined the associations between sedentary time, the short physical performance battery (SPPB), the sit-to-stand 60 second test (STS60) and 4 metre timed walk. Interaction terms determined whether results were consistent across MVPA categories (active [$>150\text{min/wk}$ of MVPA] vs. inactive [$<150\text{min/wk}$ of MVPA])

RESULTS: 621 participants had valid accelerometer and physical function data (age 63.6 \pm 8.4 years, 34.5% female, BMI=31.0 \pm 5.0kg/m²). Following adjustment for various covariates, including age, sex, ethnicity, medication and MVPA, sedentary time was detrimentally associated with SPPB score, STS60 reps and walk time. When results were stratified by MVPA (active (24.5%) vs. inactive (75.5%)), each 60 minutes of sedentary time was associated with a 0.3 lower SPPB score (p=0.020), 1.4 fewer STS60 reps (p=0.016) and 0.2s longer walk time (p=0.043) in the inactive group only. No significant associations were found in the active group.

CONCLUSION: Sedentary time is adversely associated with markers of physical function, but associations were only present in those individuals who do not meet current physical activity recommendations for health. Along with promoting MVPA, future therapeutic interventions that focus on reducing sedentary time in those with T2DM and impaired physical function may be warranted in inactive individuals. Supported by NIHR Leicester BRC

636 May 27 2:15 PM - 2:30 PM

Agreement Between Fitbit And Actigraph Estimates Of Physical Activity In Young Children

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Commercial wearables are used to track physical activity (PA) levels in children and as tools for increasing PA participation in youth. However, few studies have examined the agreement between commercial and research grade devices in assessing PA in children.

PURPOSE: To compare estimates from a wrist-worn Fitbit Flex 2 to a waist-worn Actigraph GT9X Link in elementary school children. **METHODS:** Forty children aged 6-10 years wore a Fitbit Flex 2 (on non-dominant wrist) and an Actigraph GT9X Link (on waist) for up to two weeks while school was in session. Children were instructed to wear the Fitbit continuously and to wear the Actigraph during all waking hours. Parents were given wear reminders via text each morning. For each device, an adapted Choi algorithm was used to flag non-wear periods (defined as ≥ 90 minutes of continuous 0 step values). Steps and intensity-specific estimates of daily PA from each device were averaged across time periods when both devices were worn simultaneously, and estimates were compared using days with 10+ h of concordant wear and using all available data. **RESULTS:** Across 91 days with concordant device wear of 10+ h, Fitbit estimates were 25% higher for steps (Mean \pm SD = 10318 \pm 3846 steps) and 44% higher for vigorous intensity PA (16.2 \pm 22.1 min) compared to the Actigraph GT9X Link (8260 \pm 3614 steps; 11.3 \pm 15.9 min). In contrast, Fitbit estimates of moderate intensity PA (26.8 \pm 21.1 min) were 20% lower than Actigraph estimates (33.3 \pm 24.3 min). Pearson correlations between device estimates were higher for steps (r=0.62) than for moderate (r=0.55) or vigorous (r=0.28) intensity PA. Similar patterns were observed when all available concordant data were analyzed (n=377 days), with the Fitbit recording 20% more steps, 28% less moderate PA, and 36% more vigorous PA than the Actigraph. **CONCLUSIONS:** Wrist-worn consumer wearables may produce higher estimates of steps and vigorous intensity PA, and lower estimates of

moderate intensity PA, in elementary school children. Absent additional evidence, consumers and researchers should be cautious when using wrist-worn consumer devices to assess absolute levels of PA in youth.

Supported by a grant from NHLBI (R01HL135359).

637 May 27 2:30 PM - 2:45 PM

Do GPS Capable Fitness Watches Accurately Measure Exercise Distances?

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(No relevant relationships reported)

Fitness watches have become popular for assessing activity habits. Manufacturers of GPS capable activity monitors claim their devices provide valid and reliable measures of distances traveled. **PURPOSE:** To determine if six popular physical activity watches provide accurate measures of GPS recorded distances. **METHODS:** An Apple Watch (AW), Fitbit Ionic (FI), Fitbit Versa (FV), Garmin Vivosport (GVS), Garmin Vivoactive 3 (GVA), and a Garmin Forerunner 35 (GF) were all tested on indoor and outdoor oval tracks, an outdoor walking trail and a zig-zag pattern course. Twenty trials were performed on each course by the same researcher. An industrial TR 88016 FX Series collapsible measuring wheel established actual distance (200 m). Two watches were worn at the same time on the left arm. Each watch was set to walking and their GPS signal was turned on and connected. Distance measured by the wheel and each watch was recorded. Means, standard deviations, and percent relative error were calculated for the GPS distance of each watch. **RESULTS:** For the outdoor trail condition, the results showed distances ranging from 180.0 to 204.4 m (FI: 180.2 m, 10.4%, FV: 186.6 m, 7.6%, GVA: 200.7 m, 4.0%, AW: 201.1 m, 4.2%, GVS: 204.4 m, 4.8%, GF: 204.4 m, 4.4%). For the zig-zag course condition, the range was from 184.2 to 204.4 m (GVS: 184.2 m, 4.1%, GF: 189.0 m, 6.0%, FI: 189.8 m, 5.6%, FV: 197.9 m, 4.0%, AW: 197.9 m, 4.0%, GVA: 204.4 m, 4.1%). For the outdoor track, the range was from 179.3 to 204.4 (FV: 179.3 m, 10.8%, AW: 189.8 m, 5.6%, FI: 195.5 m, 4.8%, GVS: 200.3 m, 4.0%, GVA: 202.8 m, 4.0%, GF: 204.4 m, 4.1%). For the indoor track, the range was from 164.2 to 169.0 (FI: 164.2 m, 18.3%, AW: 169.0 m, 16%). All Garmin devices failed to record an indoor measurement. **CONCLUSIONS:** The least and most accurate measurements for each condition were: trail (FI and GVA), zig-zag (GVS and FV), outdoor track (FV and GVS) and indoor track (FI and AW), respectively. The Garmins were the most accurate for the outdoor track with all exhibiting a 4.0% error. Indoor, all devices were less accurate. Only AW and FI had functioning GPS indoor and showed their most error in this setting. Caution must be used when relying on physical activity monitors if accuracy is desired in measuring distance via GPS.

638 May 27 2:45 PM - 3:00 PM

Calibrating Physical Activity And Sedentary Behavior For Wrist-worn Accelerometry In Women 60 Years And Older

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(No relevant relationships reported)

PURPOSE: While emerging approaches for defining physical activity and sedentary behavior using accelerometry exist, cutpoint-based definitions remain a frequent convention. We explored whether a calibration study could contribute to wrist-worn accelerometer count cutpoints among women ≥ 60 years.

METHODS: Women (n=199) 60-91 years wore an ActiGraph GT3X+ accelerometer on their left wrist while performing eight structured activities. Intensity was continuously measured using an Oxycon portable indirect calorimeter. Accelerometer data were analyzed in 15-second epochs with both normal and low frequency extension (LFE) filters. Receiver operating characteristic (ROC) curves were used to calculate cutpoints for sedentary behavior, light (low and high), and moderate to vigorous physical activity (MVPA) using vertical axis and vector magnitude (VM) counts. Cutpoints were selected that balanced the number of false positives and false negatives using three different classifications: one based on specific activities and two based on measured metabolic equivalents (e.g., 1 MET=3.0 or 3.5 ml/kg/min). Area under the ROC curves (AUC) were interpreted as excellent (0.90-1.00), good (0.80-0.89), fair (0.70-0.79), poor (0.60-0.69), or failure (≤ 0.59).

RESULTS: Average VM counts/15-sec varied by activities: 76 watch DVD, 675 assemble puzzle, 836 mopping, 1875 wash/dry dishes, 2180 laundry, 570 walk

1.5 mph, 637 walk 2.0 mph, 1132 walk 2.5 mph, and 1094 400 meter walk. Of the three cutpoint classifications, activity types performed best based on sensitivity and specificity. Using the normal filter, the AUC was good for sedentary cutpoints (vertical axis 0.88; VM 0.88), but was fair to poor for light high intensity (vertical axis 0.74; VM 0.64) and failed for MVPA (vertical axis 0.50; VM 0.50). Findings were similar when using the LFE filter, with only sedentary results indicating good to excellent results (vertical axis 0.90; VM 0.89).

CONCLUSION: This approach provided useful sedentary but not physical activity indicators for wrist-worn accelerometry counts. Further research is needed to understand whether wrist-worn accelerometry can accurately measure higher intensity physical activity in older adults.

B-15 Free Communication/Slide - Clinical Exercise Testing

Wednesday, May 27, 2020, 1:00 PM - 3:00 PM
Room: CC-2005

639 Chair: Jonathan Myers, FACSM. *Veterans Affairs Palo Alto Health Care System, Palo Alto, CA.*
(No relevant relationships reported)

640 May 27 1:00 PM - 1:15 PM
Calf Muscle Oxygenation Limits Maximal Respiratory Performance During Incremental Walking Test In Obese Children

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(No relevant relationships reported)

PURPOSE: To study the interrelationship between respiratory and muscle haemodynamic responses during an incremental exercise in overweight children and confirm the limitations clinically observed that lead to the premature termination of an aerobic fitness test.

METHODS: Twenty-four overweight children (12 girls and 12 boys) performed a progressive maximal treadmill test during which the slope increases every minute. Changes in muscle oxygen (O₂) supply were continuously assessed using near-infrared spectroscopy. Pulmonary gas exchanges and heart rate (HR) were measured. For each participant, changes in deoxyhemoglobin level (Δ[Hb]) in the medial head of the gastrocnemius muscle were expressed as a function of time, then as a percentage of peak of oxygen uptake (VO₂ peak). The influence of the sex, BMI and maturation on breakdown point in muscle desoxyhemoglobin (BP_{Hb}) was assessed with linear model effects.

RESULTS: Girls reach lower VO₂ peak than boys (p = 0.07). A BP_{Hb} occurred during the test in 9 girls and 6 boys and was strongly correlated with VO₂ peak (r = 0.80, p < 0.001). Expressed as a percentage of maximal theoretical value, HR peak tended to be higher in non BP_{Hb} (94.7 ± 5) than in BP_{Hb} (89.9 ± 8) participants (p = 0.1). Current data suggests that a lower maturation and lower BMI are the two main factors that delay the onset of BP_{Hb}.

CONCLUSIONS: Oxygenation of the calf muscle could limit maximal respiratory performance during an incremental walking test with a slope, especially in prepubere obese children who have lower BMI. Muscle limitations should be considered when choosing a protocol to assess VO₂ peak in this population.

641 May 27 1:15 PM - 1:30 PM
High Peak Exercise Blood Pressure In Athletes Is Proportional To Exercise Capacity.

Kristel Johanna Hilde Janssens¹, Guido Claessen², Stephen Foulkes¹, Luke Rowsell¹, Darragh Flannery¹, Erin Howden¹, Andre La Gerche¹. ¹Baker Heart and Diabetes Institute, Melbourne, Australia. ²UZ Leuven, Leuven, Belgium.
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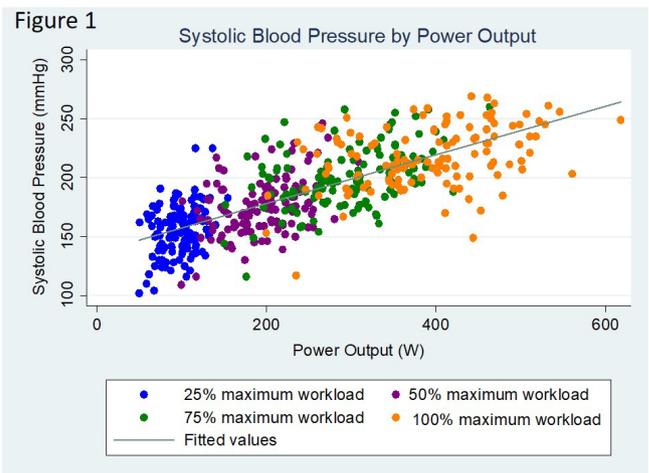
An abnormal blood pressure (BP) response to exercise is an important physiological variable associated with a risk of sub-clinical hypertension. Reference values are poorly defined and lack contextualization to physiological demands that can be obtained among very active populations.

PURPOSE: To assess the relationship between systolic BP (SBP) and workload and to determine reference values of SBP response to exercise in endurance athletes.

METHODS: We recruited 123 current and former endurance athletes (76% male), aged 16-80 years. BP was measured every 2 min during a maximal bicycle cardiopulmonary exercise test using a TangoM2 automated BP monitor. Relationship between SBP measured at 25%, 50%, 75% and 100% of maximum workload and power output during exercise were determined by linear regression analysis using STATA software.

RESULTS: SBP increased from 128 ± 13 mmHg in males (age 40±18 years) and 116 ± 12 mmHg in females (age 35±14 years) to peak 223 ± 27 mmHg and 203 ± 19 mmHg, respectively (P<0.0001). The majority of participants demonstrated an exaggerated SBP response to exercise (72% of males and 82% of females) as defined by the American Heart Association guidelines. There was a strong correlation between power output and SBP (r² = 0.67, P<0.001, Figure 1). Males achieved 123±18% and females 134±26% of their predicted VO₂ max (P<0.01). There was no statistical difference in exercise SBP response according to age or BMI. Gender and hypertensive medication did have a statistically significant, but weak correlation to SBP (P<0.01 and P<0.001 respectively r²=0.03 for both)

CONCLUSION: High SBP values are observed in athletes at peak exercise, frequently exceeding 'normal value' definitions. However, SBP increases can be explained by the supra-normal exercise capacity, thus, should be considered in the context of exercise capacity.



r² = 0.67, p < 0.001

642 May 27 1:30 PM - 1:45 PM
Aerobic Fitness Is Related To Sports Participation In Children With Congenital Heart Disease

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(No relevant relationships reported)

Purpose: Underlying structural lesions in congenital heart disease (CHD) result in differences in anatomy and physiology that may affect peak aerobic capacity (VO_{2peak}). The relationship between sports participation and VO_{2peak} is unclear in these patients. The aim of this study was to determine if children with CHD who participated in sports had a higher VO_{2peak} than those who did not.

Methods: Two-year, single-centre, retrospective review (May 2016-November 2018). Fifty-eight CHD patients were included based on diagnosis: 9 aortic valve disease; 13 coarctation; 6 Ross procedure; 20 tetralogy of Fallot, and 10 transposition of the great arteries. Sports participation was assessed by an ACSM Clinical Exercise Physiologist at the time of testing and categorized into 3 groups: 0-1 day/week; 2-3 days/week; ≥4 days/week. A validated institutional treadmill protocol (BCCH) was used. The criteria for a maximal test included: VO₂ plateau, respiratory exchange ratio>1.0, and/or a peak heart rate >200 bpm. VO_{2peak} Z-scores¹, gas exchange threshold (GET) and O₂ Pulse were calculated. Data are reported in frequency tables and as medians and interquartile ranges. Kruskal-Wallis and Mann Whitney U tests were used to test for group differences. P<0.05 was considered statistically significant.

Results:

	Sports Participation			P
	0-1 day/week n=17	2-3 days/week n=30	≥4 days/week n=11	
Age (years)	15.6 (13.5,17.8)	15.5 (13.7,17.2)	15.0 (14.0,16.1)	NS
VO _{2peak} (mL/min/kg)	30.3 (27.8,39.6)	39.9 (34.6,48.1)	44.7 (41.3,51.5)	<0.001
VO _{2peak} Z-Score	-1.89 (-2.37,-1.16)	-0.84 (-1.28,-0.30)	-0.78 (-0.88,0.05)	0.002
%VO _{2peak} @ GET	52 (45,65)	61 (45,69)	57 (44,65)	NS
O ₂ Pulse (mL/beat/kg)	0.16 (0.14,0.21)	0.20 (0.19,0.25)	0.23 (0.21,0.28)	0.004

Those who participated in sports 2-3 days/week or more had a significantly higher VO_{2peak}, VO_{2peak} Z-score, GET and O₂ Pulse than those with 0-1 day/week (Table 1). There were no differences between those who participated in sports 2-3 days/week compared to ≥4 days/week. VO_{2peak} was similar between CHD cohorts (p=0.21). Conclusions: VO_{2peak} is higher in those who participate in sports compared to those who do not. It is unclear whether those who have a higher VO_{2peak} are more inclined to participate in sports or whether sports participation leads to a higher VO_{2peak} these CHD patients. The role of exercise rehabilitation in the 0-1 day/week group needs to be explored.

¹Ahmad et al 2001

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Symptom And Physiological Response To Exercise Following Concussion

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(No relevant relationships reported)

Exercise can exacerbate concussion symptoms, even when symptom are not apparent at rest. Whether this relates to a physiologic response to exercise remains unknown. **PURPOSE:** To examine symptom and physiologic responses to a stationary bike exercise protocol among participants with concussion and uninjured controls. **METHODS:** 32 concussed individuals (age=16.9±2 years; 50% female; 12.4±5 days post-injury) and 22 healthy controls (age=18.3±2 years; 59% female) completed a modified YMCA branching exercise protocol. After warmup (3 mins; 50 watts), participants progressed to Stage 1 (3 mins; 100 watts). Stage 2 was based on Stage 1 HR (2 mins; 175 watts if <60% age predicted HR; 150 watts if 60-70% age predicted HR; 125 watts if >70% age predicted max HR). Stages 3-5 lasted 2 mins, and increased by 50 watts/stage. Stopping criteria were symptom worsening (visual analog scale [VAS, 0 - 100] change>30) or 85% age-predicted HR. We assessed changes (end - baseline) for VAS, HR, systolic/diastolic blood pressure (SBP/DBP), rating of perceived exertion (RPE), carbon dioxide output (VCO₂), respiratory exchange ratio (RER), and oxygen consumption (VO₂). **RESULTS:** The concussion group reported significantly higher symptom severity at rest than controls (21.0±19.6 vs. 5.6±5.6; p=0.002). Resting HR (63.4±9.8 vs. 64.6±7.3) and protocol duration (11.3±2.0 vs. 11.5±1.3 minutes) were similar between groups. 22% of concussed participants stopped due to symptom exacerbation. Symptom change was not significantly different between groups (VAS= 10.4±16.1 vs. 4.7±11.2; p=0.18). The control group had significantly larger increase in DBP than the concussion group (6.1±5.7 vs. 1.4±4.8; p=0.003). VAS change was significantly associated with HR change among concussed (β=-0.45; 95% CI=-0.87, -0.02; p=0.04) and control groups (β=0.67; 95% CI=0.18, 1.17), and for control subjects, VAS change was associated with RPE (β=2.9; 95% CI=0.55, 5.22; p=0.02) and SPB (β=-0.73; 95% CI= -0.97, -0.48; p<0.001) changes. **CONCLUSIONS:** Using a branching bike-based exercise protocol, most participants achieved 85% age-predicted maximum HR, rather than symptom exacerbation. The amount of symptom provocation between groups was similar. Greater HR changes during exercise were associated with greater symptom provocation independent of group.

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VO₂/WR Slope And HR/VO₂ Slope Predict Major Adverse Events In Patients With Severe Heart Failure

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(No relevant relationships reported)

In chronic heart failure (CHF), cardiopulmonary exercise testing (CPET) yields key prognostic parameters. In addition to peak oxygen uptake (peakVO₂), ventilatory efficiency (VE/VCO₂ slope) and exercise oscillatory ventilation (EOV), other parameters such as oxygen pulse [O₂-pulse; VO₂/heart rate (HR)] kinetics are considered of clinical interest. However, the prognostic value of O₂-pulse kinetics in CHF has not yet been thoroughly examined. **Purpose:** The purpose of this study was to determine whether impaired O₂-pulse kinetics and associated parameters including VO₂ as a function of work rate (VO₂/WR slope) and HR/VO₂ slope predict major adverse events in patients with CHF. **Methods:** O₂-pulse kinetics was classified as 1) continual rise; 2) plateau; and 3) decrease. To evaluate the hazard ratio and significance of the optimal cutoffs for VO₂/WR slope and HR/VO₂ slope we used a two-fold cross-validation process. Kaplan-Meier curves and univariate as well as multivariate cox regressions were used to compare time to the composite outcomes of all-cause death, heart transplantation (HTx) and left ventricular assist device (LVAD) implantation between groups. **Results:** 242 patients (55±13 years, 78% male, 50±15% of predicted peakVO₂) with CHF were included in the study. During the mean follow-up of 27.5±23.3 months, 112 patients (46%) had an event (50x LVAD, 39x HTx, 23x death). Neither an O₂-pulse plateau (43%) nor a decrease (7%) distinguished patients with and without events. However, VO₂/WR and HR/VO₂ slopes were significant univariate predictors (p<0.001) of the outcomes (Fig.1). In the multivariate analysis, peakVO₂, VO₂/WR slope and EOV [hazard ratios (95% CI): 2.06 (1.20-3.54), 2.03 (1.21-3.38) and 1.65 (1.11-2.45), respectively] remained significant independent predictors (p<0.05). **Conclusion:** VO₂/WR slope and HR/VO₂ slope during CPET appear to be of potential benefit for predicting outcomes in patients with CHF, whereas O₂-pulse kinetics did not.

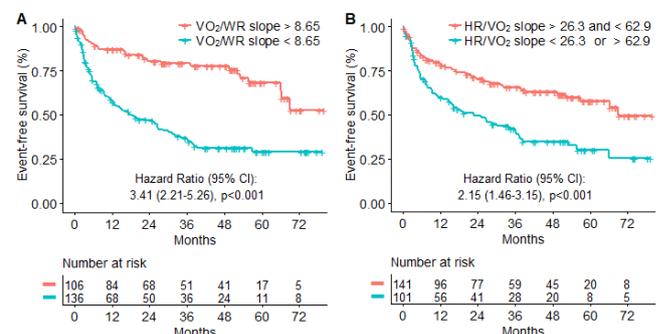


Fig.1: Kaplan-Meier curves and results of the univariate cox regression analysis [hazard ratio (95% confidence interval)] of (A) VO₂/WR slope and (B) HR/VO₂ slope

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Optimal Distance For Normal Gait Speed Testing

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PURPOSE: Walking speed tests are valid tools for predicting functional independence outcomes, however research has not yet agreed on their predictive ability for cardiovascular disease events. There are a range of distances used for walking speed tests, which generates a gap in knowledge and questions the test's accuracy and clinical significance. The purpose of the current study was to determine an optimal distance to calculate gait speed that can be used to standardize walking tests in clinical settings. **METHODS:** Participants walked at their normal gait speed for 20m through Brower timing gates set up at the starting line and at 5m, 10m, and 20m. Speeds from 0-5m, 5-10m, and 10-20m were compared using a linear mixed effect model. **RESULTS:** The average speed for 0-5m segment was 1.361 m/s, 5-10m was 1.449 m/s, and the 10-20m average speed was 1.467 m/s. Comparing 0-5m to 5-10m, the estimated difference was 0.088 m/s with a 95% CI between 0.062-0.079 m/s with a

p-value < 0.0001. Comparing 0-5m to 10-20m, the estimated difference was 0.106 m/s with a p-value of <0.0001. The estimated 5-10m to 10-20m difference was 0.018 m/s with a p-value of 0.18.

CONCLUSIONS: The most efficient distance to measure gait speed is between 5-10 meters of a 15 meter walk test to provide room for acceleration and deceleration. Using a walk speed test under 5 meters is not advised because people are still accelerating and have not achieved stable speed.

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The Predictive Value Of The Sf-36 Questionnaire In Determining CPET Performance In Patients With ME/CFS

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Introduction

Patients diagnosed with Myalgic Encephalomyelitis (ME/CFS) tend to have difficulties with higher-intensity exercise, and usually show diminished maximal exercise capabilities when compared to their sedentary healthy counterparts (sHC). Thus, it is important to find new ways to identify patients most at risk for diminished exercise performance as soon as possible.

Purpose

The present study seeks to determine the predictive validity of the Short Form Health Questionnaire (SF-36) and its subscales as a non-exercise component in patient evaluation.

Methods

18 male patients diagnosed with ME/CFS (Age: 39.2 ± 12.8 years) and 18 male sedentary healthy controls (Age: 39.9 ± 13.4 years) were asked to fill out the SF-36 health survey before participating in a symptom-limited maximal exercise test (CPET). CPET was performed on a cycle ergometer, and initial resistance was set at 30 Watts with a 30 Watt increase every 2 minutes. Subjects were asked to maintain a cycling cadence of 60-70 RPM for as long as possible, or until they experienced any of the predetermined symptoms. Maximal exercise data and veniality efficiency measures were recorded and used in correlative analyses.

Results

Significant differences were observed between ME/CFS and sHC in all relevant subscales of the SF-36 ($p < 0.005$ in all cases). The Physical Functioning, Vitality and Physical Health subscales were all positively correlated with maximal oxygen uptake ($\text{VO}_2 \text{ Max}$) in the ME/CFS group ($r = 0.67$, $p < 0.005$; $r = 0.59$, $p < 0.05$; and $r = 0.65$, $p < 0.005$ respectively), but showed poor correlations in the sHC group ($r = 0.28$, $p = 0.24$; $r = 0.16$, $p = 0.51$; $r = 0.11$, $p = 0.65$ respectively). Although there were significant differences in VE/VCO_2 slopes between the groups ($p < 0.05$), neither group showed strong correlations between and subscales and ventilatory efficiency.

Conclusions

The SF-36 and its subscales showed strong correlations with maximal exercise performance in subjects diagnosed with ME/CFS. These results were not observed in sHC, possibly due in part to the large percentage of "perfect" scores recorded in this group. While the SF-36 did not show any significant correlations with inter-test ventilatory efficiency measures, it might still hold some value in predicting outcomes of maximal CPETs in subjects with diminished exercise capacity.

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Serial Assessment Of The Cardiorespiratory Fitness Vital Sign: Prognostic Significance One Year Post Cardiac Rehabilitation

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(No relevant relationships reported)

Cardiorespiratory fitness (CRF) consistently demonstrates robust prognostic value in apparently healthy individuals and in those at risk for or diagnosed with one or more chronic conditions. While CRF at baseline and immediately following cardiac rehabilitation (CR) hold prognostic value, little is known about the significance of serial CRF assessments over a prolonged period. **PURPOSE:** Assess the prognostic utility of serial CRF assessments in patients completing CR.

METHODS: 3,185 patients (mean age = 62 ± 10 years, 82% male) with cardiovascular disease (CVD) that were referred to and completed a 12-week exercise-based CR program were included. All patients completed a symptom-limited treadmill exercise test at baseline, immediately following CR and at 1-year follow-up. Peak metabolic equivalents (METs) were determined at each exercise test from treadmill speed and grade. The difference between peak METs at baseline and immediately post CR and between baseline and 1-year post CR were also calculated. Patients were subsequently tracked for all-cause mortality.

RESULTS: 206 subjects died during the tracking period (mean tracking = 79 ± 34 months). Peak METs at baseline (Mean = 7.7 ± 2.0 METs, HR: 0.66, 95% CI: 0.62-0.71, $p < 0.001$), immediately following CR (Mean = 8.7 ± 2.0 METs, HR: 0.65, 95% CI: 0.60-0.69, $p < 0.001$) and 1-year post CR (Mean = 8.6 ± 2.2 METs HR: 0.65, 95% CI: 0.61-0.69, $p < 0.001$) were all significant predictors of survival. The mean change in peak METs from baseline to immediate post CR (0.88 ± 1.4 METs) and from baseline to 1-year post CR (0.88 ± 1.3 METs) was significant ($p < 0.001$). However, only the change in peak METs from baseline to 1-year post CR was a significant predictor of survival (HR: 0.73, 95% CI: 0.66-0.80, $p < 0.001$).

CONCLUSIONS: The current findings again demonstrate the prognostic significance of the CRF vital sign in patients with CVD undergoing CR. Our results indicate continued serial assessment of the CRF, in this analysis 1-year following completion of CR, provides important prognostic information. In particular, maintenance of CRF improvement following CR over the long-term is clinically important and should be monitored.

B-16 Free Communication/Slide - Nutritional Ergogenic Aids

Wednesday, May 27, 2020, 1:00 PM - 3:00 PM

Room: CC-2016

648 **Chair:** Shawn M. Arent, FACSM. University of South Carolina, Columbia, SC.

(No relevant relationships reported)

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The Impact Of Placebo Caffeine Dose On Cognitive Performance And Endurance Running In Recreational Athletes.

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(No relevant relationships reported)

PURPOSE: A caffeine-mediated dose-response placebo effect has previously been observed in trained cyclists. The current study aimed to determine if perceived caffeine dose influences cognitive and/or running performance in recreational athletes.

METHODS: Twenty-nine healthy individuals (23.7 ± 5 y (Mean ± SD), 16 males) completed two morning trials (repeated measures design, separated by 1 week), involving a choice reaction time (CRT) test followed by a 10km performance run. Prior to the first trial, participants indicated their beliefs of caffeine's effects on performance and any previous experience using caffeine as an ergogenic aid. On arrival to the testing facility, participants randomly received (and were told they were getting) "Low dose (100mg)" or "High dose (300mg)" of caffeine capsules (all contained placebo, (psyllium husk powder)) prior to commencing the CRT test (30min post capsule ingestion). Paired samples t tests were used to determine differences between trials and CRT latency (employing Ex-Gaussian analysis) and running performance using the entire participant sample and for the sub-groups exhibiting strong "beliefs" +/- prior experience.

RESULTS: Perceived caffeine dose did not influence CRT (μ -, σ - and τ -components respectively, Low: 400 ± 53ms vs High: 388 ± 4ms; Low: 35 ± 18ms vs High: 34 ± 17ms; Low: 50 ± 24ms vs High: 52 ± 19ms, all p 's > 0.05). Neither personal belief ($n = 9$), nor belief + experience ($n = 6$) influenced this effect. Furthermore, perceived caffeine dose did not influence run time (Low: 49.05 ± 3.75 min vs High: 49.06 ± 3.85 min, $p = 0.979$). Personal belief (Low: 48.93 ± 3.71 min vs High: 48.9 ± 3.52 min, $p = 0.976$), and belief + experience (Low: 48.68 ± 1.87 min vs High: 49.55 ± 1.75 min, $p = 0.386$) did not influence this effect.

CONCLUSIONS: Placebo effects of perceived caffeine-dose ingestion on cognitive and running performance were not observed in this study of recreationally active individuals, irrespective of individual's prior beliefs or caffeine use.

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The Perfect Timing For Sodium Bicarbonate Supplementation: Greater Possibilities With Probabilities

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PURPOSE: To describe the reliability of blood bicarbonate pharmacokinetics to sodium bicarbonate (SB) supplementation and, based on those data, to estimate probabilities of SB ingestion timing before exercise using currently accepted thresholds. **METHODS:** Thirteen males (age 27±5 y; body mass (BM) 77.4±10.5 kg; height 1.75±0.06 m) ingested 0.3 g·kg⁻¹BM SB in capsules on 3 occasions (SB1, SB2 and SB3). Blood was obtained at baseline and every 10 min following SB ingestion for 3h, then every 20 min for a further hour to determine bicarbonate concentration. Time-to-peak (Tmax), absolute peak (Cmax), absolute peak change (ΔCmax) and area under the curve (AUC) were determined and analysed using mixed models, as was the intraclass correlation coefficient (ICC), coefficient of variation (CV) and typical error (TE). Individual variation in pharmacokinetic responses was assessed using a Bayesian simulation approach using multilevel models with random intercepts. **RESULTS:** No significant differences between sessions were shown for blood bicarbonate regarding Cmax, ΔCmax or AUC (all p>0.05), although Tmax occurred significantly earlier in SB2 (127±36 min) than in SB1 (169±54 min, p=0.0088) and SB3 (159±42 min, p=0.05). ICC, CV and TE showed moderate to poor reliability for these variables. Bayesian modelling estimated that over 80% of individuals from the population experience elevated blood bicarbonate levels greater than +5 mmol·L⁻¹ between 75-240 min after ingestion, and between 90-225 min for elevations greater than +6 mmol·L⁻¹ (Table 1). **CONCLUSIONS:** Assessing SB supplementation using discrete values showed only moderate reliability at the group level, and poor reliability at the individual level, while Tmax was not reproducible. However, when analysed as modelled curves, a 0.3 g·kg⁻¹BM dose was shown to create a long-lasting window of ergogenic potential, which has practical utility for athletes and suggests that individually tailored timings are not required.

Table 1. Probability estimates of elevating blood bicarbonate above 5 mmol·L⁻¹ and 6 mmol·L⁻¹ (from baseline) at different time points following sodium bicarbonate ingestion. Probability values were estimated using Bayesian simulation (n = 1 million)

Prob-ability of increases	Time after ingestion (min)																
	0	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240
↑5 mmol·L ⁻¹ (%)	0	0	0	9	69	93	97	99	99	99	99	99	98	97	95	91	85
↑6 mmol·L ⁻¹ (%)	0	0	0	0	14	60	86	93	95	96	96	95	94	92	88	80	70

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Muscle Glycogen Utilization During Exercise Following Ingestion Of Alcohol

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PURPOSE: Following alcohol ingestion, ethanol (EtOH) is metabolized gastrically and hepatically, which may influence metabolism at rest and/or during exercise. Previous experiments involving exercise have provided EtOH via intravenous infusion rather than oral ingestion, which alters the metabolic effects of EtOH. Furthermore, no previous studies have directly compared the effects of EtOH metabolism at rest followed by exercise.

METHODS: Eight recreationally active men (Mean ± SD, Age: 24 ± 5 y; Body Mass: 76.7 ± 5.6 kg; Height: 1.80 ± 0.04 m; $\dot{V}O_{2peak}$: 4.1 ± 0.2 L·min⁻¹) performed two bouts of fasted cycling exercise at 55 % $\dot{V}O_{2peak}$ for 2-h, with (EtOH) and without (CONTROL) prior ingestion of ethanol 1 h and immediately before exercise (total dose: 0.1 g·kg lean body mass⁻¹·h⁻¹ - 30.2 ± 1.1 g 40% ABV Vodka; fed in 2 equal boluses) in a randomized order, separated by 7-10 days. NHS REC: 17/SW/0219.

RESULTS: The rate of muscle glycogen degradation was not different between conditions (CONTROL:-214.5 [nCI: -287.6—-141.4] mmol·kg⁻¹ vs EtOH:-257.7 [nCI: -330.8—-184.6] mmol·kg⁻¹) and plasma glucose concentrations during exercise were similar (mean concentration: CONTROL: 5.26 [nCI: 5.17-5.34] mmol·L⁻¹ vs EtOH: 5.26 [nCI: 5.18-5.34] mmol·L⁻¹). Ingestion of EtOH suppressed plasma non-esterified fatty acids (NEFA) at rest (mean concentration: CONTROL: 0.40 [nCI: 0.31-0.50] mmol·L⁻¹ vs EtOH: 0.30 [nCI: 0.21-0.40] mmol·L⁻¹) but not during exercise. Plasma

lactate was higher across the rest period in the EtOH condition (mean concentration: CONTROL: 0.88 [nCI: 0.79-0.97] mmol·L⁻¹ vs EtOH 1.01 [nCI: 0.91-1.09] mmol·L⁻¹) but the response during exercise was similar.

CONCLUSIONS: Ingestion of a small dose of EtOH transiently altered the resting availability of systemic NEFA and lactate but this effect did not persist during exercise. Muscle glycogen utilization was similar during exercise in both trials, which reflects the similar concentrations of systemic metabolites observed during exercise.

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Effects Of Vitamin C Enriched Hydrolyzed Collagen On Explosive Performance

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The stiffness of a tendon is determined by the amount and cross-linking of collagen within the tissue. Acute exercise and possibly vitamin C-enriched collagen supplementation have been shown to increase collagen synthesis as well as the expression of the primary enzyme involved in collagen cross-linking (lysyl oxidase). The result may be a denser and stiffer tissue. Stiffness is directly related to force transfer. Whether this nutritional supplementation can further augment response to training, in particular rate of force development (RFD), and translate to improved explosive performance compared to training alone is unknown. **Purpose:** To determine if nutritional supplementation with vitamin C-enriched collagen improves RFD compared to placebo (PLA) with an explosive power-based training regime. **Methods:** Healthy male collegiate football players (18-25 years) were enrolled in a 3-week double-blinded, parallel design study. Athletes were randomly assigned to the intervention group (COLL; 15g hydrolyzed collagen with 50mg vitamin C) or placebo group (PLA; 15g rice flour). Supplements were ingested 60min prior to training 5 days per week and with breakfast on rest days. Athletes completed the same training program and progression. RFD was measured from the best of three maximal isometric squats, countermovement jumps and squat jumps (Kistler, Novi, MI) performed at the same time on each testing day (baseline and after 1, 2 and 3 weeks of training). Two-way ANOVA (nutrition intervention and time) was used to compare RFD between groups. **Results:** At time of analysis there were no significant difference for maximal RFD in the maximal isometric squat between the interventions. RFD data from CMJ and SJ are yet to be determined. **Conclusion:** Supplementation with vitamin C-enriched collagen prior to training throughout a 3-week explosive power-based training program does not improve maximal RFD compared to exercise alone. More comprehensive analysis of all RFD parameters is required to fully interpret results from this study and will be completed prior to abstract presentation.

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Ketone Ester Supplementation Affects Neither Muscle Glycogen Utilization Nor Performance In A Simulated Cycling Race

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PURPOSE: Some recent literature data indicate that ketone bodies inhibit glycolysis in contracting muscles. Therefore, we investigated whether exogenous ketosis by oral ketone ester (KE) intake during prolonged cycling can induce a glycogen sparing action and thereby improve performance during the final phase of the event.

METHODS: In a randomized cross-over design, 12 highly-trained male cyclists and triathletes completed a simulated cycling race consisting of 3h submaximal exercise (EX₁₈₀) combined with 60g carbohydrates per h, immediately followed by a 15-min time-trial (TT₁₅) and a maximal sprint test (time to exhaustion at 175% of the anaerobic threshold). Subjects received 20-25g doses of either KE or a non-caloric placebo (CON) at 1h and 20 min before, and at 30 min during EX₁₈₀. Blood samples were collected at regular intervals. Biopsies from m. vastus lateralis were obtained before and after EX₁₈₀ and at the end of TT₁₅. **RESULTS:** KE intake transiently increased blood D-β-hydroxybutyrate to ~3 mM (range: 2.6-5.2 mM) during EX₁₈₀ (p<0.001 vs. CON). Blood pH concomitantly decreased from ~7.42 to 7.36 (range: 7.29-7.40), whilst bicarbonate dropped from 26.0 to 21.6 mM (range: 20.1-23.7) (p<0.001 vs. CON). EX₁₈₀ depleted muscle glycogen to the same degree in both groups (KE: -78 ± 9; CON: -60 ± 6 mmol/kg ww, p>0.05). Mean power output during TT₁₅ (KE: 273 ± 11; CON: 272 ± 11 W, p>0.05) and time-to-exhaustion in the sprint (KE: 59 ± 5; CON: 58 ± 5 s, p>0.05) also were similar between the groups. **CONCLUSION:** KE intake during a simulated cycling race does not cause glycogen sparing, neither does it affect performance in the final stage of the race.

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Effect Of Water-loading On Weight Cutting And Performance In Elite Judo Athletes
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The use of water-loading to enhance weight cutting is getting increasingly popular in combat and weight category sports. Athletes are overdrinking water in order to increase urine production before engaging in a fluid restriction period in the belief that it will maximise fluid driven body mass loss. Research into this practice is lacking and further investigation is needed.

PURPOSE: Determine the impact of a water-loading protocol in combination with dietary adjustments on acute body mass loss, natremia, urinary markers of hydration and arm crank performance in elite judo athletes.

METHODS: Using a crossover design, 18 elite male judo athletes underwent 2, 6 days interventions interspersed by a washout period of 2 weeks. While following a controlled diet, athletes consumed either 40 mL/kg (control condition (CON)) or 80 mL/kg (water loading condition (WL)) on days 1-3, followed for both conditions by a fluid intake of 20 mL/kg on day 4. On day 5, fluid was restricted until 11h00, body mass was then measured and for the remaining of the day athletes consumed 60 mL/kg of fluid. On day 6, fluid was consumed *ad libitum* and arm crank performance measured between 9h00-12h00.

RESULTS: Water-loading ($2.4 \pm 0.5\%$) produced a significantly ($p = 0.03$, effect size = 0.7) greater decrease in body mass, compared with CON ($1.8 \pm 0.5\%$). Urine specific gravity and osmolality became progressively lower over time with WL ($p < 0.05$), compared with CON. However, whole blood sodium concentration remained within the physiological range of 135-145 mmol/L throughout the WL condition. There were no significant differences in arm crank performance for maximum power (CON: 663 ± 103 , WL: 677 ± 95 W) and mean power (CON: 330 ± 32 , WL: 335 ± 35 W).

CONCLUSION: Our results indicate that the water-loading protocol used in this study 1) improves acute body mass loss without affecting health or arm crank performance and; 2) should be considered by combat sports athletes looking to improve their weight cutting practices.

Funding information :

1) Own the Podium i4G applied research program 2) INS Quebec PRIDI research grant

655 May 27 2:30 PM - 2:45 PM
Consumption Of Multi-ingredient Supplement With Resistance Training Enhances Gains In Muscle Fibre And Muscle Area In Men And Women
 Mai Wageh. *McMaster University, Hamilton, ON, Canada.*
 (Sponsor: Stuart Phillips, FACSM)
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 (No relevant relationships reported)

Resistance exercise training (RET) is a well-known stimulus for muscle protein synthesis. Protein supplementation in conjunction with RET has been shown to yield a superior combinatory effect, fostering greater accretion of lean body mass. Few studies have compared multi-ingredient with isonitrogenous supplements of differing protein quality. **PURPOSE:** We compared a whey protein-based supplement (containing leucine, creatine monohydrate, calcium citrate, and vitamin D), to an isonitrogenous collagen-containing protein supplement with regards to muscle fibre and whole muscle mass increases. We aimed to determine whether the multi-ingredient supplement would enhance lean body mass gains in young adults involved in a RET program. **METHODS:** Twenty-six healthy, recreationally active men and women (22 ± 2 years [mean \pm SD]) were randomly assigned to either the supplementation (SUPP, $n=13$) or control beverage (CON, $n=13$) group, ingesting their respective supplements twice daily. Participants underwent a 10-week linear RET program. Dual-energy X-ray absorptiometry (DXA), one-repetition maximum (1RM), and biopsies from the *vastus lateralis* muscle were performed. **RESULTS:** There were significantly greater increases in type II fibre cross-sectional area (CSA) in the SUPP group compared to the CON group (SUPP: $+47 \pm 24\%$, CON: $+34 \pm 25\%$; $p < 0.05$; $d = 0.53$), while changes in type I fibre CSA was not different between groups (SUPP: $+37 \pm 25\%$, CON: $+25 \pm 21\%$; $p = 0.08$; $d = 0.52$). Ultrasound *biceps brachii* CSA increase was significantly greater in the SUPP group (SUPP: $+42 \pm 39\%$, CON: $+14 \pm 10\%$, $p < 0.05$; $d = 0.98$), while increases in *vastus lateralis* CSA was not different between groups (SUPP: $+43 \pm 23\%$, CON: $+26 \pm 31\%$; $p = 0.06$; $d = 0.62$). **CONCLUSIONS:** The consumption of a multi-ingredient nutritional supplement increased type II fibre CSA and *biceps brachii* CSA, but not type I fibre CSA or *vastus lateralis* CSA in healthy young men and women.

656 May 27 2:45 PM - 3:00 PM
Comparable Exogenous Carbohydrate Oxidation With Lactose Or Sucrose Feeding During Endurance Exercise
 Oliver J. Odell, Tim Podlogar, Gareth A. Wallis. *University of Birmingham, Birmingham, United Kingdom.* (Sponsor: Janice L Thompson, FACSM)
 Email: oxo799@bham.ac.uk
 Reported Relationships: **O.J. Odell:** Industry contracted research; Volac International.

Purpose:

Endogenous carbohydrate (CHO) availability can limit endurance exercise performance. CHO ingested during exercise such as glucose, glucose polymers and sucrose are readily oxidized and can improve endurance performance. The extent to which lactose can be utilized as a fuel source during exercise is unknown. The purpose is to elucidate the metabolic response to lactose ingestion during endurance exercise, compared to sucrose or water.

Methods:

11 participants (mean \pm SD: 22 ± 4 years, 50.9 ± 4.7 mL \cdot min $^{-1}$ \cdot kg $^{-1}$) cycled for 150 min at 50% of W_{max} on 3 occasions. During exercise participants ingested, in a randomized order, water (WAT), lactose (LAC) or sucrose (SUC) containing beverages; a CHO dose of 0.8 g \cdot min $^{-1}$ (48 g \cdot h $^{-1}$) was used. Indirect calorimetry was used to calculate fat and total CHO oxidation and stable isotope tracer methodology (natural high ^{13}C abundance CHO ingestion, $^{13}C:^{12}C$ ratio determination in expired breath by isotope-ratio mass spectrometry) was used to quantify exogenous CHO oxidation. Venous blood samples were taken throughout exercise and analyzed for glucose, lactate and non-esterified fatty acids (NEFA).

Results:

Mean exogenous CHO oxidation rates in LAC (0.55 ± 0.19 g \cdot min $^{-1}$) and SUC (0.58 ± 0.10 g \cdot min $^{-1}$) were similar ($P = 0.68$). Endogenous CHO oxidation contributed less to energy expenditure (EE) in LAC ($39 \pm 14\%$) than in WAT ($50 \pm 11\%$, $P = 0.01$) and SUC ($50 \pm 8\%$, $P = 0.04$). Fat oxidation contributed most to EE in WAT ($50 \pm 11\%$), which was significantly greater than in LAC ($42 \pm 8\%$, $P = 0.04$) and SUC ($28 \pm 6\%$, $P < 0.01$), with fat oxidation higher in LAC than SUC ($P < 0.01$). Plasma glucose was significantly higher in LAC (5.2 ± 0.4 mmol \cdot L $^{-1}$) and SUC (5.3 ± 0.5 mmol \cdot L $^{-1}$) than WAT (4.6 ± 0.5 mmol \cdot L $^{-1}$, $P \leq 0.01$). Plasma lactate was significantly higher in SUC (1.7 ± 0.5 mmol \cdot L $^{-1}$) than WAT (1.5 ± 0.4 mmol \cdot L $^{-1}$, $P < 0.01$). Plasma NEFA were significantly higher in WAT (1.1 ± 0.4 mmol \cdot L $^{-1}$) than SUC (0.5 ± 0.3 mmol \cdot L $^{-1}$, $P < 0.01$), and tended to be higher in WAT than LAC (0.7 ± 0.4 mmol \cdot L $^{-1}$, $P = 0.08$).

Conclusions:

Exogenous CHO oxidation during exercise was comparable from ingested lactose and sucrose. However, lactose ingestion promoted higher fat and lower endogenous CHO oxidation during exercise than sucrose. This suggests that lactose may be at least as efficacious as commonly used CHO sources for improving exercise performance.

B-17 Clinical Case Slide - Head Injury and Concussion

Wednesday, May 27, 2020, 1:00 PM - 3:00 PM
Room: CC-3014

657 Chair: John Leddy. *University at Buffalo Sports Medicine Institute, Buffalo, NY.*
(No relevant relationships reported)

658 Discussant: Julie Wilson. *Children's Hospital Colorado, Aurora, CO.*
(No relevant relationships reported)

659 Discussant: Eugene Hong. *Medical University of South Carolina, Newtown Square, PA.*
(No relevant relationships reported)

660 May 27 1:00 PM - 1:20 PM
Oh Snap! I Got Hit In The Face.
Christina S. Gutta. *Prisma Health, Greenville, SC.* (Sponsor: Dr. Franklin Sease, FACSM)
(No relevant relationships reported)

HISTORY: 20 y.o. collegiate baseball player presents to physician in training room 1 hour after a resistance band snapped off a hook and hit him across the bridge of the nose and both eyes. He complains of immediate swelling around his eyes, difficulty opening eyelids and blurry vision for 20 minutes with tearing, difficulty opening his eyes and retro-orbital headache. He has a history of Hemophilia A with severe phenotype for which he administers Factor VIII every 2 days; with chest or head trauma, he administers an emergency dose of Factor VIII.

PHYSICAL EXAMINATION: He appears moderately distressed and uncomfortable; bilateral eyelids are swollen with tearing of clear fluid bilaterally, no periorbital ecchymosis, no proptosis, no hyphema. Bilateral subconjunctiva injection present. EOM intact but has pain in right eye when looking up. Left pupil is equal and reactive to light. Right pupil is oblong pointing towards 9 o'clock. Monocular diplopia present in both eyes. Vision 20/40 with corrective lens. No flashers or floaters. Cranial nerve exam is otherwise normal.

DIFFERENTIAL DIAGNOSIS: traumatic mydriasis, open globe injury, post-traumatic iritis, vitreous hemorrhage, retinal detachment, Retrobulbar hematoma, ocular contusion

TEST AND RESULTS: Intraocular pressure Right 15, Left 13. Fundus exam shows normal vitreous macula and intraorbital vessels. No evidence of retinal detachment. CT head WO contrast: No acute intracranial hemorrhage or infarct, no masses or midline shift. CBC 7.0>15.7/46.9<337 Factor VIII inhibitor negative. Factor VIII Clotting Activity: 61 (nl 50-180) PT 14. INR 1.1 PTT 33

FINAL WORKING DIAGNOSIS: ocular contusion

TREATMENT AND OUTCOME: He administered an emergency dose of Factor VIII immediately after the injury. Then he was admitted to the ICU for IOP monitoring and serial cranial nerve exams; was treated with Factor VIII 40 U/kg, or 3600 U q8h for 48 hours then resumed home Factor VIII dosing every 2 days. At discharge, he had normal IOP and reassuring neurologic exam. He used eye drops q2-4 hours for comfort. At ophthalmology follow up 1 week later, he had normal IOP and fundus exam. There is risk of developing angle recession glaucoma up to several months after injury and anticipatory guidance for sudden vision loss or eye pain discussed. He returned to full sport participation 2 weeks later.

661 May 27 1:20 PM - 1:40 PM
Abstract Withdrawn

662 May 27 1:40 PM - 2:00 PM
Concussion: Bouncy House
Angela Rufo. *Maine Dartmouth, Augusta, ME.* (Sponsor: James Dunlap, FACSM)
(No relevant relationships reported)

HISTORY

10 y/o M football player was referred by PCP for a concussion. Patient was jumping on a bouncy house four days earlier when he fell off and hit his head on the hardwood floor. No LOC. Brought to the ED and diagnosed with a concussion and sent home.

Over the next couple of days, had multiple episodes of emesis. Brought back to the ED, CT head showed a right occipital comminuted calvarial fracture with displacement fragment of bone intracranially and with an extra axial hemorrhage that was concerning for a subdural or epidural hematoma. Transferred to Maine Medical Center for a neurosurgical evaluation. Seen by neurosurgery and pediatric rheumatology and discharged home given stable exam. Admits to headache, photophobia, phonophobia, feeling slower, fatigue, drowsiness, difficulty falling asleep, irritability. No history of learning disorders and no previous concussions. Symptom Score 36.

PHYSICAL EXAM

General: NAD

HEENT: TTP right occiput large hematoma. PEERLA,

Neck: No TTP Full ROM. Spurling (-)

Neuro: CN2-12 intact, Sensation/Motor in all extremities intact

Memory short term: word recall (5/5) x 3. long term: intact

Cognitive: Recite months backwards 12/12, Days 7/7, Numbers 3/3, 4/4, 5/5

VOMS: intact, convergence 6cm, finger to nose intact

BESS: two leg no errors, one leg 4 errors, Tandem 2 errors

Psych: mood normal

DIFFERENTIAL DIAGNOSIS

Concussion, TBI, Subdural hematoma, Epidural hematoma, Subarachnoid, Migraine, Basilar Fracture, Occipital Fracture, Seizure Disorder

TEST AND RESULTS

CT head: Right occipital comminuted calvarial fracture with displaced fragment of bone intracranially with extra-axial fluid collection which could be a subdural or epidural hemorrhage component.

FINAL DIAGNOSIS

Concussion, Occipital bone fracture, and Subdural hemorrhage

TREATMENT AND OUTCOME

Return to school with accommodations, avoid bright lights and loud noises, limit screen time, avoid. Per Neurosurgery: Avoid any physical activity for 2-3 months

Follow at 2 weeks: Symptom Score 3. Patient much improved. Exam remarkable for poor balance

Pending Neurosurgery follow up next month. Follow up in clinic office 1 month.

663 May 27 2:00 PM - 2:20 PM

Eye Injury- Baseball

Erika Leigh Cohen, Lisa Odendal, Danielle Hirsch. *Johns Hopkins All Children's Hospital, Saint Petersburg, FL.* (Sponsor: Dilipkumar R Patel, MBBS, MBA, MPH, FACSM)
Email: erika.shuster@jhmi.edu
(No relevant relationships reported)

HISTORY: A 12 year-old male sustained an injury to left eye during a baseball game. While playing first base, the outfielder threw a ball to him so patient could tag the runner out. When catching the ball, he missed, and instead the ball struck him in the face in the area of the left eye. There was no loss of consciousness, vomiting, hematoma or altered mental status. He initially had difficulty seeing out of the eye, but vision returned soon after and appeared blurry.

PHYSICAL EXAMINATION: Normocephalic. With the exception of limitation in upward gaze of left eye, the remaining extraocular movements were intact. Hyphema of left eye noted. Pupils equal, round and reactive to light bilaterally. Moderate left periorbital edema and ecchymosis. Vision intact to left eye. Sensation intact in V1-V3 distribution, facial nerve function intact bilaterally. Normal occlusion, midface stable. Hearing to spoken voice intact and TM's clear with no evidence of hemotympanum. Remainder of examination was normal.

DIFFERENTIAL DIAGNOSIS:

1. Orbital Ridge Fracture
2. Orbital Blowout Fracture
3. Hyphema
4. Retinal detachment
5. Commotio Retinae
6. Globe Rupture

TEST AND RESULTS:

CT facial bones:

- Blowout fracture of left inferior and medial wall of left orbit
- Left orbital emphysema with small contusion vs hematoma within the retrobulbar fat
- Minimal blood within the left ethmoid and maxillary sinus

Ophthalmology Consult:

- Visual Acuity 20/30 Right, 20/200 Left
- 3 mm Hyphema of left eye
- Commotio Retinae of left macula
- Normal intraocular pressure

FINAL/WORKING DIAGNOSIS: Left orbital floor fracture, Traumatic Hyphema, Commotio Retinae involving the macula

TREATMENT AND OUTCOMES:

1. CT scan without significant displacement and no ocular muscle entrapment on repeat exam, no operative repair needed; follow-up with plastic surgery 1-2 weeks
2. Per ophthalmology recommendations:

- a. Ongoing observation for cataract, retinal detachment, and glaucoma due to increased risk from blunt ocular trauma
- b. Bed rest with bathroom privileges 3-4 days
- c. Ophthalmic prednisolone and ophthalmic atropine for hyphema with monitoring for absorption and rebleed
- d. Monitor for macular hole as increased risk secondary to commotio retinae
- e. Follow-up in 1-2 days

664 May 27 2:20 PM - 2:40 PM

Head Injury - Soccer

Mark Sederberg, Melinda Loveless. *University of Washington, Seattle, WA.* (Sponsor: Stanley Herring, MD, FACSM)

Email: mseder@uw.edu

(No relevant relationships reported)

HISTORY:

A 16 year-old male presented to an outpatient sports medicine clinic one month after a head-to-head collision during a soccer match with concern for concussion. There was no loss of consciousness, and he continued to play the rest of the game with a mild headache. He felt normal and asymptomatic that evening and was able to complete homework. The following morning he felt tired, but was able to perform adequately at school. Over the coming weeks, he noticed progressive worsening of his cognitive symptoms and tiredness. His athletic trainer became concerned for a concussion and held him from practice. One week prior to presentation he noted midline lower lip numbness, teeth pain while chewing, hearing his pulse in his left ear, and poor sleep due to sweatiness. He also felt progressive lethargy and difficulty concentrating and missed the last three days of school due to these symptoms. His medical history was significant only for a recently diagnosed inguinal hernia.

PHYSICAL EXAMINATION:

Mild cognitive deficits in attention and memory, impaired balance on BESS, normal motor strength. Cranial nerve exam showed ptosis of the left eye, mild left facial nerve palsy, decreased hearing in the left ear, and altered sensation to light touch over the middle lower lip. There was no focal tenderness or deformity of the skull or scalp.

DIFFERENTIAL DIAGNOSIS:

Mild traumatic brain injury

Intracranial hemorrhage

Cerebral mass

Bell's palsy

TESTS AND RESULTS:

MRI Brain with and without contrast: Asymmetric enhancement of the left 7th cranial nerve, asymmetric nodular enhancement along the left 5th nerve with enhancement of muscles of mastication, diffuse bilateral pachymeningeal enhancement.

Complete Blood Count: WBC 19k, platelets 80, hematocrit 30.4

CT Chest, Abdomen, Pelvis: Large abdominal soft-tissue mass herniating through the inguinal canal, most consistent with a lymphoma

CSF Cytology: Enlarged B-cells most consistent with Burkitt lymphoma.

FINAL DIAGNOSIS:

Stage IV Burkitt lymphoma, with primary lesion in abdomen, and perimeningeal spread, causing cranial nerve V and VII palsies.

TREATMENT AND OUTCOMES:

- 1. Admitted for prompt initiation of chemotherapy.
- 2. Cranial nerve symptoms resolved with chemotherapy and steroids.
- 3. After multiple rounds of chemotherapy, there is no evidence of residual lymphoma.

665 May 27 2:40 PM - 3:00 PM

A Head-Scratching Head-to-Head Case

Priya Veda Nagarajan, Carrie A. Jaworski, FACSM. *University of Chicago NorthShore, Chicago, IL.*

(No relevant relationships reported)

HISTORY: A 16-year-old high school defensive linebacker with a history of two prior concussions sustained a head injury with impact on the left side of his head. He immediately fell to the ground and with loss of consciousness for 1-2 seconds. Once he awoke, he was able to stand and be assisted off the field. He noted bilateral upper extremity numbness and weakness along with right-sided facial "heaviness." He was assessed on the sideline and did not show signs of focal deficits but was symptomatic after vestibular testing and was held from playing the rest of the game. Approximately one hour after the injury, he became increasingly fatigued with return of his bilateral upper extremity numbness and right facial heaviness. He was transported to the emergency department at this point. **PHYSICAL EXAMINATION:** Sideline exam at time of injury revealed symmetric and normal cranial nerve exam, no C-spine tenderness, and symmetric upper and lower extremity strength and sensation. He exhibited dizziness with VOMS testing but no irregular eye movements. In the ED, he had right-sided facial droop, decreased sensation in the right cheek and jaw, and an otherwise normal exam. **DIFFERENTIAL DIAGNOSIS:** 1. Intracranial hemorrhage 2. Cranial nerve palsy 3. Cervical neuropraxia 4. Concussion **TEST AND RESULTS:** CBC, CMP, and coagulation tests all normal. CT head and neck: normal MRI brain and neck: normal. MRA brain and neck: irregular petrous segment of right

internal carotid artery lumen with concern for stenosis, possibly due to artifact versus nonocclusive arterial dissection, CTA recommended. CTA head and neck: normal. **FINAL WORKING DIAGNOSIS:** 1. Concussion 2. Neuropraxia of cervical spine 3. Neuropraxia of right marginal mandibular nerve (CN V) and zygomatic and buccal branches of right facial nerve (CN VII) versus entrapment of CN VII **TREATMENT AND OUTCOMES:**

- 1. Hospitalized for two days with evaluation by neurosurgery, trauma surgery, plastic surgery, and neurology
- 2. 5-day course of oral steroids
- 3. School accommodations given related to concussion symptoms
- 4. Right-sided facial droop fluctuated and persisted for 2 weeks with subsequent resolution
- 5. Cleared to start return to play protocol by neurosurgery at 3 weeks once exam returned to baseline
- 6. Finished seasons with no additional issues related to injury

B-18 Clinical Case Slide - Running I

Wednesday, May 27, 2020, 1:00 PM - 3:00 PM

Room: CC-3020

666 **Chair:** Kentaro Onishi. *University of Pittsburgh, Pittsburgh, PA.*

(No relevant relationships reported)

667 **Discussant:** Adam Tenforde, FACSM. *Spauling Rehabilitation Hospital, Charleston, MA.*

(No relevant relationships reported)

668 **Discussant:** Brian J. Krabak, FACSM. *University of Washington, Seattle, WA.*

(No relevant relationships reported)

669 May 27 1:00 PM - 1:20 PM

Buttock Pain - Marathoner

Allison N. Schroeder, Allison Bean, Kentaro Onishi. *University of Pittsburgh Medical Center, Pittsburgh, PA.* (Sponsor: Tom Best, MD, PhD, FACSM)

Email: aschroel@alumni.nd.edu

(No relevant relationships reported)

HISTORY: History and Physical Examination: A 50-year-old competitive marathoner presented with sudden onset right buttock pain that started while sprinting during a pub run 3 days prior to presentation. He described the pain as a deep ache that localized just medial to the right ischial tuberosity. Pain was worse with truncal flexion and knee flexion. It was most apparent when walking, but improved when he applied pressure over his ischial tuberosity while walking. He denied weakness and numbness/tingling that radiated down the leg.

PHYSICAL EXAMINATION: On examination, gait was not antalgic. There was no bruising, swelling, or change in muscle bulk of the right buttock and posterior thigh. Right hip range of motion was full but end range hip flexion induced pain. He was tender to palpation in the medial and cephalad aspect of the ischial tuberosity with no tenderness over the conjoint tendon or hamstring head of the adductor magnus at the ischial tuberosity. Strength was 5/5 in the bilateral lower extremities, but he had pain with resisted right knee flexion. Sensation was intact in the bilateral lower extremities.

DIFFERENTIAL DIAGNOSIS: 1. Hamstring tear or tendinopathy 2. Piriformis syndrome 3. Tear or tendinopathy of the deep hip internal rotators (obturator internus, super gemellus, inferior gemellus) 4. Gluteus maximus muscle injury 5. Sacrotuberous ligament sprain or tear 6. Ischial femoral impingement 7. Sciatic neuropathy 8. Atypical L5 radiculopathy

TEST AND RESULTS: Limited diagnostic ultrasound of the right ischial tuberosity region was performed with a 15-6 MHz linear array transducer and showed a normal hamstring without sonopalpation tenderness. The area just proximal and medial to the conjoint tendon origin was exquisitely tender on sonopalpation at the expected site of the sacrotuberous ligament. Cortical irregularity was present on the superior medial ischial tuberosity.

FINAL WORKING DIAGNOSIS: Right sacrotuberous ligament sprain

TREATMENT AND OUTCOMES: He was referred to physical therapy for right sacrotuberous ligament sprain focused on core strengthening and frequent gentle hamstring stretching. He was pain free after one month and was able to return to running.

670 May 27 1:20 PM - 1:40 PM

Abstract Withdrawn

671 May 27 1:40 PM - 2:00 PM

Bilateral Foot Pain--Cross CountryBrian F. Allen. *University of Minnesota, Minneapolis, MN.*

(Sponsor: David E. Olson, FACSM)

Email: allen793@umn.edu

(No relevant relationships reported)

HISTORY: A 15-year-old cross-country runner presented with 6 months of bilateral foot pain. Patient described "burning" pain over lateral aspect of both feet that would occur predictably after running 1-2 miles, then gradually resolve with rest within 2 hours. No symptoms reported at rest. She denies any associated back pain, lower extremity numbness or weakness. Prior treatments included changing shoes, orthotics, therapy for plantar fasciitis, and extended rest without any improvement.

PHYSICAL EXAM:

Bilateral pes planus. No deformity, swelling, or erythema. Full ankle range of motion. 5/5 strength. Nontender palpation over the first through fifth metatarsals, tarsals, phalanges, metatarsal pads, intermetatarsal spaces, base of 5th metatarsal, or navicular. She is nontender over the medial or lateral plantar fascia. Manipulation of the foot cannot reproduce the patient's pain. She has intact sensation and strong pedal pulses.

DIFFERENTIAL DIAGNOSIS:

1. Bilateral S1 radiculopathy
2. Lateral plantar nerve compression
3. Chronic exertional compartment syndrome
4. Bilateral bone stress injury
5. Intermetatarsal neuroma

TESTS AND RESULTS:

XR Foot bilateral: Normal

MRI Left Foot: Bone marrow edema around lateral cuneiform, cuboid, and base of 3rd and 4th metatarsal.

MRI Right Foot: Bone marrow edema of the cuboid, base of 3rd and 4th metatarsals.

EMG: Normal study. Exam limited to right side due to patient tolerance.

Running Analysis: Significant hindfoot hypomobility, lack of pronation moment, decreased proximal hip strength and core control

FINAL/WORKING DIAGNOSIS:

1. Lateral plantar nerve compression secondary to impaired running mechanics
2. Bilateral bone stress injuries

TREATMENT AND OUTCOMES:

1. Activity modification and relative rest
2. Continued to recommend manual therapy and subtalar joint mobilization
3. Neuro re-education and therapeutic exercise program
4. Return to run protocol

672 May 27 2:00 PM - 2:20 PM

Achilles Tendon - RunningJulie B. Barnett¹, Annette M. Zaharoff². ¹*UT Health San Antonio Texas, San Antonio, TX.* ²*The Non-Surgical Center of Texas, San Antonio, TX.* (Sponsor: Alexis Ortiz PT, PhD, SCS, FACSM, FACSM)

Email: barnettj3@uthscsa.edu

*(No relevant relationships reported)***BACKGROUND**

The Achilles tendon is a common site for chronic tendinosis, a condition characterized by overuse and degeneration of a tendon due to repeated micro-trauma and eccentric demands commonly used in athletic demands such as running. This can lead to pain and functional limitations for an athlete. There is a growing interest in non-surgical forms of treatment for this condition including provision of regenerative injection therapy (autologous blood and platelet rich plasma injections, PRP). In this case study, a runner with an Achilles tendon injury treated with PRP later underwent an MRI after her re-injury. The MRI finding corroborate healing and in this case read as a "surgical repair" when surgery had not been performed.

PURPOSE

The study objective was to discuss an MRI finding on a prior Achilles tear treated with PRP. The Achilles was reinjured and on the subsequent MRI, the findings said that the Achilles tendon had been previously surgically repaired when the treatment had been PRP injections only and not surgery.

METHODS

A review of literature for Achilles tear reveals data in support of eccentric strengthening and platelet rich plasma injections vs surgical repair if not a complete tear. Re-injury rates and rehabilitation protocol timelines for ankle tendon injuries in sports medicine are critical for successful outcomes.

RESULTS

The Achilles tendon initial injury was treated non-surgically with regenerative injections and physical therapy. The athlete returned to sport and reinjured the same tendon. The subsequent MRI read that the tendon had been surgically repaired.

CONCLUSION

Regenerative injection therapy results in MRI changes that appear to be of surgical repair imaging. Re-injury rates need to be evaluated in regards to return to play and rehabilitation protocols post regenerative injections with the inclusion of eccentric rehabilitation. True tissue healing, without scar tissue repair, has been discussed at the cellular level of healing for soft tissue injuries with the use of regenerative injections.

673 May 27 2:20 PM - 2:40 PM

Bilateral Foot Pain-Middle Distance RunnerDimitri Constantinou, FACSM¹, Paulo Ferrao², Nickiforos Saragas². ¹*University of the Witwatersrand, Johannesburg, South Africa.* ²*Netcare Linksfield Medical Centre, Johannesburg, South Africa.*

Email: dimitri.constantinou@wits.ac.za

(No relevant relationships reported)

HISTORY: A 14-year-old female middle-distance athlete presented with a history of unilateral (right) foot pain, diagnosed as a navicular stress fracture which was managed non-surgically and made a full clinical recovery. Nine months later she sustained a suspected traumatic spring ligament injury on the opposite side, with subsequent recurrence of pain in the right foot due to overload from the non-weight bearing management of the left foot injury. She therefore presented with bilateral athletics-related foot pain, one-sided apparently traumatic in nature and the other an overload injury.

PHYSICAL EXAMINATION: On clinical examination she was noted to have bilateral mild cavus feet with an antalgic gait pattern. Right foot: Calf and Achilles tendon did not reveal any abnormalities (Silfverskiold negative). Ankle was asymptomatic. The hindfoot joints were mobile and non-tender. There was significant tenderness over the talar navicular bone ("N" spot). The mid and forefoot examination did not reveal any abnormalities. The foot was neurovascularly intact. Left foot: Calf and Achilles tendon did not reveal any abnormalities (Silfverskiold negative). The ankle was asymptomatic. The hindfoot joints were mobile and non-tender. There was once again significant tenderness over the talar navicular bone with mild swelling. The spring ligament was not tender. The mid and forefoot examination did not reveal any abnormalities. The foot was neurovascularly intact. **DIFFERENTIAL DIAGNOSIS:** Navicular stress fractures, tendinopathy of the posterior tibialis tendons, tear of the spring ligament, separation of an accessory navicular

TEST AND RESULTS: Imaging with MRI revealed bilateral navicular stress fractures (figure 1), as indicated by bony edema and a fracture line. On close inspection, the navicular fracture lines were visible on x-ray (Figure 2). Further imaging with CT scans confirmed the navicular fractures and demonstrated sclerosis along the fracture borders with no cross trabeculation, suggestive of a non-union (figure 3). **FINAL WORKING DIAGNOSIS:** Bilateral navicular stress fractures

TREATMENT AND OUTCOMES: Open reduction and internal fixation (ORIF) and bone grafting. Postop rehabilitation and graded return to activity. Back to sports with no pain or swelling in her feet 1 year post surgery.

674 May 27 2:40 PM - 3:00 PM

Return To Activity After Exertional Heat Stroke - 14 YO RunnerWilliam O. Roberts, FACSM. *University of Minnesota, Minneapolis, MN.*

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(No relevant relationships reported)

HISTORY: 14 yo CC runner in for RTP recommendation 3 wks following collapse during his 1st race. 15 min into the race his legs felt tingly & he collapsed to the ground; he could feel the grass on his face & had a hard time opening his eyes; his breathing was labored & shallow; skin was blotchy & pale. His parents transported him car to the local hospital. The ED team started cooling immediately. He was confused, combative, swearing profusely, and throwing punches at staff. As his rectal temp decreased from 41.2°C to <39°C; his behavior improved, his skin color returned to NRL, & his HR dropped from 170 bpm to NRL. ED labs were Na 140, K 4.2, & glc 89. When he arrived at Children's Hospital by helicopter, his rectal temp was 37°C. He felt a little groggy his first day back to school, but quickly returned to baseline. He participated in a low level flag football game during gym class & was told that his cheeks became flushed & blotchy. He returned to cross country practice doing the warm up, which caused him no trouble. He was eating & sleeping normally & doing his school work.

PAST MEDICAL HISTORY: No prior heat injury or heat stroke. Normal cardiac workup (2015) for palpitations; his EKG no pre-excitation.

FAMILY HISTORY: No EHS, malignant hyperthermia, or genetic issues.

PHYSICAL EXAMINATION: BP 112/75; Pulse 68; Temp 37.1°C (O); Ht 157.5 cm; Wt 54.1 kg; SpO2 99%; BMI 21.8 kg/m²; APPEARANCE: Healthy NAD. SKIN: Color NRL. CV: RR no S3, S4, or murmur. LUNGS: Clear
DIFFERENTIAL DIAGNOSIS: EHS; EHI; He with dehydration
TESTS & RESULTS: Slight SGOT elevation, transient bump in CK level, no myoglobinuria; sickle cell trait negative; EKG & echocardiogram normal
FINAL WORKING DIAGNOSIS: EHS
TREATMENT & OUTCOMES: Risk factors for EHS include a previous history & lack of acclimatization. He had 7 practices prior to the meet & he may not have been fully acclimatized. He tends to go all in during competition & that may be part of his EHS collapse. Plan to return to practice at low level exercise & gradually progress his effort over the next 3 weeks; he was already doing warm-ups; add a quarter of a workout for week 1, half the workout for week 2, & full workout for week 3. If he tolerates progressive training, he can go back into competition in about 3 weeks. The weather conditions will cool as the CC season progresses. If he has another EHS episode, will get genetic & heat lab testing.

B-19 Rapid Fire Platform - Posture and Balance in Older Adults

Wednesday, May 27, 2020, 1:00 PM - 2:20 PM
Room: CC-Exhibit Hall

675 **Chair:** Jean L. McCrory, FACSM. *West Virginia University, Morgantown, WV.*
(No relevant relationships reported)

676 May 27 1:00 PM - 1:10 PM Hip Abductors And Adductors Explosive Capacity Correlate With Step Reaction Time In Older Adults

Marcel B. Lanza, Odessa Addison, Alice Ryan, Vicki Gray.
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(No relevant relationships reported)

A loss of strength and explosive capacity (the ability to produce force as quickly as possible) may be risk factors for falls in older individuals. However, it is poorly understood if the explosive capacity of an older individual correlates with the reaction time (RT) of a predictable or unpredictable response. **PURPOSE:** Our primary aim was to investigate the relationship between rate of torque development (RTD) of the hip abductors and adductors with anticipatory postural adjustments (APA) and RT to a simple (SRST) and choice reaction step (CRST). **METHOD:** Nine older adults (5 females; 73 ± 4 y; 1.66 ± 0.07 m; 74 ± 12 kg; X ± SD) performed maximal voluntary isometric contractions (MVIC) in a standing position at 30° hip abduction. Participants performed the test as hard and fast as possible and held for ~5s. RTD was measured at 50, 100, 200 and 300 ms from torque onset (RTD₅₀, RTD₁₀₀, RTD₂₀₀ and RTD₃₀₀) and normalized to body weight and height. For the SRST and CRST a visual stimulus displayed at eye level in front of the participants indicated when to step laterally as fast as possible. APA was calculated as the first time when the difference in vertical force under the two feet increased by 5% of body weight while RT was the time between the visual stimulus and removal of the foot from the force plate. **RESULTS:** No significant correlations were found between RTD₅₀ and APA or RT. Hip abductors APA did not correlate with RTD while adductors APA correlated with RTD₂₀₀ and RTD₃₀₀ for both SRST and CRST (r = -0.71, P ≤ 0.032). Hip abductors RT correlated with RTD₁₀₀, RTD₂₀₀ and RTD₃₀₀ during CRST (r = -0.73, P = 0.025; r = -0.783, P = 0.013 and r = -0.74, P = 0.025; respectively) which was similar between hip adductors RTD₂₀₀ and RTD₃₀₀ during CRST (r = -0.85, P = 0.004; r = -0.93, P < 0.001; respectively). Hip adductors RT at RTD₃₀₀ correlated with SRST (r = -0.70, P = 0.036). **CONCLUSION:** Older adults hip abductors and adductors explosive capacity may be important when responding rapidly to an unpredictable stimulus while hip adductors also appear important in reacting to an expected stimulus. Therefore, older individuals that are not able to produce torque as fast as possible, especially during the late phase of contraction, in order to initiate the step possibly present larger risk of falls.

677 May 27 1:10 PM - 1:20 PM

Do Muscle Strength And Functional Mobility Underpin Balance Confidence In Older Adults?

Ying Liu¹, Yujie Tong¹, Xinyi Xu¹, Gordon Waddington², Roger Adams², Jeremy Witchalls², Jia Han¹. ¹*Shanghai University of Sports, Shanghai, China.* ²*University of Canberra, ACT, Australia.*

(No relevant relationships reported)

PURPOSE: Physiological, psychological and social factors are the three major determinants of falls in older adults. Psychological factors, especially balance confidence, have been suggested to be strongly associated with falls. However, it is unclear whether strength and mobility are associated with balance confidence. The purpose of the current study was to explore whether muscle strength and functional mobility reflect balance confidence in the elderly. **METHODS:** A group of 27 healthy community-dwelling adults (8M, 19F, 70.22±4.9yrs old) were recruited. Balance confidence was evaluated by using the Falls Efficacy Scale International (FES-I); functional mobility was measured by single-task Timed Up and Go test (TUG), motor dual-task TUG and cognitive dual-task TUG tests; upper limb muscle strength was measured by grip strength with a hand dynamometer; lower limb muscle strength was measured by the 30-second Sit to Stand test (30STS). SPSS was used to analyze data, with Pearson's correlation and independent samples t-test employed to examine the relationships among the measures. **RESULTS:** Pearson's correlation showed that FES-I scores for the group were moderately correlated with single TUG (r=0.569, p=0.002), cognitive TUG (r=0.463, p=0.015) and motor TUG scores (r=0.562, p=0.002). However there was no significant correlation between FES-I scores and upper or lower limbs strength (both p>0.05). According to the FES-I cut-point score of 23 for low balance confidence, participants were divided into "high balance confidence" subgroup (n=12) and "low balance confidence" subgroup (n=15). Independent samples t-tests showed significantly worse scores for the low balance confidence subgroup in single task TUG (p=0.035) and motor dual task TUG (p=0.025). **CONCLUSIONS:** The findings from this preliminary study suggest that balance confidence is associated with functional mobility, but not with muscle strength. Thus, in order to improve balance confidence, interventions based on improving functional mobility, rather than strength, should be particularly targeted involved in physiotherapy programs.

678 May 27 1:20 PM - 1:30 PM

The Relationship Between Power Production And Fall Risk

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(No relevant relationships reported)

Falls can lead to prolonged periods of hospitalization and increased medical costs. Balance has commonly been defined as a three-system model (visual, vestibular, proprioception). However, there is a normal degeneration of these systems as we age which can increase fall risk (FR). Power production is required to catch oneself from a fall, therefore it may be an important aspect to consider in the treatment of those at risk of falling. **Purpose:** The purpose of this study is to explore the relationship between isokinetic average power production (IPP), of the knee extensors (KE) and ankle plantar flexors (APF), and FR utilizing the Fall Risk Questionnaire (FRQ), Five Times Sit to Stand (5xSTS), and the Dynamic Gait Index (DGI). **Methods:** 14 Older Adults (age: 74.8±9.1 yrs., height: 172.1±10.5 cm, body mass: 77.7±14.4 kg, 11 ♀) volunteered to participate in the study. Subjects began by completing the FRQ, thereafter, in a randomized manner, subjects were assigned to one of four tests: KE IPP, APF IPP, the 5xSTS, and the DGI. IPP was performed at 4 speeds (60, 120, 180 and 240°/s) for 5 repetitions, respectively with 5 min rest between trials. The highest average power (AP) for KE and APF was recorded. The 5xSTS was timed using an Apple iPhone stopwatch and the DGI was scored by a licensed Physical Therapist. **Results:** Statistical analysis by Pearson's r correlation with 95% confidence level revealed significant r values (p<.05) between variables. Mean FRQ scores, 5xSTS times, and DGI scores were 2.4±2.8, 9.2±5.1 sec, and 19.9±2.8, respectively. Mean KE-AP and APF-AP were 114.6±54.6 W and 55.2±25.1 W, respectively. Mean AP normalized per kg body weight were 1.45±.64 W/kg for KE-AP and .71±.3 W/kg for APF-AP. The FRQ demonstrated a significant r = .768 and r = -.896 with the 5xSTS and DGI, respectively. APF-AP was significantly correlated with FRQ and DGI (r = -.557; r = .610). Significant correlations were noted between APF-AP/kg and the FRQ and DGI (r = -.618; r = .691) along with KE-AP/kg and the 5xSTS (r = -.559). **Conclusion:** For one to complete these FR assessments, significant lower extremity power must be generated to maintain upright positions and promote a dynamic balance strategy. KE-AP and APF-AP demonstrate critical importance in successfully maintaining an adequate balance strategy, which is associated with decreased fall risk.

679 May 27 1:30 PM - 1:40 PM

Mental Workload During Balance Training In Older Adults With Fall RiskLauren Q. Higgins. *University of North Carolina at Greensboro, Greensboro, NC.*

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(No relevant relationships reported)

The attentional demand of postural control is greater for older adults and increases further for older adults with balance impairments or who experienced a recent fall. Training interventions have examined balance and fall risk in older adults; focusing on improving physical factors related to balance. Further benefit to these interventions may be observed by incorporating cognitive factors such as attentional focus. It has been proposed that an external focus (EF) of attention uses automatic processing, reducing the attentional demand of postural control. This may be reflected in the mental workload (MWL) required for task execution. **PURPOSE:** This study investigated if EF of attention reduces MWL during balance training in older adults with fall risk.

METHODS: Older adults (N = 15, 4 males; 78.5 ± 7.0 yrs) who reported a fall in the past year were randomly assigned to either an EF group (N=9) or internal focus (IF) group (N=6). Participants completed 12 weeks of balance training on balance boards, twice per week for 20 minutes (20 trials; 30s balance, 30s rest). Prior to each trial, groups received respective attentional focus cues. At weeks 1, 3, and 6, heart rate variability (HRV) during balance training, and the NASA Task Load Index (NASA-TLX) were used as an assessment of MWL. HRV, R-R interval data was collected using a heart rate monitor chest strap.

RESULTS: Two-way repeated measures ANOVA's revealed a significant effect of time on four HRV outcomes: SDNN (F(2, 10) = 6.66, p = .015, partial η^2 = .571), RMSSD (F(2, 10) = 9.18, p = .015, partial η^2 = .647), (F(2, 10) = 4.18, p = .048, partial η^2 = .455), and DFA short term fluctuation slope (F(2, 10) = 6.84, p = .013, partial η^2 = .578). A significant interaction effect was observed for the NASA-TLX (F(2, 10) = 4.22, p = .047, partial η^2 = .458). Follow-up analysis revealed no significant main effects due to a cross over interaction with EF means decreasing and IF increasing from week 1 to 6. **CONCLUSIONS:** Preliminary findings suggest objective measures of MWL represent a practice effect of balance training with attentional cues. Additionally, the observed cross over interaction for MWL proposes that an external focus of attention may be an advantageous training strategy for reducing perceived MWL.

FUNDING: NIH National Institute on Aging, Grant #: 1R15AG053866

680 May 27 1:40 PM - 1:50 PM

Effects Of Resting Posture On Gait Features During Timed Up And Go In Older AdultsEryn N. Murphy. *New Mexico State University, Las Cruces, NM.* (Sponsor: Joseph Berning, FACSM)

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(No relevant relationships reported)

Altered gait mechanics and longer time to complete a 3-meter timed up and go (TUG) task are risk factors for falls in older adults. While acute change in posture influences static balance, it remains unclear if a supine resting position alters gait patterns, compared to seated rest in older adults. **PURPOSE:** The purpose of the present study is to explore the effects of resting postures on TUG performance and gait features during the TUG task. **METHODS:** In this within-subject design study, thirty-eight older adults (73.55 ± 1.04 yrs, 71.89 ± 2.31 kg, 1.64 ± 0.01 m) completed the TUG under two randomly ordered resting conditions; following 10 minutes of seated rest (SEAT) and following 10 minutes of supine rest (SUP). Participants were instructed to begin on "go" and "begin when they were ready", with time starting when they reached a seated position in SEAT and SUP conditions respectively. Total time (TUG_{TOT}, s), averaged gait velocity (TUG_{VEL}, cm/s), cadence (TUG_{CAD}, spm), and active propulsion (TUG_{APT}, % of the percentage of gait time when the center of gravity extends beyond the base of support until contralateral heel contact) over the single trial were calculated. TUG trials were calculated using Tekscan Walkway system. Paired sample t-tests were used to determine gait differences between two resting conditions. **RESULTS:** TUG_{TOT} was significantly longer after the SUP compared to the SEAT (12.14 ± 4.35 s vs. 10.52 ± 2.65 s, p=0.001). TUG_{VEL} was significantly slower after the SUP compared to the SEAT (85.28 ± 28.73 cm/s vs. 102.03 ± 21.43 cm/s, p<0.001). TUG_{CAD} was significantly lower after the SUP compared to the SEAT (108.94 ± 21.57spm vs. 119.44 ± 13.50 spm, p=0.001). TUG_{APT} was significantly less after the SUP compared to the SEAT (58.00 ± 25.53% vs. 71.72 ± 22.14%, p=0.012). **CONCLUSIONS:** Clinical standards identify older adults that take longer than 12 seconds to complete the TUG at increased risk of falling. Our results indicate that a sudden postural change from supine resting position results in increased falls risk. These findings have potential to inform patient, provider, and caregiver efforts to lower risk of falls in older adults.

681 May 27 1:50 PM - 2:00 PM

Rate Of Force Development Parameters In Young And Older Males During A Chair RiseTyler M. Smith, Phuong L. Ha, Alex A. Olmos, Matthew T. Stratton, Trisha A. VanDusseldorp, Alyssa R. Bailly, Yuri Feito, FACSM, Micah J. Poisal, Joshua A. Jones, Benjamin E. Dalton, Garrett M. Hester. *Kennesaw State University, Kennesaw, GA.* (Sponsor: Yuri Feito, FACSM)

(No relevant relationships reported)

Assessing vertical ground reaction forces (VGRF) during a chair rise may yield insight regarding age-related differences in physical function, but a comprehensive assessment of rate of force development (RFD) during this task is lacking. **PURPOSE:** To compare RFD parameters during a chair rise in young (YM) and older (OM) males, and examine correlates of chair rise time. **METHODS:** Healthy, YM (n=15, age=20.7±2.2 yrs) and OM (n=15, age=71.6±3.9 yrs) performed a single chair rise as quickly as possible on a force plate without upper-body assistance. Peak VGRF (PF), as well as peak (highest 100 ms rolling average), early (minimum VGRF to 50% PF), late (50% PF to PF), and overall (minimum VGRF to PF) RFD were recorded. RFD was calculated as the linear slope of the force-time curve (Δ force/ Δ time) during the corresponding time spans. All force measures were derived from the normalized (body mass) force signal. Chair rise time was also obtained and the trial with the shortest time was used for subsequent analysis. Independent samples t-tests were used for group comparisons, and Pearson correlation coefficients were calculated for each group to examine select relationships. **RESULTS:** Chair rise time was similar between groups (p=0.256). Early RFD was similar (p=0.051), while PF (YM=1.57±0.13 vs. OM=1.33±0.10 N/kg; p<0.001), peak (YM=12.60±1.56 vs. OM=9.05±1.46 N/s·kg⁻¹; p<0.001), late (YM=8.12±1.63 vs. OM=4.97±1.10 N/s·kg⁻¹; p<0.001), and overall RFD (YM=7.57±1.24 vs. OM= 5.49±1.16 N/s·kg⁻¹; p<0.001) were lower in the OM. For OM, only PF (r=-0.875; p<0.001) and peak RFD (r=-0.783; p=0.001) were correlated with chair rise time, while no correlations were present in YM. **CONCLUSION:** PF and RFD, especially peak and late RFD, were dramatically diminished during a chair rise in OM. PF and peak RFD demonstrated a strong inverse relationship with chair rise time in OM.

682 May 27 2:00 PM - 2:10 PM

Comparison Of Age, Gender, And Sport On Performance Of Stability Test In Senior ParticipantsRomina Villamonte¹, Dennis Eggert², Brent J. Feland². ¹New Zealand Institute of Sport, Epsom, Auckland, New Zealand. ²Brigham Young University, Provo, UT. (Sponsor: Ty Hopkins, FACSM)

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(No relevant relationships reported)

PURPOSE: The purpose of this study was threefold: to observe the differences in performance variables of the Modified Clinical Test of Sensory Interaction in Balance in active elderly participants and to compare results by age (50-59, 60-69, 70-79, 80+), sports (aerobic, basketball, golf, tennis, volleyball, and none), and gender. **METHODS:** Analyses were based on a sample of 525 World Senior Games attendees who were age 50 and over. Data were obtained from voluntary participation in balance and mobility screening as part of the health fair offered to all participants at the annual Hunstman World Senior Games. Of the 525 participants tested, 383 were participants in at least one sporting event at the games and 142 were non-participants. All modified CTSIB were performed on the NeuroCom Balance Master. The measured variables (center of gravity sway (degrees/sec)) were; firm surface with eyes open, firm surface with eyes closed, foam surface with eyes open, and foam surface with eyes closed. **RESULTS:** All data were analysed using SAS, version 9.4. An initial analysis of gender and age category was performed. A final model was run with the significant variables from the initial analysis plus sports category. Post hoc Tukey pairwise comparisons were also performed. A significant difference *(p<0.0001) was found between stratified age groups in all balance test variables. No significant differences were found between gender nor sports categories for the 4 balance variables.

Age (years)*	Participants (n)	*Firm Eyes Open	*Firm Eyes Closed	*Foam Eyes Open	*Foam Eyes Closed
50 - 59	140	0.2004	0.2494	0.6561	1.5904
60 - 69	237	0.2306	0.2816	0.7635	1.8823
70 - 79	128	0.2804	0.3448	0.8736	2.0625
80 +	20	0.3426	0.4966	1.1106	2.4164

CONCLUSION: While balance sway significantly increases with age in all 4 variables, they remain similar when comparing between gender and sports. This test may not be sensitive enough to detect differences between sports in our participants. Also,

our participants are probably too active to detect differences in the variables tested regardless of sports category. Further research is needed to better differentiate between active and non-active individuals and performance on the modified CTSIB.

683 May 27 2:10 PM - 2:20 PM
Balance Assessments In Older Adults After A Six-week Walking Intervention With Different Gait Devices

Abbie Payne, Megan Ruppert, Lana Prokop, Joshua Guggenheimer. *St. Catherine University, St. Paul, MN.* (Sponsor: Mark Blegen, FACSM)
(No relevant relationships reported)

Older adults have a relatively high incidence of falls, which are costly for both the individual and the medical system. Falls result not only in physical injury or death, but also can lead to a decreased quality of life - both mentally and socially. Measuring different aspects of balance can help predict the risk for falling. **PURPOSE:** This study investigated how walking with no device, walking poles, or a gait trainer impacted balance measures in older adults. **METHODS:** Fourteen participants (3 men, 11 women, aged 77.53 +/- 7.28 years) were randomized to one of three walking groups: Control (C) (n=4), Walking Poles (WP) (n=5), or Gait Trainer (GT) (n=5). The gait trainer is a new device aimed at preventing age-related gait decline. Assessments were performed at three separate times: prior to the intervention (Pre-test), immediately after the intervention (Post1), and six weeks after Post1 (Post2). Assessments included subjective measures of balance confidence during activities of daily living (Falls Efficacy Scale International and Activities-Specific Balance Confidence), and physical measures of balance (Berg Balance Scale (BBS) and the Timed Up and Go (TUG)). For the six-week intervention, all participants walked three times per week for 30 minutes in their assigned walking group. **RESULTS:** An ANOVA showed there were no statistically significant differences between the groups at Pre-test for all metrics ($p > 0.05$). All groups were below the cut off score of a high fall risk (≥ 14 s) for the TUG at Pre-test: C 9.00 ± 2.18 s, WP 9.41 ± 2.41 s, and GT 11.29 ± 4.99 s. All groups were above the cut off score (<45 out of 56) for greater risk of falls on the BBS at Pre-test: C 51.5 ± 1.29, WP 52 ± 5.00, and GT 48.4 ± 5.03. Between group measurements across time were analyzed using linear regression models for all metrics, with an alpha set at $p < 0.05$. There were no statistically significant differences between groups across time. **CONCLUSION:** This study found that the walking group did not impact balance measurements over time with the six-week walking intervention. All three groups were relatively high-functioning compared to age norms, which may have impacted scoring sensitivity on the TUG and BBS. Future studies may consider using more challenging interventions and balance assessments for higher-functioning older adult populations.

B-44 Thematic Poster - Biomechanics During Military Tasks

Wednesday, May 27, 2020, 3:15 PM - 5:15 PM
 Room: CC-2009

768 **Chair:** Richard W. Willy. *University of Montana, Missoula, MT.*
(No relevant relationships reported)

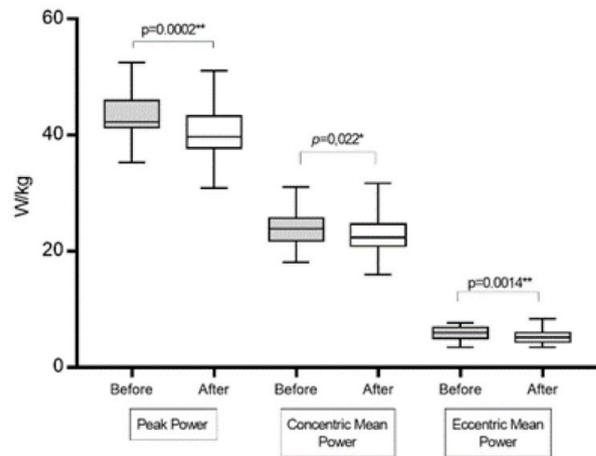
769 Board #1 May 27 3:15 PM - 5:15 PM
Military Parachuting Effects In Kinetic Variables From Countermovement Jump In Kinetics From Colombia

Jenner Cubides¹, Rodrigo E. Argothy², Maria Alejandra Dias³, Daniel Cohen⁴. ¹Militar school of cadets "General José María Córdova, Bogota, Colombia. ²Ministry of Sports, Bogota D.C., Colombia. ³Militar school of cadets "General José María Córdova, Bogota D.C., Colombia. ⁴University of Santander (UDES), Bogota D.C., Colombia.
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(No relevant relationships reported)

The military parachuting course (MPC) is one of the combat courses offer during the Colombian military career. A literature research shows that this type of courses presents a high incidence and prevalence of injuries in the lower limbs in the landing phase. Additionally, different studies show that the injury rate in the lower limbs is 2-20 every 1000 jumps performed. The most compromised areas are the ankle and knee (ligament and sprains), where 80% of the injuries occur. Moreover, the militaries present a higher injury risk because of variable conditions: high wind speeds, external load and ground conditions. Then, a good landing is very important and it requires a good stability at the knee and a good distribution of the energy at the time of contact with the ground. **PURPOSE:** Identify the effects of the military parachuting course on the muscular performance of the lower limbs **METHODS:** Descriptive observational

study with an analytical component, in 43 male cadets of the Military School from Colombia, who participated in the MPC for 4 weeks. The performance of the lower limbs was evaluated by using uniaxial force platforms before and after the course. A statistical analysis was performed using the student T test and the Wilcoxon test statistic was used to evaluate changes after the MPC **RESULTS:** Significant differences were found in the jump height (29.32 ± 3.8 vs. 26.03 ± 3.6 cm, $p = 0.0001$), peak power (43.29 ± 3.4 vs. 40.62 ± 4.3 W/kg, $p = 0.0002$), peak landing force (57.65 ± 9.8 vs. 65.15 ± 12.4 N, $p = 0.002$), eccentric peak velocity (-1.09 ± 0.1 vs. -1.01 ± 0.2 m/s, $p = 0.005$), concentric mean power (23.72 ± 2.5 vs. 22.78 ± 2.8 N/kg, $p = 0.022$) and eccentric mean power/BM (5.88 ± 1.03 vs. 5.36 ± 1.09 N, $p = 0.001$). **CONCLUSIONS:** There is an impact on neuromuscular performance that affects the strength and power of the lower limbs, and increases the ground reaction forces in the landing phase. It could become a risk factor for injuries due to a change in the mechanism of acceptance of load at the landing stage.

Kinetic Changes of Countermovement Jump Test



770 Board #2 May 27 3:15 PM - 5:15 PM
Medial Compartment Gap Is Decreased During Forced Marching And Running Load Carriage Tasks

Camille C. Johnson, Kellen T. Krajewski, Dennis E. Dever, Ajinkya Rai, Katelyn F. Allison, Mita Lovalekar, William J. Anderst, Christopher Connaboy. *University of Pittsburgh, Pittsburgh, PA.*
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(No relevant relationships reported)

Medial compartment cartilage thickness can provide an indication of early stage osteoarthritis (OA), so determining tibiofemoral joint space during dynamic loading tasks is an important step in investigating potential long-term joint degeneration. Women experience higher rates of knee OA than men and military personnel are at an even greater risk, so understanding how military-relevant load carriage tasks will affect tibiofemoral arthrokinematics in a female population is of great importance in order to inform training strategies and prevent injury. **PURPOSE:** The purpose of the study was to determine the effects of load carriage and locomotion pattern on tibiofemoral dynamic joint space. **METHODS:** Twelve physically active females (age: 24.5±2.4 years) walked (WK), ran (RN), and force marched (FM, or walking at a high velocity) on a treadmill while unloaded (bodyweight, or BW) and while loaded with an additional +25%BW or +45%BW (14.3±2.0 kg, 25.6±3.5 kg). Synchronized biplane radiographs of the right knee were collected at 150 images/second for 1 second during each movement trial. A validated model-based tracking system determined femur and tibia motion (accuracy: 0.9°, 0.7 mm). Subchondral bone distances were calculated. Two-way RMANOVA with post-hoc Bonferroni correction were used to analyze the interactions and within-subjects effect of load (BW, +25BW, +45%BW) and percent of right leg support (0%, 10%, 20%, 30%) on minimum medial and lateral compartment gap during WK, RN, and FM, independently ($\alpha=0.05$). **RESULTS:** No significant interactions were observed between load and percent support. Medial and lateral gap was lower at initial contact vs. 10% and 20% support for FM (Medial: 38%, 33% decrease, Lateral: 26%, 23% decrease). Medial gap was 23% lower at 30% vs. 20% support for FM. For RN, medial gap was lower at 30% support vs. 10% and 20% (35%, 19% decrease). No significant changes in joint space were observed for lateral RN or medial/lateral WK. No significant differences due to load were observed. **CONCLUSION:** Changes in knee dynamic joint space appear to be more sensitive

to differences in knee kinematics rather than additional load magnitude and suggest kinematics plays a vital role in knee cartilage loading and potentially the development of OA. Supported by the Freddie Fu Student Research Grant.

771 Board #3 May 27 3:15 PM - 5:15 PM
The Effects Of External Loading On Lower Extremity Landing Biomechanics In College Rotc Cadets

Jae P. Yom¹, Allen Redinger², Dustin Grooms², Janet Simon².

¹University of Illinois Springfield, Springfield, IL. ²Ohio University, Athens, OH.

(No relevant relationships reported)

Military personnel performs in combat and physical training with extensive external loading from combat gear that may increase risk for lower extremity musculoskeletal injury. Lower extremity musculoskeletal injury risk is high in this population and can threaten deployment, completion of duty, and quality of life. However, there is limited research determining the effects of external loading on landing biomechanics in military situations. **PURPOSE:** To determine if external loading affects lower extremity landing biomechanics during a jump landing task in ROTC cadets.

METHODS: Twenty five ROTC cadets (age: 20.2±1.3yr; height: 174.4±11.3cm; mass: 77.0±5.1kg) were recruited and performed two conditions of three jump landings (baseline vs loaded landing with an additional 35% body weight (BW) vest) from a 30cm high box. The box was placed a distance of 50% of their height from the landing zone of two force plates. Lower extremity angular joint kinematics and ground reaction forces (GRFs) were compared between the two conditions using paired t-tests ($\alpha < .05$).

RESULTS: The loaded landing compared to baseline landing, resulted in decreased knee (16.8±3.7 and 19.4±4.7°) and hip (30.4±6.3° and 32.7±5.4°) flexion at initial contact (IC), and increased maximal joint flexion displacements for ankle (36.0±11.5° and 31.4±9.9°), knee (56.2±7.2° and 49.0±6.5°), and hip (23.8±5.6° and 18.5±4.9°). Furthermore, loaded landings, compared with baseline landings, exhibited significantly lower vertical GRF (2.3±0.5 N·kg⁻¹ and 2.7±0.5 N·kg⁻¹) and posterior GRF (0.6±0.1 N·kg⁻¹ and 0.7±0.1 N·kg⁻¹). **CONCLUSION:** Loaded landings increased key injury risk landing biomechanics. Less knee and hip flexion at IC have been associated with potential anterior cruciate ligament (ACL) injury risk and may increase ACL loading during landing. However, the less peak vertical and posterior GRFs with greater displacement of all three lower extremity joints on during loaded landing suggests cadets employed a compensation strategy that may reduce ACL loading after IC.

772 Board #4 May 27 3:15 PM - 5:15 PM
Sex-related Differences In Patellofemoral Joint Stress With Fighting And Approach Load Carriage

Marin Plemmons, Brent Ruby, FACSM, Brittany Hanser, Kelly Christensen, Alexis Doust, Richard W. Willy. University of Montana, Missoula, MT.

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(No relevant relationships reported)

PURPOSE: Female Soldiers have 2.2x greater risk for patellofemoral pain (PFP) compared with male Soldiers. Females may experience larger increases in knee loads, versus males, with added load carriage, which is standardized in the military across sexes. Thus, we assessed sex-related differences in patellofemoral joint stress (PFJS) metrics with the addition of fighting (20 kg) and approach (35 kg) load carriage.

METHODS: Via motion capture procedures, 34 healthy, well-trained individuals with load carriage experience (17 male(M):26.8 yrs±4.3, 78.9kg±6.8; 17 female(F): 23.8yrs±4.6, 64.3kg±8.1) completed instrumented treadmill trials (1.35 m/s) with and without 20-kg and 35-kg load carriage. Peak PFJS and PFJS loading rate were estimated with a musculoskeletal model and analyzed via repeated measure ANOVAs [Sex(2) x Load(3)]. Standard mean differences (SMD) were calculated on the relative change rate of PFJS metrics in males versus females with added load carriage.

RESULTS: Significant Sex X Load interactions ($p < .01$) were found for both peak PFJS and PFJS loading rate. While moderate SMDs were found between 0kg and 20kg carriage, large SMDs were found between 0kg and 35kg carriage indicating larger relative increases in PFJS metrics in females versus males. TABLE: Mean and standard deviations for variables. *corresponds to $p < .05$ between 0kg and 20kg; †Corresponds to $p < .05$ between 0kg and 35kg.

Variable	0 kg	20 kg	SMD 0 kg =>20kg	35 kg	SMD 0 kg =>35kg
Peak PFJS	M: 2.2 mPa± 0.6 F: 2.0 mPa± 0.6	M: 2.6 mPa± 0.9* F: 2.7 mPa± 0.6*	d=0.39	M: 2.9 mPa± 0.9*† F: 3.4 mPa± 1.0*†	d=1.03
PFJS Loading Rate	M: 22.8 mPa/s ±9.7 F: 18.7 mPa/s ±10.0	M: 25.8 mPa/s ±11.8 F: 25.9 mPa/s ±13.0*	d=0.42	M: 29.2 mPa/s ±12.1*† F: 34.5 mPa/s ±12.8*†	d=0.96

CONCLUSIONS: Females experienced greater relative increases in PFJS metrics with added load carriage compared with males, but only the approach load (35 kg) resulted in large SMDs. Thus, training volume, e.g., march distances, with approach loads should be increased more cautiously in females compared with males whereas fighting loads (20kg) appear less risky and may require minimal adjustments in training volume between sexes. These findings provide insight into why females have a disproportionately higher rate of PFP in the military than the general population.

773 Board #5 May 27 3:15 PM - 5:15 PM
Compromised Perception-action Coupling Performance In Military Personnel May Be Related To Increased Deep Sleep

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(No relevant relationships reported)

Operational stressors, such as caloric and sleep restriction and physical fatigue, may compromise perception-action coupling, the cooperative function of the sensory and motor systems, in military personnel. Prior sleep may protect against performance decrements and different sleep stages may conserve different aspects of performance.

PURPOSE: To investigate changes in perception-action coupling during simulated military operational stress and understand the role of sleep stages on performance. **METHODS:** As part of a 5-day study assessing resilience to simulated military operational stress, thirty-three (6 female) active duty and reserve status service members (25.8 ± 4.7 years) completed three trials of a novel perception-action coupling task (PACT) at 1700 after a night of baseline sleep (BASE), two nights of sleep restriction (T1) and a night of recovery sleep (T2). Participants had 8-hr for baseline and recovery sleep (2300-0700) and 4-hr disturbed sleep on intervention nights (0100-0300 and 0500-0700). Polysomnography was used to identify sleep stages. The tablet-based PACT requires participants make quick, accurate perceptual judgments and responses about whether varying sized virtual balls fit through virtual apertures. Outcomes of interest included response time (RT) and accuracy (ACC). Percent time in stage 2 (N2), slow wave (SWS) and rapid-eye movement (REM) sleep were median split to form high (more sleep in a stage) and low sleep groups. Differences in PACT performance between sleep groups across time were assessed using multiple mixed model (2 x 3) ANOVA. **RESULTS:** No significant sleep group x time interaction or main effect of time were found for RT or ACC. A significant main effect of SWS sleep group was found for RT ($F_{1,31} = 4.898, p = .034, \eta^2_p = .136$). The high SWS group had slower (worse) RT than the low SWS group (.886 ± .023 vs .814 ± .024 s). No other significant main effects of sleep group were found. **CONCLUSION:** Perception-action coupling was maintained during simulated military operational stress. Participants with more baseline SWS had worse PACT performance but other sleep stages, N2 and REM, did not relate to perception-action coupling. This suggests a specific effect of SWS, which is deep sleep, on perception-action coupling abilities and behaviors.

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774 Board #6 May 27 3:15 PM - 5:15 PM

Stroboscopic Effect On Functional Balance Performance In Special Operations Forces Combat Soldiers

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Reported Relationships: J.P. Mihalik: Ownership/interest/stock; Dr. Mihalik has an equity interest in Senaptec Inc., the company that manufactures and sells the stroboscopic eyewear used in this study.

Previous work has identified that standard concussion balance measures (e.g., BESS) do not differentiate Special Operations Forces (SOF) combat soldiers with and without concussion history. Recent evidence also associates incident concussion with a subsequent increased musculoskeletal injury risk. There is a need to study functional balance performance tasks designed to challenge this military population.

PURPOSE: To study the interaction between concussion history and increasing visual occlusion on functional balance performance in SOF combat soldiers. **METHODS:** 74 SOF combat soldiers (age=34.0±4.7 yrs) participated in our study and self-reported concussion history (33 no, 41 yes). All participants completed the Y-Balance Test (YBT) under 3 different counterbalanced visual conditions: 1) eyes-open, 2) low occlusion, and 3) high occlusion. Low (level 2) and high (level 6) occlusion conditions were produced using stroboscopic eyewear. Dependent variables included the right and left composite reach distance (percentage) for each vision level. Mixed model ANOVAs evaluated differences in composite reach distance between visual conditions and concussion history. **RESULTS:** Increasing vision occlusion affects right ($F_{2,144}=11.93$; $p<0.001$) and left ($F_{2,140}=14.41$; $p<0.001$) limb YBT performance regardless of concussion history, with both low (103.5%, 95%CI: 101.2,105.8) and high (102.3%, 95%CI: 100.1,104.4) occlusion resulting in diminished YBT performance compared to eyes open (105.3%, 95%CI: 103.1,107.5). SOF combat soldiers with no concussion history demonstrated better right ($F_{1,72}=5.28$; $p=0.025$) and left ($F_{1,70}=8.49$; $p=0.005$) limb YBT performance compared to those self-reporting concussion history regardless of vision occlusion. There was no interaction effect between visual occlusion and concussion history on right ($F_{2,144}=0.71$; $p=0.492$) or left ($F_{2,140}=0.01$; $p=0.993$) limb YBT performance in our sample. **CONCLUSION:** Increasing visual occlusion or self-reporting concussion history negatively affect SOF combat soldiers' YBT performance. These data suggest introducing stroboscopic eyewear and presenting SOF combat soldiers with a challenging balance task (e.g., YBT) may be an effective post-concussion assessment consideration. Funded by US Army Special Operations Command

775 Board #7 May 27 3:15 PM - 5:15 PM

Foot Acceleration Attenuation Reduces During Military Load Carriage

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Military personnel are at risk of stress fracture injuries, especially those in load carriage-based military occupational specialty, such as infantry. Recently, wearable inertial measurement unit (IMU)-based accelerometry has become a useful tool for identifying markers of lower extremity musculoskeletal injury risk in soldiers in field settings. **Purpose:** To compare differences in accelerometry between non-dominant and dominant foot using foot-worn IMU sensors during a 2km best effort run with heavy (20kg) load carriage. **Methods:** Acceleration data from six healthy participants (3 male: 30.33±6.7 y, 1.82±0.01 m, 77.80±11.0 kg and 3 female: 21.0±2.6 y, 1.66±0.1 m, 64.62±13.5 kg) were recorded using tri-axial IMU affixed to the dorsum of each foot. Participant performed a 2km best effort march (run and walk) across grass carrying 20 kg on their back. Data were divided into 200m +/- blocks from the beginning, middle and end of the exercise for analysis. The acceleration amplitudes from each trial were expressed as the root mean square (G_{RMS}), calculated as the average of the square of the acceleration over time, and were used to quantify the accelerations attenuation. The magnitude of the resultant acceleration signal Acc_x , referred to as the "composite acceleration signal", was computed as: $\sqrt{acc_x^2 + acc_y^2 + acc_z^2}$, where acc_x , acc_y , and acc_z are obtained from each individual axis of the

tri-axial accelerometer. **Results:** The mean G_{RMS} values at the three phases obtained for the dominant and non-dominant feet of the men were 4.72, 5.15, and 5.23, and 4.93, 4.75, and 4.41 m/s^2 , respectively whereas those obtained for the dominant and non-dominant feet of the women were 3.91, 4.32, and 3.87, 4.42, and 4.71 m/s^2 , respectively. These findings revealed that the G_{RMS} values of the feet obtained for both sexes gradually increased during the load carriage task, except for the non-dominant foot of the men, which decreased. **Conclusion:** Increases in G_{RMS} during loaded marching suggest non-linear increases in culminative mechanical stress exposure as distance increases. Foot worn IMU-based measurement systems may provide means to accurately assess injury risk in real time. Supported by UK Ministry of Defence (WGCC 5.5.6-Task 0107) and US Dept. of Defense (W81XWH-17-2-0070).

B-45 Thematic Poster - Care of the Female Athlete

Wednesday, May 27, 2020, 3:15 PM - 5:15 PM
Room: CC-2007

776 **Chair:** Emily Kraus. *Stanford Hospital and Clinics, Woodside, CA.*
(No relevant relationships reported)

777 Board #1 May 27 3:15 PM - 5:15 PM

Practical And Applied Knowledge Of Athletic Trainers On The Female Athlete Triad

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BACKGROUND: The female athlete triad is the interrelation of low energy availability, menstrual dysfunction, and low bone mineral density. Athletic trainers are in a position to be able to identify the female athlete triad in athletes. However, limited research exists regarding practical and applied knowledge of the female athlete triad. **PURPOSE:** The purpose of this study was to determine the level of practical knowledge of athletic trainers on the female athlete triad and also determine if athletic trainers are applying this knowledge by properly screening athletes for the female athlete triad. **METHODS:** Certified athletic trainers (n=116) completed an online survey via Qualtrics that assessed both knowledge of the female athlete triad and current practical application of the female athlete. Linear-by-linear tests were used to find associations between practical knowledge and applied knowledge for related components of the triad. **RESULTS:** The athletic trainers mostly work with high school athletes (39%) and college athletes (32%). Fifty percent of the athletic trainers had at least 7 years of experience. Sixty-nine percent of the athletic trainers were female. While most of the general knowledge of the athletic trainers was high (for example 70% believe that increasing energy availability is key when returning an athlete back to sport and 73% believe that repeated stress fractures is a red flag for the female athlete triad) most of the applied knowledge was low (for example only 14% screen their athletes for eating disorders and only 36% ask about history of stress fractures). Linear-by-linear association ($p=0.050$) demonstrated an association between agreeing about importance of energy availability and always screening for eating disorders. However, we did not demonstrate linear-by-linear association ($p=0.354$) between agreeing that stress fractures are a red flag for the female athlete triad and asking about history of stress fractures. **CONCLUSION:** While general knowledge of the female athlete triad is high, a low percentage of athletic trainers appear to be applying their knowledge in prevention and detection of the female athlete triad. More education is need to help athletic trainers to implement screening, prevention, and return to play techniques to keep our athletes safe.

778 Board #2 May 27 3:15 PM - 5:15 PM

Prevalence And Impact Of Dysmenorrhea In Japanese Female Athletes

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(No relevant relationships reported)

Dysmenorrhea (menstrual cramps) is one of the big problems that many women suffers. It has been previously reported that dysmenorrhea is associated with lifestyle habit including sleep, exercise, smoking, and alcohol. Many female athletes have been reported to suffer with dysmenorrhea, however, the prevalence and impact of

dysmenorrhea and in relation to lifestyle in Japanese female athletes are not clarified yet. **Purpose** To investigate the prevalence and impact of dysmenorrhea in Japanese female athletes. **Methods** 98 collegiate female athletes participated in this study (mean age 21±1.6). Sports type in participants were soccer (n=23), track and field (n=31), kendo (n=13), wheel gymnastics (n=10), lacrosse (n=21). Demographic information questions addressed age, height, weight, length of sporting career, and training volume (training hour, training frequency per week, training hour per time). Lifestyle habits questions included daily wake-up time and bedtime, sleeping hours, dietary habit, coffee-drinking, alcohol-drinking and smoking habits. Age of menarche, day counts of menstrual cycle, day counts of menstruation, dysmenorrhea symptoms (e.g.; breast tenderness, abdominal pain, low back pain, headache), dysmenorrhea severity (from 0 to 10; none to very severe), and medication during menstruation were asked in the menstrual questionnaire. **Results** The dysmenorrhea symptom that many subjects complained were lower abdominal pain and fatigue. Length of sporting career, menarche age, training habits and lifestyle habits did not show significant correlation with severity of dysmenorrhea. However, the prevalence of severe dysmenorrhea positively correlated significantly with age ($p = 0.004$, $r = 0.29$). **Conclusions** In this study, we showed that severity of dysmenorrhea was associated with older age in Japanese female athletes. Therefore, in female athletes it is necessary to deal with dysmenorrhea considering age.

779 Board #3 May 27 3:15 PM - 5:15 PM

Female Athletes And Osteoporosis Risk

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Female athletes are participating in greater numbers than ever before. Across the last year, nearly 3.4 million female high school (NFSH, 2019) and 216,400 NCAA college-aged females (NCAA, 2018) competed in a variety of sports. Unfortunately, this phenomena has elevated concerns regarding the impact of relative energy deficiency in sport (RED-S) among such populations. The elevated energy expenditure required to drive such participation may lead to decreased energy availability, this coupled with hypothalamic disruption may place female athletes at greater risk of bone mineral density (BMD) loss than previously anticipated. **Purpose:** To evaluate BMD in female athletes. **METHODS:** Participants included 60 NCAA Division II college-aged female athletes from two southern universities and 13 participants aged 15 to 18 on a club team. The females identified themselves as Caucasian ($n = 59$), African American ($n = 8$), Latina ($n = 2$), or other ($n = 4$). BMD of the phalanges on the non-dominant hand was collected. Self-reported information about calcium intake, diet, and physical activity level were collected along with administration of the EAT-26. **Results:** The athletes ranged in age from 15-33 ($M = 19$, $SD = 2.2$) with a mean weight of 66.4 kg ($SD = 9.5$) and height of 1.7 m ($SD = .07$). The population was classified as asymptomatic and free of any self-reported disordered eating, and yet, not consuming the recommended amount of calcium daily (1200-1500 mg). Moreover, 31 (43.6%) participants currently had secondary amenorrhea, 15 participants (20.5%) reported a history of osteoporosis in their immediate family, and 12 participants (16.7%) had experienced a stress fracture. Of the 73 participants, 16 females (21.9%) were determined to have osteopenia. All 16 females were Caucasian. Consequently, there was a relationship between BMD and race ($r = .26$, $p < .05$) in addition to BMD and alcohol consumption ($r = .22$, $p < .05$). **Conclusion:** No relationship was found between the components of RED-S (amenorrhea and low energy availability) and BMD. However, Caucasian female athletes were at a greater risk for osteopenia than other races. This study was limited by the instrument utilized and site scanned. Further research should be conducted regarding site and sport specific adaptations on BMD employing scans from both the upper and lower body.

780 Board #4 May 27 3:15 PM - 5:15 PM

Comparing Bioelectrical Impedance Analysis To Air Displacement Plethysmography For Body Composition Assessment In Female Athletes

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(No relevant relationships reported)

PURPOSE: To compare bioelectrical impedance analysis (BIA) and air displacement plethysmography (ADP) for body composition assessment in female collegiate athletes.

METHODS: Retrospective review of body composition data for 61 NCAA female collegiate athletes (basketball $n = 14$, soccer $n = 31$, volleyball $n = 16$), measured by BIA and ADP on the same day. Paired t-tests, effect size using Cohen's d , Pearson's

correlation, and Bland-Altman plots were used to compare percent body fat (%BF) and fat-free mass (FFM) measurements from BIA and ADP for the whole sample, and within sports.

RESULTS: The sample included 61 female athletes ages 18-25 years ($\bar{x} = 19.5 \pm 1.4$ years), with heights ranging from 160-190.5 cm ($\bar{x} = 172.3 \pm 8.9$ cm), %BF measures ranging from 6.0-38.5% ($\bar{x} = 21.3 \pm 6.3\%$) for ADP and 13.4-36.0% for BIA ($\bar{x} = 22.5 \pm 4.7\%$) and FFM measures ranging from 36.2-69.3 kg ($\bar{x} = 53.4 \pm 6.8$ kg) for ADP, and 38.8-63.8 kg for BIA ($\bar{x} = 52.4 \pm 5.8$ kg). Overall, BIA and ADP had strong positive correlations for %BF ($r = 0.67$) and FFM ($r = 0.891$). BIA significantly underestimated FFM when compared to ADP (mean difference [MD] = -0.99 kg, $p = 0.016$, $d = -0.32$), while no significant difference was observed in %BF (MD = 1.17%, $p = 0.056$, $d = 0.25$). Linear regression on the Bland-Altman plots revealed small but significant negative trends for both %BF ($\beta = -0.34$, $p = 0.004$) and FFM ($\beta = -0.166$, $p = 0.01$) estimation by BIA in the total sample. This indicates possible proportional bias, in which BIA is more likely to overestimate %BF and FFM at low values, and underestimate %BF and FFM at high values. When comparing sports, BIA significantly overestimated %BF (MD = 5.42%, $p = 0.001$, $d = 1.14$) and underestimated FFM (MD = -3.71 kg, $p = 0.001$, $d = -1.07$) for basketball players and significantly underestimated %BF (MD = -2.06%, $p = 0.04$, $d = -0.56$) in volleyball players, when compared to ADP. No significant measurement differences were found in soccer players.

CONCLUSIONS: BIA gives comparable body composition results to ADP for soccer players, but gives conflicting results regarding over and underestimation of %BF and FFM in basketball and volleyball players. Conflicting conclusions based on sport may indicate the need for specialized equations when extrapolating body composition measures using BIA for athletes at the higher and lower ends of the spectrum of %BF and FFM.

781 Board #5 May 27 3:15 PM - 5:15 PM

Urogenital Dysfunction Among Female And Male High School Cross-country Runners

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(No relevant relationships reported)

While urinary stress incontinence or dysfunctions associated with this condition has been reported in various adult and female sport populations, less is known on their prevalence among distance runners, particularly adolescent female and male distance runners. **PURPOSE:** To determine the prevalence of urogenital dysfunction (UD) among female and male high school cross-country runners. **METHODS:** Participants consisted of 104 runners (48 females, 56 males; age: 15.7 ± 1.2), who competed in interscholastic cross-country in southern California. Each runner completed the Urinary Distress Inventory 6 (UDI-6) to assess urinary dysfunction. The UDI-6 is a six-symptom inventory that allows participants to categorize their symptoms during activities. Runners were identified as having had UD if they reported experiencing any of the six symptoms during the past 3 months. The runners completed the UDI-6 separately for symptoms during running and non-running activities. If a runner reported any of the six symptoms with "somewhat", "moderately", or "quite often", they were considered to have demonstrated UD. Relative risks (RR) and 95% confidence intervals (CIs) were calculated to examine associations between sex and UD. **RESULTS:** Overall, the number of runners reporting at least one UD symptom was twice as high during non-running activities (56.5%) than running activities (28.3%). Females were more likely than males to report two or more different UD symptoms during non-running activities (39.2% vs. 19.4%; $p=0.06$) and running activities (13.7% vs. 8.1%; $p=0.04$). Two female runners reported all 6 UD symptoms during running. Overall, frequent urination and leakage related to feeling of urgency were the most common urogenital dysfunction symptoms reported by the runners; and were reported more commonly during non-running activities compared to running activities (i.e., 45.2% vs. 13.5%, 21.2% vs 7.7%; respectively). Females were twice as likely (RR=2.06, 95% CI: 1.4-3.0; $p=0.001$) than males to report leakage related to feeling of urgency during non-running activities. **CONCLUSIONS:** Our findings indicated that urinary dysfunction symptoms are prevalent during non-running and running activities in high school cross-country runners; more so for females.

782 Board #6 May 27 3:15 PM - 5:15 PM

Physiological Parameters Of Bone Health In Elite Ballet Dancers

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(No relevant relationships reported)

Stress fractures are common among elite ballet dancers whereby musculoskeletal health may be affected by energy balance and overtraining. **PURPOSE:** To characterize bone health in relation to stress fracture history, body composition, and

eating disorder risk in professional male and female ballet dancers. **METHODS:** A single cohort of 59 professional ballet dancers (M=30, 24±6yr; F=29, 23±5yr) was recruited. All participants underwent bone and body composition measures using dual-energy-xray-absorptiometry (DXA). A nutritional screen and stress fracture history was also collected. Aged-matched Z-scores were calculated for bone mineral density (BMD) and body composition. A 1x3 ANOVA and Chi-Square test was used to compare BMD and frequency for history of stress fractures for those scoring 0-1, 2-6, and 7+ using the EAT26 questionnaire for eating disorder risk. Regression was used to predict BMD from body composition and demographic information. **RESULTS (Table):** Female dancers demonstrated reduced spinal (42nd percentile, 10%Z<-1) and pelvic (16th percentile, 72%Z<-1) BMD. Several anthropometric and demographic measures were predictive of BMD (p<0.05, r²=0.66-0.90, SEE=0.08-0.10g/cm²). Those with a 7+ EAT26 score were observed to have a higher frequency for history of stress fracture (p<0.05). Higher EAT26 scores were also associated with lower total and spine BMD. **CONCLUSIONS:** Professional female ballet dancers exhibit reduced BMD (particularly in the pelvis) and body mass compared to the general population whereby low BMD and stress fractures tend to be more prevalent in those with a higher risk of disordered eating. When considering only total BMD, regions of high BMD (legs) were found, in some cases, to mask areas of low BMD (spine, arms, pelvis). Lastly, anthropometric and demographic variables are predictive of BMD in this population and may be used as a field proxy in the absence of DXA.

A - BONE MINERAL DENSITY (All Dancers)

BODY REGION	TOTAL BODY		ARMS		LEGS		SPINE		PELVIS	
	M	F	M	F	M	F	M	F	M	F
BMD (g/cm ²)	1.37 ±0.02	1.16* ±0.02	1.04 ±0.17	0.76* ±0.11	1.47 ±0.02	1.2* ±0.02	1.27* ±0.02	1.04* ±0.02	1.3* ±0.02	1.07* ±0.02
Age, Gender - Matched Population Percentile Rank	85.86 ±2.5	62.42* ±4.59	88.99 ±2.47	54.88* ±5.06	81.25 ±3.14	62.58* ±4.10	88.15 ±1.96	41.55* ±5.65	38.01 ±3.84	15.67* ±3.56
Age Matched Z-Score	1.5 ±0.11	0.39* ±0.17	1.88 ±0.20	0.29* ±0.23	1.24 ±0.15	0.43* ±0.16	1.52 ±0.13	-0.21* ±0.20	-0.29 ±0.11	-1.39* ±0.15
Freq. Osteopenia	0%	0%	0%	10.34%	0%	3.45%	0%	10.34%	0%	72.41%*

B - BMD FIELD PREDICTION MODELS

REGRESSION COEFFICIENTS	CONSTANT	Gender (±0.1, M±1)	Age (years)	Height (cm)	Weight (kg)	BMI	%BF	R ²	SEE
Total Body	-0.300		0.003	0.007		0.022	-0.006	0.703	0.080
Arms	0.405	0.081			0.007		-0.006	0.849	0.065
Legs	0.350	0.047	0.003	0.003	0.006		-0.007	0.758	0.088
Spine	-0.563	-0.093	0.007	0.007		0.034	-0.013	0.659	0.098
Pelvis	-0.715	-0.071	0.01	0.010		0.027	-0.012	0.658	0.100

EXAMPLE: Total Body BMD = -0.300 + (0.003 x AGE) + (0.007 x Height) + (0.022 x BMI) + (-0.006 x %BF)

C - EAT 26 SCORING & STRESS FRACTURE HISTORY (FEMALE DANCERS)

EAT 26 Score	TOTAL BODY (BMD)			SPINE (BMD)			STRESS FRACTURE HISTORY (%)		
	0-1	2-6	7+	0-1	2-6	7+	0-1	2-6	7+
	1.2 ±0.05	1.12* ±0.04	1.13 ±0.03	1.09 ±0.04	0.99* ±0.03	1.00* ±0.03	20%	0%	66%*

A - Data are presented as means ± SEM for sex-based comparisons of total and regional bone mineral density (BMD, g/cm³) between ballet dancers relative to population norms and frequency of low BMD by either age-matched Z-score (AM Z-score). * = Significantly different from male dancers. B - Regression analysis results for the prediction of BMD using standard anthropometric measures, gender, and age. C - Data are presented as means ± SEM for total and spine BMD grouped by EAT26 scores of 0 or 1, 2 to 6, and 7+. Data are also presented as frequencies for percentage of dancers within each EAT26 category that have a known history of stress fractures. ** = significantly different from 0-1 group. Type I Error for all analyses = p<0.05

783 Board #7 May 27 3:15 PM - 5:15 PM
Parameters Of The Athlete Triad In Male Ncaa Division I Athletes
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 (No relevant relationships reported)

Male athletes are at risk of developing a condition similar to the female athlete triad that is characterized by low bone mineral density (BMD), low energy availability (EA), and reduced reproductive hormones. However, the triad has not been well studied in males.

PURPOSE: The purpose of this study was to assess BMD and EA in male NCAA division I athletes participating in leanness emphasized sports (cross country and wrestling) and non-leanness sports (soccer and basketball). We hypothesized that EA and BMD would be lower in XC and wrestling compared to soccer and basketball and EA would be positively correlated with BMD.

METHODS: Participants included 27 NCAA division I male athletes (20.3 ± 0.3 yr) participating in soccer (n = 5) or cross country (XC, n = 7), wrestling (n = 10), or basketball (n = 5). Following a 12 hr fast and abstinence from physical activity, a resting metabolic rate test, dual energy X-ray absorptiometry scan, and 24-hour food intake recall was performed during an early morning testing session. Two unannounced follow-up food intake recalls were performed over the phone and used to determine mean daily energy intake. Activity energy expenditure was assessed using an Actigraph accelerometer for 7d. Low EA was defined: [(energy intake - activity energy expenditure) / fat free mass (kg)] ≤ 20 kcal/kg.

RESULTS: XC had lower BMI, fat free mass, total, lumbar spine, and dual femur BMD (g/cm²) compared to soccer, wrestling, and basketball. XC athletes also had lower total BMD, lumbar spine, and dual femur Z-scores compared to wrestling and basketball, but not soccer. XC had significantly greater EA than basketball.

CONCLUSIONS: In support of our hypothesis, BMD was lower in athletes participating in XC, a leanness sport, compared to all other sports. Surprisingly,

EA was highest in XC and negatively correlated with BMD. These data suggest the interrelationship between components of the athlete triad is complex and low EA may not be the primary cause of low BMD in male athletes.

	XC	Wrestling	Soccer	Basketball	Overall Sports
BMI (kg/m ²)	20.6 ± 1.1 ^b	25.7 ± 1.1 ^a	25.1 ± 1.0 ^a	26.9 ± 1.0 ^a	24.9 ± 0.7
Total Body Mass (kg)	64.3 ± 3.4 ^b	77.7 ± 4.3 ^{b,c}	81.2 ± 4.3 ^a	92.8 ± 5.2 ^a	78.9 ± 2.8
Fat Mass (kg)	7.6 ± 1.0	10.7 ± 1.2	11.3 ± 1.5	11.1 ± 1.6	10.4 ± 0.7
Lean Mass (kg)	53.8 ± 2.7 ^b	63.4 ± 3.1 ^b	66.3 ± 2.9 ^{b,c}	77.2 ± 4.2 ^a	64.9 ± 2.2
Body Fat Percentage (%)	12.4 ± 1.2	14.1 ± 0.9	14.2 ± 1.2	12.5 ± 1.5	13.5 ± 0.6
Energy Availability (kcal/kg FFM)	42.2 ± 9.0 ^b	27.1 ± 4.1	26.3 ± 3.6	23.7 ± 3.7	29.5 ± 2.8
Total Bone Mineral Density (g/cm ²)	1.2 ± 0.1 ^{b,c}	1.4 ± 0.0 ^{b,c}	1.4 ± 0.0 ^{b,c}	1.6 ± 0.0 ^a	1.4 ± 0.0
Total BMD Z-score	0.9 ± 0.4	2.1 ± 0.3 ^c	1.5 ± 0.2	2.5 ± 0.4 ^c	1.8 ± 0.2
Lumbar BMD Z-Score	-0.2 ± 0.5	1.8 ± 0.4 ^c	0.9 ± 0.3	2.3 ± 0.4 ^c	1.3 ± 0.2
Dual Femur BMD Z-Score	0.5 ± 0.3	2.3 ± 0.4 ^c	1.8 ± 0.2	2.6 ± 0.7 ^c	1.9 ± 0.2

Table 1. Results. Data are presented as mean ± SEM. ^asignificantly different vs. basketball (p < 0.05). ^bsignificantly different vs. XC (p < 0.05).

784 Board #8 May 27 3:15 PM - 5:15 PM
Weekly Training Volume Impacts On The Prevalence Of Iron Depletion In Female Athletes
 Nenad D. Ponorac¹, Aleksandar M. Ignjatovic², Dragan S. Radovanovic³. ¹Faculty of Medicine, University of Banja Luka, Banja Luka, Bosnia and Herzegovina. ²Faculty of Education in Jagodina, University of Kragujevac, Jagodina, Serbia. ³Faculty of Sport and Physical Education, University of Nis, Nis, Serbia.
 (No relevant relationships reported)

Female athletes undergo rigorous training, travel, and competition schedules, and therefore may be susceptible to iron deficiency (ID), with further progression to stages 2 [iron-deficient erythropoiesis (IDE)] and 3 [ID anemia (IDA)]. **PURPOSE:** To investigate whether sporting discipline and training volume (≥ 10 h/week) impacted the prevalence of ID, IDE, and IDA in female athletes.

METHODS: A total of 85 athletes involved at higher levels of competition were assigned into groups according to sporting discipline (volleyball, n=36; handball, n=24; soccer, n=19; judo, n=6) and training volume (≥ 10 h/week, n= 47; <10h/week, n=38). The following iron depletion categorization was used: first stage-ID defined as serum ferritin <35 µg/L, transferrin saturation >16%, and hemoglobin >115 g/L; second stage-IDE defined as serum ferritin <20 µg/L, transferrin saturation <16%, and hemoglobin >115 g/L; and third stage-IDA defined as serum ferritin <12 µg/L, transferrin saturation <16%, and hemoglobin <115 g/L.

RESULTS: The prevalence of ID, IDE, and IDA were not significantly different between sporting disciplines (p>0.05). According to training volume, there was no difference (p = 0.53) at stage 1 between the groups (<10 h/week=49% vs. ≥ 10 h/week=42%). However, the results indicate that training volume ≥ 10 h/week significantly compromised iron status at stage 2 (39% vs. 17%, p=0.02) and 3 (3% vs. 0%, p=0.05) compared to lower training volume.

CONCLUSIONS: A similar prevalence of ID, IDE, and IDA suggests that female athletes competing in volleyball, handball, soccer, and judo are at a similar risk of disturbance in iron metabolism. A weekly training volume ≥ 10 h has an impact on iron status, promoting a higher prevalence of IDE and IDA in female athletes.

B-46 Thematic Poster - Hormones and Cytokines
 Wednesday, May 27, 2020, 3:15 PM - 5:15 PM
 Room: CC-2011

785 Chair: Linda E. May, FACSM. *East Carolina University, Greenville, NC.*
 (No relevant relationships reported)

786 Board #1 May 27 3:15 PM - 5:15 PM
Menstrual Cycle And Menopause Influence On Creatine Kinase Response After Exercise-induced Muscle Damage
 Nuria Romero-Parra, Rocío Cupeiro, Víctor M. Alfaro-Magallanes, Beatriz Rael, Laura Barba-Moreno, Cristina Maestre-Cascales, Eliane A. Castro, Ana B. Peinado.
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 (No relevant relationships reported)

Studies with animals have demonstrated that estrogens contribute to limit exercise-induced muscle damage. However, this effect is not entirely clear in humans, despite some benefits have been observed. For instance, estrogen replacement therapy

has shown to increase strength and reduce exercise-induced muscle damage in postmenopausal women. **PURPOSE:** To evaluate the influence of sex hormones on creatine kinase (CK) response after an eccentric squat-based workout in well-trained females with different hormonal profiles. **METHODS:** Nineteen eumenorrheic females (28.6±5.9 years, 163.4±6.1 cm, 59.6±5.8 kg) and thirteen postmenopausal females (51.7±3.7 years, 161±5.31 cm, 56.6±8.1 kg) participated in this study. A resistance-based workout was performed by the eumenorrheic females in the early follicular phase (EFP), late follicular phase (LFP) and mid-luteal phase (MLP) of their menstrual cycle, in a counterbalanced and randomized order. Postmenopausal females performed the protocol in a single visit. Blood samples were obtained at baseline and 2h, 24h and 48h after the eccentric workout to analyse serum CK. An unpaired t-test was performed to compare CK values between postmenopausal and eumenorrheic females. **RESULTS:** At baseline, postmenopausal showed higher CK concentrations (136.2±45.5 U·L⁻¹) in comparison to eumenorrheic women in the LFP (105.7±33.1 U·L⁻¹, p=0.039) and MLP (100.7±29.8 U·L⁻¹, p=0.012). However, these differences were not observed between postmenopausal and eumenorrheic women in the EFP (108.6±48.0 U·L⁻¹, p=0.114). No differences were observed in post-exercise time-points between postmenopausal and eumenorrheic women in any of the menstrual cycle phases analysed. **CONCLUSION:** Lower estrogen and progesterone concentrations may elicit higher CK values at rest. However, the lack of post-exercise differences between groups may indicate that the supposed protective role of sex hormones is not as determinant as other factors like intensity or training status. The IronFEMME Study is supported by the Ministerio de Economía y Competitividad (Contract DEP2016-75387-P).

787 Board #2 May 27 3:15 PM - 5:15 PM
Influence Of Aerobic Exercise On Select Cytokine And Hormone Levels In Pregnant Women.

Samantha Michelle McDonald, Cody Strom, Mary Remchak, Alec Chaves, Nicholas Broskey, Linda May, FACSM. *East Carolina University, Greenville, NC.* (Sponsor: Linda E May, FACSM)
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 (No relevant relationships reported)

PURPOSE: To determine the effects of prenatal aerobic exercise on select maternal cytokines and hormones.

METHODS: Data from an ongoing, 24+ week aerobic exercise intervention trial were used. Thirty-one participants of 128 randomized to aerobic (150 min of moderate weekly aerobic exercise) or control (no exercise) groups had fasted blood samples drawn at 16 and 36 weeks gestation and were eligible for analysis. Levels of NGF, IL-1 α , IL-6, IL-8, TNF- α , IL-10, Leptin, Insulin, Glucagon and GLP-1 Active were analyzed.

RESULTS: At baseline, women in the aerobic group had lower levels of TNF- α (p=0.01). At 36 weeks of gestation, aerobic-trained women had higher levels of IL-1 α (p=0.04) and lower levels of IL-10 (p=0.01). No statistical differences in the change of these biomarkers were found.

CONCLUSIONS: Prior to prenatal exercise, participants in the aerobic exercise group possessed lower inflammatory cytokines, however at 36 weeks of gestation, aerobic-trained women had higher levels of different inflammatory cytokines. The complexity of these biomarkers and their differing patterns of change during pregnancy may explain the null and unanticipated findings of higher inflammatory biomarkers following chronic exercise.

788 Board #3 May 27 3:15 PM - 5:15 PM
Sex Difference On Arterial Stiffness And Measures Of Pulse Wave Reflection Response To Weight Machines

Rebecca Schmidt, Erica M. Marshall, Jason C. Parks, Derek J. Kingsley, FACSM. *Kent State University, Kent, OH.*
 (No relevant relationships reported)

PURPOSE: To evaluate sex-specific responses to acute bout of machine weight resistance exercise on arterial stiffness and measures of pulse wave reflection.

METHODS: Resistance-trained men (n=21; Mean±SD: Age: 23±3yrs) and women (n=20; Age: 22±3yrs) volunteered to participate in the study. Arterial stiffness, measured via pulse wave velocity, and measures of pulse wave reflection, were evaluated at rest, and 10 minutes following an acute bout of weight machine exercise composed of 3 sets of 10 reps at 75% 1RM on the chest press, leg press, lat pulldown, leg flexion and leg extension. Two minutes of rest was given between sets and exercises. A 2x2x2 ANOVA was used to analyze the effects of sex (men, women) across condition (acute resistance exercise, control) and time (rest, recovery (Rec)).

RESULTS: There were no significant three-way interactions for any variable, as well as no sex specific responses. Acute resistance exercise had no effect on arterial stiffness (p=0.07), or augmentation pressure (p=0.16). A significant condition by time interaction (p=0.001) was noted for Alx@75 (Alx@75: Men: Rest: 7.0±8.1%; Rec: 19.4±9.2%; Women: Rest: 11.0±16.0%; Rec: 14.0±6.0%) such that it was increased in response to the acute resistance exercise, but not the control. A

significant (p=0.0001) condition by time effect was also noted for the subendocardial viability ratio (SEVR: Men: Rest: 141.0±24.0%; Rec: 82.1±38.0%; Women: Rest: 136.0±13.4%; Rec: 91.3±28.0%) in that the acute resistance exercise reduced SEVR during recovery, but not the control. There was also a significant (p=0.007) main effect of time for myocardial workload (Ew: Men: Rest: 809.0±639.2 dynes s/cm²; Rec: 984.0±896.0 dynes s/cm²; Women: Rest: 985.0±965.0 dynes s/cm²; Rec: 364.0±540.0 dynes s/cm²) in that it was reduced during recovery from the acute resistance exercise compared to rest, as well as the control.

CONCLUSIONS: These data suggest that weight machines may not significantly alter arterial stiffness or measures of pulse wave reflection differently between the sexes. However, an acute bout of resistance exercises consisting of weight machines may reduce function of the left ventricle for at least 10 minutes.

789 Board #4 May 27 3:15 PM - 5:15 PM
Effects Of Menstrual Cycle Phases On Measures Of Body Composition

Abigail R. Champion, Lauren E. Coleman, Heather E. Webb. *Texas A&M Corpus Christi, Corpus Christi, TX.* (Sponsor: Edmund O. Acevedo, FACSM)
 (No relevant relationships reported)

Many women complain about weight fluctuation across the span of a month as a result of hormonal changes that accompany their menstrual cycle (MC). Specific research regarding the menstrual cycle phases of females and their effects on body composition measures have been limited to examining these changes as a subset of other variables. As water makes up approximately 73% of lean body tissue, fluctuations in body water due to changes in a women's MC may impact measurements of body composition

PURPOSE: To investigate whether phases of the MC have an impact upon common measures of body composition **METHODS:** 51 apparently healthy females between the ages of 18-45 participated in data collection sessions held weekly, at the same time of day, seven days apart, for a month. Each week, participants self-reported the presence or absence of menses during that week, including starting or ending days. Participants completed three body composition assessments: bioelectrical impedance analysis (BIA), dual-energy X-ray absorptiometry (DXA), and air displacement plethysmography (ADP) according to manufacturer's instructions, and also reported their exercise habits for the previous week. **RESULTS:** RMANOVA revealed no differences in physical activity levels between sessions for participants and that total body water amounts in participants did not change across time when measured via BIA. A 3 (device) x 4 (MC phase) RMANOVA demonstrated no significant device by phase interaction effects, nor were changes in body weight, body fat percentage, or lean body mass seen across time. However, significant differences in lean body mass measures (p = .001) between DXA and BIA (\bar{x} difference = 1.62 ± 0.4 kg) and DXA and ADP (\bar{x} difference = 1.74 ± 0.36 kg) measures were seen. **CONCLUSION:** Although there were no changes in body composition across the MC phases, there were differences in body composition values among the three types of devices used to quantify body composition. These findings suggest that differences in the technology used to quantify body composition may explain varying results across studies.

790 Board #5 May 27 3:15 PM - 5:15 PM
Transitioning From Daytime To Nighttime Operations During Military Training Negatively Impacts Dynamic Balance And Vertical Jump Performance In Elite Male Army Soldiers

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 (No relevant relationships reported)

PURPOSE: Investigate the impact transitioning from daytime to nighttime operations during military training has on dynamic balance and vertical jump performance in elite Army Soldiers. **METHODS:** This study was part of a larger study investigating the impact sleep loss and circadian desynchrony during military training have on the health and performance of elite Army Soldiers. Elite Army Soldiers (all male) performed a cognitive/motor battery (pre-test), including the Y-Balance Test (YBT) and a vertical jump assessment, approximately 2 weeks prior to switching from daytime to nighttime operations during military training (getting on a "reverse sleep cycle"). After the first night into the nighttime operation training (after a full night of sleep loss), the Soldiers were reassessed (post-test) on the YBT (n=74, 26.0 ± 4.1 years) and vertical jump (n=75, 26.2 ± 3.9 years). **RESULTS:** Compared to pre-test, the elite Army Soldiers demonstrated a significant decrease during the posteromedial reach bilaterally (Right = -2.4 ± 6.5 cm, p = .003; Left = -2.9 ± 7.1 cm, p = .001), and a significantly lower composite score bilaterally (Right = -4.4 ± 15.8 cm, p = .018; Left = -4.6 ± 14.7 cm, p = .009) on the YBT at post-test. In addition, at post-test, asymmetry in the posterolateral direction was significantly worse (1.3 ± 3.9 cm, p =

.004) compared to pre-test. No other significant pre- to post-test differences were noted on the YBT. The vertical jump height was also significantly lower (-1.0 ± 3.0 inches, $p = .004$) at post-test, compared to pre-test. **CONCLUSION:** Transitioning from daytime to nighttime operations during military training negatively impacts dynamic balance and vertical jump performance in elite male Army Soldiers. Considering the post-test was conducted after the first night into the nighttime operation training, where Soldiers missed their normal sleep opportunity, sleep loss and fatigue were likely contributing factors to the decreased performance. Investigating strategies that may limit these physical impairments during the transition from daytime to nighttime operations is warranted. Future research should also to investigate whether the noted impairments have any impact on this population's injury risk considering impaired dynamic balance has been associated with injury risk in other athletic populations.

791 Board #6 May 27 3:15 PM - 5:15 PM
Effect Of Sex And Neuromuscular Training On Lower Limb Stiffness Characteristics And Jump Performance

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 (No relevant relationships reported)

Stiffness is potentially related to sports injury and athletic performance. Higher stiffness within a certain range may represent lower sports injury risk and better athletic performance. It is not clear whether a sex difference existed in lower limb stiffness changes induced by neuromuscular training.

PURPOSE: To investigate the effect of neuromuscular training on lower limb stiffness in both male and female young recreational athletes.

METHODS: Eleven recreational athletes (5 females: 24.4 ± 3.4 yr; 6 males: 24.0 ± 3.9 yr) underwent neuromuscular training 3 times a week for continuous 6 weeks, including plyometric training (e.g. squat jump, wall jump et al.) and strength training (e.g. barbell squat, bench press et al.) with progression every two weeks. Pre- and post-intervention measurements included: gastrocnemius lateralis (GL), gastrocnemius medialis (GM), soleus muscle and the Achilles tendon (AT) stiffness on both lower limbs by Myometer; vertical stiffness (Kvert), jump height and reactive strength index (RSI) by force plate during drop vertical jump from a 40 cm step.

RESULTS: Two-way repeated measures ANOVA was conducted and found no significant interaction between time and sex in all the variables mentioned above, but significant results on time in left GL stiffness ($p=0.021$), left GM stiffness ($p=0.008$), right AT stiffness ($p=0.040$), Kvert ($p=0.019$), jump height ($p=0.012$), and RSI ($p=0.008$). Paired-T test was further conducted and identified jump height in females increased significantly from pre (0.14 ± 0.04 m) to post (0.18 ± 0.05 m) intervention ($p=0.037$). After intervention, left GL stiffness had a downward tendency in males ($\Delta=39.69 \pm 68.24$ N/m) and females ($\Delta=70.00 \pm 60.46$ N/m); left GM stiffness tended to increase in males ($\Delta=34.17 \pm 82.22$ N/m) and decrease in females ($\Delta=29.60 \pm 63.53$ N/m); right AT stiffness ($\Delta=52.17 \pm 215.48$ N/m) and Kvert ($\Delta=199.33 \pm 207.36$ N/m) tended to decrease in males; RSI in males ($\Delta=0.16 \pm 0.15$ m/s) and females ($\Delta=0.162 \pm 0.146$ m/s) tended to increase.

CONCLUSIONS: Males and females may achieve similar benefits from neuromuscular training. Neuromuscular training can improve jump performance in females, with a tendency to decrease lower limb stiffness in males and females. Supported by Shanghai University of Sports A1-3G02-19-000209

792 Board #7 May 27 3:15 PM - 5:15 PM
Cardiorespiratory Variables During A Maximal Running Test In Well-trained Females With Different Hormonal Profiles

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 (No relevant relationships reported)

Differences in estrogen and progesterone levels along a natural menstrual cycle and an oral contraceptive (OC) cycle may influence female's performance. Previous literature reported lower strength, maximal oxygen consumption (VO₂ max) and systolic volume in OC users. According to postmenopausal women, their low and stable levels of sex hormones may affect them in a different way than in young women.

PURPOSE: To elucidate the effect of different hormonal profiles on maximal VO₂, heart rate (HR) and ventilation (VE) in well-trained females. **METHODS:** Thirty-three eumenorrheic females (30.1 ± 6.2 years, 59.3 ± 8.4 kg, and 164.1 ± 6.3 cm), twenty-three monophasic OC users (24.8 ± 4.3 years, 58.6 ± 5.8 kg, and 163.3 ± 5.1 cm) and thirteen postmenopausal women (51.0 ± 3.7 years, 54.9 ± 4.1 kg, and 161.5 ± 5.4 cm) participated in the study. A maximal graded test with a computerized treadmill was performed. Expired gases were measured breath-by-breath with the gas analyser Jaeger Oxygen Pro. HR was continuously monitored with a 12-lead ECG. Participants began with a

warm-up of 3 minutes at 6 km/h. Then, the speed was set at 8 km/h, increasing 0.2 km/h every 12 seconds until exhaustion. **RESULTS:** One way ANOVA reported lower values in post-menopausal females compared to the other two groups (eumenorrheic and OC users) for all variables measured: VO₂ max (2924.2 ± 389.7 ml/min for the eumenorrheic; 2808.8 ± 366.7 ml/min for the OC; and 2455.15 ± 281.04 ml/min for the postmenopausal; $p=0.001$), maximal HR (184.2 ± 10.3 ; 189.9 ± 8.4 ; and 172.1 ± 12.9 bpm respectively; $p<0.001$) and maximal VE (111.8 ± 17.5 ; 114.7 ± 15.1 ; and 96.4 ± 10.4 l/min, respectively; $p=0.003$). Nonetheless, no significant differences in VO₂max, HR and VE were found between eumenorrheic females and OC users. **CONCLUSION:** The drastic decrease of sex hormones in postmenopausal females, along with other hormonal and physiological changes caused by the age, may explain the drop in VO₂ max, HR and VE in this population. In terms of young women, despite literature reported lower values in OC users, the lack of difference observed in this study may be due to the lower concentrations of sex hormones that OC pills have nowadays, or because of the fact that all were well-trained participants.

Funding: DEP2016-75387-P (Spanish National Plan 2013-2016)

793 Board #8 May 27 3:15 PM - 5:15 PM
Work-matched High-intensity Interval And Moderate-intensity Continuous Training Adaptations On 17 Lactate Threshold Methods In Females

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 (No relevant relationships reported)

PURPOSE: to compare exercise training effects on 17 lactate threshold methods to 6 weeks (3x/week) of high-intensity interval training (HIIT) or moderate-intensity continuous training (MICT) in females. **METHODS:** 24 healthy sedentary females (mean \pm SD: peak oxygen uptake 30.0 ± 3.2 mL·kg⁻¹·min⁻¹, peak power output 151 ± 21 W, body mass index 23.4 ± 2.6 kg·m⁻²) were randomly assigned to either HIIT or MICT. Participants performed a step-incremental test on a cycle ergometer (3-min stages of 25-W increments, starting at 25 W) pre- and post-training. The HIIT group (N = 12) performed a 10-min warm-up (power output (PO) at 70% of the maximal heart rate (HR_{max})), and four 4-min intervals (PO at 90% HR_{max}) interspersed with 4-min recovery at 30 W. The MICT group (N = 12) performed 60-min continuous cycling (PO at 90% of the first lactate turning-point (LT1)). Lactate thresholds were analyzed as: Log-log, onset of blood lactate accumulation (OBLA, N = 5), fixed value above baseline (Bsln+, N = 3), D_{max} and its modified versions (N = 5), lactate turning-points (LT1 and LT2), and the minimal lactate-intensity ratio (LT_{ratio}). A two-way analysis of variance was used to test differences within (post versus pre) and between groups. Additionally, the width of confidence intervals (CI_{width}) from the delta change was calculated for each method and group. **RESULTS:** In the HIIT group, the intensity derived from all the methods significantly increased after training ($p < 0.01$), except for LT_{ratio} ($p = 0.6$). In the MICT group, the intensity from OBLA, Bsln+, and the modified D_{max} methods significantly increased after training ($p < 0.05$), whereas Log-log, D_{max}, LT1, LT2, and LT_{ratio} did not improve significantly ($p > 0.05$). The HIIT group showed a higher increase in intensity from the D_{max} methods, and in LT1 and LT2 compared with the MICT group ($p < 0.05$). No differences were observed between the groups in the improvements of Log-log, OBLA, Bsln+, and LT_{ratio}. OBLA at 3.5 and 4.0 mM, and D_{max} presented the narrowest CI_{width} (range 7 - 12 W), while Bsln+ 0.5 mM, Bsln+ 1.0 mM, and Log-log had the widest CI_{width} (range 24 - 32 W). **CONCLUSIONS:** In healthy sedentary females, improvements of the D_{max} methods, LT1, and LT2 were superior in the HIIT group. The lowest intra-individual variability in response to training was observed in the D_{max} and OBLA at 3.5 and 4.0 mM methods.

B-47 Thematic Poster - Responses to Combined Heat and Hypoxia

Wednesday, May 27, 2020, 3:15 PM - 5:15 PM
 Room: CC-2010

794 Chair: Roy Salgado. *US Army Research Institute of Environmental Medicine, Natick, MA.*
 (No relevant relationships reported)

795 Board #1 May 27 3:15 PM - 5:15 PM
The Separate And Combined Effects Of Acute Simulated Altitude And High Ambient Temperature On Cycling Time Trial Performance

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 (No relevant relationships reported)

Simulated altitude and high ambient temperature independently compromise endurance performance, although there is limited evidence on the combined exposure to both stressors. In addition, the effect of corresponding underlying key mechanisms has yet to be quantified. **PURPOSE:** To investigate the separate and combined effects of acute simulated altitude and high ambient temperature on time trial (TT) performance, VO_{2max} , the ventilatory threshold (VT) and gross efficiency (GE). **METHODS:** Ten trained male cyclists performed 4 maximal incremental exercise tests (GXT) and GE-tests, both at sea-level (0 m; 20.93% O_2) and simulated altitude (2000 m; 16.3% O_2) in high environmental temperature ($36.00 \pm 1.4^\circ C$, $42.58 \pm 0.8\%$ RH) and temperate conditions ($16.00 \pm 0.32^\circ C$, $40.20 \pm 1.2\%$ RH). The GXT included 3 min at 100 W, followed by 25 $W \cdot min^{-1}$ until volitional fatigue. GE was determined at 50% of the power attained at VO_{2max} in relative conditions, prior to and following 4000m TT performances. **RESULTS:** Although average PO was significantly reduced during TT performance at simulated altitude (31 ± 18 W, $p < .001$, $n_p^2 = .795$) and high ambient temperature (9 ± 16 W, $p = .007$, $n_p^2 = .570$), no significant interaction was found ($p = .137$). At simulated altitude, VO_{2max} (3.77 ± 2.1 ml $\cdot kg^{-1} \cdot min^{-1}$, $p < .001$, $n_p^2 = .925$), VT (3.39 ± 2.9 ml $\cdot kg^{-1} \cdot min^{-1}$, $p < .001$, $n_p^2 = .795$) and GE ($0.72 \pm 0.97\%$, $p = .021$, $n_p^2 = .555$) were significantly reduced compared to sea level. However, VO_{2max} (3.33 ± 3.1 ml $\cdot kg^{-1} \cdot min^{-1}$, $p = .005$, $n_p^2 = .608$) and VT (2.05 ± 3.1 ml $\cdot kg^{-1} \cdot min^{-1}$, $p = .021$, $n_p^2 = .462$) were significantly increased at high ambient temperature, although no effect on GE ($p = 0.240$) was found. **CONCLUSION:** The reduction in TT performance at acute simulated altitude is associated with a decline in VO_{2max} , VT and GE, likely because a lower SpO_2 . VO_{2max} and VT are significantly higher at acute high ambient temperature, likely because the metabolic cost of physiological heat stress increases relative exercise intensity at similar absolute PO. GE was unaffected by acute high ambient temperature, likely because heat exposure during the GE-test was too short to increase T_{core} . VO_{2max} , VT and GE were not compromised during combined exposure, which corresponds with the absence of a significant interaction effect in endurance performance.

796 Board #2 May 27 3:15 PM - 5:15 PM
Impact Of Heat Acclimation On Steady-State Exercise And Time-Trial Performance In Hypobaric Hypoxia (3500m)

Beau R. Yurkevicius, Kirsten E. Coffman, Karleigh E. Bradbury, Adam J. Luippold, Katherine M. Mitchell, Thomas A. Mayer, Nisha Charkoudian, FACSM, Charles S. Fulco, Robert W. Kenefick, FACSM, Roy M. Salgado. *USARIEM, Natick, MA.*
 (No relevant relationships reported)

Heat acclimation (HA) has been reported to improve endurance exercise performance in normobaric hypoxia. However, the impact of prior HA on exercise performance in hypobaric hypoxia (HH) is unclear. **PURPOSE:** To determine whether HA alters steady-state (SS) exercise responses and time-trial (TT) cycle performance during a 30 hour exposure to HH.

METHODS: Thirteen sea level (SL) resident men (mean \pm SD; age: 21 ± 3 years; height: 173 ± 8 cm; weight: 75 ± 12 kg; SL cycle ergometer VO_{2peak} : 43 ± 5 ml $\cdot kg^{-1} \cdot min^{-1}$) participated in two 30 hour HH exposures in a hypobaric chamber (496mmHg or ~3500m, $20^\circ C$, 20% RH). The HH exposures were separated by a 14 day washout period during which volunteers completed an 8-day exercise-HA protocol (2 hours of treadmill walking: 5km $\cdot h^{-1}$, 2% grade; $40^\circ C$, 40% RH). During each HH exposure, volunteers completed 30 min of SS exercise followed by a 15 min cycle TT at ~2 and

24 hours of exposure. SS exercise consisted of cycling at ~50% SL VO_{2peak} while gas exchange (oxygen consumption (VO_2), minute ventilation (V_E), end tidal partial pressure of oxygen ($P_{ET}O_2$), and oxygen saturation (SpO_2)) were recorded. For the TT, volunteers completed as much work (kJ) as possible in 15 min, with heart rate (HR), SpO_2 , and Rating of Perceived Exertion (RPE, Borg Scale) recorded at the end of exercise. A two way repeated measures ANOVA was used to compare the effects of condition (Pre HA and Post HA) and time (~2 and 24 hours).

RESULTS: There were no condition x time interaction effects among the SS or TT variables. For main effect of condition, from Pre HA vs. Post HA, SS VO_2 tended to be lower (1.63 ± 0.00 L $\cdot min^{-1}$ vs. 1.60 ± 0.01 L $\cdot min^{-1}$; $p = 0.05$), $P_{ET}O_2$ was higher (75.7 ± 1.0 mmHg vs. 76.8 ± 0.7 mmHg; $p < 0.01$), and V_E and SpO_2 did not differ ($p > 0.05$ for both). For the TT, there was no main effect of HA on total work completed (106.8 ± 23.0 kJ vs. 103.8 ± 21.3 kJ), HR (159 ± 13 bpm vs. 158 ± 13 bpm), SpO_2 ($83 \pm 3\%$ vs. $83 \pm 3\%$), or RPE (17 ± 2 vs. 17 ± 2) ($p > 0.05$, for all).

CONCLUSIONS: Our results suggest that although HA may augment some aspects of ventilation during low-intensity SS exercise, exercise performance measured by a 15 min cycle TT in HH is not affected by HA.

Supported by USAMRDC; author views not official US Army or DoD policy

797 Board #3 May 27 3:15 PM - 5:15 PM
Effects Of Short-term Heat Exposure On Time Trial Performance In Moderate Hypoxia With Trained Athletes

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 (No relevant relationships reported)

PURPOSE: To examine the effect of a 5-day training protocol in the heat on physiological acclimation, perceptual responses, and 16 km time-trial performance in moderate hypoxia. **METHODS:** Twelve well-trained, healthy male participants (age = 27 ± 8 years; $VO_{2peak} = 66.52 \pm 4.94$ ml $\cdot kg^{-1} \cdot min^{-1}$) were randomly assigned to a hot (HOT; $40^\circ C$, 35% RH) or control (CON; $18^\circ C$, 35% RH) group, and completed five consecutive days of cycling for 60 min at 50% VO_{2peak} . Participants completed a 16 km time-trial in hypoxia ($F_{O_2} = 0.165$; $S_{pO_2} = 86.00 \pm 2.64$), pre- (TT1) and post-training (TT2), to determine if heat training enhanced hypoxic cycling performance. Rectal core temperature (T_{re}), heart rate, and rating of perceived exertion were assessed through the training protocol. **RESULTS:** Time to completion from TT1 (HOT = 1637 ± 110 s, CON = 1684 ± 117 s) to TT2 (HOT = 1617 ± 118 s, CON = 1671 ± 109 s) was reduced ($p = 0.029$); however, there was no interaction between groups ($p = 0.599$). There was no difference in mean ($p = 0.443$) or peak heart rate ($p = 0.651$) between TT1 and TT2 across both groups. Training resulted in a reduction in resting heart rate (Day 1: HOT = 61 ± 14 beats $\cdot min^{-1}$, CON = 72 ± 4 beats $\cdot min^{-1}$ vs. Day 5: HOT = 58 ± 11 beats $\cdot min^{-1}$, CON = 66 ± 6 beats $\cdot min^{-1}$; $p = 0.049$) and rating of perceived exertion (Day 1: HOT = 4 ± 1 , CON = 3 ± 2 vs Day 5: HOT = 3 ± 1 , CON = 2 ± 1 ; $p = 0.001$); however, there was no interaction between the groups. There was no significant difference in T_{re} ($p = 0.836$), mean exercising T_{re} ($p = 0.127$), or peak exercising T_{re} ($p = 0.152$) responses between Day 1 and Day 5 of the training protocol. **CONCLUSION:** This study found that the 5-day training protocol improved time-trial performance in hypoxia; however, there was no perceptual, physiological or performance benefits associated with training in the heat compared to normoxic conditions.

798 Board #4 May 27 3:15 PM - 5:15 PM
Heat Acclimation Does Not Alter Cutaneous Blood Flow During Steady-state Cycling Exercise At 3500 M Altitude

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 (No relevant relationships reported)

Cutaneous vasodilation is attenuated when exercise is performed in a hypoxic environment, which may impair convective heat loss. Heat acclimation (HA) improves cutaneous blood flow in response to an increase in core temperature; however, the effect of HA on cutaneous blood flow during exercise in hypobaric hypoxia has not been examined. **PURPOSE:** The aim of this study was to test the hypothesis that cutaneous blood flow would be augmented during steady-state exercise at 3500 m altitude (hypobaric chamber) following 8 days of exercise-HA. **METHODS:** Thirteen healthy men (21 ± 3 yr; ht: 173 ± 8 cm; wt: 75.1 ± 12.2 kg; sea-level VO_{2peak} : 42.9 ± 4.6 ml/kg/min) participated in two 30 h altitude exposures (495 mmHg / ~3500 m, $20^\circ C$, 20% RH) separated by a 14 day washout period in which they completed 8 days of exercise-HA (2 h of treadmill walking in $40^\circ C$, 40% RH). At hour ~24 of each altitude exposure, subjects performed a 30-min bout of steady-state submaximal cycling exercise (~50% sea-level VO_{2peak}). Red blood cell flux (laser-Doppler flowmetry) was continuously measured during a 5 min seated baseline period and minutes 20-25 of exercise. Cutaneous vascular conductance (CVC = red blood cell flux/mean arterial

pressure) was calculated and normalized to a percentage of maximum (local skin heating to 42°C). **RESULTS:** Compared to Day 1 of HA, core temperature (Day 1: 38.1 ± 0.3 vs Day 8: 37.8 ± 0.3 °C; p<0.01) and heart rate (Day 1: 134 ± 17 vs Day 8: 121 ± 13 bpm; p<0.01) were significantly lower at min 120 of exercise on Day 8, indicating HA was achieved. Baseline cutaneous blood flow at altitude was reduced after HA (pre: 7.3 ± 1.2 vs post: 5.1 ± 0.7 %CVCmax; p=0.03). During steady-state exercise at altitude, cutaneous blood flow was not different pre- and post-HA (pre: 23.5 ± 4.4 vs post: 20.9 ± 4.4 %CVCmax; p=0.53). **CONCLUSION:** These data suggest that HA does not alter cutaneous blood flow during steady-state exercise at 3500 m altitude. However, while the magnitude of the blood flow response is unchanged, cutaneous blood flow may be elevated relative to core temperature following HA. Future studies examining potential benefits of HA on the relation between cutaneous blood flow and core temperature during exercise at altitude are warranted. Supported by USAMRDC; author views not official US Army or DoD policy

799 Board #5 May 27 3:15 PM - 5:15 PM
Muscle Metabolic Responses To Repeated Sprint Exercise In Combined Heat And Hypoxic Condition
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 (No relevant relationships reported)

Hypoxia causes nitric oxide-induced vasodilatation and increases muscle blood flow during exercise as intensity dependent, which may mediate promoted training adaptations. On the other hand, exposure to heat stress also increases muscle blood flow during exercise. However, combined effects of heat and hypoxia on muscle metabolic responses to repeated sprint exercise are unclear. **PURPOSE:** To determine the effects of combined heat and hypoxic condition on muscle blood flow and muscle oxygen consumption following repeated sprint exercise. **METHODS:** Eleven male athletes (19.4 ± 0.4 years, 173.0 ± 2.3 cm, 72.8 ± 2.0 kg) completed repeated sprint exercise (three sets of 5 × 6 s maximal pedaling) under 3 different conditions, consisting of normoxia (NOR; 23 °C, FiO₂ = 20.9%), hypoxia (HYP; 23 °C, FiO₂ = 14.5%), and combined heat and hypoxia (HH; 35 °C, FiO₂ = 14.5%) with single blind, randomized crossover design. Power output, arterial oxygen saturation, skin and rectal temperature were monitored during the exercise. We also measured muscle blood flow and muscle oxygen consumption in vastus lateralis immediately after the exercise using venous/arterial occlusion and near infrared spectroscopy. **RESULTS:** Average power output was not different significantly among three conditions (NOR: 692 ± 18 W, HYP: 679 ± 17 W, HH: 685 ± 20 W). Arterial oxygen saturation was significantly lower in HYP and HH compared with NOR (NOR: 92.4 ± 0.7%, HYP: 82.6 ± 1.3%, HH: 82.2 ± 1.5%, p<0.05), while skin (NOR: 31.9 ± 0.3 °C, HYP: 31.7 ± 0.2 °C, HH: 34.7 ± 0.1 °C) and rectal temperature (NOR: 37.2 ± 0.1 °C, HYP: 37.2 ± 0.1 °C, HH: 37.4 ± 0.1 °C) were significantly higher in HH than in NOR and HYP (p<0.05). HH showed significantly greater muscle blood flow immediately after the first set of exercise compared with NOR (NOR: 0.61 ± 0.10 mL/min/100g, HYP: 0.81 ± 0.13 mL/min/100g, HH: 0.99 ± 0.16 mL/min/100g, p<0.05). However, muscle oxygen consumption did not differ significantly among conditions (NOR: 0.36 ± 0.04 mL O₂/min/100g, HYP: 0.42 ± 0.07 mL O₂/min/100g, HH: 0.44 ± 0.06 mL O₂/min/100g). **CONCLUSIONS:** Combined heat and hypoxic condition augmented exercise-induced increase in muscle blood flow during the initial phase of repeated sprint exercise in spite of similar power output compared with thermoneutral normoxic and hypoxic conditions.

800 Board #6 May 27 3:15 PM - 5:15 PM
Effect Of Heat Acclimation-induced Plasma Volume Expansion On Arterial Oxygen Content During Exposure To Hypobaric Hypoxia
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 (No relevant relationships reported)

INTRODUCTION: Exposure to high altitude results in a loss in plasma volume (PV) which augments hemoglobin (Hb) and thus arterial oxygen content (CaO₂). Conversely, heat acclimation (HA) results in plasma volume (PV) expansion. However, it is unclear whether HA-induced PV expansion impacts the change in PV and CaO₂ during a hypobaric hypoxia (HH) exposure. **PURPOSE:** To determine whether HA-induced PV expansion alters CaO₂ during HH exposure. **METHODS:** Thirteen sea-level natives (mean ± SD; men, age: 21 ± 3 yr; ht: 172 ± 0.8 cm; wt: 76 ± 13 kg; sea level VO_{2peak}: 42.9 ± 4.6 ml·kg⁻¹·min⁻¹) participated in a three phase study consisting of: a) 1) 30 hour HH exposure (HH1; 3,500 m, 495mmHg), 2) 14-day washout period in which volunteers completed an 8-day exercise-HA protocol (treadmill walking: 5 km·hr⁻¹, 2% grade; 40°C and 40% RH), and 3) second 30 hour HH exposure (HH2). After 20 minutes of seated postural control, venous and

arterialized capillary blood samples were collected pre- and post-HA and after 22 hours of HH1 and HH2. Samples were analyzed for Hb, Hct, arterialized oxygen saturation (SaO₂), and arterialized partial pressure of oxygen (PaO₂). The percent change in plasma volume (%ΔPV) was calculated in accordance with the Dill and Costill equation while CaO₂ was calculated using the following formula: CaO₂ = (1.34*Hb*SaO₂/100) + (0.0031*PaO₂). A t-test was used to assess differences in the %ΔPV, Hb, SaO₂, PaO₂, and CaO₂ between HH1 and HH2. **RESULTS:** The %ΔPV from pre- to post-HA was 7 ± 9%. From HH1 to HH2, the %ΔPV decreased to a greater extent (-12 ± 3 vs -17 ± 5; P < 0.01). From HH1 to HH2, Hb (16.1 ± 0.9 vs 16.0 ± 0.9 mg/dl), SaO₂ (89 ± 4% vs 90 ± 4%), PaO₂ (56.7 ± 2.8 vs 57.6 ± 3.2 mmHg) and CaO₂ (19.4 ± 1.1 vs 19.4 ± 1.3 ml/l) were not different (P > 0.05). **CONCLUSION:** Our results suggests that although HA induced a PV expansion; and there was a greater change in PV during HH2, CaO₂ was not affected. Supported by USAMRDC; author views not official US Army or DoD policy

801 Board #7 May 27 3:15 PM - 5:15 PM
High Intensity Intervals Expands Plasma And Improves Cycling Performance In Acute Hypoxia
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 (No relevant relationships reported)

Introduction: Hypoxia cause decrements in submaximal and maximal exercise performance. Hypervolemia may improve O₂ delivery to the metabolically active tissue, thus lowering physiological and cardiovascular strain during moderate exercise at altitude. Since two weeks are needed to acclimate to exercise in hypoxia, we sought to expand plasma volume (PVE) through a single bout of high intensity intervals (HI) to attempt to expedite improvements in aerobic performance. **Purpose:** To determine if the hypervolemic response to a single bout of HI intervals was sufficient to mitigate the hypoxia associated declines in exercise capacity. **Methods:** In our randomized counterbalanced study, 7 males (24.4 ± 5.8 years, VO_{2max} 46.9 ± 5.8 ml·kg⁻¹·min⁻¹, 12.8 ± 4.4% body fat) performed two 15km cycling time-trials (TTs) in normobaric hypoxia (FiO₂ = 15%) before and 48 hours following HI (8x4 minutes at 85% VO_{2max} with 4 minutes rest between rounds) or a control bout (CON) performed at 50% VO_{2max}, in which duration was extended in order to assure workloads were matched between conditions (identical kilojoules between conditions). Pre-exercise blood samples were collected to quantify changes in plasma volume, while hemodynamic data were collected utilizing PhysioFlow. **Results:** Increased PVE was observed 24 hours (6.96% ± 4.84%) and 48 hours (9.77% ± 4.26%) (p<0.05) following the HI bout while the CON condition decreased plasma volume 48 hours post (-3.75% ± 2.62%). Under the HI condition, participants showed an improvement in TT performance (Time: 1880 ± 215s to 1840 ± 203s, Power: 164.8 ± 41.2W to 171 ± 39.5W) (p < 0.05) and lowered HR (164.5 ± 9.5 bpm to 161.9 ± 8.8bpm) (p < 0.05). SV and Q manifested an upwards trend during TT performance within the HI condition (p = 0.09 and p = 0.08, respectively). There was no difference in performance, Q, or SV in the CON condition. Hydration, RPE, SaO₂, and blood lactate were similar in both TTs in hypoxia. **Conclusion:** A single bout of HI intervals resulted in increased cycling performance in acute hypoxia, accompanied by an enhanced PVE both 24 and 48 hours following exercise. This observed enhancement in cardiac efficiency following intense exercise may be desirable in military populations or individual desiring to complete physical tasks at moderate altitude without the means or time to fully acclimatize.

802 Board #8 May 27 3:15 PM - 5:15 PM
Effect Of Heat Acclimation On Incidence Of Acute Mountain Sickness During Exposure To Hypobaric Hypoxia (3,500 M)
 Roy M. Salgado, Adam L. Luippold, Kirsten E. Coffman, Karleigh E. Bradbury, Beau R. Yurkevicius, Katherine Mitchell, Nisha Charkoudian, FACSM, Charles S. Fulco, Robert W. Kenefick, FACSM. *US Army Research Institute of Environmental Medicine, Natick, MA.*
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 (No relevant relationships reported)

INTRODUCTION: Adaptations gained from heat acclimation (HA) can induce protective responses to a different stressor, such as hypoxia. Rapid ascent to altitude (hypobaric hypoxia, HH) increases the risk for acute mountain sickness (AMS). However, it is unknown whether HA can protect against the development of AMS during exposure to HH. **PURPOSE:** To determine if prior HA reduces the incidence of AMS during a 30 hour exposure to HH (3,500 m). **METHODS:** Thirteen unacclimatized healthy men (mean ± SD; age: 21 ± 3 yr; ht: 172 ± 8 cm; wt: 75.1 ± 12.2 kg; sea level VO_{2peak}: 42.9 ± 4.6 ml·kg⁻¹·min⁻¹) participated in three study phases consisting of: Phase 1) baseline (pre HA) 30 hour HH exposure (HH1; 3,500 m), Phase 2) 14-day washout period during which volunteers completed an 8-day exercise-HA

protocol (treadmill walking: 120 minutes at 5 km·hr⁻¹, 2% grade; 40°C and 40% RH), and Phase 3) post HA 30 hour HH exposure (HH2). During the HA protocol, heart rate (HR) and core temperature (T_c) were recorded throughout exercise. AMS was assessed using the Environmental Symptoms Questionnaire after ~12, ~21, and ~23 hours of exposure during each HH phase. HR and pulse oxygen saturation (SpO₂) were measured at rest immediately after assessment of AMS. A t-test was used to assess difference in HR and T_c from Day 1 and Day 8 of HA. For the HH exposures, HR and SpO₂ data were analyzed by fitting a mixed effects model as implemented by GraphPad Prism 8.1.2. **RESULTS:** Heat acclimation was achieved as indicated by a lower T_c (Day 1: 38.1 ± 0.3 vs Day 8: 37.8 ± 0.3 °C; p<0.01) and HR (Day 1: 134 ± 17 vs Day 8: 121 ± 13 bpm; p<0.01) at the end of exercise on Day 8 compared to Day 1. Three of 13 volunteers developed AMS during HH1 but not during HH2. A fourth volunteer only developed AMS during HH2. From HH1 to HH2, resting HR (84 ± 6 vs 83 ± 7 bpm) and SpO₂ (87 ± 2 vs 88 ± 2%) were not different (both p >0.05). **CONCLUSION:** Our results suggest that in unacclimatized individuals, HA may be an effective, though not perfect training strategy for reducing the incidence of AMS during rapid exposure to 3,500 m. Changes in AMS incidence could not be explained by alterations in HR or SpO₂. Supported by USAMRDC; author views not official US Army or DoD policy.

B-48 Thematic Poster - Spine

Wednesday, May 27, 2020, 3:15 PM - 5:15 PM
Room: CC-2000

803 Chair: Ajit Mohan Worthen Chaudhari, FACSM. *The Ohio State University, Columbus, OH.*
(No relevant relationships reported)

804 Board #1 May 27 3:15 PM - 5:15 PM
Spinal Range Of Motion And Back Pain In Female Artistic Adolescent Gymnasts

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(No relevant relationships reported)

PURPOSE: Back pain is a common complaint among female gymnasts, but it is unknown if gymnasts with back pain demonstrate different movement patterns during gymnastics skills compared to those gymnasts without back pain. Our purpose was to evaluate gymnasts' movement patterns in their native environment using wearable sensors. Specifically, we examined three-dimensional spine range of motion (ROM) during back walkovers (BWOs) and back handsprings (BHSs) on the floor and balance beam. **METHODS:** Female artistic gymnasts ages 8 to 18 years were divided based on presence or absence of self-reported back pain within the last 12 months. Gymnasts performed BWOs and BHSs on floor and balance beam while wearing APDM Opal V2 sensors. Valid spine sagittal plane maximums, minimums, and ROM during trials for each skill were compared between groups via Kruskal Wallis analysis of variance. **RESULTS:** Seventeen participants (n=6 with back pain, mean age=13.9±2.6 years; n=11 without back pain, mean age=13.3±1.7 years) completed BWOs and BHSs. There were no demographic differences between groups for age, height, weight, competition level, or years of experience. Gymnasts with back pain had a greater maximum back extension (45.0±15.4° back pain vs. 34.6±7.1° no pain; p=0.011, Cohen's d=1.46) and range of motion (94.6±18.9° back pain vs. 80.9±19.6° no pain; p=0.032, Cohen's d=0.70) during BWOs compared to gymnasts without back pain. There were no differences between groups in peak extension, peak flexion, or ROM during BHS skills. **CONCLUSION:** Gymnasts with a history of back pain had increased spinal motion when performing BWO skills. To perform a BWO, gymnasts must have higher levels of shoulder, spine, and hip flexibility, which may relate to back pain. This study suggests the need for future studies to evaluate if increased spinal motion during gymnastics is a contributing factor to the development of back pain.

805 Board #2 May 27 3:15 PM - 5:15 PM
How Does The Dancer's Spine Move? Application Of A Multisegmented Model.

Marijeanne Liederbach¹, Christopher T.V. Swain², Ian J. Kremenic³, Karl F. Orishimo³, Marshall Hagins¹. ¹NYU Langone Orthopedic Hospital, New York, NY. ²Australian Catholic University, Melbourne, Australia. ³Lenox Hill Hospital, New York, NY. (Sponsor: Malachy McHugh, PhD, FACSM)
(No relevant relationships reported)

How does the dancer's spine move? Application of a multisegmented model.
Purpose: Historically, most biomechanical studies of the spine used a rigid single segment model. However, recent studies show that spinal segments do not move together predictably and that a multi-segmental model improves discrimination between patients and healthy controls. Although professional dancers experience low back pain equal to or more than the general and sporting population, to date, no study has described multi-segmented spinal motion of the dancer during any dance specific tasks which may place unique mechanical demands on the spine. The purpose of this study was to describe spinal motions of professional dancers during a common dance task, the arabesque, using a multi-segmented spinal model. **Methods:** As part of larger study, 25 professional dancers (ages 24.8 +/-6.2; 5 males) performed two trials each of a right and left arabesque at their own pace while spinal kinematics were captured using a five-segment model (pelvis (PEL), lower lumbar (LL), upper lumbar (UL), lower thoracic (LT) and upper thoracic (UT). Motion was captured from initiation of vertical foot movement and ended at maximal foot height. Two trials were averaged and all values were time normalized. **Results:** Means and standard deviations of motion in all segments in three planes were identified. In all three planes, the two upper segments (UT-LT and LT-UL) contributed 69-87% of the total spinal motion. In the coronal plane, side-bending of all segments occurred ipsilateral to the lifted leg with 54% of all motion occurring at a single segment (LT-UL). In the sagittal plane the spine generally extended, however the upper segment (UT-LT), began and remained in a flexed position throughout the motion, although it extended during the motion. In the transverse plane all segments rotated contralateral to the lifted leg. However, the lower two spinal segments contributed almost no motion. **Conclusion:** This study demonstrated that segmental motion was not uniform in degree or direction across multiple spine segments during an arabesque. Most spinal motion occurred in the upper spine. Using a multi-segmental model may improve understanding of the biomechanical stressors experienced by professional dancers.

806 Board #3 May 27 3:15 PM - 5:15 PM
Appropriate Neck Flexion Without Head-hitting Decreases The Thrown Player'S Risk Of Brain Injury In Judo

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(No relevant relationships reported)

PURPOSE: Judo is one of the worldwide sports and its competitive athletic events have been held in Olympic Games. Serious brain injuries, however, have been occasionally noted in judo practices and/or competitions. Since the patterns and severities of brain injuries largely depend on the kinematics of the thrown players, it is essential to investigate the mechanism of brain injury from the biomechanical viewpoint in popular throwing techniques. The aim of this study is to evaluate the brain injury criterion (BrIC), an indicator of brain injury, with measuring the presence or absence of head-hitting on the anthropomorphic test device (ATD) in judo throwing technique Ouchi-gari.

METHODS: A male judo expert (thrower) threw an ATD for 6 times by Ouchi-gari with or without head-hitting, respectively. The ATD with a straight neck component necessarily hit the occipital region on the mat, whereas an angled component was designed for preventing the ATD's head-hitting. A 3-axis angular rate sensor, mounted in the gravity center of the ATD's head, assessed head axial angular velocity in each trial. To evaluate the ATD's head impact quantitatively, we calculated the BrIC from the head axial angular velocity. High-speed digital video cameras also recorded the kinematics of the ATD's whole body during trials.

RESULTS: In all trials, the largest angular velocities were recorded in the phase of the initial head (with head-hitting) or back (without head-hitting) contacting to the mat. The peak BrIC values of ATD ranged from 0.94 to 2.27 (with head-hitting) and 0.54 to 0.91 (without head-hitting). The average BrIC value with head-hitting (1.62 ± 0.22, mean ± S.E.) trials was significantly higher than those without head-hitting (0.73 ± 0.08) trials (p<0.05). Four out of six trials with head-hitting scored BrIC values larger than 1.0, which implies the human tolerance limit for serious brain injury. However, BrIC values were less than 1.0 in all other trials without head-hitting.

CONCLUSIONS: These results suggested that thrown player's break-fall technique, with appropriate neck flexion to avoid head-hitting, decreases the BrIC value effectively and the risk of serious brain injuries in judo.

807 Board #4 May 27 3:15 PM - 5:15 PM
The Effectiveness Of Electromyography Biofeedback At Improving The Upper Trapezius To Serratus Anterior Activation Ratio

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 (No relevant relationships reported)

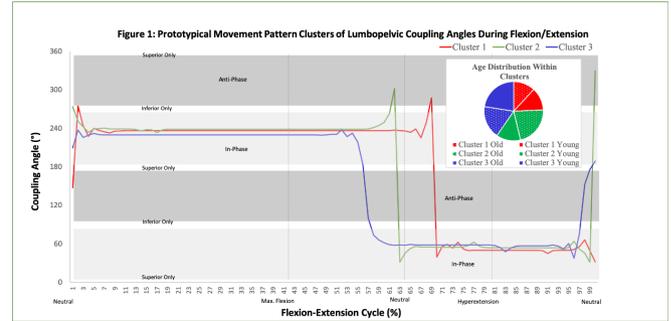
The upper trapezius (UT) to serratus anterior (SA) muscle activation ratio is essential for optimal shoulder function. An alteration of this ratio is a main area of focus in shoulder rehabilitation. Electromyography (EMG) biofeedback has been shown to be an effective technique used during rehabilitation but there is limited research on the retention of improvements. **Purpose:** To determine if EMG biofeedback can be used to improve scapular control by decreasing the UT to SA activation ratio. A secondary purpose was to determine if the predicted improvements can be retained beyond the treatment period of four weeks. **Methods:** 20 college aged (21.75±1.77 yrs) subjects participated in this study. Subjects were randomized to the exercise only (EO) group or EMG biofeedback group. Both groups performed 30 repetitions of three exercises twice a week for four weeks under supervision. The EMG biofeedback group performed them with the addition of EMG biofeedback. They were given the instructions to decrease the UT and increase the SA activation by adjusting the corresponding EMG trace on the monitor. The percent maximal voluntary contraction for each muscle during each exercise was measured on visit one, visit nine (after the four weeks) and visit 10 (after a two-week retention period) and presented as a percent change value. **Results:** There was no statistically significant effect of group on the ratio comparing visit one to visit nine (p=0.084), nor when comparing visit nine to visit 10 (p=0.065). The EMG biofeedback group had a significant decrease in UT activation (-10%) compared to the EO group (+27%) (p=0.007) at the end of the four weeks with no effect seen after the retention period (p=0.358). There was a significant increase in SA activation in the EMG biofeedback group (+196%) compared to the EO group (+29%) (p=0.000) comparing visit one to nine. There was a significant increase in SA activation comparing visit nine to visit 10 in the EMG biofeedback group (+14%) compared to the EO group (-12%) (p=0.001). **Conclusion:** EMG biofeedback was not found to decrease the UT to SA activation ratio, but the individual muscle activation changes indicate that EMG biofeedback can be effective at altering muscle activation rates in individual muscles and that those changes can be retained beyond the timeframe of the intervention.

808 Board #5 May 27 3:15 PM - 5:15 PM
Lumbopelvic Rhythm Prediction Using Machine Learning And Its Use As A Biomarker For Low Back Pain Identification

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Lumbopelvic (LUM-PEL) rhythm has the potential be used as biomarker for diagnosis and rehabilitation of athletes predisposed to mechanical low back pain (LBP). Studies till date have mostly focused on discrete variables from the time series to explain movement patterns. Machine learning algorithms provide opportunity to analyze continuous time series data for predictive classification of movement patterns into pathological and non-pathological, adding value to early diagnosis and clinical decision making for conditions such as LBP. **Purpose:** Use of machine learning to categorize healthy LUM-PEL rhythm. **Methods:** 79 participants with no LBP (Young: n=42; 18-40yr; 27.6±6.5yr; Older: n=37; 41-65yr; 51.7±7.3yr). 3D segmental kinematics of lumbar (LUM: L1-L5) and pelvis [PEL] were calculated for maximum trunk flexion-extension. Coordination patterns were divided into in-phase, anti-phase, superior and inferior-only based on the coupling angles of LUM and PEL. K-means clustering, an unsupervised machine learning algorithm, was employed to create clusters of movement patterns of the coupling and segmental angles based on dynamic time warping similarity. Sample distribution within each cluster was compared for different age groups. **Results:** LUM-PEL rhythm fell under k=3 major movement pattern clusters (Fig. 1). No difference between age groups was observed. Non-pathological LUM-PEL rhythm clusters suggest flexion movement initiation and return from hyperextension typically have segments in anti-phase (LUM leading: 40.4%), PEL/ LUM only (35.3%) and in-phase (LUM leading: 24.3%). The 2 segments predominantly move in-phase except at start and end of movement. Patterns were not apparent when using segment angles

or through discrete variable of mean coupling angles. **CONCLUSIONS:** Using the discovered movement pattern clusters, individuals with LBP could be identified and training prescriptions can be based on healthy segmental coordination.



809 Board #6 May 27 3:15 PM - 5:15 PM
Lumbo-pelvic Ratio And Conjunct Movements Differ Between Pain Intensity Groups In Low Back Pain Patients

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Back pain is linked to alterations in movement behaviour. Yet, the interaction between pain intensity and movement is not fully understood. In particular, it remains unknown if the movement quality differs between (chronic) pain intensities. **Purpose:** To compare trunk movement behaviour, assessed by lumbar/pelvic and conjunct lateral flexion contributions to the total range of motion (RoM) during trunk flexion, between people with low and moderate to high back pain intensities. **Methods:** A multi-centre study on 607 people with back pain was performed. Chronic pain intensity scores (INT [0-100]; sub-score of the Graded Chronic Pain Scale) were used to group participants into comparably low (LP; Score <30 points) and moderate to high pain intensity (HP; Score ≥ 30 points). Accordingly, 211 participants (49% f; 37±13y; 73±15kg; 174±9cm; INT 18±7) were allocated to LP and 393 participants (57% f; 41±14y; 75±16kg; 173±9cm; INT 46±13) were allocated to HP. Motion was assessed during maximal trunk flexion in upright standing. A mobile IMU system (six sensors), distinguishing between total, lumbar and pelvic motion in all three movement planes, was used. Outcome measures were total RoM, lumbo-pelvic ratio (LPR) and amount of conjunct lateral motion (CLM; sum of angular changes in lateral flexion, RoM-normalized). Between-group comparisons using adjusted unpaired t-tests/Mann-Whitney U test for RoM and LPR and two-way ANOVAs for CLM were performed. **Results:** Significant between-groups differences in trunk flexion movement were found for LPR (LP 0.92±0.65; HP 0.72±0.49; p<0.0001) but not for RoM (LP 101±27°; HP 104±25°; p=0.28). CLM differed significantly between groups during downward movements in lumbar (LP 8.0±3.1; HP 7.1±2.7; p<0.01) but not in pelvic segments (LP 7.6±3.5; HP 8.3±3.4; p=0.06). No significant difference was found (lumbar: LP 8.7±3.3 HP 8.5±3.2; p=0.62; pelvic: LP 8.5±4.1; HP 9.2±4.0; p=0.08) during upward movements of the trunk. **Conclusion:** Though total RoM between subclinical and clinical back pain patients is not different, lumbar contribution on total trunk flexion movement is reduced and conjunct lateral movements at the lumbar area are increased with higher pain intensities. This might reflect a strategy to reduce potential pain at the lumbar back during flexion movements of the trunk.

WEDNESDAY, MAY 27, 2020

810 Board #7 May 27 3:15 PM - 5:15 PM
Use Of Machine Learning To Predict Low-back Pain From Motion Capture Data Using Multi-segment Spine Model

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PURPOSE: Machine learning-based methods, which include Artificial Neural Networks [ANN], have been used successfully in varied classification problems. If these methods can successfully classify those vulnerable to musculoskeletal problems such as low-back pain [LBP], they may have utility in screening and management of such conditions and aid in identifying what assessment methods provide optimal information for practitioners. We examined whether ANN techniques could correctly classify whether subjects experienced LBP in a convenience sample of dancers. **METHODS:** 60 subjects [48 women], 36 of whom [24 women] reported an episode of back pain in the past two months, were instrumented with a multi-segment spine marker set [Swain et al., 2019] and recorded [Motion Analysis Corp Eagle, 250 Hz] while performing standing and seated rotations, walking and several functional and dance-related movements [step-over task, arabesque, passe]. The multi-segment model has five segments: pelvis, lower and upper lumbar [L/L], lower and upper thoracic [L/UT]. 3D rotations were computed both between adjacent segments, and with respect to the lab coordinate system. To determine variables of interest, 1-dimensional statistical parametric mapping [SPM1D; Pataky, 2008] analysis was performed. Features [min, max, time to min/max, and side-side difference] were extracted from these variables and used to train an ANN pattern recognition tool [MATLAB]. Approximately 75% of the data were used for training, with the remainder used for validation and testing. Because of the dearth of men, analysis was performed on the entire cohort, and of women only. **RESULTS:** Based on the SPM1D analysis, only approximately 10% of data were used for training the ANN. For example, for walking trials, LL and LT axial and UT coronal plane rotations were used. The ANN classifier was able to correctly identify incidence of LBP with approximately 65% accuracy. **CONCLUSIONS:** Based on our small sample, ANN techniques show promise for identifying subjects with LBP based on their movement patterns. A larger training set of data is needed for better results. Future work should optimize feature selection by focusing on areas of difference between data rather than by selecting fixed features [e.g., max value] and examine the effect of different ANN architectures.

811 Board #8 May 27 3:15 PM - 5:15 PM
Unilaterally Implemented Trunk Modification Associated With Asymmetrical Increase In Spinal Load

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Trunk modification (TM) is associated with reduced knee adduction moment during gait in both healthy and symptomatic individuals. Reported reductions are dependent on the magnitude of modification implemented. Evidence however suggests that increased trunk motion augments structural loading at the spine. Despite the positive adaptations at the knee, potential unanticipated changes in spinal load are yet to be investigated. **PURPOSE:** To investigate changes in trunk joint reaction force (JRF) during ipsilateral (IP) and contralateral (CT) stance phases subsequent to implementing unilateral subject-specific TM. **METHODS:** 19 healthy participants (26.7±4.8 years; 1.69±0.17 m; 72.3±11.8 kg) were recruited. Trunk lean was implemented towards the side of the preferred kicking limb. Participants average trunk angle (TA) was assessed during 10 baseline trials using a motion capture system (200Hz) and force plates (1000Hz). Subject-specific TA range was determined by adding 1-3 standard deviations (small), and 3-5 standard deviations (large) to baseline value. Participants completed 5 trials using both small and large subject-specific TM angles. Real-time TA projected as a line graph which was visible to participants during TM trials reinforced performance. Visual 3D was used to deliver feedback and determine trunk JRF (N/kg). Changes to trunk JRF was assessed using a Friedman test with Wilcoxon signed-rank test and Bonferroni-adjusted significance level. Analyses were conducted using a significance level of p<0.017. **RESULTS:** Peak lateral JRF during IP and CT stance were significantly greater during TM trials ($\chi^2(2) = 32.9$, and 30.7 , p<0.001 respectively). Participants experienced increased lateral JRF during both IP (d=1.5,

and d=1.7, small and large TM respectively), and CT (d=1.6, and d=1.7, small and large TM respectively) compared to baseline. **CONCLUSION:** Changes in trunk JRFs are indicative of elevated spinal loads. During CT stance, lateral JRF in the direction of the modified side persisted which is indicative of continued asymmetric trunk load. Findings suggest TM could result in detrimental adaptations and may be contraindicated for certain individuals. Further research employing longitudinal design is needed to investigate if observed acute changes are transient in nature.

B-49 Free Communication/Slide - Health Interventions in Youth

Wednesday, May 27, 2020, 3:15 PM - 5:15 PM
 Room: CC-3014

812 Chair: John R. Sirard, FACSM. University of Massachusetts Amherst, Amherst, MA.

(No relevant relationships reported)

813 May 27 3:15 PM - 3:30 PM
Vigorous Physical Activity Is Protective Against Unfavorably Health Trajectory In Active Children

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Physical Activity (PA) guideline recommendations for young people are intended to increase fitness and prevent overweight and obesity. However, little is known about the heterogeneity in health-related outcomes experienced by guideline concordant children.

PURPOSE: To prospectively investigate the associations between PA intensity and unfavorable health trajectories among physically active children aged between 6 and 12 yrs.

METHODS: This prospective study (2.5 yrs) included 391 students (8.1 ± 1.4 yrs) from ten public schools participating in the Childhood Health, Activity, and Motor Performance School Study Denmark (CHAMPS-dk). All children performed a daily minimum of 60-min of moderate-to-vigorous physical activity (MVPA), measured by accelerometers, at baseline and 30 months. Trajectories of body mass index (BMI), waist circumference, and aerobic fitness were constructed with a group-based multi-trajectory model and associations between PA measures and health trajectories were modeled with logistic regression.

RESULTS: Overall, 9.1% of guideline-concordant children were classified as members of an unfavorable health trajectory with BMI and waist circumference indicating overweight/obesity, and lower aerobic fitness. Time in sedentary [OR 0.98 95%CI (0.94-1.02)] and moderate intensity activity were not associated with membership in an unfavorable health trajectory [OR 0.86 95%CI (0.71-1.04)]. Each 5-min in MVPA was associated with a 23% reduction [OR 0.77 95%CI (0.66-0.91)] in the odds of being in the unfavorable health trajectory group. For every 5-min spent in vigorous PA, there was a 39% reduction in the odds of being classified as a member of the unfavorable health trajectory [OR 0.61 95%CI (0.46-0.80)].

CONCLUSION: Additional 5-min in MVPA and vigorous PA are associated with better health-related outcomes among children who adhere to PA guideline recommendations. Vigorous PA was the strongest predictor of health outcomes. PA guidelines should place greater emphasis on vigorous intensity PA.

814 May 27 3:30 PM - 3:45 PM
An Intervention For Fundamental Motor Skills And Physical Activity In Pre-schoolers: A Cluster-randomized Controlled Trial

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 (No relevant relationships reported)

PURPOSE: Physical activity (PA) is important for health and development in preschool-aged children yet only 34% of Australian pre-schoolers achieve the

recommended levels. Fundamental motor skill (FMS) interventions have been shown to improve FMS proficiency and PA levels, however, whether these changes are maintained post-intervention is unknown. We aimed to determine if a 12-week FMS program improved FMS and PA in pre-schoolers; and if so, whether these improvements were maintained 12 weeks post-intervention. **METHODS:** The Physical Activity and Fundamental Motor Skills in Pre-schoolers (PLAYFun) Program was a cluster randomized controlled trial. Participants were recruited from 4 University pre-schools. The PLAYFun Program was a 12-week, games-based, FMS program delivered directly into the centers by an exercise physiologist. Primary outcomes included FMS proficiency, objective PA and parent perceived PA assessed at baseline, 12 weeks and 12 weeks after the completion of the intervention (week 24). Differences within and between groups were assessed via a one-way analysis of variance.

RESULTS: Forty-nine participants (mean age 4.0±0.6; 54% male) were recruited. Children attended on average 2.0±1.0 sessions per week for 40 minutes per session. Participants in the PLAYFun Program demonstrated a significantly greater increase in object control ($p=0.003$) and total FMS ($p=0.019$) proficiency at week 12 compared to controls. Locomotor skills score (M 14.83 95% confidence interval (95%CI) [3.90 to 25.75]; $p=0.012$), object control skills (M 24.11 [9.93 to 38.29]; $p=0.003$) and gross motor quotient (M 20.14 [8.33 to 31.96]; $p=0.003$) all significantly improved when children attended twice a week, but these improvements were not maintained at 24 weeks. Girls in PLAYFun significantly increased objective moderate to vigorous PA after the intervention ($P=0.015$), but not boys. This increase was also not maintained 12 weeks post-completion of PLAYFun. No significant relationships between FMS and PA outcomes were identified.

CONCLUSIONS: Motor skill programs delivered directly to preschool children by an exercise physiologist within their preschool is effective at improving FMS proficiency in boys and girls and PA in girls. However, these improvements are not maintained when the practice is not ongoing.

815 May 27 3:45 PM - 4:00 PM

Effectiveness Of School-based Program To Reducing Sedentary Behavior And Improving Physical Activity In Brazilian Students

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Reported Relationships: S.F. Santos: Other (please describe); This study was funded by The São Paulo Research Foundation (FAPESP Process: 2016/09260) and Coordination of Superior Level Staff Improvement – Brazil (CAPES Process: 88881.187941/2018-01)..

Regular high intensity physical activities have been associated with healthy outcomes in adolescents. Previous studies have reported positive changes on physical activity (PA) level and sedentary time (SED) in participants of multicomponent school-based programs. The main research question was whether School in Action program is effective on promote active life style in Brazilian adolescents. **PURPOSE:** To examine the effects of a multicomponent school-based program on students' PA and SED. **METHODS:** A cluster randomized controlled trial with 370 adolescents (aged 11.7 years, SD=0.6) from four public schools from Presidente Prudente-SP, Brazil, were randomized to either an intervention or control group. School in Action program was based on ecological and self-determination theory principles and strategies consisted of: (a) 15 minutes of PA program in physical education (PE) class, (b) PA practice during the lunch break, (c) active breaks during theoretical classes, (d) monthly participation of school's health education project, (e) parent's counseling during school meeting and (f) school playground adaptation and acquisition of material resources to improve moderate-to-vigorous physical activity (MVPA). Changes in PA and SED were measured. PA level was evaluated by wrist-worn accelerometers (Actigraph, gt3x+), and Chandler's cut-points were considered. Generalized linear mixed models were used and pre-specified interactions were tested (i.e., group*time). All analyses were adjusted by sex, peak height velocity, baseline data and social economic level on SPSS, 25.0 version, 95% of significance. **RESULTS:** Total of 70.27% (n=260) of data accelerometer was valid at baseline (600 minutes per day, minimum 3 days). The proposed intervention presents decreased SED (Δ intervention group 'baseline to post-test' = -3.8; Δ control group 'baseline to post-test' = 6.3; $p=0.04$) and minimize the reduction of vigorous PA (Δ intervention group of 'baseline to follow-up' = -0.2; Δ control group 'baseline to follow-up' = -0.4; $p=0.03$). Time spent in MVPA did not differ between the groups over time. **CONCLUSION:** The multicomponent program was effective to decrease SED and can maintain students' vigorous PA level.

816 May 27 4:00 PM - 4:15 PM

Effect Of A School-based Physical Activity Intervention On Academic Performance In Norwegian Adolescents: The School In Motion Study - A Cluster Randomized Controlled Trial

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(No relevant relationships reported)

There is increasing evidence of a positive association between physical activity (PA) and academic performance. However, few studies include adolescents.

PURPOSE: To investigate the effect of a nine-month, school-based PA cluster-randomized controlled trial, School in Motion (SciM), on academic performance in 14-year-old adolescents.

METHODS: 29 secondary schools (N=2084) in Norway were cluster-randomized into three groups A) the Physical active learning (PAL) intervention group (n = 10), B) the Don't worry - Be Happy (DWBH) intervention group (n = 9) or C) control (n = 10). Target dose in the PAL and DWBH group was 120 min/week of additional PA and physical education. Academic performance (secondary outcome) was assessed by standardized national tests in reading and numeracy at baseline (September 2017) and at the end of the intervention (May 2018). Test scores are reported as t-scores (mean = 50, standard deviation (SD) = 10). We used a linear mixed model with the means as a function of time and group-by-time interaction, with schools as random effects. Participants (n = 1682) from 27 schools with valid data at both timepoints were included in the analysis. **RESULTS:** At baseline, mean values in reading were 57 (SD 9.5) and 54 (SD 10.2) points for girls and boys respectively and 56 (SD = 9.7) points for numeracy in both genders. Performance in numeracy increased in both intervention groups. In favor of the PAL group, the mean difference in change in numeracy were 1.1 points (95% confidence interval (CI) 0.3-1.8, $p = 0.024$) and 2.6 points (95% CI 1.7-3.5, $p < 0.001$) for girls and boys respectively, when compared with controls. Similarly, in favor of the DWBH group, the mean difference in change in numeracy compared to the control group was 1.4 points (95% CI 0.5-2.2, $p = 0.005$) for girls and 2.8 points (95% CI 1.8-3.8, $p < 0.001$) for boys. A significant intervention effect for reading were only observed among boys in DWBH intervention with mean difference in change of 1.8 points (95% CI 0.6-2.9, $p = 0.008$) in favor of the intervention group.

CONCLUSIONS: The findings from the SciM intervention support the notion that additional PA in school is beneficial for students' academic performance especially in numeracy.

817 May 27 4:15 PM - 4:30 PM

Effects Of A Teacher Training Program To Promote Physical Activity Among Preschoolers With Autism

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(No relevant relationships reported)

Children with Autism Spectrum Disorder (ASD) are disproportionately impacted by childhood obesity, with one contributing factor being low levels of physical activity (PA). There is a paucity of interventions for promoting PA that are responsive to the unique needs of young children with ASD. One promising approach designed for teachers working with typically developing preschoolers is WE PLAY (Wellness Enhancing Physical Activity for Young Children), an online-based training system. It was adapted to be responsive to the needs of children with ASD through a stakeholder-engaged approach. **PURPOSE:** To determine the impact of WE PLAY-Autism on the moderate-to-vigorous PA (MVPA) of preschoolers with ASD during school hours.

METHODS: A multiple baseline design across participants was used, which allowed for a rigorous experimental evaluation of the impact of WE PLAY-Autism through the repeated measurement of children's MVPA as the intervention was implemented sequentially across classrooms. Children's (N = 5) MVPA was measured daily during school hours using accelerometers (ActiGraph GT9X Link) worn at the iliac crest. Data were analyzed using validated accelerometer count cut-points for preschoolers, with min/hour of MVPA as the dependent variable. **RESULTS:** Following current best practices in single case designs, visual analysis and effect size calculations were used, indicating higher average min/hour of MVPA among preschoolers with ASD in the intervention phase (Tau- $U_{A vs. B} = .53$, $p < 0.001$, Hedges' $g = 0.99$, 95% CI [0.56, 1.43]) and post-training phase (Tau- $U_{A vs. B} = .55$, $p < .001$, Hedges' $g = 1.17$, 95% CI [0.73, 1.60]) in comparison to the baseline phase. The average increase in min/hour of MVPA from baseline to post-training was 2.51 (range = 1.35 - 4.32), which translates to approximately 38 additional minutes of MVPA across the 15-hour preschool week.

CONCLUSION: This study is, to our knowledge, the first to implement and report the impact of a preschool PA intervention adapted to be responsive to the needs of preschoolers with ASD. The results provide preliminary evidence that WE PLAY-Autism increases MVPA among preschoolers with ASD to a similar magnitude as preschool-based interventions for typically developing children.

818 May 27 4:30 PM - 4:45 PM

Dearborn SHINES: The Impact Of A Comprehensive School Health Intervention

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(No relevant relationships reported)

PURPOSE: Arab Americans account for almost 3.7 million people in the U.S., however, limited health data is available on youth and adult populations. In order to better understand the health behaviors of Arab Americans and aid in the push for healthy lifestyles in children, more research should be conducted. Therefore, the purpose of this study was to implement a culturally relevant healthy eating (HE) and physical activity (PA) intervention known as D-SHINES in a primarily Arab-American school district and understand the impact it had on students' overall PA, attitude toward PA and HE, as well as PA and HE knowledge, and perceived social support. **METHOD:** Eight schools participated in the D-SHINES intervention over one school year, with 264 (Mage=11.1; Male = 106) randomly selected students participating in pre-post testing. The intervention consisted of physical education utilizing SPARK, PA afterschool clubs, gardening and nutrition programming, and classroom physical activity breaks. Students participated in a pre-post survey with validated measures for overall PA level, HE and PA attitude, knowledge, and perceived social support. Implementation of the garden, HE, and PA curriculum tools were also tracked for fidelity. **RESULTS:** T-tests were used to determine differences among students from pre-post intervention. Results showed that students significantly increased their HE and PA knowledge over the course of the year ($p < .001$), as well as their PA attitude ($p = .021$). There was no significant difference observed in overall PA levels ($p = .92$), vigorous PA ($p = .08$), and perceived social support. Additionally, MANCOVA's showed significant differences among the variables between grade and gender ($p < .001$). **CONCLUSIONS:** Although limitations exist, the results show that while the D-SHINES program was implemented in the school, students' significantly improved their attitudes and knowledge toward HE and PA, yet, failed to show a significant increase in overall PA. Additionally, great strides were made with teachers and schools to build and implement the garden curriculum. Additional research should be conducted to better understand successful comprehensive school programming among urban Arab American youth, a population that is often understudied.

819 May 27 4:45 PM - 5:00 PM

CHANGES IN PHYSICAL ACTIVITY, PHYSICAL FITNESS AND WELL-BEING FOLLOWING A SCHOOL-BASED HEALTH PROMOTION PROGRAM

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(No relevant relationships reported)

Purpose: School-based physical activity (PA) has mostly been examined in a preventive perspective. The purpose of this study was to examine the changes in physical activity, physical fitness and psychosocial well-being in early adolescents after the implementation of a school-based health promotion program in secondary school.

Methods: Four municipalities with 15 secondary schools in Telemark County, Norway, were recruited into an intervention or a control group. A total of 644 pupils participated in the study (response rate: 79%). The schools in the intervention group implemented the Active Healthy Kids program, where the physical activity component consisted of: (1) 120 min/week of physically active lessons (PAL), (2) 25 min/week of physical active breaks during classroom lessons and (3) 135 min/week of curriculum based normal physical education. Primary outcome was physical activity assessed by accelerometer and expressed as counts per minutes. Secondary outcomes were sedentary time, physical fitness, vitality, school effort and health-related quality of life in the five domains; physical health, psychological wellbeing, parent, peers and school environment.

Results: There was a Group X Time effect for school-based, but not full-day, physical activity ($p = 0.005$), and for cardiorespiratory fitness ($p = 0.02$) and vitality ($p = 0.008$). A Group effect was found for the perceived exerted effort in class ($p < 0.001$) and the health-related quality of life domains "psychological well-being" ($p = 0.04$) and "school environment" ($p < 0.001$).

Conclusions: A multi-component, school-based, health-promotion intervention with emphasis on the use of PAL led to positive changes in school-based physical activity,

cardiorespiratory fitness, vitality and health-related quality of life among early adolescents in a county with poor public health profile. This might have implications for the development and promotion of general health and well-being throughout adolescence.

Trial registration: Approved by the Norwegian Data Protection Services (ID 54327), and registered in ClinicalTrials.gov, (ID NCT03906851).

Keywords: School-based physical activity, adolescents, Physical activity, physical fitness, Health Related Quality of Life, Norway

820 May 27 5:00 PM - 5:15 PM

Bi-directional Prospective Associations Between Objectively Measured Physical Activity And Fundamental Motor Skills In Children: A Two-year Follow-up

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(No relevant relationships reported)

PURPOSE: The direction of the longitudinal relationship between physical activity (PA) and fundamental motor skills (FMS) remains unclear. We evaluated the bi-directional, prospective relationships between intensity-specific physical activity (PA) and domain-specific fundamental motor skills (FMS) over two years in young children. **METHODS:** A sample of 235 children (mean age at baseline 4.7 yr, 52 % boys) from the Sogn og Fjordane Preschool Physical Activity Study was measured two years apart. PA was assessed using ActiGraph accelerometers (GT3X+). FMS were evaluated by a test battery inspired by the "Test of Gross Motor Development 3" and the "Preschooler Gross Motor Quality Scale". PA outcomes were total PA (TPA [counts per minute]) and intensity specific PA and sedentary behaviour (SED) (min/day). FMS outcomes were total FMS score, locomotor-, object control-, and balance skills. Linear mixed model adjusting for potential co-variables was used to evaluate the bi-directional prospective associations between these variables, including the moderating effect of sex and age. **RESULTS:** Baseline total PA, moderate-to-vigorous PA (MVPA), and vigorous PA predicted higher total FMS score, locomotor-, object control-, and balance skills at follow-up (standardized regression coefficient (β): 0.15 to 0.26, $p = 0.002-0.031$). SED predicted lower FMS in all domains except balance (β : -0.10 to -0.27, $p = 0.008-0.026$). Baseline light PA did not predict FMS at follow-up. Baseline object control- and balance skills were not associated with PA or SED at follow-up. Total FMS score at baseline predicted lower light PA at follow-up (β : -0.14, $p = 0.041$), and locomotor skills at baseline predicted higher TPA in boys relative to girls (p for interaction=0.044). **CONCLUSIONS:** PA, especially MVPA, were positively associated with development of FMS in young children. In contrast, FMS was largely unrelated to future PA levels. Our results suggest promotion of MVPA is important for FMS development in young children.

B-50 Free Communication/Slide - Investigating Maternal and Child Health

Wednesday, May 27, 2020, 3:15 PM - 5:15 PM
Room: CC-3020

821 **Chair:** James M. Pivarnik, FACSM. Michigan State University, East Lansing, MI.

(No relevant relationships reported)

822 May 27 3:15 PM - 3:30 PM

Influence Of Maternal Exercise And DHA Levels During Pregnancy On Maternal Lipids

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(No relevant relationships reported)

Elevated levels of Total Cholesterol (TC), low-density lipoprotein (LDL) and triglycerides (TG) during pregnancy have been associated with risks of gestational diabetes, preeclampsia, fetal macrosomia and cardiovascular disease. Exercise is

known to decrease TC, LDL and TG, while increasing HDL within normal ranges. Similarly, Supplementation of polyunsaturated fatty acids (PUFA), such as DHA, help control and mitigate excessive triglycerides, while increasing HDL. Research has not investigated the potential relationship of maternal exercise and PUFA levels on maternal lipid profiles. **PURPOSE:** To determine the relationship between maternal exercise and plasma levels of DHA on maternal lipid levels at 16 and 36 weeks. **METHODS:** 22 women with a singleton pregnancy (<16 weeks) were randomized to either aerobic (n=9) or non-exercising control (n=4) group. Participants exercised 3x50 minutes per week at moderate intensity for ~24 weeks, with average weekly METmins/wk calculated based on standard MET values*average minutes. Maternal plasma was collected at 16 and 36 weeks of gestation and analyzed for DHA and lipid levels. Multiple linear regression and Spearman correlation models were performed to determine relationships between maternal METmins/wk, DHA levels, and lipid levels. **RESULTS:** There is a significant negative correlation between DHA levels on HDL (-0.692, p=0.01) at 36 weeks. There are trends of significance with METmins/wk with DHA (0.500; p=0.08) and TG (-0.440, p=0.13) at 36 wks. There was not a significant regression equation found for TC (F=0.690, p=0.52) and TG (F=2.092, p=0.174), however METmins/wk showed a negative relationship to TC (-0.094, p=0.307) and trended to significantly predict TG (-0.185, p=0.081) while DHA Levels showed a positive relationship with TC (0.059, p=0.331) and TG (0.105, p=0.125). **CONCLUSION:** The current suggests a potential relationship between exercise and DHA levels during pregnancy on maternal lipids. These findings showed a negative and stronger relationship with METmins/wk compared to DHA levels, thus suggesting exercise may be more important to control excessive increases in TC and TG during pregnancy.

823 May 27 3:30 PM - 3:45 PM

Physical Activity Knowledge And Sources Of Advice During Pregnancy

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(No relevant relationships reported)

Physical activity (PA) during pregnancy is known to be beneficial for the health of both the mother and foetus, but most pregnant women do not engage in the recommended volume of activity. Lack of personal and healthcare-professional knowledge is frequently cited as a barrier to PA participation during pregnancy in both low-activity and athletic populations.

PURPOSE: To explore the sources of advice used by women to guide their PA participation during pregnancy.

METHODS: Women who had recent experience of pregnancy in Ireland (n = 102, age 35±4 years) completed an online survey with questions regarding their activity type immediately pre-pregnancy (activities of daily life only (DAILY), recreational exercise (EXERCISE) or competitive sport (SPORT)), knowledge of PA guidelines, experiences of receiving PA advice from healthcare professionals during pregnancy, and perceptions regarding different sources of advice. Between-group comparisons were made by Chi-square analysis.

RESULTS: Knowledge of the recommended volume of activity for health was significantly poorer in EXERCISE than DAILY or SPORT ($X^2_8 = 16, p = 0.037, V = 0.283$); there were no differences in knowledge of recommended intensity or type. Women in the EXERCISE and SPORT groups were significantly more likely to have felt that they needed to initiate discussion about PA with their healthcare providers than those in the DAILY group, for whom the professional was more likely to initiate the discussion ($X^2_6 = 19, p = 0.004, V = 0.310$). While 48% of respondents perceived their healthcare professionals to be their most useful source of PA advice during pregnancy; the other 52% cited sources such as friends, exercise professionals or online media, with no between-group differences. Furthermore, many women reported that they never received PA advice during their pregnancy from their general practitioner (27% of women), midwife (45%) or obstetrician (46%).

CONCLUSION: Knowledge of guidelines for PA during pregnancy is low among pregnant women in Ireland; low levels of guidance from healthcare professionals may be a contributing factor.

824 May 27 3:45 PM - 4:00 PM

Maternal Physical Activity Correlates With Fasted And Postprandial Insulin Resistance And Lipids During Late Pregnancy

Rachel A. Tinius¹, Maire M. Blankenship¹, Kevin J. Pearson², W. Todd Cade³, Elizabeth Altizer⁴, Nikki B. Zite⁴, Jill M. Maples⁴. ¹Western Kentucky University, Bowling Green, KY. ²University of Kentucky, Lexington, KY. ³Washington University School of Medicine, St. Louis, MO. ⁴University of Tennessee Graduate School of Medicine, Knoxville, TN.
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(No relevant relationships reported)

PURPOSE: Physical activity (PA) has been shown to be effective for lowering insulin resistance and blood lipid profiles during pregnancy. Recent evidence indicates sedentary time is also associated with poor pregnancy outcomes. The purpose of this study was to determine the relationships between sedentary time and moderate PA, assessed during late pregnancy, and insulin resistance (HOMA-IR) and triglycerides in fasting and postprandial conditions. Postprandial conditions are important to study as humans spend the majority of their time in a fed-state.

METHODS: Healthy pregnant women (N=61, 32-36 weeks gestation) were recruited for this study. Sedentary time and moderate intensity PA were objectively assessed using a wrist-worn Actigraph GT9X Link Accelerometer. The device was worn 24 hrs/day for 7 days. Fasting blood lipids, insulin, and glucose were assessed. A standardized high-fat breakfast was consumed and these measures were collected again 120-minutes post-meal (postprandial). All relationships were analyzed with Pearson Product Moment Correlation Coefficients while controlling for pre-pregnancy BMI.

RESULTS: Sedentary time was positively correlated with fasting and postprandial insulin resistance (fasting HOMA-IR: $r = -0.471, p = 0.001$; postprandial HOMA-IR: $r = -0.433, p = 0.002$), while these measures were negatively correlated with light PA (fasting HOMA-IR: $r = -0.395, p = 0.005$; postprandial HOMA-IR: $r = -0.364, p = 0.010$) and moderate PA (fasting HOMA-IR: $r = -0.520, p < 0.001$; postprandial HOMA-IR: $r = -0.477, p = 0.001$). Sedentary time was positively correlated with fasting triglycerides ($r = 0.296, p = 0.039$). Moderate PA was negatively correlated with fasting triglycerides ($r = -0.403, p = 0.004$) and postprandial triglycerides ($r = -0.343, p = 0.016$).

CONCLUSIONS: Decreasing sedentary time and adding any intensity PA may positively impact metabolic health during pregnancy by reducing fasting and postprandial insulin resistance, as well as reducing fasting and postprandial triglycerides. This is important as, during pregnancy, insulin resistance is associated with poor pregnancy and neonatal outcomes and increased triglycerides are associated with increased risk of preeclampsia, pre-term birth, and increased maternal cardiovascular risk later in life.

NIH NIGMS IDeA Grant 5P20GM103436

825 May 27 4:00 PM - 4:15 PM

Influence Of Physical Activity And Sedentary Behavior During Pregnancy On Labor And Delivery Type

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(No relevant relationships reported)

Physical activity (PA) during pregnancy is known to be safe and does not increase risk of medical intervention during labor and delivery. While it is known that sedentary behavior (SED) and PA have independent health effects, whether higher SED during pregnancy increases risk for medical intervention in labor and delivery is unknown.

PURPOSE: To examine the relationship of SED and PA patterns across pregnancy with labor and delivery outcomes. **METHODS:** In this prospective cohort study, objective SED (thigh-worn activPAL micro3) and physical activity (waist-worn ActiGraph GT3X-BT) were assessed in women for ≥ 4 days with ≥ 10 hours in each trimester of pregnancy. This secondary analysis includes women with available labor and delivery records, and PA and SED measures in ≥ 1 trimester (n=99). Trajectory analysis was used to identify patterns of PA and SED across pregnancy and assign women to the groups most closely related to their dominant activity patterns. Labor and delivery information was abstracted from participant medical records. Labor types were categorized as: spontaneous, induced-elective, or induced-medical. Delivery types were categorized as: vaginal, c-section-elective, c-section-medical. Differences in labor and delivery type by SED and PA trajectories were analyzed using Fisher's exact tests due to small cell sizes. **RESULTS:** Trajectory analysis resulted in and assigned women to high, medium, and low groups for PA and SED across trimesters of pregnancy. Approximately 60% of labor was spontaneous, followed by 27% medical induction, and 13% elective induction. Deliveries were 79% vaginal, 13% medically indicated c-section, and 8% elective c-section. Type of labor (L) or delivery (D) did not significantly differ by SED (L: $p = 0.185, D: p = 0.134$) or PA (L: $p = 0.756, D = 0.120$) trajectories. When elective induction and c-sections were removed to only consider risk for medical intervention, differences remained insignificant by SED (L:

p=0.136, D: p=0.088) or PA (L: p=0.527, D: p=0.128) trajectories. **CONCLUSION:** Objectively-measured patterns of SED or PA across pregnancy were not related to type of labor or delivery, including risk of medical intervention. Future research with larger samples could expand to the entire birth experience including duration of labor, medication use, or fetal complications.

826 May 27 4:15 PM - 4:30 PM
Effect Of Exercise During Pregnancy And Lactation In Obese Wistar Rats On Offspring Glycemic Control

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 (No relevant relationships reported)

PURPOSE: To determine the effect of maternal exercise in pregnant and lactating obese Wistar rats on the glycemic control of their offspring at time of weaning. **METHODS:** Two days following impregnation, 24 obese Wistar rats were separated into 2 groups. One group received 30 minutes of treadmill exercise (E) at 15-20 m/min each day while the other group received no exercise (NE). The groups were maintained after the birth of the offspring (21 days) through lactation (21 days) for a total of 6 weeks. At weaning an oral glucose tolerance test (OGTT) was performed on 12 randomly selected pups from each group. A t-test was utilized to determine differences in total glucose area under the curve (t-AUC) (mean and standard error) between groups ($p \leq 0.05$). **RESULTS:** There was an effect of maternal exercise on the glycemic control of the offspring. The ability to dispose of glucose following a glycemic load was significantly greater in the offspring of E dams (513.1 ± 11.7 mmol/L) compared to the offspring of NE dams (542.7 ± 7.1 mmol/L) ($p \leq 0.05$). **CONCLUSIONS:** Initiating moderate exercise early during the pregnancy of obese rats and maintaining exercise through lactation can positively impact glycemic control in offspring.

827 May 27 4:30 PM - 4:45 PM
The Effects Of An Antenatal Lifestyle Intervention On Pregnancy Outcomes In Overweight And Obese Pregnant Women

Jihong Liu, Sara Wilcox, FACSM, Ellen Wingard, Brent Hutto. *University of South Carolina, Columbia, SC.* (Sponsor: Sara Wilcox, FACSM)
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 (No relevant relationships reported)

Three reviews of antenatal behavioral lifestyle interventions did not find significant intervention effects on maternal complications and adverse neonatal outcomes, perhaps due to the inclusion of low to medium quality studies. **PURPOSE:** To evaluate the effect of a lifestyle intervention program on pregnancy outcomes in overweight and obese pregnant women. **METHODS:** This study was a randomized controlled trial. Overweight and obese pregnant women were recruited from Columbia, South Carolina and were randomized to a behavioral intervention group (n=110) or to a standard care group (n=104). The antenatal intervention was designed to target weight self-monitoring, increasing physical activity, and increasing healthy dietary behavioral practices. Intervention contents were delivered through one in-depth counseling session, followed by phone counseling, behavioral podcasts, and social media support. Standard care women received monthly mailings and a match number of podcasts on non-weight related topics. **RESULTS:** Our study population was racially diverse (56% white, 44% African American) with a mean prepregnancy BMI of 32.2 ± 5.9 and was 12.7 ± 2.4 wks gestation at baseline. Compared to standard care women, women in intervention group had lower percentages of gestational hypertension (9.1 vs. 21.2%, $p=0.01$) and delivering a low birth weight baby (<2500g) (1.9 vs. 10.6%, $p=0.009$). These women also had lower percentages of gestational diabetes (7.3 vs. 12.5%) and delivering a preterm baby (<37 wks of gestation) (2.8 vs. 7.7%), although these differences were not significant at the 0.05 level. No group differences were found in other outcomes (i.e., cesarean deliveries, macrosomia births (birthweight ≥ 4000 g), and Apgar scores). **CONCLUSIONS:** An antenatal behavioral lifestyle intervention designed to reduce gestational weight gain was beneficial in improving pregnancy outcomes in overweight and obese pregnant women. Future analyses will examine mechanisms for this effect.

828 May 27 4:45 PM - 5:00 PM
Change In Physical Activity In The Health In Pregnancy And Postpartum (HIPP) Randomized Controlled Trial (RCT)

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 (No relevant relationships reported)

Despite the known benefits of physical activity (PA) in pregnancy, PA is consistently shown to decrease from early to late pregnancy. Very few antenatal interventions have targeted PA and included sensor-measured outcomes in overweight and obese pregnant women.

PURPOSE: To examine whether a lifestyle intervention increased moderate- to vigorous-intensity PA (MVPA), light PA, and steps or reduced their decline from early to late pregnancy compared to a standard care condition. **METHODS:** HIPP is a RCT comparing the effects of a lifestyle intervention vs standard care on gestational weight gain (primary outcome) and health behaviors including PA (secondary outcomes) among women entering pregnancy overweight or obese. The lifestyle intervention was grounded in social cognitive theory and, during pregnancy, included an introductory behavioral counseling session followed by telephone counseling calls, behavioral podcasts, and a private Facebook group. Usual care participants received usual care from their obstetrician and received mailings and podcasts focused on a healthy pregnancy. Participants wore a SenseWear armband ≥ 21 hrs/d for ≥ 5 d at baseline (early pregnancy, n=205) and 32-wk gestation (n=167). We tested Randomization x Time interaction effects (SAS PROC MIXED) for min/d of MVPA, min/d of light PA, and steps/d. **RESULTS:** Participant demographics were: 30 ± 5 years, 44% African American, 56% white, 60% college graduate, 61% employed full-time, 67% married, 42% nulliparous, and 13 ± 2 wk gestation at baseline. While the time main effects indicated that MVPA ($p=0.07$), light PA ($p=.04$), and steps ($p<.0001$) decreased significantly, intervention effects (Randomization x Time) were not significant for these PA variables (see Table).

	Intervention		Standard Care		p
	Baseline	32-wk	Baseline	32-wk	
MVPA, min/d	38 (2)	36 (3)	35 (2)	28 (3)	.17
Light PA, min/d	219 (8)	206 (8)	200 (8)	194 (8)	.43
Steps/d	5574 (196)	5041 (209)	5114 (196)	4363 (211)	.34

CONCLUSION: A behaviorally based lifestyle intervention did not significantly lessen the decline in PA typically seen from early to late pregnancy. Assessments will be repeated at 6- and 12-mo postpartum.
 Funded by NIH/NICHD.

829 May 27 5:00 PM - 5:15 PM
A Healthy Lifestyle Intervention During Pregnancy: Key To Preventing Chronic Disease Risk?

Roberta Bgeginski¹, Taniya S. Nagpal², Harry Prapavessis¹, Barbra de Vrijer¹, Christina G. Campbell³, Karishma Hoseini¹, Stephanie Paplinski¹, Mollie Manley¹, Michelle F. Mottola, FACSM¹. ¹University of Western Ontario, London, ON, Canada. ²University of Ottawa, Ottawa, ON, Canada. ³Iowa State University, Ames, IA. (Sponsor: Michelle F. Mottola, FACSM)
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Gestational hypertension disorders and diabetes affect 6-15% of all pregnancies worldwide and are associated with adverse maternal and neonatal outcomes that can have a programming effect on future chronic disease risk. Pregnant women who receive lifestyle interventions, including healthy eating and/or physical activity, may have a decreased risk of developing complications. **PURPOSE:** To analyze the effects of a supervised healthy lifestyle intervention (nutrition and exercise) during pregnancy on diagnosis of gestational diabetes, hypertension, caesarean delivery, stillbirth, macrosomia (babies > 4500g), and low birth weight (babies < 2500g) in a cohort in London, Canada. **METHODS:** From 2016 to 2019, 111 women were enrolled at 12-18 weeks gestation in the Nutrition and Exercise Lifestyle Intervention Program (NELIP; Clinical Trials #NCT02804061) up to delivery. The nutrition goals for the intervention were: 1) Submit a weekly 24 hour-food intake record; 2) Consume approximately 1800-2200 kcal/d; and 3) Consume 200-250 g carbohydrates/d (40-55% of total energy intake). The exercise goals were: 1) Duration of session: Walk for 25 minutes and add 2 minutes each week until 40 minutes were achieved and then maintain this walking duration until delivery; 2) Frequency: 3-4 times per week; and 3) Submit a weekly step log (pedometers were provided to each participant). **RESULTS:** As of October 2019,

the average duration of the intervention was 20.9 ± 3.9 wks. Out of the 75 participants that completed the intervention, maternal age was 32.2 ± 3.3 yrs, self-reported pre-pregnancy weight was 71.2 ± 15.3 kg, and gestational age at delivery was 278.1 ± 9.0 days. No participants were diagnosed with gestational diabetes or hypertension. Data from 52 babies indicated: birth weight was 3456.0 ± 442.4 g and length was 50.7 ± 3.1 cm. None were born with low birth weight and there were no cases of stillbirth. The rate of macrosomia was 1.9% (n = 1) and caesarean delivery was 27% (n = 14). **CONCLUSION:** A healthy lifestyle intervention during pregnancy may help to prevent gestational diabetes and hypertension, and help to reduce the prevalence of stillbirth, macrosomia, low birth weight, and caesarean deliveries. Taken together, these findings may have major positive implications for the long-term health of both mothers and babies.

B-51 Clinical Case Slide - Cardiovascular

Wednesday, May 27, 2020, 3:15 PM - 4:35 PM
Room: CC-2005

830 Chair: Paul D. Thompson, FACSM. *Hartford Hospital, Hartford, CT.*
(No relevant relationships reported)

831 Discussant: Benjamin D. Levine, FACSM. *Presbyterian Hospital, The University of TX SW Medical Center, Dallas, TX.*
(No relevant relationships reported)

832 Discussant: Matthew Sedgley, FACSM. *U of Maryland Sports Medicine, frederick, MD.*
(No relevant relationships reported)

833 May 27 3:15 PM - 3:35 PM
Cardiovascular-Track And Field
 Mitchell J. Odom. *University of Michigan, Ann Arbor, MI.*
 (Sponsor: Robert Kinningham, FACSM)
(No relevant relationships reported)

HISTORY: A 21-year old senior male track and field athlete who competes in mid-distance running events in a Division I university was evaluated for a family history of hypertrophic cardiomyopathy. During his pre-participation physical exam, he denied history of dizziness, syncope, or chest pain. There was no family history of an abnormally thickened heart or early sudden cardiac death. However, his father was recently diagnosed with hypertrophic cardiomyopathy by his primary care provider. There is no other known history of hypertrophic cardiomyopathy in the family. **PHYSICAL EXAMINATION:** There were no abnormalities during his cardiac exam. There were no murmurs on standard exam or with provocative maneuvers. **DIFFERENTIAL DIAGNOSIS:** 1. Family history of hypertrophic cardiomyopathy. 2. Physiologic hypertrophy response to exercise. **TEST AND RESULTS:** 1. Standard electrocardiogram: Sinus bradycardia with a heart rate of 55, PR interval 152, QRS duration 94, QT/QTc interval 442/422, evidence of left ventricular hypertrophy, and non-specific ST-T wave changes in leads V2 and V3. 2. Stress electrocardiogram: Asymptomatic during exercise. Interpretation: decreased sensitivity of the test due to baseline left ventricular hypertrophy, non-diagnostic study. 3. Resting echocardiogram: No valvular abnormalities, normal size of right and left atria, normal size of right and left ventricles. Concentric left ventricular hypertrophy present and marked right ventricular hypertrophy present. Impression: Consider hypertrophic cardiomyopathy. 4. Stress echocardiogram: normal hyperdynamic response to exercise. Return to baseline following rest. 5. Cardiac MRI: Left ventricle size normal, maximal left ventricular wall size 11mm, normal left ventricle indexed mass, mildly dilated right ventricle. **FINAL DIAGNOSIS:** Normal physiologic response to exercise. False positive resting echocardiogram. **TREATMENT AND OUTCOMES:** 1. After discussion with a sports cardiologist, a cardiac MRI was ordered as his resting echocardiogram was concerning for hypertrophic cardiomyopathy. 2. Cardiac MRI showed no evidence of hypertrophic cardiomyopathy. 3. No restrictions were placed on activity or participation

834 May 27 3:35 PM - 3:55 PM
Incidental Cardiac Arrhythmia Identification With Consumer Grade Heart Rate Monitors: A Case Study
 Neal C. Phifer, Dale D. Brown, FACSM, Kelly R. Laurson, Skip M. Williams, Emily Jones, Karen K. Dennis, Megan Smith, Ryan Swenson. *Illinois State University, Normal, IL.* (Sponsor: Dale Brown, FACSM)
 Email: ncphife@ilstu.edu
(No relevant relationships reported)

HISTORY: A 19-year-old sophomore NCAA Division I female volleyball player was identified, via a consumer-grade heart rate (HR) telemetry system, as having what would be considered a high heart rate (123% of age predicted max HR or 233 bpm) during practice. **PHYSICAL EXAMINATION:** Athlete was observed without interaction for signs of distress, excessive heavy breathing, pallor changes, or any sort of balance issues that would indicate dizziness or syncope. After approximately 5 minutes, HR returned to a normal level that would be commensurate with the exercises/drills being performed. Once a more in-depth analysis of the collected data was performed it was determined that consultation with team physician and cardiologist was needed. Retrospective analysis of data recorded prior to this episode was undertaken and identified approximately 40% of recorded session contained a similar episode. Further clarification of both HR, and R-R interval data aided in identification of episodes. **DIFFERENTIAL DIAGNOSIS:** 1. Supraventricular tachycardia (SVT) 2. Wolf-Parkinson-White Syndrome 3. Atrioventricular Nodal Reentrant Tachycardia (AVNRT) **TEST AND RESULTS:** Electrocardiogram: --No noticeable abnormalities Holter Monitor: --identified an exercise induced SVT episode with no other abnormalities when episode was not present. --HR data was used to assist in identifying duration, initiation and termination of the episode. **FINAL/WORKING DIAGNOSIS:** Exercise induced SVT **TREATMENT AND OUTCOMES:** Athlete continued participation with continuous real time heart rate monitoring for episodic activity. When episodes of tachycardia occurred, the athlete was removed from practice/play until a return to normal HR was achieved. After conclusion of academic year an ablation was attempted to correct the problem. The remaining athletes using the HR telemetry system have performance data analyzed on a daily basis for possible identification of arrhythmic signatures. Currently development and implementation of a policy to address identified athletes is underway and will streamline addressing future instances.

835 May 27 3:55 PM - 4:15 PM
Cardiovascular-Football
 Sabrina P. Sawlani, Joshua T. Goldman, Kevin Shannon. *University of California - Los Angeles, Los Angeles, CA.* (Sponsor: Aurelia Nattiv, FACSM)
(No relevant relationships reported)

HISTORY
 A 19-year-old football offensive lineman with history of SVT (treated in infancy with propranolol and adenosine) presented during his annual pre-participation exam with palpitations for 3 months. Episodes occurred during exercise, lasting 30 seconds to 5 minutes. He admitted associated difficulty breathing and chest tightness. He denied dizziness or syncope. **PHYSICAL EXAMINATION**
 BP 133/79, HR 96, SpO2 98%/RA, BMI 35. Exam in training room: Regular heart rate and rhythm, no murmurs sitting/lying/standing, lungs clear to auscultation bilaterally, 2+ pulses throughout. **DIFFERENTIAL DIAGNOSIS**
 1. Supraventricular tachycardia
 2. Wolff-Parkinson-White syndrome
 3. Cardiomyopathy
 4. Hyperthyroidism
 5. Anemia
 6. Anxiety or panic disorder **TESTS AND RESULTS**
 CBC, CMP, TSH, A1c normal, except: AST 53, ALT 68, Ferritin 505
 CXR: No acute cardiopulmonary abnormalities
 EKG: NSR, pre-excitation in V3
 ECHO: Normal
 Treadmill stress test: Excellent exercise tolerance (92% of HRmax), limited by shortness of breath and leg fatigue. Exercise-induced chest pressure present. Pre-excitation difficult to see at peak exercise, no sudden change to suggest abrupt loss of pre-excitation. **FINAL/WORKING DIAGNOSIS**
 Wolff-Parkinson-White syndrome **TREATMENT/OUTCOMES**
 1. Urgent referral to Cardiology, EKG and ECHO (see results), outpatient cardiac ambulatory monitor placed, and treadmill stress test completed.

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2. Concern for high-risk pathway as pre-excitation persisted at higher heart rates on stress test. Cardiology recommended electrophysiology study and ablation.
3. Underwent uncomplicated catheter ablation of left posterior accessory pathway.
4. 1 week post-ablation, some degree of pre-excitation noted on follow-up EKG (however, similar to post-elimination and initial EKG).
5. 2 weeks post-ablation, ambulatory monitor with no events.
6. 6 weeks post-ablation, remained asymptomatic and received cardiac clearance to return to sport.

836 May 27 4:15 PM - 4:35 PM

Chest Pain - Football

Courtney Nicole Hintz. *UCLA Health, Los Angeles, CA.*
(Sponsor: Aurelia Nattiv, FACSM)
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(No relevant relationships reported)

HISTORY: A 23-year old male division I football linebacker developed acute-onset exertional chest pain 30 minutes into practice. The pain was substernal, radiated to his back and was associated with shortness of breath. He was immediately transferred to the ED and after two hours had resolution of his pain with intravenous ketorolac. The patient admitted to suffering from a viral upper respiratory infection with mild unreported chest pain for two weeks prior to the episode. He has a past medical history of well-controlled asthma and sickle cell trait. He denied previous episodes of chest pain or syncope and also denied family history of sudden cardiac death.

PHYSICAL EXAMINATION: Initial vital signs were BP 141/85, HR 74, O₂ saturation 96%, T 97.8°F. Athlete was in visible distress in right lateral decubitus position, clutching chest. Cardiac examination revealed regular rate and rhythm, no murmurs or rubs. Chest pain was not reproducible on palpation of anterior chest. Pain was positional and worse with leaning forward. Lungs were clear to auscultation bilaterally with no wheezing or rhonchi, and good air movement.

DIFFERENTIAL DIAGNOSIS: 1. Myocarditis/Pericarditis 2. Acute coronary syndrome 3. Anomalous coronary artery with myocardial infarction 4. Pulmonary embolism 5. Aortic dissection

TEST AND RESULTS: *Emergency Department:* Labs: Troponin 2.9, CBC: 9.3 > 15.2/45.6 < 234, BMP: 141/4.3/104/23/1.4 < 102. *Imaging:* CXR with no cardiopulmonary disease. Bedside ultrasound with no pericardial effusion, no evidence of acute right heart strain. *EKG:* Sinus rhythm, rate 69, nonspecific T-wave inversions and diffuse ST-segment elevation. *Cardiac Unit:* Labs: Troponin trend: 2.9->6.4->11.9->13.3->9.7, D dimer 650, CRP 0.4, ESR 10. *Imaging:* Normal CT pulmonary angiogram. TTE with normal LV and RV size and systolic function, EF 60-65%, no valvular abnormalities. Cardiac MRI: Mild hypokinesis in the basal septum with associated patchy mesocardial delayed enhancement and transmural delayed enhancement in the basal anterior wall and mid septum with mild hypokinesis.

FINAL WORKING DIAGNOSIS: Myocarditis **TREATMENT AND**

OUTCOMES: 1. Colchicine and high dose ibuprofen taper over 3 weeks 2. Avoidance of physical activity for 3-6 months per AHA guidelines 3. Resting and stress TTE and EKG, 24-hour Holter monitor prior to RTP.

B-52 Clinical Case Slide - Foot and Ankle

Wednesday, May 27, 2020, 3:15 PM - 4:35 PM
Room: CC-2016

837 **Chair:** Courtney Gleason. *Emory University, Atlanta, GA.*
(No relevant relationships reported)

838 **Discussant:** Jeffrey A. Ross, FACSM. *Baylor College of Medicine, Houston, TX.*
(No relevant relationships reported)

839 **Discussant:** Stephen M. Simons, FACSM. *Saint Joseph Regional Medical Center, South Bend, IN.*
(No relevant relationships reported)

840 May 27 3:15 PM - 3:35 PM

Left Foot Injury In A Female Gymnast

George Ceremuga¹, Elena Jelsing². ¹*Mayo Clinic, Rochester, MN.* ²*Mayo Clinic Square, Minneapolis, MN.* (Sponsor: Jonathan Finnoff, FACSM)
Email: ceremuga.george@mayo.edu
(No relevant relationships reported)

HISTORY: A 17-year-old female high level gymnast presented for evaluation of left heel pain and ecchymosis. Two days prior to her presentation, she was sprinting in preparation for a roundoff prior to vault take-off and felt her heel shift when she went to push-off. She fell and was immediately unable to bear weight secondary to heel pain. Pain was exacerbated by any weight-bearing activity and improved with rest. She had been wearing a walking boot and using crutches for ambulation. **PHYSICAL EXAMINATION:** Healthy-appearing female with a muscular build in no apparent distress. Antalgic gait favoring left foot, avoiding pressure on heel. Ecchymosis along both the medial and lateral aspects of the calcaneus. Tenderness to palpation and associated swelling at the plantar aspect of the calcaneus and along the subtalar joint. Ankle range of motion was full and pain-free. Pain with resisted eversion. Talar tilt and calcaneal squeeze tests were positive. No pain with plantar fascia stretching or palpation along the mid to distal plantar fascia. Achilles tendon was intact. Anterior drawer was negative. Strength was full and light touch sensation was intact. **DIFFERENTIAL DIAGNOSIS:** 1. Calcaneal stress fracture 2. Subtalar joint subluxation 3. Plantar fascia tear **TEST AND RESULTS:** Left ankle and foot radiographs were negative for acute fracture or dislocation. Left ankle MRI revealed a focal tear involving the lateral margin of the lateral cord of the plantar aponeurosis. **FINAL WORKING DIAGNOSIS:** Lateral cord plantar fascia rupture **TREATMENT AND OUTCOMES:** 1. Walking boot for 6 weeks with gradual wean out of boot during the 6th week and ankle range of motion exercises when out of the boot. 2. Once out of boot, supportive shoes with ankle brace and dorsiflexion night splint at night. 3. Physical therapy focusing on Achilles stretching, ankle range of motion and strengthening until pain and tenderness resolved. Slowly advanced to more sports-specific tasks once pain-free. 4. At 10 weeks post injury, she was pain free while performing plyometric and balance/proprioceptive exercises and had a normal exam with full pain-free range of motion. 5. Functional return to sport given her normal exam and pain-free activity with physical therapy.

841 May 27 3:35 PM - 3:55 PM

Heel Pain - Skier

Hung M. Le, Mary Dubon. *Boston Children's Hospital, Boston, MA.* (Sponsor: Pierre d'Hemecourt, FACSM)
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(No relevant relationships reported)

HISTORY: 17 year-old male with fascioscapulohumeral muscular dystrophy who developed acute left heel pain while skiing. He was alpine skiing when he struck his heel on a mogul and felt immediate heel pain. He was able to reach the bottom of the ski slope but was unable to continue skiing due to severe heel pain. He denied any popping sensation. He had no bruising, numbness, tingling, weakness or mechanical symptoms.

PHYSICAL EXAMINATION: There was no swelling or obvious deformity on inspection of his left heel. He was tender on palpation over his left heel, distal Achilles tendon, and medial malleolus. He had limited range of motion of his foot due to pain. Negative Thompson's test although left had 15 degrees compared to 30 degrees of plantar flexion on the right.

DIFFERENTIAL DIAGNOSIS:

1. Bone spur
2. Partial tear of Achilles tendon
3. Bursitis
4. Hindfoot fracture

TEST AND RESULTS:

X-ray AP and lateral views of left ankle were normal.

MRI left ankle revealed a nondisplaced fracture of the calcaneus. There was no signal abnormality involving the Achilles tendon and it appeared intact.

FINAL/WORKING DIAGNOSIS:

Nondisplaced calcaneus fracture

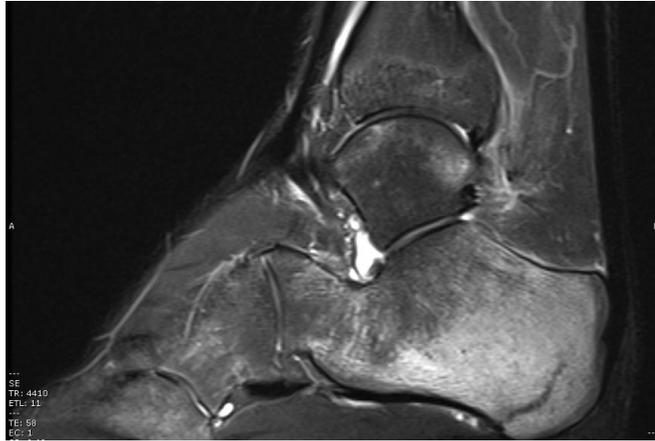
TREATMENT AND OUTCOMES:

Placed in a pneumatic boot with weight bearing as tolerated.

Out of pneumatic boot at 8 weeks.

Began physical therapy at 7 weeks.

Planning to return to skiing this winter as injury occurred in the spring.



MRI Sagittal T2 FS

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Bimalleolar Fracture In Athlete With Negative Ottawa Ankle Rules

Bilal Ittiq, Kaiser Permanente Fontana, Fontana, CA. (Sponsor: Dr. Robert E. Sallis, FACS, FACS)

(No relevant relationships reported)

HISTORY: A 16-year-old senior high school football wide receiver sustained an ankle injury while getting tackled after catching a pass. During the last few minutes of the game, he sustained an inversion ankle injury while falling to the ground during a tackle. He reported pain at the lateral malleolus during the on-field examination and was able to bear weight on the leg while walking off of the field, even though he was limping. He denied any previous ankle injuries, numbness, tingling, or radiation of pain.

PHYSICAL EXAMINATION: Examination on the field revealed full range of motion, no gross deformities, and tenderness along the anterior lateral malleolus. Further evaluation on the sideline revealed pain at the lateral ankle with inversion and eversion against resistance. The athlete was tender to palpation along the anterior lateral malleolus but he denied pain with palpation of the posterior distal 6 cm of the tibia and fibula, navicular, and base of the 5th metatarsal.

DIFFERENTIAL DIAGNOSIS: 1. Ligamentous sprain (most likely ATFL). 2. Peroneal tendon injury. 3. Fracture of the lateral malleolus. 4. Osteochondral defect.

TEST AND RESULTS: Ankle anterior-posterior and lateral radiographs: bimalleolar fracture and soft tissue edema

FINAL WORKING DIAGNOSIS: Bimalleolar fracture **TREATMENT AND OUTCOMES:**

1. Immobilization in CAM boot.
2. Transitioned to lace-up ankle brace once pain resolved.
3. Range of motion, proprioceptive, and balance exercises initiated.
4. Returned to play once he achieved full, pain-free range of motion.

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A Rare Case Of Ankle Pain In An Adolescent Male Athlete

Ike Hasley, Edward Laskowski, Mayo Clinic, Rochester, MN.

(No relevant relationships reported)

History 12-year-old healthy male presents for evaluation of progressive left lateral ankle pain for 3 weeks. Denies recent injury, trauma, change in activity, prior history

of similar pain, radicular pain, weakness/sensory symptoms. Pain present at rest and at night. Increases with walking and twisting activities. Mild improvement with ice, Tylenol, ibuprofen, compression wrap.

Physical examination Gait: Non-antalgic gait with normal cadence and stride. Strength: Bilateral lower extremity strength intact. Inspection/palpation: Significant focal edema noted at the left distal fibula which is tender to palpation correlating with area of most significant pain. Range of motion: Within functional limits. Sensation: Normal. Provocative maneuvers: Mild tenderness in the area of the left anterior talofibular ligament. Bilateral ankle drawer test, squeeze test, external rotation stress tests are negative/unremarkable.

Differential Diagnosis Osteoid osteoma, Intracortical hemangioma, Nonossifying fibroma, Distal fibula physeal injury, Chondromyxoid fibroma, Ewing sarcoma, Langerhans cell histiocytoma, Osteosarcoma, Stress fracture

Tests and results: Initial plain films Focal lucency in distal left fibular metaphysis abutting the physis. Periosteal reaction and overlying soft tissue swelling.

MRI Oval well-circumscribed area in distal left fibular metaphysis crossing the physis with surrounding bone marrow edema and periosteal reaction. No evidence of abscess.

Final working diagnosis Suspected Brodie's abscess

Treatment and Outcomes Orthopedics service was consulted and patient underwent debridement of left ankle and curettage of the distal fibula. Admitted overnight for administration of IV vancomycin and cefazolin. Infectious disease service was consulted. He was discharged with one month of oral antibiotics (cefadroxil) following operation. Cultures from tissue taken remained negative. However, the patient did have a positive nares MSSA swab. He was able to return to activity and he recovered well, without significant events or issues.

B-53 Clinical Case Slide - Oncology I

Wednesday, May 27, 2020, 3:15 PM - 4:35 PM

Room: CC-2022

844 **Chair:** Thomas Trojian, FACS, Drexel University, Philadelphia, PA.

(No relevant relationships reported)

845 **Discussant:** Shawn F. Kane, FACS, UNC - Chapel Hill, Carrboro, NC.

(No relevant relationships reported)

846 **Discussant:** Scott A. Magnes, FACS, Fort Belvoir Community Hospital, Fort Belvoir, VA.

(No relevant relationships reported)

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A 26 Year Old Pregnant Woman With Growing Wrist Pain

Keyur Desai, University of Chicago (NorthShore), Glenview, IL. (Sponsor: Carrie A. Jaworski, FACS)

Email: KeyurD@gmail.com

(No relevant relationships reported)

HISTORY: A 26 year old G1P1001 right-hand dominant woman presents 4 weeks after delivery for insidious onset right ulnar-sided wrist pain. Pain was initially present 6 months prior to visit during pregnancy. Her symptoms were initially intermittent but eventually progressed to constant pain. Pain is localized to the distal ulna without radiation. Patient endorses swelling. Patient has no previous history of wrist and hand pain or injury. Patient denies any mechanism of injury or trauma. Patient denies numbness and tingling.

PHYSICAL EXAMINATION: Vital signs: 133/77, HR79, T 97.5degF, 1.68m, 75.3kg, BMI 26.62

Inspection: Right wrist swollen medially

Palpation: Tender over volar aspect of distal ulna

Range of motion: Full AROM of wrist flexion, extension, supination, pronation, ulnar deviation, radial deviation. Pain with resisted flexion, end-range supination and pronation, and with ulnar deviation.

Strength testing: Strength 5/5 of wrist flexors, extensors, supination, pronation.

Special testing: Sensation preserved over C5-T1 dermatomes. Negative Tinel's. Negative Phalen's.

DIFFERENTIAL DIAGNOSIS:

1. ECU Tendonitis
2. TFCC Tear

3. DRUJ Instability
4. Ulnocarpal arthritis or abutment syndrome
5. Giant cell tumor
6. Chondrosarcoma
7. Bone cyst

TEST AND RESULTS: Right wrist X-ray:

Expansile lucent septated bony lesion in the distal ulna. The findings may reflect an aneurysmal bone cyst.

Right wrist MRI:

Expansile, enhancing, solid lesion within the distal ulna extending to the subarticular bone surface, with appearance most suggestive of giant cell tumor. Less likely considerations include chondroid lesions such as chondromyxoid fibroma or a clear cell/low-grade chondrosarcoma. Consider bone biopsy or surveillance follow-up imaging. **FINAL WORKING DIAGNOSIS:** Distal right ulna giant cell tumor. **TREATMENT AND OUTCOMES:** 1. Patient was referred to orthopedic oncology. 2. Patient underwent biopsy with curettage and allograft of distal right ulna. 3. Frozen specimens during procedure confirmed giant cell tumor. 4. Patient has followed up with orthopedic oncology with good improvement in pain and return of function.

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Toe Pain - Softball

Miguel Lopez, Angel Lazu, Peter Seidenberg, FACSM. *Penn State University, State College, PA.* (Sponsor: Peter Seidenberg, FACSM)

(No relevant relationships reported)

HISTORY: An 18-year-old collegiate softball player started noticing right great toe pain in March of her freshman season. Pain was unrelenting throughout the day but temporarily responded to anti-inflammatories. She denied fevers, chills, night sweats, or unexpected weight loss. She did not report her pain to the team physician. However, after seeing an outside physician for continued pain, she was placed in a walking boot and provided a bone stimulator. After an additional three weeks of pain despite these therapies, she presented to the training room for re-evaluation of her toe. **PHYSICAL EXAMINATION:** Examination revealed exquisite tenderness to palpation of the dorsal-fibular aspect of the proximal portion of the distal phalanx of the right first toe, with mild swelling but no plantar tenderness. There was full passive and active range of motion of the MTP and IP joints. Skin of the right foot was intact, without erythema or induration. Tendon function was intact. The foot was neurovascularly intact. **DIFFERENTIAL DIAGNOSIS:** 1. Stress Reaction of right first toe distal phalanx 2. Subacute/Chronic Osteomyelitis 3. Bony Tumor **TEST AND RESULTS:** Right toe AP, lateral, and oblique radiographs- bony alignment is unremarkable, no acute fracture; joint spaces well preserved. MRI of right foot without contrast - diffuse marrow edema throughout the first distal phalanx; no corresponding focal signal hyperintensity in the distal phalanx. Nuclear medicine bone marrow imaging - mild increased radiotracer uptake in the region of the distal first phalanx suggesting increased regional blood flow. The above studies were reviewed by the team physicians and there was a concern for bony mass of the proximal portion of the dorsal fibular distal phalanx. MRI with contrast confirmed this suspicion. CT right foot without contrast with 3D reconstruction - ill-defined sclerosis in the medial aspect of the base of the first distal phalanx measuring 7 mm x 4 mm x 5 mm with faint lucency proximal to the sclerosis. **FINAL WORKING DIAGNOSIS:** Osteoid Osteoma **TREATMENT AND OUTCOMES:** 1. Continued anti-inflammatories with COX2 inhibitors for symptomatic treatment. 2. Surgical curettage and excisional biopsy of the 7 mm x 4 mm x 5 mm nidus; deferment of radiofrequency ablation due to proximity to the joint. 3. Anticipated return to play in 4-6 weeks.

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New Mole In A College Football Athlete

Kathleen Roberts, Robert Hosey, FACSM, Kyle Smoot. *University of Kentucky, Lexington, KY.* (Sponsor: Robert Hosey, FACSM)

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(No relevant relationships reported)

Skin Cancer – Football

History: A 19-year-old male college sophomore football defensive lineman noted a pigmented lesion on the sole of his right foot with the appearance of a blood blister at the end of his freshman year. Over the next weeks to months the lesion grew in size and also became painful with activity. Because the pain was limiting him with football activity he presented to be seen by a dermatologist.

Physical exam: Right foot without soft tissue swelling, area on the plantar surface of the first metatarsal approximately 1.5cm in size with dark coloration, black in appearance, negative signs of infection. Tender to palpation over this area. Range of motion intact at the first metatarsal in flexion and extension without pain. Plantar and dorsiflexion, inversion and eversion intact at the ankle. Pain with ambulation when weight bearing on the area. Sensation intact to light touch. Dorsalis pedis pulse 2+.

Differential Diagnosis:

1. Dysplastic Nevus
2. Melanoma
3. Benign Nevus

Test and Results:

Shave biopsy of the right plantar forefoot overlying the first metatarsal:

- Malignant Melanoma in situ, the deep biopsy margin being free in the tissue planes examined. Lesion involves the peripheral biopsy margin.

Lesion Excision

- Malignant melanoma, 3.3mm

Final/Working Diagnosis:

Acral Lentiginous Melanoma

Treatment and Outcomes:

1. Patient underwent resection of the right foot melanoma in situ with a total defect of 2x2cm, with subsequent adjacent tissue transfer 5x3cm.
2. Sentinel node sampling performed which identified microscopic foci of melanoma in both sentinel nodes resulting in Stage IIIB (T3a, N2a), genetic testing performed showing BRAF negative.
3. PET scan performed showing no evidence of residual disease or metastatic focus.
4. Started on Nivolumab 480mg IV monthly for 13 doses.
5. Patient able to return to football competition in the middle of November, competing in the last few games of his sophomore season.

850 May 27 4:15 PM - 4:35 PM

Atraumatic Knee Swelling - Runner

Bernadette Pendergraph, Bret Namihas, Jason Alvarado. *Harbor-UCLA, Harbor City, CA.*

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(No relevant relationships reported)

HISTORY: 38-year-old male runner with 4 months of left knee pain and swelling that he noticed worsened with running. He remembers no particular injury, increase in mileage, change in footwear, or systemic symptoms such as night sweats, weight loss, or other joint swelling. He was seen in urgent care with his exam showing an effusion and painful range of motion. He was diagnosed with a knee sprain, MRI ordered, and referred to sports medicine. In our clinic, he complained about anterolateral knee pain, persistent knee effusion, and inability to train because of pain and swelling. He denied locking or giving way.

PHYSICAL EXAMINATION: Left knee with 1-2+ non-warm effusion, range of motion 0-130 degrees, lateral patellar facet tenderness, medial joint line tenderness, Lachman negative, valgus/varus testing stable, McMurray negative for click.

DIFFERENTIAL DIAGNOSIS: 1. Medial meniscal tear 2. Patellar chondromalacia 3. Rheumatologic disorder 4. Pigmented nodular synovitis 5. Synovial chondromatosis

TEST AND RESULTS: X-ray: small joint effusion MRI without contrast:

large joint effusion, small medial meniscal tear, lateral patellar facet chondromalacia Arthrocentesis: 303,500 RBCs, 839 WBCs, no crystals; ESR 10, CRP 0.08, ANA negative, RF negative, Normal CBC; MRI with contrast: multiple round lesions on the medial posterior mid joint next to the proximal tibiofibular joint with peripheral enhancement consistent with pigmented villonodular synovitis vs infection **FINAL WORKING DIAGNOSIS:** 1. Pigmented villonodular synovitis 2. Medial meniscal tear 3. Patellar chondromalacia

TREATMENT AND OUTCOMES: 1. Athlete was initially treated with physical therapy for the atraumatic meniscal tear. 2. Athlete had persistent effusion, with an aspiration that showed blood. This provoked review of prior MRI with concern of nodularity of synovium. Therefore an MRI with contrast was performed consistent with likely pigmented nodular synovitis. 3. Athlete evaluated by orthopedics for arthroscopy and synovial biopsy. Intraoperative findings included diffuse involvement of joint including anterior compartment, medial and lateral gutters, and the notch. Pathology consistent with pigmented villonodular synovitis. 4. Post op care complicated by poor progression of range of motion, current 10 to 70 degrees.

B-54 Rapid Fire Platform - Oxygen Uptake Kinetics

Wednesday, May 27, 2020, 3:15 PM - 4:15 PM
Room: CC-Exhibit Hall

851 Chair: Silvia Pogliaghi, FACSM. *Università di Verona, Verona, Italy.*
(No relevant relationships reported)

852 May 27 3:15 PM - 3:25 PM
Residual Fatigue Does Not Affect Critical Power And W' Using A Single-visit Protocol

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(No relevant relationships reported)

Traditionally, determining critical power (CP) and its related work above CP (W') requires exhaustive constant-power trials interspersed by at least 24 h rest. During the last decade several approaches were undertaken to make the protocol less time consuming and to use self-paced ecological time-trials (TT). However, it is debatable whether residual fatigue induced by a single-visit protocol might affect CP and/or W' . Parameters of oxygen uptake ($\dot{V}O_2$) kinetics and muscle deoxygenation can be suggested as suitable to assess the effects of residual fatigue. **PURPOSE:** Assessing fatigue-related parameters of $\dot{V}O_2$ kinetics and muscle deoxygenation between a single-visit and a multi-visit protocol. **METHODS:** Nine well-trained male triathletes (mean \pm SD; age: 27.7 \pm 4.3 yrs; body mass: 75.6 \pm 5.6 kg; $\dot{V}O_{2peak}$: 60.0 \pm 6.5 mL/min/kg) participated. Athletes had to perform a single-visit (2, 5 and 10 min TT, interspersed by 30 min passive rest) as well as a multi-visit determination of CP and W' (2, 5 and 10 min TT, interspersed by at least 24 h rest). During all tests, heart rate (HR) was recorded continuously, respiratory gases were measured breath-by-breath and deoxygenation was recorded at 10 Hz using near infrared spectroscopy (NIRS). The following parameters were assessed: maximal HR, $\dot{V}O_2$ during the first 2 min ($\dot{V}O_{2onset}$), mean response time (MRT), end-exercise $\dot{V}O_2$ ($\dot{V}O_{2peak}$), $\dot{V}O_2$ amplitude ($\text{ampl}\dot{V}O_2$), O_2 deficit, NIRS τ , amplitude (ampl_{NIRS}), and time-delay (TD). To compare the two protocols a paired sample t-test was used to assess the differences in CP and W' and a two-way ANOVA to assess the differences between trials and/or groups as well as and trials x groups interactions.

RESULTS: No significant differences were found for CP or W' between protocols ($p > 0.05$). Significant main effects between trials were found for HR, $\dot{V}O_{2onset}$, $\text{ampl}\dot{V}O_2$, τ and ampl_{NIRS} ($p < 0.001$), but not for MRT, $\dot{V}O_{2peak}$, O_2 deficit and TD ($p > 0.05$). A post-hoc analysis of main effects did not reveal significant differences between corresponding trials ($p > 0.05$).

CONCLUSIONS: Due to non-significant differences in fatigue-related parameters results indicate that the determination of CP and W' using a single-visit protocol is not affected by residual fatigue. Consequently, the single-visit TT approach is a valid method to accurately determine CP and W' .

853 May 27 3:25 PM - 3:35 PM
Influence Of Body Position On Pulmonary Oxygen Uptake And Muscle Deoxygenation Kinetics During Cycle Exercise

Richie P. Goulding¹, Dai Okushima², Simon Marwood³, Tze-Tuan Lei⁴, Narihiko Kondo⁴, David Poole, FACSM⁵, Thomas J. Barstow, FACSM⁵, Shunsaku Koga¹. ¹Kobe Design University, Kobe, Japan. ²Osaka International University, Osaka, Japan. ³Liverpool Hope University, Liverpool, United Kingdom. ⁴Kobe University, Kobe, Japan. ⁵Kansas State University, Kansas, KS.
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(No relevant relationships reported)

Whether pulmonary oxygen uptake ($\dot{V}O_2$) kinetics are limited by O_2 delivery remains contentious. Previous studies have demonstrated that the time constant of pulmonary $\dot{V}O_2$ kinetics ($\tau_{\dot{V}O_2}$) is greater during supine compared to upright cycle exercise, presumably reflecting the superimposition of an O_2 availability limitation. However, interpretation of these studies is compromised by their use of superficial single-site measurements using continuous-wave near-infrared spectroscopy (NIRS), which is unable to determine absolute [heme]. **PURPOSE:** To determine the impact of body position (i.e. upright [U] vs. supine [S]) on the kinetics of pulmonary $\dot{V}O_2$, as well as muscle deoxygenation (deoxy[heme]) kinetics and total[heme] using time-resolved

(TR-)NIRS. **METHODS:** 7 healthy men completed an incremental ramp test to determine $\dot{V}O_{2max}$ and the gas exchange threshold in the supine position. 4 visits followed whereby pulmonary $\dot{V}O_2$ and deoxy[heme] kinetics and total[heme] were determined via TR-NIRS at three muscle sites (deep [VLD] and superficial [VLS] vastus lateralis and superficial rectus femoris [RFs]) in two conditions: 1) during S heavy intensity constant work rate exercise at 40% Δ (between ventilatory threshold and $\dot{V}O_{2max}$); and 2) during U exercise at the same absolute work rate. **RESULTS:** $\tau_{\dot{V}O_2}$ was increased during S compared to U (S: 42 \pm 12 vs. U: 32 \pm 9 s, $P = 0.03$). The fundamental phase deoxy[heme] was greater (i.e. slower) in S compared to U for each muscle site (VLD S: 19 \pm 10 vs. U: 8 \pm 5 s; VLS S: 16 \pm 7 vs. U: 10 \pm 3 s; RFs S: 20 \pm 7 vs. U: 11 \pm 3 s, $P = 0.002$) and its amplitude was greater in S compared to U for RFs only (S: 27.4 \pm 12.1 vs. U: 9.1 \pm 2.5 μM , $P = 0.008$). Total[heme] did not differ between U and S for any muscle site (all $P > 0.05$). **CONCLUSION:** The slowing of pulmonary $\dot{V}O_2$ kinetics for S versus U occurs concomitant with a depressed rate of muscle(s) deoxygenation. This finding suggests that supine exercise results in a relatively greater fall in muscle $\dot{V}O_2$ when compared to O_2 delivery kinetics at least for VLD and VLS. The increased amplitude of deoxy[heme] in S for RFs suggests an increase in O_2 extraction to compensate for impaired muscle perfusion in S compared to U.

854 May 27 3:35 PM - 3:45 PM
Skeletal Muscle Endurance And Oxygen Uptake Kinetics During Cycling In Patients With High Affinity Hemoglobin

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(No relevant relationships reported)

Skeletal muscle oxygen (O_2) consumption is linked to the metabolic demand of the exercising skeletal muscle. In hypoxic conditions (e.g. high altitude) O_2 consumption may be the limiting factor of exercise tolerance. Patients with increased O_2 content, secondary to an increased oxygen affinity (HAH), provide an experiment of nature to investigate the effects of increased flux through the O_2 transport pathway on exercise tolerance. **PURPOSE:** To determine the effect of HAH on O_2 uptake kinetics and exercise tolerance during high-intensity exercise under normoxia (NORM) and hypoxia (HYP) conditions. **METHODS:** Five healthy controls (CTL); 4 men, 41 \pm 8 years, P_{50} =27 \pm 1 mmHg; Hemoglobin concentration ([Hb])= 14.2 \pm 1.3 g \cdot dL⁻¹; hematocrit (Hct)= 43 \pm 4% and five patients with high-affinity hemoglobin (HAH); 3 men, 37 \pm 12 years, P_{50} =15 \pm 2 mmHg; [Hb]: 19.8 \pm 2.3 g \cdot dL⁻¹, Hct= 59 \pm 7% cycled during unloaded pedaling then at a power output that elicited 85% $\dot{V}O_{2max}$ until volitional exhaustion during two different environmental conditions: 1) NORM, (F_{iO_2} =0.21), and 2) HYP, (F_{iO_2} =0.15). O_2 uptake kinetics were modeled as a double-exponential rise to maximum from continuous measurements of inspired/expired gases. Two-way ANOVA with group (HAH, CTL) and inspire (NORM, HYP) as between-subjects factors were used to compare dependent variables. **RESULTS:** HAH patients had marked polycythemia (higher [Hb] and Hct, $P < 0.05$ for both). There was no effect of inspire on any of the parameters of O_2 kinetics, all $P > 0.175$). There was no main effect of group or inspire on $\dot{V}O_2$ during unloaded pedaling (A_p , $P > 0.24$), $\dot{V}O_2$ of the primary component (A_1 , $P > 0.13$), or the $\dot{V}O_2$ slow component ($P > 0.10$). HAH exhibited a trend towards slower O_2 kinetics (HAH=64.3 \pm 17.7 s vs. CTL=49.2 \pm 17.0 s, $P = 0.08$) and significantly lower primary component amplitude (HAH=1.14 \pm 0.66 L \cdot min⁻¹ vs. CTL=1.92 \pm 0.67 L \cdot min⁻¹, $P = 0.02$). There was a trend towards reduced time-to-exhaustion in HYP ($P = 0.09$), but no main effect of group ($P = 0.21$). **CONCLUSION:** Patients with HAH had slower and blunted $\dot{V}O_2$ kinetics, which may be due to 1) blunted O_2 off-loading to the contracting skeletal muscle or 2) adaptations of skeletal muscle (e.g. myosin heavy chain expression) to HAH.

855 May 27 3:45 PM - 3:55 PM

Influence Of Priming Exercise On Muscle Deoxygenation Kinetics During Upright And Supine Cycle Exercise

Shunsaku Koga¹, Dai Okushima², Simon Marwood³, Tze-Tuan Lei⁴, Narihiko Kondo⁴, David C. Poole, FACSM⁵, Thomas J. Barstow, FACSM², Goulding P. Richie¹. ¹Kobe Design University, Kobe, Japan. ²Osaka International University, Osaka, Japan. ³Liverpool Hope University, Liverpool, United Kingdom. ⁴Kobe University, Kobe, Japan. ⁵Kansas State University, Kansas, KS.
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(No relevant relationships reported)

A bout of prior heavy "priming" exercise typically reduces the time constant of fundamental phase oxygen uptake (VO_2) kinetics (τ_{VO_2}) in the supine position, an effect that is generally absent during upright exercise. This priming-induced speeding of pulmonary VO_2 kinetics has been attributed to increased muscle oxygenation at the onset of the second bout. However, the extent to which priming-induced improvements in muscle oxy/deoxygenation status differ across distinct muscle regions, as well as between deep vs. superficial muscle and with respect to body position, remains unknown. **PURPOSE:** To examine the impact of priming exercise on pulmonary VO_2 and muscle deoxygenation kinetics at three muscle sites (superficial rectus femoris [RFs], deep [VLd] and superficial [VLs] vastus lateralis) using time-resolved near-infrared spectroscopy during upright (U) and supine (S) exercise. **METHODS:** 7 healthy men completed an incremental ramp test to determine VO_2 max and the gas exchange threshold in S. 4 visits followed whereby participants performed two 6-min bouts of heavy exercise separated by 6-min unloaded pedalling in two conditions: 1) during constant power exercise at 40% Δ in S; and 2) during exercise at the same absolute work rate in U. Pulmonary VO_2 and muscle deoxy[heme] kinetics were determined during each test. **RESULTS:** τ_{VO_2} was reduced in bout 2 in S (bout 1: 42 \pm 12 vs. bout 2: 31 \pm 7 s, $P = 0.016$) but not in U (bout 1: 32 \pm 9 vs. bout 2: 28 \pm 5 s, $P = 0.32$). The fundamental phase tdeoxy[heme] was greater in bout 2 for RFs in both postures (S, bout 1: 20 \pm 7 vs. bout 2: 31 \pm 18 s; U, 1: 11 \pm 3 vs. bout 2: 23 \pm 9 s, $P = 0.021$), whereas it was increased in bout 2 for VLs during U only (bout 1: 10 \pm 3 vs. bout 2: 15 \pm 4 s, $P = 0.028$). The fundamental phase muscle deoxy[heme] amplitude was greater in bout 2 for RFs ($P = 0.001$) and VLs ($P = 0.024$) in both U and S. Both the fundamental phase tdeoxy[heme] and amplitude did not differ between bouts 1 and 2 for VLd in either position (both $P > 0.05$). **CONCLUSION:** Prior heavy exercise reduced τ_{VO_2} in S but not U. This was accompanied by a greater amplitude and slower rate of muscle deoxygenation in superficial but not deep muscle. The contrasting responses of deep and superficial muscle to priming exercise in both U and S suggests that these muscles rely on fundamentally different O_2 transport strategies.

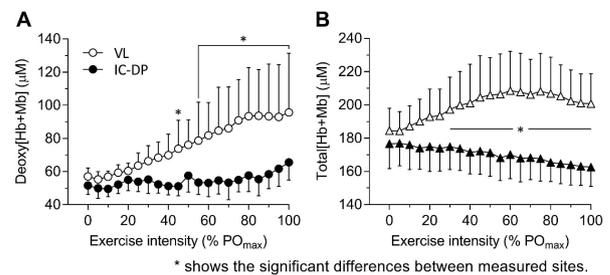
856 May 27 3:55 PM - 4:05 PM

Contrasting Patterns Of Respiratory And Locomotor Muscle Deoxygenation And Total Hemoglobin During Incremental Ramp Cycling

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(No relevant relationships reported)

Respiratory muscle demands during severe intensity exercise may constrain the blood flow increase to locomotory muscles, thereby limiting exercise tolerance. Muscle mitochondrial O_2 delivery depends on both perfusive and diffusive O_2 transport, the former reflecting the O_2 delivery-utilization balance and the latter exercise-induced changes in muscle total hemoglobin (THb). Resolution of changes in deoxygenation and THb simultaneously within these two muscle groups will provide novel insights into vascular and metabolic control. **PURPOSE:** We investigated absolute deoxygenated [Hb+Mb] (HHb, index of fractional O_2 extraction) and THb responses in respiratory and locomotor muscle using time-resolved near-infrared spectroscopy (TR-NIRS). **METHODS:** Ten males performed ramp incremental cycling (20 W \cdot min⁻¹) to exhaustion while measuring pulmonary VO_2 , HHb and THb (9-10th intercostal space for intercostal muscle and diaphragm, IC-DP, and vastus lateralis, VL). HHb and THb were corrected for adipose tissue thickness (ATT) at each optode site, using the THb-ATT regression. **RESULTS:** HHb increased systematically with power output (PO) in VL and plateaued above ~80% PO_{max} (Figure 1A). In contrast, HHb in IC-DP was unchanged from rest. THb in VL increased modestly and plateaued above ~50% PO_{max} ,

whereas THb in IC-DP declined gently from rest such that THb was greater in VL than IC-DP from 30 to 100 % PO_{max} (Figure 1B). **CONCLUSIONS:** These disparate HHb and THb profiles imply a muscle-specific regulation of perfusive and diffusive O_2 fluxes for respiratory versus locomotory muscle(s). Supported by JSPS-17J09854, 18K17875
\$\$MISSING OR BAD IMAGE SPECIFICATION {0BC9088-F976-4C3C-A330-7CBDC1763E71}\$\$



* shows the significant differences between measured sites.
Figure 1. Mean temporal profile of muscle deoxy- (HHb, A) and total [Hb+Mb] (THb, B) concentration for the intercostal and diaphragm (IC-DP), and vastus lateralis (VL) muscles across normalized power output.

857 May 27 4:05 PM - 4:15 PM

Beneficial Effects Of Exposure To Mild Hyperbaric Oxygen On Microcirculation In Peripheral Tissues

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The intent of exposure to mild hyperbaric oxygen (mHBO) is to increase the oxygenation of a person's blood by forcing additional oxygen to dissolve into the blood plasma. There is a lack of substantial evidence regarding responses of exposure to mHBO on microcirculation in peripheral tissues, and this research will provide insight into it. **Purpose:** To determine the beneficial effects of exposure to mHBO on microcirculation in peripheral tissues. **Methods:** In this experimental study 15 healthy individuals were exposed to both normobaric (1.00 ATA with 20.9% oxygen) and mHBO (1.4 ATA, Oxygen Concentration 30.8% - 39.5%) in a mild hyperbaric oxygen chamber for 70 minutes in each condition. Peripheral capillary oxygen saturation (SpO_2) and blood flow in capillaries of muscles and skin were measured every 15 minutes during both exposures in the supine position. Repeated measures ANOVA and paired t-test were used for statistical comparisons. An analysis with a p-value < 0.05 was considered significant. **Results:** The mean age of participants was 24.6 \pm 4.9 years and mean BMI was 20.5 \pm 2.7. Average blood flow in capillaries was increased from 94 $\mu\text{m/s}$ to 105 $\mu\text{m/s}$ after exposure to normobaric condition whereas average blood flow was increased from 92 $\mu\text{m/s}$ to 126 $\mu\text{m/s}$ after exposure to mHBO. We found a significant effect of conditions ($p < .008$), time ($p < .001$) as well as interactional effect ($p < .001$). SpO_2 was increased from 97.6% to 99.5% after exposure to mHBO and it was unchanged after exposure to the normobaric condition. We found a significant effect of conditions ($p < .001$), time ($p < .001$) as well as interactional effect ($p < .001$). **Conclusion:** The results of this study confirm that exposure to mHBO increases oxygen saturation and blood flow in the capillaries of peripheral tissues.

B-63 Free Communication/Poster - Resistance Training

Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
Room: CC-Exhibit Hall

875 Board #1 May 27 1:30 PM - 3:00 PM

Strengthening Knee Extensor Muscles In Healthy Individuals: Single-joint Or Multi-joint Exercises?

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Introduction

Increases in muscle strength from resistance training are maximized when the spatiotemporal recruitment of the muscle is full and the peripheral perturbation is high.

During maximal single-joint knee extension and multi-joint leg extension movements, activation of the *vastii* knee extensor muscles is similar, however, little is known of the magnitude and etiology of fatigue development when these movements are repeated.

Purpose

To compare the magnitude and etiology of fatigue in the *vastii* knee extensor muscles following repeated maximal contractions performed through single-joint (knee extension) or multi-joint (leg extension) exercises.

Method

On separate days, 16 participants completed 60 maximal unilateral: i) knee extensions on a dynamometer (K_{EXT}) or ii) leg extensions on a cycle ergometer (L_{EXT}). Knee range of motion ($\sim 120^\circ - 30^\circ$ flexion) and angular velocity ($\sim 80^\circ \cdot s^{-1}$) were matched. Maximal torque, *vastii* muscle EMG and M-wave amplitude (M_{max}) were calculated during the first and last three contractions of both exercises. Knee extensor isometric maximal voluntary force (IMVF), voluntary activation (VA) and resting twitch force ($RT_{10:100\text{ Hz}}$) were measured pre-exercise and 40-s post-exercise.

Results:

Similar torque (K_{EXT} : 152 ± 33 N·m vs. L_{EXT} : 165 ± 30 N·m, $P > 0.05$), EMG (K_{EXT} : $95 \pm 6\%$ vs. L_{EXT} : $96 \pm 8\%$, $P > 0.05$) and M_{max} (K_{EXT} : $95 \pm 5\%$ vs. L_{EXT} : $97 \pm 5\%$, $P > 0.05$) were measured at the start of the exercises. Larger reductions in torque (K_{EXT} : $-60 \pm 10\%$ vs. L_{EXT} : $-38 \pm 14\%$) and EMG (K_{EXT} : $-21 \pm 16\%$ vs. L_{EXT} : $-13 \pm 16\%$) were seen for K_{EXT} during the final part of the exercise ($P \leq 0.05$), whereas no differences were reported in M_{max} ($P > 0.05$). Larger reductions in VA were seen after K_{EXT} whereas greater reductions in $RT_{10:100\text{ Hz}}$ were seen after L_{EXT} (both $P \leq 0.05$). Ultimately, similar reductions in IMVF were seen following K_{EXT} ($-32 \pm 10\%$) and L_{EXT} ($-35 \pm 13\%$) ($P > 0.05$).

Conclusion:

A lower-limb resistance training program which adopts multi-joint exercises may induce superior strength gains in *vastii* knee extensor muscles compared to single-joint exercises, as it is possible to induce larger levels of peripheral fatigue with a smaller reduction in voluntary activation.

876 Board #2 May 27 1:30 PM - 3:00 PM Neural And Muscular Responses To Maximal Strength Training

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(No relevant relationships reported)

PURPOSE: Maximal strength training (MST), performed with heavy loads ($\sim 90\%$ of one repetition maximum; 1RM) and few repetitions (4-5), yields large improvements in efferent neural drive and skeletal muscle force generating capacity. However, it is elusive how MST-induced neural adaptations may translate to muscular factors regulating excitation-contraction coupling. **METHODS:** Sixteen healthy young males (24 ± 4 years) were randomized to MST 3 times per week for 8 weeks ($n=8$), or a control group (CG; $n=8$). Measurements were taken of 1RM and rate of force development (RFD), and evoked potentials recordings (V-wave and H-reflex normalized to M-wave (M) in musculus soleus) applied to assess efferent neural drive to maximally contracting skeletal muscle. Biopsies were obtained from m. vastus lateralis and analyzed by western blot and mRNA isolation to investigate the protein expression of Sarcoplasmic Reticulum Ca^{2+} ATPase (SERCA) and mRNA expression of SERCA1 and SERCA2, myostatin, MuRF1 and Ryanodine receptor (RyR1). **RESULTS:** 1RM ($17 \pm 9\%$; $p < 0.05$) and early (0-100ms), late (100-200ms) and maximal RFD increased ($31-53\%$; $p < 0.01$) in the MST group, accompanied by increased maximal V-M wave ratio ($9 \pm 14\%$; $p < 0.05$), with no change in H-reflex to M-wave ratio. No changes were observed in the CG. No pre- to post-training differences were found in mRNA or protein expressions in either group ($p > 0.05$). **CONCLUSION:** MST increased efferent neural drive to maximally contracting skeletal muscle, and resulted in improved force generating capacity. The neural adaptations were not reflected in key muscular factors involved in excitation-contraction coupling, indicating that responses to high intensity strength training may predominantly be governed by neural adaptations.

877 Board #3 May 27 1:30 PM - 3:00 PM Ten Weeks Of Resistance Training Increased Total Hemoglobin Mass Without Increasing Maximal Oxygen Uptake

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(No relevant relationships reported)

PURPOSE: Resistance training increases muscles mass whereas maximal oxygen uptake remains normally unchanged. The purpose of the present study was to investigate the effect of 10 weeks resistance training on total hemoglobin mass, lean mass and maximal oxygen uptake in young healthy males.

METHODS: Thirteen young male subjects (age: 22.2 ± 2.6 years; height: 177.7 ± 3.7 cm) completed 10 weeks of resistance training. The resistance training consisted of 5 weekly sessions of full body resistance training. The training program consisted of 13 exercises; for all exercises 3 sets with 12 repetitions were conducted. Each training session lasted 70-90 min. Body composition was measured with Dual-energy X-ray absorptiometry (DXA), total hemoglobin mass with CO rebreathing method, and maximal oxygen uptake was tested on treadmill.

RESULTS: Body mass did not increase significantly during the training intervention (before: 74.5 ± 7.9 ; after: 77.6 ± 6.2 kg; $p=0.30$), but fat free mass increased 8.8% ($p < 0.05$). Total hemoglobin mass (tHb) increased from 865.1 ± 70.6 to 981.2 ± 89.8 g ($p < 0.05$) during the training intervention and hematocrit was unchanged. Hemoglobin mass per kg body weight did not increase significantly (before: 11.0 ± 1.7 ; after: 13.4 ± 1.9 g/kg; $p=0.25$). Maximal oxygen was 3.32 ± 0.47 L/min before and 3.38 ± 0.52 L/min after the resistance training. Maximal oxygen uptake related to body weight did neither change during the training intervention (before: 44.4 ± 4.0 ; after 43.7 ± 5.9 ml \cdot kg $^{-1} \cdot$ min $^{-1}$).

CONCLUSIONS: Whole body resistance training for ten weeks increased fat free mass and tHb, but VO_{2max} did not increase. These data show that increased total hemoglobin mass is not sufficient to increase maximal oxygen uptake in young healthy males.

878 Board #4 May 27 1:30 PM - 3:00 PM Variation Of Resistance Exercise Intensity Versus Resistance Exercise Selection: The Effects On Strength And Power

Jonathan Hummel, East Stroudsburg University, East Stroudsburg, PA. (Sponsor: Shala Davis, FACSM)

(No relevant relationships reported)

Variation of resistance exercise intensity versus resistance exercise selection: the effects on strength and power

Jonathan W. Hummel, Gavin L. Moir, Matthew R. Miltenberger, Shawn N. Munford. East Stroudsburg University, East Stroudsburg, PA.

Purpose: To compare the effects of exercise selection variations versus exercise intensity variations on absolute strength and power measures across a 4-week training block for in-season collegiate athletes. **Methods:** 14 Division II collegiate track and field athletes ($n=5$ females; $n=9$ males; age: 20.7 ± 1.4 yrs; primarily anaerobic based track and field events) participated in one of two 4 week periodized exercise programs: 1) manipulation of resistance training intensity (INT group), 2) manipulation of resistance training exercise selection (EXE group). Exercise selection was held constant in the INT group while the intensity was varied (85%-90%). The EXE group held intensity at a constant but varied the selection of exercises (e.g. pin squat, box squat). The mean intensity and working repetitions across the 4-week block of training were equated across the groups. Absolute strength was assessed with a 1-repetition maximum (1RM) back squat and power was assessed in a vertical jump. **Results:** Both INT (mean improvement: 3.52 kg, $p < 0.05$) and EXE (mean improvement: 3.08 kg, $p < 0.05$) increased 1RM across the training period, but there were no significant differences between the groups ($p > 0.05$). Both groups produced an increase in jump height (INT mean improvement: 0.04 m, $p < 0.05$; EXE mean improvement: 0.04 m, $p < 0.05$) with no significant differences between the groups ($p > 0.05$). **Conclusion:** Variation in training applied through the manipulation of exercise intensity was as effective as that applied through the manipulation of exercise selection for improving strength and power in collegiate track and field athletes during a 4-week block. Both variables are equally important when considering implementation into programming for athletic populations.

879 Board #5 May 27 1:30 PM - 3:00 PM Diurnal Sensitivity Of Muscle Force And Acceleration Parameters Of The Upper Limb

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(No relevant relationships reported)

Novel technology permits more precise investigation of motor function. Limited data exist on diurnal variation in force and acceleration parameters of the upper limb. **PURPOSE:** To detect the optimal time of day for maximum power output and development rate in unilateral row and press motions. **METHODS:** We tested 112 physically active male and female subjects on Proteus (Proteus Motion, USA). In total, they performed 2,750 unilateral, isotonic sets, evenly divided between rows and presses. Loads were applied through three-dimensional magnetic resistance at 10lb (862 sets), 15lb (646 sets), 20lb (612 sets), and 25lb (630 sets). Testing was performed at various times over a 14-hour span (6:00am to 8:00pm). For each individual set, Proteus calculated average peak power of all repetitions (PP_{max}), highest power achieved during any single repetition (PP_{max}), average peak force development rate across all repetitions ($PFDR_{max}$), and the highest rate achieved during a single repetition ($PFDR_{max}$). Mixed model ANOVA with repeated measures tested the differences in these parameters between push and pull motions, loads applied, and

times of day. Linear regression models isolated the effect of time on performance holding other influential factors constant. RESULTS: Across all movements, loads, and times, PP_{mean} was 235.2 ± 114.1 w; PP_{max} was 254.1 ± 120.0 w; $PFDR_{mean}$ was $1,036.1 \pm 631.6$ w/s; and $PFDR_{max}$ was $1,243.4 \pm 789.6$ w/s. Differences in both PP_{mean} and PP_{max} were detected by time of day ($p < 0.001$) and load ($p < 0.001$). The highest values were achieved between 2:00pm and 4:00pm. Similar relationships were found with time of day in $PFDR_{mean}$ ($p < 0.001$) and $PFDR_{max}$ ($p < 0.001$). Holding constant the subject performing the set, arm dominance, exercise being performed, and the load applied, linear regression analyses found that if performance occurred between 2:00pm and 4:00pm, there was a 139.6 w/s increase in $PFDR_{mean}$ (95% CI: 75.5-203.6), 164.7 w/s increase in $PFDR_{max}$ (95% CI: 79.7-249.8), 29.6 w increase in PP_{mean} (95% CI: 20.7 \pm 38.5), and 33.6 w increase in PP_{max} (95% CI: 24.4 \pm 42.8). CONCLUSIONS: Success in many athletic contexts depends on expressions of power and the rate of its development. Our findings demonstrate diurnal rhythms in power parameters of the upper limb, with optimal performance occurring in the afternoon.

880 Board #6 May 27 1:30 PM - 3:00 PM
Assessing True Variability And Mean Changes To Two Distinct Resistance Training Protocols

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(No relevant relationships reported)

Millions of dollars are spent analyzing inter-individual differences in response to resistance exercise, but the lack of a non-exercise control group makes it possible that these studies may simply be examining random error. Furthermore, it has been hypothesized that the magnitude of variability may differ depending upon the exercise protocol employed, but this yet to be appropriately tested.

PURPOSE: To determine differences in two distinct resistance training protocols and whether true variability could be detected after accounting for random error.

METHODS: Individuals (n=151) were randomly assigned to one of three groups: (1) a traditional exercise group performing four sets of elbow flexion exercise to failure; (2) a one-repetition maximum (1RM) performing a 1RM elbow flexion test; and (3) a time-matched non-exercise control group. Both exercise groups performed 18 sessions over six weeks. A Bayesian ANCOVA was used to test for mean changes across groups while adjusting for pre-values. To assess whether the variability in response to each exercise intervention differed from that of the control group, Bayesian Levene's tests were computed. Bayes Factors (BF_{10}) were used to quantify evidence for or against the null hypothesis.

RESULTS: Both 1RM (2.3kg; $BF_{10} = 4.791e+6$) and traditional training groups (2.4kg; $BF_{10} = 11,915$) increased 1RM strength similarly ($BF_{10} = 0.21$), but only the 1RM group increased untrained arm 1RM strength (1.5kg; $BF_{10} = 271$). Only the traditional exercise group increased ultrasound measured muscle thickness (~0.23 cm across all sites; all $BF_{10} \geq 224$). Across both training groups, the only differential responses were found in the change in 1RM strength of the trained arm in the traditional training group ($BF_{10} = 5.381$). This resulted in a true variability of 1.8 kg after the removal of random error.

CONCLUSION: These findings demonstrate the importance of taking into consideration the magnitude of random error when determining response heterogeneity, as many studies may be classifying individuals based on random error. Additionally, our mean results demonstrate that strength is largely driven by task specificity, and the cross-over effect of strength may be load dependent.

881 Board #7 May 27 1:30 PM - 3:00 PM
Progressive Movement Training: An Analysis Of Its Effects On Muscular Strength And Power Development

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(No relevant relationships reported)

Muscular strength and power are important attributes in many sports, so research on resistance training (RT) methods that may improve these attributes are of great interest. One such RT method is Progressive Movement Training (PMT) which incorporates a partial range of movement (ROM) with a supramaximal load. **PURPOSE:** This study compared the effects of PMT and traditional full ROM RT on the 1-RM back squat (BSQ), vertical jump (VJ) height, and power output (PO). **METHODS:** High school male participants were randomly assigned to either a PMT RT group (n=21, age: 17.4 \pm 0.7 yrs, height: 174.9 \pm 5.8 cms, mass: 84.7 \pm 26.5 kgs) or a full ROM RT group (n=15, age: 17.3 \pm 0.7 yrs, height: 175.9 \pm 8.8 cms, mass: 82.1 \pm 14.9 kgs). The experimental groups then engaged in a 7-week intervention period using either the

PMT or full ROM BSQ modality in order to target lower body strength and power. The participant's body weight, 1-RM BSQ and VJ were measured prior to and upon completion of the intervention period. PO was calculated using the Lewis formula. No additional lower body auxiliary movements were performed in the study. Dependent t-tests (two-tailed) were used to compare the dependent variables (DVs) from pre to post RT intervention within experimental groups. Independent t-tests (two-tailed) were used to compare the gain scores for each of the DVs between experimental groups. **RESULTS:** The PMT group improved significantly from pre to post intervention period for all DVs: 1-RM BSQ (pre: 96.0 \pm 37.8, post: 110.6 \pm 37.0 kg), VJ (pre: 55.8 \pm 8.0, post: 59.4 \pm 9.5 cm) and PO (pre: 1365.8 \pm 410.7, post: 1417.2 \pm 394.7 W) ($p < 0.01$). The full ROM group improved significantly from pre to post intervention period for the 1-RM BSQ only (pre: 91.3 \pm 23.3, post: 102.3 \pm 19.4 kg) ($p < 0.01$), VJ (pre: 59.3 \pm 9.8, post: 60.7 \pm 10.6 cm) ($p > 0.05$) and PO (pre: 1359.3 \pm 203.9, post: 1397.1 \pm 221.8 W) ($p > 0.05$). When comparing gain scores between each group there were no significant differences between the PMT and full ROM groups for any of the DVs ($p > 0.05$). **CONCLUSION:** Within the parameters of this study, PMT is as effective and may be more effective than full ROM RT for increasing lower body strength and power.

882 Board #8 May 27 1:30 PM - 3:00 PM
Strength Adaptions And Body Composition Changes Following High Vs. Low Volume Resistance Training And Detraining

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(No relevant relationships reported)

Resistance training (RT) is used for improving strength and body composition. However, it is still under debate whether higher RT volume (HV) is necessary in novices, or if lower volume (LV) is equally effective. In addition, effects of detraining (DTR) following HV and LV RT are not well understood.

PURPOSE:

To determine the effects of a 12-week HV program (3 sets, 10 repetitions) compared to LV RT (1 set, 10 repetitions) to concentric muscle failure on strength and body composition, followed by four weeks of DTR in male and female subjects.

METHODS:

Forty-two untrained subjects were randomly assigned to either LV (female n=10; male n=10; age 32.9 \pm 11.8y, height 174.2 \pm 8.4cm; weight 70.3 \pm 13.5kg) or HV RT (female n=11; male n=11; age 33.0 \pm 9.6y, height 174.2 \pm 11.2cm; weight 72.4 \pm 18.1 kg). RT consisted of two RT sessions per week (squat, bench press, arm and leg flexion and extension). Measurements were taken prior to and post RT, and after DTR. Body composition was assessed using BIA. Strength measurement (10-RM) was done using the aforementioned exercises. Six subjects were eliminated from the study due to various reasons, resulting in 36 subjects included for further analysis (HV female n=10, male n=8; LV female n=9, male n=9). Compliance was 100%. Comparisons were made using two-way ANOVA with repeated measures.

RESULTS:

Both groups increased strength through RT with no difference between groups (squat HV 61.1% vs. LV 59.0%, $p < 0.001$; bench press HV 28.9% vs. LV 31.3%, $p < 0.001$; leg extension HV 54.6% vs. LV 50.2%, $p < 0.001$; leg flexion HV 30.9% vs. LV 30.3%, $p < 0.001$; arm extension HV 51.0% vs. LV 44.8%, $p < 0.001$; arm flexion HV 36.9% vs. LV 31.7%, $p < 0.001$). Body mass ($p = 0.182$), fat mass ($p = 0.238$), and fat-free mass ($p = 1.000$) was unaltered by RT. After DTR strength in arm flexion ($p = 0.007$), arm extension ($p = 0.001$), bench press ($p < 0.001$), and squat ($p = 0.039$) decreased to the same extend in both groups. Leg flexion and extension strength was unaltered following DTR, while fat-free mass increased ($p = 0.004$).

CONCLUSION:

HV and LV RT was equally effective in untrained subjects to increase strength. Novices could therefore save time with LV, with similar results. Yet, RT alone was not sufficient to change body composition. Following DTR strength gains were still elevated but in some measurements slightly lower than post RT.

883 Board #9 May 27 1:30 PM - 3:00 PM
Effect Of Gender And Body Type On Strength Gain From Different Modes Of Resistance Training

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(No relevant relationships reported)

The discussion of the influence of body type on potential to gain strength from resistance training (RT) is a relatively new field of investigation. What has not been

explored is the degree to which body type might impact the potential for strength gains between men and women. **PURPOSE:** To determine the influence of sex and body type on changes in upper-body strength resulting from free-weight RT in college men and women. **METHODS:** College men and women were measured for fat mass (FM) and fat-free mass (FFM) determined from gender-specific skinfold equations. Body type was determined by regressing FFM/Ht² on FM/Ht² for each sex and partitioned into thirds as slender (SL), average (AV), and solid (SO). Men and women were matched for body type: SL (men = 40, women = 50), AV (men = 62, women = 44), and SO (men = 60, women = 43). RM bench press was measured before and after 12 weeks of linear periodization free weight RT performed 3 times/week in 3 sets of 6 overall body exercises. **RESULTS:** Sex x body type ANOVA on absolute strength revealed significantly greater ($p < 0.001$) gains by men (6.8 ± 8.4 kg) than women (4.2 ± 3.0 kg) but no significant difference ($p = 0.15$) across body types (SL = 6.5 ± 8.9 , AV = 5.3 ± 5.9 , SO = 5.2 ± 5.4 kg). The sex x body type interaction was not significant ($p = 0.60$). Absolute strength gains were poorly correlated with initial strength ($r = 0.01$, $r = -0.10$, respectively) and body type ($r = 0.00$, $r = -0.11$, respectively) in men and women. Sex x body type ANOVA on relative strength gain indicated a significantly greater ($p = 0.04$) gain by women ($14.0 \pm 14.2\%$) than men ($10.6 \pm 12.6\%$) but no significant difference among body types (SL = $13.8 \pm 15.3\%$, AV = $11.9 \pm 14.2\%$, SO = $11.0 \pm 11.1\%$). The sex x body type interaction was not significant ($p = 0.38$). Relative strength gains were significantly correlated with initial strength in both men ($r = -0.27$) and women ($r = -0.34$) as well with body type ($r = 0.06$ and $r = -0.07$ respectively). **CONCLUSIONS:** When following the same RT program, men make a greater absolute gain but women make a greater relative gain in upper-body strength. Body type does not seem to influence the degree of absolute or relative strength gain in RT in either sex. Initial strength level has little influence on the amount of strength to be gained during short-term training.

884 Board #10 May 27 1:30 PM - 3:00 PM
Acute Response Of Blood Glucose After Two Resistance Training Protocols With Different Execution Velocities

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 (No relevant relationships reported)

PURPOSE: Studies have demonstrated that a single session of resistance training (RT) can reduce glycemia in subjects with or without diabetes. The aim of this study was to compare the acute response of blood glucose after 2 resistance training protocols with different execution velocities in amateur weightlifting athletes. **METHODS:** A randomized clinical trial was conducted in 24 amateur weightlifting athletes (23.5 ± 6.2 years). The participants were randomized into 2 groups: high velocity (MV, $n = 12$) or low velocity (LV, $n = 12$). The RT training protocol was based on a session with these characteristics: 3 sets of 12 repetitions at 60% of a maximum repetition in each of the exercises (bench press, squat and military press). The only difference between the training session was that the MV group performed all the repetitions at 100% of their maximum velocity and the LV group performed at 50%. This variable was controlled with the T-force system. An oral glucose tolerance test (OGTT) was conducted with metabolic measurements immediately after each RE protocol and every 30 min until 120 min of recovery. For the statistical analysis, the area under the blood glucose curve (AUC) was calculated at each time point. Cohen's d for effect size were also calculated to determine the magnitude of the group differences. The criteria to interpret the magnitude of the ES was as follows: trivial (< 0.2), small ($0.2-0.59$), moderate ($0.60-1.19$), large ($1.2-2.0$), or very large (> 2.0) **RESULTS:** The responses of blood glucose following each protocol and OGTT was similar in all groups, reaching the glycemic peak at 30 min of recovery. However, the MV group exhibited significantly lower values in the AUC when compared with LV group over two hours monitoring period ($P = 0.021$, $ES = 1.198$). **CONCLUSIONS:** The present study showed that RT at different velocities can generate different metabolic responses. In conclusion, the results of this study indicated that RT at a high velocity could be the optimum for postprandial glucose control.

885 Board #11 May 27 1:30 PM - 3:00 PM
Effect Of Body Type On Upper-body Strength Gain From Resistance Training In Men And Women

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 (No relevant relationships reported)

Discussion of the influence of body type on the potential to gain strength from resistance training (RT) is a relatively new field of investigation. What has not been

explored is the degree to which body type might impact the potential difference between men and women to make strength gains from RT. **PURPOSE:** To determine the influence of sex and body type on changes in upper-body strength resulting from free-weight RT in college men and women. **METHODS:** College men and women ($n = 903$) were measured for fat mass (FM) and fat-free mass (FFM) as determined from gender-specific skinfold equations. Body type was determined by regressing FFM/Ht² on FM/Ht² and partitioning into thirds for each sex as slender (SL), average (AV), and solid (SO). Sexes were matched within the 3 body types for SL (men = 47, women = 23), AV (men = 43, women = 18), and SO (men = 44, women = 16). Each participant was measured for 1RM bench press before and after 12 weeks of linear periodization RT in 3 sets of 6 exercises. **RESULTS:** Sex x body type ANOVA on absolute strength gain revealed no significant difference between sexes ($M = 6.3 \pm 5.7$ kg; $W = 4.5 \pm 5.0$ kg) or across body types (SL = 4.9 ± 5.8 , AV = 6.0 ± 5.7 , SO = 6.5 ± 4.9 kg). The sex x body type interaction was not significant. SO (36.6 ± 8.3 kg), SL (35.8 ± 8.0 kg), and AV (35.1 ± 8.4 kg) differed by $< 2\%$ in initial 1RM. Absolute strength gains had low correlations with initial strength in both men ($r = -0.16$) and women ($r = 0.12$) as well with body type ($r < 0.12$). **CONCLUSIONS:** Untrained men and women of comparable body types appear to make similar gains in upper-body strength when following the same periodized free-weight RT program. The level of initial strength seems to have little bearing on the amount of strength that can be gained during training.

886 Board #12 May 27 1:30 PM - 3:00 PM
Muscle Damage And Inflammatory Response From Resistance Exercise With Higher Vs Lighter Loads

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 (No relevant relationships reported)

Resistance exercise is considered the most efficient strategy for strength, power, and muscle endurance enhancement. **PURPOSE:** The aim was to analyze the effects of different resistance exercise (RE) loads on inflammatory response and muscle tissue damage. **METHODS:** Ten trained men with at least one year of resistance training were selected (26.40 ± 4.73 years, 80.71 ± 8.95 kg, 176.03 ± 6.11 cm, $9.86 \pm 3.25\%$ body fat, bench press relative strength: 1.27 ± 0.27 kg/kg-1 of body mass), and alternately ordered to perform two separate visits. The first consisted of five submaximal sets of 10 repetitions at 80% of 10-RM, and the second consisted of five submaximal sets of 20 repetitions at 40% of 10-RM, for the horizontal bench press and leg press exercises with one-minute of rest, guaranteeing the volume equalization for both conditions. Circulating concentrations of creatine kinase (CK), lactate dehydrogenase (LDH), and leucocyte count were measured at pre-exercise (PRE) and post 3h, 6h, 12h, and 24h. **RESULTS:** The ANOVA presented increases in CK compared to the PRE moment, from 6h ($p < 0.0001$), to 24h after the higher 80% of the 10-RM load. The area under the curve differed significantly ($p = 0.009$) between 80% of 10-RM (4572.42 ± 1169.54 u/L) and 40% of 10-RM (3268.68 ± 1042.02 u/L). For the LDH concentration, a significant interaction effect (load x moment of the checks) was observed ($p = 0.019$). Specifically, for the main effect of verification moments ($p < 0.0001$), the data revealed that both loading protocols resulted in significant increases in LDH compared to PRE at 12 hours after exercise. The magnitude of the findings verified by the effect size showed large elevations of LDH from 6h to 12h for the higher load condition. For the 40% of 10-RM load, large elevations were observed in 3h, 6h, 12h, and 24h. For leucocyte count, the main effect of verification moments elevations ($p < 0.0001$), occurred from the time of 3h to 12h after exercise for both conditions. **CONCLUSION:** We found differences in tissue damage such an increase in the CK lesion marker with 80% 10-RM loading, which did not happen with 40% 10-RM loading, however with no differences on the inflammatory response concerning the total leucocyte count, neutrophils, lymphocytes and monocytes between different loads conditions. Supported by CAPES Brazil: 2.034.476.

887 Board #13 May 27 1:30 PM - 3:00 PM
Ischemic Preconditioning Of Thigh Muscles: Number Of Proper Repetitions And Effectiveness

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Ischemic preconditioning (IPC) was introduced after it was demonstrated that repetitions of short-term ischemia and reperfusion of coronary arteries can reduce the myocardial damage following prolonged ischemia (direct IPC). It was later shown that the IPC of coronary arteries also protects remote cardiac tissue not directly exposed to IPC (remote IPC). Several studies suggested that the IPC of a limb may protect

remote organs against an ischemic incident. Because of the intermittent nature of blood flow during intense muscle actions, it was proposed that IPC prior to exercise could increase muscular performance. Although most of the prior exercise studies used an IPC protocol involving four cycles of 5-min circulatory occlusion followed by a 5-min reperfusion period, the optimal number of repetitions of IPC has been unknown. **PURPOSE:** We examined the effects of direct IPC on thigh strength and sought to determine the optimal repetitions of IPC for successful results. **METHODS:** In a randomized cross-over study, 12 healthy young males (19.8 ± 2.1 yrs, body mass index: 22.1 ± 2.7 kg/m²) performed maximal knee extension (Biodex System 3; New York, USA) of the right leg preceded by direct IPC at four different repetitions (1, 2, 3, and 4 sets) and a control intervention. One IPC consisted of 5-min circulatory occlusion by 1.3-times systolic blood pressure and 5-min reperfusion. **RESULTS:** There was no significant difference in the maximal voluntary torque of knee extension between the control and any number of repetitions of the IPC, as shown below.

MVT	Control	1 set	2 sets	3 sets	4 sets
60°/sec, Nm	287.3 ± 46.3	275.3 ± 46.3	276.4 ± 47.1	270.2 ± 52.0	262.6 ± 44.5
180°/sec, Nm	191.9 ± 25.2	198.0 ± 23.6	190.5 ± 20.4	199.3 ± 31.6	188.3 ± 22.7
300°/sec, Nm	144.7 ± 21.4	150.0 ± 17.4	144.7 ± 18.3	146.2 ± 16.7	141.7 ± 16.4

MVT, maximal voluntary torque; Nm, newton meter. Data are mean ± SD (n=12). **CONCLUSIONS:** These data indicate that direct IPC for the thigh muscles could not improve maximal strength regardless of the number of repetitions. The application of pre-exercise IPC for improving performance should be further carefully examined concerning the optimal protocol and its indications, such as exercise types and target muscles.

888 Board #14 May 27 1:30 PM - 3:00 PM
Effect Of Respiratory Training On Vas Pain Rating And Via Thickness In Patients Withrating And Via Thickness In Patients With Chronic Non-specific Lumber Pain

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(No relevant relationships reported)

PURPOSE: Non-specific low back pain(NLBP) is defined as a lumber pain that does not belong to an identifiable specific pathology. The probability of experiencing lumber pain in one's lifetime is as high as 84 %. According to the most accurate estimate, the prevalence of NLBP is 23 %, and 11 % of them have disabilities as a result. Compared with conventional physical therapy methods, core strength training can effectively relieve patients 'pain. Due to the overlap of the core muscle group and respiratory muscle in the anatomical structure, there is also a certain relationship in its function. But it is easy to ignore the training of respiratory muscle during the core force training. Therefore, this study compared the effect between respiratory training combined with core strength training and single core strength training in patients with NLBP, in order to confirm the effect of respiratory training on NLBP.

METHODS: 26 patients with NLBP were equitably distributed into observation group and control group according to random number table method. All the patients were taken in 3*40min exercise intervention for 8 weeks. The observation group adopted breath training combined with core strength training, while the control group only conducted core strength training. The VAS score measured with pain visual analog scale (VAS) and the thickness of transverse abdominis of patients were determined with Bone Ultrasound Instrument before and after the intervention.

RESULTS: The difference of VAS scores (4.40 ± 1.30 vs. 4.45 ± 1.29 , $P=0.92$) and thickness of transverse abdominis (0.35 ± 0.03 vs. 0.37 ± 0.03 , $P=0.12$) between groups were not obvious before intervention. But VAS score in observation group was significantly lower than that in the control group (3.20 ± 1.15 vs. 4.18 ± 1.17 , $P<0.05$), and the thickness in myalgia side of transverse abdominis was significantly higher than that in the control group (0.42 ± 0.03 vs. 0.39 ± 0.01 , $P=0.00$) after intervention.

CONCLUSIONS: The effect of respiratory training combined with core strength training on patients with NLBP is significantly better than that of the single core strength training, suggesting that respiratory training plays an important role in the treatment of NLBP.

889 Board #15 May 27 1:30 PM - 3:00 PM
Cross-validation Of A Prediction Equation For Energy Expenditure Of An Acute Resistance Exercise Bout.

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Previously, our laboratory introduced a regression equation for predicting net kcal consumption of a resistance exercise (RE) bout: Total net kcal = $0.874(\text{height, cm}) - 0.596(\text{age, years}) - 1.016(\text{fat mass, kg}) + 1.638(\text{lean mass, kg}) + 2.461(\text{total volume} \times 10^{-3}) - 110.742$ ($R^2 = 0.773$, $SEE = 28.5$ kcal).

PURPOSE: The purpose of this study was to validate this regression equation using the same variables as predictors.

METHODS: Forty-seven healthy, active subjects (23 men, 24 women, 20-58 yrs, 173.5 ± 10.5 cm, 85.5 ± 19.0 kg, $VO_{2max} 36.0 \pm 8.4$ ml/kg/min) were randomly divided into validation and cross-validation groups ($n_v = 24$, $n_{cv} = 23$). The validation group's data was used to develop an equation to predict net kcal consumption, which was applied to the cross-validation group's data to estimate net kcal consumption. Similarly, a prediction equation was derived from the cross-validation group's raw data and applied to that of the validation group. The strength of the relationship between each group's measured and estimated net kcal consumption was assessed via correlational analysis.

RESULTS: Multiple linear regression yielded the following estimates of net kcal consumption: validation net kcal = $1.125(\text{height, cm}) - 0.662(\text{age, years}) - 0.800(\text{fat mass, kg}) + 1.344(\text{lean mass, kg}) + 2.278(\text{total volume} \times 10^{-3}) - 144.846$ ($R^2 = 0.751$, $p < 0.0001$, $SEE = 29.7$ kcal); cross-validation net kcal = $0.515(\text{height, cm}) - 0.520(\text{age, years}) - 1.220(\text{fat mass, kg}) + 1.995(\text{lean mass, kg}) + 2.620(\text{total volume} \times 10^{-3}) - 59.988$ ($R^2 = 0.823$, $p < 0.0001$, $SEE = 29.2$ kcal). These equations had a cross-validation coefficient of 0.902 and a double cross-validation coefficient of 0.863.

CONCLUSION: The strong relationship between the measured and estimated net kcal consumption of both the cross-validation and validation group lead us to conclude that the regression equation derived by this laboratory is valid for estimating net energy expenditure for a total RE bout.

890 Board #16 May 27 1:30 PM - 3:00 PM
Effects Of High-Load And High-Volume Resistance Training On Maximal Strength, Peak Torque, And Mean Torque

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Purpose: This study was conducted to compare the effects of high-load, moderate-volume and high-volume, moderate-load resistance training on estimated one repetition maximum (Est. 1RM) on unilateral leg press and leg extension as well as isokinetic knee extension peak and mean torque.

Methods: Well-trained college-aged males ($n=15$; training age = 7 ± 3 years, mean squat relative to body weight = 1.9 ± 0.4), completed a 6-week (3 days per week) unilateral training program. Training involved exercising one leg with high loads at moderate volumes (HL: 82.5-95% Est. 1RM, 3 sets of 5 repetitions), and the other leg with moderate loads at high volumes (HV: 60% Est. 1RM, 5 - 10 sets of 10 reps). 3RM leg press, 3RM leg extension, and isokinetic knee extension at 60 and 120 deg/sec using an isokinetic dynamometer were collected on each leg prior to training (PRE), 72 hours following the last training bout (POST), and 10 days following passive recovery (POSTPR). Two-way repeated measures ANOVAs [condition (HL versus HV) x time (PRE, POST, POSTPR)] were performed for all dependent variables. Where appropriate, post-hoc analysis included Fisher's LSD and paired samples t-tests. Significance was set at ($p < 0.05$).

Results: There was a significant condition*time effect for leg extension ($p=0.017$). Both HV and HL significantly increased leg extension from PRE to POST ($p<0.001$) and PRE to POSTPR ($p<0.001$). However, HL was significantly greater than HV at both POST (mean difference 5 ± 6 kg, $p=0.007$) and POSTPR (5 ± 6 kg, $p=0.009$). There was a main effect of time for Est. 1RM leg press ($p<0.001$), with Est. 1RM being higher in both conditions from PRE to POST ($p<0.001$) and PRE to POSTPR ($p<0.001$). Similar trends were evident for mean knee extensor torque at 60 deg/sec ($p=0.041$) with mean knee extensor torque at 60 deg/sec being higher from PRE to POSTPR ($p=0.029$) and from POST to POSTPR ($p=0.43$). There were no significant interactions or main effects for isokinetic knee extension peak torque at 60 and 120 deg/sec or mean torque at 120 deg/sec.

Conclusion:

Our data suggest the effects of different unilateral loading schemes may be expressed to a greater extent in single joint movements. Additionally, isokinetic dynamometry may not be a valid method to detect strength changes to resistance training in a previously-trained population.

891 Board #17 May 27 1:30 PM - 3:00 PM
Men And Women Express Similar Power Profiles In Pull Motions But Not Push

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 (No relevant relationships reported)

Pushing and pulling occurs in athletic and nonathletic settings. Weaknesses in either movement could compromise sport performance or daily functioning. Determination of optimal load may aid in sport performance and reduce the risk of injury. **PURPOSE:** To determine power output differences between men and women using colinear resistance. **METHODS:** We enrolled 32 recreationally active men (n=14) and women (n=18), ages 18-25, to evaluate power profiles in horizontal and vertical push and pull exercises using Proteus (Proteus Motion, USA), which applies continuous, three-dimensional, concentric resistance. Subsequent data collection involved 2 repetitions with the dominant arm at 7lb, 14lb, 21lb, and 28lb in each exercise (32 total repetitions). Proteus software computed power output in watts for each set performed. Analysis of variance (ANOVA) with repeated measures tested the differences in power output at each load. **RESULTS:** In both horizontal and vertical pull motions, there was a significant difference by load ($p < 0.001$) and an interaction effect by sex ($p < 0.001$). The expression of power was most similar between men and women at the lowest resistance horizontally ($p = 0.020$) and vertically ($p = 0.038$); both deviated more as weight increased. No plateaus were demonstrated in either motion; higher loads were required for both sexes to achieve peak power. In horizontal and vertical push motions, there was a significant difference by load ($p < 0.001$) and an interaction effect with sex ($p < 0.001$). Men and women were closest in power at 7lb horizontally ($p = 0.017$) and vertically ($p = 0.004$). Women experienced a plateau at 21lb; further change was insignificant both horizontally ($p = 0.147$) and vertically ($p = 0.519$). Men did not exhibit a plateau; power continued to increase from 21lb to 28lb ($p < 0.001$). **CONCLUSIONS:** In our population, the power produced between sexes was similar in press motions, but differed in pulls. By assigning sex-specific training loads, athletes can optimize performance.

892 Board #18 May 27 1:30 PM - 3:00 PM
Neuromodulation Does Not Enhance Neural Adaptations To Strength Training In Previously Trained Individuals

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 (No relevant relationships reported)

Introducing resistance training to an initially untrained population induces rapid, early strength increases due to neural adaptations and are thereafter increased due to morphological adaptations within the musculotendinous unit. However, transcranial direct current stimulation (tDCS) is a method of neuromodulation that has been speculated to elicit further neural adaptations in already trained individuals, though the efficacy of tDCS to do so remains unsubstantiated. **PURPOSE:** To examine the effect of tDCS on performance following a short-term resistance-training protocol. **METHODS:** Forty-three trained males and females (Age = 20.7 ± 1.4yrs) participated in this investigation and reported on 12 separate occasions for pre- and post-testing and lower-body resistance training. During the initial visit, participants performed submaximal lower-body strength (predicted-1RM) and power testing (countermovement jump height [CMJ], peak power [PP], and peak velocity [PV]), and were familiarized with isometric strength testing procedures (knee extensor maximal voluntary isometric contractions). Participants reported 48-72hrs later for isometric testing to evaluate knee extensor peak torque (PT) and peak rate of torque development (pRTD), and were randomly assigned to either a control (CON), stimulation (tDCS), or sham (S-tDCS) condition thereafter. Each condition engaged in an identical training protocol 2x/wk for four weeks. Individuals in the tDCS and S-tDCS condition received stimulation to the primary motor cortex for 21 minutes prior to training. Post-testing occurred within the 3-7 day period following the final training session. Six separate 2x3 (Time x Condition) repeated-measures ANOVAs were conducted to assess between-condition differences in pre- to post-training measures of strength and power. **RESULTS:** No significant Time x Condition interaction effects were observed within any of the dependent variables (DV). However, a main effect of Time was observed in measures of CMJ, PP, PV, PT, and predicted 1RM strength ($p < 0.05$). When collapsed across condition, significant improvements ($p = 0.000 - 0.048$) were observed in

these DVs. **CONCLUSION:** These results suggest that tDCS did not elicit superior improvements in lower-body strength and power compared to CON and S-tDCS conditions.

893 Board #19 May 27 1:30 PM - 3:00 PM
Agreement Between Kinovea And The Open Barbell System For Barbell Velocity And Range Of Motion

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PURPOSE: The aim of this study was to examine the degree to which Kinovea video analysis software and a linear position transducer, the Open Barbell System (OBS), agree for measurements of average (ACV) and peak concentric velocity (PCV), as well as concentric range of motion (ROM) during the free-weight back squat and bench press exercises.

METHODS: Sixteen males (age: 23.6±2.8yrs, body mass: 82.0±12.2kg, height: 171.8±7.5cm, training age: 7.0±3.6yrs) performed a bench press and squat one-repetition maximum (1RM) in the first session. Then, in 3 different sessions subjects performed 3 (sets) X 1 (repetition) at 60% and 80% of 1RM. On each repetition, ACV, PCV, and ROM were assessed via both Kinovea and OBS. A smartphone was used to obtain videos from the lateral aspect that were later uploaded for analysis via Kinovea software, while the OBS was attached to the barbell via a cord and all outcomes were displayed on the unit in real time. Paired t-tests, intraclass correlation coefficients (ICCs), Bland-Altman plots, and folded empirical cumulative distribution plots (mountain plots) were used to analyze results.

RESULTS: Due to recording errors 348 out of a possible 352 repetitions were recorded. Paired t-tests revealed significant differences between measurement systems in all outcome variables for both the squat and bench press ($p < 0.01$). ICCs for the squat were: 0.929 (ACV), 0.913 (PCV), and 0.188 (ROM). ICCs for the bench press were: 0.930 (ACV), 0.929 (PCV), and 0.683 (ROM). Large limits of agreement were observed in all Bland-Altman plots and visual inspection of the mountain plots revealed deviation from the zero-difference line and long tails in all plots denoting a lack of agreement between devices.

CONCLUSION: In summary, the Kinovea software and OBS do not agree for measurement of ACV, PCV, and ROM during the squat and bench press. The OBS is a validated device versus a motion capture system, therefore we do not recommend Kinovea for these outcomes.

894 Board #20 May 27 1:30 PM - 3:00 PM
Sex Differences In Blood Lactate Concentration And Changes In Lifting Velocity During And After Resistance Exercise For Strength Gain And Muscle Hypertrophy.

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Strength training variants, such as load, repetition, and set, are manipulated for strength gain and muscle hypertrophy. However, there is little evidence of optimal training variants for women. **PURPOSE:** To investigate sex differences in blood lactate concentration and changes in lifting velocity during and after resistance exercise for strength gain and muscle hypertrophy, respectively. **METHODS:** Fourteen subjects (men=8, age 21.1±0.8 years, weight 70.9±7.2 kg, height 170.7±5.4 cm; women=6, age 20.7±1.1 years, weight 58.3±5.0kg, height 159.5±5.5 cm) with significant physical education and resistance training experience participated in this study. Participants performed four sets of parallel squats as part of two protocols, one for strength gain (four repetitions at 85% of 1RM) and one for muscle hypertrophy (10 repetitions at 70% of 1RM) using a cross over design. We measured blood lactate concentration before, during, and after the exercise. We also measured lifting velocity during exercise using a transducer (GymAware). **RESULTS:** Blood lactate concentration significantly increased after both protocols in both men (strength 1.4±0.7 to 4.1±1.7 mmol/l, $p = 0.001$, hypertrophy 1.6±0.5 to 8.3±2.0 mmol/l, $p < 0.001$) and women (strength 1.3±0.3 to 1.8±0.5 mmol/l, $p = 0.012$, hypertrophy 1.5±0.3 to 4.0±2.0 mmol/l, $p = 0.269$). The protocol for muscle hypertrophy, led to a more significant increase in blood lactate concentration in both men ($p = 0.001$) and women ($p = 0.040$) after exercise than the protocol for strength gain. After both protocols were applied, blood lactate concentration immediately after exercise was significantly higher in men than in women (strength $p = 0.008$, hypertrophy $p = 0.005$, respectively). Lifting velocity showed a decreasing tendency for both protocols, especially for muscle hypertrophy, in men, but without any significant differences between men and women. **CONCLUSIONS:** Our results suggest that there are no significant sex differences

in blood lactate concentration and lifting velocity during and after the application of the two protocols for strength gain and muscle hypertrophy. However, blood lactate concentration was significantly higher in men than in women.

B-64 Free Communication/Poster - Running

Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
Room: CC-Exhibit Hall

895 Board #21 May 27 1:30 PM - 3:00 PM Distance Runners' Perceptions Of A Strength Training Intervention

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PURPOSE: This study is one part of a Randomised Controlled Trial investigating the effect of strength training on distance runners' mechanics and performance. The aim of this study was to examine runners' perceptions of the strength training intervention. **METHODS:** Thirty distance runners (18 male, 12 female) were recruited for this study. In addition to their normal running training, the experimental group undertook strength training two days per week for 10 weeks. Total training time was matched, with the control group performing additional low-intensity running and body-weight exercises. Running performance and biomechanics during submaximal running (3.8 m/s) and maximal sprinting were assessed immediately before and after the intervention period. At the completion of the 10 week intervention period, the strength training group were also surveyed on their perceptions of the strength training intervention using an online questionnaire in Qualtrics.

RESULTS: Twenty-eight participants completed follow-up testing. Strength training significantly improved two kilometre running performance ($F(1,26) = 10.497, p = .003$, partial $\eta^2 = .288$) more than running training alone. The mean (95% CI) difference between groups was 11.31 (3.73 to 18.98) seconds. However, strength training did not change maximal aerobic capacity, running economy (3.3 m/s) or lower-limb joint kinematics or kinetics during running. Survey responses showed 64% ($n = 9$ of 14) of the experimental group believed the strength training program improved their running performance and 79% ($n = 11$) reported they would continue using strength training. Half ($n = 7$) of the experimental group believed strength training had a considerable effect on their running technique.

CONCLUSIONS: Strength training appears to improve runners' physical and task-specific self-efficacy, and increased confidence may facilitate faster running performance. This study also demonstrated a discrepancy between measured and perceived effects of strength training on running technique.

896 Board #22 May 27 1:30 PM - 3:00 PM Setting A New World Record: The Demands Of Running 833km On Treadmill In 7 Days

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Ultra-running (UR) comprises running events longer than a marathon (>42.2km). Due to the prolonged duration of UR, decrements in most or all physiological parameters are to be expected, and include a decrease in body mass and dehydration, loss of skeletal muscle mass and increased total body water. **Purpose:** to present data on a female multiple world record holding ultra-runner, examining haematological and physiological perturbations, as well as nutritional strategies throughout a successful treadmill world record attempt for total distance completed in seven days on a treadmill (833.05km). **Methods:** Sharon Gayter (SG) 47 years, 162.5cm, 49kg, $\dot{V}O_{2max}$ 48 ml/kg/min⁻¹ ran continuously for 7 days on a treadmill located at Teesside University, UK. 3-hours of running were followed by 30-minute breaks, and night-time rest from 1am-5am. Heart rate (HR), oxygen uptake ($\dot{V}O_2$), weight (kg), blood lactate (La; mmol.L⁻¹), haemoglobin (Hb; g.DL⁻¹), haematocrit (hct; %), glucose (G; g.L⁻¹), and nutrition were recorded. **Results:** SG ran at approx. 7km/h for 17.5 hours/day, covering an average of 120km. Mean $\dot{V}O_2$ 1.2 ± 0.1 L.min⁻¹/ 24.7 ± 3.2 mL.kg.min⁻¹, RER 0.80 ± 0.03, HR 125 ± 5 b.min⁻¹. Weight increased from 48.6 to 49.5kg. Hb decreased from 13.7 to 11 g.DL⁻¹, and hct decreased from 40% to 33%. Average G was 6.3 ± 1.6 g.L⁻¹, (range 2.65-9.14 g.L⁻¹), and average blood lactate was 1.0 ± 0.5 mmol.L⁻¹, (range 0.4-3.3 mmol.L⁻¹). Energy expenditure (EE) for each 24-hour period was 6878 kcal, and energy intake (EI) was 2701 kcal. Hourly EE was 382 kcal, with 66.6% and

33.4% of the energy coming from fat and carbohydrate oxidation, respectively. 7-day EI was 26,989 kcal and EE was 48,147 kcal, resulting in a total energy deficit (ED) of 21,158kcal. **Conclusion:** The previous record of 753.24km was extended by 79km to a new world record of 833.05km. SG exhibits an enhanced fat metabolism through which she covered the large daily ED. The increase in body weight could be the result of protein catabolism. The corresponding development of hypoproteinaemic oedema, and increased plasma volume, likely lead to the reduced Hb and hct. Her success can be attributed to a combination of physiological and psychological factors, as she remained upbeat throughout the event and stated that she felt that the attempt was easy but became a bit 'tedious' towards the end.

897 Board #23 May 27 1:30 PM - 3:00 PM Prevalence Of Low Bmd Of High-level Kenyan Male And Female Distance Runners Compared To Kenyan Controls

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Kenyan male and female runners have dominated international running events for decades, however the information about their bone health to date is lacking. High training volumes and low energy availability concurrently could potentially impact greatly on bone health. Previous reports lack comparison with the proper control group.

PURPOSE

To determine the bone health indices of Kenyan high-level male and female distance runners.

METHODS

Participants were 26 female (28.7±6.3 yr; 51.8±5.0 kg; 1.63±0.07 m; 19.5±2.0 kg·m⁻²; IAAF performance score: 1029±132 pt) and 30 male (28.1±3.8 yr; 57.7±6.1 kg; 1.73±0.05 m; 19.6±1.8 kg·m⁻²; IAAF performance score: 1087±66 pt) high level Kenyan distance runners. Control group consisted of 29 female (25.0±5.7 yr; 63.4±9.1 kg; 1.65±0.06 m; 23.3±3.2 kg·m⁻²) and 29 male (24.1±3.8 yr; 62.5±10.1 kg; 1.7±0.08 m; 21.8±5 kg·m⁻²) university students of similar age. DEXA was used to measure BMD at the lumbar spine (LS-BMD), right femur (RF-BMD) and total body (TB-BMD). Low BMD was defined as Z-score between -1.0 and -2.0 and osteoporosis < -2.0.

RESULTS

There were no differences in LS-BMD Z-score, RF-BMD Z-score and TB-BMD Z-score between female-male athletes and their respective controls. LS-BMD Z-score, RF-BMD Z-score and TB-BMD Z-score frequency count in the range of -1 to -2 and below -2 is shown in table 1.

Table 1. Number of participants with Z-scores in the range of -1 to -2 and below -2.

	F Athletes (n=26)	M Athletes (n=30)	F control (n=29)	M control (n=29)
LS-BMD Z -1 to -2	7	5*	6	7
LS-BMD Z < -2	3	1*	2	2
RF-BMD Z -1 to -2	5	2*	3	3
RF-BMD Z < -2	2	0*	3	2
TB-BMD Z -1 to -2	3	1	3	3
TB-BMD Z < -2	0	0	1	0

* - sample size for these values was 20; M = male, F = female

CONCLUSION

There was high prevalence of low BMD (Z-score < -1) in high level male and female Kenyan distance runners and somewhat unexpectedly for control groups too; but, no statistical differences in bone health indices between female-male athletes and corresponding control groups. These findings warrant additional investigation be conducted into the energy balance, eating disorders, disordered eating and hormonal markers to further explain causality, both among Kenyan athletes and controls.

898 Board #24 May 27 1:30 PM - 3:00 PM May The Force Be With You: Acceleration-based Estimates Of Vertical Ground Reaction Forces During Running

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(No relevant relationships reported)

Running-related injury (RRI) may be caused by combinations of load magnitudes and numbers exceeding musculoskeletal structure capacity. Few methods exist, however,

to quantify external loads (vertical ground reaction forces; vGRFs) during running in ecologically valid settings. **PURPOSE:** Develop models to accurately estimate vGRF second (“active”) peaks during running from iliac crest and sacrum accelerations. **METHODS:** Anthropometric and sex data were collected from 40 runners. Runners wore inertial measurement units (IMUs) ($\pm 100g$, $\pm 2000deg/s$, 1000Hz) secured to their iliac crests and sacra while they ran a 25m track with embedded force plate (1000Hz). Speed, IMU accelerations, and force plate data were synchronously recorded for ten stances per foot at “slow”, “typical”, and “fast” self-selected speeds. Accelerations were transformed to a segment coordinate system. Force and acceleration signals were 50Hz low-pass filtered and divided into 0-8Hz low frequency (LoF) and ≥ 10 Hz high frequency (HiF) signals. Acceleration and vGRF peaks were extracted from the original, LoF, and HiF signals. Two multiple linear regressions were created to estimate log-transformed vGRF second peak: One used sacrum accelerations to predict bilateral forces, the other used iliac crest accelerations to predict ipsilateral forces. Each model included sex and limb lengths as fixed effects and was validated using an eight-fold cross-over. **RESULTS:** Both models predicted observed vGRF second peaks well ($r^2=0.78$, mean absolute error $<7\%$). Addition of participant as a random effect ($r^2 \geq 0.93$, mean absolute error $<4\%$) or speed as a fixed effect ($r^2 \geq 0.83$, mean absolute error $<6\%$) further improved results. **CONCLUSIONS:** The models developed here demonstrate a single IMU secured over the iliac crest or sacrum can estimate ipsilateral or bilateral vGRF second peak, respectively, with high accuracy. This approach could greatly impact our understanding of RRI by facilitating quantification of the step-by-step external forces experienced by runners over long time periods in ecologically valid settings. Supported by an ACSM Doctoral Student Research Grant, a Sigma Xi Grant-in-Aid of Research, the Maury Hull Endowed Fellowship for Musculoskeletal Biomechanics Research, and an NSERC Post-Graduate Scholarship.

899 Board #25 May 27 1:30 PM - 3:00 PM
Are All Running Workloads Created Equal?
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 (No relevant relationships reported)

Training workload (WL) has become a more common monitoring approach in runners and is defined as the product of external and internal training loads. Although rating of perceived exertion (RPE) is a widely accepted measure of internal load, various types of external load metrics can be used in running. **PURPOSE:** The purpose of this study was to compare week-to-week changes among different training WL measures in high school runners. **METHODS:** 12 male cross-country runners from the same high school team participated in two consecutive weeks of training monitoring. Training minutes were prescribed by the team coach. Session internal load was collected after each run using RPE on a 1-10 visual analog scale. Session external loads included miles, minutes, IMU-based proprietary tibial load (Bone Stimulus, IMeasureU), and estimated cumulative peak vertical force obtained from wireless insole data (Force, loadsol, Novel). Different weekly WL measures were calculated from session RPE and external load measures. Paired t-tests and Cohen’s *d* effect sizes were used to compare between-week percent change (%Δ) among different WL measures and weekly minutes ($p \leq 0.05$). **RESULTS:** Different between-week %Δ were observed between RPExMinutes ($p = 0.003$; $d = 1.83$), RPExBone Stimulus ($p < 0.001$; $d = 0.74$), RPExForce ($p = 0.002$; $d = 1.91$), and weekly miles ($p = 0.011$; $d = 0.71$) compared to weekly minutes (Figure 1). We also observed greater individual variability in the between-week differences for all three WL measures compared to the volume only measures (Figure 1) due to high variability in the between-week %Δ in average sRPE (SD = 26%). **CONCLUSION:** These findings suggest that only monitoring a prescribed volume metric can greatly obscure week-to-week individual training responses of runners. The inclusion of an internal training load (i.e., session RPE) allows for the monitoring of the physiological response to training and explains the large variability of the three WL measures.

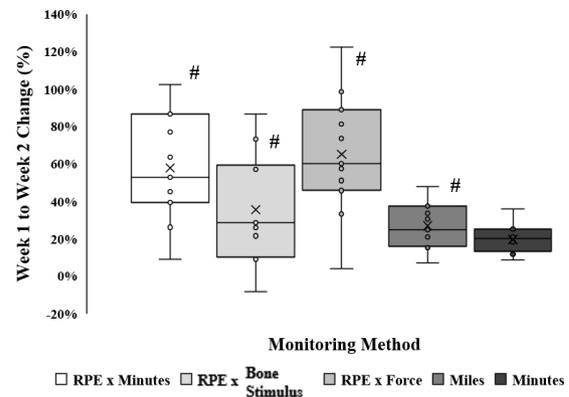


Figure 1. Box plot of week-to-week percent change among different methods of training monitoring. Force (estimated cumulative peak vertical force from combination of wireless force insole peak vertical GRF and cadence), Bone Stimulus (metric from IMeasureU IMU-Step software), and Minutes were used as the external load measures in combination with sRPE to calculate three difference training WLs. #: different than Minutes.

900 Board #26 May 27 1:30 PM - 3:00 PM
Effect Of Cupping Therapy On Respiratory Gas Exchange And Hip Extensor Force Production In Runners
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 (No relevant relationships reported)

Literature on the efficacy of cupping therapy (CT) is limited. Potential mechanisms of action of cupping therapy include increased localized blood and restructuring of fascial protein conformations through mechanotransduction, which has implications for improved running economy (RE) and hip extensor force production (HEFP). **PURPOSE:** To elucidate the effects of myofascial decompression through CT on RE and HEFP in well-trained runners. **METHODS:** Five minutes of CT or placebo gel was applied to bilateral gluteus maximus, biceps femoris, semimembranosus, and semitendinosus of 7 female (29.3 ± 2.1 yrs, 1.68 ± 0.06 m, 60.2 ± 3.4 kg) and 8 male (27.5 ± 6.2 yrs, 1.77 ± 0.04 m, 69.1 ± 4.0 kg) well-trained runners (female 10-km time = 41.4 ± 4.4 min, male 10-km time = 33.5 ± 1.2 min) after a 10-minute treadmill warm-up. Maximal HEFP was measured immediately post CT or gel using an isokinetic dynamometer. Then RE was measured using two 6-minute steady-state treadmill runs (fixed velocity and subject 10-km velocity). Maximal oxygen consumption (VO_2 max) test followed the RE tests. All subjects performed both conditions in randomized order separated by at least 1 week, but not more than 3 weeks. Maximal HEFP, RE, respiratory exchange ratio (RER) during steady-state, and VO_2 max after CT and gel were compared independently using paired two-sample t-tests. Effect size for all variables was calculated using Cohen’s *d*. **RESULTS:** Maximal HEFP was not significantly different between conditions (CT: 1.63 ± 0.47 Nmkg⁻¹; 1.51 ± 0.40 Nmkg⁻¹, $p = 0.18$, $d = 0.29$). There was no difference in RE expressed as % VO_2 max between CT and gel (fixed = $76.9 \pm 10.6\%$ of VO_2 max vs. $76.6 \pm 10.5\%$ of VO_2 max, $p = 0.72$, $d = 0.02$; 10-km = $84.2 \pm 7.2\%$ of VO_2 max vs. $83.7 \pm 6.9\%$ of VO_2 max, $p = 0.17$, $d = 0.07$). There was also no difference in VO_2 max between CT and gel (65.1 ± 9.1 mlkg⁻¹min⁻¹ vs. 65.0 ± 10.3 mlkg⁻¹min⁻¹, $p = 0.96$, $d = 0.004$); however, RER was significantly increased by CT compared to gel (fixed = 0.92 ± 0.06 vs. 0.90 ± 0.04 , $p = 0.04$, $d = 0.32$; 10-km = 0.94 ± 0.04 vs. 0.92 ± 0.03 , $p = 0.02$, $d = 0.52$). **CONCLUSIONS:** Acute cupping therapy increases steady-state carbon dioxide expiration in well-trained runners without changing oxygen consumption. This has implications for enhanced buffering from putative increased localized blood.

901 Board #27 May 27 1:30 PM - 3:00 PM
Acute Physiological And Cognitive Responses During A 100-mile Ultramarathon
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 (No relevant relationships reported)

Participation in ultra-running events, particularly 100-mile races, is rapidly increasing, yet the physiological demands and dynamics during these events are not well-

understood. It is clear is that physical and metabolic costs of these events are quite high; most participants take 20-35 hours to complete the distance and burn upwards of 10,000 calories. As such, many 100-mi. events are reporting 30-50+% "Did Not Finish" (DNF) rates among their participants. Ultra-runners are also challenged by sleep deprivation, which may lead to the decline of cognitive skills and reaction time over the course of these events, potentially leading to exhaustion or injury. **PURPOSE:** To observe and assess physiological and cognitive dynamics during a 100-mile ultramarathon with relatively flat terrain (~7500 ft. vertical gain). **METHODS:** Nine registered participants (age 46 ± 9.5 yrs., weight 74.0 ± 6.1 kg., height 176.4 ± 7.8 cm.) completed the 100-mile distance (Finish time 24.02 ± 3.23 hrs.). Measurements were collected pre-race, at each 20-mile interval (20, 40, 60, 80), and post-race. Measurements included lap time, foot volume, cognition, and reaction time. Foot volume was measured by making a figure-8 with cloth tape around the subjects' bare foot and ankle. Cognitive performance was assessed using mental calculation and reaction time tests via iOS applications. The mental calculation test involved solving as many equations possible in 100 s, while the reaction test required the participant to tap the screen as many times as possible in 30 s. Comparisons were made across the 20-mile intervals using repeated-measures ANOVA. **RESULTS:** While the duration to complete each 20-mi. lap significantly differed throughout the race ($F_{4,20}=7.896$, $p=0.001$), no differences were found in foot volume ($F_{5,15}=2.13$, $p=0.118$), reaction time ($F_{5,10}=.945$, $p=0.493$), or cognition ($F_{5,20}=.896$, $p=0.503$). **CONCLUSIONS:** A relatively flat-terrain 100-mile distance does not elicit cognitive exhaustion or significant foot swelling. More research is needed to determine if there are other physiological or metabolic variables correlated with high DNF rates, and to compare these data to those of more "challenging" courses with greater elevation gain/loss.

902 Board #28 May 27 1:30 PM - 3:00 PM

Is There A Difference In Strength, Flexibility, Range Of Motion Between Postpartum And Nulliparous Runners?

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Research has shown that women are returning to sport as soon as two weeks after birth with most resuming running by two months postpartum. There are significant musculoskeletal and physiologic changes during pregnancy as well as the effects of childbirth that a postpartum runner to recover from to return to running. Research on returning to running guidelines are nonexistent in the postpartum population. **Purpose:** To investigate the differences in strength, range of motion (ROM), and flexibility between postpartum runners (PP) and nulliparous controls (NC). **Methods:** Healthy postpartum (up to 3 years) and nulliparous runners were recruited from local running groups. Three trials of strength, ROM and flexibility of the hip, knee and ankle were collected using a hand held dynamometer, inclinometer or goniometer respectively and then averaged. An independent samples t-test was performed to compare groups. **Results:** 28 runners participated (14 PP, 14 NC) and were matched for BMI (24.2 kg/sq.m). There were no significant differences in strength of the hip, knee and ankle between the groups. Right and left ankle dorsiflexion was significantly greater in PP group (Right Soleus: PP, 10.33 ± 3.9 cm; NC, 6.75 ± 2.68 cm; $p=0.01$; Left soleus: PP, 11.32 ± 3.8 cm; NC, 7.34 ± 2.74 cm; $p=0.004$; Right Gastrocnemius: PP, $7.95 \pm 2.74^\circ$; NC, $4.67 \pm 4.59^\circ$; $p=0.032$; Left Gastrocnemius: PP, $8.48 \pm 3.39^\circ$; NC, $4.5 \pm 5.23^\circ$; $p=0.026$). Knee and Hip ROM were not significantly different between the groups. **Conclusion:** The current study shows that postpartum runners have significantly more dorsiflexion ROM than controls. When breastfeeding, hormones that influence elasticity like prolactin are still present in the body which may be allowing for the postpartum women to have significantly more ROM than nulliparous controls. Future studies should investigate the effect of breastfeeding duration on range of motion in runners as well as if while breastfeeding return to running guidelines should be different than women that cease breastfeeding at different stages.

903 Board #29 May 27 1:30 PM - 3:00 PM

Abstract Withdrawn

904 Board #30 May 27 1:30 PM - 3:00 PM

Effects Of A 4-week Supplemental Breathwork Program On Aerobic Performance Of Recreational Runners

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(No relevant relationships reported)

PURPOSE: This study investigated the effects of a novel supplementary functional breathing program (FBP) on the aerobic performance of recreational runners. **METHODS:** Two groups of recreational runners participated in a 4-week aerobic

endurance training program. One group supplemented the aerobic endurance training program with FBP (FBP; $n=8$, 34.8 ± 5.1 yrs, 25.3 ± 2.5 kg/m²), and one completed the same aerobic endurance program, but not the FBP (CON, $n=8$, 28.8 ± 5.4 yrs, 22.7 ± 2.3 kg/m²). The 4-week running program consisted of 3 days of low intensity running (i.e. below aerobic threshold heart rate), and 1 day of high intensity interval running (i.e. above ventilatory threshold heart rate) per week. FBP consisted of daily breathing exercises completed at rest, and nasal breathing completed during low intensity running sessions. Subjects were tested before (PRE) and after (POST) 4-weeks of training. Testing included a breath holding test (BOLT) followed by a treadmill $\dot{V}O_{2max}$ test using a progressive workload. During the $\dot{V}O_{2max}$ test subjects wore a secure piece of tape covering their mouth under a face mask and were instructed to perform the $\dot{V}O_{2max}$ test to the best of their abilities using this induced nasal breathing condition. When they felt that they could no longer run with nasal breathing, the tape was removed, and the test continued under normal breathing conditions until $\dot{V}O_{2max}$ was reached. The maximal running time using nasal breathing only (MNRT) and maximal nasal breathing oxygen uptake (MNB $\dot{V}O_2$) were recorded and data were assessed using a two-way ANOVA ($p < 0.05$). **RESULTS:** No significant groupXtime interactions were found in MNRT, MNB $\dot{V}O_2$, or $\dot{V}O_{2max}$. There was a significant groupXtime interaction in BOLT times [Δ from PRE: +1.9 sec (CON), +11.7 sec (FBP); $p = 0.04$]. There were significant time effects in MNRT (+58.7 sec, $p=0.038$), MNB $\dot{V}O_2$ (+2.34 ml/kg/min, $p=0.007$), and $\dot{V}O_{2max}$ (+1.26 ml/kg/min, $p=0.028$), suggesting the training stimulus was adequate for the relatively short training program. **CONCLUSION:** This study demonstrated that the 4-week supplementary functional breathing protocol was effective in increasing breath hold time at rest, but not MNRT, MNB $\dot{V}O_2$, and $\dot{V}O_{2max}$ in recreational runners.

905 Board #31 May 27 1:30 PM - 3:00 PM

Should Runners Pay Less Life Insurance

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(No relevant relationships reported)

PURPOSE: An ad "Can You Run An 8 Minute Mile?" (so that you could qualify for lower rates on life insurance) has brought lots of public attention and discussions, and the purpose of this study was to examine the scientific basis for this claim by estimating the impact of physical fitness on modifiable health risk behaviors and related health care expenditures.

METHODS: Using keywords "Physical Fitness," "Cardiorespiratory," "Health Risks," "Health Care Costs," etc., a comprehensive literature search was conducted, and identified publications were reviewed and analyzed.

RESULTS: Over 45 research publications were documented, and 15 articles were included in this review, focusing mostly on 10 modifiable health risks. Over 23 components were found in influencing the future medical costs, e.g., emotional health, stress, blood glucose levels, extreme bodyweight, tobacco user, sedentary lifestyle, per metabolic equivalents (METs) increase, and so on. Amount them, the key components rising the potential health care costs are high blood glucose levels ranging from 12.5% to 111.5%, high stress ranging from 17.45% to 70%, depression ranging from 8.5% to 46%, etc. The most effective measure to reduce potential health care costs is increasing metabolic equivalents (METs) per unit by aerobic exercises ranging from 5.4% to 13.4%.

CONCLUSION: A set of measures has been developed to assess the relationships between health risks and aerobic fitness, and there is a foundation to support the claim that a fit runner will likely have better aerobic fitness, less likely to have health risks, therefore spend less money in health care and medical expense. Yet, significant work is still needed to develop specific and accurate prediction equations so that the cost of life insurance can be determined based on aerobic fitness and other risk factors.

906 Board #32 May 27 1:30 PM - 3:00 PM

Abstract Withdrawn

907 Board #33 May 27 1:30 PM - 3:00 PM

Validity Of A Field-based Critical Velocity Test On Predicting 5,000 M Running Performance

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(No relevant relationships reported)

Measuring and modeling known adaptations to endurance training can be achieved through a variety of physiological parameters. A unique and emerging performance parameter receiving attention is the notion of critical velocity (CV). This concept allows an athlete's performance to be mathematically modeled based on the relationship that exists between distance and time. **PURPOSE:** To assess the validity

of a field-based CV test on predicting 5,000 m running performance. **METHODS:** Five runners ($VO_{2peak} = 60.14 \pm 4.96 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$) completed a graded exercise test to determine VO_{2peak} , a CV test to predict performance, and a 5,000 m time-trial. The CV assessment protocol included time-trials of 3,600 m, 2,400 m, and 1,200 m at maximal exertion on a standard 200 m indoor track. Running performance was predicted using the distance-time model where CV was given by the slope and the anaerobic work capacity (D') was given by the intercept from linear regression analysis of distance covered against time for each of the three time-trials. Statistical significance was determined *a priori* at $p < 0.05$. **RESULTS:** Predicted 5,000 m performance ($18.28 \pm 4.38 \text{ min}$) and actual 5,000 m performance ($18.17 \pm 4.07 \text{ min}$) were not significantly different, $t(4) = 0.58$, $p = 0.594$, $d = 0.26$. The mean difference in performance was $0.11 \pm 0.42 \text{ min}$ [95% LoA, -0.71 min , 0.93 min]. CV ($4.59 \pm 0.88 \text{ m}\cdot\text{s}^{-1}$) was significantly slower than actual 5,000 m velocity ($4.73 \pm 0.82 \text{ m}\cdot\text{s}^{-1}$), $t(4) = -3.081$, $p < 0.05$, $d = -1.37$. The mean difference in velocity was $-0.14 \text{ m}\cdot\text{s}^{-1} \pm 0.10 \text{ m}\cdot\text{s}^{-1}$ [95% LoA, $-0.34 \text{ m}\cdot\text{s}^{-1}$, $0.06 \text{ m}\cdot\text{s}^{-1}$]. **CONCLUSION:** The linear distance-time model can be used to predict 5,000 m running performance. This field-based approach allows performance predictions to be made in a relatively short period of time without the need for access to expensive laboratory equipment.

908 Board #34 May 27 1:30 PM - 3:00 PM
Attempting To Acutely Manipulate Ground Contact Time Imbalances Impairs Running Economy

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(No relevant relationships reported)

Running economy (RE) is a key performance determinant. Biomechanical markers have been linked to RE, including ground contact time (GCT), cadence, and vertical oscillation (VO). Recently, we showed a strong relationship between GCT imbalances and RE. Because these markers can be tracked real-time with consumer-wearable devices, runners now have access to instant feedback concerning their mechanics. **Purpose:** Determine if attempting to correct GCT imbalances real-time alters mechanics and RE. **Methods:** 7 recreational runners ($38 \pm 15 \text{ years}$, $24.7 \pm 2.8 \text{ kg/m}^2$, 5 male) completed 2, 10-minute running trials (9.65 km/hr) on separate days. For both trials, subjects ran with a heart rate (HR) monitor/watch that measured GCT, GCT imbalances, cadence, and VO. For the control trial, subjects were not permitted to receive feedback from the watch. During the feedback trial, the watch was set to display GCT imbalances, and subjects were prompted every 20-30 seconds to monitor/attempt to correct any imbalances. Both trials were preceded by a dynamic warmup and 5-minute jog. For the feedback trial warmup, subjects were acclimated to the watch and allowed to experiment with manipulating their GCT imbalances. VO2 was monitored continuously throughout each 10-minute trial, and average values from 6 to 9 minutes were determined for each trial. Average values for all running biomechanical variables were calculated from 0.5 minutes to 9.5 minutes. Comparisons between trials were made with a dependent sample t-test. **Results:** Data are displayed in Table 1. **Conclusions:** Acutely attempting to correct GCT imbalances did not result in improved mechanics and actually impaired RE. Altering mechanics based on real-time feedback from consumer-wearable devices may impair performance in the short term. Given that GCT imbalances have been linked to impaired RE, future research should determine how to better correct these imbalances rather than attempting to acutely manipulate them.

	Control	Feedback	p-value
VO2 (ml/kg/min)	33.4 (1.8)	35.5 (1.6)	0.011*
RER	.91 (.04)	.92 (.05)	0.170
Heart Rate (beats/min)	159 (26)	163 (24)	0.191
GCT Difference (%)	1.69 (.67)	1.70 (1.70)	0.983
GCT Difference (ms)	9 (3)	8 (7)	0.717
GCT (ms)	272 (26)	268 (31)	0.536
Cadence (steps/min)	165 (9)	167 (9)	0.486
VO (cm)	9.3 (2.0)	9.2 (1.9)	0.856
VO ratio (cm/m)	9.5 (1.6)	9.5 (1.6)	0.947

Values represent mean (SD). p-values from dependent t-test. * $p < .05$

909 Board #35 May 27 1:30 PM - 3:00 PM
Changes In Step Time And Length Between Kilometer Eleven And Thirty-nine Of A Marathon

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(No relevant relationships reported)

Purpose: Marathon running invokes neuromuscular fatigue which has been shown to result in kinematic changes in a laboratory setting. However, there are limited studies on changes that take place during a race. The purpose of this study was three-fold: 1) to evaluate the step time and step length at an early and late time point in a full marathon and quantify the change between the two points; 2) to identify differences in step time and length associated with sex; and 3) to determine if step time and length are predictors of race finish time. **Methods:** This is an observational study in which runners were filmed at two stations, at kilometer 11 (S1) and kilometer 39 (S2) of a full 42.2 kilometer marathon. Each station incorporated two cameras, one in the sagittal plane to assess kinematics and the second to identify the runners' bib numbers. A 5-meter section of roadway was marked with chalk, delineating each meter, to allow for assessment of step length using Dartfish 5.5 Video Analysis software (Dartfish, Fribourg, Switzerland). **Results:** Step time was slower at S2 compared to S1 with a mean difference \pm SD of $0.290 \pm 0.403 \text{ m/s}$ (95%CI $0.246 - 0.334$; $p < 0.001$). Step length was shorter at S2 compared to S1 with a difference of $0.098 \pm 0.111 \text{ m}$ (95%CI $0.086 - 0.110$; $p < 0.001$). There was no interaction in step time for males or females between S1 and S2 (S1, Male $0.35 \pm 0.02 \text{ s}$, Female $0.33 \pm 0.02 \text{ s}$; S2, Male $0.35 \pm 0.02 \text{ s}$, Female $0.34 \pm 0.02 \text{ s}$; $p = 0.099$) however, an interaction was detected for step length (S1, Male $1.16 \pm 0.13 \text{ m}$, Female $1.05 \pm 0.11 \text{ m}$; S2, Male $1.05 \pm 0.13 \text{ m}$, Female $0.98 \pm 0.11 \text{ m}$; $p = 0.01$). A regression model to predict finish time found that step length at S1 accounted for 47% of the variability ($F(1,323) = 283.7$; $p < 0.001$), this increased to 68.3% when S1 step time was included ($F(2,322) = 350.4$; $p < 0.001$), S2 step length increased this to 75.2% ($F(3,321) = 328.4$; $p < 0.001$) while including S2 step time increased it to 76.7% ($F(4,320) = 268.4$, $p < 0.001$). **Conclusion:** Step time was slower and step length was shorter at the 39-kilometer point of the full-marathon compared to the 11-kilometer point. Step time did not differ at either time point in the race for males or females; however, they both demonstrated a reduction in step length. Step time and step length at both points in the race are able to account for a significant amount of finish-time variability.

910 Board #36 May 27 1:30 PM - 3:00 PM
CHARACTERIZING PERFORMANCE IN ELITE TRACK AND FIELD SPRINTERS IN RELATION TO THE ACUTE:CHRONIC WORKLOAD RATIO

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PURPOSE: The acute:chronic workload ratio is a method of training load quantification that quantifies internal and external responses to training. Chronic training load is a rolling average of the most recent 28 days of training, and the acute workload is the most recent 7 days. The purpose of this study was to explore the relationship between the acute:chronic workload ratio and peak performance in elite track and field sprinters over the course of the 2018 outdoor season. **METHODS:** The acute:chronic workload ratio was determined retrospectively by calculating the sum of the 7 days before a competition session ratings of perceived exertion of training load (acute load) and dividing it by the average weekly session rating of perceived exertion of training load over the 28-days prior to competition (chronic workload). Partial correlations were used to characterize the relationship between race time (covaried for confounding variables of temperature, humidity, and wind) and the acute:chronic workload ratio. Secondly, the adjusted race times were used to create Z-scores for each sprinters' race time. Bins were then created for the acute:chronic workload ratio ranges, and the Z-scores were pooled into the acute:chronic workload ratio bins with which they corresponded. **RESULTS:** Moderate, positive correlations between the acute:chronic workload ratio and race times for the 100m ($r = 0.542$) and 200m ($r = 0.711$) races were observed. 85% of 100m sprinters and 60% of 200m sprinters had their lowest times within the 0.8-1.3 z-score bin: a range cited in previous research as being associated with a lowest risk of injury. **CONCLUSIONS:** Maintaining an acute:chronic workload ratio between 0.8 and 1.3 may be optimal for elite track and field sprinters to reach their peak performance in the 100m and 200m races. An individualized approach to training load using the acute:chronic workload ratio should help coaches and performance staff with individualized training-load prescription for the sprinters to reach peak performance.

WEDNESDAY, MAY 27, 2020

- 911** Board #37 May 27 1:30 PM - 3:00 PM
Evaluating The Validity Of Heart Rate Measured By The Suunto Spartan Sport Watch During Trail Running
 RW Salatto¹, James W. Navalta, FACSM¹, Jeff Montes², Nathaniel Bodell³, Bryson Carrier¹, Jacquelyn V.L. Sertic¹, Brenna Barrios¹, Peyton Cater¹, Dustin Davis¹, Jacob W. Manning⁴, Mark DeBeliso, FACSM⁴. ¹University of Nevada, Las Vegas, Las Vegas, NV. ²Monmouth College, Monmouth, IL. ³California State University, San Bernardino, San Bernardino, CA. ⁴Southern Utah University, Cedar City, UT. (Sponsor: James Navalta, FACSM)
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Purpose: In the last decade or so, a plethora of fitness tracking devices have come to market. With this, use of these devices has increased exponentially. Among these devices' many functions is the ability to monitor heart rate (HR). The purpose of this investigation was to determine if HR measured by the Suunto Spartan Sport watch was statistically comparable to that of our criterion, the Polar H7 HR monitor.

Methods: Twenty-one participants (male n = 11, female n = 10, age = 31±2 yrs [mean±SE], ht = 173±2 cm, wt = 76±3 kg) completed a two-mile trail run which included elevation changes of 48 m (McCullough Hills Trail, Henderson, NV), 55m (Three Peaks Trail, Cedar City, UT) or 104m (Bristlecone Trail, Mt Charleston, NV). Heart rate was obtained from the Suunto Spartan Sport watch with accompanying heart strap and the Polar H7 chest-worn heart rate monitor as the criterion reference. Validity was determined using the Mean Absolute Percent Error (MAPE), Bland-Altman analysis with accompanying bias and Limits of Agreement (LoA), and single measures Intraclass Correlations (ICC). A Pearson Product Moment Correlation Coefficient was used to determine the relationship between the validity measures with significance accepted at p<0.05. **Results:** During uphill running, the MAPE was 1.46%, and the lower and upper LoA were -11.53 and 12.34, respectively. The single measures ICC was 0.95 with a 95% CI of 0.953 to 0.956 (F(14834, 14834) = 43.15, p < 0.000). During downhill running, the MAPE was 2.18% with the lower and upper LoA at -15.76 and 14.15, respectively. The single measures ICC was .94 with a 95% CI of 0.946 to 0.951 (F(9075, 9075) = 38.45, p < 0.000). **Conclusions:** These results demonstrate a there was a very low percentage of error for the Suunto Spartan Sport watch in recording HR for both uphill and downhill running. This suggests that The Suunto Spartan Sport might be a valid and reliable option for consumers wishing to monitor HR during outdoor trail running activities.

- 912** Board #38 May 27 1:30 PM - 3:00 PM
The T10 Treadmill Test Is Reliable And Valid To Determine Critical Speed In Recreational Runners
 Sergio G. da Silva, Lucio Follador, Edilson F. de Borba, Armando L. Bonfim Neto. UFPR, Curitiba, Brazil. (Sponsor: Carlo Baldari, FACSM)
 (No relevant relationships reported)

Current methods to assess critical speed (CS) are limited by the need for subjects to perform a set number of time-to-exhaustion trials at a constant speed on a treadmill or through several maximal runs on separate days on a running track. **Purpose:** To assess the reliability and validity of a 10-minute submaximal treadmill test of critical speed (CS). **Methods:** Twenty-nine recreational road runners (21 men, 8 women; age: 31.8 ± 5.7 years; VO_{2max}: 52.5 ± 6.9 ml.kg⁻¹.min⁻¹) completed a familiarization trial consisted of running 10 minutes (T10) at a vigorous self-selected speed plus two experimental trials (T10-test and T10-retest). Speed from the T10-test and T10-retest were assessed using coefficient of variation (CV), limits of agreement (LoA) and intraclass correlation (ICC). Next the CS assessed from an additional T10-test was compared with the CS assessed through Field tests. The Field tests consisted of 3 runs on separate days on a running track over 1200, 2400 and 3600 m. **Results:** Reliability analysis between the T10-test and T10-retest showed a CV of 3.2% (95% CI: 2.5-4.3%), LoA of ± .32 m.s⁻¹, and an ICC of .94 (95% CI: .87, .97). Validity data showed that speed (m.s⁻¹) (T10-test: 3.79 ± .47; Field-test: 3.80 ± .49) did not differ between trials (p = 1). Also, the T10-test was highly correlated with the Field-test (r = .90, p < .001) and presented a CV of 4% (95% CI: 3.2-5.4%) and LoA of ± .41 m.s⁻¹. **Conclusion:** The submaximal 10-minute treadmill test (T10) yields reliable and valid estimates of CS providing a useful alternative for assessing CS on a treadmill.

- 913** Board #39 May 27 1:30 PM - 3:00 PM
Comparison Of Running Economy Between Straight-line Running And Running With Change Of Direction In Collegiate Males
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Running economy (RE) is one of the important indicators for evaluating endurance. However, treadmill running (TR) test, seems not to be specific enough for team sport, considering their running characteristics with change of direction. **PURPOSE:** To investigate the RE of TR and 20m-shuttle running (SR).

METHODS: 18 physically-active collegiate men (22.4 ± 2.4yrs, 177.4 ± 7.5cm, 69.3 ± 8.2kg, VO_{2max}: 48.9 ± 6.2 ml/kg/min, training experience: 4.6 ± 1.6yrs) volunteered to participate in one incremental TR (8, 10, 12 and 14km/h) and one incremental SR (6, 8, 10 and 12km/h), with the duration of 5 min for each step, and the interval of 1 min between each 2 steps. The VO_{2max} was also assessed in combination with the TR test. The portable gas metabolism system (K4b², Cosmed, Italy) was used to measure the breathing gas during running. The RE for each speed was calculated as the averaged VO₂ of the last 1 min during each step.

RESULTS: At the same running speed (8, 10 and 12km/h), the RE of the SR are lower (oxygen consumption is higher) than the TR (34 ± 3.6 vs. 32.5 ± 4.9 ml/kg/min, 47.9 ± 5 vs. 37.9 ± 5.9 ml/kg/min, 54.9 ± 6.2 vs. 42.0 ± 7 ml/kg/min), with the difference significant at the two higher speed (p<0.05). **CONCLUSIONS:** At the same running speed, the RE of SR is lower than that of TR. Assessment of RE with TR might overestimate the RE in running with change of direction. Running test with change of direction (e.g. SR) is recommended for examining the RE in team sport players.

- 914** Board #40 May 27 1:30 PM - 3:00 PM
Roller Massage Prior To Running Does Not Affect Gait Mechanics In Well-trained Runners
 Jessica G. Hunter, Ross H. Miller. University of Maryland, College Park, MD. (Sponsor: Irene S. Davis, FACSM)
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 (No relevant relationships reported)

Fatigue is often considered an injury risk factor due to gait adjustments that occur during prolonged running, and 41% of physical therapists recommend roller massage (RM) for injury prevention. However, whether RM prior to running affects gait mechanics and fatigue is currently unknown.

PURPOSE: To investigate the effects of an acute bout of RM on gait mechanics and fatigue after a treadmill run.

METHODS: Fourteen well-trained runners (mean VO₂ max: 53 ml/kg/min) completed 3 sessions each on separate days. In a Baseline session, participants sequentially ran overground at their 5k pace, performed 3 maximal countermovement jumps (CMJ), and completed a maximal oxygen consumption test. Force and motion data were measured during running and jumping. In fatigue sessions, run and CMJ protocols identical to the Baseline session were performed before (PRE) and after (POST) a 30-minute fatiguing treadmill run at a pace associated with 84% of ventilatory threshold. Before the fatiguing run, participants rested for 12 minutes (REST) in one visit, and performed a 12-minute RM protocol (ROLL) in the other visit. Two-way analysis of variance (ANOVA) compared end tidal pressure of carbon dioxide (PETCO₂) every 5 minutes of the treadmill runs to assess fatigue. From the run and CMJ data, 2-way multiple analysis of variance (MANOVA) compared vertical average loading rate (VALR), free moment, tibial shock, and jump height between REST and ROLL conditions at times PRE and POST.

RESULTS: PETCO₂ decreased throughout both treadmill runs, indicating general fatigue (p < 0.001). VALR, free moment, tibial shock, and jump height did not differ significantly between PRE and POST treadmill run on both REST and ROLL days (Table 1).

CONCLUSIONS: Well-trained runners exhibited fatigue in respiratory measures but not in neuromuscular performance, or gait mechanics. RM had no effect on any outcomes. We can conclude no benefits of pre-run RM on resistance to fatigue-induced changes in running mechanics.

Table 1. Outcomes by Condition and Time (mean (SD))

Condition	Time	VALR (BW/s)	Free Moment (%BW*Ht)	Shock (g's)	Jump Height (m)
REST	PRE	100.0 (31.0)	16.6 (7.7)	2.37 (1.06)	0.35 (0.08)
	POST	110.0 (32.5)	17.0 (5.3)	2.57 (0.76)	0.34 (0.08)
ROLL	PRE	95.9 (28.9)	16.1 (5.3)	2.35 (0.70)	0.35 (0.07)
	POST	100.7 (28.6)	17.0 (5.8)	2.61 (0.74)	0.30 (0.06)

B-65 Free Communication/Poster - Blood Flow

Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
Room: CC-Exhibit Hall

**915 Board #41 May 27 2:30 PM - 4:00 PM
Impact Of Cell-free Hemoglobin On Exercising Muscle Vascular Control In Rats**

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(No relevant relationships reported)

Hemolysis associated with Sickle Cell Disease (SCD) compromises nitric oxide (NO) bioavailability and results in a plethora of cardiopulmonary and skeletal muscle complications causing severe exercise intolerance. Recent evidence suggests that cell-free Hb reduces NO bioavailability and lowers the skeletal muscle microvascular PO₂ during contractions, likely due to a reduction in blood flow. Despite these observations, the effects of Hb on skeletal muscle vascular control during locomotory exercise remain unknown. **Purpose:** We tested the hypothesis that acute exposure to Hb would increase mean arterial pressure (MAP) and decrease hindlimb muscle blood flow in the exercising rat. **Methods:** MAP and hindlimb skeletal muscle blood flow (fluorescent microspheres) were measured in male Sprague-Dawley rats (3-6 months, n=8) during submaximal treadmill running (20 ml/min, 5% grade) following a vehicle (0.2 ml of saline) and Hb (50 mg/kg) infusion. **Results:** Relative to control, Hb resulted in a significantly greater exercising MAP (control: 137 ± 3, Hb: 150 ± 3 mmHg, p<0.05) and blood [lactate] (control: 2.51 ± 0.25, Hb: 3.13 ± 0.42 mM, p<0.05). Total exercising hindlimb skeletal muscle blood flow (control: 179 ± 14, Hb: 111 ± 7, ml/min/100 g, p<0.05) and vascular conductance (control: 1.34 ± 0.13, Hb: 0.75 ± 0.05 ml/min/100 g/mmHg, p<0.05) were lower following Hb infusion when compared to control. **Conclusion:** These data support the hypothesis that free Hb impairs vascular control and lowers skeletal muscle O₂ delivery during exercise and provides a potential mechanism by which hemolytic diseases like SCD impair exercise tolerance in humans. Support: NIH-P30DK048520 (SKF), NIH-1R01HL125642-01A1 (DCI)

**916 Board #42 May 27 2:30 PM - 4:00 PM
Peripheral Revascularization Reverses The Decline In Active Muscle Oxygen Saturation In Peripheral Artery Disease**

J. Carter Luck¹, Danielle JK Kim¹, Cheryl A. Blaha¹, Samuel Pai¹, Faisal Aziz¹, John F. Radtka, III¹, Kimberly S. Faszewski², Abigail SL Stickford², Amanda J. Miller¹, Matthew D. Muller³, Lawrence I. Sinoway¹. ¹Penn State College of Medicine, Hershey, PA. ²Appalachian State University, Boone, NC. ³University Hospitals Cleveland Medical Center, Cleveland, OH.
(No relevant relationships reported)

Peripheral artery disease (PAD) is a progressive atherosclerotic disease that limits blood flow to the skeletal muscles in the lower extremity. Reductions in blood flow may be more pronounced during ambulation or exercise and produce leg cramping or pain known as intermittent claudication. Recent studies have shown an exaggerated blood pressure response with lower muscle oxygen saturation (SmO₂) during foot exercise in patients with PAD. However, it is unclear whether surgical and/or

endovascular interventions normalize this response. **PURPOSE:** To examine whether revascularization procedures improve calf muscle SmO₂ and reduce blood pressure responses during dynamic foot exercise in patients with PAD. We hypothesized that revascularization would improve SmO₂ responses (indicating greater tissue perfusion) and that the blood pressure response would be attenuated during exercise. **METHODS:** Patients with symptomatic PAD (n = 6) performed incremental supine plantar flexion exercise, starting at 0.5 kg and increased by 0.5 kg every minute for up to 6 minutes, pre- and one-month post peripheral revascularization procedure. SmO₂ was measured continuously from the gastrocnemius muscle, while heart rate and blood pressure were measured beat-by-beat. **RESULTS:** Reductions in SmO₂ from baseline to end-exercise were attenuated post-revascularization (-6.5 ± 6.2% vs. -39.8 ± 22.5%, P < .05). The change in mean arterial blood pressure was reduced post-revascularization (4 ± 4 mmHg vs. 16 ± 12 mmHg P < .05). PAD patients exercised longer post-revascularization (5.8 ± 0.4 min vs. 4.0 ± 1.5 min P < .05). **CONCLUSIONS:** These data suggest that revascularization lessens the degree and rapidity of decline in SmO₂ during exercise, and lowers the exaggerated blood pressure response in patients with PAD. Supported by NIH Grant P01 HL134609

**917 Board #43 May 27 2:30 PM - 4:00 PM
Endothelial Shear Stress In The Common Carotid Artery During Boxing Training**

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(No relevant relationships reported)

PURPOSE: Endothelial function is highly regulated by the interaction between blood flow and the endothelium. Endothelial shear stress (ESS) is defined as the dragging force generated by this interaction and it has been reported that low ESS affects nitric oxide bioavailability which in turn might increase blood pressure. Exercise programs are one of the best suited approaches to prevent high blood pressure, however, there are no studies describing changes on ESS in the common carotid artery during specific modalities of exercise, such as boxing training. Therefore, the purpose of this study was to quantify ESS in the common carotid artery during maximal and submaximal boxing training in normotensive and pre-hypertensive subjects. **METHODS:** A cohort of 5 healthy normotensive and 5 pre-hypertensive subjects matched by age, gender, height, and weight were recruited for this study. All 10 subjects performed two boxing tests. The first was a graded maximal boxing test to estimate their maximal oxygen uptake (VO₂max). The second one, performed 48 hours after the first evaluation, was a 2-workload steady-state boxing test at 60%VO₂max and at 95%VO₂max for 3 minutes each. A high-definition Doppler ultrasound recorded common carotid artery diameters and blood flow velocities throughout each steady-state condition. ESS was estimated using Womersley's approximation. **RESULTS:** There was a significant increase in antegrade ESS with higher workloads in both groups (p < 0.05 for all). No difference were found in antegrade ESS at baseline (Normotensive: 33.9±13.9 dynes/cm², Pre-HTA: 34.7±5.5 dynes/cm²; p = 0.936), at 60%VO₂max (Normotensive: 51.3±19.1 dynes/cm², Pre-HTA: 49.6±7.6 dynes/cm²; p = 0.894, and at 95%VO₂max (Normotensive: 72.9±30.9 dynes/cm², Pre-HTA: 85.2±12.5 dynes/cm²; p = 0.560) between both groups. Meanwhile, no retrograde blood flow was present at baseline for either groups, but it was identified at 60%VO₂max (Normotensive: 8.1±0.7 dynes/cm², Pre-HTA: 7.8±7.8 dynes/cm²; p = 0.971) and 95%VO₂max (Normotensive: 22.5±18.9 dynes/cm², Pre-HTA: 20.8±5.6 dynes/cm²; p = 0.891). **CONCLUSIONS:** ESS increases in an exercise-intensity manner during boxing training in normotensive and prehypertensive population. Boxing training might be beneficial in high blood pressure prevention due to increments on ESS.

**918 Board #44 May 27 2:30 PM - 4:00 PM
The Effects Of A High Fat Meal On Blood Flow Regulation During Arm Exercise**

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A diet high in saturated fats results in endothelial dysfunction and can lead to atherosclerosis, a precursor to cardiovascular disease. Exercise training is a potent stimulus though to mitigate the negative effects of a high saturated fat diet; however, it is unclear how high-saturated fat meal (HSFM) consumption impacts blood flow regulation during a single exercise session. **PURPOSE:** This study sought to examine the impact of a single HSFM on peripheral vascular function during an acute upper limb exercise bout. **METHODS:** Ten young healthy individuals completed two sessions of progressive handgrip exercise. Subjects either consumed a HSFM (0.84 g of fat/kg of body weight) 4 hours prior or remained fasted before the exercise

bout. Progressive rhythmic handgrip exercise (6kg, 12kg, 18kg) was performed for 3 minutes per stage at rate of 1 Hz. The brachial artery (BA) diameter and blood velocity was obtained using Doppler Ultrasound (GE Logiq e) and BA blood flow was calculated with these values. **RESULTS:** BA blood flow and flow mediated dilation (normalized for shear rate) during the handgrip exercise significant increased from baseline in all workloads, but no differences were revealed in response to the HFSM consumption. **CONCLUSION:** Progressive handgrip exercise augmented BA blood flow and flow mediated dilation in both testing days; however, there was no significant differences following the HFSM consumption. This suggests that upper limb blood flow regulation during exercise is unaltered by a high fat meal in young healthy individuals.

919 Board #45 May 27 2:30 PM - 4:00 PM

A Physiological Analysis Of Vibrating Orthotics

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(No relevant relationships reported)

INTRODUCTION: Orthotics are commonly used to aid individuals with foot disorders such as foot or arch pain and gait abnormalities. A new development of vibrating orthotics, which sends out safe vibration frequencies, are gaining popularity on the market. Future developments could lead to vibrating insoles being beneficial for individuals with restricted blood flow, nerve damage, or balance issues caused by diseases such as diabetes or multiple sclerosis. However, few studies have been done on the efficacy and potential benefits. **PURPOSE:** The purpose of this study was to determine if vibrating orthotic insoles increased the amount of blood flow to the foot and ankle at rest. **METHODS:** Participants included 5 students ages 22-26 years. An Initial baseline test was administered upon arrival and again after resting for 30 minutes on the examination table. The Logiq 7 ultrasound Doppler transducer (9L probe at 5 Mhz) was used to locate the posterior tibial artery for the baseline measurement and probe placement was marked on the skin for consistent measuring. Following the second baseline measurement, vibrating orthotics were turned on and blood flow measurements were taken in 5 minute increments for 45 minutes. For each measurement, the artery was found and blood flow was measured for 7 seconds. Blood flow was calculated in milliliters per minute based on blood velocity and arterial radius utilizing the following equation: $\text{Blood flow} = \text{Vmean} \pi (\text{vessel diameter})^2 \times 60$. **RESULTS:** Blood flow was analyzed across time using a multi-level model with subject as a random effect and time (categorical) as a fixed effect. There was a significant main effect of time. Tukey post hoc analysis revealed a difference between the first baseline and after 45 minutes of vibration ($p=0.0375$), but no significant difference between any other measurements. After 45 minutes of vibration, blood flow increased 3.46 ml/min (126%). **CONCLUSION:** The results suggest that the use of vibrating insoles may be beneficial for increasing blood flow in the foot and ankle. The use of vibrating insoles may be beneficial for individuals with conditions that restrict blood flow in the foot and ankle such as peripheral artery disease, diabetes, or poor circulation.

920 Board #46 May 27 2:30 PM - 4:00 PM

Upper Body Exercise And Passive Limb Movement To Increase Limb Blood Flow In Paraplegics

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(No relevant relationships reported)

Previous investigations on the ability of upper body exercise (UBE) to increase femoral artery blood flow (FABF) in the paraplegic population have produced a wide range of results. However, this could have been the result of a non-homogenous population with a wide range of injury level and severity. The use of a more homogenous population, controlling for both level and severity of injury may result in more robust data. In addition, previous reports suggest passive limb movement (PLM) could be used as a modality to increase femoral artery blood flow in this population. A combination of UBE and PLM may provide a sufficient stimulus for a robust increase in femoral artery blood flow. **PURPOSE:** To determine the effectiveness of UBE when used alone and in combination with PLM to increase FABF in the paraplegic population. **METHODS:** Nine paraplegics with a clinically confirmed complete lesion between the 3rd and 11th thoracic vertebra participated in the study. The subjects underwent 10 minutes of (UBE), 5 minutes at a low intensity (LI) and 5 minutes at a moderate intensity (MI), during which FABF was measured. After a 30 minute break, the protocol was replicated with the addition of repeated bouts of passive limb movement being conducted every other minute during the upper body exercise (CMB). **RESULTS:** Two-way repeated measures ANOVA showed no statistically significant interactions ($p>0.05$) between the two exercise modalities for changes in FABF. During the UBE condition, while not statistically significant, FABF increased from

113±78 ml/min to 160±130 ml/min ($p=0.06$) and 162±131 ml/min ($p=0.06$) during the LI and MI conditions, respectively. FABF for the CMB protocol was 119±93 ml/min and increased to 150±125 ($p=0.09$) and 155±136 ($p=0.13$) ml/min during LI and MI conditions, respectively. **CONCLUSIONS:** While not statistically significant, these data indicate the upper body exercise when used in combination with passive limb movement can invoke a large increase in femoral artery blood flow. This could have a profound clinical application for this population.

921 Board #47 May 27 2:30 PM - 4:00 PM

Dietary Nitrate Does Not Increase Exercising Muscle Blood Flow In Rat With Pulmonary Arterial Hypertension

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PURPOSE: Pulmonary arterial hypertension (PAH) is a disease characterized by pulmonary artery remodeling, right ventricular hypertrophy, and exercise intolerance. We have previously found a significant reduction in skeletal muscle blood flow during exercise in a rat model of PAH, accompanied by an increase in blood lactate. In an attempt to increase flow, we administered beetroot juice (BRJ) to severely afflicted PAH rats, as BRJ has previously been shown to be effective in animal models and patient populations.

METHODS: Male Sprague Dawley rats ($n=18$, 200-250 g) were injected with 60 mg/kg monocrotaline to elicit a severe PAH phenotype. At 3 wk post-injection, rats performed two trials of a $\text{VO}_{2\text{max}}$ treadmill test 2 h after oral gavage of a single dose (1 mmol/kg) of BRJ (BRJ, $n=9$), or placebo (PL, $n=9$), in counterbalanced order. Three days later, rats performed a final treadmill run 2 h after gavage of either BRJ or PL, in which fluorescent microspheres were administered during running (at 50% $\text{VO}_{2\text{max}}$) to determine skeletal muscle blood flow. Nitrate and nitrite concentrations in plasma and skeletal muscle samples were determined via HPLC, whereas muscle cGMP was measured using ELISA.

RESULTS: As expected, MCT induced impaired exercise tolerance with a 26±6% (+/-SE) reduction in $\text{VO}_{2\text{max}}$ at 3 wk post-injection, that was not improved with BRJ ($p=0.15$). BRJ significantly increased plasma nitrate ($p<0.001$) and nitrite ($p=0.002$) compared to PL; however only nitrate was elevated in the soleus ($p=0.006$) and vastus lateralis ($p=0.02$) by BRJ, with no significant differences in nitrite ($p=0.13-0.66$) or cGMP ($p=0.08-0.68$). BRJ did not increase blood flow in any of the 8 muscles sampled when compared to PL ($p=0.23-0.96$), nor did it reduce lactate accumulation during exercise ($p=0.37$).

CONCLUSIONS: A single dose of dietary nitrate does not enhance exercising muscle blood flow or $\text{VO}_{2\text{max}}$ in a PAH rat, despite significantly increasing plasma nitrate and nitrite. This may be explained by a lack of efficacy in BRJ increasing muscle nitrite and cGMP, known mediators of the nitric oxide pathway and tissue perfusion. Future work should examine mechanisms for reduced skeletal muscle blood flow and further exploration of nitric oxide signaling in PAH patients. Funding: NIH HL121661 (MB Brown) and AG053606 (AR Coggan)

922 Board #48 May 27 2:30 PM - 4:00 PM

Racial Differences In Exercising Limb Blood Flow During Elevated Sympathetic Activity

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(No relevant relationships reported)

PURPOSE: Young, healthy African Americans (AA) exhibit lower vascular conductance during an exercise bout compared to Caucasian Americans (CA). This disparity may be due to greater sympathetic vasoconstriction and an impairment in functional sympatholysis during exercise in AA. Thus, the purpose of this study is to examine racial differences in vascular conductance during lower limb exercise in the presence of elevated sympathetic activity administered via cold pressor test (CPT). **METHODS:** A total of 5 African American (AA) and 4 Caucasian (CA) young (24 ± 2 yrs), healthy males were recruited. Subjects then underwent 6 minutes of rhythmic plantar flexion (PF) exercise at 30% of their previously determine maximum voluntary contraction (MVC). Doppler ultrasonography was utilized to measure superficial femoral artery blood flow on the exercising leg while simultaneous measures of mean arterial pressure (MAP) were obtained via finger plethysmography. Subjects underwent the CPT (minutes 4-6) during which the hand was placed in cold water (4 °C) during PF exercise. Measures were obtained during steady state exercise blood flow

(measured at minutes 3-4) and during the CPT (measured at minute 5-6) to determine differences in vascular conductance with and without the presence of elevated sympathetic activity.

RESULTS: The CPT resulted in similar increases in MAP in both AA (+24.8 ± 3 mmHg) and CA (+25.56 ± 13 mmHg) (p = 0.95) when compared to PF exercise alone. Exercising leg blood flow [AA (-38.89 ± 62 mL/min); CA (+137.97 ± 62 mL/min) (p = .09)] or leg vascular conductance [AA (-1.00 ± .6 mL/min/mmHg); CA (-0.28 ± .4 mL/min/mmHg) (p = .35)] was not different between groups when evaluated during the CPT and expressed as change from PF exercise alone.

CONCLUSIONS: This study suggests that during lower limb exercise, young AA males, when compared to CA, are similarly resistant to reductions in lower limb vascular conductance in response to elevated sympathetic activity.

923 Board #49 May 27 2:30 PM - 4:00 PM
Abstract Withdrawn

924 Board #50 May 27 2:30 PM - 4:00 PM
Sex-differences In Exercising Hemodynamics: Role Of Exercising Muscle Mass

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(No relevant relationships reported)

Sex-differences in O₂ transport include O₂ content (C_aO₂) and quantity of muscle mass. **PURPOSE:** To determine their consequences on exercising hemodynamics with large (e.g., 2-leg cycling (BIKE)) vs. small (e.g., 1-leg knee extension (KE)) muscle mass. **METHODS:** Healthy young subjects (4M, 3W) completed BIKE and KE exercise tests. The femoral artery and vein were catheterized to measure leg blood flow (Q), C_aO₂, and mean arterial pressure (MAP). Vascular conductance (VC), O₂ delivery, and leg O₂ uptake (VO₂) were calculated. Measures were normalized to the right leg (BIKE) or quadriceps (KE) lean mass. Whole body VO₂ was measured with a metabolic cart. Men and women were compared at similar and maximal work rates. **RESULTS:** Body mass was greater in men (M: 80±6 vs. W: 59±12 kg, p=0.03). Although quadriceps mass (3.3±0.2 vs. 2.0±0.3 kg, p<0.001) and C_aO₂ were lower, women had a higher mass-specific Q, VC (p=0.054), O₂ delivery, and leg VO₂ to maintain whole body VO₂ during similar KE (Table 1). These differences were maintained during maximal KE, at which women tended to achieve a higher mass-specific work rate (21±2 vs. 25±3 W·kg⁻¹, p=0.10). They were also apparent during similar BIKE despite a lower leg lean mass in women (8.7±0.3 vs. 5.3±0.7 kg, p<0.001). However, the differences were no longer present during maximal BIKE when mass-specific work rate was similar (21±2 vs. 20±2 W·kg⁻¹, p=0.70) and whole body VO₂ was lower in women. **CONCLUSION:** These findings highlight a greater hemodynamic capacity for women to overcome differences in C_aO₂ and maintain whole body VO₂ at similar work rates during exercise. They also implicate the quantity of exercising muscle in facilitating the greater hemodynamic capacity and mass-specific work rate during maximal exercise with a small but not large muscle mass. Support: The Swedish National Centre for Research in Sports, Ministerio de Educacion y Ciencia of Spain, Dr. Manuel Morales Foundation, NSERC

Table 1 - Exercising hemodynamics (*p<0.05, **p<0.01, ***p<0.001 men vs. women)

	Similar KE		Maximal KE		Similar BIKE		Maximal BIKE	
	M	W	M	W	M	W	M	W
Work rate (W)	40	40	70±8	50±10*	230	213±42	365±17	220±53**
VO ₂ (L·min ⁻¹)	1.02±0.16	1.08±0.02	1.73±0.47	1.43±0.37	3.40±0.20	3.03±0.46	5.01±0.25	3.06±0.51**
Q (mL·min ⁻¹ ·kg ⁻¹)	1599±213	2934±636*	2294±301	3351±288**	616±55	1254±19***	1186±160	1300±88
C _a O ₂ (mL·dL ⁻¹)	19.3±1.2	16.7±1.9	19.7±0.9	16.9±1.4*	20.1±0.5	18.3±1.3*	20.2±0.8	18.5±1.0*
MAP (mmHg)	113±10	136±10*	135±17	145±15	113±7	121±6	120±17	123±11
VC (mL·min ⁻¹ ·mmHg ⁻¹ ·kg ⁻¹)	14.6±2.2	23.7±6.9**	18.3±1.6	28.6±2.8**	5.8±11	11.7±0.4***	11.3±1.6	12.4±0.9
O ₂ delivery (mL·min ⁻¹ ·kg ⁻¹)	310±50	488±102*	452±61	567±65***	124±13	230±15***	240±30	240±3
Leg VO ₂ (mL·min ⁻¹ ·kg ⁻¹)	163±31	307±83*	292±19	394±22**	91±12	190±15***	196±25	201±12

925 Board #51 May 27 2:30 PM - 4:00 PM

Effects Of Dietary Sodium Intake On Blood Flow Regulation During Exercise In Salt Resistant Individuals

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Effects of Dietary Sodium Intake on Blood Flow Regulation During Exercise in Salt Resistant Individuals

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PURPOSE: Dietary guidelines for sodium intake is less than 2,300 mg/day, yet 90% of Americans exceed this value. This study examined individuals resistant to salt-induced changes in blood pressure to determine the impact of a high sodium diet on blood flow regulation during upper and lower limb exercise. **METHODS:** Six young (25 ± 2 years) males followed recommended dietary sodium intake guidelines on two separate weeks, with one week supplemented with salt capsules (HS: 6,900 mg/day of sodium) and the other week supplemented with placebo capsules (LS: 2,300 mg/day of sodium). Resting central hemodynamic measurements [heart rate (HR), heart rate variability (HRV), and mean arterial pressure (MAP)] were evaluated the end of each diet. Peripheral hemodynamic measurements [blood flow (BF), shear rate (SR), and flow mediated dilation (FMD)/SR] of the brachial and superficial femoral artery were taken during rhythmic (1 Hz), progressive handgrip (HG) and plantar flexion (PF) exercise, respectively. Exercise workloads were three minutes in length and increased by increments of 8 kilograms until exhaustion. **RESULTS:** Between each diet (LS and HS) there were no significant differences in resting MAP (82 ± 4 v 80 ± 5 mmHg; p = 0.3), HR (56 ± 6 v 59 ± 10 bpm; p = 0.4), or HRV (2.7 ± 1.9 v 8.3 ± 15.1 LF/HF; p = 0.4). During progressive HG and PF exercise the BF, SR, and FMD/SR were significantly increased by workload (p < 0.03 for all), but not different between diets (p > 0.05 for all). **CONCLUSION:** Despite previous evidence reporting a HS diet can impair resting vascular function, this study revealed that peripheral vascular function and blood flow regulation during exercise is not impacted by a HS diet in salt resistant individuals.

926 Board #52 May 27 2:30 PM - 4:00 PM
Impact Of 6-month Exercise Training On Neurovascular Function In Persons With Spinal Cord Injury

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(No relevant relationships reported)

Accumulating evidence shows an exacerbated incidence of cognitive impairment after spinal cord injury (SCI); however, the physiology that underlies this apparent post-SCI cognitive decline is unknown.

PURPOSE: To investigate the impact of injury and 6-month full-body exercise training on neurovascular coupling in individuals with SCI.

METHODS: In 24 participants with SCI and 16 controls, we investigated hemodynamic (heart rate, blood pressure, CO₂) and middle cerebral artery blood flow velocity responses to a working memory task (neurovascular coupling) before and after training. Neurovascular coupling was compared across groups while accounting for injury parameters. Within individuals with SCI, 6-month changes in neurovascular coupling and its relation to changes in aerobic capacity were compared via linear mixed effect model.

RESULTS: Reaction time tended to be higher in individuals with SCI, especially those with high-level ($\geq T4$) injuries, possibly due to upper motor impairments. Neurovascular coupling was graded across task difficulty ($p < 0.01$), while injury did not have a significant impact (group effect $p = 0.99$, interaction $p = 0.70$). Individuals with low-level injuries ($< T4$) had higher aerobic capacity than those with high-level injuries ($p < 0.01$). Aerobic capacity increased significantly with training in both groups ($p < 0.01$). While there was no overall significant improvement in neurovascular coupling with training at the group level, the degree of improvement was closely related to that in aerobic fitness in individuals with high-level ($R^2 = 0.19$, $p = 0.03$) but not low-level ($R^2 = 0.04$, $p = 0.46$) injuries, which translated to an increase in reaction time ($R^2 = 0.16$, $p = 0.05$).

CONCLUSIONS: The apparent cognitive impairment after SCI is primarily due to physical deconditioning, rather than injury itself, and can be mitigated by aerobic exercise training. This has significant implications for long-term care and management for individuals with SCI.

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927 Board #53 May 27 2:30 PM - 4:00 PM
L-citrulline Does Not Change Blood Flow Kinetics At The Onset Of Exercise In Young Women

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Oral supplementation with L-citrulline (CIT) has been reported to improve muscle oxygenation during moderate-intensity exercise in young men; however, examination of the impact of CIT in young women is scarce. **PURPOSE:** To examine the influence of CIT on muscle blood flow responses to exercise in young women. **METHODS:** Women were assessed during the follicular ($n = 13$, 24 ± 2 y) and luteal ($n = 11$, 25 ± 2 y) phases of the menstrual cycle. Supplementation with CIT (6 g/day) or placebo occurred 7 days prior to the testing day in a crossover design across two menstrual cycles. All women performed rhythmic handgrip exercise at 10% maximal grip strength while forearm blood flow (FBF) was measured in the right brachial artery using Doppler ultrasound. FBF was calculated per duty cycle (contract:relax, 1:2s) before being fit with a monoexponential model. Amplitude of the FBF response and the number of duty cycles for FBF to reach 63% of the steady-state amplitude (τ FBF) were derived from the model. **RESULTS:** Menstrual cycle groups were similar in age, body mass index, resting brachial artery diameter, and maximal grip strength (all $p > 0.10$). CIT did not change the amplitude of FBF or τ FBF as compared to placebo in women tested during the follicular (CIT vs. placebo: 166 ± 50 vs. 158 ± 52 ml/min, $p = 0.41$; 7 ± 5 vs. 6 ± 3 duty cycles, $p = 0.28$) or luteal phases (163 ± 41 vs. 173 ± 49 ml/min, $p = 0.34$; 11 ± 5 vs. 9 ± 4 duty cycles, $p = 0.26$). Interestingly, the amplitude of the FBF response was similar between women tested during the follicular (163 ± 44 ml/min) and luteal (170 ± 41 ml/min, $p = 0.68$) phases, but τ FBF was slower for women tested during the luteal as compared to the follicular phase (11 ± 4 vs. 7 ± 3 duty cycles, $p = 0.01$). **CONCLUSION:** Muscle blood flow response to rhythmic handgrip exercise was not changed by short-term supplementation with CIT in young women irrespective of menstrual cycle phase.

B-66 Free Communication/Poster - Disease

Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
 Room: CC-Exhibit Hall

928 Board #54 May 27 2:30 PM - 4:00 PM
Hypertrophic Cardiomyopathy And Heart Failure With Preserved Ejection Fraction: A Common Phenotype Explaining Exercise Intolerance

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(No relevant relationships reported)

Hypertrophic cardiomyopathy (HCM) is characterized by diastolic dysfunction which contributes to exercise intolerance despite a preserved ejection fraction. This phenotype is strikingly similar to that reported in HFpEF. While disease etiologies clearly differ and HCM patients may not have heart failure, the degree of exercise intolerance is comparable and may be due to similar impairments in cardiac function. **PURPOSE:** To compare systolic function and early diastolic relaxation during submaximal cycle exercise in HCM and HFpEF patients. **METHODS:** Patients with HCM without heart failure ($n = 12$, 48 ± 7 years) were compared to HFpEF patients ($n = 12$, 67 ± 5 years), and old ($n = 11$, 70 ± 5 years) and young ($n = 11$, 31 ± 3 years) controls. Subjects underwent semi-recumbent echocardiography at rest and during steady state exercise at a heart rate of 100bpm. Tissue Doppler velocities of the septal and lateral mitral annulus were averaged during systole (S') and early diastole (E'), and the difference in resting and exercise velocities were calculated. **RESULTS:** There were no differences in resting S' between groups, and all subjects similarly increased S' from rest to exercise (Figure). HCM patients had significantly lower resting E' velocities compared to HFpEF patients and young controls ($P = 0.032$ and $P < 0.001$, respectively). While all groups augmented E' from rest to exercise ($P < 0.05$), the magnitude of the increase was significantly less in patients with HCM compared to young and old controls but indistinguishable from HFpEF patients. **CONCLUSION:** Patients with HCM are unable to increase E' from rest to exercise to the same extent as healthy young and old individuals. In fact, augmentation of early diastolic relaxation was similar between HCM and HFpEF patients, despite the HCM cohort being almost 20 years younger and without heart failure. Although the disease etiologies differ, these data suggest a common phenotype explaining exercise intolerance in HCM and HFpEF.

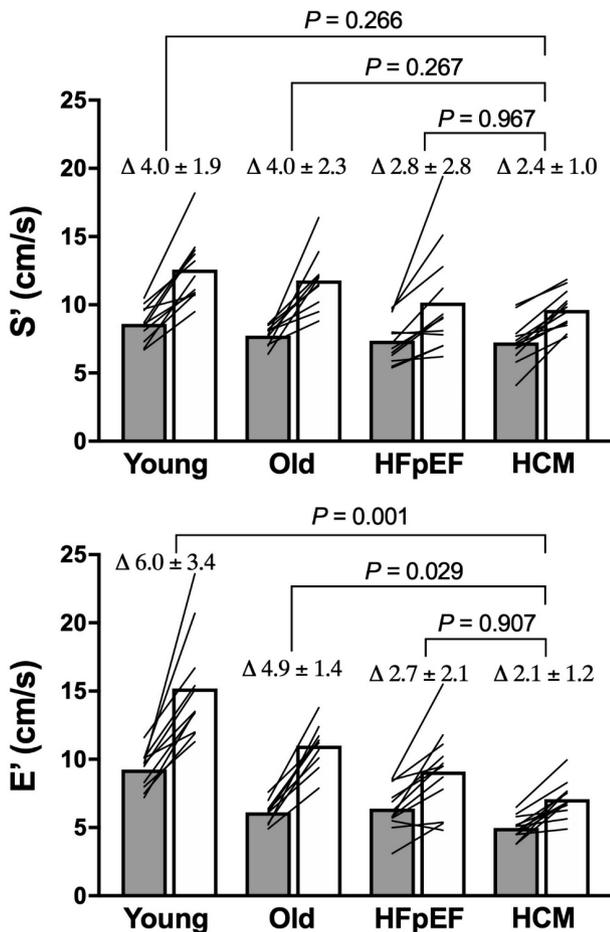


Figure. Systolic (S') and diastolic (E') tissue Doppler velocities at rest (grey bar) and during steady state exercise (white bar) in healthy young and old subjects, and patients with HFpEF and HCM. Δ indicates the mean change and standard deviation from rest to exercise.

and CON (86±12 mmHg; P=0.17) and MAP increased similarly during IHG (ARNi: Δ 10±12 vs. CON: 8±10 mmHg) and PEI (ARNi: Δ 6±4 vs. CON: 5±10 mmHg; ANOVA P>0.90). Resting MAP was reduced after 12 weeks of ARNi (87±7 mmHg) and was unchanged in CON (91±20 mmHg; ANOVA interaction P=0.048). However, the increase in MAP during IHG (ARNi: Δ 11±8 vs. CON: 13±6 mmHg; P>0.60) and PEI (ARNi: Δ 8±6 vs. CON: 12±3 mmHg; P>0.60) after 12 weeks was not impacted by ARNi (ANOVA time P=0.24) or different between groups. Maximal raw force and RPE ratings during IHG were similar between groups and not different following 12 weeks of ARNi (ANOVA P>0.70). **CONCLUSION:** These preliminary data suggest that although 12 weeks of ARNi therapy reduces resting MAP in HFREF, there are no significant reductions on MAP response to exercise. Additional data are needed to fully understand the impact of ARNi on cardiovascular responses to exercise in HFREF. Supported by ACSM grant 19-00934 and P20 GM 113125.

930 Board #56 May 27 2:30 PM - 4:00 PM
The Feasibility And Physiological Responses Of Single Leg Cycling In Individuals With Hemiparesis
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INTRODUCTION: The primary treatment for individuals post stroke is intensive rehabilitation focusing on improving and restoring motor control. Typically, the rehabilitation does not focus on increasing cardiovascular fitness due to the inability of these individuals to coordinate those modalities of aerobic exercise (i.e. walking and cycling). Both cycling and walking can promote increases in cardiovascular fitness in individuals' post-stroke but most of the increases are minimal. Single leg cycling (SLC) is a modality of exercise that has never been attempted by this population. Working around their affected side while utilizing SLC may be what they need as a means to get a quality cardiovascular workout. **PURPOSE:** The purpose of this study aims to examine feasibility and safety of SLC in this population as well as how effective it may be at increasing oxygen consumption, heart rate, blood pressure, cognitive function, cerebral blood flow and proprioception compared to traditional double leg cycling (DLC). **METHODS:** Individuals with completed a bout of DLC and SLC. We continuously collected metabolic data (Oxygen consumption, resting exchange ratio), cardiovascular data (Heart rate, blood pressure, cardiac output, stroke volume) as well as tissue saturation via Near infrared spectroscopy. The subjects were randomized into either SLC or DLC. We started both exercise bouts at a wattage they could handle and increased by 10w every 30 seconds until volitional fatigue or they reached a goal of 55% of their heart rate reserve. They had a 15-minute washout period in between exercise bouts. **RESULTS:** Vo₂ was elevated during the SLC trial compared to the DLC trial (p=0.05). HR and BP were also elevated during the SLC trial compared to DLC (p=0.01). There was no significant difference in RPE across the two conditions. **CONCLUSION:** The results suggest that single leg cycling may be more beneficial to individuals with hemiparesis. Elevated Vo₂, HR, and BP during SLC suggest that they were able to work around their affected side and coordinate this exercise more effectively than traditional DLC.

929 Board #55 May 27 2:30 PM - 4:00 PM
Effects Of Angiotensin Receptor Nephrylsin Inhibition On Blood Pressure Response To Exercise In Heart Failure
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Angiotensin Receptor Nephrylsin inhibitors (ARNi) is a new class of drug approved for heart failure patients with reduced ejection fraction (HFREF). ARNi reduces resting blood pressure (BP) in HFREF. However, the effect of ARNi on BP response to exercise in HFREF has not been established. **PURPOSE:** We hypothesized that BP response to isometric handgrip exercise (IHG) would be attenuated in HFREF after 12 weeks of ARNi therapy. **METHODS:** HFREF participants were recruited from local cardiology clinics and completed a baseline experimental visit and follow up visit 12 weeks later: 6 patients were prescribed ARNi by their cardiologist [64±10 years, Men: 5, BMI: 30±6 kg/m², EF: 26±7%; 4 with Non-ischemic cardiomyopathy (NICM)], and 5 participants continued on conventional treatment [CON: 57±6 years, Men: 2, BMI: 27±5 kg/m², EF: 30±4% and NICM: 3; all P = NS]. During each experimental visit, BP was measured at rest and during 2-minutes IHG at 30% maximal voluntary contraction followed by post-HG exercise ischemia (PEI) to isolate the metaboreflex. The change in mean arterial pressure (Δ MAP) from baseline to exercise and PEI was assessed; statistical comparisons were performed using 2x2 repeated-measures ANOVA. **RESULTS:** At baseline, resting MAP was similar between ARNi (96±14 mmHg)

931 Board #57 May 27 2:30 PM - 4:00 PM
Sensory Neuron Sensitization By Pkc-induced Trpv1 Phosphorylation In Type 2 Diabetic Rats
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 (No relevant relationships reported)

Skeletal muscle reflex-induced increases in blood pressure are exaggerated during exercise in type 2 diabetes mellitus (T2DM). We previously demonstrated that skeletal muscle afferent discharge in response to capsaicin, a transient receptor potential cation channel subfamily V member 1 (TRPV1) agonist, is heightened in T2DM likely contributing to the potentiated pressor response. However, the underlying mechanisms remain unclear. Evidence suggests that the high glucose levels in T2DM sensitize sensory neurons through the receptor for advanced glycation end products (RAGE)/ protein kinase C (PKC) pathway in dorsal root ganglia (DRG). Moreover, early-stage diabetes associated with TRPV1 overactivity is mediated through PKC. Therefore, it was hypothesized that the augmentation in muscle afferent discharge in T2DM previously reported is due to the phosphorylation of TRPV1 via an overactive RAGE/PKC pathway. **PURPOSE:** To investigate 1) the impact of T2DM on plasma levels of advanced glycation end products (AGE) and high-mobility group box-protein 1 (HMGB-1), both RAGE ligands, and 2) the impact of T2DM on the RAGE/PKC pathway including the phosphorylation of TRPV1 in DRG subserving skeletal muscle afferents. **METHODS:** For 14-16 weeks, Sprague-Dawley rats were given either a normal diet (control) or a high fat diet in combination with a low dose (35 mg/kg) of

streptozotocin (T2DM). Plasma insulin, HMGB1 and AGE were determined using ELISA. RAGE, phosphorylated PKC and TRPV1 protein levels were quantified in DRG by western blotting. **RESULTS:** After overnight fasting, T2DM rats exhibited hyperglycemia (95 ± 6 vs. 156 ± 18 mg/dL, $P < 0.05$) and hyperinsulinemia (1.6 ± 0.2 vs. 4.1 ± 0.4 ng/mL, $P < 0.05$). HMGB1, AGE and RAGE did not differ between groups. Phosphorylated PKC (1.0 ± 0.1 vs. 1.2 ± 0.2 arb unit, $P = 0.08$) and TRPV1 (1.0 ± 0.3 vs. 1.3 ± 0.4 arb unit, $P = 0.08$) levels in DRG tended to be greater in T2DM than control.

CONCLUSIONS: These findings suggest that phosphorylated TRPV1 may be increased by PKC overactivity in DRG of T2DM but acts independently of RAGE. Importantly, these changes may mediate the sensitization of skeletal muscle afferents facilitating the exaggerated pressor response to exercise characteristic of T2DM.

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932 Board #58 May 27 2:30 PM - 4:00 PM
Acute Effect Of Hyperglycemia On The Mechanoreflex And Metaboreflex

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Recent studies in both humans and rodents have shown that the mechanoreflex and metaboreflex are exaggerated in type 2 diabetes mellitus (T2DM). Hyperglycemia is a main characteristic of T2DM and is known to cause damage to both cardiovascular and nervous system structures. However, the effects of the presence of hyperglycemia on the mechanoreflex and metaboreflex are not known. **PURPOSE:** To determine the acute effect of hyperglycemia on the mechanoreflex and metaboreflex.

METHODS: Experiments were conducted after an overnight fast in unanesthetized, decerebrated healthy male and female Sprague-Dawley rats. The mechanoreflex was evoked by stretching the Achilles tendon for 30 s and the metaboreflex was evoked by locally injecting lactic acid (0.2ml, 24mM) into the hindlimb. Time and dosage for glucose infusion were selected based on a preliminary study that showed infusing 250 mg/ml of glucose solution for 15 min into the hindlimb circulation, with blood flow to and from the hindlimb restricted, would elevate local blood glucose concentration to the same degree as that seen in T2DM rats with an exaggerated exercise pressor reflex. To elicit an acute hyperglycemia environment while preventing an endogenous insulin response, somatostatin (3.9 ug/100 ul) was infused systemically and simultaneously along with local glucose infusion. Changes in mean arterial pressure (Δ MAP) and heart rate (Δ HR) in response to tendon stretch and lactic acid injection were measured and compared before and after infusion.

RESULTS: We found that the peak pressor and cardioaccelerator responses to tendon stretch were not significantly affected by acute hyperglycemia (Δ MAP before: 12 ± 2 mmHg, after: 12 ± 3 mmHg, $n=6$, $p>0.05$; Δ HR before: 10 ± 3 bpm, after: 10 ± 3 bpm, $n=6$, $p>0.05$). Likewise, the pressor and cardioaccelerator responses to lactic acid were not significantly affected by acute hyperglycemia (Δ MAP before: 13 ± 2 mmHg, after: 16 ± 3 mmHg, $n=10$, $p>0.05$; Δ HR before: 10 ± 2 bpm, after: 12 ± 5 bpm, $n=10$, $p>0.05$).

CONCLUSIONS: The acute presence of hyperglycemia in the local circulation of the hindlimb does not contribute to the exaggerated mechanoreflex or metaboreflex. This project was supported by NIH R01 HL144723.

933 Board #59 May 27 2:30 PM - 4:00 PM
The Role Of Camk2δ-MEF2 Signaling Pathway In Aerobic Exercise-induced Improvement Of Cardiac Function In Hypertension

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Objective: The purpose of this study was to investigate the effects of aerobic exercise on the Calcium/calmodulin-dependent protein kinase II δ (CaMKII δ)-Myocyte enhancer factor-2(MEF2) signaling pathway in SHR myocardial cells, and the role of the A-kinase anchoring protein 150(AKAP150).

Methods: 12-week-old male SHR and WKY rats were randomly assigned to sedentary groups (WKY-SED, SHR-SED) and exercise training groups (WKY-EX, SHR-EX). Exercise groups were performed a 12-week moderate intensity treadmill running. After 12 weeks, the myocardial cells were enzymatically isolated. The experimental methods include HE staining, the Langendorff technique of isolated heart perfusion, immunohistochemistry, immune cell fluorescence, Western blot.

Results: 1) After 12 weeks of exercise, SBP in both WKY-EX and SHR-EX were significantly lower than that of their sedentary counterparts. 2) Compared with the WKY-SED group, the SHR-SED group +dp/dtmax, -dp/dtmax significantly decreased, and the SHR-EX group was significantly higher than the SHR-SED group, +dp/dtmax significantly increased, -dp/dtmax decreased ($P < 0.01$), LVSP increased ($P < 0.01$). 3) The fluorescence intensity of CaM and AKAP150 in the SHR-SED group was higher

than WKY-SED group ($P < 0.01$), and the fluorescence intensity of the SHR-EX group AKAP150 was higher than SHR-SED group ($P < 0.01$), and the expression of CaM was lower than the SHR-SED group ($P < 0.01$). 4) The protein expression of p-CaMKII δ , CaMKII δ and AKAP150 in the SHR-SED group was higher than that in the WKY-SED group ($P < 0.01$). The expression of p-CaMKII δ /CaMKII δ , p-HDAC4/HDAC4 and MEF2 of SHR-EX group are lower than the SHR-SED group ($P < 0.01$). The expression of AKAP150 of SHR-EX was higher than SHR-SED group ($P < 0.01$).

Conclusion: Aerobic exercise reduced the activity of the CaMKII δ -MEF2 signaling pathway and increased the expression of AKAP150 in the SHR myocardial, which is one of the molecular mechanisms to improve the function of the heart.

Key words: cardiac function; CaMKII δ -MEF2 signaling pathway; aerobic exercise; AKAP150

B-67 Free Communication/Poster - Renal Physiology

Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
 Room: CC-Exhibit Hall

934 Board #60 May 27 2:30 PM - 4:00 PM
Physical Activity Is An Important Prescription For Kidney Transplant Patients And Those Receiving Dialysis

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Chronic kidney disease (CKD) affects 13% of U.S. adults. Patients endure a disproportionate amount of cardiovascular complications with nearly 50% of dialysis patients experiencing a premature death related to cardiovascular disease. Although participation in regular physical activity can mitigate CKD complications, more than half of nephrologists fail to recommend it to their patients. **PURPOSE:** To investigate the effects of physical activity on hemoglobin and health outcomes in CKD patients.

METHODS: We analyzed patients admitted to a hospital in the Midwestern United States. A comprehensive metabolic panel and health history, including physical activity (PA) levels, were obtained upon admittance. Patients were assigned a status of either active (N=23) or sedentary (N=45). Independent-samples t-tests and chi-squared tests compared sedentary and active groups. Linear and negative binomial regression models tested the effect of PA on Hb and hospital length of stay (LOS). **RESULTS:** Across the total sample, patients were 64.7 ± 17.4 years old, 40.3% were obese, they remained in the hospital for 6.9 ± 7.5 days, 16.2% received dialysis during treatment, 5.9% had a history of kidney transplant, and 4.4% died. Patients with a history of transplant had a reduction in Hb of 3.7 g/dL ($p < 0.001$) and exhibited a trend for a higher rate of engagement in PA ($p = 0.073$). Patients receiving dialysis had 2.4 g/dL lower Hb ($p = 0.006$) and comparable rates of PA ($p = 0.616$). All cases of mortality occurred in the sedentary group, and the Hb of patients who expired was 2.2 g/dL lower; owing to a small sample, this failed to reach significance ($p = 0.179$). Physically active patients had 1.4 g/dL higher Hb ($p = 0.041$). Holding constant transplant status and whether patients received dialysis, PA predicted an increase in Hb of 1.75 g/dL ($p = 0.007$; 95% CI: 0.489 to 3.011) and a 96.4% shorter LOS ($p = 0.005$; 95% CI of IRR: 0.003 to 0.373). In turn, Hb was a trending predictor of mortality; each additional g/dL predicted a 38.3% reduction in odds ($p = 0.069$; 95% CI of OR: 0.367 to 1.038). **CONCLUSION:** Independent of dialysis and transplant status, engagement in regular physical activity elicited an increase in Hb and shortened hospital stays among CKD patients. Our findings reinforce the importance of physical activity prescription as a standard component of care.

935 Board #61 May 27 2:30 PM - 4:00 PM
Evaluating Acceptability Domain Of An Intradialytic Exercise Program-Patient Adherence And Nursing Documentation

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 (No relevant relationships reported)

For patients with end stage renal disease, exercise during hemodialysis (HD), intradialytic exercise (IDE), may mitigate treatment related symptoms including

cramping, restless legs, and fatigue. In Alberta Kidney Care North, IDE is supervised by a clinical exercise physiologist (CEP) and dialysis unit staff assist with program delivery.

PURPOSE: The aim of this study was to examine program responsiveness to the patients' needs (acceptability) by evaluating documentation of patient adherence. **METHODS:** 1,752 exercise sessions were audited at 6 hemodialysis units. Patient reported participation was collected directly from patients within 10 days of the audit. Baseline and subsequent physical reassessments were examined to verify the validity of patient recall, relative to the required exercise dose. Data points were divided into 2 categories: active IDE participants (A-IDE) and non-active IDE (NA-IDE) participants. A-IDE were defined as patients who completed at least 1 IDE session/week for 4 weeks. NA-IDE participants were defined as those previously assessed and programmed but recently discharged, on a medical hold, or participating in a home exercise program at the time of the audit.

RESULTS: Of the 1,332 A-IDE sessions audited, nurses documented patient participation 28.08%, no participation 49.4%, and did not document 22.52%. Patients reported adherence 63.74%. Physical reassessment data showed improved outcome measures thereby, validating patient recall of adherence. Of 420 NA-IDE HD data sheet analyzed, nurses documented patient participation 1.9%, no participation 70.24%, and did not document 27.85%. Patient report and documentation agreed 2.7%. **CONCLUSIONS:** Assessment of IDE participation is an integral component to the evaluation of an IDE program. Discrepancies between patient report and documented adherence exist. We found that patient report is valid, based on improved measures at reassessments; however, we must establish feasible methods for dialysis staff to collect adherence when CEPs are not present. Staff training, including regular surveys to assess staff knowledge of processes, may provide valuable information on units with a high staff turnover. Implementing an IDE prescription confirmation, as a standard practice in HD treatment preparation, may affirm participation.

936 Board #62 May 27 2:30 PM - 4:00 PM
Resveratrol Ameliorates Exhaustive Exercise-induced Acute Kidney Injury In Rats Via Sirt1/nf-κB Pathway Modulation

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PURPOSE: Resveratrol is a naturally sirtuin1 activator, its renal protective effects have been validated in a variety of animal models of kidney disease, however, there is still no systematic study on resveratrol to improve rat kidney damage caused by exhaustive training, and whether the regulation of renal inflammatory response is through SIRT1/NF-κB signaling pathway.

METHODS: In this study, 32 SD rats were randomly divided into: control group (Con), resveratrol group (Rsv), exhaustive exercise group (Ex), exhaustive exercise+resveratrol group (Ex+Rsv). Rsv and Ex+Rsv group were given resveratrol(50mg/kg body weight)by gavage, Ex and Ex+Rsv group performed four weeks of exhaustive training. Anesthesia treatment was taken 24 hours after the last training. **RESULTS:** The results showed that Scr in the Ex group (175.66 ± 16.08 vs. 153.34 ± 8.67 , $P < 0.01$), BUN (6.67 ± 0.53 vs. 5.37 ± 0.19 , $P < 0.01$) and urinary NGAL (9.01 ± 0.18 vs. 7.48 ± 0.31 , $P < 0.01$) were increased significantly compared with the Con group. The expression of NF-κB P65 in Ex group was significantly increased (0.77 ± 0.10 vs. 0.27 ± 0.03 , $P < 0.01$). The expression of SIRT1 in Rsv and Ex+Rsv group were significantly higher than that in the Con (0.90 ± 0.14 vs. 0.43 ± 0.15 , $P < 0.05$) and Ex (1.0 ± 0.28 vs. 0.38 ± 0.12 , $P < 0.01$) respectively; Compared with the Ex group, the NF-κB P65 (0.77 ± 0.11 vs. 0.27 ± 0.03 , $P < 0.05$) and Ac-NF-κB P65 (0.52 ± 0.13 vs. 0.78 ± 0.11 , $P < 0.05$) in Ex+Rsv showed a significant decrease in protein level expression. **CONCLUSIONS:** The above results indicate that high-intensity exhaustive exercise leads to renal injury in rats and activates the expression of NF-κB in rat kidney. Resveratrol can significantly increase the expression of SIRT1 at the protein level and increase the deacetylation to reduce the level of acetylation of NF-κB P65 protein, further reducing the expression of NF-κB. The mechanism by which resveratrol reduces the inflammatory response induced by exhaustive training in rats may be related to the SIRT1/NF-κB pathway.

937 Board #63 May 27 2:30 PM - 4:00 PM
Role And Determinants Of Chronotropic Incompetence In A Kidney Transplant Recipients Population

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Hemodialysis patients reveal a significantly reduced exercise capacity, often associated with the presence of Chronotropic Incompetence (CI). Both these conditions are well known cardiovascular risk factors. Very limited data exists on CI in Kidney Transplant Recipients (KTRs).

PURPOSE: To describe the prevalence of CI in a KTRs population and to analyze its potential determinants and its effects on functional capacity. **METHODS:** Consecutively recruited KTRs 3 months after transplantation underwent a Cardiopulmonary Exercise Test with an incremental protocol. 175 KTRs were included and the test was repeated in 60 subjects after a mean period of 22 months. Laboratory and drug therapy data were collected. CI was defined by the formula: $MCI = (HR_{peak} - HR_{rest}) / (HR_{predicted} - HR_{rest}) / (\dot{V}O_{2,peak} - \dot{V}O_{2,rest}) / (\dot{V}O_{2,predicted} - \dot{V}O_{2,rest})$ (MCI: metabolic chronotropic index, HR: heart rate, $\dot{V}O_2$: oxygen consumption). The prevalence of CI was calculated on 175 KTRs, while the multivariate regression analysis was conducted on 60 KTRs that repeated the test.

RESULTS: In the whole population the CI prevalence was 30.9%. The 60 reassessed KTRs (age 51.6 ± 1.3 years, 77% men) showed significant differences between 3 and 22 months after transplantation in the hemoglobin level (123.4 ± 16.6 vs 136.4 ± 17.8 g/L, $p < 0.001$) and in the proportion of beta-blocker therapy (50 vs 23.3%, $p < 0.001$), but no differences in $\dot{V}O_2/kg$ peak (26.5 ± 7.0 vs 26.8 ± 8.2 ml/kg/min, $p = 0.85$) nor in CI prevalence (31.7 vs 36.7 , $p = 0.41$). KTRs with CI demonstrated no significant differences of $\dot{V}O_2,peak$ nor at 3 or at 22 months after transplantation, compared to KTRs without CI. The only determinant of CI at the two visits was the presence of arterial hypertension. Gender, age, BMI, the presence of diabetes, the type of immunosuppressive therapy, the duration of follow-up and beta-blocker therapy did not appear to be determinants of CI. **CONCLUSIONS:** KTRs are characterized by reduced functional capacity but the CI does not seem to significantly limit their functional level. In contrast to what it would be expected, beta-blocker therapy does not appear to be a CI determinant, while its only significant determinant was arterial hypertension.

938 Board #64 May 27 2:30 PM - 4:00 PM
Circulating Steroid Changes In Response To Extreme Physical Stress In Male Athletes

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PURPOSE: Athletes put themselves on a regular physical load to stay competitive. Steroids play a significant role in the regulation of cardiovascular, metabolic and many other functions in stress situations. Our aim was to monitor the response of steroid hormones to physical stress.

METHODS: We investigated the plasma levels of 14 different endogenous steroid molecules in a model of extreme acute physical stress (vita maxima treadmill test) in male athletes (n=45; median age=21). Steroid levels were measured using liquid chromatography-tandem mass spectrometry. Cardiovascular-, metabolic-, and gas-exchange parameters were also evaluated. All values were measured at baseline, at maximum stress and 30 minutes into the rest period.

RESULTS: The plasma concentrations of 9 steroids elevated significantly ($p < 0.05$) at the peak compared to baseline, and 11 metabolites elevated significantly ($p < 0.05$) in the rest period compared to baseline. After load 9 steroid showed an increase of at least 50% compared to baseline. Aldosterone showed the highest increase at peak, with 75.83%, and in the rest phase corticosterone elevated with 123.36%. Blood pressure, heart rate and lactate parameters increased significantly at the peak of the load ($p < 0.01$). Cardiac and metabolic values did not correlate with the steroid concentrations. We calculated 11 enzyme activities from the product and substrate ratios, and we found significant differences. There were 4 enzymatic pathway which showed significant increase. 11β-HSD ($p < 0.01$) and aldosterone-synthase ($p < 0.01$) elevated at the peak. In the restitution 17,20-lyase and 11β-HSD in another pathway increased significantly ($p < 0.01$).

CONCLUSIONS: All three lines of the adrenal cortex are affected by extreme physical stress. Cardiovascular, metabolic and gas-exchange parameters increase early,

followed by changes in the levels of endogenous steroids, as a later response. We showed for the first time in this model the elevation of some steroids, like aldosterone, corticosterone and others, and identified the enzymatic pathways involved. Literature results were partially reproduced, with further changes in steroid levels revealed by our model. This research was supported by: GINOP-2.3.2-15-2016-00047, Széchenyi 2020., 20765/3/2018 FEKUTSRAT projects.

939 Board #65 May 27 2:30 PM - 4:00 PM
Renal And Segmental Artery Hemodynamic Response To Mild Hypercapnia

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The risk of kidney disease is elevated in conditions associated with sustained or transient elevations in the partial pressure of carbon dioxide, such as chronic obstructive pulmonary disease or sleep apnea. Indirect evidence indicates that hypercapnia induces renal vasoconstriction, a response that differs from the vasodilatory response that occurs in most other vascular beds. Thus, one mechanism underlying an increased risk of kidney disease is that repeated hypercapnia-induced episodes of renal vasoconstriction reduce oxygen delivery and compromise renal oxygenation. However, it is unknown if hypercapnia elevates vascular resistance in vessels going to or within the kidneys. **PURPOSE:** To test the hypothesis that breathing a hypercapnic gas mixture increases vascular resistance in the renal and segmental arteries. **METHODS:** After 45 min of supine rest, renal hemodynamics were assessed in eleven healthy adults (27 ± 4 years, 5 females) immediately prior to (AIR) and while breathing a 3% CO₂, 21% O₂, 76% N₂ gas mixture for 5 min (CO₂). The partial pressure of end-tidal CO₂ (PETCO₂, capnography) and mean arterial pressure (MAP, finger photoplethysmography) were measured continually. Blood velocity (BV) in the distal segment of the right renal artery (Renal) and the middle portion of the same segmental artery within a given subject (Segmental) were assessed using the coronal approach via Doppler ultrasound. Vascular resistance (VR) was calculated as MAP/BV. **RESULTS:** CO₂ increased PETCO₂ (45 ± 3 vs. 48 ± 3 mmHg, P<0.01). CO₂ did not change MAP (AIR: 90 ± 4, CO₂: 90 ± 5 mmHg, P=0.83). In the renal artery, CO₂ reduced BV (33.7 ± 8.0 vs. 31.3 ± 7.7 cm/s, P=0.02), and elevated VR (2.8 ± 0.9 vs. 3.1 ± 1.0 mmHg/cm/s, P=0.03). Similarly, in the segmental artery, CO₂ reduced BV (24.5 ± 5.9 vs. 22.0 ± 4.6 cm/s, P<0.01) and increased VR (4.0 ± 1.1 vs. 4.3 ± 1.1 mmHg/cm/s, P<0.05). **CONCLUSION:** These findings suggest that mild hypercapnia elevates vascular resistance in the renal and segmental arteries.

940 Board #66 May 27 2:30 PM - 4:00 PM
Heart Rate Variability Responses To Exercise In Mid-spectrum Chronic Kidney Disease

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 (No relevant relationships reported)

BACKGROUND: Heart rate variability (HRV) is a measure of autonomic nervous system (ANS) activity, and decreased HRV is associated with many cardiovascular conditions. Chronic kidney disease (CKD) is characterized by a decrease in renal function and may be associated with ANS imbalances in the renal vasculature. Low HRV is associated with CKD incidence. Exercise is able to alter HRV by modulating the ANS. The effect of exercise on HRV in mid-spectrum CKD patients remains understudied. **PURPOSE:** To determine the effect of steady-state exercise (SSE) and high-intensity interval exercise (HIIE) on post-exercise HRV in patients with stage 3 or 4 CKD. **METHODS:** Twenty participants with stage 3 or 4 CKD (n = 6 men; n = 14 women; age 62.0 ± 9.9 yr; weight 80.9 ± 16.2 kg; body fat 37.3 ± 8.5% of weight; VO_{2max} 19.4 ± 4.7 ml/kg/min, eGFR 51.5 ± 6.82). On separate days, each participant completed 30 minutes of aerobic exercise on the treadmill with exercise intensities set at 65% VO₂ reserve for SSE and 90% and 20% of VO₂ reserve in 3:2 min ratio for HIIE in a randomized crossover design. Both conditions averaged ~ 65% VO₂ reserve. HRV was measured at baseline, immediately post-exercise (IPE), 1-hr post-exercise, and 24-hr post-exercise. HRV was measured for 5 mins in the supine position using an elastic belt and Bluetooth monitor (Polar H7). CardioMood software was used to process HRV variables high frequency (HF), low frequency (LF), and standard deviation of all NN intervals (SDNN). Data were analyzed using 2 (condition) by 4 (time) repeated-measures ANOVAs. Data violated normality and were natural log (ln) transformed prior to analysis. Significant main effects were followed up using pairwise comparisons using a Bonferroni adjustment for multiple comparisons. All analyses were performed using SPSS (v.26). **RESULTS:** For ln LF/HF there were no significant main effects for exercise condition, time, or their interaction (p > 0.05). For ln HF (F

= 3.507, p < 0.05, η_p² = 0.156). In LF (F = 3.093, p < 0.05, η_p² = 0.140), and ln SDNN (F = 3.761, p < 0.05, η_p² = 0.165) there was a significant main effect for time. Post-hoc comparisons revealed that HF, LF, and SDNN were lower IPE than for all other time points. **CONCLUSION:** Thirty minutes of aerobic exercise transiently decreases HRV in mid-spectrum CKD patients. This response was not modified by exercise condition.

941 Board #67 May 27 2:30 PM - 4:00 PM
INCREASES IN PHYSICAL CAPACITY (VO2 PEAK) IMPROVES RENAL PROTECTIVE EFFECTS IN CKD AND MITOCHONDRIAL FUNCTION

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 (No relevant relationships reported)

PURPOSE: Physical exercise improves mitochondrial function and biogenesis. It is common for CKD patients to be physically inactive having less physical and functional capacity when compared to the general population. The aim of this study was to evaluate physical capacity, renal function and mitochondrial function in rats with CKD by nephrectomy 5/6 (Nx5/6)

METHODS: Adult Wistar rats were divided into groups (n=8): SHAM; Sedentary+Nx5/6+Sedentary (Sed), Sedentary+Nx5/6+Exercise (SE), Exercise+Nx5/6+Sedentary (ES) and Exercise+Nx5/6+Exercise (Exe). The physical capacity was performed with ergospirometry test (Vo2 peak) and maximal exercise test (Mtest). EXE periods were as follows: 40-60min/day, 5 days a week, during 8 weeks, 40 to 60% of Mtest. We evaluated proteinuria (uProt), blood urea nitrogen (BUN) and blood pressure (BP). By Western Blotting evaluated renal AMPK Pathway (AMPK and PGC1- alpha) was

RESULTS: The Physical Capacity (VO2 peak) was increased in SE and Exe vs Sed (31.8±0.7; 35.2±0.9 vs 23.1±1.8. p<0.05, respectively), and Mtest was improved in SE and Exe vs Sed (34.2±2.1; 37.9±1.7 vs 24.8±0.6. p<0.05, respectively). The Exe group presented a significant reduction in proteinuria when compared to the SE and ES (61.1±20.9 vs 173±39.2 vs 124.4±14.1. p <0.05, respectively). BUN was higher in SE and ES vs Exe (57.2±7.4 vs 65.6±7.8 vs 51.1±7.4. p <0.05, respectively). There was a decrease in BP in the SE and Exe groups when compared with the Sed group (215±1 and 219±2 vs 251±2, p <0.05, respectively), but the blood pressure values still remained high. The Renal AMPK Pathway was reduced in all group vs Sed in terms of protein levels (AMPK and PGC1- alpha)

CONCLUSIONS: The Increased physical capacity Vo2 peak and Mtest minimized the impact of Nx5/6 in the CKD, attenuating proteinuria, an important index of progressive loss of renal function and to improve mitochondrial function. Finally, previous exercise induced protection for CKD, especially under this experimental protocol. Thus, it is reasonable to suggest that exercise may be an additional strategy to be employed in CKD

942 Board #68 May 27 2:30 PM - 4:00 PM
Overshoot Of The Respiratory Exchange Ratio During Recovery From Maximal Exercise In Kidney Transplant Recipients

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 (No relevant relationships reported)

PURPOSE: The overshoot of the respiratory exchange ratio (RER) during recovery from maximal cardiopulmonary exercise testing (CPET) has been found reduced in magnitude among patients with heart failure, possibly due to the slow recovery kinetics of VO₂. To investigate whether this phenomenon could be present also in patients with peripheral limitations to exercise, a population of kidney transplant recipients (KTRs) was specifically studied, since these patients may present peripheral alterations at the muscular and microvascular level. **METHODS:** RER was retrospectively evaluated during recovery after maximal exercise (peak RER > 1.1) in KTRs without history of systolic dysfunction that underwent CPET for clinical purposes. Variables assessed were the maximum RER during recovery (RER-max), the RER overshoot magnitude (RER-OM: (RER-max - peak RER) / peak RER %) and the time from peak RER to RER-max. Patients signed informed consent. **RESULTS:** 57 KTRs were included in the study (28% females). The median value of peak RER was 1.2 (IQR 0.1). Mean RER-max and RER-OM were 1.6 ± 0.2 and 28.4 ± 12.7%, respectively. The time to reach RER-max was on average 131.4 ± 42.8 s. RER-OM showed significant correlations with peak VO₂ (ρ=0.57; P<0.01), VO₂ at the anaerobic threshold (r=0.44; P<0.01), VE/VCO₂ slope (r=-0.32; P<0.05) and oxygen uptake efficiency slope (r=0.48; P<0.01). RER-max showed comparable correlations with these parameters, however, conversely to RER-OM, it was conditioned by peak RER (ρ=0.50; P<0.01). Finally, RER-OM was found significantly different among sub-populations of KTRs when stratified by patients' aerobic capacity (Weber class A vs. B+C: 31.1 ± 12.1% vs. 18.6 ± 9.9%; P<0.01) or ventilatory efficiency (Ventilatory class I vs. II: 30.9 ± 13.3% vs.

23.2 ± 9.6%; P=0.03). CONCLUSIONS: This is the first study in KTRs investigating the recovery of RER, which seems to be affected by patients' cardiorespiratory fitness. The present data showed that the RER-OM values of this population are similar to normal subjects' values reported in literature. Moreover, RER-OM appears as a valuable parameter to assess the recovery of RER, being independent from peak RER and directly correlated to other prognostic CPET parameters.

B-68 Free Communication/Poster - Vascular Function I

Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
Room: CC-Exhibit Hall

**943 Board #69 May 27 2:30 PM - 4:00 PM
A Practical Measure Of Endothelial Function Applicable To The Routine Clinical Setting?**

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Background: The VENDYS-II is an alternative, fully automated and noninvasive methodology to evaluate endothelial function using temperature change on finger as a surrogate measure of the magnitude of vascular reactivity index (VRI). Due to the simplicity, it could provide more feasible technique to assess vascular endothelial function in the clinical setting. A most recent modification to the technique includes the application of occlusion cuff at the base of a finger. **Purpose:** To assess the validity of the VENDYS-II device compared with the standard flow-mediated dilation (FMD) protocol. **Methods:** Twelve participants (7 males; 37±16 years) varying widely in age, health, ethnic, and socioeconomic status were studied. Occlusion cuff was placed over the right antecubital fossa or at the base of the right index finger. Temperature monitors were placed on bilateral index fingers to assess change in temperature throughout 5-minute occlusion and recovery phases. FMD was obtained simultaneously using high-resolution ultrasound. **Results:** Mean brachial artery FMD was 7.2±2.6%. Measures of VRI obtained with the upper arm occlusion were significantly associated with simultaneously obtained brachial artery FMD (r=0.73). VRI values obtained with the finger occlusion (1.6±0.4AU) were not significantly different from VRI measured with the brachial artery occlusion (1.7±0.3AU), and both VRI values were moderately correlated with each other (r=0.50). **Conclusion:** Finger-based VRI may be a valid and novel alternative measure of endothelial function that is more suitable than the standard FMD for the assessment of endothelial function in the routine clinical setting.

**944 Board #70 May 27 2:30 PM - 4:00 PM
Chronic And Acute Benefits Of Reduced Sitting In Individuals With Increased Cardiovascular Risk**

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Sedentary behavior increases the risk for cardiovascular and cerebrovascular disease. However, little work examined the causal link between a decline in sedentary behavior and cardio- and cerebrovascular function, and the potential underlying mechanisms for this relation. **PURPOSE** to examine the chronic (16-week) and acute (3-hour) impact of reducing sedentary behavior on vascular and cerebrovascular function in subjects with increased cardiovascular risk. **METHODS** This prospective study included 24 individuals with increased cardiovascular risk (65±5 years, 29.8±3.9 kg/m²). Before and after 16-week reduced sitting, using a mobile-Health device with vibrotactile feedback, we examined: *i.* vascular function (flow-mediated dilation (FMD)), *ii.* cerebral blood flow (CBFv, transcranial Doppler), and *iii.* cerebrovascular function (cerebral autoregulation (CA) and cerebral vasomotor reactivity (CVMR)). To better understand potential underlying mechanisms, before and after intervention, we evaluated the effects of 3-hour sitting with and without light-intensity physical activity breaks (every 30-minutes). **RESULTS** The first wave of participants showed no change in sedentary time (n=9, 10.3±0.5 to 10.2±0.5 hours/day, P=0.87). Upon intervention optimization, the subsequent participants (n=15) decreased sedentary time (10.2±0.4 to 9.2±0.3 hours/day, P<0.01). This resulted in significant increases in FMD (3.1±0.3 to 3.8±0.4%, P=0.02) and CBFv (48.4±2.6 to 51.4±2.6 cm/s, P=0.02), without altering CA or CVMR. Before and after the 16-week intervention, 3-hour exposure to uninterrupted sitting decreased FMD and CBFv, whereas physical activity breaks prevented a decrease (both P<0.05). CA and CVMR did not change (P>0.20).

CONCLUSION Long-term reduction in sedentary behavior in older subjects with increased cardiovascular risk improves peripheral vascular function and cerebral blood flow, and acutely prevents impaired vascular function and decreased cerebral blood flow. These results highlight the potential benefits of reducing sedentary behavior to acutely and chronically improve cardio/cerebrovascular risk. Study is registered at the Netherlands Trial Register (NTR6387) (<https://www.trialregister.nl/trial/6215>).

**945 Board #71 May 27 2:30 PM - 4:00 PM
EXPLORING SEX DIFFERENCES ON ARTERIAL STIFFNESS IN RESPONSE TO HEAVY ROPE EXERCISE**

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PURPOSE: To evaluate sex differences on aortic and carotid arterial stiffness, and carotid artery compliance (CAC), following heavy rope exercise (HRE). **METHODS:** Twenty-seven resistance-trained individuals (Men: n=14, Mean±SD: Age: 23 ± 3 yrs; Women: n=13, Age: 22 ± 2yrs) participated. All measurements were collected at Rest, and 15 (Rec1), 30 (Rec2), and 60 (Rec3) minutes following HRE. Aortic arterial stiffness was assessed by pulse wave velocity (PWV), while carotid arterial stiffness, via beta stiffness index (BSI), and CAC, were collected via Doppler ultrasound. HRE utilized six 15-second exercise bouts using a double wave pattern (180bpm), with 30-second seated recovery. Two-way repeated measures ANOVAs were used to determine differences in PWV, BSI, and CAC, between the sexes across time. **RESULTS:** Men had significantly greater height (p ≤ 0.001) and weight (p ≤ 0.001). There were no significant sex by time interactions for PWV (p = 0.96) or BSI (p = 0.09). A significant main effect of time (p ≤ 0.001) showed that PWV significantly increased during Rec1, however, returned to below resting value at Rec3 (Men= Rest: 5.9 ± 0.7 m/s, Rec1: 6.2 ± 0.7 m/s, Rec2: 6.0 ± 0.7 m/s, Rec3: 5.7 ± 0.7 m/s; Women= Rest: 5.3 ± 0.8 m/s, Rec1: 5.7 ± 0.9 m/s, Rec2: 5.3 ± 0.7 m/s, Rec3: 5.1 ± 0.5 m/s). A main effect of time for BSI (p = 0.002) showed a significant increase during Rec1 and Rec2 from Rest, while Rec3 returned to Rest (Men= Rest: 3.2 ± 1.1 units, Rec1: 4.0 ± 1.5 units, Rec2: 3.5 ± 1.6 units, Rec3: 3.3 ± 1.5 units; Women= Rest: 2.6 ± 1.0 units, Rec1: 3.6 ± 1.6 units, Rec2: 4.3 ± 1.7 units, Rec3: 2.4 ± 0.8 units). There was a significant sex by time interaction for CAC (p = 0.05). Men did not significantly change across time, however, from Rest women significantly decreased during Rec2, then significantly increased from Rec2 to Rec3 (Men= Rest: 0.2 ± 0.1 mm²/mmHg, Rec1: 0.2 ± 0.1 mm²/mmHg, Rec2: 0.2 ± 0.1 mm²/mmHg, Rec3: 0.2 ± 0.1 mm²/mmHg; Women= Rest: 0.3 ± 0.1 mm²/mmHg, Rec1: 0.2 ± 0.1 mm²/mmHg, Rec2: 0.2 ± 0.1 mm²/mmHg, Rec3: 0.3 ± 0.1 mm²/mmHg). **CONCLUSIONS:** These data suggest that HRE does not produce differences in aortic or carotid arterial stiffness between sexes. The initial decrease in women's CAC is likely due to greater relative intensity, while the increase in CAC back to resting values is potentially due to the cardioprotective effects of estrogen.

**946 Board #72 May 27 2:30 PM - 4:00 PM
Abstract Withdrawn**

**947 Board #73 May 27 2:30 PM - 4:00 PM
L-citrulline Supplementation Attenuates Aortic Pressure And Wave Reflection Responses To Cold Stress In Older Adults**

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PURPOSE: Aging is a major risk factor for cardiovascular events due to increased pressure wave reflection. Cold exposure augments central blood pressure and wave reflection due to sympathetic-mediated vasoconstriction, which elevates the risk for adverse cardiovascular events in older adults. L-citrulline (L-CIT) supplementation improves endogenous synthesis of nitric oxide and contributes to reduce aortic systolic blood pressure (SBP) and pulse pressure (PP) responses to cold pressor test (CPT) in young men; however, the impact on wave reflection in older adults is unknown. The purpose of this study was to elucidate the efficacy of L-CIT to attenuate aortic hemodynamic responses to CPT in older adults. **METHODS:** Sixteen adults (n=16, 60-85 yrs) were randomly assigned to placebo or L-CIT (6g/day) for 14 days in a crossover, double-blind design. Brachial and aortic SBP, PP, augmented pressure (AP), augmentation index standardized at 75 bpm (AIx@75), and pressure of the forward (Pf) and reflected (Pb) waves were evaluated at

WEDNESDAY, MAY 27, 2020

rest and during CPT before and after the assigned intervention. An analysis of variance with repeated measures was used to determine if there were differences within and between interventions at rest and during CPT.

RESULTS: No significant changes with either intervention were observed at rest. Responses in aortic PP (-9.1 vs. 2.9; $P=.008$), AP (-4.1 vs. 2.1; $P=.004$), AIx (-3.7 vs. 2.1; $P=.015$), AIx@75 (-3.4 vs. 2.4; $P=.024$), Pf (-5.1 vs. 2.9; $P=.034$), and Pb (-3.4 vs. 1.7; $P=.027$) were significantly attenuated following L-CIT supplementation compared with placebo.

CONCLUSIONS: Although L-CIT had no effect on resting aortic hemodynamics, L-CIT attenuated aortic pressure and wave reflection responses during CPT in older adults. Therefore, short-term L-CIT supplementation may elicit cardioprotection during cold exposure in older adults.

948 Board #74 May 27 2:30 PM - 4:00 PM
Single Dry Cupping Treatment On Vascular Function In Healthy Young Individuals

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(No relevant relationships reported)

Cupping, part of traditional Chinese medicine, is regularly observed to bring about pain relief and to increase a patient's general feeling of well-being. It has been suggested that cupping promotes hyperemia (i.e., increased blood flow). Flow-mediated dilatation (FMD) is a widely used method of assessment of vascular function that provides a surrogate index for arterial health. **PURPOSE:** To examine the effect of a single dry cupping treatment on vascular function among healthy young individuals. **METHODS:** Five apparently healthy young individuals (3 women and 2 men, average age: 22 ± 1.48 years) participated in this study. Dry cupping treatment was performed applying two plastic cups on the non-dominant arm of each participant. Before and after a 10-minute cupping treatment, brachial FMD was evaluated using a high-resolution ultrasound with a 7.5-MHz linear array transducer. **RESULTS:** Following the 10-minute cupping treatment, brachial FMD increased significantly after the treatment from 7.40 ± 0.65 to $8.98 \pm 1.4\%$, $p < 0.05$. Participants did not experience complications as a result of the intervention. **CONCLUSIONS:** These findings demonstrated that in healthy individuals, dry cupping treatment, was capable of increasing vascular function. This study underlies the role of cupping treatment in promoting vascular function improvements. Finally, cupping is an inexpensive and low-risk alternative therapeutic modality.

949 Board #75 May 27 2:30 PM - 4:00 PM
Dietary Nitrate Counteracts The Elevated Blood Pressure Response To Nitric Oxide Synthase Inhibition In Humans

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(No relevant relationships reported)

Decreased production of nitric oxide (NO) via the endogenous NO-synthase (NOS) pathway is a hallmark of impaired endothelial function and is associated with elevated blood pressure. Potentiation of the alternative nitrate-nitrite-NO pathway via the diet has been suggested as a possible therapeutic strategy to counteract NOS dysfunction, but proof-of-concept that exogenous nitrate treatment compensates in situations of NOS inhibition in humans is lacking. **Purpose:** To determine whether dietary supplementation with nitrate-rich beetroot juice attenuates the detrimental effects of acute NOS inhibition achieved by intravenous infusion of N^o-monomethyl-L-arginine (L-NMMA) on vascular function. **Methods:** Seven male volunteers (age 23 ± 3 years, body mass 77.9 ± 6.8 kg) completed four conditions in a double-blind, randomised cross-over design: 1) 5-d dietary placebo supplementation with acute saline infusion (PL-CON), 2) 5-d placebo supplementation with acute L-NMMA infusion (3 mg/kgBM over 5 min followed by 55 µg/kgBM/min; PL-LNMMA), 3) 5-d dietary nitrate supplementation (12 mmol/d) with acute saline infusion (BR-CON), and 4) 5-d nitrate supplementation with acute L-NMMA infusion (BR-LNMMA). Heart rate (HR), brachial mean arterial pressure (MAP), and femoral artery blood flow (FBF) were measured every 5 min during 20 min of infusion and compared between conditions using repeated measures ANOVA. **Results:** L-NMMA infusion resulted in decreases from baseline in HR (PL-LNMMA -5 ± 3 , BR-LNMMA -6 ± 5 bpm) and FBF (PL-LNMMA -114 ± 85 , BR-LNMMA -95 ± 71 mL/min) that were greater than after saline infusion (HR: PL-CON -2 ± 5 , BR-CON -1 ± 4 bpm, $P < 0.05$; FBF: 20 ± 40 and 18 ± 36 mL/min, $P < 0.05$), with no effects of dietary supplementation. MAP was elevated by L-NMMA (PL-LNMMA 9 ± 2 , BR-LNMMA 4 ± 2 mmHg) compared to saline infusion (PL-CON -2 ± 2 , BR-CON 0 ± 2 mmHg, $P < 0.05$), and this response was attenuated by ~56% following BR ingestion ($P < 0.05$). **Conclusions:** Acute NOS blockade through systemic infusion of L-NMMA resulted in reduced HR and FBF, and elevated MAP, in healthy humans, resembling cardiovascular impairments

observed in conditions of chronic NOS-dysfunction. BR attenuated the elevation in MAP, highlighting the potential for exogenous nitrate to improve vascular control in situations where NOS function is impaired.

950 Board #76 May 27 2:30 PM - 4:00 PM
Association Between Arterial Stiffness, Body Mass Index And Cardiorespiratory Fitness In 7-to-17 Years Old Children

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Excess adiposity is a risk factor for cardiovascular disease, however, the obesity paradox suggests the existence of a subpopulation of obese individuals that do not suffer from those cardiovascular risks. Cardiorespiratory fitness (CRF) is a strong indicator of cardiovascular health in children and adults. Both obesity and low CRF have shown to independently increase the risk of cardiovascular diseases. **PURPOSE:** The aim of this study was to investigate how central arterial stiffness is associated with aerobic capacity and body fat percentage and body mass index (BMI) in children aged 7-to-17-years. **METHODS:** Seventy healthy children, 34 boys and 36 girls (age 7-17 years; BMI 21.5 ± 5.4 kg/m²; fat mass $23.4 \pm 11.5\%$), participated in this study. Percentage of fat mass (FM%) and fat free mass (FFM) were assessed using air displacement plethysmography (Bod Pod COSMED). Arterial stiffness was assessed measuring carotid-femoral PWV (cfPWV) with the SphygmoCor XCEL (AtCor Medical, Inc.). CRF was assessed through breath-by-breath gas analysis (K5, COSMED) using a 15 watts per minute graded exercise test on a cycle ergometer. The VO₂ at the first ventilatory threshold (VT1) was identified using the V-slope technique and as the lowest respiratory equivalent for oxygen. Differences in cfPWV between quartiles of VO₂ at VT1, %BF, and BMI were assessed using a multivariate general linear model. **RESULTS:** cfPWV was higher in the first VO₂ at VT1 quartile compared to the fourth when VO₂ is normalized by FFM (4.99 ± 0.73 vs 4.24 ± 0.69 m/s, $p < 0.05$). No differences in cfPWV were observed between first and fourth VO₂ at VT1 quartiles when VO₂ is normalized by body mass (5.05 ± 0.92 vs 4.34 ± 0.71 m/s). cfPWV was higher in the fourth and third BMI quartile compared to the first (4.26 ± 0.53 and 4.90 ± 0.66 vs 5.09 ± 0.89 , $p < 0.05$) but no differences in cfPWV were observed between fourth, third and first BF% quartiles (5.06 ± 1.04 , 4.57 ± 0.54 , 4.61 ± 0.64). **CONCLUSION:** Low central arterial stiffness in children is associated with high CRF expressed as VO₂ at VT1, and with low BMI.

951 Board #77 May 27 2:30 PM - 4:00 PM
Brachial And Aortic Blood Pressure Soon After Delivery In Women With Versus Without A Past Adverse Pregnancy Outcome

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PURPOSE: Adverse pregnancy outcomes (APOs), such as preterm birth, gestational diabetes, and hypertensive disorders of pregnancy, are associated with excess maternal risk of hypertension and cardiovascular disease years later. Little is known about the effect of an APO on aortic blood pressure (BP) in the first few years after delivery. Our purpose was to test the hypothesis that women with a history of APO would have higher peripheral and aortic BP in the 6 months- 3 years after delivery. **METHODS:** We recruited 37 women aged 18-45 years (26 white/9 black /2 other), from the greater Columbia, SC area who delivered a singleton infant 6 months - 3 years ago to participate in our study. Women were excluded if they were smokers, had diabetes, HIV/AIDS, or were receiving cancer therapy. Participants completed a single visit following an overnight fast during which brachial and aortic BP were measured using an oscillometric cuff and applanation tonometry, respectively. History of APO and sociodemographic information were determined via self-report. After assessing the distribution of the data with Shapiro-Wilk tests, we tested for differences in brachial and aortic systolic, diastolic, and mean BP between groups using t-tests or Kruskal-Wallis tests, as appropriate. **RESULTS:** Mean age was 33 ± 1 yrs and mean BMI was 26.6 ± 1.0 kg/m² with no difference between groups. Of the 37 women in the study, 12 had a history of APO with no difference in race distribution by group. Mean brachial and aortic systolic BP tended to be higher in women with a history of APO: 116 ± 4 versus 108 ± 3 mmHg, $p = 0.07$ (brachial) and 105 ± 4 versus 97 ± 1 mmHg, $p = 0.08$ (aortic). There was no difference in brachial or aortic diastolic or mean BP between groups.

CONCLUSIONS: Women with a history of APO tended to have higher peripheral and aortic systolic BP 6 months- 3years after delivery. The effects of an APO on BP may be detectable soon after the pregnancy ends and might represent a target for prevention of overt cardiovascular disease in affected women.

952 Board #78 May 27 2:30 PM - 4:00 PM
The Effect Of A High-fat Meal On Sympathetic Vasoconstrictor Responsiveness In Men And Women

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(No relevant relationships reported)

Consumption of a high-fat (HF) meal has been shown to reduce flow-mediated dilation (FMD) in men, but not women. This decline in FMD may be a result of decreased nitric oxide (NO) bioavailability. NO inhibits sympathetic vasoconstriction and a HF meal may, therefore, heighten sympathetic vasoconstrictor responsiveness. However, the effect of a HF meal on sympathetic vasoconstriction in men and women has not been investigated. **PURPOSE:** The purpose of this study was to investigate the hypothesis that consumption of a HF meal would heighten sympathetic vasoconstrictor responsiveness in men, but have no effect in women. **METHODS:** In a randomized cross-over design, young males (n=15) and females (n=15) consumed a HF or an isocaloric low-fat (LF) meal on separate days. Two hours post-meal, subjects underwent a cold pressor test (CPT) and measurement of brachial artery FMD to determine sympathetic vasoconstrictor responsiveness and endothelial function, respectively. Beat-by-beat blood pressure was measured by Finometer and mean arterial pressure (MAP) was calculated. Forearm blood flow (FBF) was measured by Doppler ultrasound at the brachial artery and forearm vascular conductance (FVC) was calculated as FBF/MAP. Sympathetic vasoconstrictor responsiveness was calculated as the percentage decrease in FVC (%ΔFVC) in response to CPT. FMD was calculated as the percentage increase in brachial artery diameter from baseline and normalized for cumulative shear rate. **RESULTS:** Sympathetic vasoconstrictor responsiveness was not different ($p>0.05$) between meal conditions or between females (LF: $-27\pm 14\%$; HF: $-30\pm 15\%$) and males (LF: $-29\pm 23\%$; HF: $-24\pm 16\%$) in either meal condition. FMD was higher (main effect of sex; $p<0.05$) in females (LF: $8.1\pm 2.1\%$; HF: $7.4\pm 1.4\%$) compared to males (LF: $6.2\pm 1.5\%$; HF: $5.1\pm 1.1\%$) and FMD was lower (main effect of meal; $p<0.05$) in the HF compared to the LF meal condition. No interaction ($p>0.05$) was observed between meal condition and sex for FMD. FMD normalized for shear rate was not different ($p>0.05$) between meal conditions or between females and males in either meal condition. **CONCLUSION:** These data suggest that, despite evidence of a post-prandial decrease in endothelial function, a HF meal does not alter sympathetic vasoconstrictor responsiveness in men or women.

953 Board #79 May 27 2:30 PM - 4:00 PM
The Relationship Between Estimated Pulse Wave Velocity With Cardiorespiratory Fitness In Young Adults

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(No relevant relationships reported)

Introduction: Carotid-femoral pulse wave velocity (cfPWV) is used to measure aortic stiffness and offers insight into cardiovascular disease (CVD) risk. The measurement requires specialized equipment and technical expertise to perform accurately. Estimated carotid-femoral pulse wave velocity (ePWV) is an easily calculated alternative to objectively measured cfPWV that offers comparable CVD risk prediction. Whether ePWV also offers similar insight into CVD resiliency has not been explored. Cardiorespiratory fitness (CRF) is associated with lower CVD risk and individuals with greater CRF have lower cfPWV. **Purpose:** To investigate the relationship between ePWV and CRF in young adults. **Methods:** Sixty young, healthy adults (mean age 25 ± 7 years; mean body mass index 24.7 ± 4.0 kg/m²; female $n=30$) volunteered for this study. cfPWV was assessed using applanation tonometry via simultaneous measurements of carotid and femoral pressure waves. ePWV was calculated from a regression equation using age and mean arterial pressure. A treadmill protocol with metabolic gas analysis was used to measure VO₂ peak. Pearson correlation coefficients were used to analyze the association between PWV measures and VO₂ peak. **Results:** cfPWV and ePWV were moderately associated ($r=-0.34$, $p=0.007$) with a mean difference between measures of 0.6 m/s and a coefficient of variation of 13%. There was a significant, inverse correlation between measured cfPWV and VO₂ peak ($r=-0.26$, $p=0.045$). There was also a significant, inverse correlation between ePWV and VO₂ peak ($r=-0.30$, $p=0.021$). **Conclusions:** Individuals with higher CRF have lower aortic stiffness. ePWV and measured cfPWV were similarly associated with CRF. As such, ePWV may offer comparable insight into CVD resiliency as measured cfPWV.

954 Board #80 May 27 2:30 PM - 4:00 PM
Effects Of Methionine Restriction And Exercise On Cardiac Fibrosis Of Spontaneously Hypertensive Rats.

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PURPOSE: To investigate the effect of low methionine diet and endurance exercise training on cardiac function of spontaneously hypertensive rats. **METHOD:** A total 80 male spontaneously hypertensive rat (SHR) (six-week-old) were randomly divided into four groups: (1) 0.86% methionine diet and sedentary lifestyle (C), (2) 0.17% methionine diet and sedentary lifestyle (MR), (3) 0.86% methionine diet and endurance exercise (EX), (4) 0.17% methionine diet and endurance exercise (MR+EX). The body weight, water intake, and food consumption were recorded once per week. In the exercise group, the rats were adapted to exercise on treadmill (10 m/min, 10 min/day) for three days. The endurance exercise protocol on the treadmill started from 15 m/min, and progressively enhanced to 27 m/min during eight weeks, and then maintain to 12 months. The rats were trained on treadmill 5 days/week, 60 min/day for 2 or 12 months. We measured the rats' diameter of left ventricle (LVD), and left ventricular posterior wall (LVPW) during diastole and systole period by using echocardiography at beginning and after 2 and 12 month intervention. All data were presented as mean \pm SEM. One-way ANOVA was used to evaluate differences between the changes, while Dunnett T3 post-hoc analysis was used to compare significant differences between test conditions. Statistical significance was accepted at $p<0.05$. **RESULTS:** Compared with C group, MR restriction and endurance training significantly reduced the gain of body weight during 12-months intervention ($p<0.05$), but there is no difference between Ex and EX+MR. Age, Ex, and MR reduce the LVD during diastole ($p<0.05$). The LVPW of diastole and systole were thickened as growth, endurance training, and restricted with methionine of individual ($p<0.05$). Cardiomyocytes were enlarged as growth ($p<0.05$), but endurance training and methionine restriction decelerate the effect. Cardiac fibrosis also increased as growth, endurance training and methionine restriction limited the development of fibrosis. **CONCLUSIONS:** The MR diet might be used as a strategy to ameliorate the pathological effect of hypertension evidenced by reducing the cardiac fibrosis.

955 Board #81 May 27 2:30 PM - 4:00 PM
Sleep Variability Is A Predictor Of Peripheral Vascular Function In Apparently Healthy Undergraduate College Students

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Experimental studies suggest that highly variable sleep-wake patterns may impair vascular function, suggesting a potential mechanism for the increased risk of cardiovascular (CV) diseases seen in shift workers and those with sleep disorders. However, it is unclear if naturalistic, day-to-day variability in sleep-wake patterns of generally healthy individuals poses a risk to vascular function. **PURPOSE:** To examine the association between sleep variability (SLV) and vascular function in undergraduate college students. **METHODS:** SLV metrics were estimated in 39 healthy undergraduate students (20 ± 0.2 years) using wrist actigraphy for 14 days and nights. Sleep timing was defined by sleep midpoint (halfway point between sleep onset and wake onset). Sleep timing variability (STV) was then quantified as the standard deviation (SD) of sleep midpoint, and sleep duration variability (SDV) as the SD of sleep duration across 14 days. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI). Peripheral vascular function was indexed as the magnitude of hyperemia in response to passive leg movement (PLM) and was performed immediately following the end of sleep monitoring. Blood velocity and femoral artery diameter were measured via Doppler ultrasound. **RESULTS:** In a linear regression model adjusting for sex and body mass, SDV predicted peak leg blood flow (LBF) ($\beta=-0.49$, $p<0.01$), change in LBF from baseline to peak ($\beta=-0.50$, $p<0.01$), and LBF area under the curve (AUC) ($\beta=-0.57$, $p<0.01$) during PLM. Associations remained significant when the model included PSQI score (all $p<0.01$). Similarly, models adjusting for sex and mass found that STV predicted LBF AUC ($\beta=-0.30$, $p=0.05$). **CONCLUSION:** In adjusted models, greater SLV is associated with less optimal peripheral vascular function in healthy college students. These data support the growing body of literature suggesting that regular sleep schedules may be important for CV health, even in otherwise healthy young adults. Supported, in part, by NIH P20GM113125.

956 Board #82 May 27 2:30 PM - 4:00 PM

Influence Of Type 2 Diabetes And Cardiovascular Disease Family History On Metabolic Syndrome Severity

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INFLUENCE OF TYPE 2 DIABETES AND CARDIOVASCULAR DISEASE FAMILY HISTORY ON METABOLIC SYNDROME SEVERITY

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Background: Family history of cardiovascular disease (CVD) is considered a strong predictor of developing metabolic syndrome (MetS), in part through promoting endothelial dysfunction. In addition, a family history of type 2 diabetes (T2D) relates to lower metabolic insulin sensitivity and may compound their MetS risk severity. We examined in people with MetS if a family history of CVD and T2D (CVD+T2D) increases MetS risk severity compared to individuals with a family history of CVD only (CVD). **Methods:** Twenty, middle-aged obese individuals with MetS (55.9 ± 6.5 yrs; 32.5 ± 3.6 kg/m²) were divided into CVD (n=9; 6F) or CVD+T2D (n=11; 9F). MetS was defined using the NCEP ATP III criteria. MetS severity Z-score was calculated from waist circumference, blood pressure, fasting blood glucose, triglycerides, and high-density lipoproteins. Metabolic insulin sensitivity (i.e. glucose infusion rate, GIR) was measured using a 2-hr hyperinsulinemic-euglycemic (40 mU/m²/min, 90 mg/dl) clamp. Insulin-stimulated brachial artery flow-mediated dilation (FMD) was also measured as the change from fasting to 2-hr during the clamp to assess endothelial function and gain tissue-specific insight into the origin of insulin action. **Results:** There was no difference in anthropometrics between groups. There was also no statistical difference between CVD and CVD+T2D in MetS severity (2.62 ± 1.12 vs. 1.65 ± 0.56 , $P=0.42$), GIR (2.35 ± 0.55 mg/kg/min vs. 2.63 ± 1.56 mg/kg/min, $P=0.86$), or insulin-stimulated FMD ($0.33 \pm 1.57\%$ vs. $1.68 \pm 1.19\%$, $P=0.52$). However, waist circumference was inversely correlated to GIR ($r=-0.63$, $P=0.01$).

Conclusion: In adults with MetS, T2D family history does not exacerbate MetS severity in adults with CVD family history. However, waist circumference appears to be important for lowering metabolic insulin sensitivity. Thus, targeting abdominal fat may contribute to improved metabolic health independent of T2D and/or CVD family history.

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957 Board #83 May 27 2:30 PM - 4:00 PM

High Fat Relative To Low Fat Ground Beef Consumption Lowers Blood Pressure And Does Not Negatively Alter Arterial Stiffness

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(No relevant relationships reported)

Beef consumption has been stigmatized as an unhealthy dietary choice. However, randomized control trials to support this claim are lacking. **PURPOSE:** To examine the effect of low-fat (5%) and high-fat (25%) ground beef consumption on blood pressure (BP) and carotid-femoral pulse wave velocity (PWV). **METHODS:** Twenty-three male subjects (age 40 ± 11 yrs, height 177.4 ± 6.7 cm, weight 97.3 ± 25.0 kg, lean mass 64.5 ± 9.5 kg, fat mass 30.6 ± 19.1 kg) volunteered to participate in this cross-over design study. Each participant completed two, 5-week ground beef interventions in a randomized order with a 4-week washout period in-between. All participants visited the lab four times after an overnight fast. Each visit to the lab consisted of supine BP, dual energy x-ray absorptiometry (DXA) scan to assess body composition, and PWV analysis. The PWV recording was assessed on the right carotid and femoral arteries. The distance used for the PWV calculation was 80% of the actual distance between carotid and femoral sites. All PWV measures were completed according to previously published procedures (Van Bortel, 2011). BP and PWV results were analyzed separately via 2x2 repeated measures ANOVA. **RESULTS:** Our results indicate there was a significant decrease in systolic BP ($p=0.01$) following the high-fat ground beef intervention compared to the low-fat. The BP values for low-fat beef and high-fat beef are 120/74 and 116/73 mmHg, respectively. Further, there were no significant differences between the PWV measures. **CONCLUSION:** Based on our results, high fat ground beef favorably alters systolic BP and does not negatively affect PWV measures.

958 Board #84 May 27 2:30 PM - 4:00 PM

Association Of Physical Activity With Depression And Estimated Pulse Wave Velocity In Older Male Veterans

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Physical inactivity is associated with an increased risk for cardiovascular disease (CVD) and depression. Veterans are a physically inactive population with a higher risk of developing CVD and depression than the general population. Whether objectively measured physical activity is associated with CVD risk and depressive symptoms in veterans has not been widely studied. **PURPOSE:** To examine the relationship between accelerometer measured moderate-vigorous physical activity (MVPA) and novel measures of CVD risk (estimated aortic stiffness and systemic inflammation) and depression in older veterans. **METHODS:** 152 older male veterans (mean age 71.9 ± 9.2 years) from the 2005-2006 NHANES were used in this analysis. Valid accelerometer data and MVPA were determined using standard NHANES procedures. Cardiovascular disease risk was determined by calculating estimated pulse wave velocity (ePWV) from a regression equation using age and mean blood pressure. Systemic inflammation was determined as C-reactive protein (logCRP). Depression score was determined through the Depression Screener Questionnaire (DPQ). One-tailed Spearman correlations were conducted to determine associations between variables. **RESULTS:** Physical activity guidelines were met by 17% of the veterans in this analysis. There was a significant, inverse relationship between MVPA and ePWV ($r=-0.34$, $p<0.01$), MVPA and logCRP ($r=-0.24$, $p<0.01$), and MVPA and depression score ($r=-0.16$, $p<0.05$). In addition, a significant positive association between ePWV and depression score ($r=0.17$, $p<0.05$) was noted. **CONCLUSION:** Decreased moderate-vigorous physical activity levels in older male veterans are associated with elevated aortic stiffness, systemic low-grade inflammation, and depressive symptomatology. This suggests that veterans who do not meet recommended physical activity guidelines may be at higher risk for CVD and depression.

959 Board #85 May 27 2:30 PM - 4:00 PM

Sex Differences In Microvascular Function In Pre-pubertal Children

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There is little research examining the effect of sex on skin blood flow (SkBF) in adults, and less in children. Sex-related differences in SkBF may help explain known thermoregulatory differences between males and females.

Purpose: To determine whether there are sex-related differences in the SkBF response to exercise, local heating, and acetylcholine (ACh). Additionally, the role of nitric oxide (NO) was examined.

Methods: Laser-Doppler flowmetry was used to assess forearm SkBF. Responses to exercise (30 min cycling, 60%V_{O₂max}), local heating (44°C), and ACh iontophoresis were assessed in 15 pre-pubertal boys (age=10±1y, V_{O₂max}=1.66±0.25 l/min) and 10 girls (age=10±1y, V_{O₂max}=1.58±0.35 l/min), with and without NO synthase inhibition, using L-NAME iontophoresis. Three-way (group, time, treatment) repeated measures ANOVA was used to examine sex-related differences in the SkBF response during exercise and in the SkBF-ACh dose response. A two-way (group, treatment) repeated measures ANOVA was used to examine local heating-induced increase in SkBF.

Results: Exercise-induced SkBF was greater in boys compared with girls (654 ± 355 and $316 \pm 182\%$ of baseline, respectively, $p<.0001$). L-NAME blunted the SkBF response more in boys than in girls (group-by-treatment interaction, $p=.004$). Local heating-induced SkBF was not significantly different between boys and girls ($1705 \pm 739\%$ and $1488 \pm 600\%$, respectively, $p=.35$), with no effect of L-NAME. The maximal ACh-induced SkBF was similar in boys and girls ($650 \pm 420\%$ and $612 \pm 411\%$, respectively). L-NAME similarly blunted the SkBF response in boys and girls (group-by-treatment interaction, $p=.52$).

Conclusion: These findings demonstrate that while maximal SkBF and the vasodilatory response to ACh stimulation are similar in boys and girls, boys display a greater increase in SkBF during exercise of similar intensity. Further, the role of NO in the SkBF response appears greater in boys than girls only during exercise. Since absolute and relative exercise intensity was similar in the two groups, it is suggested that sex-related factors (e.g., hormones) may interact with the exercise response or with other vasodilators, resulting in different SkBF response.

960 Board #86 May 27 2:30 PM - 4:00 PM
Improved Endothelial Function Following Eight Weeks Of Low-intensity Resistance Training In Young Adults

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Cardiovascular diseases (CVD) are the leading cause of death worldwide, and compelling evidence indicates that exercise prevents and attenuates CVD. Resistance training (RT) exerts positive health effects; however, there is a lack of evidence regarding the RT intensities that could be prescribed to improve vascular endothelial function. **PURPOSE:** To compare the effects of two RT intensities during eight weeks on vascular endothelial function in sedentary young males. **METHODS:** Thirty-four sedentary men were recruited (age = 20.6 ± 1.8 yr., height = 171.3 ± 5.2 cm, weight = 65.2 ± 10.6 kg, DXA fat mass = 22.3 ± 7.4 %), and randomly assigned to a control group (CTRL, no exercise), RT at 50% of a maximum repetition [1-RM] and RT at 80% 1-RM. The RT program was performed twice a week for eight weeks, and except for the CTRL group, participants performed the same RT exercises at similar total workloads (1920 arbitrary units [AU] for the 80%RM and 1950 AU for the 50%RM). Vascular endothelial function was measured before (pre) and after (post) eight weeks by ultrasound and determined by the percentage of flow-mediated dilatation (%FMD). Mixed factorial ANOVA (3 groups x 2 measurements x 2 occlusions), effect size (ES) and 95% confidence interval (CI_{95%}) were computed for %FMD. **RESULTS:** A significant triple interaction was found on %FMD (p = 0.021). The eight-week post-intervention follow-up analyses showed a significant increase (p = 0.010) in %FMD in the 50%RM (Mean = 9.93 ± 3.73%, ES = 3.70, CI_{95%} = 1.59 to 5.79) compared to the control group (Mean = 5.72 ± 1.71%, ES = 1.67, CI_{95%} = -0.21 to 3.55), and no significant differences between 50%RM and 80%RM (Mean = 7.90 ± 2.51%, ES = 2.18, CI_{95%} = 0.27 to 4.10), and between 80%RM and control groups. **CONCLUSION:** A 50%RM intensity RT program elicited a positive vascular endothelial function adaptation following eight-weeks of training. It seems unnecessary to perform high-intensity RT to obtain arterial health benefits.

961 Board #87 May 27 2:30 PM - 4:00 PM
Sacubitril-Valsartan Treatment Improves Vascular Function And Functional Capacity In Heart Failure With Reduced Ejection Fraction

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The PARADIGM-HF (Prospective Comparison of ARNI with an ACE-Inhibitor to Determine Impact on Global Mortality and Morbidity in Heart Failure) trial identified a marked reduction in the risk of death from cardiovascular causes or hospitalization for heart failure (HF) in patients with HF with reduced ejection fraction (HFrEF) treated with sacubitril-valsartan. The mechanisms responsible for this improvement have not been fully identified, but may be related, in part, to improvements in vascular function and functional capacity, two important predictors of mortality and morbidity in this patient group. **PURPOSE:** We sought to test the hypothesis that short-term treatment with sacubitril-valsartan would improve vascular function and functional capacity in patients with HFrEF. **METHODS:** Eleven stable, class II/III patients with HFrEF (10M/1F, age: 69±3 yrs; BMI: 29.0±1.0 kg/m²; ejection fraction: 27±3%) were studied prior to initiation of treatment and at months 1, 2 and 3 of sacubitril-valsartan therapy. Vascular function was evaluated by brachial artery flow-mediated dilatation (FMD) and reactive hyperemia (RH), while functional capacity was determined using the six-minute walk test (6MWT). **RESULTS:** Treatment with sacubitril-valsartan improved brachial artery %FMD after 1 month of treatment, and this favorable response persisted during months 2 and 3 (baseline: 3.25±0.53%; 1-month: 5.23±0.71%; 2-month: 5.81±0.54%; 3-month: 6.35±0.84%, p<0.05). Likewise, %FMD normalized for the shear stimulus improved significantly at months 2 and 3 (baseline: 0.08±0.01%; 1-month: 0.13±0.01%; 2-month: 0.17±0.02%; 3-month: 0.20±0.03%). There was no change in RH, an index of microvascular function, at any time point (p>0.05). The 6MWT distance also increased significantly at months 2 and 3 (baseline: 420±28m; 1-month: 436±30m; 2-month: 465±35m; 3-month: 460±33m), but the changes in 6MWT distance were not correlated to the changes in %FMD or %FMD normalized for the shear stimulus (r=0.13, p=0.39 and r=0.01, p=0.97, respectively). **CONCLUSIONS:** These preliminary findings provide new evidence for the efficacy

of short-term treatment with sacubitril-valsartan to improve vascular function and functional capacity, two possible mechanisms underlying this treatment's benefits, in patients with HFrEF.

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Insulin Stimulation Reduces Arterial Stiffness In Adults With Metabolic Syndrome

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Purpose: Adults with metabolic syndrome (MetS) have increased fasting arterial stiffness compared with healthy counterparts, and this, in turn, increases risk for cardiovascular disease (CVD) and cardiac events. Although insulin acts to reduce arterial stiffness in healthy adults, the effects in obese individuals with MetS are unclear. We hypothesized that insulin stimulation would reduce measures of arterial stiffness in relation to aerobic fitness and body fat. **Methods:** Thirty-one obese adults (24F; 53.7±6.0yrs; 37.4±4.8kg/m²) were screened for MetS (NCEP ATP III criteria) following an overnight fast. Augmentation index (AIx), augmentation pressure (AP) and brachial systolic (bSBP) and diastolic blood pressure (bDBP) were assessed using SphygmoCor before and after a 2hr euglycemic-hyperinsulinemic clamp (90 mg/dl, 40 mU/m²/min). Aerobic fitness (VO_{2peak}; ml/kg/min) was measured through a treadmill protocol while body fat (BF; %) was determined using DEXA. **Results:** Compared to fasting, insulin significantly reduced AIx (28.5 ± 9.9 vs. 23.2 ± 9.9%, P<0.01) and AP (15.1 ± 6.7 vs. 21.1 ± 5.8 mmHg, P<0.01). However, there was no effect of insulin on bSBP (P=0.19) or bDBP (P=0.21). Fasting AIx and AP correlated with VO_{2peak} (r=-0.42, P=0.02 and r=-0.37, P=0.04) and BF (r=0.64, P<0.01 and r=0.68, P<0.01). Interestingly, neither the change in AIx nor AP from fasting to insulin stimulation correlated with VO_{2peak} (r=-0.18, P=0.33 and r=-0.12, P=0.95) or BF (r=-0.29, P=0.24 and r=-0.17, P=0.58). **Conclusion:** Insulin stimulation reduces indices of arterial stiffness in adults with MetS. While high aerobic fitness and lower BF may contribute to less arterial stiffness in the fasted state, they were not associated with insulin action. This suggests that insulin impacts arterial stiffness through another mechanism. Future research is warranted to determine the role of insulin on arterial health in order to optimize CVD prevention/treatment. Funding was supported by the National Institutes of Health RO1-HL130296.

963 Board #89 May 27 2:30 PM - 4:00 PM
The Protective Mechanism Of Exercise Training For Coronary Vascular Dysfunction In Atherosclerosis: Er Stress And Ucp-2

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PURPOSE: Endoplasmic reticulum (ER) stress and uncoupling protein-2 (UCP-2) are a key modulator for endothelial dysfunction in atherosclerosis. We determined the effects of exercise on ER stress and UCP-2 in endothelial dysfunction in atherosclerosis. **METHODS:** We used 4 groups of mice; wild type (WT), WT with exercise training, running on the treadmill for 12 weeks (WT-EX), apolipoprotein E knockout (ApoE KO) and ApoE KO with exercise training (ApoE KO-EX). We measured endothelium-dependent acetylcholine (ACh)-induced vasodilation of isolated and pressurized coronary arterioles in a concentration-dependent manner. Also, ACh-induced vasodilation was elicited in the presence of an inhibitor of eNOS and UCP-2 (L-NAME and Genipin) and the ER stress inducer (Tunicamycin). Immunoblotting was performed to measure the protein expression of ER stress markers (GRP78, IRE1, eIF2α, and CHOP), NLRP3 inflammasome signaling (NLRP3, caspase-1, IL-1β), Bax, TXNIP, and UCP-2 in the heart. The expression of p67^{nox} and superoxide were visualized using immunofluorescence and DHE staining in coronary arterioles. NO production was measured by nitrate/nitrite assay. **RESULTS:** ACh-induced endothelium-dependent vasodilation was attenuated in coronary arterioles of ApoE KO, but it was improved in ApoE KO-EX. L-NAME, tunicamycin, and Genipin attenuated vasodilation in WT, WT-EX and ApoE KO-EX, but not in ApoE KO. Exercise training reduced the expressions of ER stress (GRP78, p/t-IRE1, p-eIF2α, and CHOP), NLRP3 inflammasome (TXNIP, caspase-1 p20, and IL-1β), Bax, superoxide production, and NADPH oxidase p67^{nox}, but it increased NO production in ApoE KO-EX mice. **CONCLUSION:** Our findings suggest that exercise training alleviates endothelial dysfunction in atherosclerotic coronary arterioles through the NOS, UCP-2, and ER stress signaling pathways including TXNIP/NLRP3 inflammasome and oxidative stress.

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Isometric Exercise Training, Regardless Of Muscle Mass, Reduces Resting Blood Pressure In Normotensive Healthy Males

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(No relevant relationships reported)

PURPOSE: Isometric exercise training (IET) is an effective adjunct for the management of resting blood pressure (RBP) but responsible mechanisms have not yet fully been identified. Isometric contractions reduce blood flow as a result of vascular compression altering intramuscular metabolism. In response, active muscle could increase the production and circulation of vasoactive molecules (e.g., VEGF) and alter inflammatory biomarkers (e.g., IL-6 and TNF- α), which may lead to adaptations in resistance vessels. We studied the influence of bilateral arm or leg IET on blood pressure and plasma VEGF, IL-6, and TNF- α over the course of 6-weeks.

METHODS: The study was approved by the UNC Charlotte IRB. Twenty-eight healthy and recreationally active normotensive males (19-25 years) gave written informed consent and were randomized to one of three conditions; double bicep curl IET (IBC), double leg extension IET (ILE), or control (CON). IET groups completed exercise sessions at 15% maximal voluntary contraction (6 x 2-minute contractions) 3 days per week for 6-weeks with RBP assessed at each visit. For a subsample (n=17), 3 blood samples (pre-, 1 hour post-, 24 hours post-training) were collected at the first and last training visits. The CON group performed all study procedures except IET.

RESULTS: Using a repeated-measures ANCOVA (controlling for acclimation RBP and cohort), a significant time by treatment effect was observed from Week 1 to Week 6, $F(2, 23) = 4.10$, $p=.03$, $\eta^2 = .263$. Specifically, IET resulted in a lower systolic RBP, but did not differ by IET group: IBC -4.4 ± 4.0 mmHg; ILE -4.3 ± 7.6 mmHg; CON 2.3 ± 4.0 mmHg. Diastolic RBP did not significantly change for any group. Currently, there are no acute or chronic IET effects on the systemic biomarker levels.

CONCLUSIONS: 6-weeks of bilateral arm or leg IET resulted in significant reductions in systolic RBP. Due to the small sample size (n=17), power may have limited the ability to detect significant effects on circulating VEGF, TNF- α and IL-6. Research should continue to examine how IET alters RBP. The research was funded by Faculty Research Grant (JMB & HR) and the Thomas L. Reynolds Graduate Student Research Award (B.D.H.G)

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Oscillometric Ambulatory Blood Pressure Monitors Are Prone To Errors In A Controlled Laboratory Setting

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We developed a dual monitor protocol for testing the accuracy and reliability of 24-hr ambulatory blood pressure monitors (ABPMs) and determined in normotensives (n=15), hypertensives (n=14) and alcohol-dependents (n=11) that a popular auscultatory ABPM was highly variable, misclassifying up to 70% of patients.

PURPOSE: To determine the accuracy and reliability of two widely used oscillometric ABPMs, the Oscar 2 (Suntech Medical, Morrisville, NC) and the Spacelabs 90207 (Spacelabs Healthcare, Snoqualmie, WA) under controlled lab conditions. **Hypothesis:** Oscillometric proprietary algorithms were developed from auscultatory reference BPs, thus ABPMs would differ from each other and from observers (O1, O2) using a Hg column and Thinklabs digital stethoscope. **Methods:** BPs were measured in triplicate on both arms in 17 seated subjects (10 ♂, 7 ♀) with simultaneous same arm BPs by O1 & O2 alternating with simultaneous opposite arm BPs by ABPMs. **Results:** The average (x \pm SE) systolic (SBP) and diastolic (DBP) BPs for O1, O2, Oscar & Spacelabs ABPMs were 114.2/67.3 \pm 2.0/1.8 mm Hg, 114.1/67.1 \pm 2.0/1.8 mm Hg, 124.0/67.7 \pm 2.1/1.4 mm Hg, and 119.3/67.9 \pm 1.9/1.3 mm Hg, respectively. Compared to O1O2, the Oscar overestimated SBP by 9.8 \pm 0.9 mm Hg ($P < 0.001$), while the Spacelabs overestimated SBP by 5.2 \pm 0.8 mm Hg ($P < 0.001$). SBP also differed significantly between ABPMs ($P < 0.001$). Though the DBP difference was small between observers and ABPMs, (O1O2 - Oscar = -0.6 mm Hg; O1O2 - Spacelabs = -0.7 mm Hg), there was a high degree of variability with the Oscar ranging from 23 mm Hg above to 20 mm Hg below and the Spacelabs 23 mm Hg above to 26 mm Hg below the observers. Compared to O1O2, Oscar SBP and DBP differed by > 5 mm Hg in 15/17 (88%) and 7/17 (41%), while the Spacelabs SBP and DBP differed by > 5 mm Hg in 11/17 (65%) and 8/17 (47%) of subjects, respectively. **Conclusions:** Controlled lab testing revealed significant measurement errors in widely used oscillometric ABPMs. Given light exercise during 24-hr ambulatory monitoring, the outlook for

accuracy and reliability appears worse. Oscillometric nomogram-like equations are population-specific and indirect 2nd generation estimations and cannot account for individual variations making them highly susceptible to errors, though more testing is required in a greater number of hypertensives.

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Associations Of Objectively Measured Sedentary Time With Endothelial Function Biomarkers In Young Male Adults

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PURPOSE: Sedentary behavior (SB) is recognized as a serious global health issue. SB-induced down regulation of shear rate and blood flow play a key role in the pathogenesis of endothelial dysfunction, an important prognostic marker for cardiovascular disease. The purpose of this study was to assess the association between objectively measured sedentary time and endothelial function biomarkers in young male adults.

METHODS: A total of 93 participants (age, 21.8 \pm 3.8 yr; body height, 171.6 \pm 6.4 cm; body weight, 62.1 \pm 6.4 kg; % body fat, 15.6 \pm 4.6%; body mass index (BMI) 21.1 \pm 1.7 kg/m²; waist circumference 74.5 \pm 5.1 cm; heart rate (HR) 67.6 \pm 9.5 bpm; systolic blood pressure (SBP) 108.4 \pm 9.1 mmHg; diastolic blood pressure (DBP) 71.6 \pm 8.1 mmHg) wore the activPALTM continuously for 7 days without removal. Total sedentary time was assessed using PALanalysis v8.0. Bedtime and wake-up time were recorded by participants. Sleep duration was determined as the time between bed time and wake-up time. Sedentary time during waking hours was calculated as the total sitting/lying time minus sleep duration. A fasting venous blood sample was drawn from each of the participants from which serum endothelial cell adhesion molecules E-selectin, P-selectin, Intercellular Adhesion Molecule 1 (ICAM-1) and Vascular Cellular Adhesion Molecule 1 (VCAM-1) were measured using flow cytometry. Multiple linear regression models examined the associations of sedentary time with endothelial function biomarkers using SPSS version 23.0.

RESULTS: E-selectin ($\beta = 0.226$, 95% confidence interval [CI]: 0.021, 0.431) and P-selectin ($\beta = 0.216$, 95% CI: 0.017, 0.415) were positively associated with sedentary time after controlling for age and BMI. After moderate-to-vigorous physical activity (MVPA) was added to the model, there were no significant association between E-selectin and sedentary time. No significant associations were found between ICAM-1 or VCAM-1 with sedentary time or between ICAM-1 or VCAM-1 with sedentary time after controlling age, BMI, and MVPA.

CONCLUSIONS: Objectively measured sedentary time was positively associated with E-selectin and P-selectin in young male adults independent of age and BMI. MVPA may alleviate the adverse effects of sedentary time on biomarkers of endothelial function.

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Regular Resistance Training Enhances Fibrinolytic Potential

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Blood clots cause most cardiovascular events, such as heart attack and stroke. Blood markers of fibrinolysis, the capacity to dissolve blood clots, are independently associated with cardiovascular morbidity and mortality. Regular resistance training (RT) produces various muscular and vascular adaptations that are theorized to influence thrombotic potential, but there are no published longitudinal studies that examine fibrinolytic adaptations to RT. **PURPOSE:** The purpose of this study was to identify effects of an 8-week RT program on fibrinolytic potential. **METHODS:** Sixteen healthy adults (n = 12 women, 4 men; age = 23 \pm 5 years) completed a RT program that targeted all major muscle groups, 3 times per week for 8 weeks. Exercises included 2-3 sets of 8-12 repetitions performed at approximately 60-80% of 1 RM. Body composition, circumferences, and 1 RM leg and chest press strength measures were obtained via standard methods. Resting blood samples were obtained by clean venipuncture at baseline and after 8 weeks of RT. Enzyme-linked immunosorbency assays were used to assess plasma concentrations of the following fibrinolytic variables: active tissue plasminogen activator (tPA:c), tissue plasminogen activator antigen (tPA:g), active plasminogen activator inhibitor-1 (PAI-1:c), and plasminogen activator inhibitor-1 antigen (PAI-1:g). Statistical analyses were conducted using paired t-tests. **RESULTS:** Significant increases in lean mass (PRE = 52.18 \pm 10.03, POST = 53.64 \pm 10.42 kg), arm circumference (PRE = 29.89 \pm 5.12, POST = 30.97 \pm 4.92 cm), and mid-thigh circumference (PRE = 49.96 \pm 5.43, POST = 51.08 \pm 5.83 cm) were observed (all $p < 0.05$). Maximal chest press (PRE = 57.8 \pm 37.5, POST = 73.3 \pm 43.2 kg) and leg press strength (PRE = 189.5 \pm 95.8, POST = 256.7 \pm 97.9 kg) significantly increased ($p < 0.01$). PAI-1:c (PRE = 20.3 \pm 32.5, POST

= 9.5 ± 20.9 U/ml, p=0.05) and PAI-1:g decreased (PRE = 10.18 ± 8.98, POST = 7.20 ± 5.74 ng/dl, p<0.05). No change in tPA:c or tPA:g occurred. **CONCLUSION:** The decrease in plasma concentrations of total and active PAI-1 indicate reduced inhibition of fibrinolytic activation, suggesting that the risk of a cardiovascular event is reduced after resistance training. The mechanisms underlying this specific adaptation may relate to increased skeletal muscle mass, but additional research is warranted.

968 Board #94 May 27 2:30 PM - 4:00 PM
Evaluation Of Inter-rater And Test-retest Reliability For Near-infrared Spectroscopy Reactive Hyperemia Measures
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Near-Infrared spectroscopy (NIRS) is a non-invasive tool used to measure blood flow in peripheral tissues. More information on test-retest reliability and inter-rater agreement of NIRS-based reperfusion assessments is needed. **PURPOSE:** To assess inter-rater agreement for NIRS based data analysis, and evaluate the measurement's reliability across days. **METHODS:** On three separate days, participants' (N=15 males, 22± 2 yr.) reactive hyperemia was measured in the left gastrocnemius muscle using Continuous-Wave NIRS. A blood pressure cuff was placed proximal to the knee and inflated to occlude lower leg blood flow for 5 minutes. The cuff was rapidly deflated, and the blood flow responses were measured until values returned to baseline. Raw NIRS data were exported and analyzed in a custom-written routine in MATLAB by two individuals. The following NIRS parameters were selected:(1) the time for the O₂Hb signal to reach 50% peak post-occlusion hyperemia (T_{1/2}), (2) The O₂Hb range used to normalize the NIRS signal; (3) the post peak-hyperemic O₂Hb recovery slope, taken as an index of sustained microvascular dilation. Inter-rater agreement was assessed using Intraclass Correlation Coefficients (ICC), calculated using an absolute agreement two-way mixed effects model. 95% confidence intervals (CI) of ICCs are reported. Cronbach's alpha was used to assess day to day reliability for each of the measures. **RESULTS:** The ICC data indicate that there is "good" to "excellent" agreement between NIRS analyzers as shown in table 1.

	Visit 1 Rater 1 (SD)	Visit 1 Rater 2 (SD)	Visit 1 ICC (CI)	Visit 2 ICC (CI)	Visit 3 ICC (CI)
T _{1/2}	9.03 (2.43)	9.71 (3.07)	.63 (.22-.86)	.99 (.98-1.0)	.97 (.91-.99)
O ₂ Hb Range	31.72 (8.57)	33.06 (6.47)	.71 (.33-.89)	.98 (.94-.99)	.97 (.92-.99)
Post peak-hyperemic O ₂ Hb recovery slope	-.17 (.05)	-.18 (.06)	.77 (.45-.92)	.91 (.71-.97)	.86 (.65-.95)

The Cronbach's alpha for raters 1 and 2 were: T_{1/2} (α =.89, α = .91), O₂Hb (α =.95, α = .89), and post peak-hyperemic O₂Hb recovery slope (α =.74, α = .83). **CONCLUSION:** Our data indicate multiple raters can be used to analyze NIRS based reperfusion measures with good agreement and that the method has sufficient test-retest reliability to use in experimental designs involving multiple laboratory visits.

969 Board #95 May 27 2:30 PM - 4:00 PM
The Influence Of Sleep On Blood Pressure In Healthy Children
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Loss of ideal cardiovascular health can begin in childhood with the development of cardiovascular disease (CVD) risk factors occurring on a continuum. Central blood pressure (BP) values may be more reflective of CVD risk than peripheral BP but are rarely measured in children. Additionally, in adults, poor sleep quality is associated with higher BP and incidence of CVD, however these relations are not as well elucidated in children. **PURPOSE:** To evaluate the role of sleep duration, sleep quality, and sleep variability (SLV) on resting central and peripheral BP in apparently healthy 7-12 yr old children. **METHODS:** Sleep duration, total time in bed (TTIB), sleep quality (assessed by sleep efficiency (SE) and wake after sleep onset (WASO)),

and SLV (assessed by sleep midpoint standard deviation (SMSD)) were recorded in 20 healthy children (10 ± 0.5 yrs, 10 boys, 10 girls) for 7 consecutive nights outside of the laboratory via wrist accelerometry. Following sleep monitoring, peripheral BP was measured and using pulse wave analysis (PWA) central BP was estimated. Central and peripheral BP were measured and averaged over 3 trials. Pearson's r correlations were used to assess relations between sleep metrics and BP values. Independent samples t-tests were used to determine group (low vs. high SE) differences. **RESULTS:** Sleep duration averaged 7.9 ± 0.2 hrs/night, while TTIB averaged 9.6 ± 0.1 hrs/night. SE was 82 ± 2%, WASO was 89 ± 9 mins, and SMSD was 48 ± 6 mins. Sleep duration, TTIB, SE, WASO, and SMSD were not significantly associated with central or peripheral BP values. When using an 85% cutoff for SE, central and peripheral BP were not significantly different between groups. Additionally, using the same cutoff for SE, TTIB was not significantly different between groups, however sleep duration was significantly different (7.4 hrs <85% vs 8.4 hrs >85%, p < 0.001). **CONCLUSION:** Preliminary data suggest that children age 7-12 are not getting the recommended amount of sleep (9-11 hrs/night) despite adequate time in bed. Thus far, there seems to be no effect of shortened, poor-quality, and more variable sleep on BP in healthy children age 7-12, but further research is needed. Supported by NIH grant P20GM113125

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THE IMPACT OF REPEATED, EXERCISE-INDEPENDENT INCREASES IN BLOOD FLOW ON LOWER LIMB ENDOTHELIAL FUNCTION
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(No relevant relationships reported)

Exercise training improves endothelial function partially through increases in blood flow-associated shear stress. Local heat training can be used to isolate the exercise-independent effect of increased shear stress on endothelial function. Forearm heat training has been found to improve brachial artery endothelial function, however, this has never been investigated in the lower limb. **PURPOSE:** To examine the effect of heat training on superficial femoral artery (SFA) endothelial function in young, healthy females utilizing reactive hyperemia flow-mediated dilation (RH-FMD) and sustained stimulus FMD (SS-FMD). **METHODS:** Female participants (n=13, 23±2 yrs) had one leg randomized to the heat training intervention (EXP; other leg: control (CON)). The EXP leg underwent 8 weeks of heat training via immersion in 42.5°C water for five 35-minute sessions per week. At week 0, 2, 4, 6, and 8, SFA RH-FMD and SS-FMD were measured in each leg via duplex ultrasound. RH-FMD was characterized as the peak % change in diameter following release of 5 min of thigh occlusion. SS-FMD was characterized as the peak % change in diameter during 6 min of plantar flexion exercise at a target shear stress of 13 dynes/cm². **RESULTS:** Week zero RH and SS-FMD were as follows: RH-FMD: CON 7.3±3.1, EXP 5.1±4.2; SS-FMD: CON 8.1±4.3, EXP 9.2±6.4. RH-FMD and SS-FMD did not change over the training period (RH: p=0.128; SS: p=0.063) or differ between EXP and CON legs (RH: p=0.685; SS: p=0.337; interaction RH: p=0.076; SS: p=0.958). Covariation for the shear stress stimulus did not alter the results. **CONCLUSION:** 8-weeks of leg heat training in young, healthy females did improve SFA endothelial function. These results are in contrast with previous findings that heat training improves upper limb endothelial function. The increased blood flow-associated shear stress elicited by the heating protocol may have been inadequate to elicit adaptation in the SFA. Future studies are needed to determine whether other lower limb conduit arteries or the microvasculature benefit from local, lower limb heat training.

971 Board #97 May 27 2:30 PM - 4:00 PM
High Intensity But Not Moderate Intensity Exercise Attenuates Carotid Shear-mediated Dilation
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(No relevant relationships reported)

PURPOSE: Exercise training improves cerebrovascular function. It has been recently speculated that shear-mediated dilation of the internal carotid artery (ICA) is a useful marker of cerebrovascular function. Although exercise intensity is a major factor of exercise prescription, the effects of exercise intensity on shear-mediated dilation of the ICA remain unknown. This study investigated the shear-mediated dilation of the ICA following acute, moderate-, and high-intensity exercise in healthy males. **METHODS:** Twelve healthy males (22 ± 2 years) completed a 30 min leg cycling exercise at moderate [(55-65% of age-predicted maximal heart rate (HR_{max}))] and high (75-85% HR_{max}) intensities. Shear-mediated dilation of the ICA was assessed at pre-exercise (Pre), 5 min (Post5), and 60 min (Post60) after the cessation of exercise. Shear-mediated dilation was induced by 3 min of hypercapnia (target end tidal partial pressure of carbon dioxide +10 mmHg from an individual's baseline) and calculated

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as the percent rise of the peak diameter from baseline diameter. Doppler ultrasound was employed to measure the carotid diameter, and blood velocity during exercise, and hypercapnia. Conductance and shear rate (SR) of the ICA at 25 min of exercise was calculated based on the Doppler variables and mean blood pressure.

RESULTS: Neither type of exercise altered the SR of the ICA (Interaction effect; $P = 0.93$, main effect of time; $P = 0.14$). Conductance decreased during high-intensity exercise (Pre to 25 min; 5.1 ± 1.3 to 3.2 ± 1.0 ml/min/mmHg, $P < 0.01$) but not during moderate-intensity exercise (5.0 ± 1.3 to 4.0 ± 0.8 ml/min/mmHg, $P = 0.11$). Shear-mediated dilation immediately declined after high-intensity exercise (Pre to Post5; 6.9 ± 1.7 to $4.0 \pm 1.4\%$, $P < 0.01$), but not after moderate-intensity exercise (7.2 ± 2.1 to $7.3 \pm 1.8\%$, $P = 1.00$). Shear-mediated dilation did not show significant changes at Post60 in either exercise intensity (Post 60; Moderate; 8.0 ± 3.1 , High; $6.4 \pm 2.9\%$). **CONCLUSIONS:** The acute decline of shear-mediated dilation in the ICA following high-intensity exercise may have been due to changes in the sympathetic activity and hemodynamics rather than in the SR. Current findings suggest that moderate-intensity exercise is more suitable for promoting cerebrovascular health than high-intensity exercise.

972 Board #98 May 27 2:30 PM - 4:00 PM
Concurrent Vibration During Muscle Contractions Acutely Reduces Following Central Arterial Stiffness

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(No relevant relationships reported)

Whole body vibration has been shown to elicit vasodilation after intervention. **PURPOSE:** To test the hypothesis that concurrent local vibration while muscle contraction would reduce the vasoconstrictive response induced by exhaustive resistance exercise. **METHODS:** A total of 18 apparently young healthy males (age=22±1 yrs; BMI=23 ± 1kg/m²) were recruited. Following the maximal isometric voluntary contraction determination (MVC), participants were randomly assigned to perform 2 trials of isotonic knee extensor exercise (40%MVC×3 sets, 8 reps for the first 2 sets, exercise to exhaustion in the 3rd set, 1 min rest interval) with (KE+V) and without (KE) concurrent vibration (26Hz, 2-4mm in magnitude) on the customized motor-driven knee extensor device. Brachial blood pressure measured by sphygmomanometer, central and peripheral pulse wave velocity determined by photoplethysmography, and heart rate variability (HRV) were measured before and 5 mins after exercise. **RESULTS:** Heart rate, brachial blood pressure parameters significantly increased from baseline during exercise, and there was no difference between treatments. KE+V trial significantly reduced central pulse wave velocity after exercise, whereas KE did not elicit any changes on pulse wave velocity measures compared with the baseline. HRV analysis showed KE significantly increase low to high frequency ratio (LF/HF) and reduced RMSSD after exercise, whereas no significant changes were observed in KE+V trial. **CONCLUSIONS:** Local concurrent vibration with muscle contraction also exerts vasodilatory responses after exercise, which may be associated with relatively higher parasympathetic dominance induced by vibration.

973 Board #99 May 27 2:30 PM - 4:00 PM
Distribution Of Passive Leg Movement-induced Hyperemia In Old And Impact Of Occluding The Lower Leg

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PURPOSE: With passive leg movement (PLM), a vascular function assessment, in the young, of the total blood flow (BF) that passes through the common femoral artery (CFA), ~70% is directed to the deep femoral artery (DFA), while only ~30% passes through the superficial femoral artery (SFA). With lower leg cuff-induced BF occlusion, a common practice with drug infusions during PLM, there is an attenuated response in the SFA, which is reflected by a fall in BF in the CFA, but not in the DFA. Interestingly, the proportion of blood passing through the DFA and SFA is unchanged. However, BF distribution during PLM, and the impact of cuffing the lower leg, with aging is unknown. **METHODS:** Therefore, PLM was performed with and without cuff-induced lower leg BF occlusion in 6 healthy old subjects, with BF assessed by Doppler ultrasound. **RESULTS:** In terms of BF distribution during PLM, like the young, of the 80±27 ml of blood that passed through the CFA, 69±22% was directed to the DFA, while only 31±22% passed through the SFA. However, unlike the young, the cuff resulted in the complete ablation of SFA BF and the fall in CFA BF did not achieve statistical significance. As with the young, DFA BF was unaltered by the cuff. **CONCLUSIONS:** Thus, in the old, as with young, the PLM-induced hyperemia

predominantly passes through the DFA. Cuffing appears to impact the SFA BF in the old to a greater extent than the young, but, again, in this population there is no effect on PLM-induced DFA BF.

974 Board #100 May 27 2:30 PM - 4:00 PM
Decreased Pulse Wave Reflections Associated With Isometric Handgrip Training Improves Cognitive Function In Older Adults

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(No relevant relationships reported)

PURPOSE: The purpose of this study was to investigate whether the decrease in pulse wave reflection and central systolic blood pressure (SBP) as a result of isometric handgrip (IHG) training improves cognitive function in older adults.

METHODS: Twenty-two men and women (age 75±7 years, mean±standard deviation) who were not actively involved in regular resistance or endurance training were randomly assigned to either the group that performed IHG training (IHG group, n=11) or the sedentary control group (CON group, n=11). The IHG exercise comprised four unilateral 2-min isometric contractions at 30% of maximal voluntary contraction using a programmed handgrip dynamometer with 1-min rest periods for 5 days per week for 8 weeks. Carotid augmentation index (AIx), an index of the magnitude of pulse wave reflections, and carotid SBP were non-invasively measured after resting in the supine position for at least 5 min in both groups before (baseline) and after 8 weeks of training using an arterial applanation tonometry system. Trail making test (TMT) Part A, which measures processing speed, and Part B, which assesses task shifting, were used to determine processing speed and flexibility in task switching and cognition.

RESULTS: Carotid AIx and carotid SBP in the IHG group after training were significantly lower than baseline values, decreasing from 52±4 to 39±3 mmHg and from 148±5 to 137±5 mmHg, respectively ($p < 0.05$ for both). TMT-A and TMT-B in the IHG group after training were significantly lower than baseline values, decreasing from 34.73±3.04 to 26.41±2.33 and from 60.52±5.25 to 49.39±4.51 s, respectively ($p < 0.05$ for both). The carotid AIx, carotid SBP, TMT-A and TMT-B did not significantly change before and after training in the CON group. A significant positive correlation was observed between the amount of change in carotid AIx and the amount of change in TMT-A ($r = 0.603$, $p < 0.05$) and TMT-B ($r = 0.591$, $p < 0.05$). In addition, a significant positive correlation was observed between the amount of change in carotid SBP and the amount of change in TMT-A ($r = 0.736$, $p < 0.01$) and TMT-B ($r = 0.582$, $p < 0.05$).

CONCLUSIONS: These results demonstrate that isometric handgrip exercises reduce carotid AIx and carotid SBP, which is associated with improving cognitive function.

975 Board #101 May 27 2:30 PM - 4:00 PM
Abstract Withdrawn

976 Board #102 May 27 2:30 PM - 4:00 PM
Abstract Withdrawn

977 Board #103 May 27 2:30 PM - 4:00 PM
A Cross-sectional Comparison Of Vascular Health Between Physically Active Pre- And Post- Menopausal Women.

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Following menopause, the risk of developing cardiovascular diseases increases significantly in women. The hormonal changes observed during the menopause transition, including the cessation of estrogen production by the ovaries, seems to accelerate arterial aging by decreasing vasoreactivity and increasing arterial stiffness. Physical activity is considered the most effective strategy to maintain optimal vascular health. For older men, research has demonstrated a positive influence of physical activity on markers of vascular health. However, in older women, the benefits of physical activity on vascular health are still unclear. **PURPOSE:** To determine if physically active post-menopausal women demonstrate preserved vascular health compared to physically active pre-menopausal women. **METHODS:** Five pre- (49 ± 3 years) and five post- (54 ± 2 years) menopausal healthy and active women were recruited. Blood pressure (24-hour ambulatory blood pressure monitoring), physical activity levels (7-day accelerometry), vasoreactivity (brachial artery flow-mediated dilation) and central arterial stiffness (carotid-femoral pulse wave velocity) were compared between groups. **RESULTS:** Despite both groups being physically active

(post: 708 ± 235 vs. pre: 445 ± 302 min/week, P=0.16), post-menopausal women tend to have greater 24-hour systolic blood pressure (125 ± 9 vs. 115 ± 8 mmHg, P=0.14). In contrast, vasoreactivity (post: 3.35 ± 3.68 vs. pre: 4.58 ± 1.40 %, P=0.62) and central arterial stiffness appear similar between groups (post: 7.19 ± 2.11 vs. pre: 6.84 ± 1.40 m/s, P=0.78). **CONCLUSION:** Physically active post-menopausal women tend to have greater systolic blood pressure compared to physically active pre-menopausal women, despite similar values of endothelial function and arterial stiffness.

Grant fundings: Mirella and Lino Saputo Research Chair in Cardiovascular health and the prevention of cognitive decline; HABISAN (Handicap Biologie Santé) program, Regional council of Nouvelle Aquitaine

978 Board #104 May 27 2:30 PM - 4:00 PM
Sitting-induced Endothelial Dysfunction Is Prevented In Endurance-trained Individuals

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(No relevant relationships reported)

PURPOSE: Prolonged sitting impairs leg endothelial function, which seems to be mediated by a sustained reduction in blood flow-induced shear stress. However, whether regular endurance training is effective in preventing sitting-induced leg endothelial dysfunction remains largely unknown. Herein, we tested the hypothesis that sitting-induced leg endothelial dysfunction is prevented in high endurance-trained individuals.

METHODS: The endurance-trained group comprised 11 male collegiate cyclists (age, 19.7 ± 0.6 years; height, 168.4 ± 6.2 cm; weight, 62.7 ± 7.0 kg; body mass index, 22.1 ± 2.4 kg/m²), and the untrained group comprised 9 male with no regular endurance training (age, 21.1 ± 1.8 years; height, 170.1 ± 6.6 cm; weight, 72.2 ± 8.1 kg; body mass index, 24.8 ± 1.5 kg/m²). Peak oxygen uptake (VO_{2peak}) was initially determined in all participants using incremental exercise test (37.9 ± 4.7 mL/min/kg in the untrained group vs. 60.5 ± 3.6 mL/min/kg in the endurance-trained group). At second visit, the popliteal artery flow-mediated dilation (%FMD) was assessed before and after a 3-h sitting period. During the sitting period, the popliteal artery diameter and blood velocity were measured every hour.

RESULTS: The popliteal artery shear rate was significantly and similarly reduced during the sitting period in both groups (the untrained group and the endurance-trained group: 51.9 ± 19.2 sec⁻¹ vs. 58.3 ± 23.5 sec⁻¹ at pre-sit, 25.5 ± 10.9 sec⁻¹ vs. 25.5 ± 15.2 sec⁻¹ at 1h during sitting period, 19.4 ± 7.4 sec⁻¹ vs. 27.5 ± 12.3 sec⁻¹ at 2h during sitting period, 21.4 ± 8.1 sec⁻¹ vs. 20.8 ± 8.3 sec⁻¹ at 3h during sitting period, 29.4 ± 13.9 sec⁻¹ vs. 29.7 ± 15.8 sec⁻¹ at post-sit, P < 0.001). In a 3-h sitting, a significant impairment in popliteal artery %FMD was observed in the untrained group (4.5 ± 0.6 % vs. 1.6 ± 0.2 % P = 0.003), but it was prevented in the endurance-trained group (6.9 ± 0.7 % vs. 6.2 ± 1.3 %, P < 0.431).

CONCLUSIONS: In conclusion, the present study revealed that sitting-induced leg endothelial dysfunction is preventable in endurance-trained individuals.

B-69 Free Communication/Poster - ACL Injury

Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
 Room: CC-Exhibit Hall

979 Board #105 May 27 1:30 PM - 3:00 PM
The Functional Movement Screen Is Not Associated With Self-reported Disability, Gait, Or Drop Vertical Jump In Individuals With ACL Reconstruction

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(No relevant relationships reported)

Purpose: To determine the associations between Functional Movement Screen (FMS) scores and the International Knee Documentation Committee (IKDC) questionnaire score, Knee Injury and Osteoarthritis Outcome Score (KOOS) subscales scores, gait biomechanics, and drop vertical jump (DVJ) biomechanics in individuals with ACL reconstruction (ACLR).

Methods: 30 individuals with ACLR (53% female; 71.0±46.4 months post-ACLR; 22.6±1.8 years old; 11 patellar tendon graft, 12 hamstring tendon graft, 7 allograft) completed the IKDC and KOOS. Bilateral gait biomechanics were obtained from 5 trials on a 10m runway over 2 force plates. DVJ biomechanics were obtained using a 30cm box placed half their height from the force plates. FMS tasks were scored from 0-3 and summed for analysis. Bilateral gait biomechanics included the knee flexion

angle (KFA) at heel contact, peak KFA, and vertical ground reaction force (vGRF) in the first 50% of stance. Bilateral DVJ biomechanics included the peak knee abduction angle, KFA at heel contact, peak KFA, and peak vGRF. A limb symmetry index (LSI) was calculated for peak KFA and peak vGRF during gait and DVJ. Involved limb values and LSI from gait and DVJ were used for analysis. Separate stepwise linear regression examined the association between the FMS and the IKDC, KOOS subscales, and gait and DVJ biomechanics after accounting for sex and time since ACLR.

Results: No associations were found between FMS score (Mean: 15.0±1.8) and the IKDC (Mean: 84.3±10.6) and KOOS (Mean: 72.0 - 95.6±1.8 - 21.3) after accounting for sex and time since ACLR (ΔR²=0.01 - 0.05, Δp=0.23 - 0.95). No associations were found between FMS score and involved limb biomechanical variables or their LSI's for gait (ΔR²=0.01 - 0.07, Δp=0.17 - 0.79) and DVJ (ΔR²=0.01 - 0.11, Δp=0.08 - 0.99) after accounting for sex and time since ACLR.

Conclusion: The IKDC and KOOS indicated that participants reported some knee-related disability. Conversely, the average FMS score was above the clinical threshold for dysfunctional movement patterns. Therefore, the FMS may not identify knee-related disability in individuals with ACLR. Moreover, FMS score was not associated with gait or DVJ biomechanics, and thus the FMS may not identify hazardous knee movement patterns in individuals with ACLR.

980 Board #106 May 27 1:30 PM - 3:00 PM
The Relationship Between Hip And Thigh Muscle Strength After Acl-reconstruction

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(No relevant relationships reported)

Purpose: Weakness post ACL reconstruction (ACLR) of hip and thigh muscles are evaluated to track rehabilitation progress and/or inform decisions about return to sports. Lower extremity muscle adaptations are common mechanisms by patients coping with muscle weakness. Relationships among hip and thigh strength measures after reconstruction in ACLR patients may help identify potential coping mechanisms and targets for therapeutic intervention.

Methods: Thirty-four patients with primary unilateral ACLR (21.09±6.70yr, 18M, 170.82±11.95cm, 76.82±21.36kg, 7.97±5.22 mo post ACLR) performed maximum isometric contractions for hip abduction (AB) and adduction (AD) in a supine hook-lying position with the hips flexed to 45-degrees and knee flexed to 90-degrees and knee extension (EX) and flexion (FL) while seated with the hip and knee flexed to 90-degrees; average peak torque was recorded and normalized to body mass. We used Pearson correlation coefficients to determine associations among hip and knee muscle strength.

Results: There were statistically significant positive relationships between all hip and thigh strength values of both limbs (Table 1). Correlations between knee EX and hip AB of the ACLR limb were between 0.640 and 0; the contralateral limb was between 0.583 and 0.769. Correlations between knee FL and hip AB of the ACLR limb were between 0.600 and 0.615; the contralateral limb was between 0.583 and 0.606. Correlations between knee EX and hip AD of the ACLR limb were between 0.579 and 0.726; the contralateral limb was between 0.574 and 0.754. Correlations between knee FL and hip AD of the ACLR limb were between 0.681 and 0.702; the contralateral limb was between 0.642 and 0.700.

Conclusion: Statistically significant, moderate to strong, positive relationships among hip and thigh strength measures were found of both limbs about 7 months post ACLR. Relationships among hip and quadricep strength are all moderate to strong, appearing slightly weaker in the ACLR limb.

Table 1. Pearson Correlation Strength Values for Hip Abductor, Adductor, Quadriceps, and Hamstring of ACLR and Contralateral limbs (*P<0.05)

		Knee EXtension		Knee FLexion	
		ACLR Limb	Contralateral Limb	ACLR Limb	Contralateral Limb
Hip ABduction	ACLR Limb	0.640*	0.793*	0.600*	0.615*
	Contralateral Limb	0.583*	0.769*	0.585*	0.606*
Hip ADduction	ACLR Limb	0.579*	0.726*	0.681*	0.702*
	Contralateral Limb	0.574*	0.754*	0.642*	0.700*

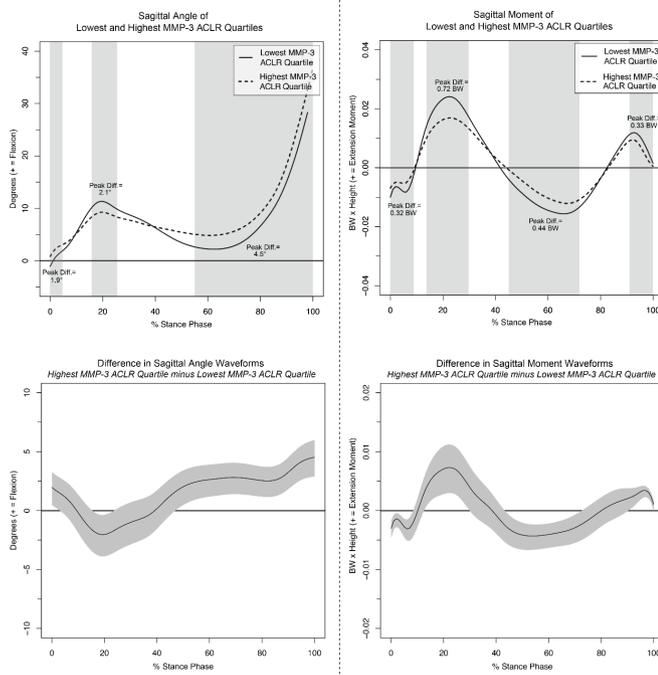
981 Board #107 May 27 1:30 PM - 3:00 PM

Greater Matrix Metalloproteinase-3 Concentrations Following ACL Injury Associate With Worse Gait Biomechanics 6-months Post-ACL Reconstruction

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(No relevant relationships reported)

Matrix metalloproteinase-3 (MMP-3) is a degenerative enzyme associated with joint tissue breakdown and has been shown to be a potential biomarker of osteoarthritis. It remains unknown if synovial fluid (SF) MMP-3 concentrations following ACL injury influence gait mechanics. **PURPOSE:** To compare knee flexion angle (KFA) and internal knee extension moment (KEM) during gait 6 months post-ACL in individuals with the highest concentrations of SF MMP-3 compared to those with the lowest concentrations of SF MMP-3 collected within the first 14 days of injury. **METHODS:** Thirty-seven individuals with ACL injury scheduled for primary patellar tendon autograft ACLR (57% females, 21±4 yrs, 23.7±2.8 BMI) participated. Individuals were grouped into highest (HQ; n=9) and lowest (LQ; n=10) quartiles based on MMP-3 knee joint SF concentrations sampled 6±4 days after ACL injury. At 6 months post-ACLR, biomechanics were collected using 3-dimensional motion capture during gait performed at a self-selected speed. Functional analyses of variance were conducted to compare KFA and KEM between HQ and LQ groups throughout stance. Groups were considered different at any percentage of stance where the 95% confidence intervals of the mean differences did not cross zero. Peak differences (PD) and corresponding effect sizes (Cohen's *d*) within portions of stance demonstrating differences were also calculated. **RESULTS:** HQ exhibited lesser knee flexion excursion; KFA was lower during 17-24% of stance (PD: 2.1°, *d*=0.44) and greater during 48-100% of stance (PD: 4.5°, *d*=0.93). HQ also exhibited lower KEM during 14-30% and 91-100% of stance (PD: 0.72 BW, *d*=0.67; PD: 0.33 BW, *d*=1.42) and greater KEM during 45-72% of stance (PD: 0.44, *d*=0.76) **CONCLUSION:** Compared to individuals in the lowest quartile of SF MMP-3, those in the highest exhibited a stiffened knee gait strategy. Pre-surgery levels of MMP-3 following ACL injury may serve as a biomarker predicting worse gait mechanics 6 months post-ACLR.



982 Board #108 May 27 1:30 PM - 3:00 PM

Knee Extensor Torque Complexity During A Maximal Voluntary Isometric Contraction Differs Between ACL-reconstructed And Healthy Individuals

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PURPOSE: Rehabilitation goals following anterior cruciate ligament reconstruction (ACLR) are structured around maximal force generating capabilities of the quadriceps. ACL injuries may occur through the inability to adapt motor output rapidly and accurately to external demands. Approximate Entropy (ApEn) can be used to describe the complexity of torque production to reflect the functional capacity of the neuromuscular system. The purpose of this study was to compare torque complexity of a maximal voluntary isometric contraction (MVIC) in ACLR limbs compared to the uninvolved limb and healthy controls. **METHODS:** A total of 215 individuals (120 ACLR [65 Female, 21.0±8.3 years, 5.96±48-mo. post-ACLR] 95 Healthy [50 Female, 21.5±2.9 years]) participated in the study. Participants completed a 30-second knee extensor MVIC which was stratified into three 10-second bins. The 3-seconds of lowest variation were used to calculate ApEn for the Early (ApEn₁), Middle (ApEn₂), and Late (ApEn₃) time bins. Torque complexity was compared across the trial, between limbs, and between groups using a repeated measures design. The dependent variable was torque complexity (ApEn) and the independent variables were group (ACLR, Healthy) and time bins (Early, Middle, Late). *A priori* alpha was set at 0.05. **RESULTS:** There was a significant time main effect for torque complexity (*P*<.001). For all participants, ApEn₁ and ApEn₂ were significantly higher than ApEn₃ (*P*<.001, Figure 1). There was also a significant group by limb interaction (*P*<.001). The ACLR limb (.46±.12) demonstrated greater torque complexity than the uninvolved limb (.38±.12, *P*<.001) and of healthy individuals (.38±.10, *P*<.001, Figure 1). **CONCLUSIONS:** The ACLR limb demonstrated a greater torque complexity at the end of a 30-second MVIC compared to healthy controls and the contralateral limb. Force fluctuations during a sustained maximal task may draw clinical insight into the recovery of motor function following ACLR.

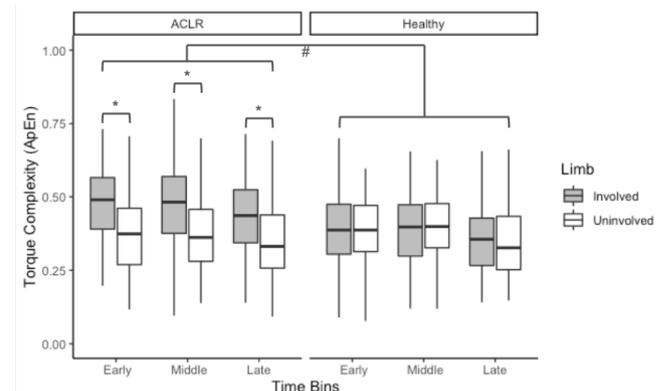


Figure 1: Torque complexity of knee extensor maximal contraction compared between limbs and groups. The involved limb of the ACLR individuals demonstrated significantly higher torque complexity compared to the uninvolved limb (denoted by *) and the healthy individual trials (denoted by #).

983 Board #109 May 27 1:30 PM - 3:00 PM

Influence Of Resistance Training On Strength And Gait Kinetics In Individuals With Acl Reconstruction

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(No relevant relationships reported)

Purpose: Individuals with anterior cruciate ligament reconstruction (ACLR) demonstrate reduced hip and knee extensor strength in their injured limb. Previous research suggests strength imbalances reduce an individuals' ability to propel themselves forward during gait as indicated by the impulse of the anterior ground reaction force (propulsive force; pGRF). As resistance training increases muscular strength, it may improve any propulsion deficits. Therefore, the purpose of this study was to compare hip and knee extensor strength as well as pGRF characteristics between individuals with ACLR who resistance train (RT) and ones who do not (NRT). **Methods:** Hip and knee extensor strength and gait were measured in 16 individuals (22.4±4.2 yr, 1.7±0.1 m, 73.8±15.1kg) with unilateral ACLR via isokinetic dynamometry and force platforms, respectively. The RT group had individuals who

resistance trained according to the American College of Sports Medicine guidelines consistently after completion of physical therapy. The NRT group included individuals who did not resistance train at all. Independent samples T-tests were used to compare peak hip and knee extensor strength (Nm/kg⁻¹), peak pGRF (N/kg⁻¹), and pGRF impulse (N*s/kg⁻¹) between the RT and NRT groups. Bivariate correlations were used to identify if hip and knee extensor strength were related to pGRF and pGRF impulse. **Results:** The RT group had greater peak knee extensor torque at 60°/sec⁻¹ (KE60) and 180°/sec⁻¹ (KE180) compared to the NRT group. No differences were observed between groups in peak hip torque, pGRF, or pGRF impulse. There was a negative correlation between KE60 and pGRF during walking ($r = -0.531$, $p = 0.034$). No correlations were found between pGRF impulse and hip or knee torque. **Conclusion:** Results confirm our hypothesis that in ACLR, individuals in the RT group exhibited greater knee extensor torque than the NRT group. Additionally, greater KE60 was related to less pGRF during walking. An exploratory analysis found no differences in walking or running velocities, indicating the RT group accomplishes the same goal with less force. This may demonstrate greater movement efficiency resulting from resistance training above the improvements in strength alone.

984 Board #110 May 27 1:30 PM - 3:00 PM
Effects Of ACL Reconstruction On In Vivo Quadriceps Contractile Behavior During Weight Acceptance In Walking

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(No relevant relationships reported)

Appropriate knee loading during walking is essential for optimal health of mechanosensitive joint tissues and is largely governed by quadriceps muscle forces. However, individuals with anterior cruciate ligament reconstruction (ACLR) often exhibit quadriceps muscle dysfunction conventionally measured via reduced peak knee extensor moments (pKEM). Recent advances in ultrasound imaging provide a unique opportunity to determine if quadriceps dysfunction also manifests as altered contractile behavior between those with ACLR and uninjured controls. **PURPOSE:** Determine differences in quadriceps contractile behavior during weight acceptance in walking between ACLR, contralateral, and control limbs. **METHODS:** Six individuals to date with unilateral ACLR (4 females, 20±2 yrs, BMI: 25.3±1.8, months post-surgery: 7.1±0.7) and 11 uninjured controls (6 females; 24±3 yrs, BMI: 22.0±2.0) walked for 2 min on an instrumented treadmill. We collected motion capture and ground reaction force data and recorded cine B-mode ultrasound images of the vastus lateralis (VL). We quantified pKEM, knee flexion excursion (KFE), and VL fascicle length change during weight acceptance (i.e., heel-strike to the instant of pKEM). We report effect sizes (ES) for all comparisons. **RESULTS:** pKEM was 25% lower in the ACLR limb (0.18±0.18 Nm/kg) than the contralateral limb (0.24±0.11 Nm/kg, ES=0.40) and 75% lower than for uninjured controls (0.74±0.19 Nm/kg, ES=3.03). Similarly, the ACLR limb exhibited 21% less KFE (11.4±3.4°) than the contralateral limb (14.5±2.2°, ES=1.08) and 32% less KFE than in uninjured controls (16.8±3.5°, ES=1.57). In uninjured controls, VL fascicles shortened by 0.13±0.23 cm during weight acceptance despite 1.21±0.26 cm of muscle-tendon-unit lengthening, alluding to a predominant role of tendon elongation. VL fascicles in the contralateral limb of ACLR subjects also exhibited shortening during weight acceptance (0.07±0.33 cm). Conversely, we observed fundamentally different behavior in the ACLR limb, for which VL fascicles lengthened by 0.10±0.14 cm (vs controls, ES=1.21). **CONCLUSION:** ACLR alters quadriceps contractile behavior during weight acceptance in walking. Fascicle lengthening unique to the ACLR limb may be a functional consequence of quadriceps dysfunction relevant to altered knee loading.

985 Board #111 May 27 1:30 PM - 3:00 PM
Knee Extensor Torque Variability Correlates With Impaired Functional Knee Kinetics After ACLR In Collegiate Athletes

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(No relevant relationships reported)

Quadriceps neuromuscular dysfunction is universal following anterior cruciate ligament reconstruction (ACLR). Quadriceps performance is often characterized by peak strength, but the ability to generate consistent knee extensor (KE) torque is not captured by maximal strength assessments and may be functionally significant. Torque steadiness (TS) quantifies the capacity to produce smooth and consistent contractile forces, but is not well-defined post-ACLR.

PURPOSE: To evaluate KE TS in collegiate athletes 4, 6, and 12 months post-ACLR, and determine the associations between TS, strength, and knee joint kinetics during athletic tasks.

METHODS: 13 Division I athletes (age 20.5 ± 1.0, BMI 26.3 ± 4.7, 6 male) completed maximal voluntary isometric KE contractions (MVIC), countermovement jumps (CMJ), and treadmill running (2.68 m/s) while 3D kinematics and ground reaction forces were recorded 4.1 ± 0.6 (4), 6.3 ± 0.6 (6) and 11.9 ± 1.1 (12) months post-surgery. TS was defined as the mean difference between raw KE torque and a lowpass filtered signal (4th order butterworth filter, 2 Hz cutoff) within a 4 second torque plateau window. Sagittal plane KE impulses were computed from the stance phase of running (RUN) and the concentric (CON) and landing (LAND) CMJ phases. Wilcoxon Signed-Ranks tests assessed between-limb comparisons at each interval, and Spearman's correlation evaluated the associations between TS, MVIC, and KE impulses.

RESULTS: Involved limb TS was significantly reduced at 4 (limb symmetry index (LSI): 36.8%, $p = .002$), 6 (LSI: 75.3%, $p = .001$), and 12 months post-surgery (LSI: 84.7%, $p = .033$). TS was significantly associated with RUN at 4 and 6 months post-surgery ($r_s = .881$ and $.865$), CON at 4, 6, and 12 months ($r_s = .720$, $.587$, and $.708$), and LAND at 6 and 12 months ($r_s = .678$ and $.564$). MVIC was significantly correlated with RUN at 4 months ($r_s = .762$) and CON at 4, 6, and 12 months ($r_s = .787$, $.587$, and $.689$). TS and MVIC were not correlated at any interval ($r_s = -.335$, $-.346$, and $-.225$). **CONCLUSIONS:** KE TS is reduced 4-12 months post-ACLR in collegiate athletes, and asymmetrical TS is generally strongly associated with asymmetrical KE kinetics. KE TS and strength appear to be unique characterizations of quadriceps performance post-ACLR. Interventions to improve KE TS post-ACLR are recommended to restore knee function.

986 Board #112 May 27 1:30 PM - 3:00 PM
Similar Biomechanics During Change Of Direction In Adolescents With Contact Versus Non-contact Acl Injury

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(No relevant relationships reported)

Purpose: Patients who sustain non-contact (N-CON) anterior cruciate ligament (ACL) injuries may be predisposed to injury due to deficient biomechanics. In contrast, patients who sustain contact (CON) ACL injuries may be injured due to unlucky trauma rather than poor biomechanics. This study compared biomechanics during change of direction movements between patients with CON vs. N-CON ACL injury mechanisms. We hypothesized that patients with CON ACL injury would have better biomechanics (greater shock absorption and less dynamic limb valgus) than patients with N-CON ACL injury.

Methods: 15 patients age 10-18 years with CON ACL injury (4 female; mean age 15.5, SD 2.1) and 94 with N-CON ACL injury (11 female; mean age 15.6, SD 1.9) underwent motion analysis 6-12 months (mean 7.5, SD 1.3) after ACL reconstruction (ACLR). Subjects performed forward-backwards and lateral change of direction tasks. 3D kinematic and kinetic variables reflecting dynamic limb valgus (frontal and transverse plane) and shock absorption (sagittal plane) were compared between patients who had CON and N-CON injury mechanisms using 2-tailed t-tests.

Results: No significant differences were observed between the CON and N-CON groups (Table).

Conclusion: The CON injury group did not have better biomechanics than the N-CON group. This may be due to both groups engaging in similar rehabilitation programs. Alternatively, the CON injury group may have had similar pre-injury biomechanics to the N-CON group but happened to suffer a contact injury. These results suggest that all patients post-ACLR have potentially modifiable risk factors for re-injury and should have their biomechanics evaluated so any deficiencies can be rectified prior to return to sport regardless of injury mechanism.

Table: Comparison of kinematics and kinetics between contact and non-contact ACL injury groups

	Deceleration			Lateral Shuffle		
	Non-Contact	Contact	P-value	Non-Contact	Contact	P-value
SHOCK ABSORPTION						
Max hip flexion	75.3 (15.2)	76.9 (16.4)	0.72	68.4 (14.6)	71.9 (13.6)	0.39
Max knee flexion	65.2 (14.1)	68.8 (20.9)	0.39	61.4 (13.1)	65.2 (13.5)	0.31
Max ankle dorsiflexion	-5.5 (7.1)	-2.3 (2.2)	0.12	16.0 (7.5)	18.2 (8.9)	0.32
Max hip flexion moment	2.8 (1.5)	2.5 (0.9)	0.58	2.07 (0.52)	2.10 (0.63)	0.89
Max knee flexion moment	1.3 (0.5)	1.2 (0.7)	0.55	1.20 (0.50)	1.25 (0.45)	0.72
Max ankle dorsiflexion moment	0.84 (0.22)	0.82 (0.29)	0.80	1.07 (0.30)	1.14 (0.55)	0.52
Energy absorption at hip	0.66 (0.43)	0.56 (0.39)	0.39	0.50 (0.26)	0.45 (0.25)	0.50
Energy absorption at knee	0.50 (0.35)	0.44 (0.38)	0.52	0.38 (0.26)	0.38 (0.19)	0.96
Energy absorption at ankle	0.17 (0.11)	0.14 (0.06)	0.25	0.41 (0.19)	0.42 (0.25)	0.84
DYNAMIC LIMB VALGUS						
Max hip internal rotation	7.8 (7.4)	5.1 (7.8)	0.19	13.7 (8.8)	9.3 (7.5)	0.07
Max hip adduction	1.9 (6.4)	2.6 (4.5)	0.70	-18.3 (8.3)	-17.2 (7.0)	0.65
Min knee varus	-1.1 (4.8)	-3.8 (6.6)	0.05	-2.4 (5.1)	-3.5 (5.4)	0.44
Min knee varus moment	-0.34 (0.34)	-0.32 (0.32)	0.82	-0.85 (0.69)	-0.81 (0.93)	0.84

External moments are reported. Angles are expressed in degrees, moments in N/kg, energy absorption in J/kg.

987 Board #113 May 27 1:30 PM - 3:00 PM
Revisiting Central And Peripheral Contributions To Muscle Weakness After ACL-Reconstruction

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Purpose: Alterations in quadriceps muscle morphology (i.e. cross-sectional area [CSA]) and volitional activation (VA) contribute to muscle weakness following anterior cruciate ligament reconstruction (ACLR). Research on the relative contributions between each factor and quadriceps weakness remain inconclusive as few studies have concurrently evaluated VA and muscle morphology in the same cohort of ACLR patients. Further, the magnitude of contribution of morphology and activation may vary depending on whether data are considered for the ACLR limb alone or if data are reported as a limb symmetry index (LSI), taking into account the uninvolved leg. Thus, aims of this study were to determine the contributions of VA and CSA on quadriceps strength in ACLR patients and to determine if the contributions were similar when using the involved limb or the LSI. **Methods:** Sixteen individuals 6-12 months post-ACLR (time post ACLR: 40.3±8.2 wks, Age: 22.3±6.0yr, Height: 1.7±0.1m, Mass: 68.7±11.5 kg, Sex: 9F) were recruited for this study. Quadriceps isometric peak torque (PT) and VA, via the interpolated triplet technique, were assessed bilaterally at 90° of knee flexion on a dynamometer. Ultrasound images were acquired to assess vastus lateralis CSA in both legs. LSI's were calculated for all outcome variables by expressing values of the involved leg as a percent of the uninvolved leg. Paired t-tests were used to compare outcomes between legs (Bonferroni-adjusted $\alpha = 0.017$). Two separate stepwise linear regressions were performed to examine the contribution of VA and CSA on quadriceps PT where model 1 used LSI for all variables, and model 2 used variables from the involved leg (Bonferroni-adjusted α 's = 0.025). **Results:** Regression model 1 indicated PT LSI was significantly predicted by VA LSI ($R^2=0.45$, $P<0.01$), but not by VL CSA LSI ($R^2=0.01$, $P=0.87$). Model 2 indicated that involved leg PT was significantly predicted by VL CSA ($R^2=0.50$, $P<0.01$) but not quadriceps VA ($R^2=0.08$, $P=0.11$) of the involved leg. All dependent variables were smaller in the involved compared to uninvolved leg ($P<0.017$). **Conclusions:** The contributions of VA and CSA on

quadriceps PT differed greatly if LSI or involved leg outcomes were used. Evaluation of VA and CSA in unison may provide a more holistic understanding of the sources of muscle weakness after ACLR.

988 Board #114 May 27 1:30 PM - 3:00 PM
Preventing Acl Injuries With Martial Arts Break Falling Training

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PURPOSE: ACL injuries have remained prevalent despite numerous prevention attempts. Most prevention has focused on traditional approaches. We propose a novel approach to injury prevention by implementing martial arts falling techniques. This training uses proprioceptive and kinesthetic conditioning to reinforce the athlete's ability to mitigate at-risk postures. This study aims to evaluate the proprioceptive function and risk factors in soccer athletes that undergo fall training. **METHODS:** Members of a premier soccer club, ages 9 to 16, were recruited to. All subjects continued usual training. Subjects partook in the interventional training of martial arts fall training, taught by a 3rd degree black belt master in karate and aikido, twice weekly for ten weeks. Baseline and post-intervention, proprioceptive testing was performed using the Neurocom Balance Master. A linear mixed model was used to determine the effect of the intervention on variables of interest. The fixed effect was time point, used to compare pre to post intervention measures, and random effects included intercepts for subjects and trials within subjects. The level of significance was 0.05.

RESULTS: A significant increase in movement time from pre to post (Premean=1.14, Postmean=1.94, $p=0.032$), no significant change in turn time, turn sway, or sway energy. There was a non-significant decrease in impact index (Premean=46.3, Postmean=36.9, $p=0.206$). A significant decrease in the mean impact index for the right lower extremity. While not statistically significant, downward trends were observed in right lower extremity for mean turn time, mean turn sway, and mean sway energy. Additionally, increases noted for mean equilibrium and mean strategy.

CONCLUSIONS: Results of the mean impact index test highlight the efficacy of martial arts fall training in the dominant lower extremity. Furthermore, the trend of improvement in the dominant leg in a variety of proprioceptive metrics is noteworthy, suggesting the intervention reinforced the more honed neural pathways of the dominant side quicker than the non-dominant. Future research is needed to elucidate whether the non-dominant side can demonstrate the plasticity seen in the dominant side. Finally, the overall increase seen in mean equilibrium and mean strategy is promising.

989 Board #115 May 27 1:30 PM - 3:00 PM
Decreased Loading During Gait Alters Intralimb Coordination In Anterior Cruciate Ligament Reconstructed Individuals

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Aberrant lower extremity loading following anterior cruciate ligament reconstruction (ACLR) is theorized to play a role in posttraumatic osteoarthritis (PTOA) development. Cueing an increase or decrease in loading could potentially optimize gait biomechanics and slow progression to PTOA. Stable coordination is fundamental for functional gait as a mediating process for the distribution of joint loads. Accordingly, examining how joint loading impacts coordination during gait may elucidate compensatory movement strategies following ACLR. **PURPOSE:** Determine the effect of cueing an increase or decrease in lower extremity loading on intralimb coordination between the knee-hip joints in ACLR participants. **METHODS:** Coordination was assessed in 10 individuals (age: 21±4 years; 9±1 months post-surgery; 4F) with unilateral ACLR during three separate loading conditions. Loading was manipulated via real-time feedback using a force measuring treadmill that cued a change in peak vertical ground reaction force (vGRF). Three conditions were conducted on separate days in a random order: 1) preferred (no feedback), 2) overload (cue 5% body weight [BW] increase in vGRF), and 3) underload (cue 5% BW decrease in vGRF). The intralimb coordination between sagittal plane knee-hip angles was assessed via measures of coordination dynamics (mean [M] and standard deviation [SD] of relative phase [RP] and percent determinism [%DET] from cross-recurrence quantification analysis) for each condition. One-way repeated-measures analyses of variance were used to determine differences among conditions. **RESULTS:** A main effect of loading was observed for M RP ($F_{2,26}=6.9$, $p<0.05$) and SD RP ($F_{2,26}=9.5$, $p<0.05$). The underloaded condition exhibited significantly different coordination stability (lower M and higher SD of RP) compared to the preferred and overloaded conditions ($p<0.05$).

A significant effect of loading on %DET ($F_{2,26}=2.7$ $p<.05$) was also observed; the underloaded condition led to tighter coupling than the preferred condition. ($p<.05$).
CONCLUSIONS: Overall, underloading changed the pattern and multi-scale stability of knee-hip coordination. These findings indicate manipulations in joint loading result in altered movement strategies that concern the development of PTOA.

990 Board #116 May 27 1:30 PM - 3:00 PM
Changes In Gait Biomechanics Between Level And Downhill Walking Do Not Differ Between Those With Anterior Cruciate Ligament Reconstruction And Controls

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Conflicting evidence exists regarding the presence of aberrant gait biomechanics after the first year post-anterior cruciate ligament reconstruction. Overground walking may not elucidate differences in those further removed from surgery due to the unexact nature of the task. Deleterious gait biomechanics following ACLR are partly attributable to quadriceps dysfunction. Downhill walking may exacerbate aberrant gait biomechanics, as this task places greater demands on the quadriceps compared to level walking.

PURPOSE: To compare gait biomechanics between individuals with ACLR and healthy controls during level and downhill walking conditions.

METHODS: 24 individuals more than 1 year removed from primary ACLR (83% female, age= 21 ± 3 yr, time since ACLR 44 ± 26 mo, BMI= 23 ± 3 kg/m²) and 24 healthy controls (79% female, age= 21 ± 1 yr, BMI= 24 ± 3 kg/m²) completed both level and downhill (10° grade) gait biomechanics assessments on an instrumented split-belt treadmill at their preferred walking speed. Peak variables were evaluated over the first 50% of stance including the vertical ground reaction force (vGRF), internal knee abduction moment, internal knee extension moment, knee flexion angle, and knee abduction angle. Moments were normalized to %body weight*height (%BW*Ht) and vGRF was normalized to %body weight. Dependent variables were compared across groups and conditions via two-way repeated measures ANCOVA controlling for gait speed.

RESULTS: There were no significant condition*group interaction effects nor group main effects for any outcomes. However, there were significant condition main effects for peak internal knee extension moment ($p = 0.020$, level to downhill mean increase of 0.042 %BW*Ht) and peak knee flexion angle ($p = 0.018$, level to downhill mean increase of 13.2°).

CONCLUSIONS: Downhill walking necessitates a larger internal extension moment and knee flexion angle compared to level gait. Our results suggest that changes in gait biomechanics between level and downhill conditions do not differ between individuals with ACLR > 1 year post reconstruction and controls. These results suggest that aberrant gait biomechanics may be mitigated over time in those with ACLR.

991 Board #117 May 27 1:30 PM - 3:00 PM
Fewer Steps Per Day Associates With Greater Cartilage Breakdown Biomarkers Post Anterior Cruciate Ligament Reconstruction

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PURPOSE: Individuals with anterior cruciate ligament reconstruction (ACLR) engage in fewer steps per day (steps/day) compared to uninjured controls. While regular physical activity can improve outcomes of idiopathic knee osteoarthritis such as disability, it is unknown if physical activity influences post-traumatic knee osteoarthritis outcomes following ACLR. Cartilage oligomeric matrix protein (COMP) is a biomarker outcome associated with cartilage breakdown, and it is responsive to mechanical loading during walking. Therefore, the purpose was to determine the association between steps/day and change in COMP (ΔCOMP) following walking in individuals with an ACLR. **METHODS:** Steps/day was assessed over 7 days using ActiGraph accelerometers worn on the right hip in 31 participants (age=22±4years, body mass index=23.9±2.9kg/m², 52±37 months post-ACLR, 55% females) with primary unilateral ACLR ≥ 6 months at the time of testing. Subjects walked at a preferred speed for 3000 steps (~30 minutes) on a treadmill to introduce cartilage loading. Blood samples were collected immediately pre- and post-walking, and serum COMP concentrations were analyzed with ELISA kits. ΔCOMP was calculated with post-walking concentrations expressed as a percentage of pre-walking levels. Greater

ΔCOMP was interpreted as greater cartilage breakdown during the walking protocol. A univariate linear regression was conducted to determine the association of steps/day with ΔCOMP.

RESULTS: Fewer steps/day (mean±SD: 9,626±2,452) associated with greater ΔCOMP (+11.5±16.4%; $R^2=0.152$, $\beta=-0.003$, $p=0.030$).

CONCLUSIONS: Individuals after ACLR who habitually engage in fewer steps/day demonstrated greater ΔCOMP during a walking protocol. We postulate fewer steps/day in individuals with a history of ACLR may result in deleterious changes in cartilage homeostasis due to inadequate mechanical stimulation of joint tissues. Future studies should determine if increasing steps/day improves knee cartilage outcomes following ACLR.

992 Board #118 May 27 1:30 PM - 3:00 PM
Does Lower Limb Dominance Change After An Anterior Cruciate Ligament Reconstruction?

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 (No relevant relationships reported)

Changes in limb dominance, the limb to kick a ball or recover a fall, after an anterior cruciate ligament reconstruction (ACLR) could occur if the limb has not fully recovered. Due to the impact of an ACLR on the quadriceps, a poor quadriceps limb symmetry index (Q-LSI) could influence changed limb dominance. The difference in the leg used during a quick regain of balance (step-limb) from the subjects' self-reported limb dominance, could identify poor motor planning required to use the limb.

PURPOSE: Evaluate if patients reporting tearing their dominant, defined as the leg to kick a ball, (DOM group) or non-dominant (N-DOM group) limb is the same as the step-limb used during a reactive balance test. For the DOM group, Q-LSI was compared between subjects who switched dominance and those that did not.

METHODS: 36 ACLR (15M, 18±5 years) reported their dominant leg 6-months after ACLR. A reactive balance test was performed where subjects were passively leaned forward 10 degrees. In 5 out of 10 trials they were released and had to step to regain their balance. The most frequently used (3 out of the 5 trials) step-limb was recorded. Q-LSI were calculated through the maximum voluntary isometric contractions at 90 degrees of knee flexion. A Fisher's exact evaluated if the step-limb was similar to the reported dominant limb, comparing the DOM and N-DOM groups. For the DOM group, a Student's t-test compared the differences in Q-LSI between switchers and non-switchers.

RESULTS: 75% (27 DOM: 9 N-DOM) of the subjects tore their DOM limb. When a loss of balance occurred, 48% of the DOM group (13:14) switched dominance. This was significantly greater than the N-DOM group (11%, 1:8, $p=0.02$). The DOM group who did not switch limbs had higher Q-LSI (switchers: 57% Q-LSI, non-switchers: 78% Q-LSI, $p=0.04$).

CONCLUSIONS: Almost half of the subjects who tore their dominant limb stepped with their uninjured/non-dominant limb 6-months after an ACLR and had a lower Q-LSI than those who stepped with their dominant limb. These results suggest that with lower Q-LSI, subjects' preplanning of initial movements is altered. Switching limb dominance to the non-dominant/uninjured limb may affect performance during tasks that require quick movements. Future studies should evaluate the effects of changes in limb dominance on subsequent injuries after ACLR.

993 Board #119 May 27 1:30 PM - 3:00 PM
Altered Corticospinal Tract Structure And Excitability In Patients With Anterior Cruciate Ligament Reconstruction

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Underlying neural factors contribute to poor outcomes following anterior cruciate ligament reconstruction (ACLR). Neurophysiological adaptations have been identified in motor cortex activation and corticospinal tract excitability, however limited evidence exists on neurostructural changes that may influence motor recovery in ACLR patients.

PURPOSE: To 1) quantify hemispheric differences in structural properties of the corticospinal tract in patients with a history of ACLR, and 2) assess the relationship between excitability and corticospinal tract structure. **METHODS:** Ten ACLR participants (age: 22.6 ± 1.9 yrs; height: 166.3 ± 7.5 cm; mass: 65.4 ± 12.6 kg, months from surgery: 70.0 ± 23.6) volunteered for this cross-sectional study. Corticospinal tract structure (volume; fractional anisotropy [FA]; axial diffusivity [AD]; radial diffusivity [RD]; mean diffusivity [MD]) was assessed using diffusion tensor imaging, and excitability was assessed using transcranial magnetic stimulation (motor evoked potentials [MEP]) for each hemisphere. Hemispheric differences were evaluated using paired samples t-tests. Pearson product moment correlational analyses were conducted on structural and excitability outcomes. Alpha level was set at $p \leq 0.05$. **RESULTS:**

The hemisphere of the ACLR injured limb demonstrated lower volume (567.1 ± 75.3 voxels; $p = 0.005$), lower FA (0.49 ± 0.01 ; $p = 0.02$), higher MD ($7.58 \times 10^{-4} \pm 0.35 \times 10^{-4}$; $p = 0.01$), and smaller MEPs (0.013 ± 0.007 ; $p = 0.04$) compared to the hemisphere of the non-injured limb (659.7 ± 64.3 voxels; 0.53 ± 0.02 ; $7.23 \times 10^{-4} \pm 0.10 \times 10^{-4}$; 0.028 ± 0.010), indicating disrupted white matter structure and a reduction in excitability of the corticospinal tract. Correlation analyses revealed a strong, positive correlation between corticospinal tract volume and MEP of the ACLR injured limb ($r = -0.890$; $p = 0.001$). **CONCLUSIONS:** ACLR patients demonstrated asymmetry in structural properties of the corticospinal tract that may influence the recovery of motor function following surgical reconstruction. More research is warranted to establish the influence of neurostructural measures on patient outcomes and response to treatment in ACLR populations.

994 Board #120 May 27 1:30 PM - 3:00 PM
Gait Biomechanics Linked To Post-traumatic Osteoarthritis Following Anterior Cruciate Ligament Reconstruction Are Improved With Vibration

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PURPOSE: Anterior cruciate ligament reconstruction (ACLR) incurs a high risk of post-traumatic knee osteoarthritis (PTOA). Aberrant gait biomechanics contribute to PTOA and are attributable in part to quadriceps dysfunction. Vibration improves quadriceps function following ACLR, but its effects on gait biomechanics are unknown. The purpose of this study was to evaluate the effects of whole body vibration (WBV) and local muscle vibration (LMV) on gait biomechanics in individuals with ACLR. **METHODS:** 75 volunteers with primary unilateral ACLR (72% females; age 21 ± 3 yr; time since ACLR 27 ± 16 mo) were randomized to WBV, LMV, or Control interventions. WBV and LMV were applied 6 x 1 minute (30Hz, 2g). Walking biomechanics were assessed prior to and following the interventions. Outcomes included the peak vertical ground reaction force (vGRF) and its loading rate, peak internal knee extension and valgus moments, and peak knee flexion and varus angles during the first 50% of stance. vGRF magnitude and rate were normalized to body weight (BW) and moments were normalized as % body weight*height (%BW*Ht). ACLR limb change scores (post-pre) for each outcome were compared across groups via one-way ANCOVA controlling for gait speed, time since ACLR, and baseline values. **RESULTS:** Change scores did not differ across groups for peak knee flexion ($p = 0.374$) or varus ($p = 0.801$) angles, vGRF ($p = 0.656$), or internal valgus moment ($p = 0.866$). However, changes in vGRF loading rate differed across groups ($p = 0.024$), with a significant decrease in the LMV group (-3.6 BW/s) that was greater than the changes in the WBV (-0.3 BW/s; $p = 0.035$) and Control (0.5 BW/s; $p = 0.010$) groups. Additionally, the change in peak internal extension moment differed across groups ($p = 0.016$), with a significant increase in the WBV group (0.27 %BW*Ht) that was greater than the change in the Control group (-0.17 %BW*Ht; $p = 0.005$) but not the LMV group (0.01 %BW*Ht; $p = 0.101$). **CONCLUSIONS:** Lower knee extension moments and greater loading rates during gait have been linked to declines in joint health following ACLR. WBV acutely increased the peak knee extension moment and LMV decreased loading rates. These data suggest that vibration has the potential to mitigate aberrant gait biomechanics, and may represent an effective approach for mitigating PTOA risk following ACLR.

995 Board #121 May 27 1:30 PM - 3:00 PM
Can Increased Gait Speed Improve Knee Loading Mechanics Following Anterior Cruciate Ligament Reconstruction?

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Knee extensor moments (KEM) deficits during gait persist long term following anterior cruciate ligament reconstruction (ACLR) and are attributed to progression of osteoarthritis. KEM are reduced in surgical limb through modulation of heel rocker mechanics (HRM): reduced knee flexion excursion (KFE), shank anterior angular velocity (SAV) and posterior ground reaction force (pGRF). Improved KEM are more therapeutically desirable if accomplished by improving underlying HRM. Increased gait speed increases knee loading in healthy individuals but it is not known if those with long term deficits post-ACLR respond to gait speed with improved KEM or if these improvements are accomplished by improving underlying HRM

PURPOSE: To determine if individuals with long term KEM deficits post-ACLR respond to increase treadmill gait speed with increase KEM and HRM and if improved KEM is related to improved HRM

METHODS: Individuals > 1 year post-ACLR with KEM deficits >10% are recruited; data collection on-going. Participants (N=4, 61.4±29.8 months post-ACLR) walked on a treadmill at self-selected (SS) and 50% faster than SS (FAST) speeds (3 minutes/ speed). 3D kinematics (Qualisys) and kinetics (Bertec) were collected in last 30 seconds (6 steps/limb). KEM (inverse dynamics), SAV, pGRF and KFE during loading response (surgical limb) were compared between speeds; strength of difference indicated by effect size (ES). Pearson correlations used to determine association between percent increase (SS to FAST speed) in peak KEM and increase in HRM (peak SAV, peak pGRF and KFE)

RESULTS: KEM ($97.1 \pm 74.8\%$, $ES = 1.1$), SAV ($44.9 \pm 4.4\%$, $ES = 1.5$), pGRF ($62.9 \pm 3.5\%$, $ES = 1.6$) and KFE (4 ± 1.9 degrees, $ES = 1.3$) increased with speed. Increased KEM correlated with increases in KFE ($r = .92$, $p = .08$), and SAV ($r = .99$, $p = .01$) but not pGRF ($r = -.18$, $p = .82$)

CONCLUSIONS: This preliminary analyses suggest that increased gait speed improves KEM and all features of HRM. A 97% increase in KEM was strongly related to improvements in KFE and SAV. Sample size calculations suggests these results will hold up in our full study sample (expected for May presentation). If results hold, it will suggest that increasing treadmill gait speed may be an effective stimulus for retraining kinematic features of HRM and KEM in those who have persistent KEM deficits during gait following ACLR

996 Board #122 May 27 1:30 PM - 3:00 PM
Bilateral Changes In Running Biomechanics Observed From Pre-injury To 6-months Post Anterior Cruciate Ligament Reconstruction

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Reduced knee function during running has been observed in anterior cruciate ligament reconstructed (ACLR) knees, persisting up to 5 years after surgery. Current evidence is limited to cross-sectional design and often utilizes the contralateral limb for comparison with questionable appropriateness. Pre-injury running biomechanics, although difficult to obtain, can be used to assess post-surgical changes in both the involved and uninvolved limbs. Through pre-season injury screening, we obtained running mechanics on collegiate athletes. This study utilizes this pre-injury data for evaluation of bilateral changes in those athletes who sustained an ACL injury and then underwent ACLR. **PURPOSE:** To assess changes in knee joint mechanics during running from pre-injury to 6-months post-ACLR in Division 1 collegiate athletes. **METHODS:** Whole body kinematics and ground reaction forces (GRF) were collected during treadmill running for 9 athletes (5 females) prior to a primary ACL injury (PRE) and 6.1±0.3 months post-ACLR (6M). Athletes ran at a maximally comfortable speed at 6M (3.8 ± 0.5 m/s) and speed-matched PRE data was reviewed. Knee joint mechanics and GRF variables were compared between PRE and 6M within the involved (INV) and uninvolved (UNI) limb using Wilcoxon Signed-Rank Tests. Results are presented as within-limb percent change (kinetics, GRF) or median difference (kinematics) between PRE and 6M.

RESULTS: Knee joint metrics decreased from PRE to 6M in the INV limb: knee flexion excursion during stance (5.4° , $p < 0.01$), knee extensor impulse (59.1% , $p < 0.01$), rate of knee extensor moment (37.0% , $p < 0.01$). No change in knee joint mechanics were observed in the UNI limb ($< 5\%$, $p > 0.1$). Furthermore, INV limb demonstrated reduced vertical GRF impulse (2.8% , $p < 0.01$) and braking impulse (13.6% , $p = 0.01$), while both metrics increased in the UNI limb (vertical, 5.7% , $p = 0.01$; braking, 23.8% , $p = 0.01$).

CONCLUSIONS: This is the first study to assess changes in running biomechanics following ACLR relative to the pre-injury state. Consistent with cross-sectional studies, INV knee kinematics and kinetics did not return to pre-injury state by 6 months post-ACLR. Additionally, the UNI limb appears to be a valid comparator for the INV limb for knee joint specific running mechanics at 6M, but not for GRF variables. NIH award TL1TR002375

997 Board #123 May 27 1:30 PM - 3:00 PM
Gait Variability Of Younger Children Is More Altered By Footwear Type Compared To Older Children

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 (No relevant relationships reported)

The role footwear plays on the development of children's gait and gait variability is not often considered. Many factors contribute to the development of children's gait, including growth, coordination, and motor control, but little attention is paid to the

added constraint of footwear and its role in guiding the development of children's gait. **Purpose:** To determine the affect different footwear types have on children's gait variability at different stages in development. **Methods:** 28 healthy children were divided into four groups by ages 2-3, 4-5, 6-7, and 8-10 years old respectively. Gait variability (coefficient of variation (CV)) measures of stride length (SL) and stride time (ST) parameters were collected for three minutes of treadmill walking in barefoot (BF), moccasin (MO), athletic (AT), and rigid shoes (RS) conditions. A mixed factorial ANOVA (4 age x 4 shoe) was performed to determine significant differences. Tukey post-hoc tests were conducted where applicable. **Results:** There was a significant age x shoe interaction for ST CV ($p=.003$). Specifically, MO decreased from youngest to oldest while BF, AT, and RS increased from 2-3 to 4-5 before decreasing to 6-7 and 8-10. There was a significant age x shoe interaction for SL CV ($p=.007$). There was linear decrease for the MO condition from youngest group to oldest group for SL CV while SL CV increased from 2-3 to 4-5 old before decreasing for the 6-7 and decreasing again for the 8-10 for the BF, AT, and RS conditions. **Conclusion:** Younger children were more sensitive to the varying types of footwear conditions than older children. Concerning footwear, MO most closely resembles BF gait compared to AT and RS. It is important to note the increased sensitivity to footwear differences for younger children. The results of this study raised the concern of what types of footwear should be most appropriate for a developing child, recommending moccasin type shoes and not typical athletic or rigid shoes.

CV Spatiotemporal

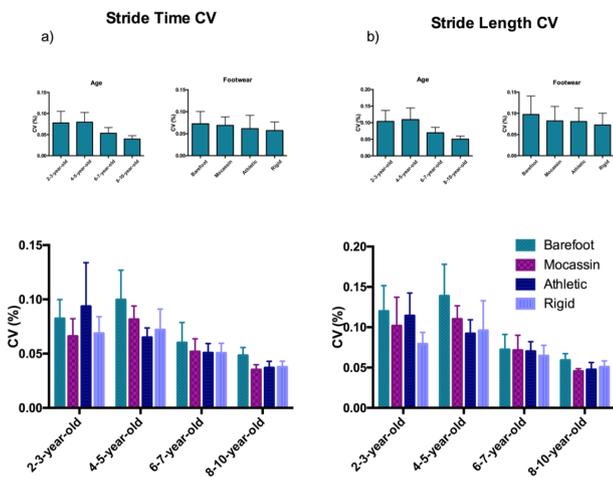


Figure: Bar charts showing the mean and standard deviation for CV Stride time and CV stride length spatiotemporal time series. Data are reported for main effect of age group and footwear condition as well as pairwise comparisons.

AG: -2.9%) angle showing the more leveled foot angle control. There was a greater reduction of foot elevation at mid-swing in CG than AG ($p=0.007$; CG: -11.1%; AG: 8.6%). Lower lateral step variability ($p=0.021$; CG: 5.2%; AG: 34.5%) and greater reduction of lumbar motion in transverse plane ($p=0.030$; CG: -27.7%; AG: -9.4%) were also exhibited in CG. **CONCLUSION:** The study highlights that to attain a comparable secondary task performance with adults, children group adopted more cautious gait patterns when walking and texting. The observed changes, therefore, may suggest that a greater compromise in motor-domain seems necessary in younger age smartphone users under dual-tasking conditions.

999 Board #125 May 27 1:30 PM - 3:00 PM
Sex And Height Differences Associated With High Impact Physical Activities In Children
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 (No relevant relationships reported)

INTRODUCTION: During childhood mechanical loading is important for developing a resilient skeleton. High impact activity interventions cause improvements in bone mineral density in youth and can promote long term bone health. When designing interventions, it is important to know if sex and height play a role in loading magnitudes experienced during various jumping activities. **PURPOSE:** Examine if sex and height impact the magnitude of peak ground reaction forces (pGRF) during different jump tasks. **METHODS:** Four males (Age: 9±1 years; Height: 1.36 ± 11 m; Mass: 31 ± 5 kg) and four females (Age: 11±1 years; Height: 1.46±0.05 m; Mass: 36±6 kg) performed five trials for each jump condition. Each subject performed a broad jump (BJ), countermovement jump (CMJ), jumping jack (JJ), leap jump (LJ), and a drop jump (DJ). Data were collected on a force plate (1000 Hz), and pGRF in units of body weight (BW) was determined during the landing phase. A mixed ANOVA was employed to assess sex differences across conditions. Correlation analysis assessed the relationship between height and pGRF for each condition. **RESULTS:** No differences in pGRF were observed between males (m) and females (f) across conditions [BJ (m: 2.14± 0.09, f: 2.33± 0.18 BW), CMJ (m: 2.42±0.2, f: 2.44±0.25 BW), JJ (m: 2.55±0.16, f: 2.53±0.25 BW), LJ (m: 1.98±0.02, f: 2.02±0.15 BW), and DJ (m: 2.88±0.31, f: 3.25±0.48 BW)]. There was a moderate correlation between height and pGRF for DJ ($r = 0.59$). **CONCLUSION:** Larger pGRF exhibited with taller subjects during the DJ condition can be explained by considering a higher center of mass contains more gravitational potential energy converted to kinetic energy during the DJ, and thus requires a larger pGRF to slow the participant's center off mass during landing. Height differences should be considered when designing interventions involving drop jumps to elicit bone adaptations in youth.

WEDNESDAY, MAY 27, 2020

B-70 Free Communication/Poster - Functional Biomechanics in Young People
 Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
 Room: CC-Exhibit Hall

998 Board #124 May 27 1:30 PM - 3:00 PM
Comparison Of Gait Characteristics Between Children And Adults During Walking And Texting
 Eun Hye Kwon, Jongil Lim, Henry Martinez, Ian Martinez.
 Texas A&M University San Antonio, San Antonio, TX.
 (No relevant relationships reported)

Average age for a child getting their first smartphone is getting younger. While well-established negative impacts of using smartphone on walking characteristics were generally found for the adult population, its age-related differences are not clear. **PURPOSE:** To examine age-related differences in gait characteristics during walking and texting. **METHODS:** A total of 24 participants were recruited in this study: 12 children (CG; age = 11.7±1.0 years; 1.15 ± 0.11 m; 50.5 ± 13.8 kg) and 12 adult participants (AG; age = 24.8±2.5 years; 1.61 ± 6.3 m; 65.4 ± 18.6 kg). Two conditions were employed (No-texting and Texting). In each condition, subject performed two 60 sec walking trials at their preferred speed along a rectangular walkway (8 x 12 m). Participants were asked to walk while matching a preferred foot strike to the beat of an auditory metronome corresponding to a preferred step frequency measured in baseline. Gait parameters including spatial and temporal step characteristics were measured from wireless inertial sensor system. Dual-task cost (DTC) was calculated as the percentage change between single-task (No-Texting) and dual-task (Texting) conditions. Two-way repeated measures ANOVA's were performed for all dependent variables, with texting condition as a within-subjects variable and group as a between-subjects variable. **RESULTS:** No significant group differences in DTC were observed for texting speed and accuracy. DTC for the gait speed was not significantly different between groups (CG: -14.1%; AG: -11.3%). CG exhibited greater DTCs of foot strike ($p=0.008$; CG: -12.9%; AG: -7.9%) as well as toe-off ($p=0.023$; CG: -6.0%;

1000 Board #126 May 27 1:30 PM - 3:00 PM
Loading Profiles Associated With High Impact Physical Activities In Children
 Zach L. Fassett, Adam E. Jagodinsky, Carlos Santillan, David Q. Thomas, FACSM, Skip M. Williams, Illinois State University, Normal, IL.
 (No relevant relationships reported)

INTRODUCTION: Physical activities that involve impact loading are important for improving bone strength and bone mineral density in children. However, there is little research quantifying the impact loads associated with various high impact activities. **PURPOSE:** Examine the magnitude of peak ground reaction forces (pGRF) of a variety of jumping tasks. **METHODS:** Eight adolescents, within the ages of 8-12 years (age: 9.63±1.49 years; height: 1.42±0.08 m; mass 33.69±4.81 kg), performed five trials for each jump condition. Each subject performed a broad jump (BJ), countermovement jump (CMJ), jumping jack (JJ), leap jump (LJ), and a drop jump (DJ). All jumps were performed on a force plate (1000Hz). pGRF was determined during the landing phase of each jump condition, and expressed in units of body weight (BW). A repeated measures ANOVA was employed to assess differences in pGRF across conditions. **RESULTS:** DJ exhibited significantly greater pGRF (3.09±0.46 BW) in comparison to the BJ (2.25± 0.2 BW; $P=.003$), and LJ (2.01±0.1 BW; $P=.002$). LJ exhibited significantly less pGRF compared to the CMJ (2.45±0.22 BW; $P=.001$), JJ (2.56±0.21 BW; $P<.001$), and DJ ($P=.002$). **CONCLUSION:** Vertical jumping tasks (CMJ, JJ, DJ) elicited greater vertical impact loads compared to horizontal tasks (BJ and LJ) due to the nature of landing. Previous studies indicated loads between 3-9 BW are sufficient for stimulating increases in bone mineral density in pre and early pubertal

children. All conditions except DJ exhibited loading below three BW, suggesting these activities may not sufficiently stimulate bone remodeling to influence bone mineral density.

1001 Board #127 May 27 1:30 PM - 3:00 PM
Strength And Power As Indicators Of Differences In Fiber Type Contributions In Children And Adolescents
 Zachary M. Gillen, Marni E. Shoemaker, Nicholas A. Bohannon, Nicholas A. Bohannon, Joel T. Cramer, FACSM. *University of Nebraska-Lincoln, Lincoln, NE.*
 (No relevant relationships reported)

PURPOSE: Examine individual patterns of peak torque (PT) and mean power (MP) across a range of angular velocities in children and adolescents and how these patterns relate to measurements of growth. **METHODS:** Seventeen children (age = 11 ± 0.4 years) and 22 adolescents (age = 14 ± 0.6 years) performed maximal voluntary isometric contractions, isokinetic leg extensions at 60, 120, 180, 240, and $300^\circ \cdot s^{-1}$, and 50 consecutive maximal isokinetic leg extensions at $180^\circ \cdot s^{-1}$. Patterns of responses for PT and MP across angular velocity were fit with quadratic equations for each subject with r^2 values ranging from 0.803-0.934 for PT and 0.908-0.996 for MP, respectively. Derivatives of each quadratic formula quantified velocity-related changes in PT and MP. Each quadratic formula predicted the peak velocity at which torque could be generated (V_{PT}) or the velocity at which the greatest MP would occur (V_{MP}). The percent of fast-twitch fibers (FT%) was estimated from the fatigue index of the 50-repetition test. Measurements of growth included age, maturity offset, height, body mass, fat-free mass, and quadriceps femoris muscle cross-sectional area. **RESULTS:** All measurements of growth, PT, and MP were greater for adolescents than children ($p \leq 0.003$). As expected, PT decreased quadratically ($p < 0.001$), while MP increased quadratically to $180\text{--}240^\circ \cdot s^{-1}$ ($p < 0.001$) and plateaued ($p = 0.056$) or decreased ($p < 0.001$) to $300^\circ \cdot s^{-1}$. V_{PT} was 352 ± 18 Nm for children and 527 ± 34 Nm for adolescents ($p < 0.001$), while V_{MP} was 216 ± 11 W for children and 268 ± 11 W for adolescents ($p < 0.001$). FT% was $39 \pm 4\%$ for children and $46 \pm 4\%$ for adolescents ($p < 0.001$). Derivatives indicated that PT decreased while MP increased across velocity more rapidly in adolescents than children ($p \leq 0.016$). Derivatives of PT vs. velocity exhibited a high relationship with body mass for adolescents ($r = -0.727$), while derivatives of MP vs. velocity exhibited high relationships with body mass and fat-free mass in children ($r = 0.714\text{--}0.795$). V_{TO} and V_{MP} exhibited high relationships with age for adolescents ($r = 0.884$). **CONCLUSION:** Isometric and isokinetic muscle actions in children and adolescents indirectly demonstrate between growth-related increases in fast-twitch fiber contributions to maximal, voluntary muscle strength and power across the velocity spectrum.

1002 Board #128 May 27 1:30 PM - 3:00 PM
Relationship Between Core Stability And Running Mechanics In Adolescent Runners
 Allison Hoffee, Scott Monfort, James Becker. *Montana State University, Bozeman, MT.*
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 (No relevant relationships reported)

Stability of the lumbopelvic "core" is essential for the control and movement of the lower extremity and for absorption and transfer of force. In adult runners, poor core stability is related to increased running injury risk and decreasing core stability results in negative effects on mechanical variables associated with running injuries. It is currently unknown if relationships between core stability and running mechanics exist in adolescent populations. **PURPOSE:** Evaluate the relationship between core stability and mechanical variables associated with running injuries in adolescent runners. **METHODS:** 20 adolescent runners (11 M/9 F; age: 12.38 ± 0.79 years; easy training run pace: 3.24 ± 0.17 m/s) participated in this study. Kinematics and kinetics were recorded using a motion capture system as participants ran on an instrumented treadmill. Core stability was assessed using a novel method which evaluates center of pressure movement over 30 seconds while participants sit still on an unstable surface. Core stability was calculated as total center of pressure excursion (CoPEX) during the test, and Pearson's product-moment correlations were used to determine relationship between CoPEX and running mechanics. **RESULTS:** Mean CoPEX was 1.39 ± 0.41 m, and mean values for running mechanical variables are shown in Table 1. CoPEX was not correlated with any of the mechanical variables. **CONCLUSIONS:** In contrast to what has been reported in adult runners, core stability was not related to running mechanics in this sample of adolescent runners. Without fully developed motor control, adolescent runners may have more overall variability in their running gait, leading to minimal relationships between running mechanics and core stability. Further research is needed to reveal whether reducing core stability influences injury risk factors, as has been shown in novice adult runners, or whether relationships between core stability and running mechanics change as adolescents mature.

Table 1. Mean, standard deviation (SD), p-value, and correlation coefficient (r) for eight injury risk-related mechanics; VALR: vertical average loading rate; BW: body weight

Variable	Mean	SD	p-value	r
Peak hip abductor moment (Nm/kg)	1.81	0.37	0.95	0.01
Hip abductor impulse (Nm/kg*s)	0.18	0.04	0.96	0.01
Peak knee extensor moment (Nm/kg)	1.82	0.50	0.65	-0.11
Knee extensor impulse (Nm/kg*s)	0.13	0.07	0.75	-0.07
Peak knee abductor moment (Nm/kg)	0.67	0.29	0.15	0.34
Knee abductor impulse (Nm/kg*s)	0.03	0.04	0.44	0.18
Peak impact force (BW)	1.85	0.42	0.74	0.08
VALR (BW/s)	72.12	16.80	0.85	0.05

1003 Board #129 May 27 1:30 PM - 3:00 PM
Movement Screening For Adolescent Runners: Relationship Between Single Limb Step Down Performance And Running Mechanics
 James Becker, Allison Hoffee, Scott Monfort. *Montana State University, Bozeman, MT.*
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 (No relevant relationships reported)

The single limb step down (SLSD) is a movement screen commonly used to assess neuromuscular control of the lower extremity. In adult runners, performance on the SLSD is predictive of running mechanics. However, it is unknown whether this is also the case for adolescent populations. If so, the SLSD could be a useful tool for injury risk screening in adolescent athletes. **PURPOSE:** Determine whether performance on the SLSD predicts running mechanics in adolescent runners. **METHODS:** 21 runners participated in this study (12 M/9 F; age: 12.38 ± 0.79 years; weekly mileage: 23.2 ± 6.4 miles; easy training run pace: 3.25 ± 0.17 m/s). Participants ran for five minutes on an instrumented treadmill after which 10 SLSD trials were performed bilaterally from a 15 cm box. Running and SLSD kinematics were recorded using motion capture. Peak frontal plane hip, knee, and ankle, and transverse plane hip and knee angles were calculated during both SLSD and running. The sum of the frontal plane angles was calculated to indicate total medial collapse (TMC). Five additional kinetic variables previous linked to running injuries were calculated for the running trials. Linear regressions were used to determine whether performance on the SLSD predicted kinematics or kinetics during running, with left and right limbs analyzed separately. **RESULTS:** Kinematics on the SLSD predicted kinematics during running (Figure 1). However, TMC during SLSD did not predict vertical loading rates ($R^2 = .008, p = .568$), peak hip adductor moments ($R^2 = .021, p = .363$) or impulses ($R^2 = .007, p = .602$), or peak knee abductor moments ($R^2 = .014, p = .446$) or impulses ($R^2 = .039, p = .209$) during running. **CONCLUSIONS:** The SLSD can predict kinematics during running in adolescent runners. However, performance on the SLSD does not provide information regarding kinetic factors associated with running injuries. Additional research is required to confirm the suitability of the SLSD for identifying adolescent runners at risk of injury.

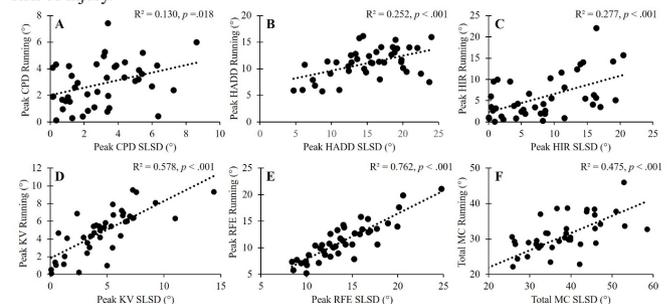


Figure 1. Plots of kinematics on the single limb step down (SLSD) versus kinematics during running for peak contralateral pelvic drop (CPD; A), peak hip adduction (HADD; B), peak hip internal rotation (HIR; C), peak knee valgus (KV; D), peak rearfoot eversion (RFE; E), and total medial collapse (MC; F).

1004 Board #130 May 27 1:30 PM - 3:00 PM
Effects Of Rehabilitation Exercise On Muscle Group Working Characteristics Of Adolescent Patients With Scoliosis
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 (No relevant relationships reported)

PURPOSE: At present, most studies using surface electromyography (sEMG) to diagnose muscle working characteristics of scoliosis patients were limited to static status. The purpose of the study was to explore the acute effects of corrective exercise

for adolescent scoliosis. METHODS: Adolescent scoliosis patients with Cobb angle between 10-40° were screened. Patients with other predisposing spinal and neurological abnormalities were excluded. 19 girls (age 14.18 ± 2.58) were recruited into experimental group, including 9 patients with thoracic right protrusion (TRP), 7 patients with lumbar left protrusion (LLP) and 3 patients with S-shaped curvature of spine (SSC). 20 healthy subjects (age 14.91 ± 1.23) were randomly selected. The experimental group was given rehabilitation exercises of 60 minutes for twice. sEMG was used to test the muscles at T2, T7, T10 and L4 level. Basic movements were tested in relax mode (RM) and spine correction mode (SCM). RESULTS: 1. For patients with TRP, when sitting, iEMG of muscle groups at T2 level (left -4.53±3.58, p<0.05; right -2.59±0.96, p<0.01), T7 (left -3.19±1.94, p<0.05; right -1.27±1.16, p<0.05) and right muscle group at T10 level (-3.78±2.19, p<0.01) were lower in SCM than in RM; when walking, iEMG of left muscle group at T7 level (-2.07±1.61, p<0.05) was lower in SCM than in RM. Compared to control group, for SCM of this sub-group, when sitting, activation of the left muscle group at T2 level was increased (2.32±1.58, p<0.05). 2. For patients with LLP, compared to control group, when sitting, activation level of right muscle group at L4 level was increased (0.33±0.69, p<0.05). 3. For patients with SSC, when sitting, the iEMG of right muscle group of T2 level was lower in SCM than that in RM (-1.39±0.45, p<0.05). In SCM of standing with balanced legs, compared to control group, this sub-group has higher activation level of the L4 right muscle group (2.71±1.20, p<0.05). CONCLUSION: 1. The asymmetry between convex and concave sides of paraspinal muscles in adolescents with scoliosis was not obvious. 2. The muscle activation of the thoracic spine-related muscle group was more important for the adjustment of adolescent scoliosis. 3. Posture corrective exercises for adolescent scoliosis had good acute rehabilitation effects and contributed to the maintenance of good postures in daily life.

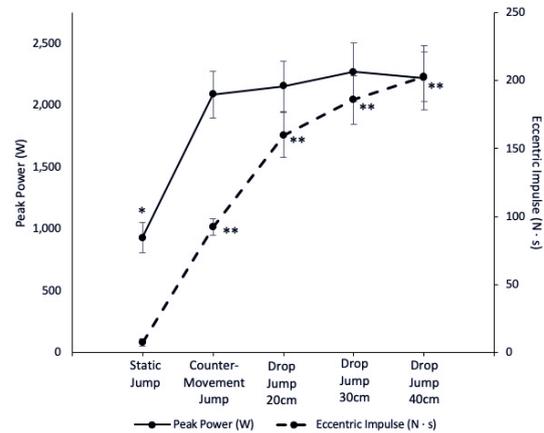


Figure 1. Increases in peak power (PP, left axis) with increases in eccentric pre-loading (ECC, right axis) across vertical jump techniques. * PP for SJ < CMJ, DJ20, DJ30, DJ40; ** ECC for SJ < CMJ < DJ20 < DJ30 < DJ40.

1005 Board #131 May 27 1:30 PM - 3:00 PM

Effects Of Eccentric Pre-loading On Vertical Jump Performance In 9-17-year-old Female Athletes

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(No relevant relationships reported)

PURPOSE: Examine peak force (PF), rate of force development (RFD), peak power (PP), eccentric impulse (ECC), concentric impulse (CON), and jump height (JH) during static (SJ), counter-movement (CMJ), and drop (DJ) jumps in young female athletes.

METHODS: Twenty females ranging from 9-17-years old performed SJs, CMJs, and DJs from drop heights of 20, 30, and 40 cm (DJ20, DJ30, and DJ40, respectively) in random order. Measurements included PF, RFD, PP, ECC, CON, and JH for each vertical jump condition. Measurements of growth included age, maturity offset, height, body mass, fat-free mass (FFM), and thigh muscle cross-sectional area (CSA).

RESULTS: As an indicator of eccentric pre-loading, ECC increased systematically from SJ to CMJ to DJ20 to DJ30 to DJ40 (p < 0.001-0.038) (Figure 1); however, CON was not different across vertical jump conditions (p = 1.0). PF and RFD increased from SJ to CMJ (p = 0.009) and from CMJ to DJ20 (p < 0.001), but did not change from DJ20 to DJ30 (p = 1.0) or DJ30 to DJ40 (p = 1.0). PP increased from SJ to CMJ (p < 0.001), but remained constant from CMJ to DJ40 (p = 0.486-1.0) (Figure 1). JH during the CMJ was greater than all other vertical jumps (p ≤ 0.001). The change in PP from SJ to CMJ was moderately to highly correlated with growth measures (r = 0.558-0.815, p ≤ 0.010), except thigh CSA (r = 0.416, p = 0.068).

CONCLUSIONS: These findings were consistent with previous evidence in young male athletes indicating that eccentric pre-loading beyond the CMJ does not result in greater vertical jump power in young female athletes. In contrast to previous evidence in young males, thigh CSA was less related to the increase in vertical jump power from SJ to CMJ than other measures of growth (age, maturity offset, height, body mass, and fat-free mass). In young females, compared to young males, factors other than muscle size contribute more to vertical jump power production. It is unclear how landing mechanics may have influenced the DJ performance measures.

1006 Board #132 May 27 1:30 PM - 3:00 PM

Baseline Assessment High School Athlete: Normative Functional Movement Values

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(No relevant relationships reported)

A significant amount of research has aimed to understand ACL injuries, a common injury in high school athletes. It has yet to be determined how to best evaluate athletes' injury risk. To accomplish this, we need functional movement and injury data for a cohort of athletes across time. **Purpose:** To determine functional movement quality in high school athletes and explore the impact of age, gender, single-sport participation on movement quality and changes over time. **Methods:** 121 male (15.83±1.14 yo, 1.77±0.38m, 75.68±16.8kg) and 70 (15.95±1.19 yo, 1.63±0.08m, 59.04±8.78kg) female high school athletes were recruited to complete a Functional Movement Screen (FMS), a Landing Error Scoring (LESS) test, and a hop series including a single limb hop (SH), triple hop (TH), crossover hop (CH) and a 6m timed hop. For the hop series, a limb symmetry index was calculated by: (Right/Left)*100%. SPSS was then used to determine if differences exist between the youngest 25% of athletes tested and the oldest 25%, sexes, or athletes of a single sport and athletes who participated in multiple high school sports using a t-test (α=0.05). Additionally, 42 athletes were re-tested 9.53±3.5 months after the first visit. A 2x2 repeated measures ANOVA (Gender: Male (n=25), Female (n=17); Time: Visit 1, Visit 2) to identify differences in the population over time (α=0.05). **Results:** The males had higher symmetry on the single limb hop compared to the females. Additionally, the older students performed better on the LESS, SH, and CH. Between visits there was a significant increase in limb symmetry on the SH. **Conclusion:** Several differences exist between age groups, while only SH symmetry varied between genders and over time. This work provides a basic understanding of how high school athletes move and provides a data set to investigate injury risk.

WEDNESDAY, MAY 27, 2020

	Visit 1						Between Visits			
	Male	Female	Young	Old	Single	Multi	Visit 1		Visit 2	
	n=121	n=70	n=48	n=48	n=73	n=118	Male	Female	Male	Female
FMS p-value	14.71 (2.73)	15.10 (2.10)	14.46 (2.79)	15.46 (2.32)	14.84 (2.50)	14.86 (2.55)	15.08 (2.06)	14.71 (1.99)	14.84 (2.98)	15.00 (2.34)
	0.272		0.059		0.939		I: 0.599 S: 0.852, V: 0.957			
LESS p-value	5.76 (2.67)	6.02 (2.55)	7.07 (2.75)	5.41 (2.39)	6.15 (2.16)	5.67 (2.86)	6.86 (2.78)	6.89 (1.76)	6.43 (1.86)	7.78 (3.23)
	0.542		0.002*		0.211		I: 0.258, S: 0.386, V: 0.690			
SH p-value	94.59 (4.54)	92.87 (5.85)	92.60 (6.69)	95.39 (4.12)	93.59 (4.96)	94.25 (5.17)	94.24 (5.30)	93.02 (6.13)	94.74 (4.61)	97.94 (1.41)
	0.031*		0.015*		0.404		I: 0.061, S: 0.52, V: 0.023*			
TH p-value	94.15 (5.20)	93.43 (5.06)	93.89 (3.97)	94.35 (4.63)	93.89 (4.49)	93.91 (5.55)	94.50 (4.24)	94.34 (5.16)	94.41 (3.37)	96.47 (2.67)
	0.379		0.571		0.987		I: 0.281, S: 0.419, V: 0.317			
CH p-value	93.87 (4.36)	93.28 (6.07)	91.70 (5.95)	94.18 (4.80)	93.76 (4.81)	93.61 (5.15)	93.84 (4.93)	93.80 (6.33)	92.15 (6.74)	95.26 (2.73)
	0.498		0.027*		0.844		I: 0.278, S: 0.376, V: 0.937			
6m p-value	93.23 (5.59)	93.01 (5.31)	92.64 (6.42)	94.08 (4.29)	92.84 (5.86)	93.36 (5.24)	92.28 (6.35)	93.62 (5.02)	93.84 (3.89)	92.46 (3.86)
	0.798		0.181		0.531		I: 0.276, S: 0.988, V: 0.873			

Single (SH), triple (TH), crossover (CH), interaction (I), sex (S), and visit (V) *p-value < 0.05.

This study was funded by the National Federation of High School Sports.

B-71 Free Communication/Poster - Musculoskeletal Modeling

Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
 Room: CC-Exhibit Hall

1007 Board #133 May 27 1:30 PM - 3:00 PM
Effects Of Step Length And Speed On Lower Extremity Individual Muscle Force During Forward Lunge

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 (No relevant relationships reported)

Lunge technique variations can affect the biomechanics of lower extremity. However, only a few studies have examined the muscle forces during the forward lunges.
PURPOSE: The purpose of this study was to compare the force of individual muscles of the lower limb during the forward lunges with the change of step length and speed.
METHODS: Three healthy adults performed (1 male, 2 females 35 ± 8 years) forward lunges with different step lengths and speeds. The step lengths were set at 70% and 100% of the leg length (from the greater trochanter to the lateral malleolus); the speeds were set to slow, normal, and fast (30, 40 and 50 lunges/min, respectively). Kinematic and kinetic data were sampled using a three-dimensional motion analysis system and force plate, respectively. Individual muscles of the lower extremities including four muscles of the quadriceps (rectus femoris, vastus medialis, vastus intermedius, vastus lateralis) and four muscles of the hamstrings (semitendinosus, semimembranosus, biceps femoris long head, and biceps femoris short head) were analyzed. Total forces (active+passive force) were calculated using the musculoskeletal modeling technique (Seth et al., 2018). Two-way repeated measure ANOVAs were used to find the effects of the step and speed on the forces of hamstring and quadriceps muscles.
RESULTS: The total forces of the four hamstring muscles were similar between two-length conditions (3.16±2.90 vs. 3.34±3.53 N/kg; 70% vs. 100%; all muscle forces of each speed conditions were pooled, p-values > 0.05) and three-speed conditions (4.26±4.08 vs. 2.60±2.36 vs. 2.89±2.81 N/kg; Slow vs. Normal vs. Fast; all muscle forces of each length conditions were pooled, p-values > 0.05). The total forces of the four quadriceps muscles were similar between two-length conditions (2.23±0.81 vs. 2.29±1.15 N/kg; all muscle forces of each speed conditions were pooled, p-values > 0.05) and three-speed conditions (2.71±1.10 vs. 1.89±0.71 vs. 2.18±0.96 N/kg; all muscle forces of each length conditions were pooled, p-values > 0.05).

CONCLUSIONS: Our preliminary results suggest that the changes in the step length and the speed used in this study did not affect the kinetics of hamstring and quadriceps muscles. This might be due to the limited number of subjects. Further studies are needed.

1008 Board #134 May 27 1:30 PM - 3:00 PM
Knee Medial Compartment Joint Loads In Stationary Cycling With Increased Q-factor

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 (No relevant relationships reported)

As Q-Factor (QF: inter-pedal width) is increased, the knee abduction moment also increases. Though the knee abduction moment has been associated with knee medial compartment joint load, it is not a direct measure of joint contact forces. In the absence of *in vivo* measurement using an instrumented knee implant, musculoskeletal modeling simulations may provide a viable option for estimation of knee joint contact forces.

PURPOSE: To estimate the total knee joint compressive force (TCF) and knee medial compartment joint compressive force (MCF) in stationary cycling with increasing QF using musculoskeletal simulation.

METHODS: Five recreationally active males cycled on a stationary ergometer at a workrate of 80 Watts and a cadence of 80 rotations per minute at two QF: original QF (150mm), and wide QF (276mm). Wide QF was increased using pedal extenders. Three-dimensional kinematic data (240 Hz, Vicon) and pedal reaction forces using two custom instrumented bike pedals (1200 Hz, Kistler) were collected. A modified gait2392 model with a knee that includes hinge joints for the medial and lateral compartments was used to estimate muscle forces with static optimization and TCF and MCF with joint reaction analysis (3.3 OpenSim, SimTK, Stanford University). Paired samples t-test and Cohen's d were used to detect differences between conditions.

RESULTS: Peak TCF increased from original to wide QF (960.2 ± 258.2 N to 1117.3 ± 202.1 N; p = 0.299; d = 0.54) and MCF increased from original to wide QF (792.2 ± 98.4 N to 1029.2 ± 315.5 N; p = 0.116; d = 0.89).

CONCLUSION: Large standard deviations and small sample size may account for the lack of statistical significance, yet medium and large effect sizes may allude TCF and MCF increases with greater QF (Figure 1). It appears the majority of TCF is born by the medial compartment; TCF and MCF ranged from 1.46 and 1.14 BW for original and 1.75 to 1.42 BW for wide QF, respectively. These loads are much smaller than 2.0-2.5 BW found in walking and 4.0 BW in jogging.

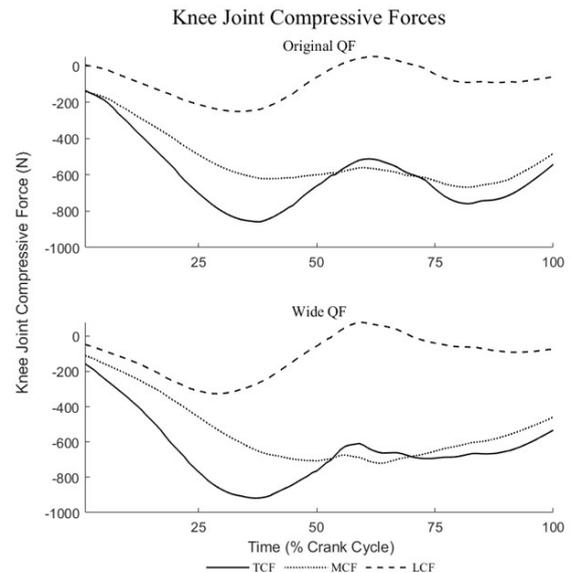


Figure 1: Ensemble curves of the total knee contact force (TCF), medial compartment compressive force (MCF), and lateral compartment compressive force (LCF) during stationary cycling.

1009 Board #135 May 27 1:30 PM - 3:00 PM
The Influence Of The Asymmetry Of Myodynamia On Bilateral Lower Limbs On Kinetics And Kinematics Performance

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(No relevant relationships reported)

PURPOSE: The experiment aims to research the kinetics and kinematics differences between bilateral lower limbs of athletes who have the asymmetry of myodynamia on bilateral lower limbs and provide some basis for avoiding sports injury.

METHODS: The experiment test subjects' Peak Torque of their extensor kinematic chain of bilateral lower limbs. Define subjects whose difference value of peak torque is great than 10% as the experimental group, the rest is the control group. Each group has 10 subjects. Two groups will finish 3 kinematics tests items including running with full power, triple jump by left leg and triple jump by right leg. And also every subject will finish 4 kinetics test items including drop jump, vertical jump by two legs, vertical jump by left leg and vertical jump by right leg on the force platform.

RESULTS: In the intra-group testing, the peak force and impulse in the takeoff phase of vertical jump by two legs (the dominant side peak force is 1000.814±194.59N, the non-dominant side peak force is 852.346±198.23N; the dominant side impulse is 315.887±70.87N*s, the non-dominant side impulse is 255.821±72.00 N*s), the impulse in the takeoff phase of vertical jump by single leg (the dominant side impulse is 611.121±82.10 N*s, the non-dominant side impulse is 430.946±106.76 N*s) and the peak force in the takeoff phase of drop jump (the dominant side peak force is 916.301±272.47N, the non-dominant side peak force is 772.171±159.04N), these four indexes of dominant-side is much higher than the opposite side in the experimental group (p<0.05). But there is no significant difference in control group. There was neither significant difference in the two groups of dominant side nor in the two groups of non-dominant side.

CONCLUSIONS: There are no significant influence on the sports performance of running, vertical jumping and drop-jumping caused by asymmetry of myodynamia of bilateral lower limbs when the Peak Torque of their extensor kinematic chain of bilateral lower limbs is lower than 27% , but it will have a great significant influence on sports performance and sports ability of some relative movements like long jump with single leg and vertical jump with single leg.

1010 Board #136 May 27 1:30 PM - 3:00 PM
M-mode Ultrasound Detects Changes In Lumbopelvic-hip Muscle Activity Using Body Mass Normalization Technique

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(No relevant relationships reported)

M-mode or motion mode allows for non-invasive assessment of contractile tissue movement from echogenicity changes. This method has been used in muscles surrounding the lumbopelvic-hip complex, including the gluteals, however this measurement has not been explored to our knowledge in the rectus abdominis, external oblique, or erector spinae. A normalization technique has not been utilized for M-mode to ensure proper comparison within and between groups as normalization strategies have been applied with other musculoskeletal ultrasound techniques, such as B-mode imaging.

PURPOSE: To determine activity ratio and timing of rectus abdominis (RA), external oblique (EO), erector spinae (ES), gluteus maximus (Gmax), and gluteus medius (Gmed) with a body mass normalization technique. **METHODS:** Ten healthy, physically active individuals with no history of low back or lower extremity injury (21.1±0.7yrs, 67.1±14.8kg, 168.1±6.9cm, 5F) participated in this study. B-mode ultrasound images were collected at rest and during contraction: supine, hook-lying for RA and EO; prone for ES; and side-lying for Gmax and Gmed. Thickness from B- and M-mode images were normalized to body mass (kg) and timing of M-mode was measured in seconds (s). Contracted muscle thickness was divided by rested muscle thickness to calculate activity ratios from B-mode images. Paired *t*-tests were used to compare activity ratios and contraction timing (cm-s/kg) between muscles. **RESULTS:** There were no significant differences (p>.05) between activity ratios, although the EO had the largest activity (1.66±0.72). The RA followed with the second highest activity ratio (1.48±0.38), then ES (1.34±0.43), Gmed (1.30±0.51), and finally Gmax (1.06±0.27). ES exhibited the greatest output from the M-mode normalization technique (0.019± 0.004cm-s/kg) and EO had the least at 0.0053±0.002cm-s/kg (p<.001). **CONCLUSIONS:** The anterior musculature assessed, EO and RA, generated the largest activity ratios, while ES and EO had the greatest disparity detected during motion. The balance of activity between anterior and posterior muscles of the lumbopelvic-hip complex should be noted especially with M-mode activity with this body mass normalization application as the variance in size of muscle plays a major role in how ultrasound data may be interpreted.

1011 Board #137 May 27 1:30 PM - 3:00 PM
Patellofemoral Joint Loading Performing The Forward And Side Lunge With Step Height Variations

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(No relevant relationships reported)

PURPOSE: Forward and side lunge exercises are frequently employed during patellofemoral joint syndrome rehabilitation. The purpose was to compare patellofemoral joint force and stress while performing the forward and side-lunge at ground level and up to a 10 cm platform. **METHODS:** Sixteen participants performed a forward and side lunge at ground level and up to a 10 cm platform. Electromyography, ground-reaction-force, and kinematic variables were collected and input into a biomechanical optimization model, and patellofemoral joint force and stress were calculated as a function of knee angle during the lunge descent and ascent and assessed with a repeated-measures 2-way analysis of variance (p<0.05). **RESULTS:** Collapsed across step-height, at 10° (p=0.003) knee angle during lunge descent and 10° and 30° (p<0.001) knee-angles during lunge ascent patellofemoral joint force and stress were greater in forward lunge than side lunge. At 40°(p=0.005), 50°(p=0.002), 60°(p<0.001), 70°(p=0.006), 80°(p=0.005), 90°(p=0.002), and 100°(p<0.001) knee angles during lunge descent and 50°(p=0.002), 60°(p<0.001), 70°(p<0.001), 80°(p<0.001), and 90°(p<0.001) knee angles during lunge ascent patellofemoral joint force and stress were greater in side lunge than forward lunge. Collapsed across lunge type, at 60° (p=0.009) knee angle during lunge descent and 40°(p=0.008), 50°(p=0.009), and 60°(p=0.007) knee angles during lunge ascent patellofemoral joint force and stress were greater lunging at ground level than up to 10 cm platform. No interactions occurred between lunge type and step height. **CONCLUSIONS:** Patellofemoral joint loading changed according to lunge type, step height, and knee angle. When the goal is to initially minimize and then gradually progress patellofemoral joint loading, the following may be a prudent lunging progression: 1) forward lunge at lower knee angles(0°-30°) at ground level or up to 10 cm platform; 2) forward lunge at middle knee angles(0°-60°) up to 10 cm platform and progressed to ground-level; 3) side lunge at middle knee angle(0°-60°) up to 10 cm platform and progressed to ground level; 4) forward lunge at higher knee angles(0°-100°) up to 10 cm platform and progressed to ground level; and 5) side lunge at higher-knee angle(0°-100°) up to 10 cm platform and progressed to ground level.

1012 Board #138 May 27 1:30 PM - 3:00 PM
Interpreting Knee Valgus: Orthogonal Distance Vs Cardan/Euler Angles

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(No relevant relationships reported)

Cardan/Euler angles (EAs) are commonly used to quantify knee valgus. Although EAs precisely describe the orientation of segments, their geometrical interpretation may not relate well to the underlying joint *kinetics* and can be difficult for practitioners to interpret. Having a metric that is both better related to the knee joint kinetics (e.g. knee abduction moment (KAM) and tibial external rotation moment (TRM)) and easier to interpret would be advantageous for researchers and practitioners. **PURPOSE:** Assess the relationship between (1) EAs and a novel kinematic descriptor of knee valgus - the orthogonal distance of the knee joint center from the hip-foot plane (OD), and (2) EAs and OD with KAM and TRM. **METHODS:** Two datasets were used; in the first, 26 varsity athletes performed 10 bodyweight squats and 10 jump squats. In the second, 13 participants performed 4-5 drop vertical jumps. EAs were used to decompose orientation matrices between the shank and thigh. OD was computed by first creating a plane using the midpoint between the 1st and 5th metatarsals, the ankle joint center, and the hip joint center. Then, the scalar projection of the knee joint center and a vector normal to this plane was computed. Newton-Euler equations of motion were used to compute net joint moments at the knee. Repeated-measures correlation (*r*) and percent agreement (%AG) scores were used to compare continuous and binary (i.e. valgus vs no valgus) metrics at initial contact (Purpose 1), peak knee flexion (Purpose 1 & 2), and the instant when KAM was highest (Purpose 1 & 2). **RESULTS:** EA and OD demonstrated poor correlations (*r*= -0.28 – 0.43) and low agreement when categorizing valgus vs not valgus (%AG= 17.69 – 56.45%). The OD showed stronger links to KAM and TRM in comparison to EAs (Table 1). **CONCLUSION:** Although both kinematic measures were poorly correlated with KAM and TRM, OD was better able to categorize knee valgus kinetics. OD may also be easier to visually observe.

Table 1.

	KAM		TRM	
	r	%AG	r	%AG
OD	-0.39 - -0.13	67.74 - 95.16%	0.21 - 0.51	48.39 - 96.77%
EA	-0.71 - -0.28	24.19 - 38.71%	-0.48 - 0.10	33.87 - 70.78%

1013 Board #139 May 27 1:30 PM - 3:00 PM

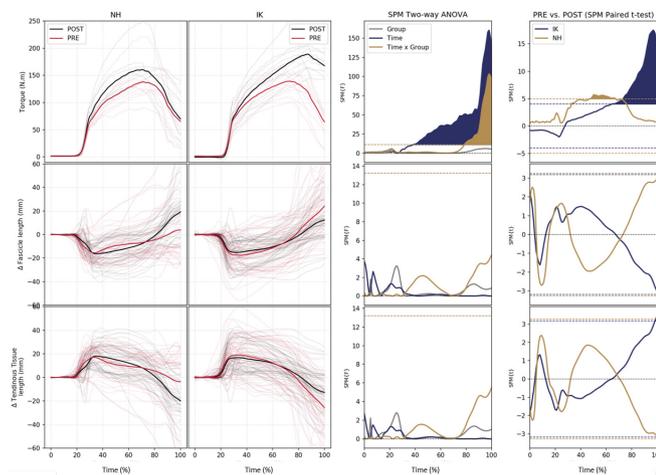
Effects Of An 8-week Nordic Hamstring Vs. Isokinetic Eccentric Training Intervention On Biceps Femoris Muscle-tendon Interactions

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(No relevant relationships reported)

Resistance eccentric training triggers adaptations in both active and passive elements of the muscle tendon unit (MTU). Previous research highlight the buffering role that tendinous tissues may play to mitigate muscle strain and to optimize operating fascicle lengths. However, the effects of eccentric training on the muscle-tendon interactions of the *biceps femoris* remain unexplored. **PURPOSE:** To evaluate the effects of eccentric training on torque and muscle-tendon interactions of the *biceps femoris* muscle during lengthening contractions. **METHODS:** Eighteen participants completed an 8-wk standardized eccentric training intervention comprising 15 sessions of Nordic Hamstring (NH) or isokinetic leg curl (IK; n=10) exercise. Pre and post training, torque and fascicle, tendinous tissue and MTU length of the *biceps femoris* muscle were measured during maximal 70° lengthening knee extensions at 60°·s⁻¹. One sample t-test statistical parametric mapping (SPM) analyses were performed to evaluate fascicle and tendon behaviour during the contractions. Training effects were evaluated with two-way repeated measures ANOVA and paired t-test SPM. **RESULTS:** Both groups increased torque from 38% to 100% of the contraction duration, with greater improvements in IK from 78.5 to 100% (p < 0.001). The contribution of tendinous tissue to MTU length changes slightly increased only in IK at the last 2% of the contraction (p = 0.04). Despite opposite trend changes in NH, no training effects on fascicle or tendon behavior occurred. The tendinous tissues contribution to MTU lengthening was greater than fascicles up to 75% of the contraction. The fascicles contribution progressively augmented at the end of the contraction (p < 0.05). **CONCLUSION:** We provide novel findings on the muscle-tendon interactions of the *biceps femoris* muscle during lengthening contractions. A 15-session eccentric training program comprising NH or IK exercise does not seem to affect muscle-tendon interactions.



1014 Board #140 May 27 1:30 PM - 3:00 PM
Relationships Between Body Mass Normalized Abdominal Wall Thickness And Self-reported Activity And Global Health

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(No relevant relationships reported)

The anterolateral abdominal wall, rectus abdominis (RA), external oblique (EO), and internal oblique (IO), contributes to lumbopelvic-hip strength; and its role in injured populations such as low back pain has been well explored. However, it is important to establish the association between a body mass normalized measure of muscle size with overall physical activity in a healthy population due to their utility as a frequently used control group and for the potential of this measurement technique in aging, resistance training, and abdominal fat assessment.

PURPOSE: To determine relationships between muscle thickness (at rest and during contraction) of RA, EO, IO and patient-reported outcome measures on physical activity and health. **METHODS:** Eight active participants with no history of low back or lower extremity injury (23.1±5.4yrs, 171.1±11.3cm, 70.6±15.1kg, 4F) completed a single imaging session of RA, EO, and IO. Before imaging, participants completed the PROMIS Global Health (GH), PROMIS Physical Function (PF), and International Physical Activity Questionnaire Short Form (IPAQ). Ultrasound images were collected at rest while supine, hook-lying and during contraction with participants instructed to perform an abdominal crunch for RA, and crunches toward either knee for EO and IO. Thickness measures were normalized to body mass (kg). Pearson's r correlation coefficients were used to determine relationships. **RESULTS:** Six of the 8 participants scored high on the IPAQ (≥3000 METmin/week) and the rest were moderate (≥600 METmin/week). The average hrs/day participants spent sitting was 4.6±2.3hrs. The PROMIS GH (37.5±4.7) and PROMIS PF (98.9±2.4) both confirmed overall health and activity levels. Right side EO at rest (r=.74, p=.04) and during contraction (r=.84, p=.01) were strongly related to hours spent sitting per day. **CONCLUSIONS:** Normalized EO muscle thickness was found to increase, at rest and during contraction, as healthy, active individuals sat longer. Although this was the only significant correlation, this controversial finding may be explained due to the relative 17.4% decrease in EO activity on the right side, compared to the left. The connection between the abdominal wall and self-reported physical activity is important to distinguish, especially with a body mass normalization technique.

1015 Board #141 May 27 1:30 PM - 3:00 PM

Kinematic Analysis Of Single-leg Hopping In Adults With And Without Autism Spectrum Disorder

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(No relevant relationships reported)

Purpose: Adults with Autism Spectrum Disorder (ASD) may be predisposed to deficient biomechanics or neuromuscular control. This study compared the biomechanics of adults with and without ASD completing a single-leg hopping task. We hypothesized that adults with ASD would demonstrate deficient biomechanics (i.e., decreased pelvic control and greater dynamic limb valgus) compared to adults without ASD.

Methods: 10 participants with ASD (8 male; mean age 23.3, SD ± 3.8) and 10 without ASD (8 male; mean age 21.5, SD ± 2.5) were included in this analysis. 3D motion capture data were collected while participants performed five consecutive single-leg hops. Two of the middle hops were analyzed and kinematic values were averaged across hops. Dynamic limb valgus and frontal plane pelvis range of motion were compared between groups using independent samples t-tests.

Results: No statistically significant differences were observed between the individuals with and without ASD (Table).

Conclusion: Our hypothesis was not supported. Individuals with ASD did not demonstrate deficient biomechanics during the single-leg hopping task when compared to individuals without ASD. The high-level of function of the adults with ASD in the present study may be related to their proficient hop performance. It is also possible other biomechanical variables not presently measured may highlight differences in performance between populations. The present results suggest adults with ASD have similar biomechanics as adults without ASD, though further study is needed.

Table: Comparison of Kinematic Variables Between Groups

	ASD (n=10)*	Non-ASD (n=10)*	Between-Group Differences	p-value
Pelvis ROM	-8.3±2.81	-6.7±2.35	-1.6	0.194
Hip flexion	45.7±8.69	45.9±11.03	0.2	0.965
Hip adduction	8.1±3.99	4.4±4.81	-3.7	0.077
Hip internal rotation	6.6±6.16	9.3±5.6	2.7	0.321
Knee abduction	7.1±4.81	3.6±3.94	3.5	0.100
Knee flexion	50.1±8.77	49.9±5.78	0.2	0.888
Ankle dorsiflexion	24.4±2.98	22.01±6.52	2.4	0.4
Abbreviations: ASD=Autism Spectrum Disorder, ROM = range of motion				
*Values are mean±SD degrees				

1016 Board #142 May 27 1:30 PM - 3:00 PM
Abstract Withdrawn

B-72 Free Communication/Poster - Pitching, Throwing, and Hitting
 Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
 Room: CC-Exhibit Hall

1017 Board #143 May 27 1:30 PM - 3:00 PM
The Relationship Of The Kinematic Sequence And Shoulder Compression Forces During Fastpitch Softball
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Reported Relationships: D.M. Scarborough: Salary; FIGUR8, Inc. Ownership/interest/stock; future stock options.

INTRODUCTION: The Kinematic Sequence (KS) refers to the order of peak angular velocities of connected body segments during a specific movement. There are many possible KS patterns. The proximal-to-distal sequence (PDS) KS ordered: pelvis->trunk-> arm-> forearm-> hand is reported as the most efficient pattern for overhead throwing. Simulation studies report that the PDS KS results in reduced torques across the joints of the overhead throwing limb, potentially reducing risk of injury. Another KS is the PDS Variant which has a similar PDS pattern of pelvis-> trunk-> arm->, but with simultaneous forearm & hand peak velocities. A third KS pattern, Delayed CORE, demonstrates delayed peak velocity of the trunk: pelvis-> hand -> trunk-> simultaneous arm & forearm. While the PDS KS concept is instructed in fastpitch softball pitching, KS studies have not been published. The study purpose was to investigate the KS in a group of fastpitch softball pitchers.
METHODS: 3D biomechanical analyses using high-speed motion capture cameras (240Hz) were performed on 140 fastball pitches from 21 softball pitchers (16 high school, 5 collegiate, mean age 16.15 ± 2.31 y). For each fastball pitch, Visual 3D v6 biomechanical analysis software calculated the peak angular velocity of the pelvis, trunk, arm, forearm and hand after the time of stride which allowed KS identification. Shoulder compression forces and stride length was also calculated for each of 3 primary groups of fastball pitches PDS n=12, PDS Variant n= 28 and the Delayed CORE n= 27. ANOVA and T-test comparisons were performed.
RESULTS: There were no significant differences in stride length between the 3 KS patterns, p = 0.14. The Delayed CORE KS pattern demonstrated statistically significantly greater shoulder compressive force than the other groups, mean= 8.23 ± 1.04 (F(2,64)= 23.45, p< 0.01). There were no differences in shoulder compression forces between the PDS (6.89BW ± 0.5) and the PDS Variant (6.74BW ± 0.73) group, p= 0.524.
CONCLUSION: This foundational study is the first to apply a KS classification system to the fastball softball pitch. Use of the PDS or PDS Variant KS promoted less shoulder compression force than the Delayed CORE group. The KS classification system could potentially guide underhand pitching instruction for injury prevention.

1018 Board #144 May 27 1:30 PM - 3:00 PM
A Comparison Of Pitch Velocity And Elbow Valgus Torque Between Collegiate Baseball Pitchers Trained With And Without Weighted-ball Exercises
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(No relevant relationships reported)

Several training strategies have been suggested and evaluated for their effects on baseball pitching performance and injury risk. There is some data in the current literature which indicates that plyometric based weighted-ball training is effective at altering the kinematics and kinetics of the throwing motion. However, it is unclear whether weighted-ball trained pitchers throw faster with lower joint kinetics than those trained otherwise. **PURPOSE:** To compare throwing velocity and maximum elbow valgus torque (MEV) between collegiate male baseball pitchers trained with weighted-ball exercises and those without. It was hypothesized that weighted-ball trained pitchers exhibit higher throwing velocity and MEV than pitchers trained without weighted-ball exercises. **METHODS:** Twenty-one collegiate baseball pitchers participated in this study, 13 of whom trained using weighted baseballs and 9 of whom trained without weighted baseballs as part of their in-season training regimen. After providing written informed consent, each participant threw 15 fastballs while ball speed and MEV were measured using a radar gun and a wearable inertial measuring unit (IMU), respectively. **RESULTS:** There was no significant difference in ball speed between weighted-ball trained pitchers (36 ± 1 m/s) and non-weighted-ball trained pitchers (35 ± 3 m/s, p = .108). Conversely, weighted-ball pitchers threw with greater MEV (110 ± 28 N-m) than non-weighted-ball trained pitchers (52 ± 6 N-m, p < 0.001). **CONCLUSION:** These findings suggest that pitchers who train using weighted-ball exercises throw at ball speeds comparable to those who do not but may do so at a higher risk of a pitching-related elbow injury.

1019 Board #145 May 27 1:30 PM - 3:00 PM
The Relationship Of Stride Length And Joint Stresses Among Adolescent Female Fastpitch Softball Pitchers
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(No relevant relationships reported)

PURPOSE: During the softball windmill pitch delivery, power is generated from the lower extremities and transferred up through the kinetic chain out to the throwing hand. At time of stride, the lead lower extremity incurs significant momentum breaking forces that could contribute to injury risk. Joint angle positions at the time of stride may vary based on stride length and extreme ranges of stride length may correlate with biomechanics that are associated with vulnerability to injury. This study investigates the relationship between stride length and 1) joint angles of the lead lower extremity at time of stride and 2) peak joint torques of the lead hip and throwing shoulder during the softball windmill pitch.
METHODS: 17 pitchers (mean age= 15.4 ± 1.4 y) underwent 3D biomechanical analysis of 80 fastballs using a 20 motion capture camera system (Vicon Motion Systems Ltd UK) at 240 hz. A 15-segment whole-body model for each pitcher was created. Ankle, knee, hip, and pelvis angles of the lead lower extremity and peak hip and shoulder torques at time of stride were calculated within a biomechanical analysis software (Visual 3D v6, C-Motion). Analyses included 2-tailed Pearson correlations.
RESULTS: Stride length correlated positively with peak shoulder external rotation torque (r= 0.245, p= 0.029), lead ankle eversion/inversion, and hip flexion/extension angle at time of stride. Stride length negatively correlated with lead knee valgus/varus, hip abduction/adduction, hip rotation, and pelvis flexion/extension angle at the time of stride (Table 1). No other correlations were observed.
CONCLUSION: The most prevalent reported injuries among softball pitchers occur at the shoulder, hip, and low back. Study findings suggest that pitch instruction on lead leg joint position at time of stride as well as stride length may be important for injury prevention during fast pitch softball pitching.

Table 1: Correlation of Joint Angles to Stride Length

Joint	Angle	Average (°) ± SD	Correlation Coefficient	P value
Ankle	Eversion (+)/ inversion (-)	-22.71 ± 10.29	.265	0.018*
Knee	Valgus (+)/ Varus (-)	10.08 ± 5.00	-.320	0.004*
Hip	Flexion (+) / Extension (-)	40.90 ± 11.21	.499	<0.001*
	Abduction (+) / Adduction (-)	17.99 ± 8.74	-.262	0.019*
	External Rotation (+) / Internal Rotation (-)	6.20 ± 8.47	-.228	0.042*
Pelvis	Flexion (+) / Extension (-)	-9.44 ± 9.78	-.401	<0.001*

* reached established level of significance p<0.05

1020 Board #146 May 27 1:30 PM - 3:00 PM

Effects Of A 6 Week Balance Training Program On Throwing Velocity And Joint Kinetics In Collegiate Baseball Pitchers

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(No relevant relationships reported)

It is known that high elbow valgus torque in the pitching motion can contribute to the occurrence of elbow injury. Lately, studies have shown pitchers with UCL tears had significantly lower balance measures than healthy players when tested after injury occurred. There is a paucity of research on the effect of balance-specific training on the joint loading of the elbow and player performance in baseball pitching.

PURPOSE To investigate the effect of a balance training intervention on the biomechanical factors that can contribute to a pitcher's increased risk of elbow injury. **METHODS** Thirteen collegiate baseball pitchers were randomly assigned to a training group: control or intervention. The control group did only the team training and the intervention group did the team training and a specific balance training program. The intervention was performed 3 times a week for 6 weeks. Measurements of balance (Y-Balance), limits of stability (center of pressure excursion), ball speed, and joint kinematics and kinetics, specifically maximum elbow valgus torque (MEV), through motion capture were collected before and after the 6-week training program. **RESULTS** None of the outcome measures showed a significant difference between training type (Y-Balance $p=.405$; COP excursion $p=.537$, ball speed $p=.150$; MEV $p=.945$). Three outcome measures, COP excursion ($p=.007$), ball speed ($p=.003$), and MEV ($p<.001$) showed significant decreases over time regardless of training type. A Pearson Correlation was run for the entire study population ($n=13$) between ball speed and MEV for initial ($p=.409$) and final ($p=.300$) testing and showed no significant correlation between the variables. **CONCLUSION** The balance training program had no observable effect on a pitchers' pitching performance or elbow kinetics. There was no significant difference between groups in pre or post measures, therefore, any change in balance measures can be attributed to normal in-season training strength development.

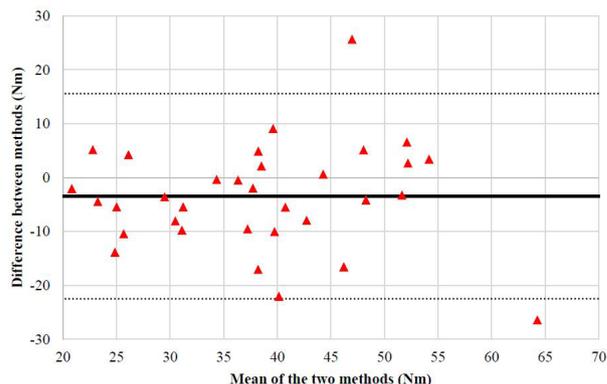
	Pre-Intervention	Post-Intervention
<i>Y-Balance</i>		
Control	123.1 ± 9.7 cm	124.5 ± 11.9 cm
Intervention	119.0 ± 7.7 cm	122.0 ± 9.6 cm
<i>COP Excursion</i>		
Control	160.5 ± 33.9 cm	129.4 ± 4.3 cm
Intervention	152.4 ± 24.7 cm	131.1 ± 13.0 cm
<i>Ball Speed</i>		
Control	81.2 ± 3.2 mph	77.9 ± 3.8 mph
Intervention	81.1 ± 2.6 mph	73.5 ± 3.4 mph
<i>Maximum Elbow Valgus</i>		
Control	103.6 ± 28.6 Nm	64.5 ± 8.7 Nm
Intervention	117.0 ± 27.2 Nm	77.0 ± 13.7 Nm

1021 Board #147 May 27 1:30 PM - 3:00 PM

Validation Of A Wearable Sensor In The Estimation Of Elbow Valgus Torque During Baseball Pitching

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(No relevant relationships reported)

Because of its relationship to pitching-related elbow injuries, the valgus torque at the elbow during baseball pitching has been a measure of interest that has clinical implications for the assessment and treatment of ulnar collateral ligament (UCL) injuries in pitchers. However, there currently is no feasible method to quantify elbow valgus torque in game-like settings. **PURPOSE:** To estimate the concurrent validity of a wearable sensor in measuring valgus torque at the throwing elbow during the pitching motion. **METHODS:** After providing informed consents, thirty-four adolescent pitchers threw 10 fastballs from a regulated mound while the joint kinematics and kinetics were simultaneously being measured with a 3D motion capture system and an inertial measurement unit (IMU) sensor, which was used to specifically estimate elbow valgus torque during baseball pitching. The Pearson correlation and Bland-Altman charts were used to estimate the concurrent validity and degree of accuracy of the IMU using the 3D motion capture system as the criterion method. **RESULTS:** The concurrent validity of the IMU in measuring elbow valgus torque was moderate ($r = 0.686$, $p < 0.01$) with a mean error of -3.48 N·m (Fig. 1). **CONCLUSION:** The wearable sensor was found to have moderate concurrent validity in estimating elbow valgus torque, the magnitude of which was underestimated by the sensor.



1022 Board #148 May 27 1:30 PM - 3:00 PM

Relationship Between Kinematics, Strength, And Throwing Velocity Of Adolescent Softball Players During Overhand Throwing

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(No relevant relationships reported)

The kinematics of overhand throws by adolescent softball players is currently under-reported. Identifying the relationship between kinematics, strength and velocity can help guide further research and promote better understanding of the sport. Current research has investigated the differences between softball and baseball but has not looked at how kinematics and strength correlate with throwing velocity in softball. **Purpose:** To identify the relationship between kinematics, strength, and velocity of an overhand throw in adolescent softball players. **Methods:** 25 adolescent softball players performed 3 maximum effort overhand throws. The throws were filmed using a 2-D video analysis system consisting of 3 cameras set up in the frontal and sagittal planes. The velocity of the throws were recorded using a speed gun. Key positions were identified in six throwing phases and angles were measured using software on a tablet. Bilateral hip and shoulder strength of each player were measured using standardized methods via handheld dynamometer. Correlation coefficients were determined. **Results:** A moderate and significant correlation was found between the velocity of overhand throw and the stride knee flexion angle during the arm cocking phase ($r = .55$, $p = .004$), the stance knee flexion angle during stride phase ($r = .49$, $p = .015$), and the elbow flexion angle during arm acceleration phase ($r = -.45$, $p = .024$). A moderate and significant correlation was found between trunk flexion angle during follow through phase and hip internal rotation ($r = -.45$, $p = .04$) as well as hip external rotation ($r = -.53$, $p = .013$) strength. **Conclusion:** Increases in velocity were influenced by lower extremity variables including increases in stride knee flexion angle during the arm cocking phase and increased stance knee flexion during stride phase. Upper extremity

variables that related to higher velocity included decreased elbow flexion at the end of acceleration phase. Strength parameters including hip internal and external rotation strength were found to be related to higher velocities. These findings highlight the potential influence of lower extremity kinematic variables and strength on performance as measured by velocity. These results can benefit players or coaches who are teaching or learning how to do the overhand throw.

1023 Board #149 May 27 1:30 PM - 3:00 PM
Effects Of Weighted Baseball Throwing On Youth Glenohumeral Joint Reaction Force

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 (No relevant relationships reported)

INTRODUCTION: Weighted baseball throwing programs are often used to increase pitch velocity. However, increased injury risk has been reported and questions regarding possible mechanism of injury exist. Kinematics and kinetics have been investigated with inverse dynamics approach, but the effects of individual muscle forces have rarely been taken into account by these models and in consideration of pitch mechanics. Analysis of shoulder joint reaction force with a musculoskeletal model including individual muscle forces may provide new insight on injury mechanism.

PURPOSE: To compare the effects of varied weighted baseballs on glenohumeral (GH) joint reaction forces during youth pitching.

METHODS: 7 baseball pitchers (Age 15.7 ± 2.4) participated in the study. Participants performed 5 pitches for strikes with 5oz, 7oz, and 9oz baseballs. Full body, 3D segment position data were collected using a motion capture system (200 Hz) and ball velocities were measured via radar gun. Highest velocities of 3 pitches were selected and 3D marker trajectories input into a 19 DOF musculoskeletal model utilizing a standard inverse dynamics and static optimization routine to produce individual muscle forces to yield GH joint reaction forces. Mean distraction force, anterior shear force, and superior shear force on GH joint were calculated and compared with RMANOVA (alpha = .05) during the acceleration phase of the pitch with Bonferroni post-hocs.

RESULTS: Differences were noted between the ball weights on ball velocity (5oz 66.9 ± 8.8mph, 7oz 61.6 ± 7.8 mph, 9 oz 56.9 ± 6.1 mph, p<0.001). Also, throwing heavier baseballs exhibited increased distraction forces (5oz 1987±472.5N, 7oz 2386±544.1N, 9oz 2414±601.1N, p = 0.007); while anterior shear force and superior shear force did not present distinct differences.

CONCLUSIONS: Distraction force pulls humeral head out of the glenoid fossa, and weighted baseball throwing program may cause more stresses on biceps brachii, rotator cuff, and surrounding structures by the increased distraction force.

1024 Board #150 May 27 1:30 PM - 3:00 PM
The Kinematic Sequence Of The Baseball Bat Swing And Associated Upper Extremity Torques

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 (No relevant relationships reported)

PURPOSE: The Kinematic Sequence (KS) is the timing of peak angular velocities generated across connected body segments during a movement pattern. The most efficient KS reported in sport is when the timing occurs in a proximal-to-distal (PDS) pattern. This 'ideal' KS follows the order of pelvis, trunk, arm, forearm, and hand. Based on simulated models of the golf swing, the PDS KS results in greater ball distance and decreased joint stresses. Despite similarities to the golf swing, there is limited research on the KS during batting. Study aims: 1) Identify KSs during the baseball swing and 2) compare the leading upper extremity torques across the 3 primary KSs.

METHODS: 23 baseball players (professional=2, collegiate=11, high school=10) underwent 3D biomechanical swing analysis, totaling 47 trials. A 15-segment model was constructed using a 20 Vicon™ camera motion capture system (240 hz). Body segment and bat velocities as well as peak shoulder and elbow torques were calculated using Visual 3D™ biomechanical software. Time of peak angular velocity of the pelvis, trunk, arm, forearm, and hand was recorded. The torques were compared across the two most performed KS patterns as well as the KS representing the closest to a PDS pattern. The KS patterns were labeled by the first body segment that disrupted the PDS pattern: proximal (PUE) and distal (DUE) upper extremity. Analyses included an ANCOVA using bat velocity as a covariant.

RESULTS: 11 unique KS patterns were identified. The most commonly performed KSs were DUE (n=23) then PUE (n=13). No batter displayed the exact PDS KS. Therefore, 5 trials that most closely represent the PDS, those with forearm and hand velocities peaking simultaneously, were grouped as PDS. Peak elbow extension torque

differed significantly between the 3 KS groups ($F(2,37)=4.95$, $\eta^2=0.21$, $p=0.012$) with lower values for PDS (PDS: 17.94 ± 12.83 Nm, PUE: 51.09 ± 25.19 Nm, DUE: 43.01 ± 22.26 Nm, $p=0.012$).

CONCLUSIONS: This foundational study is the first to apply a KS classification system to the baseball swing. Lower elbow extension torques for the PDS group are consistent with the idea that a PDS KS may result in decreased joint stress. KS analyses could potentially guide clinicians and hitting instruction to minimize biomechanical risk factors during batting.

B-73 Free Communication/Poster - Sports Biomechanics

Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
 Room: CC-Exhibit Hall

1025 Board #151 May 27 1:30 PM - 3:00 PM
The Measurement Of Thrust In Competitive Swimming: The Association Between Different Thrust Variables

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 (No relevant relationships reported)

Swimming acceleration and velocity are the net balance between Drag Force and Thrust. It is a standard procedure to do the decomposition of the Thrust-Time curve, assessing the swimmer's thrust. However, there is not a convention or standard procedure on the variables to be selected. Researchers report on regular basis either the Peak Thrust, Mean Thrust or Thrust-Time Integral. It is yet unclear to which extend these variables can be used, reported and interpreted interchangeably. **PURPOSE:** To analyze the association between different thrust variables performing arm-pulls in competitive swimming. **METHODS:** 671 front-crawl arm-pull cycles of 14 competitive swimmers were analyzed. Thrust was collected by an in-house built system composed by differential pressure sensors and underwater camera (Aquanex, Swimming Technologies, USA). A customised software (LabVIEW®, v.2017) was used to acquire ($f=50$ Hz) and streaming time-series and video signal. Data was transferred to interface by a 14-bit resolution acquisition card (NI-6001, National Instruments, Austin, USA). Then, it was imported into a signal processing software (AcqKnowledge v.3.9.1, Biopac Systems, USA). It was extracted the Peak Thrust, Mean Thrust and Thrust-Time Integral of each arm-pull. Coefficients of Determination were computed between the three thrust variables. **RESULTS:** All Coefficients of Determination were significant ($P<0.001$). Peak Thrust vs. Mean Thrust was $R^2=0.49$, Peak Thrust vs. Force-time Integral $R^2=0.51$, and Force-time Integral vs. Peak Thrust $R^2=0.61$. Interception on Y-axis at the origin of the pairwise variables noted in the same SI unit (i.e. Newton) were very close to zero (-1.6948<c<4.5029) and standard error of estimate acceptable (6.54<S<12.14). **CONCLUSIONS:** There is a strong association between different thrust variables, even though the proportion of the variance is about 50-60%. Supported by: NIE AcRF Grant (RI 6/17 TB); Portuguese Foundation for Science and Technology (UID/DTP/04045/2019); European Fund for regional development (FEDER)-COMPETE 2020 (POCI-01-0145-FEDER-006969).

1026 Board #152 May 27 1:30 PM - 3:00 PM
Power Parameters Appear Less Important To Water Polo Success Than Motor Control

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 (No relevant relationships reported)

Conditioning programs for water polo players typically focus on muscular power to enhance the wrestling and shooting components of play. While improvements in strength training are easily quantifiable, the relationship between upper limb power and in-game performance has yet to be established. **PURPOSE:** To test the effect of upper limb force parameters on offensive performance in women's water polo players. **METHODS:** We conducted biomechanical testing on 12 D1 women's water polo players using Proteus (Proteus Motion, USA). After completing a familiarization and warm-up protocol, subjects performed a single set of 10 repetitions at 3lb of magnetic resistance in 3 different exercises: shoulder adduction, internal rotation of the shoulder while in horizontal abduction, and a throw motion. Proteus calculated peak power (PP), peak force development rate (PFDR), and consistency (accuracy of movement

replication in 3D space during successive repetitions). The corresponding season statistics (2018-2019) were tabulated for assists, goals scored, and shooting percentage. Descriptive statistics characterized the sample; linear regressions tested the effect of PP, PFDR, and consistency on in-game performance. **RESULTS:** During the test season, players scored 23.1 ± 19.9 goals, had a shooting percentage of $41.6 \pm 12.1\%$, and accomplished 10.5 ± 10.9 assists. In the throw motion, Proteus calculated a PP of 59.2 ± 15.5 watts, PFDR of 104.3 ± 33.0 watts/sec, and consistency of $81.0 \pm 8.7\%$. PFDR exhibited negative relationships with goals scored ($p=0.021$) and shooting percentage ($p=0.049$), and a non-significant negative relationship with assists ($p=0.111$). Similar relationships were found with throw PP as well as PP and PFDR in shoulder adduction and internal rotation; all corresponded to worse performance in every performance metric. Consistency in all motions had a positive, non-significant relationship with all performance metrics; statistical trends were reached with horizontal shoulder adduction in which consistency predicted 7.1% more goals ($p=0.062$) and 8.8% more assists ($p=0.050$). **CONCLUSIONS:** These data provide preliminary evidence that skill-based fine motor coordination may be more valuable than power development in offensive performance in women's water polo.

1027 Board #153 May 27 1:30 PM - 3:00 PM
Core Temperature While Swimming In A Wetsuit During 1000-m Race Pace Swim

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(No relevant relationships reported)

Majority of fatalities that occur in the sport of triathlon happen during the swim portion of the race (Harris et al., 2010, JAMA). The potential risk of death while swimming has raised safety concerns. The governing body, USA Triathlon (USAT), has implemented guidelines related to water temperatures and the use of wetsuits. The varying water temperatures allow for a wide selection of wetsuits. Using a wetsuit while swimming in warm water may increase body heat storage which could increase core temperature. Currently, there are only limited data on the influence of triathlon wetsuits on core temperature when swimming in warm water while swimming a short distance at a somewhat hard swim pace (Aura et al., 2019, MSSE). **PURPOSE:** The purpose of this study was to examine core temperature while swimming a long distance (1000 m) at a fast pace in warm water (25.5°C) while wearing a wetsuit. **METHODS:** Two experienced triathletes (mean \pm standard deviation (SD), age 38.5 ± 23.3 years, height 1.83 ± 0.03 m, weight 80.1 ± 1.1 kg) participated in the study. At least 8 hours prior to attending the test session, participants swallowed an ingestible core temperature pill (BodyCap). Before beginning data collection, core temperature (T_c) data were transferred to a computer and sample rate was set to 0.1 Hz (1 sample every 10 s). Testing consisted of a self-directed warm up of 250-m followed by a 1000-m swim in an indoor pool (set to 25-m length) for each condition: no wetsuit (NW) and full sleeve wetsuit (FS). Participants swam at a self-selected pace at a "race pace" intensity (Borg Rating of Perceived Exertion = 16). Participants were required to rest until core temperature was within 0.5°C of baseline before starting the next condition. Core temperature data were transferred to a computer after each swim. Average T_c of each swim was computed for analysis. **RESULTS:** The average core temperatures of NW and FS were $37.75 \pm 0.11^\circ\text{C}$ and $37.74 \pm 0.46^\circ\text{C}$, respectively. The total swim time for the NW and FS conditions were $14:04 \pm 1:43$ and $13:05 \pm 1:06$ minutes. Mean stroke rate calculated for NW and FS were 30.12 ± 0.17 and 30.68 ± 0.45 strokes per minutes. Average swim speeds for NW and FS were 1.19 ± 0.15 and 1.28 ± 0.11 meters per second. **CONCLUSIONS:** Based upon the analysis of the results, the use of a wetsuit while swimming in warm water does not influence core temperature.

1028 Board #154 May 27 1:30 PM - 3:00 PM
Is There An Optimal Vertical Ground Reaction Force Profile For Maximizing Jump Height In A Countermovement Jump?

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PURPOSE: The vertical ground reaction force (VGRF) during a countermovement jump (CMJ) is classically described with a single peak force occurring at the low position of the countermovement. However, in practice, jumpers display a variety of CMJ VGRF profiles, including single and double peaks, and jumps where the peak force occurs at, or after, low position. The purpose of this study was to identify the optimal CMJ VGRF profile for maximizing jump height.

METHODS: The top 100 CMJs (based on jump height) from a database of over 2000 jumps, from 211 division one college athletes were analyzed. The 100 athletes (21 \pm 3 yr, 96 men) were from several different sports teams (hockey n=33, lacrosse n=25, soccer n=14, basketball n=14, other n=14). All jumps were performed with the hands

on the hips. Jumps were categorized as having a single or a double peak in VGRF and whether the peak GRF occurred at, after, or before low position. Jump heights were categorized as above average (1SD=mean), average (within 1SD of mean), or below average (1SD<mean). The association between jump metrics and VGRF profiles was examined using chi square analyses and independent t-tests.

RESULTS: Of the 100 CMJs 22 had a single peak VGRF, of which 14 occurred at low position and 8 occurred after low position. Of the 78 CMJs with a double peak, the 1st peak was higher in 47 jumps (30 at low position, 13 after low position, 4 before low position), the peaks were equal in 20 jumps (10 at low position, 10 after low position), and the 2nd peak was higher in 11 (all after low position). Peak GRF occurred at the low point of the countermovement for 82% (14 of 17) of the above average jumps versus 52% (33 of 64) of the average jumps and only 37% (7 of 19) of the below average jumps ($P=0.007$). For the 78 jumps with two distinct VGRF peaks the 1st peak was greater than the 2nd for 77% (10 of 13) of above average jumps, 61% (30 of 49) of average jumps and only 44% (7 of 16) of below average jumps ($P=0.033$).

CONCLUSIONS: The optimal VGRF profile appeared to be peak force occurring at low position regardless of whether there was a single or double peak. The worst VGRF profile appeared to be jumps with two peaks where the 2nd peak was greater than the 1st peak, or the 1st and 2nd peaks were equal, but the 1st peak occurred after low position. In conclusion, achieving peak VGRF at the low position of a CMJ appears to be optimal.

1029 Board #155 May 27 1:30 PM - 3:00 PM
Effect Of Countermovement Depth On The Neuromechanics Of A Vertical Jump

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PURPOSE: The purpose of this study was to examine kinematic, kinetic and muscle activation metrics during countermovement jumps (CMJs) with varying countermovement depths. The hypothesis was that a shallow countermovement depth would compromise jump height by disrupting neuromechanical control.

METHODS: Ten healthy men (age 26 ± 8 yr, height 1.81 ± 0.08 m, mass 83.5 ± 9.0 kg) performed maximal CMJs at self-selected countermovement depth (self-selected CMJ), at reduced countermovement depth (shallow CMJ) and at increased countermovement depth (deep CMJ). Three jumps were performed in each condition on force plates with ankle, knee and hip motion recorded and electromyograms (EMG) recorded from the gluteus maximus (GM), vastus lateralis (VL) and medial gastrocnemius (MG) muscles. During CMJs knee flexion angle was recorded with an electrogoniometer. Jumpers were instructed to flex 15% less (shallow CMJ) and 15% more (deep CMJ) than the self-selected CMJs. Kinematic, kinetic and EMG metrics were compared between the different CMJ depths using repeated measures ANOVA.

RESULTS: Compared with self-selected CMJs, shallow CMJs had 26% less countermovement depth (9.5 cm less, $P<0.001$) and the deep CMJs had 28% greater countermovement depth (10.2 cm more, $P<0.001$). Jump height was 8% less for the shallow vs. self-selected CMJs (0.344 m vs. 0.373 m, diff 2.9 ± 2.5 cm, $P=0.007$) but not different between self-selected and deep CMJs (0.373 m vs. 0.378 m, diff 0.05 ± 0.19 cm, $P=0.254$). Shallow CMJs differed from self-selected CMJs at the initiation of the countermovement (unweighting phase). For self-selected CMJs force dropped to 43% of body weight during unweighting but only to 58% for shallow CMJs ($P=0.015$). During unweighting VL EMG averaged 5.5% of MVC during self-selected CMJs versus 8.1% for shallow CMJs ($P=0.014$). Percent decline in jump height with shallow versus self-selected CMJs was correlated with the difference in VL EMG during unweighting between shallow and self-selected CMJs ($r=0.651$, $P=0.041$). **CONCLUSIONS:** Failure to deactivate the quadriceps during the unweighting phase of shallow CMJs compromised unweighting and resulted in a reduced jump height. These findings highlight the importance of unweighting at the initiation of the countermovement in dictating subsequent jump performance.

1030 Board #156 May 27 1:30 PM - 3:00 PM
Task Intensity Alters How Anterior Knee Pain Influences Frontal-plane Hip Biomechanics During Landing And Jumping

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Anterior knee pain (AKP) often affects individuals participating in activities involving high-intensity landing and jumping. Task intensity may alter the influence of AKP on lower-extremity landing and jumping biomechanics. **PURPOSE:** Determine whether

task intensity affects the influences of AKP on frontal-plane hip biomechanics during landing and jumping. **METHODS:** 13 healthy adults (6 females, 7 males; 70 ± 15 kg; 1.7 ± 0.1 m; 22 ± 2 years) performed three land and jump trials under three conditions: pre-pain, pain (1-ml hypertonic saline (5% NaCl) injection into the right infrapatellar fat pad), and post-pain. Subjects jumped over an obstacle, landed on a force plate, then jumped over a second obstacle. Obstacle heights of 80 and 50% of maximal vertical jump height defined high and low task intensities. Frontal plane hip angles and internal moments were calculated for the right leg. A functional analysis ($\alpha=.01$) was used to evaluate differences between conditions for each intensity, across the duration of foot contact with the force platform (ground contact). **RESULTS:** For the high intensity task, AKP resulted in increased hip adduction angle, as much as 2° between 1-20% and 75-95% of ground contact, and increased hip abduction moment, up to 6 Nm between 10-30% of ground contact (Figures 1E-F). For the low intensity task, AKP resulted in decreased hip adduction angle, as much as 1.3° between 25-75% of ground contact, and decreased in hip abduction moment, as much as 15 Nm between 25-60% of ground contact (Figure 1G-H). Changes due to AKP persisted after pain abatement (Figures 1I-L). **CONCLUSIONS:** Experimental AKP effects frontal plane hip biomechanics and these effects differ between task intensity. Especially during the high-intensity task, the AKP resulted in increased hip adduction angle and internal abduction moment. More data are needed to determine how/if the present changes influence the risk of chronic knee injury/disease.

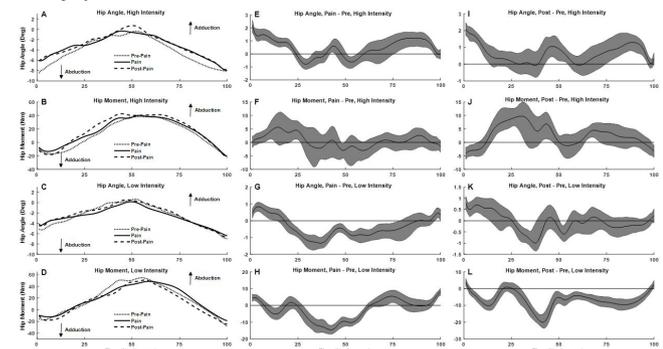


Figure 1. Grand ensembles for each condition and each intensity (A-D). Results of condition comparisons, pain minus pre-pain (E-G) and post-pain minus pre-pain (H-K). For plots E-K, mean differences and corresponding 95% confidence intervals are plotted as a function of time. When shaded area does not cross the zero line, condition differences exist ($p<.05$).

1031 Board #157 May 27 1:30 PM - 3:00 PM
Breast Support Alters Knee Joint Biomechanics During A Landing Task.
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 (No relevant relationships reported)

Females have a greater rate of traumatic knee injuries than male athletes. Trunk position has been shown to affect knee joint biomechanics during a landing task. Given the position of breast tissue, insufficiently supported breasts may also alter knee joint biomechanics. However, no previous research has investigated the effect of breast tissue or support on knee joint biomechanics during landing. **PURPOSE:** to determine the effect of breast support on knee and hip joint kinetics during a landing task. **METHODS:** Fifteen female athletes performed five step-off landings from a height of 40 cm in each of three bra support conditions: control (CON), low support (LOW) and high support (HIGH). 3D kinematics and ground reaction forces (GRFs) were simultaneously recorded using a 9-camera motion capture system (240 Hz.) and pair of force platforms (1200 Hz.) was used to calculate knee and hip joint angles and moments. Custom software (was used to determine peak joint angles and moments. Repeated measures ANOVAs with Tukey's post-hoc analyses were used to compare mean knee and hip joint kinetics. **RESULTS:** No differences in peak knee abduction moments were observed, though peak knee external rotation moments were smaller in the LOW compared to CON ($p = 0.007$) and HIGH conditions ($p = 0.013$). No differences were observed between CON and HIGH ($p = 0.423$). No differences were observed in peak hip abduction moment or peak hip external rotation moment. **CONCLUSIONS:** These findings indicate that knee joint biomechanics during a landing task are affected by breast support. The current study did not address the role of trunk orientation or differences in breast size amongst participants. Future research should address the role of breast motion on trunk kinematics and kinetics. Table 1. Mean knee and hip joint moments in the CON, LOW and HIGH support conditions.

Variable (Moments)	CON	LOW	HIGH	p-value
Knee Abduction	0.44 (0.35)	0.44 (0.30)	0.42 (0.21)	0.422
Knee External Rotation	-0.32 (0.21)	-0.24 (0.25)	-0.32 (0.22)	0.029
Hip Abduction	-0.62 (0.22)	-0.66 (0.26)	-0.57 (0.27)	0.216
Hip External Rotation	-0.57 (0.18)	-0.60 (0.16)	-0.58 (0.19)	0.353

1032 Board #158 May 27 1:30 PM - 3:00 PM
The Effects Of Whole-body Vibration And Fatigue On Vertical Jump Performance
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 (No relevant relationships reported)

Whole Body Vibration (WBV) is the exposure of oscillating vibration to the body, which may result in an increase of the rate of motor unit activation. Fatigue of knee extensor muscles has been shown to hinder vertical jump (VJ) performance. **PURPOSE:** The purpose of this study is to investigate the effects of WBV and fatigue on vertical jump (VJ) performance. **METHODS:** Sixteen active males and females (age, 23.19 ± 2.56 ; weight, 79.05 ± 16.97 ; height, 174.36 ± 12.11) volunteered for five-day study. On day 1 familiarization, after completing an IRB approved informed consent and health screening questionnaire participants were prepped on testing protocols. Following a dynamic warm up, testing sessions 2-5 will include one of four conditions: No WBV and No Fatigue (C1), WBV and Fatigue (C2), WBV and No Fatigue (C3), and No WBV and Fatigue (C4). WBV was performed using a frequency of 50Hz and a low amplitude while performing quarter squats for a total of 4min with a 30s rest or work ratio. Lower-body fatigue induced using Bosco fatigue test, performing 60s of jump squats. VJ was performed using an AMTI force plate and peak force, velocity, and power were calculated and a Vertec was used to measure vertical jump height (VJH). VJ data was collected pre and post conditions each day. Percent change scores (%Δ) were calculated between pre and post conditions and used for analysis. SPSS was used to perform a Repeated Measures ANOVA. **RESULTS:** There was significant differences between C1 and C2 ($p = 0.005$; $C1 = -1.21 \pm 5.91$; $C2 = -7.83 \pm 6.17$ %Δ), C1 and C4 ($p = 0.002$; $C1 = -1.21 \pm 5.91$; $C4 = -8.94 \pm 6.90$ %Δ), C2 and C3 ($p < .001$; $C2 = -7.83 \pm 6.17$; $C3 = 0.97 \pm 4.63$ %Δ), C3 and C4 ($p < 0.001$; $C3 = 0.97 \pm 4.63$; $C4 = -8.94 \pm 6.90$ %Δ) in VJH. There were significant differences between C1 and C4 ($p = 0.011$) and between C3 and C4 ($p = 0.017$) in peak force. There were significant differences between C1 and C2 ($p = 0.01$), C1 and C4 ($p = 0.02$), C2 and C3 ($p < 0.001$), and C3 and C4 ($p = 0.001$) in peak velocity. There were significant differences between was between C1 and C2 ($p = 0.03$), C1 and C4 ($p = 0.03$), C2 and C3 ($p = 0.004$), and C3 and C4 ($p = 0.008$) in peak power. There were no significant ($p > 0.05$) differences between other variables. **CONCLUSIONS:** WBV did not show to change the detrimental effects of lower-body fatigue, however this study did show lower-body fatigue decreases vertical jump performance.

1033 Board #159 May 27 1:30 PM - 3:00 PM
Effects Of w' Depletion On The Torque Velocity Relationship In Cycling
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The torque-velocity (T-v) curve has been used to study the effects of energy expenditure on contractile muscles at various workloads related to VO_{2max} . **PURPOSE:** The purpose of this study was to further quantify changes to the T-v curve, but based on anaerobic energy (W') expenditure at powers above Critical Power (CP6). **METHODS:** A group of 10 subjects (37.8 ± 11.6 yrs, 72.8 ± 16.2 kg, $1.75 \pm .11$ m) performed a Time to Exhaustion Test (TTE) interspersed with 6-second sprints to generate their T-v curve at 3 stages of W' expenditure: after initial warmup (FRESH), fatigued (after 2 minutes at CP6, 2MIN), and at TTE. **RESULTS:** ANOVA results indicated a statistically significant decrease in normalized Maximal Power (P_{max}) from FRESH to 2MIN (16.89%, $p < .0005$), 2MIN to TTE (24.71%, $p = .004$), and from FRESH to TTE (41.6% $p = .04$). Statistically significant decreases in normalized Maximal Velocity (v_{max}) were seen from FRESH to 2MIN (14.1%, $p < .0005$), from 2MIN to TTE (11.8%, $p = .001$), and FRESH to TTE (25.9%, $p < .0005$). No significant changes occurred in Maximal Torque (T_{max}). Linear regression

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models were run using W' expended to explain variations in P_{\max} , v_o , and T_o . There were significant negative correlations for T_o ($P = 0.020$) and significant strong negative correlations for P_{\max} ($P < 0.005$), and v_o ($P < 0.005$).

CONCLUSIONS: This suggests that W' expenditure can be used to predict the performance parameters Torque (T_o), Shortening velocity (v_o), and Maximal Power (P_{\max}) during continuous cycling above Critical Power.

1034 Board #160 May 27 1:30 PM - 3:00 PM
Effects Of Bicycle Crank Length On Hip And Knee Joint Kinematics And Compressive Forces

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PURPOSE: Crank length (CL) on a bicycle may affect knee and hip joint compressive forces and range of motion (ROM). The relationship between knee/hip joint forces, moments, and ROM can have an influence on hip and knee joint health (i.e. osteoarthritis, patellofemoral disorder, ligament damage, etc.). The purpose of this study was to examine the effects of four different CL (155, 165, 175, and 185 mm) on ROM and resultant compressive forces on the hip and knee. **METHODS:** 12 non-cyclists (4M, 8F, aged 18-55) participated in a single blind randomized cross-over experiment with four CL. An Enhanced Helen Hayes marker protocol was used to place 32 retroreflective markers on anatomical landmarks to track kinematic data using a 12-camera 3D motion analysis system with Cortex software (Motion Analysis Corp., CA, USA). Kinetic data were collected using a stationary bike (SRM IndoorTrainer, Germany) retrofitted with custom pedals containing 6-axis load cells (AMTI, MA, USA). A 3 minute warm-up for each CL was performed at 1.5 W/kg and 70 rpm. 4x1 minute trials were conducted at 2 W/kg. The first two trials were at a constant cadence of 70 rpm and the second two trials were at a constant pedal speed (PS) of 1.47 m/s. There were 10 seconds of rest between trials and 5 minutes of recovery between each condition. Kinematic data was processed using Cortex software and filtered (4th order Butterworth, cutoff 6 Hz). Kinetic data was filtered using MATLAB (MathWorks, MA, USA). All data was averaged from 30 seconds of each trial. **RESULTS:** During submax cycling, the 155 mm CL had a significantly smaller hip ROM (42 deg vs. 49 deg; $p < 0.05$) and a significantly smaller knee ROM compared to the 185 mm CL (72 deg vs. 80 deg, $p < 0.05$). No significant differences were found at a cadence of 70 rpm: 155 mm CL peak hip compressive force (1.3 N/kg) vs. 185 mm CL (0.9 N/kg); 155 mm CL peak knee compressive force (2.8 N/kg) vs. 185 mm CL (2.6 N/kg). No significant differences were found at a PS of 1.47 m/s: 155 mm CL peak hip compressive force (0.6 N/kg) vs. 185 mm CL (0.7 N/kg); 155 mm CL peak knee compressive force (2.3 N/kg) vs. 185 mm CL (2.5 N/kg). **CONCLUSION:** Hip and knee ROM was significantly greater with a longer CL. There are no significant differences in hip or knee peak compressive forces. Implementation of a shorter CL at a PS of 1.47 m/s may minimize peak hip and knee joint compressive forces.

1035 Board #161 May 27 1:30 PM - 3:00 PM
Effects Of Workrate And Seat Position On Knee Biomechanics In Recumbent Cycling

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Cycling is one of the most popular rehabilitation tools for knee osteoarthritis (OA) patients. In recent years, recumbent bicycle has become a popular trend over upright bikes in exercise and rehabilitation. Previous literature has largely focused on upright cycling with few examining knee biomechanics in recumbent biking in the sagittal plane. Little is known on the effects of workrate and seat position on knee biomechanics in recumbent bike. **PURPOSE:** To examine the effects of different workrates and seat positions on knee biomechanics during stationary recumbent cycling. **METHODS:** Fifteen healthy participants (55.5±3.7 years, 1.75±0.09 m, 84.3±15.7 kg) cycled on a recumbent ergometer in six test conditions of three seat positions at two workrates. Seat positions were "far" (20-30° of peak knee flexion angle), "medium" (30-40°) and "close" (40-50°), and the workrates were set at 60 and 100 Watts (W). A 3D motion analysis system (240 Hz, Vicon) and a pair of custom-made instrumented pedals were used to collect kinematic and kinetic data in each condition. A 3x2 (seat position x workrate) repeated measures ANOVA was used to determine if differences existed between conditions ($p < 0.05$). **RESULTS:** Peak knee extension moment, peak knee abduction moment (KAbM), peak knee extension angle and peak knee extension ROM were significantly higher at 100 W compared to 60W (all $p \leq 0.008$). There was a significant main effect of seat position for peak

knee flexion moment. Pairwise comparisons showed that peak knee flexion moment was significantly higher in the far seat position (-18.9±6.3 Nm) compared to medium (-13.1±6.5 Nm) and close seat position (7.28±7.33 Nm). In addition, the peak flexion moment was significantly higher in the medium seat position (-13.1±6.5 Nm) than close position (-7.28±7.33 Nm). **CONCLUSION:** Increased workrates significantly increased peak KAbM and knee extension moment. Different seat positions did not change either peak KAbM or knee extension moment. For patients with knee OA, a low workrate may be considered in recumbent cycling exercises, while the seat position could be chosen based on personal preferences.

1036 Board #162 May 27 1:30 PM - 3:00 PM
Preoperative And Postoperative Cycling Biomechanics Following Cam Femoroacetabular Impingement Corrective Surgery: A Pilot Study

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 (No relevant relationships reported)

PURPOSE: Cycling is commonly prescribed following femoroacetabular impingement (FAI) corrective surgery. This surgery alters gait mechanics in the postoperative period, but alterations in cycling mechanics have not been reported. In this case study, we sought to determine if cam FAI corrective surgery altered cycling biomechanics postoperatively in a highly active female subject. **METHODS:** Bilateral cycling biomechanics were collected preoperatively when the subject was asymptomatic and again 11-weeks postoperatively. During each visit, pedal forces and limb kinematics were collected and used to determine joint-specific work. The subject was instructed to target a power output of 240 W during isokinetic cycling at 80 RPM. Limb symmetry index (LSI) was calculated to compare power production at the pedal. Normalized joint-specific work was compared both inter- and intralimb, as well as pre- vs. postoperatively. **RESULTS:** LSI decreased from 96% to 84% postoperatively. Summed joint extension work increased in the surgical limb from 90% to 97% postoperatively. This increase was the result of a 67% decrease in hip extension work (30% to 10%, Figure 1) and a compensatory 28% increase in knee extension (50% to 64%, Figure 1) and 70% increase in ankle extension (10% to 17%, Figure 1) work within the surgical limb. In the nonsurgical limb, there was a 333% increase in knee flexion work postoperatively (3% to 13%, Figure 1). **CONCLUSION:** Cycling mechanics following FAI corrective surgery exhibited significant changes suggesting the development of compensatory patterns. The results of this pilot study combined with the prevalence of cycling in FAI surgery rehabilitation warrant further studies on the development and persistence of compensatory patterns and to possibly identify early intervention strategies.

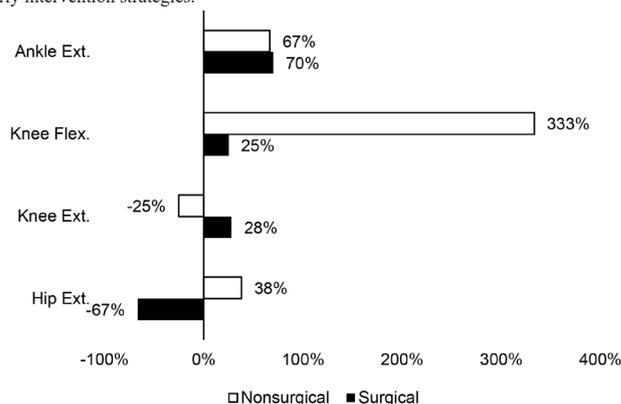


Figure 1. Pre- to postoperative changes in joint-specific work for the surgical and nonsurgical limbs.

1037 Board #163 May 27 1:30 PM - 3:00 PM

Biomechanics Metrics Associated With Golfing Prowess

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PURPOSE: The biomechanics of the golf swing have been studied extensively but specific metrics related to golfing proficiency have not been identified. The purpose of this study was to compare golf swing biomechanics between proficient and average golfers and thereby identify specific metrics associated with golfing proficiency.

METHODS: Twenty-two male golfers were categorized as proficient (golf index <6, n=10) or average (golf index 10-24, n=12). Three-dimensional kinematics and ground reaction forces (GRF) were recorded as subjects hit standard golf balls into a net using a driver. Angular velocities of the pelvis, trunk, lead arm and golf club, as well as X-factor, were calculated from the kinematic data. GRF under the lead and back legs are expressed as a % of bodyweight. The effect of golf proficiency on golf swing biomechanics was assessed using independent samples t-tests.

RESULTS: Proficient golfers were younger (26±6 yr vs. 48±16 yr, P=0.001) but did not differ in height (P=0.114) or weight (P=0.330). Peak pelvis and trunk velocities were higher (P=0.004) in proficient golfers (525.1±91.6 deg/s and 621.8±89.4 deg/s, respectively) versus average golfers (414.3±67.7 deg/s and 521.3±75.5 deg/s, respectively) but peak club velocity was not different (2509.8±226.1 deg/s vs. 2446.6±420.3 deg/s; P=0.675). Proficient golfers had greater X-factor at the top of the backswing (56.0±6.0 degrees vs. 44.1±11.4 degrees, P=0.008), greater peak X-factor (61.4±5.7 degrees vs. 49.3±11.8 degrees, P=0.008) and greater X-factor at ball impact (34.2±5.8 degrees vs. 22.5±6.5 degrees, P=0.001). Proficient golfers had a higher peak GRF on the lead leg compared with average golfers (142±17 %BW vs. 122±18 %BW, P=0.018), while paradoxically having a lower lead leg GRF at ball impact (56±18 %BW vs. 89±17 %BW, P<0.001).

CONCLUSIONS: The higher X-factor in proficient golfers is indicative of a more effective use of elastic energy in the trunk that is sustained through ball impact. The GRF data indicate that proficient golfers more effectively loaded the lead leg during the initiation of the downswing and more effectively unloaded the lead leg prior to ball impact. In conclusion, golf swing proficiency appears to be a function of a more effective transfer of power from the ground and a more effective use of elastic energy in the trunk.

1038 Board #164 May 27 1:30 PM - 3:00 PM

Biomechanical Comparison Of The Half To Full Golf Swing - Clinical Implications

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(No relevant relationships reported)

PURPOSE: Golf is popular, with many middle-aged participants. A concern for healthcare workers is how to advise those wishing to return to golf after a lower extremity (LE) injury or surgery. A common recommendation is to use a half swing, however, it is not known whether this reduces the motion or muscular torque for the LE. The purpose of this study was to examine the peak torques and positions of the hip during a half swing versus a full golf. **METHODS:** 11 healthy amateur male golfers with handicaps ≤ 21 participated in this study. All participants completed 20 golf swings (10 full swings, 10 half swings). A 10-camera motion analysis system, with force plates, were used to record swing data. Data was reduced using a 3-D modeling program and standard inverse dynamics were used to determine internal net joint torques. Peak torques (Nm; normalized by %BWHT) and movement positions (degrees) were analyzed in SPSS (Version 24) Differences and correlations considered significant if at the .05 level of probability. A repeated measures ANCOVA (club-head velocity in mph, as the covariate) was used to compare half to full swing for each movement. **RESULTS:** Subjects had an average age of 44±16 years and an average handicap of 13±6. Club-head speed ranged from 69 to 113mph, with an average of 91±12mph. The highest torques in both full (12.02±1.97 Nm/%BWHT) and half swings (12.04±2.07 Nm/%BWHT) occurred in trail hip extension. This was followed by lead hip flexion and hip abduction, and trail hip abduction in both swing styles. (6.58±2.46, 6.04±2.07 and 5.75±1.11 Nm/%BWHT, respectively). The highest peak positions were in the trail leg for flexion and abduction. There was a significant correlation between each half and full swing position ranging from r=.85 to r=.98. Repeated measures ANCOVAs found no significant differences between half and full golf swings.

CONCLUSIONS: Contrary to a pilot study, our data show that using a half swing did not reduce the amount of internal torque around the hip, as compared to a full swing. All torques were similar to a published study in which it was noted that the torques

were much higher than reported hip torques for walking and activities of daily living. These findings suggest that clinicians should use caution in recommending a half vs a full swing for those returning to golf following an injury or surgery.

1039 Board #165 May 27 1:30 PM - 3:00 PM

Correlation Of Lumbopelvic-hip Complex Stability To Pain In NCAA Division III Golfers

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(No relevant relationships reported)

Lumbopelvic-hip complex (LPHC) stability is known to be a major contributor in injury prevention of ballistic movement. However, the literature primarily focuses on the kinematics of the hips and trunk relative to swinging sports, specifically in professional golfers. Data is sparse regarding isometric strength (ISO) and muscular endurance (ME) of the LPHC relative to pain in male and female collegiate golfers.

PURPOSE: Therefore, the purpose of this study was to determine the relationship of LPHC isometric strength and muscular endurance to upper extremity, lower extremity, and back pain in NCAA Division III golfers. **METHODS:** Thirty-two NCAA Division III golfers (19.8 ± 1.3 yrs.; 70.0 ± 11.1 kg.; 173.4 ± 11.1 cm) volunteered to participate. Thirteen were female, and nineteen were male. A health history questionnaire was used to establish current pain or stiffness within each athlete. Bilateral internal and external rotation ISO, as well as adduction and abduction ISO, was measured using a handheld dynamometer. Two trials were conducted for each variable, and the mean was used for statistical analysis. Additionally, ME of the anterior and posterior trunk was measured using the trunk flexor endurance and trunk extensor endurance tests of the standardized McGill's Torso Muscular Endurance Test Battery. A Pearson product-moment correlation was run to determine relationships between ISO and ME to current pain. **RESULTS:** A statistically significant, negative correlation was found between lead hip internal rotation ISO, relative to the golf stance, and current pain (r = -.369, n = 32, p = .038). Of the 14 reported cases of pain, 11 instances were localized to the back and hips. No other statistically significant correlations were established between current pain and ME or ISO of bilateral external rotation, abduction, adduction, and internal rotation of the back hip. **CONCLUSION:** Deficient internal rotation isometric strength of the lead hip could be considered a risk factor for hip and back pain in collegiate golfers.

1040 Board #166 May 27 1:30 PM - 3:00 PM

Balance And Kinematic Swing Sequence In Older Female Golfers

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(No relevant relationships reported)

Female golfers account for approximately 25% of the entire golfing population in the United States and 16% of female golfers are over the age of 60. While balance and golf swing kinematic sequence are frequently cited as important performance determinants, literature involving the older female golfer is limited.

PURPOSE: To examine the balance profile (during specific dynamic tasks) and kinematic golf-swing pattern displayed in older female golfers.

METHODS: Thirteen female golfers using a right-handed swing strategy (mean age ± SD, 67.5 ± 5.5) completed the Modified Clinical Test of Sensory Integration of Balance and the Rhythmic Weight Shift (RWS) protocols in order to collect balance data. A golf-swing kinematic assessment was also performed. Three recorded drives were used to analyze the swing and establish a dominant sequence. Balance outcome data were examined with reference to established age-matched normal values. Golf-swing kinematic sequence patterns were compared between those participants within (N=7; mean age ± SD, 66.1 ± 5.2) and outside of (N=6; mean age ± SD, 69 ± 5.9) normal Forward-Backward Directional Control (FBDC).

RESULTS: All participants displayed normal directional velocity values for the RWS assessment but only half demonstrated normal FBDC. The kinematic sequence analysis revealed that 53.8% of all participants optimally initiated the downswing by leading with the pelvis. Golfers with normal FBDC (mean % time on axis ± SD, 79.1 ± 5.5), were more likely (71.4%) to initiate a normal kinematic swing sequence compared to 33.3% of those with abnormal FBDC (mean % time on axis ± SD, 64 ± 7).

CONCLUSIONS: The results of this study suggest that this population of golfers may need to consider exercise or training programs designed to improve forward/backward dynamic balance control as a means to assist in optimizing the kinematic sequence and overall golf-swing performance.

1041 Board #167 May 27 1:30 PM - 3:00 PM

Crosse Use Effects On Running And Drop Jump Mechanics In Male And Female Lacrosse PlayersHeather K. Vincent, FACSM, Michelle L. Bruner, Cong Chen, Sharareh Sharififar, Kevin R. Vincent, FACSM. *University of Florida, Gainesville, FL.*

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(No relevant relationships reported)

PURPOSE: A unique feature of lacrosse is the use of a crosse to move the ball during complex running and jumping movements. It is unclear whether there is a differential biomechanical effect of holding the crosse during key sport-specific motions in female and male youth and high-school/collegiate players. The purpose of the study was to determine the motion differences of running and drop jumps when holding a short stick or a defensive pole in youth (11.8±1.4 yrs; 21% female) and high-school/collegiate players (18.4±1.9 yrs; 35% female).

METHODS: Players (N=70) performed drop jumps and running at near sprint speed. Drop jumps were completed under three conditions: bare hands, short stick and defensive long pole. Running was performed under three conditions: bare hands, and dominant side one-handed and two-handed holds while cradling. A 3D motion tracking system and floor embedded force plates captured motion about the ankle, knee, hip, pelvic and trunk during three trials of each condition for each motion. Sex and age group differences were tested using univariate analyses of variance.

RESULTS: For drop jumps, foot landings (heel, mid or toe) differed more often when holding a crosse versus bare hands for all players (31.4%-34.2% vs 27.1%). Irrespective of age, female players demonstrated more ankle 7°-9° dorsiflexion than males in all conditions (p<.05). Youth demonstrated 28% more knee adduction in all jump conditions than high-school/collegiate players (p<.05). Compared to males, females had 5.2°-6.5° less anterior trunk flexion at initial ground contact when holding a short or long stick and 9.8%-20% less anterior flexion after landing versus bare hands (p<.05). During running, females had 12.7% more hip adduction and 43% more trunk lateral lean than males with one or two-hand holds compared to bare hands irrespective of age (p<.05). A two-handed hold produced greater trunk transverse rotation than other conditions compared to males and across conditions (p=.001).

CONCLUSIONS: Holding a crosse differentially affects biomechanics in female and male players but not by age group. Preseason conditioning with movements while holding the crosse may provide help reduce excessive motion at affected joints. Funded by US Lacrosse.

1042 Board #168 May 27 1:30 PM - 3:00 PM

Relationships Between Accelerometer-derived Training Loads And Rpe In Collegiate Women'S Volleyball PlayersNatalie Kupperman, Jay Hertel, FACSM. *University of Virginia, Charlottesville, VA.**(No relevant relationships reported)*

Purpose: The relationship between ratings of perceived exertion (RPE) and objective training load metrics in women's volleyball players is unknown. This study examined relationships between RPE and accelerometer-derived variables in practices and games in this population.

Methods: External training loads were measured with triaxial accelerometry during team practices and games along with subjective RPE collected on the Borg CR-10 scale. Data from 12 athletes over a 7-week in-season period (13 games, 19 practices) were collected from an NCAA Division I women's volleyball team. The accelerometer-derived variables were: total playerload (PL), total change of direction (COD), total jumps, total accelerations, total decelerations, and total repeated high-intensity events (RHIE). Relationships between RPE and the accelerometry variables in practices and games were analyzed using Pearson correlations (r) and least ordinal squares regression.

Results: Correlations with RPE during games and practices were: PL (0.79, 0.57), COD (0.57, 0.23), jumps (0.68, 0.46), accelerations (0.55, 0.30), decelerations (0.76, 0.61), and RHIE (0.52, 0.52). Regression models for games revealed that accelerometry measures explained 70% of variance in RPE (PL, jumps, decelerations, $p < 0.05$; COD, accelerations, RHIE, $p > 0.05$). For practices, accelerometry variables explained 44% of variance in RPE (PL, decelerations, RHIE, $p < 0.05$; COD, jumps, accelerations, $p > 0.05$). PL alone explained 62% and 33% of the variance in RPE for games and practices, respectively ($p < 0.001$).

Conclusions: Accelerometer-derived variables informed the understanding of athlete-reported RPE in collegiate women's volleyball players. The selected volume-based accelerometer-derived variables had a stronger relationship with RPE for games than practices. The calculation of PL includes aspects of the other accelerometry variables assessed which may explain why PL was the strongest single predictor of RPE.

1043 Board #169 May 27 1:30 PM - 3:00 PM

Effects Of Hip Thrust And Resistance Training On Shuttle Run, Hand Grip Strength And Countermovement Jump In Colombian Elite Male Volleyball PlayersCristian Yanez, Cesar Lovera, Luis Cardozo, Jhonatan Peña, Felipe Martin, Frank Rincon, Angela Perdomo. *Area Andina Foundation University, Bogota, Colombia.*

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(No relevant relationships reported)

PURPOSE: This study aimed to determine whether a hip thrust and resistance training could improve performance on shuttle run, hand grip strength and countermovement jump in elite volleyball athletes.

METHODS: eleven elite male volleyball players (23,09 ± 2,87 years), body weight (84.91 ± 10.15 kg), average weight lean muscle (40,18 ± 3.07%), body fat (18.16 ± 5.45%) completed 2 training sessions per weeks, which included hip thrust exercise and upper resistance training. Over the 10 week season, the athletes performed 3-4 sets of 6-10 repetitions for resistance exercises during each training session. All sessions were supervised by one of the investigators as well as by the Colombian team coach. Shuttle run, hand grip strength and countermovement jump were assessed before and after the 10 week training program. A total of 12 variables was analyzed through CMJ: (peak flight time (PFT), peak contact time (PCT), Peak eccentric duration (PDE), peak concentric duration (PDC), Peak eccentric work (PWE), Peak Concentric work (PWC), Peak jump height (PMH), Peak maximum velocity (PMV), Peak maximum power (PMP), Peak maximum force (PMF), Peak rate of force development (PRFD) and Peak time to maximum force (PTFM) were simultaneously quantified with the Gyko inertial sensor system (Microgate, Bolzano, Italy).

RESULTS: Non parametric data were analysed by Wilcoxon and Spearman test. Significant correlations (r) were found next to the p value and the effect size (ES) of shuttle run, hand grip strength and those of countermovement jump respectively. Shuttle run (SR, $p=0,000$, $r=0,96$, $ES=0,23$), Right hand grip strength (HGS R, $p=0,000$, $r=0,90$, $ES=0,18$), Left hand grip strength (HGS L, $p=0,000$, $r=0,91$, $ES=0,22$). CMJ performance variables: Peak concentric duration (PDC, $p=0,000$, $r=0,68$, $ES=0,44$), Peak Jump Height (PMH, $p=2,0$, $r=0,88$, $ES=1,1$), Peak maximum velocity (PMV, $p=0,000$, $r=0,63$, $ES=0,61$).

CONCLUSIONS: The findings suggest that elite male volleyball players can improve speed, agility, hand grip strength and vertical jump performance during the pre competition season by implementing a well designed training program that includes both hip thrust and resistance training exercises.

1044 Board #170 May 27 1:30 PM - 3:00 PM

Examination Of Landing Error Scoring System Scores For Division 1 Basketball PlayersJessica Smith, Timothy G. Coffey. *Longwood University, Farmville, VA.**(No relevant relationships reported)*

The injuring of the anterior cruciate ligament (ACL) is one of the most prevalent sports related knee injuries to occur in athletics, specifically female athletes. **PURPOSE:**

To examine differences in LESS (Landing Error Scoring System) scores between frontcourt and backcourt, male and female NCAA Division 1 basketball players and to measure any changes in LESS scores between the beginning and end of the season.

METHODS: Participants were 24 Division 1 basketball athletes (10 females, 14 males). Participation for the initial LESS screen prior to the season was 24 participants, but only 15 completed the postseason LESS screen (12 males, 3 females). These losses in participants were due to team departures, injuries, and NCAA restrictions on team activities post season. They completed a LESS screen (three consecutive jumps per screen) while being filmed in the frontal and sagittal plane and these videos were analyzed using a visual analysis computer system (Darfish). The clinician examined the torso, feet, knees, and hips in the frontal and sagittal plane and assigned the athlete a score based on the landing performance. Athletes who scored above five points indicated an increased risk for an ACL injury. These screens were scored by a researcher using the LESS scoring sheet determined by Padua and then analyzed using an ANOVA 2x2 repeated measures test in SPSS to test for statistical significance. Statistical results were considered significant if they had a p-value ≤ .05.

RESULTS: There were no statistically significant difference in LESS scores between position ($p=0.650$) or gender ($p=0.904$), but there was a significant decrease in preseason LESS scores versus postseason LESS scores for men and women ($p \leq 0.001$). Preseason men LESS scores averaged 6.30 ± 1.31 and women averaged 6.38 ± 1.63 . Postseason LESS scores for men averaged 5.47 ± 1.09 and women averaged 6.44 ± 0.84 .

CONCLUSIONS: This sample of Division 1 basketball athletes' LESS scores did not seem to differ based on gender or position which could conclude that the athletes training regimens may be similar to each other and not determined by ACL risk, gender, or positions. The significant decrease in preseason LESS scores to postseason LESS scores could be attributed to the similar training regimens.

1045 Board #171 May 27 1:30 PM - 3:00 PM
Lower Extremity Joint Work During Braking Phase Of The Triple Hop For Distance

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The triple hop for distance (THD) involves three consecutive single leg hops for maximal horizontal displacement. This task imposes variable mechanical demands challenging balance, coordination and leg strength. While THD is common during late-stage rehabilitation, these demands may also qualify THD as appropriate for healthy athletes. While research shows that energy absorption strategies vary between landing styles, genders and heights, a limitation is the use of a single contact for analysis or training. As a result, changes in landing strategy over repeated landings are not well understood. **PURPOSE:** To determine changes in sagittal plane joint energetic landing strategy during each contact of THD. **METHODS:** Nine female college soccer players performed THD on the dominant limb. Ground reaction forces and lower extremity kinematics were measured using a force platform (1200Hz) and 9-camera motion capture system (240Hz). Three trials were collected of each contact in the THD sequence. Negative joint work was calculated as negative joint power integrated with respect to time. Total negative joint work (TJW) is the sum of eccentric work done on the hip, knee, and ankle, and the proportion of TJW done on each joint was defined as relative negative joint work (RJW). **RESULTS:** TJW increased from the first (-80.5 ± 26.3J) to the second (-95.5 ± 33.7J), and third (-145.2 ± 42.5J) landings. From the first to second contacts, RJW done on the ankle (33.5% vs 34.7%, $d = 0.10$), knee (53.9% vs 52.1%, $d = 0.20$), and hip (12.6% vs 13.1%, $d = 0.08$) was unchanged. From the second to third contacts, RJW done on the ankle was substantially decreased (34.7% vs 18.4%, $d = 1.67$), while RJW done on the hip was substantially increased (13.1% vs 25.4%, $d = 1.68$). RJW done on the knee was modestly greater (52.1% vs 56.3%, $d = 0.54$) in the second compared to third contacts in THD sequence. **CONCLUSION:** The serial nature of THD requires athletes to adapt to different demands in each ground contact. This includes progressively greater braking forces and landing strategy modulation during each contact. This represents a task which exposes athletes to variable demands of both ground reaction forces and joint work in a controlled manner. THD may therefore address multiple athletic performance qualities during performance enhancement and rehabilitation.

1046 Board #172 May 27 1:30 PM - 3:00 PM
Kinematic And Kinetic Differences During A Conventional Deadlift With And Without Shoes

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Despite the popularity of deadlifting without shoes, little research has examined the kinematic and kinetic differences during a conventional deadlift when performing the exercise barefoot. Excess joint torque in the frontal plane can be indicative of injury. **PURPOSE:** To examine the differences in frontal plane mechanics of the lower extremity and force development during a conventional deadlift with and without shoes. **METHODS:** Thirty participants with a mean height and weight of 1.75±0.10 meters and 81.12±16.05 kg. Participants recruited had consistently performed the conventional deadlift for six or more months and strength training at least two days per week. During the participant's first visit, a one repetition maximum (1RM) using NSCA guidelines was determined. A second visit occurred at least 72 hours or more after the 1RM testing. Kinematic and kinetic data were collected using a 15-camera Qualisys Oqus system (240Hz) and two Bertec force plates (1200Hz). Participants performed five consecutive reps at 70% of their 1RM in random order (shoes and barefoot). Visual 3D was used to process raw marker and force data and to calculate frontal plane joint moments at the hip, knee, and ankle during the concentric phase. A one-way MANOVA ($p < 0.05$) was used to investigate the different footwear conditions. **RESULTS:** There was a statistically significant difference between shoes (-0.28 ± 0.11 Nm/kg) and no shoes (-0.38 ± 0.14 Nm/kg) for internal ankle eversion moments ($p = 0.018$). No significant differences were detected for knee and hip abduction moments. Peak vertical ground reaction force in the barefoot condition (1035.2±281.4 N) was not significantly different than the shoe condition (1044.9±286.5 N). **CONCLUSION:** The absence of shoes created an increase in frontal plane ankle moments, but there was no change in the vertical force characteristics. An increased internal eversion moment did not affect the joint moments further up the kinetic chain despite undergoing similar loading patterns.

1047 Board #173 May 27 1:30 PM - 3:00 PM
The Effects Of Whole-body Vibration And Fatigue On Isometric Mid-thigh Pull

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Musculature exposed to continuous stress overtime will begin to decrease performance as a result of fatigue. However, past research has shown that Whole Body Vibration (WBV) can have a positive effect on performance by increasing motor unit recruitment.

PURPOSE: The purpose of this study is to analyze the effects of WBV and Fatigue on Isometric Mid-Thigh Pull (IMTP).

METHODS: Sixteen active males and females (age: 23.19 ± 2.56yr, weight: 79.05 ± 16.97kg, height: 174.36 ± 12.11cm) volunteered to participate in a 5-day study. Day 1 consisted of familiarization where participants completed an IRB approved informed consent, Health History Questionnaire, and a PARQ. Following anthropometrics measurements, participants were familiarized with all the testing protocols and interventions. Day 2-5 testing sessions consisted of a dynamic warm-up followed by pre-testing of IMTP's. Post-tests for IMTP were taken following the completion of one of 4 conditions, each performed on separate days. Conditions consisted of C1 (No WBV-No Fatigue), C2 (WBV-Fatigue), C3 (WBV-No Fatigue), and C4 (No WBV-Fatigue) in a randomized order. Peak Force for the IMTP was measured using an AMTI Portable Force Plate. WBV was administered while performing quarter squats at a frequency of 50Hz and low amplitude on for a total of 4min with a work to rest ratio of 30s/30s. The Bosco fatigue protocol was administered to induced lower-body fatigue by having participants perform 60s of jump squats. Percent change scores were calculated between pre- and post-tests for each condition and analyzed for statistical differences between conditions. SPSS was used to run a Repeated Measures ANOVA to compare condition differences of percent change scores (%Δ). An alpha level was set at $p < 0.05$ to determine significance.

RESULTS: There were no significant ($p = 0.84$) differences found between conditions (C1 1.25 ± 9.98 %Δ; C2= -0.79 ± 7.77 %Δ; C3= 1.53 ± 5.95 %Δ; C4= 1.32 ± 10.69 %Δ) for peak force.

CONCLUSIONS: Although no significant differences were found for peak force between pre- and post-tests for IMTP, further studies need to investigate alternative ways to evaluate the effects WBV on lower-body muscular performance.

1048 Board #174 May 27 1:30 PM - 3:00 PM
NEUROMUSCULAR FATIGUE ASSESMENT IN HAMSTRING MUSCLES IN ELITE ULTIMATE FRISBEE PLAYERS

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Ultimate Frisbee (UF) is a new team-sport, with more than 1.5 million practitioners worldwide. It is characterized by changes of direction, accelerations / decelerations, jumps and landings. It has been found that the incidence and prevalence of lower body injuries is 68% of total injuries and 73% are hamstring injuries.

PURPOSE: To determine hamstring neuromuscular fatigue in UF players.

METHODS: A descriptive observational study with analytical component was performed in 18 elite male UF players (age: 26 ± 5 years, weight: 67.5 ± 7kg, height: 1.73 ± 0.05m, BMI: 22 +/- 2), who participated and won the Colombian Interclubes National Tournament 2019. The strength of the hamstrings was evaluated using force platforms with isometric hamstring test, each player performed a maximum isometric contraction in supine position, 90° hip flexion and knee of the analyzed leg. The athlete exerts maximum force with the heel on the force platform for 3 seconds. 3 attempts were made with each leg with 30 seconds rest between each attempt, at the start of the tournament and at the end of the tournament. The athletes played 8 90-minute matches during 4 days of competition. A statistical analysis was performed using the student T test and the Wilcoxon test.

RESULTS: Significant differences were found between the pre and post-tournament evaluation in the variables of peak vertical force of the right leg (314 ± 51.5 vs 256 ± 38.5 N $p = < 0.001$), compared with the peak vertical force of the left leg (272 ± 43.5 vs 246 ± 46.6 N $p = 0.4$) that had a non statistically significant change. It was also found that the force in the right leg had significant differences at 100 ms (113 ± 37.6 vs 95 ± 40.1 $p = 0.02$) 150 ms (165 ± 52.8 vs 133 ± 53.9 $p = 0.002$) and 200 ms (200 ± 57.3 vs 167 ± 57.5 $p = 0.0004$).

CONCLUSIONS: The decrease found in hamstring peak vertical force corresponds to the fatigue that athletes present and accumulate during the tournament and predispose to be a risk factor for hamstring and anterior cruciate ligament injury due to changes in direction and unipodal landings. They are frequent in this sport. Likewise, the predisposition of the right leg as the dominant leg increases the incidence of injuries in the knee joint compromising dynamic stability

1049 Board #175 May 27 1:30 PM - 3:00 PM
Effect Of Moxibustion On Knee Joint Stiffness Characteristics In Recreational Athletes Pre And Post Fatigue

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Stiffness is the coupling of nervous system and joint mechanics, and thus the comprehensive representative of joint stability. It has been reported that moxibustion can improve weakness and alleviate fatigue symptoms.

PURPOSE: To investigate whether moxibustion could enhance knee joint stiffness characteristics in recreational athletes pre and post fatigue. **METHODS:** Twenty-four participants were partially randomized into intervention (9 males: 20.2 ± 1.5 yr; 6 females: 20.7 ± 1.2 yr) and control group (5 males: 19.4 ± 0.9 yr; 4 females: 20.5 ± 0.6 yr). Intervention group: Acupoints ST36 (bilateral) and CV4 for indirect moxibustion 30 min every other day for 4 consecutive weeks; control group: no moxibustion intervention. Peak torque (PT) of right knee extensors, relaxed and contracted muscle stiffness (MS) of vastus lateralis, knee extensors musculoarticular stiffness (MAS) were assessed by isokinetic dynamometer IsoMed 2000, Myometer and free oscillation technique respectively, at three time points: pre-intervention (time-point 1), post-intervention (time-point 2), and after a treadmill fatigue protocol (time-point 3). **RESULTS:** Two-way repeated measures ANOVA found a significant interaction between time and group in MAS ($p = 0.001$) and normalized PT ($p = 0.004$). Post-hoc tests with the Bonferroni-adjusted α were conducted and identified that MAS in intervention group (time-point 1: 521.8 ± 201.3 N/m, time-point 2: 637.7 ± 181.2 N/m) increased more from pre to post intervention when compared to the control group (time-point 1: 615.4 ± 196.6 N/m, time-point 2: 597.1 ± 190.4 N/m) ($p = 0.022$). There was a tendency that after fatigue MAS increased more in intervention group (time-point 2: 637.7 ± 181.2 N/m, time-point 3: 712.1 ± 156.9 N/m) than in control group (time-point 2: 597.1 ± 190.4 N/m, time-point 3: 629.8 ± 172.7 N/m) ($p = 0.202$); and the tendency that normalized PT (PT/body mass) increased in intervention group (time-point 2: 1.49 ± 0.20 Nm/kg, time-point 3: 1.53 ± 0.17 Nm/kg) whilst it decreased in control group (time-point 2: 1.41 ± 0.21 Nm/kg, time-point 3: 1.34 ± 0.21 Nm/kg) ($p = 0.033$). **CONCLUSION:** Moxibustion enhanced the knee MAS, may benefit the ability of fatigue resistance in young recreational athletes, and thus could be utilized in injury prevention.

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1050 Board #176 May 27 1:30 PM - 3:00 PM
Acute Effects Of Practical Blood Flow Restriction On Knee Proprioception During Low Intensity Aerobic Exercise

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Practical blood flow restriction (pBFR) exercise techniques decreases blood flow to targeted muscles while increasing local metabolic accumulation, both of which could impair joint proprioception post-exercise. The impaired proprioception which typically occurs after high intensity aerobic exercise can provide faulty sensory feedback to the brain during movement, resulting in increased risk of injury. Currently, there have been no studies investigating whether pBFR low intensity aerobic exercise has an effect on joint proprioception. **PURPOSE:** To investigate how low intensity aerobic exercise with pBFR affects knee joint proprioception. **METHODS:** Fourteen participants (8 males and 6 females) completed 3 sessions. On the first session, participants walked at 5.6 km/h at a 0% grade for two minutes followed by a 2% increase in the incline each minute until 40% of their heart rate reserve was achieved. Participants were familiarized with a "7/10" (moderate tightness) on the perceived tightness scale using elastic knee wraps as well as the position sense and countermovement jumps.

On session 2 or 3, participants walked on a treadmill for 15 minutes with or without elastic wraps at 5.6 km/h at the grade determined on the first session. Absolute angular error (AAE) was measured before and immediately after each treadmill walking protocol. Muscle fatigue was determined by changes in average power and peak power measured during countermovement jumps. Change scores were computed for each condition and paired sample t-tests were used to determine differences between pBFR and Control. **RESULTS:** The change in AAE was not different (pBFR: -1.5 vs. Control degrees: 0.19, $p = 0.171$) between low intensity exercise with and without pBFR [mean difference of -1.73 (-4.3, 0.85) degrees]. The change in peak power was also similar (pBFR: -34.5 vs. Control: 150.1 W, $p = 0.739$) between exercise with and without pBFR [mean difference of -185 (-1358, 988) W]. Similarly, the change in average power (pBFR: 9.1 vs. Control: -3.4 W, $p = 0.544$) was also not different [mean difference of 12.6 (-31.1, 56.2) W]. **CONCLUSION:** The walking exercise with pBFR did not effect joint proprioception in young adults, suggesting that walking exercise with pBFR might be safely applied without increasing the risk of injury.

1051 Board #177 May 27 1:30 PM - 3:00 PM
Flight Stability Control Mechanism Of Ski Jumping In Lateral Wind Environment

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Wind is not only closely associated with the discussion of fairness in ski jumping, but also very important to flight safety. Flight stability is essential for performance and safety in ski jumping, and mainly involved several factors, such as environmental wind and flight posture. However, the flight stability control mechanism of ski jumping in lateral wind environment remains unclear.

PURPOSE: To determine the flight stability control mechanism of ski jumping in lateral wind environment.

METHODS: The aerodynamic characteristics of ski jumping during flight under different lateral wind and yaw angles are predicted by numerical simulation of computational fluid dynamics, and the effects of the above two elements on flight stability are compared and analyzed. The jumper and skis were regarded as a multi-body system, and partially averaged Navier-Stokes turbulence model was used to simulate aerodynamic characteristics of the system based on a general flight attitude and then the forces and torques were obtained. The lateral wind speed involved in the numerical prediction includes 1.5 m/s, 3 m/s, 4.5 m/s and 7.5 m/s, and the flight yaw angle involved includes 2.5°, 5° and 7.5°.

RESULTS: When lateral wind speed is small (less than 3m/s), yaw force, yaw torque and rolling torque are small and almost negligible, and when lateral wind speed is larger than 4.5m/s, yaw force, yaw torque and rolling torque are more obvious. When wind speed is 4.5m/s and 7.5m/s, yaw force, yaw torque and rolling torque are 9.5 N and 26.3 N, 2.3 Nm and 6.3 Nm, 2.8 Nm and 7.8 Nm, respectively. When yaw angles are 2.5°, 5° and 7.5°, yaw force, yaw torque and rolling torque are 6.8 N, 12.9 N and 21.9 N, 2.5 Nm, 5.0 Nm and 6.8 Nm, 2.7 Nm and 8.3 Nm, respectively. When wind speed is 4.5 m/s and yaw angle is 2.5°, yaw force, yaw torque and rolling torque results of these two conditions are close to each other. Similarly, When wind speed is 7.5 m/s and yaw angle is 7.5°, yaw force, yaw torque and rolling torque results of these two conditions are close to each other.

CONCLUSION: The larger lateral wind can have a significant adverse effect on flight stability control of ski jumping, but it is possible to compensate or even eliminate this adverse effect by taking the appropriate flight yaw angle.

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1052 Board #178 May 27 1:30 PM - 3:00 PM
Effect Of Footwear On Leg Stiffness Of Female Athletes

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Leg stiffness is a fundamental property of the lower limb spring pattern, and is expressed by the ratio of the maximum vertical ground reaction force (GRF) to the vertical displacement of the body's center of mass. The foot-ground interface, i.e. the footwear (FW), is an important factor that contributes to the functional leg stiffness.

PURPOSE: To examine the FW effect on leg stiffness of young female athletes in a variety of team sports. **METHODS:** Twenty - six female basketball, handball and volleyball players (24.9 ± 6.1 years, height 176.4 ± 7.6 cm, body mass 71.0 ± 6.9 kg) performed 30 s of two-legged hopping in place, barefoot (BF) and with their usual FW, at a preset hopping frequency (digital metronome at 2.2 Hz which approximates the natural hopping frequency). Two-legged hopping was performed on a force platform (Kistler 9260AA, 1000Hz, Bioware Software 2812 A1-3) which was used to record

the vertical GRF. The variables used for the statistical analysis of the FW effect were extracted from 10 consecutive hops, and were analyzed using two-way ANOVA ($p < 0.05$). **RESULTS:** leg stiffness was significantly increased in the FW condition, both in absolute (BF: 32.7 ± 8.5 kN/m, FW: 36.9 ± 8.3 kN/m, $p = 0.014$), as well as in relative to body mass values (BF: 0.478 ± 0.101 kN/m/kg, FW: 0.520 ± 0.110 kN/m/kg ($p = 0.017$)). Also, despite the instruction to follow the same hopping frequency as set by the digital metronome in both the BF and the FW, hopping duration was shortened (BF: 0.469 ± 0.022 s, FW: 0.430 ± 0.013 s, $p = 0.001$) and the propulsive vertical GRF was increased (BF: 32.4 ± 4.7 N/kg, FW: 33.7 ± 5.6 N/kg, $p = 0.048$) in the FW condition. **CONCLUSIONS:** FW appears to increase leg stiffness, which may favor the myotendinous force transfer and contribute to a more effective lower limb spring pattern.

1053 Board #179 May 27 1:30 PM - 3:00 PM

Characteristics Of Eight Irish Dance Landings: Implications For Overuse Injury And Training

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The aesthetics in Irish dance have evolved to create greater physical demands on dancer's bodies. Irish dancers must land from difficult movements without letting their knees bend or heels touch the ground, causing large forces to be absorbed by the body. The majority of injuries incurred by Irish dancers are due to overuse (79.6%). **PURPOSE:** The purpose of this study was to determine loads on the body in female Irish dancers, including peak force, rise rate of force, and impulse in selected Irish hard shoe and soft shoe dance movements. It was hypothesized that the 8 movements would produce different GRF characteristics. **METHODS:** Sixteen female Irish dancers were recruited from the three highest competitive levels. Each performed a warm-up, reviewed 8 common Irish dance movements, and then performed each movement three times upon a force plate. Of the 8 movements, 4 were performed in soft shoes and 4 were performed in hard shoes. Ground reaction forces (GRFs) were measured using a three-dimensional force plate recording at 1000 Hz. Peak force, rise rate, and vertical impulse were calculated. GRFs were normalized by each dancer's body weight. **RESULTS:** Peak forces, rise rates, and impulses were significantly different across movements ($F = 65.4$, $p < 0.01$; $F = 65.0$, $p < 0.01$; and $F = 67.4$, $p < 0.01$ respectively). The movement with the highest peak force was the stomp. The movement with the highest rise rate was the double-toe. The movement with the highest impulse was the leap. The skip had the lowest values for all GRFs measured. Individual peak forces ranged from 0.67-9.86 times body weight. Individual rise rates ranged from 10-147 body weights per second. Individual impulses ranged from -0.12 to 0.32 body weight seconds. Years of experience was not correlated with peak force, rise rate, or impulse ($p > 0.40$). **CONCLUSIONS:** There is a large range in GRF characteristics created by Irish dancers. Dance movements that have high average peak forces may be associated with higher risk of overuse injury. Irish dancers should use appropriate training methods to strengthen the tissues at greatest risk of overuse injury.

1054 Board #180 May 27 1:30 PM - 3:00 PM

The Effect Of Treadmill Speed And Grade On Ice Hockey Skating Biomechanics

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Skating treadmills are used by ice hockey players to develop stride efficiency, power, and endurance. **PURPOSE:** Evaluate the effect of treadmill speed and grade on biomechanics. It was hypothesized that greater speeds and grades would elicit larger ranges of motion (ROM) and decrease stride time. **METHODS:** Seven competitive male ice hockey players (22.0 ± 0.6 y, 86.5 ± 4.4 kg, 1.82 ± 0.06 m) skated at five speed and grade conditions including 4.47 m·s⁻¹ at 4% grade (10/4), 5.36 m·s⁻¹ at 0% grade (12/0), 5.36 m·s⁻¹ at 4% grade (12/4), 5.36 m·s⁻¹ at 8% grade (12/8), and 6.26 m·s⁻¹ at 4% grade (14/4). Left leg biomechanics were assessed using three-dimensional motion capture. Stride time was determined as the mean time between successive initial contacts of the left skate blade with the treadmill. Kinematics were normalized to percent of gait cycle. ROM was calculated as the difference between the maximum and minimum left hip and knee angles during the stance phase of the normalized kinematics. Separate repeated measures ANOVA and corrected, paired t-tests were used to assess the effect of condition. Significance was set to $p < .05$. **RESULTS:** A significant effect of condition on stride time ($p < .001$) was identified. Pairwise comparisons revealed that stride time was different for each condition (10/4 = $.87 \pm .07$ s, 12/0 = $1.18 \pm .13$ s, 12/4 = $.83 \pm .06$ s, 12/8 = $.68 \pm .05$ s, 14/4 = $.77 \pm .06$ s). A significant effect of condition on hip sagittal plane ROM ($p < .001$) was identified. 12/0

($57.4 \pm 4.4^\circ$) had smaller ROM than 12/4 ($65.4 \pm 6.6^\circ$), 12/8 ($70.8 \pm 7.0^\circ$), and 14/4 ($66.6 \pm 7.3^\circ$), 10/4 ($63.0 \pm 5.5^\circ$) had smaller ROM than 12/8, and 12/4 had smaller ROM than 12/8. A significant effect of condition on hip frontal plane ROM ($p = .007$) was also revealed, although no significant pairwise comparisons were identified (10/4 = $27.6 \pm 4.4^\circ$, 12/0 = $31.3 \pm 4.8^\circ$, 12/4 = $26.6 \pm 4.6^\circ$, 12/8 = $23.3 \pm 5.3^\circ$, 14/4 = $26.7 \pm 4.0^\circ$). No effect of condition on knee sagittal plane ROM was revealed ($p = .271$; 10/4 = $44.6 \pm 4.7^\circ$, 12/0 = $44.6 \pm 4.9^\circ$, 12/4 = $44.8 \pm 2.6^\circ$, 12/8 = $41.9 \pm 3.0^\circ$, 14/4 = $42.3 \pm 2.6^\circ$). **CONCLUSIONS:** In this small sample, increasing skating treadmill speed, grade, or both appears to decrease stride time, increase hip joint sagittal plane ROM, and have no effect on knee joint sagittal plane ROM. Results may aid in training program design and future ice hockey biomechanics research.

1055 Board #181 May 27 1:30 PM - 3:00 PM
The Characterization Of The Transition Phase During A 180° Change Of Direction Task

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The evaluation of change of direction ability should not merely rely on the measurement of total sprinting time, but it should focus also on the understanding of specific movement patterns. **PURPOSE:** To evaluate the transition phase (TP) during a 180° change of direction (COD) task. **METHODS:** 14 recreational basketball athletes (age: 21.4 ± 2.6 years) were evaluated during a 10-m COD test. TP has been identified considering 3 consecutive steps (i.e., final decelerating foot contact [DFC], turning foot contact [TFC], first accelerating foot contact [AFC]), using two force platforms. Differences in total (TCT), braking (BCT), and propulsive (PCT) contact time, vertical braking (VBGRF) and propulsive (VPGRF) ground reaction force (relative to body mass), and vertical braking (VBI), propulsive (VPI), and total (VTI) impulse (relative to body mass) were evaluated in relation to leg preference, the 3 steps, and groups (slower vs. faster defined as those below and above the 50th percentile of total sprinting time). **RESULTS:** No differences emerged for leg preference. TP (1.199±0.11 s) contributed for an average of 42.6±3.4% to the total sprinting time (2.817±0.14 s), with DFC involving only a braking action, whilst TFC and AFC comprising both a braking and propulsive action. Differences ($p < 0.05$) among the 3 steps emerged for TCT (DFC: 0.380 ± 0.07 s; TFC: 0.525 ± 0.06 s; and AFC: 0.303 ± 0.04 s), VBGRF (DFC: 22.7 ± 7.5 N·kg⁻¹; TFC: 20.3 ± 2.8 N·kg⁻¹; and AFC: 8.1 ± 2.7 N·kg⁻¹), VBI (DFC: 2.1 ± 0.4 m·s⁻¹; TFC: 2.5 ± 0.5 m·s⁻¹; and AFC: 0.4 ± 0.2 m·s⁻¹), and VTI (DFC: 2.1 ± 0.4 m·s⁻¹; TFC: 5.6 ± 0.6 m·s⁻¹; and AFC: 2.6 ± 0.3 m·s⁻¹). Furthermore, differences ($p < 0.05$) between TCF and AFC were evident for VPGRF (TFC: 14 ± 1.2 N·kg⁻¹; and AFC: 15.6 ± 1.7 N·kg⁻¹) and VPI (TFC: 3.1 ± 0.6 m·s⁻¹; and AFC: 2.2 ± 0.4 m·s⁻¹). Differences between groups emerged in the TFC only, with faster individuals demonstrating shorter TCT (0.489 ± 0.1 s) and PCT (0.281 ± 0.1 s), and lower VPI (2.8 ± 0.5 m·s⁻¹) compared to slower individuals (TCT: 0.542 ± 0.1 s; PT: 0.339 ± 0.1 s; and VPI 3.4 ± 0.6 m·s⁻¹). **CONCLUSIONS:** Findings revealed specific movement patterns during the TP of a COD task and the central role played by the turning step in differentiating faster and slower recreational basketball athletes, with potential further implications for future testing and training procedures.

1056 Board #182 May 27 1:30 PM - 3:00 PM
Effects Of Different Pressure Compression Garments On Oxygen Uptake And Blood Lactate

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Compression garment (CG) has now been viewed as a potential tool for enhancing performance and recovery. CG may boost lactate removal and enhance oxygen supply. However, there are only a small amount of research supporting usefulness of CG. **PURPOSE:** To determine the effect of different pressure CG on oxygen uptake during running and lactate removal after exercise. **METHODS:** 12 recreational male long-distance runners (age 22.5 ± 1.9 y, height 1.78 ± 0.04 m, mass 70.7 ± 4.9 kg) participated in this study. Subjects performed 3 maximal incremental exercise test (the Bruce protocol) on a treadmill with 3 different garments. The subjects performed experimental trials with a high pressure CG (HCG, 17.5 mmHg at the middle of thigh), low pressure CG (LCG, 8.0 mmHg at the thigh), or without a CG (CON condition). The 3 tests were assigned in a random order under a cross-over design, and were conducted at the same time of the day, 3-5 day apart. Oxygen uptake were continuously determined using the METAMAX 3 system. Fingertip blood samples of 20 µl were taken at 1, 4, 7 and 10 min after exercise. The lactate concentration was determined by EKF Biosen C-Line Clinic system. An ANOVA with repeated measures followed by Bonferroni pairwise comparisons were used to analyze the differences in 3 conditions. All tests were two-tailed and a .05 probability level was considered

significant. **RESULTS:** The Oxygen uptakes were significantly lower with CG at 6 min time point ($P < .05$, HCG 22.0 ± 1.5 , LCG 21.3 ± 2.0 vs CON 23.2 ± 2.7 ml/min*kg), and there were no significant differences on VO₂ between 3 conditions at any other time point. There were no significant differences on the maximum lactate and lactate elimination rates between 3 conditions at any time point. **CONCLUSIONS:** Different pressure CGs have no significant effect on the maximum oxygen uptake during running, but it is possible to reduce oxygen consumption during exercise at low intensity. CGs have no significant effect on the removal of blood lactate after running.

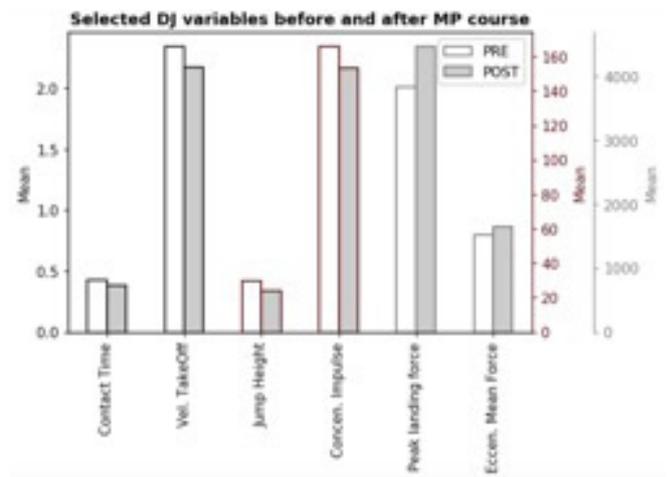
TABLE 1 Oxygen uptake (ml/min*kg) during maximal incremental exercise

TIME	HCG	LCG	CON
3min	15.45±1.03	14.87±1.09	15.04±0.74
6min	22.04±1.49*	21.34±1.96*	23.23±2.74
9min	34.16±2.80	33.41±1.06	35.22±3.59
12min	49.01±4.03	46.52±2.68	48.50±2.67
15min	56.85±4.34	55.67±2.35	56.50±3.48
VO ₂ MAX	59.24±5.10	58.50±3.62	59.59±3.91

Note. *Significantly ($P < 0.05$) different from Control

TABLE 2 Blood lactate concentration (mmol/L) measured during recovery

Post exercise	HCG	LCG	CON
1min	14.7±3.2	13.2±2.5	14.1±2
4min	14.5±3.3	14.3±3.4	13.7±2.2
7min	13.8±3.2	13.4±3.5	13.4±2.7
10min	12.9±3.2	12.6±3.2	12.1±2.5



1057 Board #183 May 27 1:30 PM - 3:00 PM

Parachuting Course Impact In The Lower Limbs Neuromuscular Performance In Militaries From Colombia

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(No relevant relationships reported)

Most of the injuries in the military parachuting course (MPC) occur during the landing phase because of intrinsic or extrinsic variables. It is important to assess the lower limbs neuromuscular (NM) impact of the MPC to understand the muscular adaptations and the eccentric work, because via the reflex activated by the eccentric phase, it can strengthen the elastic characteristics of the muscle-tendon complex (MTC). Besides, the evaluation of the ground reaction forces (GRF) allow to evaluate muscles function in eccentric-concentric conditions, elastic and reflex components of the MTC through jumping tests that report NM changes due to a training. **PURPOSE:** Assess the lower limbs neuromuscular impact of the MPC in Colombian militaries. **METHODS:** A prospective study was performed in 43 male cadets from the military school who went to the MPC (4 weeks). Each cadet performed 5 drop jump (DJ) test before and after the course, and landed in uniaxial force platforms. For the statistical analysis a paired t-student was performed to determine the changes in the variables that described the DJ, due to the MPC. **RESULTS:** Positive changes were found in the reduction of contact time (0.43 ± 0.1 vs 0.38 ± 0.1 s, $p < 0.01$) and the increase of the eccentric mean force (1513.5 ± 281.4 vs. 1642.9 ± 289.1 N, $p < 0.01$). However, negative changes were observed in the reduction of the jump height (27.7 ± 3.9 vs. 24 ± 3.6 cm, $p < 0.01$), concentric impulse (165.7 ± 26 vs. 153.1 ± 23.7 Ns, $p < 0.01$) and vertical velocity at takeoff (2.34 ± 0.18 vs. 2.17 ± 0.16 m/s, $p < 0.01$) and an increase in the peak landing force (3836.4 ± 825.1 vs. 4461.5 ± 1032.2 N, $p < 0.01$). **CONCLUSION:** There is an improvement in the myotatic reflex related to the adaptations of the lower limb extensor in response to the eccentric force. However, the variables that defined the power and the GRF shown a negative effect over NM characteristics of LL performance, increasing their risk of injury because of high impacts that are not transfer properly to other soft tissues.

1058 Board #184 May 27 1:30 PM - 3:00 PM
Estimation Of Joint Torque During Countermovement Jump From Position Coordinates Using Deep Residual Recurrent Network

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Mechanical outputs (MO) exhibited explosively in the lower limbs are important in many sports. Vertical countermovement jump (VCMJ) is often utilized to evaluate the ability to exhibit MO. To calculate MO, inverse dynamics is performed with body position data and ground reaction forces (GRFs) recorded by the motion-capture system and force-plates. However, it is difficult to obtain GRFs without laboratory setting because force-plates are usually quite expensive. Because of this device-dependent issue, it is hard to obtain MO in the common sporting scenes. **PURPOSE:** To create and develop an artificial neural network that is possible to estimate MO without force-plates, with body position data as inputs. **METHODS:** We designed a deep residual recurrent network (DRRN) to estimate the sagittal right knee torque as MO. Datasets were established for training and evaluating DRRN. Eighteen young males performed VCMJ under 3 conditions (make counter movement freely, deeply and shallowly) with arm swing. Body position data and GRFs were recorded by motion-capture system (250Hz) and force-plates (1250Hz). Three out of 18 subjects' data were randomly chosen as validation data (validation subject A, B, and C). The other 15 subjects' data were divided into two groups, i.e., 80% for training data and 20% for test data. As the objective variable, sagittal right knee torque was calculated using inverse dynamics. Explanatory variables were sagittal body position data. Parameters of DRRN were determined by an optimization calculation that aimed to reduce the difference between actual and estimated torque. To evaluate the predictive performance of DRRN, R² score (R²) and root mean square error (RMSE) were calculated. **RESULTS:** R² and RMSE of whole validation data were $87.7\% \pm 6.2$ and 0.23 ± 0.07 , respectively. These indicators suggest DRRN model has a consistency in the level of predictive ability. R² and RMSE of validation subject A, B and C were $82.8\% \pm 7.1$ and 0.26 ± 0.07 , $89.2\% \pm 3.6$ and 0.25 ± 0.06 , $91.2\% \pm 3.5$ and 0.18 ± 0.06 , respectively. These differences among subjects suggest that personal characteristics might not have been processed sufficiently. **CONCLUSIONS:** Deep RRN is effective in the estimation of joint torque with only body position data as inputs.

B-74 Free Communication/Poster - Upper Extremity

Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
 Room: CC-Exhibit Hall

1059 Board #185 May 27 1:30 PM - 3:00 PM
Three-dimensional, Isotonic Comparison Of Dominant And Non-dominant Upper Limb Force Production

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 (No relevant relationships reported)

Athletes and coaches have traditionally relied on isokinetic devices to compare dominant and non-dominant strength ratios; the information provided is limited in its application. Recent technology permits strength and power comparisons in an isotonic, three-dimensional environment that is more compatible with the load profiles experienced during sport performance. **PURPOSE:** To determine the difference in power between dominant and non-dominant arms across various loads, motions, and planes. **METHODS:** 206 subjects performed 3,727 unilateral sets of 10 repetitions in upper-extremity movements on Proteus (Proteus Motion, USA). Loads were applied through magnetic resistance and ranged from 5-25 lbs; they were divided between dominant (n=1,975) and non-dominant (n=1,747) arms. The performance variables were explosiveness (peak force development rate), peak power, and braking (rate of deceleration). Descriptive statistics characterized mean performances. Linear regression models predicted the effect of arm dominance on performance parameters, holding the load and exercise constant. **RESULTS:** Across all sets, explosiveness was 852.61 ± 629.46 watts/sec, peak power was 206.40 ± 112.42 watts, and braking was 1059.90 ± 766.63 watts/sec. Dominant and non-dominant arms were different in explosiveness ($p=0.005$), peak power ($p=0.041$), and braking ($p=0.035$). With confounding variables held constant, linear regression found use of the non-dominant arm to predict a 10-watt decrease in peak power ($R^2=0.691$; $p<0.001$), a 46-watt/sec decrease in mean explosiveness ($R^2=0.553$; $p=0.001$), and a 65-watt/sec decrease in braking ($R^2=0.668$; $p<0.001$). **CONCLUSIONS:** In an athletic population, the independent use of dominant and non-dominant limbs is often critical to success. It is important to know the non-dominant performance deficit in a setting applicable to sport performance. This information can contribute to optimal training protocols and return-to-play testing batteries.

1060 Board #186 May 27 1:30 PM - 3:00 PM
Muscle Activity In Upper Extremity Is Modulated During Arm Cycling Exercises After Cervical Spinal Cord Injuries

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Regaining upper extremity function following spinal cord injury (SCI) is one of the most important outcomes for quadriplegics with regards to enhancing quality of life. To facilitate locomotor recovery through increased activation of the lower limb muscles, ground reaction forces are commonly manipulated to optimal levels. Using similar mechanisms, manipulating power production during arm cycling exercises could facilitate activation of the upper limb muscles after SCI. **PURPOSE:** To determine if upper limb muscles activation is modulated during arm cycling exercises after SCI.

METHODS: Five participants with chronic SCI at C4; classified as AIS A (1), B (2), C (1) and D (1) according to the American Spinal Injury Association Impairment Scale performed arm cycling exercises at four power levels (0, 5, 10, 15W) with their hands securely attached to the handles. Surface EMG signals were recorded during a series of 10 consecutive cycles from one muscle above the lesion: medial trapezius (C2-C4); and six muscles below the lesion: deltoid posterior (C5-C6), biceps brachialis (C5-C6), triceps brachialis (C6-C8), extensor digitorum (C6-C8), flexor carpi radialis (C6-C8) and extensor carpi radialis (C6-C8).

RESULTS: Arm cycling exercises were successfully performed at cadences ranging from 30 to 50 rpm. EMG signals were detected in all muscles from all participants. Modulation of EMG signals within the cycle was seen in most exercise conditions and participants, while modulation was most identifiable when participants produced larger levels of power. Increasing power production from 0 to 15 W led to an increase in the peak EMG activity of the trapezius muscle, as well as in four muscles below the lesion: deltoid, biceps and triceps brachialis, and extensor carpi radialis ($P < 0.05$).

CONCLUSIONS: Participants of all levels of impairment successfully performed the arm cycling exercises. Increasing power production up to 15W improved modulation of EMG signals during the cycle and increased activation of some muscles below the lesion, crossing the shoulder, elbow and wrist joints. Including arm cycling exercises

in rehabilitation programs should be considered to take advantage of spinal circuitry available below the level of injury and facilitate the recovery of upper extremity function after SCI.

1061 Board #187 May 27 1:30 PM - 3:00 PM
An Investigation Of Bilateral Differences In Emg Responses During Submaximal Arm Ergometry

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PURPOSE: To determine bilateral differences in neuromuscular fatigue patterns in the Biceps Brachii (BB), Triceps (Tri), and Latissimus Dorsi (LD) muscle groups during arm cranking exercise. **METHODS:** A sample of 4 male and 4 female subjects (aged 22.2 ± 2.2 yrs) performed a submaximal arm cranking test for 10-minutes each @ 40% and 60% of the maximal workload attained previously, in randomized order. Oxygen consumption was determined continuously via indirect calorimetry. Mean EMG Root Mean Square (EMG_{RMS}) was calculated for 10 epochs from 15-second recordings at each minute. Slope coefficients were determined and a 2-way repeated measures ANOVA was used to analyze the differences between exercise intensity and side (left vs. right) for each of the three muscle groups. **RESULTS:** Submaximal VO_2 @ 60% ($1.54 L \cdot min^{-1} \pm 0.2$) was significantly greater ($p \leq 0.01$) than the VO_2 @ 40% ($1.2 L \cdot min^{-1} \pm 0.2$) indicating an expected energy cost difference. However, there were non-significant differences in EMG_{RMS} for muscle ($F=1.8$, $p \geq 1.0$) and intensity ($F=0.49$, $p \geq 0.4$). **CONCLUSIONS:** During submaximal arm ergometry at two different workloads, possible limb dominant asymmetries were not evident, indicating similar time-dependent acute neuromuscular adaptations for the three muscle groups studied.

1062 Board #188 May 27 1:30 PM - 3:00 PM
Quantifying Kinematic Fidelity Of Demonstrated Therapeutic Shoulder Exercises Between Therapist And Patient

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Reduced cost and greater portability of 3D motion tracking technology increases the likelihood of its use in clinical settings to evaluate therapeutic exercise quality in reference to an ideal movement pattern. It must first be determined how accurately healthy individuals can mirror a demonstrated exercise to understand the inherent variability of this approach. **PURPOSE:** To test the kinematic fidelity between therapeutic shoulder exercises demonstrated by a therapist and mirrored by patients. **METHODS:** Ten, healthy, young (21.4 ± 0.5 yr, 70.2 ± 12.3 kg, 1.68 ± 0.08 m) men and women with a history of resistance exercise training simulated the roles of therapist and patients. A physical therapy aid performed unloaded forward and lateral raise shoulder exercises while a 2D video camera and 12-camera, 3D motion capture system recorded shoulder kinematics. The 2D video recording of the therapist was played back on a life-size screen to each patient who emulated the therapist's demonstrated exercise. Upper-body marker data of both therapist and patients were recorded at 250 Hz, smoothed with a 6 Hz low-pass filter, and shoulder joint kinematics were obtained. Custom software was used to time normalize kinematic data, obtain cross-correlations between each patients' joint positions and the therapist's as a global measure of agreement, calculate the mean absolute error across the range of motion, and error at peak joint excursion. Shoulder angles were compared in the sagittal plane for forward flexion and frontal plane for lateral flexion exercises. **RESULTS:** The mean cross-correlation coefficient for the forward raise was $r = 0.98$, 95% CI [0.96, 1.00], the mean error across the range of motion was 11.9 deg, 95% CI [7.8, 16.0], and error at peak excursion was 7.1 deg, 95% CI [1.6, 12.5]. The mean cross-correlation coefficient for the lateral raise was $r = 0.96$, 95% CI [0.95, 0.98], the mean error across the range of motion was 14.6 deg, 95% CI [11.6, 17.7], and error at peak excursion was 4.4 deg, 95% CI [0.6, 8.2]. **CONCLUSIONS:** After time normalization, cross-correlations revealed healthy, young people have an excellent ability to replicate the shape of demonstrated uniaxial shoulder exercises. Yet, a modest amount of absolute position error exists across the range of motion and at peak joint excursion.

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1063 Board #189 May 27 1:30 PM - 3:00 PM
Alterations In Scapular Kinematics And Scapular Muscle Activity After Fatiguing Shoulder Flexion And Extension Movements

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(No relevant relationships reported)

Repetitive overhead motions in combination with heavy loading were identified as risk factors for the development of shoulder pain. However, the underlying mechanism is not fully understood. Altered scapular kinematics as a result of muscle fatigue is suspected to be a contributor. **PURPOSE:** To determine scapular kinematics and scapular muscle activity at the beginning and end of constant shoulder flexion and extension loading in asymptomatic individuals. **METHODS:** Eleven asymptomatic adults (28±4yrs; 1.74±0.13m; 74±16kg) underwent maximum isokinetic loading of shoulder flexion (FLX) and extension (EXT) in the sagittal plane (ROM: 20-180°; concentric mode; 180°/s) until individual peak torque was reduced by 50%. Simultaneously 3D scapular kinematics were assessed with a motion capture system and scapular muscle activity with a 3-lead sEMG of upper and lower trapezius (UT, LT) and serratus anterior (SA). Scapular position angles were calculated for every 20° increment between 20-120° humerothoracic positions. Muscle activity was quantified by amplitudes (RMS) of the total ROM. Descriptive analyses (mean±SD) of kinematics and muscle activity at begin (task_b) and end (task_e) of the loading task was followed by ANOVA and paired t-tests.

RESULTS: At task_b activity ranged from 589±343mV to 605±250mV during FLX and from 105±41mV to 164±73mV during EXT across muscles. At task_e activity ranged from 594±304mV to 875±276mV during FLX and from 97±33mV to 147±57mV during EXT. Differences with increased muscle activity were seen for LT and UT during FLX (mean_{diff} = 141±113mV for LT, p<0.01; 191±153mV for UT, p<0.01). Scapular position angles continuously increased in upward rotation, posterior tilt and external rotation during FLX and reversed during EXT both at task_b and task_e. At task_escapula showed greater external rotation (mean_{diff} = 3.6±3.7°, p<0.05) during FLX and decreased upward rotation (mean_{diff} = 1.9±2.3°, p<0.05) and posterior tilt (mean_{diff} = 1.0±2.1°, p<0.05) during EXT across humeral positions.

CONCLUSIONS: Force reduction in consequence of fatiguing shoulder loading results in increased scapular muscle activity and minor alterations in scapula motion. Whether even small changes have a clinical impact by creating unfavorable subacromial conditions potentially initiating pain remains unclear.

1064 Board #190 May 27 1:30 PM - 3:00 PM
Wrist Guards/supports In Gymnastics: Are They Helping Or Hurting You?

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(No relevant relationships reported)

BACKGROUND: The prevalence of wrist pain among gymnasts ranges from 46-79%. To reduce and prevent wrist pain, gymnasts wear "wrist guards/supports" (WG) and most worn are Tiger Paws (TP) or Skids/Ultimate Wrist Supports (SUWS). There are no studies that have investigated what WG actually do to the wrist in terms of motion and force. **PURPOSE:** To examine whether WG decrease or increase the angle and force at which the wrist impacts the ground while performing a back handspring. **METHODS** A cross-sectional study design was used. Twenty-three young female gymnasts (age: 12.3±1.5 years) performed back handsprings with the following three conditions: wearing no WG, wearing SUWS, and wearing TP. Kinematics and kinetics were captured by 3D motion analysis and force plates. Analysis of variance (ANOVA) was employed to analyze the data. **RESULTS:** Not wearing WG was found to be statistically significant (P= 0.036) in having an increased arc of motion when compared to wearing WG (no WG (67.8 ± 11.0 (62.6, 72.9)), SUWS (59.6 ± 9.4 (55.2, 64.0)), and TP (60.6 ± 11.2 (55.0, 66.1))). There was a statistically significant finding (p= 0.001) with an increased sagittal plane moment when performing a back handspring with SUWS when compared to no WG (no WG (3.75 ± 0.79 (3.39, 4.12)), SUWS (4.76 ± 0.76 (4.40, 5.12)), and TP (4.00 ± 0.97 (3.52, 4.48))). **CONCLUSIONS:** WG do decrease the arc of motion at the wrist when performing a back handspring which could be beneficial if a Sports Medicine provider is trying to limit motion at the wrist joint; however, our data indicated an increase in moment while wearing WG, which may be indicative to an increased risk of injury.

1065 Board #191 May 27 1:30 PM - 3:00 PM
The Effect Of Kinesio Taping On Wrist Flexor Sensorimotor Control In Healthy People

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(No relevant relationships reported)

Sensorimotor control of hand is important for our daily function. Kinesio taping can improve our joint position sense(JPS), force sense(FS), and corticomuscular coherence(CMC) which means the functional connection of our brain and muscle. We can have additional tension on kinesio tape, but we don't know how tension influence its sensorimotor control effect. In addition, the effect of kinesio taping on wrist flexor sensorimotor control has not been thoroughly investigated.

PURPOSE: To determine the effect of kinesio taping on wrist flexor sensorimotor control in healthy people and explore how additional tension influence its effect. **METHODS:** This is an observational study with one group repeated measures design. 14 healthy participants were recruited. Participants randomly received three types of taping: (1) without taping; (2) taping with neutral tension;(3) taping with additional 20% tension. The four outcomes were JPS, FS, reaction time(RT), and CMC were measured and compared among the three taping conditions. Friedman's test and Wilcoxon sign-rank test (post hoc comparison test) were used to compare the difference between the three taping conditions. Significant level was set at 0.05. **RESULTS:** We recruited 14 participants (7 males and 7 females). Results revealed no significant difference in joint position sense (2.8±1.64 vs. 2.3±1.53 vs. 2.1±1.49 deg., P=0.319), FS(1.47±1.02 vs. 1.28±0.89 vs. 1.5±0.88 Kgw , P=0.751), RT(263±71 vs. 255±53 vs. 306±92 ms, P=0.794), and CMC(0.3±0.29 vs. 0.37±0.34 vs. 0.45±0.47, P=0.755) between the three conditions. However, subgroup analysis revealed that taping with neutral tension and taping with additional 20% tension have a tendency to reduce errors for people having error over 2.5 degrees on JPS test without taping condition (2.1±1.58 vs. 4±1.4 vs. 2.5±1.65 deg., P=0.05). Subgroup analysis also showed that taping with neutral tension and taping with additional 20% tension have a tendency to increase CMC for people having error over 2.5 degrees on JPS test without taping condition (0.2±0.16 vs. 0.45±0.36 vs. 0.68±0.55, P=0.066).

CONCLUSIONS: Kinesio taping seems to have positive effects for people with poorer JPS and increase their CMC. There is no difference in the sensorimotor control effect of taping with neutral tension and taping with additional 20% tension.

1066 Board #192 May 27 1:30 PM - 3:00 PM
Effects On Hand Grip Strength: An Evaluation For Fifa E-sport Players

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(No relevant relationships reported)

PURPOSE: This research project found the effects at the neuromuscular level in the forearm of training session usage of video games through measuring of hand grip strength in players of the FIFA19 video game. **METHODS:** The present study had a universe of 25 men aged 25±5 years, body mass 67.6±9.9 kg and body height of 172.4 ± 6.72 cm, who practiced the FIFA video game for more than 3 days per week and three hours training sessions. Participants were asked for a 24-hour rest period in which they should not have done any physical activity, nor used their video game consoles. An initial measurement of hand grip strength was made using a portable dynamometer Baseline (±1) with a capacity of 90 kg of hand grip, and a competition system that was randomly designed in the FIFA19 all-in-all game, for a consecutive 30-minute practice per player. Finally, new measurements of hand grip strength were found to verify that the strength in the forearm changed. **RESULTS:** An average decrease of 10 kg of force in the right hand and 6 kg in the left hand were found. The statistical test of Shapiro-Wilk was applied in order to conclude whether the sample had a normal distribution; finding that the data followed a non-parametric behavior, based on this result a Mann Whitney U test was used with a confidence interval of 92% confirming that the change of strength in the right arm had a substantial change effect with a p=0.061 and the left arm presented a non-significant variation p=0.122. **CONCLUSIONS:** Prolonged exposure to video games with the use of joysticks represented a risk at the neuromuscular level in the forearm due to the continued position that each player usually maintained. Additionally, the loss of strength could lead to generate injuries such as tendonitis, carpal tunnel, epicondylitis and other musculoskeletal disorders or Trigger-finger due to the fatigue presented. Therefore, it is essential to develop strategies that improve the response level in the resistance and strength of the forearm in people who practice E-Sports both in professional or amateur mode.

B-75 Free Communication/Poster - Health Promotion

Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
Room: CC-Exhibit Hall

**1067 Board #193 May 27 2:30 PM - 4:00 PM
Analysis Of The Current Situation Of Chinese Youth Science And Fitness**

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(No relevant relationships reported)

PURPOSE: The purpose of this study is to analyze the status of Chinese youth participation in scientific fitness activities and to provide reference for enhancing the scientific fitness activities of Chinese youth.

METHODS: A total of 4663 healthy adolescents (age: 22.56 ± 5.81yrs, female: 54.5%) were investigated for the intervention from 33 provinces (central municipality, national autonomous region). Divided into three groups according to age: juvenile (12-17yrs), pre-youth (18-28yrs), and late youth (29-40yrs); divided into three regions based on the administrative districts: Eastern Region (ER), Central Region (CR) and Western Region (WR).

RESULTS: The Questionnaire consists of two parts: (1) Knowledge and Skills (RRC 0.91), and (2) Cognitive, Attitude and Behavior (ICC 0.97, RRC 0.93). The content validity of the questionnaire was assessed by 11 experts. The structural validity was evaluated by the factor analyses. The results show that: (1) fitness location analysis: 70.6% of youth fitness venues in playground and park squares, gyms accounted for 12.1%, and other proportions of 9.1%. (2) Analysis of fitness methods: 81.5% of fitness methods tend to run and ball sports, the proportion of fitness and bodybuilding projects is 9.4%, the proportion of water projects is 2.5%, and the other proportion is 6.6%. (3) Analysis of fitness duration: 58.1% of young people's fitness time is 30-120 minutes, 30 minutes or less accounted for 33.0%, and more than two hours accounted for 8.9%. (4) Fitness frequency analysis: 62.1% of teenagers are not regular fitness, 17% have planned fitness, and 20.9% do not exercise very much. (5) Analysis of the number of fitness times in the week: 57.5% of the youth fitness no more than 2 times, 29.2% of the teenagers were 3-4 times and 13.3% of the teenagers were 5 times or more.

CONCLUSIONS: Chinese youth participation in fitness activities is relatively concentrated; most of the youth fitness can be controlled within a relatively scientific range but the fitness activities are not regular. Relevant departments use a variety of strategies to promote the systematic and diverse participation of young people in fitness activities. (This study was supported by NPOPSS Grant 15CTY011)

**1068 Board #194 May 27 2:30 PM - 4:00 PM
Physical Activity And Its Association With Other Wellness And Risk Behaviors From A College Sample**

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PURPOSE: The University of Vermont Wellness Environment App Study is an app-based longitudinal research study focused on promoting health and reducing risky behaviors in a college student population. The mobile ecological momentary assessment over an academic year provides a unique opportunity to accomplish two aims in this study: 1) to assess physical activity (PA) variation across days of the week and throughout the academic year and 2) to explore the correlates that were associated with PA. **METHODS:** Students who enrolled in the study were asked to report their wellness and risk behaviors on a 14-item survey through a smartphone app every day. Each student was also provided an Apple Watch to track their real-time PA. Data were collected from 805 college students, with an average of 97 days of daily surveys and steps data from Sept 2017 to early May 2018. Daily survey and step data were merged by day for each participant. General estimating equations were implemented in SAS PROC MIXED, with an autoregressive covariance structure to estimate the daily steps by demographic variables and other wellness behaviors. **RESULTS:** Based on average daily step counts, females were significantly more active than male college students (Female=8904 and Male=8488, p=.0082). Age-related PA decline was found from freshmen to seniors, but only freshmen was significantly more active than seniors (freshmen=8714 and senior=8023, p=.0051). Students were significantly more active (p<.0001) during the weekday (Monday to Friday ranged from 8800 to 9384 steps) than weekend (Sat=8356 and Sun=7145). Temporal patterns were also revealed that students were less active during Thanksgiving, Winter, and Spring breaks.

Strong correlations were found between daily steps and self-reported mood (p<.0001), sleep (p<.0001), fruit and vegetable consumption (p<.0001), water intake (p<.0001), and screen time (p<.0001). No significant associations were found for marijuana use (p=.997), cigarette use (p=.2518), drug use (p=.1546) but significant associated were observed for illicit pill use (p=.0083), alcoholic drink consumption (p<.0001), and liquor shot consumption (p<.0001). **CONCLUSION:** The study provides a comprehensive surveillance on longitudinal PA pattern and its association with a variety of wellness and risky behaviors in college students.

**1069 Board #195 May 27 2:30 PM - 4:00 PM
The Effects Of Adhering To ACSM Physical Activity Guidelines On Female University Employees**

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Despite the benefits of physical activity (PA), 50.9% of Americans do not meet the American College of Sports Medicine (ACSM) guidelines for exercise. Physical inactivity, low cardiovascular fitness (CVF), obesity and body fat percentage (BF%) are risk factors for increased cardiometabolic morbidity and mortality. Universities create sedentary environments that do not promote PA, thus jeopardizing their employees' health. **PURPOSE:** To educate university employees about the health-related benefits of PA and the time frame needed to see changes by meeting the minimum ACSM PA guidelines. **METHODS:** Female physically inactive university employees were targeted (age 40 ± 11 yrs, body weight 76.9 ± 4.4 kg). Participants underwent basic anthropometric, mean arterial pressure, body composition measurements, and a submaximum oxygen consumption test (using a Bruce protocol) as baseline measurements. Participants were given the ACSM guidelines and instructed to follow them for 12 weeks. No other control was made on participants' lifestyle factors between the pre- and post-measurements. They were given a Fitbit® tracker to record and monitor their PA activity levels. This is an ongoing funded project from the Advancement of Interprofessional Collaboration and Education (ADVICE) project and the reported results reflect pre- and post-values from the end of weeks 1 to 4 (N=4). Thus, all measurements were repeated after 4 weeks of the intervention. One-way factorial ANOVA was used to detect changes between Week 1 and Week 4. Significance was set at p < 0.05. All analyses were performed using SPSS®. **RESULTS:** BF% was significantly reduced by 38.8% ($F_{1,5} = 9.943, p = .025, \eta^2 = .665$). Lean mass was increased by 15.6%, mean arterial pressure was reduced by 9.6% (p > .005), waist circumference was reduced by 5.7% (p > .005), waist hip ratio was reduced by 20.7% (p > .005), minutes of being physically active were increased by 13.7% (p > .005), and predicted maximum oxygen consumption was increased by 4% (p > .005). **CONCLUSION:** Even though these results represent preliminary data from small sample size the practical significance of this study is that university employees can improve their risks factors for cardiometabolic morbidity and mortality by adhering to the ACSM PA guidelines for even 4 weeks.

**1070 Board #196 May 27 2:30 PM - 4:00 PM
Motivational Factors Associated With Physical Activity In Middle School Students**

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PURPOSE: The purpose of this study was to identify physical activity motivators in middle school students.

METHODS: Students (n = 219) self-reported demographics and physical activity motivators via questionnaire. Predetermined options for motivators were: friends, advertisements, music, family, look good, feel good, fun, and other. Weight status was determined by the age- and gender-specific BMI percentile CDC recommendations for children: underweight (< than 5th), healthy weight (5th - 85th), overweight (85th - 95th), obese (95th or greater).

RESULTS: Male students (n=113) were 12.65 (± 1.63) years old, had a BMI of 21.23 (± 6.03). For males, 53.8% were categorized as healthy weight, 18.7% as obese, 17.6% as overweight, and 9.9% as underweight. Grade distribution for males was 37.2% 6th graders, 39.8% 7th graders, and 23% 8th graders. The top activity motivators for males were to look good (24.5%), friends (22.7%), and music (20.0%). Additionally, underweight and overweight male students were motivated by feeling good (22.2%; 57%, respectively) and overweight males by advertisements (14.3%). Evaluating motivators by grade for males showed 8th graders were motivated by music (33.3%), 7th graders by looking good (26.7%), and 6th graders by friends (29.3%). Females (n=106) were 12.57 (± 1.05) years old, had a BMI of 21.43 (± 6.47). For females, 60.3% were categorized as healthy weight, 17.8% as obese, 12.3% as overweight, and 9.6% as underweight. Grade distribution for females was 44.8% 6th graders, 28.6% 7th

graders, and 26.7% 8th graders. The top activity motivators for females were friends (25.0%), looking good (24.0%), and music (23.1%). Additionally, overweight students were motivated by feeling good (50.0%) and obese females were motivated by family (15.4%). Evaluating motivators by grade for females showed the top motivators for 8th graders to be looking good (36.4%) and feeling good (27.3%); while the top motivators for 7th and 6th graders were friends (32.1%, 27.7%) and looking good (21.4%, 25.5%). **CONCLUSIONS:** In this study of middle school students, motivators for activity were influenced by gender, grade and BMI. Recognizing and addressing population-specific motivators may enhance activity program outcome success.

1071 Board #197 May 27 2:30 PM - 4:00 PM
Efficacy Of Smartphone App In Worksite Physical Activity Intervention And Anthropometric Changes In Obese Women

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Most U.S. office workers engage in little physical activity and increased time sitting which increases risk for adverse health conditions such as obesity. Research on the effectiveness of smartphone apps to increase physical activity and reduce sitting time in workers is limited. **PURPOSE:** To examine the efficacy of a smartphone app and worksite physical activity intervention program to increase daily physical activity with the goal of reducing sitting time via walking or increased steps on anthropometric changes over an 8-week period. **METHODS:** Subjects (N=22) were obese, female volunteers, all of whom had access to a smartphone and the Stridekick™ app, that recorded steps, with a progressive goal of 7,500-15,000 daily steps. Relative (%) body fat was measured via DEXA scan, along with five anthropometric measurements, biceps, waist, abdomen, hips and thigh, prior to and after 8 weeks. Dependent samples t tests probed for significant differences at the $p < 0.05$ level. Values are expressed as mean±standard deviation. **RESULTS:** Significant changes were determined for the pre-post anthropometric measurements: biceps, hips and thigh (12.0 ± 1.1 vs. 11.5 ± 1.3 ; 42.8 ± 5.1 vs. 42.2 ± 5.1 ; 24.9 ± 2.7 vs. 23.8 ± 2.8 in, respectively). Pre-post BMI, waist, abdomen measurements and % relative fat were not significantly different (31.0 ± 5.7 vs. 30.5 ± 5.7 kg/m²; 34.1 ± 4.8 vs. 34.1 ± 4.9 in; 39.2 ± 4.7 vs. 39.0 ± 4.8 in; 41.4 ± 6.6 vs. 41.8 ± 6.3 %fat, respectively). **CONCLUSION:** This work is suggestive that the incorporation of a smartphone app into a worksite physical activity intervention may change anthropometric measures via increasing steps and ultimately reduce adverse health concerns.

1072 Board #198 May 27 2:30 PM - 4:00 PM
Effects Of Aerobic Exercise On Vascular Function Of Recessive Obese Women

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PURPOSE: To reveal features of changes in vascular function among recessive obese women after aerobic exercise, instruct them to do exercise scientifically and prevent cardiovascular disease.

METHODS: Thirty nine young women (21.8 ± 1.9 yrs) participated in the study that was approved by IRB at Beijing Sport University. There were twenty recessive obese women (RO group) and nineteen normal weight women (NC group). Everyone completed 30min walking exercise at the intensity of 65% HRR on the treadmill. The exercise began after two hours of the meal. The pulse wave velocity (PWV) and ankle brachial index (ABI) were determined before exercise, immediately after exercise, then every 5 minutes for half an hour.

RESULTS: (1) There were no significant differences between the participants of two groups in age, height, weight, body mass index, PWV or ABI at rest. However, the percent body fat in the RO group were significantly higher than in the NC group ($P < 0.01$). (2) Immediately after the exercise, the RO group demonstrated significantly decreased level of PWV (912.8 ± 88.1 vs 1001.0 ± 112.6 cm/s, $P < 0.01$). And 30 minutes after the exercise, the level of PWV in the RO group returned to the baseline level. Whereas PWV level in the NC group remained unchanged ($P > 0.05$). (3) Immediately after the exercise, participants in the RO group had a significant reduction in the ABI level (13.6%, $P < 0.01$). 30 minutes after the exercise, participants in the RO group demonstrated significantly increased level of ABI (11.6%, $P < 0.01$). Participants in the NC group had the same trend. Moreover, there were significant differences in changes in ABI level between the two groups (13.6% vs 9.5%, $P < 0.05$).

CONCLUSIONS: Although there was no difference in arterial stiffness between recessive obese women and normal weight women in resting state, the vascular elasticity of recessive obese women was weaker than normal weight women during exercise. Vascular function of healthy women in the same intensity exercise was more adaptable than that of recessive obese women. Aerobic exercise at the intensity of 65% HRR could ameliorate arterial stiffness and improve vascular elasticity of recessive

obese women, which were beneficial to prevent cardiovascular disease in early life. Supported by Scientific Fitness Guidance Program of General Administration of Sport(2017B064).

1073 Board #199 May 27 2:30 PM - 4:00 PM
Investigation Of Physical Activity Instruction In United States Nurse Practitioner Curricula

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Investigation of Physical Activity Instruction in United States Nurse Practitioner Curricula

Purpose: The purpose of this study is to investigate formalized physical activity (PA) training in United States (US) Nurse Practitioner (NP) curricula. There are over 270,000 currently certified NPs with over 72% delivering primary care. PA is an important lifestyle behavior that can aid in prevention and treatment of chronic conditions therefore, having primary care providers trained in PA assessment and counseling to patients is vital in disease prevention and chronic conditions management.

Methods: Data was collected in 3 faculty-student teams in the Pacific Northwest, Eastern, and Southern US from 1083 NP training programs through website evaluation. Examined program descriptions, course titles and course descriptions for mention of general health keywords, PA and nutrition. General health key words included: health promotion, chronic disease, disease prevention. Exclusion criteria included: programs unaccredited at time data extraction or with non-primary care focus. Chi-square and Fisher's exact tests were used to compare differences in keywords within course titles and descriptions by institution type, program type, program specialty, and program delivery were assessed.

Results: There was a dearth PA keywords in program descriptions. Differences were found for general keywords in course titles by program specialty ($p < 0.001$) and program delivery ($p < 0.001$); general keywords in a course descriptions by program specialty ($p < 0.001$) and program delivery ($p = 0.011$); and nutrition keywords in a course descriptions by institution type ($p = 0.038$).

Conclusion: These results are the first step in the process of ensuring that NPs have a working knowledge of PA and the skills to provide PA counseling to their patients. Direct assessment of NP programs should be done to confirm our findings. The presence of general keywords is promising and can be built upon, and this will lead to the next step of confirming findings through survey collection.

1074 Board #200 May 27 2:30 PM - 4:00 PM
Changes In Physical Activity Patterns Upon Transitioning To College And Away From Organized Sports Participation

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The trend for individuals between 18 and 24 years of age, many of whom are undertaking tertiary education, is to reduce their amount of physical activity upon their transition to college. Reasons cited for the decline in physical activity among these vulnerable individuals usually include 'not enough time' due to studying and taking exams, yet different physical activity opportunities for college students may also influence how these individuals change if and how they remain physically active.

PURPOSE: To examine changes in physical activity patterns in students who recently transitioned from high school to college.

METHODS: A Qualtrics survey was emailed to approximately 3,500 undergraduate students who lived in the residence halls at a moderately-large Mountain West university during the 2016-2017 and the 2017-2018 academic school years. Survey questions addressed known correlates of physical activity such as age, sex, self-efficacy, attitude, history of physical activity, and social environment.

RESULTS: Two-hundred thirteen students responded to the survey, and approximately 73% of the respondents who reported that they were physically active on a regular basis when they were in high school remained so during their first year in college. There was a significant association of previous activity levels and whether these students continued to be active when they were in college ($\chi^2 = 10.3973$, $df = 1$, $p\text{-value} = 0.001262$, $p < 0.01$). Also, survey respondents reported an 88% reduction in organized sports participation (e.g., high school basketball, soccer, and volleyball team sports) and a concomitant 87% increase in activities such as 'personal workouts,' running, and weight training.

CONCLUSIONS: Student suggestions to enhance engagement in physical activity on campus included better advertisement of Campus Rec programs and reduced costs for intramurals and group exercise classes suggesting increased opportunities to engage more in organized sports and activities.

1075 Board #201 May 27 2:30 PM - 4:00 PM
Relationship Between Different Bouts Of Physical Activity And Physical Fitness In Preschool Children

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Purpose: To examine the relationship between bouts of physical activity and physical fitness in preschool children. **Method:** Sporadic sessions (2-4 seconds) of moderate-to-vigorous physical activity (MVPA), short bouts (5-9 seconds) of MVPA; and medium-to-long bouts (≥ 10 seconds) of MVPA were measured over 7 days using ActiGraph GT3X accelerometers. Physical fitness was assessed by a 20-meter multistage shuttle run test (cardiorespiratory fitness), handgrip and standing long jump tests (musculoskeletal fitness), and the 2x10-meter shuttle run test (speed/agility). A composite score of physical fitness was created from the mean of the standardized values of all physical fitness tests. The bouts of physical activity and composite scores were categorized into quartiles (Q1-Q4 group) by sex; the highest quartile (Q4) of composite scores were assigned as high healthy fitness (HPF). Logistic and linear regression were used to investigate the relationship between bouts of MVPA and HPF. **Results:** A total of 265 participants were included in the final statistical analysis (boys, 149; girls, 116; 57.19 \pm 5.33 months). After adjusting for confounding factors, relative to Q1, the odds ratios (OR) for a HPF in Q4 were 11.72 (95% CI=2.27- 60.53), 7.53 (95% CI=1.83-30.90) and 8.98 (95% CI=1.78-45.39) for sporadic MVPA, short bouts and medium-to-long bouts of MVPA in boys, respectively. Similar results were also observed in girls, 11.85 (95% CI=2.33-60.19), 12.34 (95% CI=2.47-61.57) and 8.58 (95% CI=1.70-43.41), respectively. There was a non-linear relationship between overall MVPA and HPF in boys. When the total MVPA ≤ 65 min/day, the OR of achieving HPF increased by 17% (OR = 1.17, 95% CI = 1.02-1.35) for every 1 minute/day increment in total MVPA; no increases in HPF with increased MVPA were observed for >65 min/day. This non-linear relationship was not found in girls. **Conclusion:** There is a significantly positive relationship between bouts of MVPA and HPF in preschool children. To achieve HPF in preschool children, it is recommended that boys accumulate total MVPA 65 minutes or longer every day. Supported by National Natural Science Foundation of China (81703252)

1076 Board #202 May 27 2:30 PM - 4:00 PM
Injury Rates For Novice Half And Full Marathoners As A Function Of Increased Distance

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Purpose: To examine the change in training load, i.e. the increase in distance from week to week, that causes injury in half-marathon and full marathon runners. **Methods:** Runners, N=292, wore foot pods tracking distance and duration of runs. The runners also submitted a survey each week indicating areas of pain, how much it hurt, and the training effect of that pain. They chose whether their pain was minimal (did not miss any training), moderate (missed one day of training), severe (three or more days of training), or crippling (could not participate in that week of training). The majority were novice, college aged runners (runners who had never ran a half-marathon or full-marathon distances) who participated in a 15 week class training for a half or full marathon, with a weekly lecture and a weekly long run. The runners also had access to a physical therapist during the lecture and the long run. Runners excluded from the study did not have at least three consecutive weeks of training, including the week of the injury. **Results:** The data indicates that the runners ran erratically, with an average 1 week distance increase for uninjured runners of 27.9% and a 2 week increase of 58.9%. In contrast, injured runners (N=41) changed their distance from the week prior to injury to the week of reporting the injury by 0.95% and 2 weeks prior to injury to the injury by -1.1%. **Conclusion:** This data was derived from novice runners with deadline driven schedules leading to less consistent training habits. This may account for the lack of correlation to previous studies which show a 10% increase in mileage week to week, or a 30% increase over 2 weeks, leads to an increased risk of injuries rather than the lack of mileage difference seen in this study. What was apparent, rather than week to week mileage, was cumulative load over the duration of the class appears to have led to the injury, as the average time to injury was 11.2 weeks and standardized distance increase prescriptions are not applicable to novice runners.

1077 Board #203 May 27 2:30 PM - 4:00 PM
Exercise Patterns And Perceptions Among South Asian Adults In The Us: The Shape Study

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Purpose: Our objective was to determine biological differences and perceptions about exercise among an immigrant South Asian population living in the southeastern United States (US). **Methods:** This is a descriptive study of exercise patterns and perceptions using baseline data from a diabetes intervention study with immigrant South Asian adults now living in the US. The sample included middle aged, predominantly male, well-educated, immigrant South Asians. Participants were recruited through advertisements in local South Asian magazines, information sent through community organization listservs, and in-person outreach at health fairs and screening, diabetes information events, and South Asian stores. Participants reported to the Georgia Clinical and Translational Science Alliance General Clinical Research Center at Emory University Hospital and completed a baseline visit for the South Asian Health and Prevention Education pilot study. **Results:** The mean age of this cohort was 44.6 [10.6] years and 35% female. Of the 52 people included in this analysis, 81% did not exercise at least 150 minutes per week to meet the US Physical Activity Guidelines. Of those that did meet the Physical Activity Guidelines, 90% reported walking as their primary form of exercise. Overall, 65% reported preferring walking to other modes of exercise. There were no differences between exercisers and non-exercisers when asked about the benefits or barriers of exercise. **Conclusion:** South Asians living in the southern US do not meet the US Physical Activity Guidelines. The preferred mode of exercise is walking close to home. Although barriers to exercise are similar to those of other races in the US, preferred mode of exercise and preferences of women should be considered when implementing physical activity interventions.

1078 Board #204 May 27 2:30 PM - 4:00 PM
Design Of A Questionnaire To Support Behaviour Change In Fitness Centres

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The 6-month dropout rates of fitness centres' members (FCM) are reported to be up to 85%; while the attendance rate oscillates between 1.1 and 5.6 sessions/month. **PURPOSE:** Design a questionnaire that identifies individual determinants of FCM to engage in regular exercise at fitness centres. **METHODS:** A pragmatic literature review and three discussion groups (n = 9) were used to design the draft version of the questionnaire that addresses the six components of the COM-B Model (Capability [Physical & Psychological]; Opportunity [Social & Physical]; and Motivation [Reflective & Automatic]). An external panel (5 PhD in behaviour change; 4 PhD in sport science and 4 professionals from the fitness industry) critically reviewed the questionnaire until achieving sufficient consensus on items' relevance and clarity (content validity). The current version consists of 35 items categorized as Physical Capability = 3 items; Psychological Capability = 6 items; Social Opportunity = 4 items; Physical Opportunity = 11 items; Reflective Motivation = 7 items; Automatic Motivation = 4 items. Construct validity was assessed via Known-group validity by using the responses from 162 FCM. We hypothesized that those who have a low attendance rate (< 2 days/week) get lower punctuation on the studied variables than those with a middle attendance rate (2-3 days/week) and high attendance rate (≥ 4 days/week). One-way ANOVA, Kruskal Wallis Test and Monte Carlo simulation were used for groups comparisons. The internal consistency reliability was assessed with Cronbach's Alpha. **RESULTS:** Content validity: Relevance (CVI = 0.94; Aiken's V = 0.980); Clarity (CVI = 0.97; Aiken's V = 0.990). Construct validity: FCM with low attendance rate showed lower values (p < 0.05) for Motivation (Reflective & Automatic), Opportunity (Social & Physical) and Capability (Physical & Psychological) than the other two groups. The internal consistency of the questionnaire was $\alpha = 0.884$. **CONCLUSIONS:** The questionnaire shows acceptable content validity, known-group validity and internal consistency reliability. Moreover, the questionnaire has proved to be sensitive to the FCM with low attendance rate as the group-validity hypothesis was confirmed. Therefore, it may be used to support individual FCM's in increasing their attendance and engaging in regular exercise.

1079 Board #205 May 27 2:30 PM - 4:00 PM
Physical Activity And Cognitive Characteristics Of 5th Grade Student Participants In The Power Program

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High volumes of sedentary instructional time during the school day contradicts research supporting the role of physical activity (PA) in enhancing students' attention, academic achievement and executive function (EF).

PURPOSE: To describe PA, EF and academic performance in 5th grade student participants prior to a multimodal classroom curriculum called POWER that incorporates both PA and the teaching of EF skills.

METHODS:

A convenience sample of six 5th grade classes in two diverse schools in New Jersey were studied. Three classes in one school received POWER starting September 2019 (POW); 3 waitlist control classes in the other school (CONT) will begin POWER in January 2020. Students wore wrist-worn accelerometers for a full school week and completed the Youth Activity Profile (YAP). EF was assessed by 3 cognitive tests from the NIH Toolbox (NIHTB). Academic performance was assessed via STAR math tests. Data are reports as mean (standard deviation). Groups comparisons were made by independent samples t-test.

RESULTS:

86 students (POW n = 49; CONT n = 37; mean age = 10 (0.2) years) completed the YAP and NIHTB cognitive tests at baseline. A subset of 70 students (n = 35 in each group) wore accelerometers. POW spent 77.4% (2.6%) of the school day in sedentary behavior and 20.2% (2.6%) in MVPA, while CON spent 87.2% (1.4%) and 11.39% (1.3%) respectively in sedentary and MVPA. The YAP activity score at school was 3.5/5 for POW and 3.2/5 for CON. The age-corrected composite score for NIHTB was 94.1 (10.8) for POW, and 97.4 (9.5) for CON (national average=100). Students' scaled score for the STAR math assessment was 735 (86.3) and 730.5 (78.7) (~70th percentile) for POW and CON, respectively.

CONCLUSIONS:

POW PA was significantly higher than CON ($p = .001$), possibly due to intervention teachers' implementing some aspects of POWER earlier than instructed. Students tested below age-corrected national averages on both the NIHTB and academic tests; there were no significant differences between groups ($p = .15$ and $p = .81$).

1080 Board #206 May 27 2:30 PM - 4:00 PM
Effects Of An 8-week CrossFit Program On Psychophysical Well-being In Healthy Adolescents

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It is well known that High-Intensity Interval Training, such as CrossFit, positively influences physical and mental well-being. However, few rigorous studies evaluated both psychological and physical fitness variables in young people.

PURPOSE: To investigate if 8 weeks of CrossFit training program could positively influence the psychophysical well-being in adolescents.

METHODS: 30 healthy participants (n= 18 males and 12 females) were matched into pairs based on gender and randomly allocated into an intervention group (n=15; 18.2 ± 0.8 years) that performed the 8 weeks CrossFit training program or control group (n=15; 18.3 ± 0.8 years). At baseline and after 8 weeks, physical fitness tests (i.e. squat, push-up, lunge, and 20-meter run) and psychological measures (PCS and MCS indexes of the Short Form-12, and Regulatory Emotional Self-Efficacy scale (RESE, negative and positive)) were performed.

RESULTS: After 8 weeks, the intervention group showed significant improvements in the number both of maximal repetitions for the squat test ($\Delta 6.66 \pm 2.58, p < 0.001$), push-up test ($\Delta 5.87 \pm 4.23, p < 0.05$), and lunge test ($\Delta 7.89 \pm 3.11, p < 0.001$) and of maximal laps for the 20-m run test ($\Delta 3.60 \pm 2.27, p < 0.01$). Also, higher scores for the PCS ($\Delta 4.7 \pm 1.3, p < 0.01$) and MCS ($\Delta 5.2 \pm 0.9, p < 0.001$) indexes, and the RESE negative ($\Delta 6.0 \pm 3.9, p < 0.001$) and RESE positive ($\Delta 4.0 \pm 2.7, p < 0.001$) scales were found in the intervention group. No statistical differences were detected in the control group for all dependent variables.

CONCLUSION: Findings suggest that an 8-week CrossFit intervention program could positively affect the general physical well-being and mental attitude and improve the emotional perceived self-efficacy in managing negative affect and in expressing positive emotions in healthy adolescents.

1081 Board #207 May 27 2:30 PM - 4:00 PM
Motivation, Segmented Physical Activity, Sedentary Behavior, And Weight Status In Adolescents: A Path Analysis

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 (No relevant relationships reported)

PURPOSE: The purpose of this study was to examine the relationships linking motivational variables with BMI percentile (BMI%) via segmented physical activity (PA) and sedentary behavior (SB) in adolescents using path analysis.

METHODS: Secondary data analysis was performed using participants from the Family, Life, Activity, Sun, Health, and Eating (FLASHE) study. A non-probability panel balanced to the US population on sex, Census division, household income and size, and race/ethnicity were screened for eligibility. The final sample consisted of 1,643 adolescents (822 girls, 821 boys). Motivational variables consisted of PA enjoyment, self-efficacy, and peer social support. Mediator variables consisted of segmented weekly PA and SB assessed using the Youth Activity Profile (YAP). BMI% was the outcome. A recursive bootstrapped path analysis was conducted to examine the relationships between motivational variables, segmented PA and SB, and BMI% with indirect effects calculated via bootstrapped mediation analyses.

RESULTS: The relationships between motivational variables and segmented PA and SB were stronger than relationships between segmented PA and SB and BMI%. Three mediated paths were observed: self-efficacy and BMI% using sedentary YAP as the mediator (IE = -0.38, 95%CI: -0.65, -0.18), enjoyment and BMI% using weekend YAP as the mediator (IE = -0.62, 95%CI: -1.14, -0.12) and social support and BMI% using weekend YAP as the mediator (IE = -0.53, 95%CI: -1.00, -0.07).

CONCLUSIONS: The relationship between adolescent motivational variables and segmented PA and SB is relatively strong and specific motivational variables' relationships with BMI% is mediated through segmented PA and SB. This is one of the few studies to examine these relationships using a large U.S. sample of adolescents, supporting strong external validity evidence to the U.S. adolescent population. It also adds to the knowledge base regarding the relative strength of the inter-relationships among the observed variables. The relationships among motivation, PA, and health outcomes are complex and this study provides some new information that can be used to promote PA and reduce SB in the adolescent population.

1082 Board #208 May 27 2:30 PM - 4:00 PM
Perceptions And Use Of Internet-based Physical Activity And Health Resources Among Postmenopausal Women: A Qualitative Analysis.

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PURPOSE: With about 80% of women over age 50 reporting little/no regular physical activity (PA), this group is the most sedentary population in the U.S. Social media and new technologies provide an opportunity for home-based health promotion and behavioral interventions. **Purpose:** Use a qualitative approach to explore how women over age 50 use social media and online activities to access health information and participate in PA.

METHODS: Telephone interviews were conducted on a sample of healthy women over the age 50 years. A semistructured interview guide was used to acquire information on common internet use, online health information search history, and history of accessing physical activity programming. Responses were transcribed and examined for recurring themes and language-based sentiments using established qualitative content analytic procedures.

RESULTS: All women were in their mid-50's with a mean age was 55.5 years (range 53-56 years). All women were peri- or post-menopausal, and were either married or widowed. Facebook was the most commonly used online social app and was used to "keep up" with family and friends, to access support groups and read health articles. Fitbit was used by the majority of interviewees to track daily steps, sleep patterns, and calories burned during workouts. The participants also liked the goal-setting, self-monitoring, and social component (competition/social comparison) provided by Fitbit. MyFitnessPal was a commonly used app to track activity and monitor the relationship between calories consumed and calories expended. A number of women, particularly those with health conditions, accessed online sources to research medications/drug interactions and learn more about their condition. Participants reported that they were distrustful of much online information and were skeptical of many health web sites. Additionally, the women indicated that they would like to see more age-related content and access to communities of women of similar age.

CONCLUSIONS: Internet access to social groups and health/PA information is important to women over the age of 50. This demographic is receptive to information and interventions accessed online that are age-appropriate and include a strong social support component.

1083 Board #209 May 27 2:30 PM - 4:00 PM
The Relationship Of Physical Activity And Motor Ability Development In Children Aged 7-8 Years

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Two thirds of children does not meet physical activity (PA) guidelines in China. The fundamental movement skills (FMS) level is a good predictor of physical activity levels and weight status in children. Also, early motor skill has long-term effect on individual's PA level. So, understanding the relationship of FMS and PA is important for physical activity intervention planning. **PURPOSE:** To analyze the relationship of daily physical activity participation and the motor ability of children aged 7-8 years. **METHODS:** The Movement Assessment Battery for Children-2 (M-ABC-2) and the Test of Gross Motor Development - 2nd edition (TGMD-2) were used to test the motor ability of 91 children aged 7-8 years. The ActiGraph GT3X+ accelerometer was used to measure the physical activity participation for 7 consecutive days. **RESULTS:** The total time of boys spent in moderate physical activity (MPA) and moderate-to-vigorous physical activity (MVPA) was 21.4±7.5min and 27.3±11.2min, respectively, which was higher than those of girls (17.5±7.4min and 22.2±9.7min, $P<0.05$). The score of object control subscale in boys was 6.73±2.49, which is better than that of girls (5.71 ± 2.14, $P<0.05$); children's fine motor skill and locomotor skill were positively correlated with VPA, MPA and MVPA ($r = 0.2 - 0.3$). **CONCLUSION:** In this study, children spent less time in MVPA, especially in girls. The development of object control ability in boys is better than that of girls; there is a positive correlation between children's fine motor skills and physical activity. Therefore, children need to learn and practice FMS for participation and maintenance of PA. FMS should be tested in primary schools, so weaknesses could be identified in children and improved via proper intervention. Supported by The National Social Science Fund of China(Key Project of National Education Science, ALA190015)

1084 Board #210 May 27 2:30 PM - 4:00 PM
Hkjc Physical Activity Tracker (a Wrist Tracker) Validation Study

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PURPOSE: To investigate whether the number of steps from the tracker can accurately reflect the energy expenditure and movement intensity in various exercise activities.

METHODS: Fifteen participants (9 males, 6 females; age range: 19-36 years; body mass index range: 18.4-29.7) were fitted with JC tracker on the wrist to record steps and Cosmed K5 metabolic analyzing system to measure energy expenditure. Participants performed low, moderate and high intensity exercise respectively, in which the exercise was randomly selected, including running, cycling, arm curl and squat. They performed these activities for 5 min or reached to the targeted number of repetition. Descriptive statistics and one-way ANOVA were used to test if with the change of exercise intensity, the number of steps of the JC tracker will change accordingly. **RESULTS:** The Mean-VO₂ (mL/min/Kg) was significantly changed as the exercise intensity elevated in running (low intensity: 14.13±0.63; moderate: 28.53±2.13; high: 34.96±7.08, $p<0.05$), stationary bike (low intensity: 11.5±2.3; moderate: 25.8±2.8; high: 25.6±2.08, $p<0.05$) and arm curl (low intensity: 6.88±1.6; moderate: 10.17±5.82; high: 14.54±4.3, $p<0.05$), but the changes are not obvious in the squat exercise (low intensity: 13.51±2.56, moderate: 16.55±2.15, high: 19.02±4.01, $p=0.144$). However, as the Mean-VO₂ changed, there was no significant difference of steps measured by the tracker. Moreover, although there was a trend of increasing the number of steps in the running exercise (low intensity: 607.5±79.9; moderate: 736.4±97.8; high: 742.2±95.35), it was not statistically significant ($p=0.252$).

CONCLUSIONS: The JC tracker can reflect the changes in energy consumption in the dynamic movement, such as running; while doing stationary cycling, arm curl or squat, the tracker did not accurately reflect the participants' actual energy expenditure. A tracker with both heart rate and steps may be able to more accurately measure and reflect energy expenditure and physical activity levels regardless of motion. This project was supported by Hong Kong Jockey Club Charity Trust Fund.

1085 Board #211 May 27 2:30 PM - 4:00 PM

Understanding Associations Of Children's And Parents' Enjoyment With Their Subsequent Co-participation In Physical Activity

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PURPOSE: To determine if children's or parents' enjoyment of physical activity (PA) is associated with future co-participation in PA.

METHODS: Each parent-child dyad (n=28; age (mean±SD), parents: 38.0±6.6 years, children: 6.0±1.7 years) was guided through five PAs (walking, jumping games, body-weight exercises, tag, dancing) in a research fitness center. Immediately after completing each PA, researchers provided the Visual Analog Scale (1-"Do not like it at all" to 5-"Like it very much") to assess children's and parents' independent enjoyment of the PA. Dyads were asked to complete the PAs at home during the following week. Parents reported their dyad's participation in the PAs one week later. Separate logistic regression analyses were performed to examine the association of children's and parents' PA enjoyment with subsequent completion of the PAs at home.

RESULTS: For all five PAs, children's enjoyment of the activity was not significantly associated with the dyad's completion at home (all $p>0.05$). However, parents' enjoyment of the activity was significantly associated with the dyad's completion of the PA at home for jumping games (parental enjoyment (mean±SD): 4.73±0.65 for dyads that completed PA at home; 3.78±1.1 for dyads that did not; $p=0.033$) and dancing (parental enjoyment (mean±SD): 4.32±0.82 for dyads that completed PA at home; 3.10±1.73 for dyads that did not; $p=0.032$).

CONCLUSIONS: Parents' enjoyment of PA may be more important than children's enjoyment of PA in predicting whether dyads complete activities at home. This could inform future exercise promotion research of parent-child dyads by focusing on PAs that the parents enjoy.

1086 Board #212 May 27 2:30 PM - 4:00 PM

Applying The RE-AIM Framework To The Health Promotion Policy In Toyooka City.

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PURPOSE: Toyooka city, located on the western frontier of Japan, is regarded as harboring a typical Japanese super-aging society. The rapid aging of the population is placing a hefty financial burden and has led to an increased focus on strategies that help the elderly maintain physical activity. In 2012, the health promotion policy of "Walking as a way of life" was formulated to enforce the municipal office to play a more significant role in promoting physical activity at the population level in Toyooka city. This study aimed to evaluate the implementation and impact of this policy based on the RE-AIM (Reach, Effectiveness, Adoption, Implementation) framework. **METHODS:** A sample comprising 2,500 randomly selected residents were mailed a questionnaire. The data were analyzed using the RE-AIM framework. The use of the RE-AIM framework can enhance the generalizability of results when implementing the enforcement of the policy. Reach was defined as the proportion of eligible citizens that reported being aware of this program. Effectiveness of physical activity and social capital factors (i.e., networks in the neighborhood, trust for the community, social participation) was compared between citizens who were aware of the policy against those who were not aware of it. Independent sample t tests were used to compare groups for differences. Adoption was evaluated according to the proportion of organizations that had delivered results. Implementation governed how the results would be publicized. **RESULTS:** In total, 873 response questionnaires were completed and returned. There were 340 citizens (38.9%) who were aware of this policy. The group that was aware had significantly higher social capital than the group that was not ($p<.01$). However, no significant differences were found in adherence to physical activity. Of all organizations, 30.9% reported adoption. When considering the most cited information sources, the print media from the municipal office was distributed to 100% of homes. **CONCLUSIONS:** The use of the RE-AIM framework revealed that the health promotion policy of "Walking as a way of life" in Toyooka-city could reach residents with high social capital, but could not increase their physical activity. The authors have no conflicts of interest.

1087 Board #213 May 27 2:30 PM - 4:00 PM
Time-Based Changes In Physical Education Offerings In Response To A Legislative Mandate

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Physical education (PE) remains one of the most effective strategies for promoting school-based physical activity. Fewer than 10 states mandate public schools meet current public health recommendations for PE. Moreover, it remains unknown how implementing such mandates affects PE offerings. In 2007, Oregon passed legislation requiring elementary schools to provide 150+ min/week of PE by fall of 2017. No funding was offered to support this mandate.

PURPOSE: To evaluate time-based changes in PE offerings among Oregon public elementary schools for 8 years (2009-10 to 2016-17) preceding required compliance to the legislative mandate requiring 150+ min/week of PE.

METHODS: A total of 752 Oregon public elementary schools reported yearly minutes of PE offered and the total number of school weeks in session per year. Mean PE min/week were calculated by dividing yearly PE minutes by weeks in session. Additional publicly available explanatory variables including rurality (rural vs. non-rural county designations) and school schedule (four vs. five-day school week) were collected. A linear-mixed effects model was fit to evaluate time based-changes in PE with min/week of PE as the dependent variable, school year, rurality, and school schedule as fixed effects, and school as a random effect.

RESULTS: Although significant year-to-year variability in PE minutes was observed ($p < 0.001$), between 2009-10 to 2014-15 mean PE minutes remained relatively stable at 74 to 77 min/week before experiencing two larger year-to-year increases in 2015-16 (+3.9 min/week from 2014-15 to 80.8 ± 1.8 min/week) and 2016-17 (+4.0 min/week from 2015-16 to 84.8 ± 1.9 min/week). Schools located in rural counties were offered significantly more PE than non-rural schools (80.7 ± 1.7 vs. 74.6 ± 1.8 min/week, respectively, $p < 0.001$). No significant difference in mean PE min/week was observed between four vs. five-day school week formats (77.7 ± 2.3 vs. 77.5 ± 1.3 min/week, respectively, $p = 0.924$).

CONCLUSION: Despite having a 10-year lead-in period to increase PE time to 150+ min/week, Oregon elementary schools were only offering about half the required PE min/week (56.7%) in the year prior to mandatory compliance. Unfunded mandates requiring large increases in PE offerings may not effectively increase PE min/week to the required level.

1088 Board #214 May 27 2:30 PM - 4:00 PM
Partnering With Cooperative Extension To Advance Physical Education Policies And Practice: Evaluating The Train-the-trainer Approach

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Optimizing physical education (PE) is a proven strategy to increase children's physical activity. In Oregon, elementary schools are required to provide PE for ≥ 150 minutes/week. However increasing PE delivery requires resources (e.g. personnel, space, training) which many schools do not possess. One tactic to meet the minute requirement is for classroom teachers to deliver PE, which is permissible in Oregon using programs aligned to national PE standards. **PURPOSE:** We evaluated the effectiveness partnering with Cooperative Extension to train classroom teachers to implement Be Physically Active 2Day (BEPa 2.0), a standard-aligned classroom-based PE program. **METHODS:** Extension trainers (ET) were trained by the BEPa 2.0 Master Trainer (MT). Teachers (N=244) were subsequently trained by either ET or the MT. Trainers provided information about school-based physical activity, best practice strategies, and BEPa 2.0 activity simulations. Trainers also facilitated barrier-busting brainstorm sessions to elicit implementation problem solving strategies. Teachers completed post-training surveys to assess confidence, comprehension, and self-efficacy to implement BEPa 2.0. Survey scores were compared between MT and ET groups using the Wilcoxon-Mann-Whitney test. Transcriptions from the barrier busting activities were assessed qualitatively to evaluate teachers' perceptions of barriers and supports to implement BEPa 2.0. **RESULTS:** Surveys were returned by 152 teachers (response rate 62.3%). Over 94% indicated a high level of satisfaction with the training. There were no differences between MT (n=58) and ET (n=94) training groups in perceived confidence ($p=0.12$), comprehension ($p=0.08$), or self-efficacy ($p=0.18$) to implement BEPa 2.0. Qualitative results highlighted four themes encompassing implementation barriers and related problem-solving strategies; time constraints, space constraints, classroom interruptions/distractions, and limited school support. **CONCLUSIONS:** High training satisfaction and similar quality across ET and MT

groups indicate the train-the-trainer approach is a promising strategy to enhance BEPa 2.0 dissemination. Cooperative Extension partnerships may be an overlooked mechanism to enhance physical activity promotion efforts in school settings.

1089 Board #215 May 27 2:30 PM - 4:00 PM
Self-reported Confidence And Movement Competence Are Associated In Children

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(No relevant relationships reported)

Physical literacy is a growing concept in the United States and is vital for a child's long-term physical activity participation. Physical literacy is the ability, confidence, and desire to be active. There is little known about the relationship between confidence and physical ability in children. **Purpose:** To evaluate the association between a child's self-reported confidence and movement competency. **Methods:** A cross-sectional design with a single test session was used. Children (ages:5-14) recruited from local schools volunteered to participate. The Physical Literacy Assessment for Youth (PLAY) Self survey was completed by the student with an adult. Children were asked to rate "I'm confident when doing physical activities" with the following options: not true at all, not usually true, true, and very true. Responses were coded as: confident ("very true") or not confident (all other responses). Participants completed the PLAY Fun assessment in a randomized order, which evaluates movement competency in 5 domains: balance, lower extremity object control, upper extremity object control, running, and locomotor. Each task was scored on a 100cm visual analogue scale (VAS). Tasks were dichotomized into "not competent" (≤ 50 cm) or "competent" (> 50 cm). Total and domain-specific competency were calculated as the average total score across all tasks, or within each domain, respectively. Chi-square tests were used to evaluate associations between confidence (Yes, No) and competence (Yes, No). Sensitivity and specificity were calculated to evaluate the ability of confidence to predict competency. **Results:** A significant association was observed between confidence and competence for lower extremity object control ($p < 0.001$, specificity=.899, sensitivity=.289), upper extremity object control ($p = 0.020$, specificity=.872, sensitivity=.247) and running ($p = 0.041$, specificity=.883, sensitivity=.235). No other significant associations were present. **Conclusions:** The observed associations between self-reported confidence and competency are important because both factors likely impact future physical activity participation. Future research should evaluate if these results can improve the efficiency of measuring physical literacy, and identify the causal factors leading to confidence and competence.

1090 Board #216 May 27 2:30 PM - 4:00 PM
Sports Injury In China School Environment: A Policy Study

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(No relevant relationships reported)

PURPOSE: The frequent incidents of sports injuries in Chinese schools have seriously jeopardized the physical and mental health of students. The economic and legal disputes are so frequent that many schools reduced or limited their students' physical activities (PA). Therefore, this study aimed to collect and research the Chinese school sports injury policy from 1949 to 2019, and provide reference for the formulation and improvement of relevant policies in the future.

METHODS: We searched historical documents, searched government websites, Baidu, Google, other search engines, and CNKI, VIP, other scientific research databases, to collect and sort out the policy documents related to sports injuries in China. The searched data were collated and analyzed in chronological order and the department category of the issued documents.

RESULTS: Together, there are 11 policy documents about the school sports injuries were issued in China, only one of them *Interim Measures for Risk Prevention and Control of School Sports* issued by the Chinese Ministry of Education in 2015 is a policy document specifically aimed at school sports injuries in China. Other more related documents are *Interim Provisions on Health Work in Schools (Draft)* (1976,1980), *Regulations on Student Health Work(1990)*, *Regulations on the Handling of Student Injury Accidents Law(2002)*, and *Tort Liability Law(2009)*, etc.. At the same time, some provincial people's congresses in China have also issued policies related to campus sports injuries, such as Jiangsu Province (2006), Shanghai (2011), Guizhou Province (2014), Jiangxi Province (2015) and Hunan Province (2018), etc., which have successively issued some policies, some items in these policies are related to school sports injuries. Because there is not a report system for sports injuries of students, and no information communication channels between schools and hospitals and clinics, there is a lack of statistical data related to sports injuries in schools in China.

CONCLUSIONS: A great improvement is urgently needed for China's school sports injury policy, and the lack of reporting system and statistical data on school sports injury made the policy developed untargeted and ineffective. Urgent actions are needed to address these barriers so that school sport-related injury can be better prevented.

1091 Board #217 May 27 2:30 PM - 4:00 PM
Physical Activity Changes Before And After Connection Of A Multi-use Trail In Rural Appalachia
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Physical inactivity is a significant global health issue. The State of Kentucky, one of the 13 Appalachian states has a greater rate of physical inactivity than the national average. Most research directed at the built environment and recreational opportunities for physical activity has focused in urban areas with little attention to rural settings. **PURPOSE:** To examine the changes in physical activity before and after the connection of two multiuse trails in a rural Appalachian city. **METHODS:** The primary outcome measures were mode (walking, jogging, or cycling) of physical activity, distance and duration. A valid and reliable survey was used to intercept and interview trail users, modeled after a rails to trails conversion of the American Tobacco Trail. Data were collected on each of the trail segments during the months of May, June and July in 2017, 2018, and 2019. **RESULTS:** During the 3-year study period, 51% of users were female, 93% were white, and the age range of users was 18-85 years. Physical activity time: there was no significant differences in total physical activity time before or after connection of the trail. Average activity time was 58.2 ± 35.5 minutes in 2017 (n = 95), 64.5 ± 62.7 minutes in 2018 (n = 140) and 62.3 ± 30.3 in 2019 (n = 80). There were no significant differences in mode of trail use, or trail use by gender. However, after connecting the two one-mile segments total distance significantly increased. In 2017, walkers (n = 84) average 2.4 ± 1.2 miles, after trail lengthening participants walked an average of 3.12 ± 1.7 miles (p = 0.27) in 2019. Thirteen runners statistically significantly lengthened runs in 2017 an average of 3.40 ± 1.9 miles to 4.02 ± 2.5 (p = 0.28). Cycling length did not change. **DISCUSSION:** The results indicate that in the two years that the trail was not expanded, physical activity usage patterns did not change. Yet, once the one-mile connector was completed and lengthened to three miles, trail users significantly increased the distance traveled on the trail. Given the emphasis on built environments to improve community physical activity, further analysis is warranted to estimate health impact and return on investment for municipalities.

1092 Board #218 May 27 2:30 PM - 4:00 PM
Comparison Of Participating New Competitive Sport Motives Among University Students With And Without Exercise Habit
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 (No relevant relationships reported)

PURPOSE: The aim of this study was to examine differences in participation motives of new competitive sport among university students with regard to their gender and exercise habit. **METHODS:** Before the commencement of the 3-month university rowing team training program which consists of three 2-hour water and land training sessions per week, one hundred fifty-six novice rowers (103 men, 53 women; mean age: 19.5 ± 1.5 years; BMI = 20.9 ± 2.2 kg/m²) completed the Exercise Motivation Inventory-2 (EMI-2; Markland & Ingledew, 1997), Rosenberg's Self-Esteem Scale (Chinese translation: Ng, Barron & Swami, 2015), Body Appreciation Scale-2 (BAS-2; Swami & Ng 2015) and Dissatisfaction with Body Parts Scale (Chen & Jackson, 2012). They self-reported whether they had undergoing at least 150-minute moderate exercise per week. **RESULTS:** There was no statistically significant interaction effect between gender and exercise habit on the combined dependent variables, F(17, 136) = 0.801, p = .690; Wilks' Λ = .909. Among all the participants, the three top reasons for participating the selection were positive health (M = 4.05, SD = 0.67), strength and endurance (M = 3.97, SD = 0.66) and challenge (M = 3.84, SD = 0.70). There was no statistically significant gender difference on the combined dependent variables, F(17, 136) = 0.801, p = .317; Wilks' Λ = .875, whilst statistically significant exercise habit difference was found on the combined dependent variables, F(17, 136) = 2.733, p = .001; Wilks' Λ = .745. Results of independent samples Mann-Whitney U test showed that students with exercise habit (n=105; 71 male, 30 female) had significantly higher mean scores than those with no exercise habit (n=51; 30 male, 21 female) for strength and endurance, competition, stress management, affiliation, enjoyment, revitalization, positive health, self-esteem and BAS-2. **CONCLUSIONS:** Participants with and without exercise habit were motivated to take part in regular training by intrinsic factors such as positive health, strength and endurance, revitalization and challenge.

1093 Board #219 May 27 2:30 PM - 4:00 PM
Examining College Students' Motivation Participating In Virtual Reality-based Exercise: A Self-determination Theory Perspective
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Virtual reality (VR) has become a popular modality for exercise, physical therapy, and rehabilitation. VR-based exercise is becoming more available and could be a viable form of exercise. In addition, the self-determination theory (SDT; Deci & Ryan, 1985) has been used to examine college student's motivation to exercise. However, more empirical research evidence is needed to examine college students' motivation to participate in VR-based exercise from the SDT perspective.

PURPOSE: The purpose of this study was to examine the relationship between college student's situational motivation and intention to participate in VR-based exercise. **METHODS:** Seventy-two college students (Male = 39; Mage = 20.72, SD = 1.66) experienced at least 5 minutes of VR-based stationary bike gaming using the VirZoom Arcade. Afterward, they were assessed on situational motivation and intention to participate in VR-based exercise via a validated survey. The Situational Motivation Scale (Guay, Vallerand, & Blanchard, 2000) was used to assess situational motivation and one question was used to assess their intention for future participation in VR-based exercise. In order to determine the relationship between situational motivation (i.e., intrinsic, identified, external, amotivation) and intention to exercise, a multiple linear regression was performed to investigate motivation to predict intention to exercise. **RESULTS:** The multiple regression model showed a statistically significant effect, F(2, 69) = 12.920, p < .001, R² = .272, indicating that 27.2% of the variation in intention can be explained by identified regulation (β = .43) and amotivation (β = -.23). **CONCLUSIONS:** The results suggest that the intention for further participation in VR-based exercise is strongly predicted by the identified regulation or importance college students place on VR-based exercise. As with other modalities of exercise, lack of motivation and interests can be a deterring factor for participation in VR-based exercise. Further research is needed to understand how to empower college students who are motivated to participate in VR-based exercise. Finally, these results confirm the theoretical tenets of the SDT.

1094 Board #220 May 27 2:30 PM - 4:00 PM
BOX-HIT IS PERCEIVED MORE ENJOYABLE AND AS PHYSIOLOGICALLY DEMANDING AS RUN-CONT AND HIT-RUN
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PURPOSE: The aim of this study was to quantify enjoyment and the physiological effects associated with a BOX-HIT protocol, which incorporates boxing and circuit training set in an out of laboratory setting compared to a moderate intensity continuous run (RUN-CONT) and a high-intensity interval run (HIT-RUN) protocol all matched for duration (50 minutes). We hypothesized that the BOX-HIT protocol will be more enjoyable and produce similar physiological effects. **METHODS:** Using a randomized counterbalanced design ten (five male and five female) recreationally active adults (mean ± sd: age, 24 ± 2 years; weight: 73 ± 5 kg; height: 1.71 ± 0.09 m; body mass index: 22.67 ± 2.14; $\dot{V}O_{2max}$: 45.5 ± 6.9 mL·min⁻¹·kg⁻¹) performed three exercise protocols on three different occasions separated by at least 48 hrs. The protocols were a BOX HIT (50 min protocol consisting of running, circuit and core training and boxing), a HIT-RUN (6 x 3 min at 90% $\dot{V}O_{2max}$ interspersed with 6 x 3 min active recovery at 50% $\dot{V}O_{2max}$ preceded by a 7-min warm-up and followed by a cool down at 70% $\dot{V}O_{2max}$) and a RUN-CONT (continuous running at 70% $\dot{V}O_{2max}$).

RESULTS: Ratings of perceived enjoyment were higher following the BOX-HIT (P=0.042) in comparison to the RUN-CONT; however, no significant difference was found between the BOX-HIT and HIT-RUN (P=1.000) or between HIT-RUN and RUN-CONT (P=0.469). There was also a significant difference between mean lactate during the BOX-HIT and RUN-CONT (a difference of 3.82 m·mol⁻¹, P<0.001), mean lactate during the BOX-HIT and HIT-RUN (a difference of 1.83 m·mol⁻¹, P=0.023), and mean lactate during the RUN-HIT and RUN-CONT (a difference of 1.99 m·mol⁻¹, P=0.002). However, there was no difference in average RPE, average heart rate, average $\dot{V}O_2$, average $\dot{V}CO_2$, RQ, or energy expenditure between the three protocols. **CONCLUSIONS:** The greater enjoyment of the BOX-HIT and similar physiological effects to the other exercise protocols make the BOX-HIT a great tool for improving exercise adherence as it is set in a real world setting. This protocol shows great potential for providing health benefits and adaptations similar to those seen following high-intensity and sprint interval training.

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Low Tech Or High Tech: How Does Types Of Engagement With An Activity Monitor Influence Physical Activity?

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Commercial physical activity (PA) tracking devices have gained popularity both in the general public and research settings to monitor and increase PA. High tech versions automatically track and record data while low tech versions require regular manual logging to retrieve the data. Different types of activity trackers require different data engagement, which may influence PA levels. **Purpose:** The purpose of the study was to investigate if the differences in data engagement from two types of activity monitors influenced PA levels. **Methods:** Employees at a midwestern university (N=39) enrolled in a four-week worksite walking intervention. A 2-arm randomized study design was used to compare the influence of type of data engagement on average weekly steps between two types of activity monitors: 1) manual log (MANUAL) utilizing a standard hip accelerometer (NL-1000) and 2) digital log (DIGITAL) utilizing a wrist accelerometer (FitBit Charge 2). Participants wore a blinded activity monitor for week to determine baseline averages. Then participants were randomly assigned to track activity wearing one of the two types of activity trackers, unblinded, for four additional weeks. The MANUAL group recorded their steps by hand daily in an activity log. The DIGITAL group was asked to monitor their steps through the activity tracker's app which was downloaded to their personal smart phones. **RESULTS:** Significant increases in weekly step averages was found for both the MANUAL ($t(20) 1,280.89, p < .001$) and the DIGITAL ($t(19) 755.74, p < .001$) groups from Week 1 to Week 4. There were no significant between group differences found for Week 1 step averages ($t(39) -224.17, p = .299$) or Week 4 step averages ($t(39) 300.99, p = .200$). **CONCLUSION:** Steps were significantly increased for both groups during the intervention but there was no statistical difference found between the groups. To our knowledge, no other study has examined if data engagement influences PA. With so many types of activity monitors on the market these findings indicate that cheaper, low tech activity trackers are as effective in behavior change as their more expensive, high tech counterparts. Since differences in data engagement does not appear to impact short-term step increases individuals can choose either high tech or low tech options depending on resources and preferences.

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Physical Activity Preferences Of Urban, Middle School Students

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PURPOSE: The purpose of this study was to investigate the physical activity preferences of middle school students. **METHODS:** Participants were 219 students in grades 6-8 at a public, urban middle school. Data were collected via self-report questionnaire that included questions with specified options and questions with write-in opportunities assessing demographic information, physical activity preferences, and activities students would like to learn. **RESULTS:** Results indicated that the middle school boys (n=113) were 12.65 (± 1.63) years old and overall preferred basketball (38.3%) and football (25.2%) and wanted to learn more about basketball (19.8%), football (12.9%) and soccer (11.9%). Eighth grade boys (n=26) preferred basketball (19.8%) and football (12.9%) and wanted to learn basketball (21.7%), football (17.4%) and baseball (13.0%). Seventh grade males (n=45) preferred jogging (44.4%), basketball (28.9%) and football (15.6%) and wanted to learn basketball (20%), baseball (12.5%), soccer (17.5%), tennis (10.0%) and swimming (10.0%). Sixth grade boys (n=42) preferred basketball (32%) and football (28%) and wanted to learn basketball (21.7%), football (17.4%) and baseball (13.0%). Girls (n=106) were 12.57 (SD = 1.05) years old and overall preferred basketball (28.3%), jogging (23.2%) and dancing 12.1%, and wanted to learn about basketball (29.3%) tennis (15.2%) and soccer (13.0%). Eighth grade girls (n=28) preferred basketball (33.3%), jogging (29.6%) and dancing (11.1%) and wanted to learn baseball (30.4%) and soccer (13.0%). Seventh grade girls (n=30) preferred dancing (17.9%), jogging (17.9%), swimming (17.9%) and basketball (14.3%) and wanted to learn about baseball (36%), soccer (16%), swimming (12%) and tennis (12%). Sixth grade girls (n=47) preferred basketball (34.9%) and jogging (23.3%) and wanted to learn about basketball (25.6%), tennis (20.9%) and soccer (11.6%).

CONCLUSIONS: In addition to population team sports, participants in this study indicated interests in individual and dual sports and fitness activities. Understanding preferences and interests is crucial to the development of population specific programs aimed at promoting current and lifelong physical activity participation.

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Young Adults' Rating Of Perceived Exertion And Mood In Exergaming Dance And Aerobic Dance

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PURPOSE: Exergaming has been evident to be a novel and interesting channel to enhance young adults' affection and emotion while engaging in physical activity, yet no known research has been conducted to compare its efficacy versus traditional exercise modality. In response, this project investigated mean differences in young adults' rating of perceived exertion (RPE) and mood in different exercise modalities (exergaming aerobic dance vs. traditional aerobic dance).

METHODS: Forty young adults (20 females; $M_{age} = 20.38$) were recruited from a Chinese university and completed two separate 12-minute dance sessions: 1) non-stop exergaming aerobic dance (Xbox 360 Kinect Just Dance - Just Sweat around the World); and 2) traditional aerobic dance led by an experienced instructor. Participants' RPE was assessed via the Borg Rating of Perceived Exertion (14-point Likert scale) every 4 minutes and mood was measured by the Brunel Mood Scale (5-point Likert scale; anger, confusion, depression, fatigue, tension, and vigor) during each session. MANOVA with repeated measures was used to detect mean differences in these outcomes between the two dance sessions.

RESULTS: Significant differences were identified between dance sessions for the overall model, Wilks' Lambda = 0.13, $F(7,33) = 31.05, p < 0.01, \eta^2 = 0.87$. In detail, participants had significantly lower RPE toward exergaming dance (9.06 ± 1.07) compared to aerobic dance (11.36 ± 0.85), $F(1,39) = 209.45, p < 0.01, \eta^2 = 0.84$. In terms of mood, exergaming dance showed significantly lower confusion (3.00 ± 1.72) comparing to aerobic dance (4.25 ± 1.50), $F(1,39) = 4.97, p < 0.05, \eta^2 = 0.11$. Similarly, participants reported significantly lower fatigue in exergaming dance (3.00 ± 1.43) versus aerobic dance (4.00 ± 1.78), $F(1,39) = 7.58, p < 0.01, \eta^2 = 0.16$. No other significant differences were detected for other outcomes.

CONCLUSION: Findings suggest that exergaming dance may lead to less perceived RPE, confusion and fatigue among young adults compared to traditional aerobic dance. The findings have practical implications, as young adults might be more likely to engage in game-like exercise when less effort, confusion and fatigue are perceived.

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Psychological Needs Satisfaction Self-determined Motivation And Physical Activity Of Students In Physical Education

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Physical Education (PE) plays a critical role in promoting physical activity participation of school students. There is a need to understand student motivation towards PE and how this motivation work in student PE activities engagement. **PURPOSE:** To apply the self-determination theory (SDT) to test the hypothesized relationships between three basic psychological needs (i.e., autonomy, competence, and relatedness), self-determined motivation, and student moderation-to-vigorous physical activity (MVPA) during elementary and secondary school physical education (PE) in Shanghai, China. Gender and school level differences were also explored. **METHODS:** The participants were 1829 Grade 3-9 students (872 boys and 957 girls) aged six to 15 years in Shanghai. Accelerometers were used to measure the MVPA duration of the students in PE. The Self-regulation questionnaire and Psychological Needs Satisfaction Scale were completed by the participants to assess student PE motivation and three psychological needs. **RESULTS:** The model of hypothesized relationships demonstrated a good fit with the data [$\chi^2 = 29.323, df = 3, p < .001$; CFI = .985; IFI = .985; SRMR = .026; RMSEA = .069]. The results from the multi-group path analysis revealed none of the paths in the model was found to be significantly different in regard to male versus female students. However, the relationship between self-determined motivation and MVPA was stronger for secondary school students ($b = .130, p < .001$) than elementary students ($b = .093, p < .01$), $\Delta\chi^2 = 3.925, \Delta df = 1, p = .048$. No other significant differences existed in the other paths across elementary and secondary school students. **CONCLUSION:** These findings supported the applicability of SDT in understanding and promoting physical activity of Chinese school students in PE. Practitioners should consider tailoring intervention to address school level differences to increase physical activity participation of students in PE.

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Efficacy And Feasibility Of Bigu Intervention On Selected Physical Outcome Measures Among Individuals With Obesity

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Bigu is a comprehensive health care technique based on the Chinese traditional health preservation method, including fasting, Qigong, and Chinese medicine. **PURPOSE:** To explore the efficacy and feasibility of a 7-day Bigu intervention on selected physical outcome measures among individuals with obesity. **METHODS:** Twenty-three participants, 11 male, and 12 female (age: 31.65±10.38 yrs; body height: 169.48±9.01 cm; body mass: 98.26±17.14 kg) were enrolled in the comprehensive 7-day intervention of Bigu, which consists of 1) fasting: drinking plenty of water but no food, except some fruits, such as grapes and apples. 2) Qigong exercise: including stretching exercise; eight sections of brocade for 90-minute daily under the instructions of Qigong master. 3) Chinese herb: Linggui Zhugan decoction as daily drink. Before and after the Bigu intervention, the outcome measures were: body weight, body fat, fat-free body weight, waist circumference, heart rate, blood pressure, and blood glucose. The paired test was employed to examine the differences of the outcome measures before and after the Bigu intervention. **RESULTS:** After the Bigu intervention, the body weight (Pretest: 98.26±17.14 vs Posttest: 92.77±16.24, $p < .01$), BMI (Pretest: 34.35±3.73 vs Posttest: 32.37±3.58, $p < .01$), waist circumference (Pretest: 110.83±10.47 vs Posttest: 106.35±10.01, $p < .01$) and body fat (Pretest: 41.91±8.42 vs Posttest: 40.79±8.57, $p < .01$) of the participants were significantly decreased. Heart rate and blood pressure remained no change, however, the skeletal muscle (Pretest: 33.32±6.45 vs Posttest: 31.60±6.61, $p < .01$) and fat-free body weight (Pretest: 59.28±10.66 vs Posttest: 56.28±11.02, $p < .01$) were significantly decreased. The blood glucose (Pretest: 5.69±2.28 vs Posttest: 3.82±1.34, $p < .01$) drops significantly within normal physiological range. **CONCLUSIONS:** Bigu may effectively help individuals with obesity to relieve obesity and control body weight and could be a feasible exercise for the individuals with obesity, however, there may be a risk of losing fat-free body weight during Bigu intervention. How to prevent the loss of fat-free body weight in Bigu intervention would warrant for future research.

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You Earn What You Get...Like Old Man Strength: Oral History Accounts Of Wellness

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Health is multidimensional (WHO, 1946) and can include aspects of physical, social, emotional, and spiritual wellness. Social Ecological Models (e.g., Sallis 2012; Van Dyck, et al., 2010) suggest that individuals' personal experiences of health and wellness and lifespan historical narratives are embedded within community resources and built and natural environments. **PURPOSE:** To investigate how adults articulate the intersections of multiple dimensions of health throughout the lifespan with regard to the historical development of built and natural environments supporting health. **METHODS:** An oral history approach was used to allow participants (N=11) to articulate moments in their lives that offered clarity and definition to their self-described meanings of health. Interviews included conversations about physical activity, use of community resources, and the integration of built environment features into personal-historical articulations of health. **RESULTS:** Semi-structured oral history interviews were transcribed verbatim and subjected to thematic analysis (Boyatzis, 1998). Transcripts were coded for content themes using the multiple dimensions of wellness as an organizing model. Inter-coder reliability was established through the use of multiple, independent coders and an iterative discussion process to connections among key themes. Results indicate 1) the importance of historical moments in structuring both natural and built environments to promote health for individuals' narratives of health, and 2) intersections between dimensions of health within individuals' oral histories of lived experiences. Preliminary results suggest generational differences in the articulation of the historical importance of public resources and definitions of wellness. **CONCLUSIONS:** Despite the small sample size and preliminary nature of this study, results support the importance of both built and natural environments for promoting health for how individuals think about and articulate wellness across multiple dimensions. Oral history accounts of personal interactions with built and natural environments offer a useful mechanism for exploring how health emerges in community spaces.

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Exercise, BMI, HIV, and PrEP Use among African American Men Who Have Sex With Men

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HIV affects Black/African American gay, bisexual, and other men who have sex with men more than any other group in the United States. The Eastern Health Planning Region of Virginia contains the state's highest percentage (34%) of new HIV diagnoses among Men Who Have Sex with Men (MSM). **PURPOSE:** This study investigated physical activity and body mass index relationship to HIV status, HIV risk perception, and knowledge of and attitudes toward PrEP (an anti-HIV medication) use among men who have sex with men and transgender persons of color in the Hampton Roads area. **METHODS:** A cross-sectional, 61-item online survey was administered from September 28, 2017 to March 4, 2018 to a convenience sample of the priority population. Descriptive analysis summarized all self-reported baseline data, cross tabulations clarified differences in data patterns in respondent subgroups, and Pearson's chi-square test assessed categorical variables of interest. One-way ANOVA assessed differences in subgroup means and was followed with Tukey post hoc analysis. The level of significance was $p < 0.05$. **RESULTS:** Among the 289 participants included in the analyses, 87.5% were Black/African American and the mean age, weight, and height were 31.0 ± 8.7 years, 85.1 ± 21 kilograms, and 175.4 ± 9.4 centimeters, respectively. Mean body mass index (BMI) was 27.7 kg·m² with 38.4% considered overweight and 23.5% obese. Only 30.4% of respondents reported achieving the national physical activity (PA) recommendation (≥ 30 minutes of moderate-intensity physical activity on ≥ 5 days per week) (USDHHS, 2008). Most respondents reported a negative HIV status (62.6%), 6.9% did not know their HIV status, and 19% had not heard of PrEP. After removing participants who self-identified as HIV positive, most respondents did not feel they were at risk for HIV (57.6%). *HIV Status, Willingness to take PrEP, Perceived HIV Risk, and Prior Knowledge of PrEP* were not associated with meeting national PA recommendations or BMI. **CONCLUSIONS:** High rates of obesity and low levels of physical activity may further complicate healthcare outcomes for this population with primary or comorbid chronic conditions creating a competition for prioritization of health conditions. Engagement in regular physical activity and exercise must be promoted.

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Evaluation Of Sitting Time On Faculty And Staff In A Small Private University

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Sedentary Death Syndrome (SeDS) is the 2nd greatest, yet preventable threat to public health, resulting in multiple chronic diseases and millions of premature deaths annually. Work-related environmental conditions have been implicated as factors related to declines in physical activity (PA) in the United States and abroad. Staff and faculty in a university setting may experience greater quantity of sitting time at work, which would impair the ability to achieve recommended daily levels of PA. Few studies exist that have evaluated sitting levels among university personnel. **PURPOSE:** The purpose of this investigation was to explore sitting levels among working members of Biola University. **METHODS:** Eligible survey respondents (N = 393) were men (n = 154, 44.9 ± 12.8 years of age, 178.7 ± 8.3cm in height, 85.3 ± 15.0kg in weight, and an average body mass index (BMI) of 26.7 ± 4.5kg/m²) and women (n = 239, 40.9 ± 13.1 years of age, 164.9 ± 8.1cm in height, 69.2 ± 15.5kg in weight, and an average BMI of 25.56 ± 6.1kg. kg/m²) who are employees of Biola University. Participants completed the International Physical Activity Questionnaire (IPAQ), using the Survey Monkey® platform. Distinction between faculty and staff positions were made along with job type and educational status. Total sitting min/day on a weekday and on a weekend were gathered and used to calculate total weekly sitting minutes and average sitting min/day. Kruskal-Wallis Independent Samples testing was employed to assess group differences. **RESULTS:** Weekday, weekly and daily average sitting minutes between staff and faculty were significantly ($p < 0.05$) different. Women employees' (187.84 min/day) weekday sitting was significantly ($p < .014$) greater than men's (137.84 min/day). Average daily sitting was significantly ($p < .002$) different for level of education attained, with masters (157.07 min/day) and doctorate (165.27 min/day) employees sitting less than those with a 2-yr college degree (247.44 min/day). There were no differences in total minutes of sitting on the weekend between faculty and staff, gender, job type or educational status. **CONCLUSIONS:** Clear discrepancy in PA exists between staff and faculty, men and women and educational attainment. Thus necessitating targeted interventions for the increase of PA on University campuses.

- 1103** Board #229 May 27 2:30 PM - 4:00 PM
Low Socio-economic Patients' Preferences For Lifestyle Interventions: A Qualitative Analysis
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Individuals with low socio-economic statuses (SES) have lower physical activity levels and poorer diet compared to their higher SES counterparts. Furthermore, these individuals typically have other health disparities (e.g. race, access to health care), which may impact their health status. Although lifestyle diseases (e.g. diabetes) are managed in the primary care setting, low-SES patients' behaviors and preferences for lifestyle are rarely assessed, despite being needed to guide care. **PURPOSE:** To examine qualitatively the preferences for lifestyle interventions for individuals with low SES within a clinical setting. **METHODS:** Patients (N = 185; 70.2% female; 51.5% African American) were surveyed at two free community health clinics. Survey questions focused on patients' preferences for physical activity and nutrition services; patients' current physical activity and food related behaviors; and desired health information. Data were analyzed using content analysis to identify themes. **RESULTS:** Patients reported preferences for programs that were similar to those provided at the YMCA, general nutrition counseling, and smoking cessation. Majority of individuals who exercised did so at either a gym or at home. The most common reasons for not exercising or preparing food were lack of time, work schedule constraints, pain, and health issues. Patients reported regular fast food consumption. Participants reported they would value information on general wellness, low-impact physical activity, and weight loss. **CONCLUSIONS:** This study is the first to qualitatively examine low SES patients' physical activity, diet, and other lifestyle behaviors along with intervention preferences within the clinical setting. Data demonstrates that individuals desire lifestyle intervention programs, especially ones that address reported barriers (e.g. pain, lack of financial resources, limited time). Notably, this study also asked patients their preferences rather than having program planners and researchers determine the best intervention for this population. As such, planners and researchers should tailor programming to this unique population's needs. Future research and practice efforts should implement tailored lifestyle programs while also evaluating acceptability and feasibility of these programs.

- 1104** Board #230 May 27 2:30 PM - 4:00 PM
The Effect To Adl Of Short-term Intervention To The Ankle Mobility Of Health Club Participant
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Many elderly persons feel anxiety during daily life due to a decrease in walking speed, a fear going up and down stairs, fall by balance capacity decline. Although ankle joint mobility decreases with aging, the relation to activities of daily living (ADL) hasn't been investigated so much. **PURPOSE:** The purpose of this study was to investigate the relation between ankle joint mobility and ADL ability of elderly health club participants, and to examine whether the ADL ability is improved to when ankle joint mobility is improved. **METHODS:** Forty elderly people (age 60 ± 12.9 yrs., height 153.2 ± 6.10 cm, weight 52.1 ± 6.87 kg) health club participants participated in this study. Knee to wall (KTW [cm]; ankle mobility, right and left ankle), timed up and go test (TUG [sec.]) and one leg standing test with open eye (OLS [sec.], ADL function, right and left ankle), and stairs up and down time (SU and SD [sec.]; ADL) were measured before and after health club intervention. Coefficient of correlation between measurements before intervention was calculated. The effect of intervention was considered from the measurements before and after intervention using paired t-test for TUG, 2 factor ANOVA for KTW (each left and right) and SU&SD, and Wilcoxon signed rank test for OLS (each left and right). **RESULTS:** Measurement results before intervention were KTW (average of right and left ankle) 12.5±3.1, TUG 6.7±2.25, OLS (average of right and left ankle) 32.0±20.16, SU 3.6±2.33, and SD 5.4±3.46. The coefficient of correlation with the KTW were TUG -0.674, OLS 0.412 (Spearman's rank correlation coefficient), SU -0.483, and SD -0.579. Measurement results after intervention were KTW (average of right and

ankle) 13.3±2.75, TUG 6.1±1.94, OLS (average of right and left ankle) 38.8±20.34, SU 4.0±3.66, and SD 4.5±3.07. KTW, OLS and SD were improved significantly (p<.01, respectively). **CONCLUSIONS:** The relation between the ankle joint mobility and ADL ability of elderly health club participant was observed. Improvement of ADL ability was caused by improvement of ankle joint mobility by health club intervention.

- 1105** Board #231 May 27 2:30 PM - 4:00 PM
What Is App With Maintenance? Regular And Enhanced Physical Activity Maintenance Among Latinas
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 (No relevant relationships reported)

PURPOSE: Physical activity (PA) promotion research has increasingly focused on Latina women, as they report comparatively lower rates of PA and higher rates of some related diseases. Nevertheless, there is a paucity of research on PA maintenance upon completion of interventions among this population, and whether smartphone apps could provide tools to help with PA maintenance. This study aimed to: (1) assess 3-month PA maintenance among Latinas who complete a PA intervention; (2) evaluate the acceptability and preliminary efficacy of smartphone apps as tools for PA maintenance; and (3) qualitatively explore the role that apps played in PA maintenance. **METHODS:** 27 participants who reported increasing their moderate to vigorous PA (MVPA) to ≥ 60 minutes/week upon completing a 12-month PA intervention study were recruited. Participants were randomly assigned to enhanced maintenance (i.e., taught how to use 2 commercial smartphone apps, N=14), or control (N=13). After a 3-month maintenance period with no contact, participants' PA was re-assessed via the 7-day PA Recall. Longitudinal mixed effects regression models assessed group by time effects on PA (Aim 1). Frequency and satisfaction with apps were evaluated via a Likert-style questionnaire (Aim 2). Qualitative data were collected and analyzed using individual interviews with 21 participants (Aim 3). **RESULTS:** Mean minutes/week of MVPA was 16.85 (SD=24.73) before the intervention, 230.50 (SD=199.29) immediately after the tapered intervention, and 163.10 (SD=125.49) after the maintenance period. There were significant effects of time ($\beta=102.24$, SE=42.06 for pre-intervention to post-maintenance, and $\beta=-85.17$, SE=34.62 for post-tapered intervention to post-maintenance), but not of group assignment, on self-reported PA. Nine out of 14 participants in the enhanced maintenance group reported using apps at least a little to help with PA maintenance. Reasons for not using apps included not finding them appealing or necessary. **CONCLUSIONS:** This study used quantitative and qualitative data to provide new knowledge regarding PA maintenance among Latinas. Few women reported returning to pre-intervention levels of PA, yet there was a significant drop in self-reported PA after the tapered intervention ended. Smartphone apps contributed little to PA maintenance.

- 1106** Board #232 May 27 2:30 PM - 4:00 PM
Korean Baby Boomers' Perceptions About Physical Activity
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In South Korea, Baby Boomers - those born after the Korean war, between 1955 to 1963, will contribute to demographic trends. Maintaining the health and independent functioning of the baby boomer generation is public health priority in the nation. Among the baby boomers, there is an increasing trend for older adults to adopt physically active lifestyles in an effort to remain healthy and preserve independence. While participating in physical activities (PA) is one of key elements for maintain health, we know surprisingly little about how baby boomers conceptualize PA and the role that PA plays in their lives. **PURPOSE:** The objective of the study was to identify and analyze active baby boomers self-perceptions, the role that PA plays in their identity, and how they incorporate PA to their everyday lives. **METHODS:** Consensus Qualitative Research (CQR) was employed. CQR is a qualitative research method that helps build consensus among a research team and an auditor to yield robust conclusions. Semistructured interviews were conducted with 12 active baby boomers. Date from the interviews were coded and reviewed in depth by the research team with the goal of achieving consensus about the themes that emerged from the study. **RESULTS:** The themes encountered were: self-perceptions and identity, the definition and significance of physical activity, the experience of PA among active seniors. The

major findings were; the active baby boomers perceived themselves and aging process positively due to their healthy bodies, continuing economic activities, and high self-esteem; they defined PA as all movements which needed for their every lives and they believed that their self-esteem and health could facilitate participating in PA; the interviewers appeared to be content with their decisions to maintain a physical activity routine and that self-satisfaction motivated them to continue physical activities and extend to new sports and hobbies.

CONCLUSIONS: The interviews showed PA appear to be important in active baby boomers lives. Increasing our understanding of how and why preferences and values interact with PA, will assist in the development of strategies for increasing PA among baby boomers who are not yet physically active with the goal of improving their health and quality of life.

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Fragile And Feminine? The Effects Of Benevolent Sexism On College Women's Physical Activity

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Women are generally less active than men but the reasons for this gender disparity are not well understood. Benevolent sexism is a seemingly positive, covert form of sexism based on the idea that women are fragile and feminine to compliment the masculinity of men. Endorsement of benevolent sexism has been shown to have a negative impact on work and academic performance in women. Benevolent sexism may inform underlying reasons for the PA gender disparity. **PURPOSE:** To explore the relationship between PA and endorsement of benevolent sexism in young women. **METHODS:** Nineteen women (20.7±1.1 yrs.) completed the International Physical Activity Questionnaire (IPAQ) Short Form and the Ambivalent Sexism Inventory (ASI). The IPAQ was scored for total weekly; minutes of moderate-to-vigorous-PA (MVPA), MET-mins., and Sitting time (ST). The ASI is a 22-item questionnaire with two subscales measuring an individual's endorsement of benevolent and hostile sexism; the mean score (range 0-5) on the benevolent sexism items was used for analyses. Spearman correlations assessed the associations between PA outcomes and endorsement of benevolent sexism. Participants were split into tertiles for each PA outcome. Wilcoxon Rank-Sum tests and Cohen's d assessed the differences in ASI scores between the 1st (T1) and 3rd (T3) tertile. **RESULTS:** MVPA and MET-mins were both negatively associated with benevolent sexism ($r=-0.32$, $r=-0.35$, respectively) but there was no association with ST ($r=-0.06$). There was no significant difference between endorsement of benevolent sexism between participants in T1 and T3 for MVPA (\bar{x} and Interquartile Range) [T1; $\bar{x}=40$,IQR=55), T3; $\bar{x}=68.5$,IQR=150, $p=0.84$, $d=-0.1$] and MET-mins [T1; $\bar{x}=300$,IQR=960), T3; $\bar{x}=2680$,IQR=5040), $p=0.44$, $d=0.72$]. **CONCLUSION:** There was a small, inverse relationship between benevolent sexism and both MVPA and MET-mins, in the hypothesized direction. Additional work needs to further explore these relationships in larger, more diverse samples.

1108 Board #234 May 27 2:30 PM - 4:00 PM

Exergaming And Body Mass Index Among Female Adolescent In Riyadh Saudi Arabia

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(No relevant relationships reported)

Abstract:

Purpose: To examine the association between exergaming and body mass index (BMI) among female adolescents in Riyadh, Saudi Arabia.

Materials and Methods: A sample of 200 female students age 10-14 years in Riyadh, Saudi Arabia completed a self-administered questionnaire with the help of their parents after the completion of an informed consent letter by the parents. Anthropometric measurements of weight and height took place at schools under controlled conditions after the completion of the enrollment questionnaire. The survey instrument included items and scales adopted from the validated Adolescent Sedentary Activity Questionnaire (ASAQ) that assessed the time spent watching TV, videogames as well as sitting hours during weekdays and weekend. The survey questions included the type and duration of exergaming. The questions on the survey were translated into Arabic using the back-method translation. A multiple linear regression model was conducted to examine the association of exergaming with BMI.

Results: There was a significant negative association between exergaming and BMI among Saudi female adolescents after the adjusting for several covariates ($p<0.001$).

Conclusion: Exergaming is associated with lower BMI among female adolescent in Saudi Arabia. This could be an alternative solution for being more active in a population with limited physical activity options due to cultural norms

1109 Board #235 May 27 2:30 PM - 4:00 PM

Association Between Body Mass Index And Waist-hip Ratio And Parameters Of Diet And Sleep In University Students

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(No relevant relationships reported)

A change of lifestyle, college culture, has shown potential in deteriorating students' well-being, especially diet and sleep parameters, which accompanied by public health concern.

Purpose: To determine the association between body mass index and waist-hip ratio and parameters of diet and sleep in university students.

Methods: The sample consisted of 365 university students (n = 107; male, n = 258; female), aged 18-26 years, who enrolled course of Sports and Exercise in the academic year of 2018. Body mass index (BMI) and waist-hip ratio (WHR) were measured at the initiation of course. BMI was calculated by dividing body weight in kilograms by the square of height in meters. Waist circumference (cm) was measured using a measuring tape, from mid-point of the costal margin to the iliac crest in the mid-axillary line or above the belly button. The hip circumference (cm) was taken by measuring their widest point of the greater trochanter. WHR was then being calculated by the measurement of the waist circumference divided by the circumference of the hip. The data regarding parameters of diet and sleep, including dinner time, bedtime, and sleep duration, were collected by a set of online questionnaires which was used as a surveying tool at the end of course. The data expressed as percentage, means, and standard deviation. Pearson correlation was performed with statistically significant at level .05. **Results:** There was evidence that all categories of BMI, underweight (22.7%), normal weight (49.9%), overweight (10.7%), and obesity (16.7%), were mostly female. More than half of students had dinner at 6-8 p.m. which was greater in male (67.3% within sex). The late bedtime, after 12 a.m., was apparently observed in male (52.3% within sex). Most of students reported 4-6 hours of sleep duration, especially female (74.8% within sex). BMI showed a positive association with WHR across all genders ($p<0.001$). While gender was inversely associated ($p<0.05$) among BMI, WHR, and dinner time. **Conclusions:** Gender has a unique affect BMI, WHR, and dinner time. These findings underscore some of the parameters put some individuals at more risks of developing health problems. This should be expanding the scope of wellness program for promoting health in the university students.

1110 Board #236 May 27 2:30 PM - 4:00 PM

Relationship Between The Use Of Social Networks And Physical Activity Level In University Students

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In 2016, more than 1.9 billion adults aged 18 years and older were overweight in the world and of these over 650 million adults were obese. These are preventable conditions that lead to chronic diseases. Overweight prevention includes: changes in eating habits, reduced time in front of the TV and computer to less than two hours a day and increased physical activity. Physical activities and exercise programs have been promoted by social marketing, especially on the social networks (Facebook, Instagram, Twitter). Social marketing it is a carefully planned, long-term approach to change human behavior. This one can be used in different ways to promote the physical activity.

PURPOSE: The purpose of the research is to determine the relationship between social marketing through social networks aimed at exercise programs and the level of physical activity in a group of university students. 50 participants completed a self-administered questionnaire via e-mail or social network. **METHODOLOGY:** Two self-administered questionnaires were: 1) the level of physical activity will be measured using the IPAQ, and 2) the use of social networks with social marketing directed to physical activity exercise programs.

RESULTS: Most of the participants were women with a participation of 79.6%. Age was between 20 and 25 years (40.8%). 93.8% have some electronic equipment where 91.8% access social networks. 32.6% prefer Facebook, Instagram and Twitter within their selection. 36.7% use it 5 to 10 times a day. 49% Access the networks in order to obtain information on health, nutrition, exercises and lifestyle while 57.1% follow an online health or fitness professional. However, 69.4% do not publish their eating habits and 75.5% do not publish on physical activity habits on social networks. The average of weekly minutes in some physical activity in students who follow a health or fitness professional exceed the average of students who do not follow or look for health or fitness professionals.

CONCLUSION: University- aged students have a high use of social networks where they search information about health and fitness.

1111 Board #237 May 27 2:30 PM - 4:00 PM
DO PHYSICAL ACTIVITY PROMPTS FROM CONSUMER ACTIVITY MONITORS ALTER SEDENTARY OR PHYSICAL ACTIVITY BEHAVIORS?

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 (Sponsor: Robert R. Kraemer, FACSM)
 (No relevant relationships reported)

INTRODUCTION: Many consumer activity monitors include features, such as visual and haptic prompts, designed to alter users sedentary (SED) or physical activity (PA) behaviors. However, the ability of these PA prompts to alter SED/PA behaviors is unclear. **PURPOSE:** To evaluate the effectiveness of PA prompts from consumer wearable devices in changing SED/PA behaviors in university employees. **METHODS:** 25 university employees (43.5±9.2yrs) without a history of consumer activity, monitor wear volunteered to wear a Fitbit Alta HR (FB) that was randomly assigned to administer PA prompts (Prompt group) or no PA prompts (Non-Prompt group). Participants were blinded to the aims of the study. Before receiving a FB, participants wore an activPAL (PAL) for 5 days to measure baseline SED/PA behaviors. After returning the PAL, participants wore the FB for 12 consecutive days during all waking hours and rewore the PAL for the last 5 days of the FB wear period. PA prompts were triggered when participants achieved <250 steps in the first 50 minutes of an hour from 6 am to 8 pm each day. Changes in PAL measured SED/PA were adjusted for baseline values. Average FB steps were calculated during the first 50 mins and last 10 mins of each hour and compared between hours when a prompt was received (Prompt group) or would have been received (Non-Prompt group). **RESULTS:** When participants achieved <250 FB steps in the first 50 min of an hour, the average FB steps in the last 10 minutes of these hours was significantly lower ($p<0.01$) when a prompt was given (49±21 steps) compared to when a prompt was not given (Non-Prompt group) (91±45 steps). Changes in overall PAL sitting time were not significantly different ($p=0.36$) between the PA prompt group (Mean±SD change; 38.7±93.4 min/day) and Non-Prompt control group (3.9±88.5min/day). Changes in PAL standing time were also not significantly different between groups ($p=0.47$) (Prompt group: 13.3±76.5 min/day, Non-Prompt group: 36.2±75.7 min/day). **CONCLUSIONS:** PA prompts did not influence SED/PA behaviors in university employees. Further research is needed to assess the effectiveness of PA prompts provided by other wearable brands and in larger and more diverse samples, including clinical populations.

1112 Board #238 May 27 2:30 PM - 4:00 PM
Abstract Withdrawn

B-76 Free Communication/Poster - Health Promotion/Interventions Among Those with Disabilities

Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
 Room: CC-Exhibit Hall

1113 Board #239 May 27 2:30 PM - 4:00 PM
Perceived Barriers Of Physical Activity In Danish Manual Wheelchair Users

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Physical activity reduces the risk of chronic diseases in mobility disabled populations including manual wheelchair users (MWCU). Nevertheless, physical activity level is low in MWCU.

PURPOSE: To define physical activity barrier prevalence and impact among Danish MWCU and association with physical activity level.

METHODS: We translated The 'Barriers to Physical Activity Questionnaire – Mobility Impairment' (BPAQ-MI) from English to Danish according to published guidelines. Danish MWCU (N=133) completed BPAQ-MI online; 51% were female, 64% had a spinal cord injury, and 50% were unemployed. Mean ± SD for age, BMI, & years in chair were: 48±13 yrs, 25.8 ± 6.3 kg/m², & 17±14 yrs. The BPAQ-MI covers subdomains of intrapersonal, interpersonal, organizational and community barriers. Participants first indicated if a barrier hindered them from physical activity participation in the last 3 months. If "no", impact was scored as 0, and

if "yes", impact was scored 1-very small to 5-very big. Self-reported physical activity level (PAL) was rated from 1-"not being physically active at all" to 10-"extremely physically active".

Individual barrier prevalence was computed as frequencies (% of yes). Individual barrier impact was computed as 1 to 5 and reported as median. Summed barrier impact was computed as the sum of individual questions within each subdomain. Spearman's rho identified associations between PAL and subdomain summed barrier impact.

RESULTS: The 3 most prevalent barriers included 2 intrapersonal (~63%) and 1 community (55%) barrier.

The 3 most impactful barriers all had a median score of 5 (very big impact), but were less common: 2 organizational (0.8%, 23%), and 1 community (40%) barrier, PAL was inversely associated with interpersonal ($r=-0.175$, $p=0.05$) and intrapersonal ($r=-0.523$, $p<0.00$) summed impact. PAL was not associated with organizational ($r=-0.124$, $p=0.16$) or community ($r=-0.025$, $p=0.77$) summed impact.

CONCLUSION: Intrapersonal barriers were highly prevalent. Increased cumulative intrapersonal barrier impact was moderately associated with lower PAL, indicating that a higher perception of physical activity barriers are related to lower PAL. Finally, the results suggests that specific organizational and community barriers could be impactful at the individual level when they are present.

1114 Board #240 May 27 2:30 PM - 4:00 PM
From Development To Global Implementation Of Special Olympics Fitness Programs For People With Intellectual Disabilities

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PURPOSE: People with intellectual disabilities (ID) are at greater risk of obesity, diabetes, and cardiovascular disease compared to typically developing peers. People with ID face disparity and lack access to many healthcare services so community-based fitness and physical activity interventions can be crucial ways to improve health in this population at high risk. Yet, most fitness interventions are not designed for people with intellectual disabilities (ID), often due to cost, accessibility, and literacy level. Special Olympics Inc. (SOI), a leading non-profit sports organization for people with ID, has made it a priority to improve health in the ID population through increasing fitness and physical activity. **METHODS:** This case study describes the process of developing and implementing fitness models for people with ID. Special Olympics Inc. (SOI) assessed fitness activities being done in local Special Olympics Programs (SO Programs) for effectiveness, feasibility, replicability, and scalability. Then, SO Programs were funded to continue fitness activities and collect data. SOI endorsed three of these 'fitness models' that showed most promise. SOI then funded other SO Programs to implement the models between 2016-2018. The results from that implementation is assessed. **RESULTS:** 5481 individuals from 75 SO Programs in 48 countries participated. Key components of fitness models were group fitness sessions, including participants without ID, goal setting, and incentives. Over 90% of SO Programs collected baseline systolic and diastolic blood pressure in >80% of participants. Programs were less likely to have >80% completed baseline data for weight (76.7% of programs), height (75.0%), and BMI (75.0%). For those that started in 2016, >99% had data from two time points. In 2017, 88.8% had two data time points or more and in 2018 70.1% had data from 2 or more time points. SO Programs reported participants were empowered and were motivated by the incentives. Getting buy in from participants families and the community greatly improved the implementation. However, data collection issues were common. **CONCLUSION:** Based on the ability to enroll participants, collect data, and implement the activities, SOI fitness models may be a feasible fitness intervention for people with ID. Supported by CDC Grant U27 DD001156.

1115 Board #241 May 27 2:30 PM - 4:00 PM
Effects Of An 8-week Judo Program On Behaviors In Children With Autism Spectrum Disorder

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PURPOSE: Prior studies suggest that a combination of physical activity and mind-body exercises, often seen in martial arts, may attenuate negative behaviors in youth with Autism Spectrum Disorder (ASD). Therefore, the aim of this study was to examine the effects of an 8-week judo program on behavioral factors in children with ASD, using a mixed-methods approach.

METHODS: A total of 25 children (ages 8-17), diagnosed with ASD, participated in an 8-week judo program (1x week). Parents of participants were given the Aberrant Behavior Checklist (ABC) to compare the severity of ASD-related behavior at baseline

and at the end of the program. A subset of parents (n=9) participated in semi-structured interviews that focused on their child's behaviors during the judo program. Non-parametric paired t-tests were conducted to compare differences in ABC subscales (irritability, hyperactivity, stereotypic behaviors, lethargy, inappropriate behaviors) at baseline and at the end of the program. Interviews were coded independently by two trained researchers and categorized into behavioral themes.

RESULTS: Participants attended an average of 7.04 ± 1.06 classes (out of 8 possible sessions). Although both irritability (6.38 vs. 5.28) and hyperactivity scores (11.03 vs. 9.08) decreased following the judo program, the difference was not significant ($p > 0.05$). Parent interviews revealed that 78% of parents observed improvements in both social skills and self-esteem as a result of the judo program.

CONCLUSIONS: Despite no significant differences in ABC scores pre- and post-judo, data from parent interviews indicate improvements in self-esteem and social skills. Future studies should further examine the effects of judo in a larger sample of youth with ASD, and include control conditions (e.g. no exercise group) for comparison purposes.

1116 Board #242 May 27 2:30 PM - 4:00 PM

Use Of Smartphones To Self-report Eating And Exercise In Young Adults With Intellectual Developmental Disability

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Internet applications (apps) have been shown to motivate people to form and maintain healthy dietary (D) and exercise (Ex) habits. However, research on the effectiveness of using apps by persons with Intellectual and Developmental Disabilities (IDD) is limited. **PURPOSE:** To evaluate the use of a smartphone app (Ap) compared to app plus text reminders (Ap+T) for tracking D and Ex behavior in persons with IDD in an independent setting without caregiver support. **METHODS:** Young adults (n=5, 19-26 yrs) who were enrolled in a college experience program consented to participate in the study which had been approved by the university's IRB. Participants were living on campus and had their own smartphones. Baseline conditions were determined as participants used paper and pencil to self-record D and Ex for at least 5 days. In a single-case design, participants served as their own controls and were randomly assigned to alternating treatments of Ap or Ap+T conditions. The Ap (Kurbo Health Inc.) allowed tracking of food items and portions as well as exercise tracking in 10-minute segments. The Ap+T condition added 4 times/d text message reminders about recording D and Ex. Treatment conditions changed every 1-2 days in random order over the course of 3 weeks. Data analysis included evaluation of mean level increases and percentages of nonoverlapping data (PND) between conditions. **RESULTS:** Participants demonstrated mean level increases from baseline to Ap (range: 15-66%) and baseline to Ap+T (range: 23-72%). Comparisons between baseline and treatment conditions yielded PND scores ranging from 45-77% for Ap and 33-92% for Ap+T. Comparison between treatments revealed a PND range of 0-50%. **CONCLUSION:** Although neither treatment emerged as superior, results of the study indicated that use of smartphone apps by persons with IDD increased self-recording of D and Ex behaviors and is a promising tool for promoting independent living skills.

1117 Board #243 May 27 2:30 PM - 4:00 PM
Objectively Measured Physical Activity And Sedentary Time In Adults With Autism Spectrum Disorder

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PURPOSE: Adults with autism spectrum disorder (ASD) are purportedly inactive, but this conclusion is inferred from data on children and youth, and parent proxy reports. Objective assessment using activity monitors is needed to better understand physical activity (PA) and sedentary behavior in this population segment. The purpose of this study was to examine the general levels of PA and sedentary time in adults with ASD using accelerometry.

METHODS: Eleven adults aged 18-55 (6 females; mean = 31.9, SD = 12.5) and diagnosed with ASD were included in the study. Participants wore a GT3X+ accelerometer on their right hip for 7 days during waking hours except water-based activities, and accelerometers were programmed to collect data in 60-second epochs. ≥ 10 hours of device wear was defined as a valid day and ≥ 3 valid days was required for each participant to be included in the analyses. Activity intensities were determined using the following cutoffs (counts/min): sedentary <100, low 100-499, light 500-2019, moderate 2020-5999, and vigorous >5999 (Tudor-Locke et al., 2010), and non-wear period was determined by a minimum length of 90 min of consecutive

0-counts by Choi algorithm (Choi et al., 2011). Descriptive statistics were calculated for moderate to vigorous PA, light- and low-intensity PA, sedentary time, and walking steps.

RESULTS: The average total monitored length was 761.5 min/day (SD = 76.4). Results of the PA measures are as follows: moderate to vigorous PA - 42.8 min/day (SD = 30.5); light PA - 109.9 min/day (SD = 32.4); low PA - 97.9 min/day (SD = 33.9); and sedentary time - 511 min/day (SD = 84.6). The daily average percentage of time spent in moderate to vigorous PA was 5.8% (SD = 4.4), and the average step counts were 3799.7 steps/day (SD = 2953.9). 81.8% of the participants met the recommended PA guidelines of 150 min of moderate to vigorous PA per week.

CONCLUSION: Although the majority of adults with ASD in this study met the PA guidelines, they were also extremely sedentary. More research is needed to determine if sedentary time, rather than PA, should be targeted to improve preventive health in adults with ASD.

1118 Board #244 May 27 2:30 PM - 4:00 PM
Feasibility Of The Assessment Of The H-reflex In Adult Dancers And Non-dancers With And Without Down Syndrome: A Pilot Study.

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PURPOSE: The analysis of monosynaptic Hoffman's reflex (H-reflex) involves recording the response to electrical stimulation of Ia-afferent fibers from the muscle spindle. The H-reflex can be used as a probe to study spinal neuronal pathways and mechanisms at rest and during movement in humans. The purpose of this study was to analyze the feasibility of the assessment of the H-reflex in people with Down syndrome (DS), and to compare it between adult dancers and non-dancers with and without DS.

METHODS: Twenty-five participants were included and divided into four groups (6 non-dancers and 6 dancers with DS and, 7 non-dancers and 6 dancers without DS). The H-reflex was recorded at the level of the soleus muscle in its central area. We analyzed the H response in three different conditions: decubitus prone, static standing position with open eyes and closed eyes. **RESULTS:** Non-dancers with DS showed a faster H-reflex latency than both groups without DS (all $p < .005$). In the present study, we provide evidence of the feasibility of eliciting the H-reflex in adults with DS. Interestingly, the H-reflex was present in decubitus position but not in standing position in most non-dancers with DS and dancers without DS. **CONCLUSIONS:** The data from this study can help to perform future research in adults with DS and the development of full-scale studies to analyze this variable in adults with intellectual disability with and without DS.

1119 Board #245 May 27 2:30 PM - 4:00 PM
Heart Rate Variability Response Following Two Physical Activity Programs In Senior With Intellectual Disability

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Introduction: Improvements on heart rate variability (HRV) in healthy persons were found following exercise programs. There are gaps in our knowledge about the response of the HRV in seniors with intellectual disability (ID) without Down Syndrome (DS). **Purpose:** To compare the HRV response before, during and after 6-minutes walking test (6MWT) in seniors with ID without DS after two different exercise programs.

Methods: Fifteen seniors with mild to moderate ID without DS participated in this study. Participants were randomly divided into 3 randomized groups: sprint interval training group (SITG), combined-aerobic exercise group (AEG) and control group (CG). Participants from the SITG and AEG performed exercise 3 times/wk, 1.5 hs, during 24 wks. The 6MWT was performed before and after the programs. The intervals between R waves (RRi) were registered at rest (10 min), during the 6MWT and during the recovery (10 min) with a Polar RS800CX. HRV was analyzed by linear measures (variance) and nonlinear measure (symbolic analysis - 0%V and 2U%V). 0%V indicates sympathetic and 2U%V parasympathetic modulation.

Results: Distance walked on 6MWT, variance and 0%V values do not present effect of group, moment or interaction. Better values on mean ($p < .001$) and 2U%V ($p < .01$) were founded in post-intervention in comparison with pre-intervention, but neither group effect nor interactions were observed.

Conclusion: Despite there is a tendency showing better HRV response values after physical activity programs, it cannot be concluded that exercise promotes beneficial

changes on HRV responses. We believe that future studies with larger sample size are necessary to get across the changes on autonomic cardiac function and exercise in seniors with ID without DS.

Funding sources: MINECO (DEP2017-86862-C2-1-R); AGAUR (2019 FI_B 00893); Ministerio de Ciência e Tecnologia de Brasil (PDSE/CAPES 88881.189815/2018-01).

Moment	Variables	AEG (n = 5)		SITG (n = 4)		CG (n = 6)	
		Pre-training	Post-training	Pre-training	Post-training	Pre-training	Post-training
Resting period	RRi mean (ms)*	867.80 (70.47)	820.34 (130.29)	757.17 (87.02)	813.89 (48.07)	844.52 (141.96)	850.51 (128.42)
	Variance (ms ²)	1045.36 (483.70)	848.69 (545.10)	1516.70 (1096.26)	1254.71 (367.72)	1881.25 (1064.71)	2068.76 (2361.60)
	0V%	32.07 (08)	34.03 (8.90)	32.94 (6.27)	24.11 (11.66)	38.24 (13.18)	36.21 (26.29)
6MWT	2UV%**	11.84 (3.33)	12.78 (4.64)	8.63 (2.26)	15.68 (6.75)	13.40 (8.68)	17.19 (12.35)
	RRi mean (ms)*	509.16 (92.53)	502.44 (104.67)	516.73 (23.25)	517.10 (67.68)	569.73 (142.69)	603.63 (62.58)
	Variance (ms ²)	78.33 (59.10)	66.69 (70.10)	82.03 (46.50)	135.22 (104.45)	409.90 (400.10)	220.36 (241.85)
Recovery period	0V%	29.49 (12.50)	21.57 (6.37)	32.25 (18.49)	28.33 (22.87)	32.03 (12.90)	36.14 (22.17)
	2UV%**	20.71 (7.91)	26.35 (2.95)	15.10 (8.35)	21.18 (10.27)	20.98 (10.52)	22.81 (15.25)
	6MWT distance	515.40 (47.51)	539.80 (44.57)	508.50 (62.98)	537.75 (69.77)	470.17 (87.50)	464.33 (66.62)
Recovery period	RRi mean (ms)*	763.14 (92.43)	757.94 (107.57)	699.48 (88.98)	694.49 (76.17)	796.50 (125.33)	821.34 (116.30)
	Variance (ms ²)	1206.15 (1226.26)	1014.60 (1211.97)	766.06 (426.17)	1566.97 (891.03)	1462.89 (1017.59)	2011.49 (1287.76)
	0V%	32.82 (7.29)	32.47 (15.81)	34.90 (10.87)	46.67 (15.59)	27.84 (9.57)	38.69 (16.53)
Recovery period	2UV%**	9.98 (4.02)	14.04 (9.86)	8.13 (3.38)	6.47 (3.64)	19.74 (9.81)	13.46 (9.75)

Note: values are means (Standard Deviation).
 Results are based on a Two-way repeated-measures ANOVA at rest, 6MWT and recovery condition. Effect of group, moment (pre vs post training) and interaction was verified with significant level set at p<0.05
 Abbreviations: 6MWT (6-minutes walking test); AEG (Aerobic group); SITG (sprint interval training group); CG (control group); RRi (intervals between R waves)
 * Significant difference (p ≤ .01) between moments
 ** Significant difference (p ≤ .001) between moments

1120 Board #246 May 27 2:30 PM - 4:00 PM
Analysis Of The Cortical Hemodynamic Responses To Active-assistive Exercise In Individuals With Parkinson's Disease.

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 (No relevant relationships reported)

Background: Gait and motor impairments are common symptoms in people with Parkinson's disease (PD). Previous studies found active-assistive exercise to be effective in improving PD symptoms. The underlying neural mechanism contributing to these improvements is currently unknown. No previous studies have investigated how the brain responds to active-assistive exercise in people with PD. **Purpose:** To investigate the cortical hemodynamic responses to active-assistive exercise in individuals with PD. **Methods:** A total of 7 individuals with PD (70.29 ± 5.44) and 10 controls (58.71 ± 9.30) participated in this cross-sectional study. All participants completed three modes of exercise including active exercise (AE), passive exercise (PE), and active-assistive exercise (AAE) using computerized cycling equipment (MOTomed viva 2, RECK MOTomed, Betzenweiler, Germany, 2017). Each mode of exercise was performed at a predetermined pace for 10 minutes on three separate days while a neuroimaging device, functional near-infrared spectroscopy (NIR Sport, NIRx Medical Technology, Berlin, Germany, 2017) captured oxy-hemoglobin (HbO) levels in the prefrontal lobe. **Results:** Repeated measures ANOVA showed no significant difference in ΔHbO among exercise modes. A trend showed that the PD group displayed the greatest level of ΔHbO during PE and minimum with AE. A 2x3 mixed model ANOVA revealed no significant group x mode interaction. However, a trend showed that the PD group displayed greater levels of ΔHbO during PE and AAE whereas the control group revealed greater levels during AE and AAE. Four representative channels were selected for regional comparison of brain activation during AAE between groups. They demonstrated significant differences in the middle frontal cortex (p<.049), orbital cortex (p<.039), intermediate frontal cortex (p<.033), and granular frontal cortex (p<.022). **Conclusion:** Our findings suggest that people with PD showed higher levels of brain activity during passive and active-assistive modes of exercise as compared to active cycling. Brain activity levels during active-assistive

exercise can be different when compared to those without PD. The results may help understand the underlying neural mechanism associated with positive outcomes following active-assistive exercise in PD.

1121 Board #247 May 27 2:30 PM - 4:00 PM
Impact Of Marriage On Physical Activity Behavior In Women With Multiple Sclerosis

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PURPOSE: Support is critical for individuals with multiple sclerosis (MS) to adopt and continue physical activity (PA). The role that spouses play in the adoption and continuation of PA in women with MS has yet to be explored.

METHODS: Four women with MS volunteered for in-depth interviews lasting approximately an hour. The interviews were semi-structured and covered topics such as: marriage context, PA choices and behaviors, PA activities alone and with spouse, etc. Interviews were transcribed (with identifiers removed) and analyzed in case studies, then cross-cases for overlapping themes.

RESULTS: Four cases were developed. Theresa is an older woman with MS for which PA is encouraged by her spouse, and some PA is engaged in together, such as walking pets. She states, "It's not walking like we used to walk, but we are out there together." Margaret is an older woman with MS for which PA is engaged in completely alone. Intentional PA is performed alone because of her spouse's lack of motivation. She states, "I always feel like he could use it as much as I could, but there's no motivation and he has to motivate himself." Claire is a young woman with MS who engages in PA outdoors with her spouse but feels her choices in PA done together can be dependent on her spouse's desires over her own. She states, "Maybe sometimes if he's not with me, I would um... push myself harder I think." Joanna is a mid-life woman with MS who engages in PA outdoors with her spouse and children, as well as indoors with a personal trainer focused on mobility. She feels that her spouse provides support in both types of PA. She states, "Oh, he so strongly encourages it! He, he is honestly my #1 fan if, if there is something new that I did at the gym that day, he wants to see it, he wants to do it... knowing he has my back and is in my corner lets me know that you know it will be a struggle but it is, it is worth it." All four women discussed the importance of support in PA, despite differences in spousal engagement in PA.

CONCLUSIONS: This study points to the importance of support and perception of support by marriage partners for women with MS. Future physical activity programs for women with MS should consider the role marriage partners play in decisions to be physically active. Effectiveness of PA interventions might be enhanced by increasing the involvement of marriage partners.

1122 Board #248 May 27 2:30 PM - 4:00 PM
Multimodal Pain Management Following Total Knee And Hip Arthroplasty: Impact On Functional Outcomes

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 (No relevant relationships reported)

PURPOSE: To investigate if multimodal pain medication management improves functional status and decreases opioid consumption in the inpatient subacute rehabilitation setting following total hip and knee arthroplasty.

METHODS: Retrospective cohort electronic medical record analysis over a three-year period. Patients divided into 3 groups based on pain regimens: Opioid Only (O), Opioid and NSAIDs (NS), Opioid and Neuromodulators (ON). Morphine milligram equivalent (MME) doses were calculated for all opioids. Charts were evaluated for Functional Independence Measure (FIM) scores in walking, wheelchair, bathing, toilet transfer, bed transfer, and walking distance.

RESULTS: A total of 161 patients were included in the study: 99 O, 43 ON, and 19 NS. The mean age of the study population was 65 years old, with 70% of patients being female, African American, and having received unilateral knee replacement surgery. There were no significant inter-group demographic differences. The ON group showed the greatest improvement in FIM scores for Walking, Wheelchair mobility, Bathing, and Bed transfers (See FIM Score table). All patients treated with multimodal pain regimens improved from walking 50-149 feet on admission to greater than 150 feet on discharge, whereas 3/17 patients treated with opiates only did not improve to walking greater than 150 feet. At discharge, the O group was using ~59 morphine milligram equivalent (MME) doses per day, whereas the ON group was using 50 MME, and the NS group was using 41.5 MME. Differences in FIM scores and MME dosing did not reach statistical significance.

CONCLUSIONS:

Patients treated with multimodal pain regimens achieved CDC recommended guidelines of <50 MME per day on discharge. Patients treated with opiates and neuromodulators showed the greatest functional outcome gains in 4/5 categories.

Functional Status

	Group	Walking	Wheelchair	Bathing	Toilet transfer	Bed transfer
Admit	O	3.48	4.32	3.76	4.11	3.89
	ON	2.84	3.67	3.11	3.95	3.55
	NS	3.52	4.05	3.94	4.31	3.94
Discharge	O	5.72	5.81	5.63**	5.88	5.84
	ON	5.42	5.55	5.46**	5.65	5.6
	NS	5.89	5.57	5.31**	6	5.94
FIM Change	O	2.24	1.49*	1.86	1.77	1.94
	ON	2.58	1.88*	2.34	1.69	2.04
	NS	2.36	1.52*	1.36	1.68	2

*p = 0.076
**p = 0.073

1123 Board #249 May 27 2:30 PM - 4:00 PM

Addition Of A Kinesiologist-guided Functional Exercise To Intradialytic Cycling Program: A Randomized Controlled Trial

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Purpose Intradialytic cycling is a widely used workout mode for hemodialysis patients whereas added benefit of other exercise modalities remains unknown. This is the first randomized controlled trial on the effects and sustainability of the functional training and exercise counseling in addition to a standard basic intradialytic cycling exercise program. **Methods** Patients were randomly assigned to a kinesiologist-guided functional training in addition to intradialytic cycling (n = 20, experimental group) or intradialytic cycling only (n = 20, control group) over 16 weeks. The experimental group attended predialysis guided functional exercise and counseling session in the first 8-week induction phase. In the second 8-week maintenance phase, the experimental group was encouraged to perform functional training at home on non-dialysis days. The main study endpoint was 10-repetition-sit-to-stand test time at 8 weeks. **Results** In the 10-repetition-sit-to-stand test at 8 weeks, the experimental group improved significantly better than controls (-4.5±1.9 s, 95% CI -8.4 to -0.7; P=0.021), which was maintained at week 16 (-4.7±2.1 s, 95% CI -9.0 to -0.3; P=0.037). For the secondary endpoints at week 8, the experimental group significantly outperformed controls at handgrip strength for 3.7±1.2 kg (95% CI 1.3 to 6.2; P=0.004), sit-and-reach lower body flexibility test for 5.8±1.4 cm (95% CI 2.9 to 8.6; P<0.001), Stork balance test for 0.7±0.2 s (95% CI 0.4 to 1.1; P<0.001), and back scratch upper body flexibility test for 5.8±1.8 cm (95% CI 2.2 to 9.5; P=0.003). At week 16, superior results of the experimental group in secondary end-points remained preserved for handgrip strength, balance, and back scratch flexibility tests (p<0.05 for all). No major exercise-related adverse events were observed. **Conclusions** Functional training with exercise counseling added to basic intradialytic cycling program meaningfully improves physical performance and successfully prepares dialysis patients for sustainable home exercise.

1124 Board #250 May 27 2:30 PM - 4:00 PM

Effect Of A Rural Multidisciplinary Community Program On Postural Stability Among Individuals With Parkinsonism

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Parkinson's disease (PD) is a multimodality disorder that often times impairs an individual's gait, balance, cognition, speech, swallowing and overall quality of life. Alarming, individuals with PD are two times more likely to fall when compared to individuals with other neurological disorders and are thus 60-70% more likely to experience a fall when compared to the generally healthy geriatric population. **PURPOSE:** The purpose of this study was to examine the effect of a rural multidisciplinary community program on balance among individuals with Parkinson's disease and Parkinson plus conditions. **METHODS:** Participants with idiopathic PD or corticobasal degeneration (CBD) with no co-existing neurological disorders (n=6) engaged in a 16-week rural multidisciplinary community program that met weekly for 90 minutes. The Biodex Balance System was used to assess postural stability which

is an indicator of balance. The dependent variables were OSI, API, MLI with eyes opened and eyes closed. Wilcoxon Signed Rank test was utilized to analyze differences in balance pre and post 16-week intervention. The treatment session consisted of 45-minute dual-task fall prevention exercises followed by a 45-minute speech and cognitive program (i.e., the LOUD Crowd® program). **RESULTS:** The average duration of the disease was 5.5 years. There were statistically significant results at post-data collection for MLI eyes open (Z = -2.201, p = .028), OSI eyes closed (Z = -1.997, p = .046), API eyes closed (Z = -2.023, p = .043), and MLI eyes closed (Z = -2.207, p = .027). However, there were no statistically significant results for OSI eyes open (Z = -.420, p = .675) and API eyes open (Z = -1.472, p = .141). **CONCLUSION:** Findings from the study suggest that a rural multidisciplinary community program that utilizes dual-task fall prevention, speech, and cognitive exercises may be beneficial for improving balance among individuals with Parkinson's disease and Parkinson plus conditions. Researchers recommend a follow-up study with a larger sample size and a true control group. This research project was partially sponsored by the Parkinson's Foundation Community Grant.

1125 Board #251 May 27 2:30 PM - 4:00 PM

Effectiveness Of SNPE On Disability, Range Of Motion, Muscular Strength, And Pelvic Pain In Women With Chronic Low Back Pain

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Purpose The SNPE (Self Natural Posture Exercise), developed and practiced widely in Korea uses unique tools and body correction belts to make tension release and to correct unbalanced posture. This study examined the effectiveness of SNPE on disability, range of motion (ROM), muscular strength, and pelvic pain in young women with chronic low back pain. **Methods** Twenty five women (27.6±6.5 yrs, 23.8±3.8 kg/m²) who had back pain for more than 3 months and scored 5-14 of the Korean Oswestry Disability Index (KODI) were divided into three groups; SNPE group (SNPEG, n=9), stretching group (SG, n=8), and non-exercise group (NG, n=8). SNPEG and SG participated in a respective 60 min exercise program twice a week for 12 weeks, while NG did not. KODI, Remodified Schober Test, Finger-to-Floor Distance Test, back strength, and VAS were measured at pre and post of 12 weeks. Statistical analysis was performed by paired t-test and ANCOVA. **Results** The lumbar disorder index was significantly decreased in SNPEG (pre: 7.6±2.7 vs. post: 3.1±2.7, p<0.001), and the decrease was the biggest in SNPEG than other two groups (p<0.001). Flexion of lumbar increased from 22.4±2.7 to 26.8 ± 2.9 cm (p<0.05) while extension decreased from 12.2±1.0 to 10.9±1.0 cm (p<0.05). Lateral flexion to left side was decreased from 46.8±3.9 to 42.5±2.7 cm in SNPEG and from 46.6±3.2 to 44.7±3.4 in SG (p<0.01), and lateral flexion to right side showed similar changes (p<0.01). No changes in lateral flexion to both side in NG was found. The changes in flexion, extension, and lateral flexion to left and right were the largest in SNPEG (p<0.05). Back strength increased in SNPEG from 57.5±13.4 to 72.6±12.5 kg (p<0.001), while other groups did not increase. Pelvic pain in SNPEG decreased in all 10 sites from 4.6±1.1, 3.0±1.5, 6.5±1.4, 5.8±1.6, 4.7±2.2, 5.7±1.9, 5.2±2.5, 6.3±2.1, 6.3±2.2, and 6.4±2.4 to 0.7±0.9, 1.2±1.3, 2.3±1.5, 2.2±1.6, 1.6±1.9, 2.1±1.6, 2.5±2.2, 3.1±2.4, 1.8±0.8, and 1.7±0.8 in Sacrum left and right (L-R), Iliopsoas L-R, Lateral Iliac Crest L-R, Adductor L-R, and Gluteus maximus L-R, respectively (p<0.05). Pelvic pain in SG also decreased in all sites (p<0.05) while not in NG. **Conclusion** The results suggest that the SNPE can be an effective exercise program for improving disability, ROM, muscular strength, and pelvic pain release in young women with low back pain.

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Arm Use In The Humeral Elevation Range Of Tendon Compression For Manual Wheelchair Users

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Shoulder tendon pathology is 10 times more likely in chronic manual wheelchair (MWC) users than in controls [1]. The increase in pathology is often attributed to a narrowing of the subacromial space, which is smallest between 30-60° of humeral elevation (HE) [2]. MWC users spend significantly more time in 30-60° of HE than controls [3]; however, their arm activity while in this workspace is unknown. **PURPOSE:** To determine the active and sedentary time of the arms for MWC users and controls while in 30-60° of HE. **METHODS:** Under IRB approval, participants wore three wireless inertial measurement units (Emerald, APDM, Inc.; 128 Hz) on their bilateral upper arms and

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torso for one to two days. Custom MATLAB (MathWorks, Inc.) code calculated the HE [3] and acceleration-based activity levels [4] of both arms for each second. The percentage of daily wear time each participant spent in sedentary and active time in 30-60° of HE was calculated for each arm. Separate paired t-tests were used to determine differences between cohorts ($\alpha < 0.05$).

RESULTS: 34 MWC users (sex: 6f, age: 43 ± 13, injury level: C6-L1, years since injury 11 ± 11) and 34 controls (sex: 6f, age: 43 ± 13) were enrolled. MWC users and controls spent similar amounts of time active; however MWC users spent a significantly higher percentage of time sedentary.

Percentage of the day spent active, sedentary, and overall in 30-60° of humeral elevation			
	Manual Wheelchair Users	Control	p-value
Percentage of day in 30-60° of humeral elevation (%) [3]: Dominant Arm	63.6 ± 14.4	50.4 ± 13.1	<0.0001
Percentage of day in 30-60° of humeral elevation (%) [3]: Non-Dominant Arm	59.5 ± 14.3	48.4 ± 13.5	0.003
Percentage of daily wear time spent active (%) in 30-60° range of humeral elevation: Dominant Arm	23.6 ± 8.8	21.1 ± 7.6	0.25
Percentage of daily wear time spent active (%) in 30-60° range of humeral elevation: Non-Dominant Arm	21.5 ± 9.3	19.5 ± 8.9	0.41
Percentage of daily wear time spent sedentary (%) in 30-60° range of humeral elevation: Dominant Arm	40.6 ± 15.2	30.2 ± 11.8	0.002
Percentage of daily wear time spent sedentary (%) in 30-60° range of humeral elevation: Non-Dominant Arm	38.9 ± 14.9	29.4 ± 11.6	0.007

CONCLUSIONS: Although MWC users spend more time in 30-60° of humeral elevation, the majority of this time is sedentary, emphasizing the importance of understanding other factors such as arm loading and velocity of movement in this population. MWC users may be loading their arms more while in sedentary (i.e., resting condition) and active (i.e., propulsion) conditions, which may contribute to the increase in pathology.

[1] Akbar M et al., 2010. JBJS, 92:23-30.[2] Larence R et al., 2017. J Orthop Res, 35:2329-37. [3] Goodwin B et al., 2019. Under Review. [4] Lugade V et al., 2014. Med Eng Phys, 36:169-76. Supported by NIH R01HD84423-01 and NCATS UL1 TR002377

1127 Board #253 May 27 2:30 PM - 4:00 PM

An Adapted Judo Program Improves Psychosocial Behaviors In Children With Autistic Spectrum Disorders

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INTRODUCTION: Persons with Autistic Spectrum Disorder (ASD) present several effects on the neurological development, with difficulties on social, behavioral and communication abilities that negatively affect daily life activities. Judo is a sport with great pedagogical tradition that provides benefits in children with ASD further than the physical activity by itself. **PURPOSE:** to study the evolution of psychosocial behavior of children after an adapted judo program, a study of feasibility

METHODS: 11 children of both sexes (age 11,36 ± 2,34 year, height 156,78 ± 7,37 cm, and weight 56,71 ± 7,14 kg) participated in the study after obtaining the IRB approval, informed consent from their parents/legal tutors and informed assent from themselves. After 8 controlled weeks without an intervention, all the children participated in an adapted judo program once every week during 12 weeks. Psychosocial behavior was measured with the Gilliam Evaluation Scale used for ASD diagnosis (GARS-3), who includes 6 sub-scales: Repetitive Behaviors, Social Interaction, Social Communication, Emotional Responses, Cognitive Style, Maladaptive Speech. The GARS-3 was applied to the same sample three times: baseline, after 8 weeks without intervention (as control assessment) and after 12 week of intervention. Descriptive for all variables and an ANOVA of repeated measurements were calculated to study differences Baseline, pre and post intervention ($p < 0.05$).

RESULTS: No differences were found between the first and second assessment in all six sub-scales, as expected. Between the second and the third assessments, there were significant differences in the Social Interaction sub-scale (17.7 ± 10.1 vs 9.1 ± 4.3; $p < 0.05$) showing an improvement post-intervention, as a low value does not correspond to a typical ASD behavior

CONCLUSIONS: Adapted judo program can improve psychosocial behaviors in children with ASD. More research is needed increasing the number of participants and the number of sessions per week.

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Physical Activity And Shoulder Health Behaviors In Recreational Wheelchair Athletes

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PURPOSE: To assess exercise habits, injury prevention behaviors, and the prevalence of shoulder pain in a population with physical disabilities involved in adaptive sports.

METHODS: A cross-sectional descriptive survey was completed by 24 recreational wheelchair athletes (13 male, 11 female) age 13 and older. Participants were surveyed at two separate community events promoting adaptive sports participation. All participants were cognitively able to complete the survey independently. **RESULTS:** 70.8% of respondents practiced, competed, or trained in their primary sport year-round, and 29.2% participated in more than one adaptive sport. When in-season 58.3% reported achieving >150 minutes of moderate to strenuous exercise per week, and 41.7% achieving >240 minutes per week. Compared to the off-season, 45.8% and 25.0% of athletes completed >150 minutes per week and >240 minutes per week of moderate to strenuous exercise respectively. 58.3% reported not being satisfied with their amount of physical activity, citing time, access to adaptive equipment and facilities as the most common barriers. 62.5% reported shoulder pain as a result of adaptive sports participation, 41.7% had experienced shoulder pain in the past year, and 37.5% endorsed shoulder pain interfering with daily function. 75.0% reported regularly performing injury prevention exercises, but of those who did not, access to equipment and lack of information on current recommendations were cited as the most common barriers. Encouragingly, a majority of respondents reported discussing physical activity (95.8%) and shoulder health (75.0%) with a health care professional.

CONCLUSION: Within this group of adaptive athletes most participants reported significant amounts of physical activity when engaged in their primary sport, however a notable decrease in activity was noted during off-season periods. Most athletes had experienced shoulder pain as a result of sport participation, with this pain frequently interfering with daily function. Given barriers identified, implementation of adaptive fitness and injury prevention programs should focus on athlete education, be low-cost, and provide convenient access to appropriate adaptive equipment.

1129 Board #255 May 27 2:30 PM - 4:00 PM

A Comparison Of Sleep And Physical Activity Patterns Between Typically Developing Adolescents And Adolescents With Developmental Disorders

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(No relevant relationships reported)

PURPOSE: Youth with developmental disabilities (such as ASD and CP) may be less like to meet recommendations for moderate to vigorous physical activity (MVPA) or sleep duration compared to typically developing adolescents. However, there is limited research comparing objective measures of activity and sleep among TD children, children with ASD, and children with CP. The purpose of this study was to examine objectively-measured MVPA, sedentary behavior, and sleep quality in TD adolescents and adolescents diagnosed with CP and ASD. **METHODS:** Subjects consisted of 10 TD children, 10 children with ASD, and 8 children with CP, matched on age and gender (mean age: 10.5 years; 60% male). Children wore an ActiGraph GT9X accelerometers, over a 7-day period, to assess minutes per day of MVPA, sedentary behavior, and total sleep time. Sleep efficiency was also collected for all three groups. One-way ANOVA was used to examine differences among TD youth, youth with ASD, and youth with CP. Tukey post-hoc tests were then conducted to determine where differences existed between the three groups. **RESULTS:** Children with CP accumulated significantly more sedentary minutes (662 ± 199) than TD children (388.2 ± 79.9 $p = .002$), while TD children accumulated significantly greater minutes of MVPA (118.45 ± 50.36) compared to both children with CP (17.32 ± 17.89) and children with ASD (53.7 ± 45.8), ($p < 0.0001$). Additionally, youth with CP (95% ± 3.6) had greater sleep efficiency than youth with ASD (89% ± 4.8; $p = .03$). **CONCLUSIONS:** Children with developmental disorders may accumulate lower amounts of MVPA compared to TD youth, however, no differences were found between TD youth and youth with CP regarding sleep quality. These findings suggest that population-specific interventions are critical to improve health in both TD youth and youth with developmental disabilities.

1130 Board #256 May 27 2:30 PM - 4:00 PM

The Effects Of Muscle Quality On Physical Function

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INTRODUCTION: Type 2 diabetes mellitus is associated with loss of muscle quality may alter the functional capacity. **PURPOSE:** To investigate whether handgrip muscle strength or quality could be useful to predict dynapenia and assess functional capacity in Type 2 DM elderly. **METHODS:** A total of 79 elderly with diabetes were recruited (n=79; male=38; female=41; age: 69.8±8.7 years old). Body composition (Inbody), physical function (walking speed, 30 second Sitting-Standing, Timed Up and Go, balance, physical activity scale for the elderly (PASE)), handgrip quality (handgrip strength divided by body lean mass (BLM) in Kg/KgBLM) were evaluated. The correlation between age, muscle strength, PASE score, body composition and physical function tests was analyzed by Pearson's correlation coefficient (r). T-test and One-Way ANOVA were used to analyze the effect of three different muscle strength groups on physical function. P values ≤0.05 were considered statistically significant. **RESULTS:** In male, a positive correlation was observed between the handgrip quality (kg/BLM) and open eyes one leg standing (r=0.567, p=0.002), close eyes sharpened Romberg (r=0.450, p=0.005), 30 second Sitting-Standing (r=0.374, p=0.022), Timed Up and Go (r=-0.375, p<0.02), and PASE score (r=0.423, p=0.01). In female, the results showed a positive correlation between handgrip quality (kg/BLM) and close eyes one leg standing (r=0.391; p=0.011), 30 second Sitting-Standing (r=0.447; p<0.003), and Timed Up and Go (-0.380, p<0.014). There was no correlation between handgrip quality, Romberg test and fasting blood glucose. To evaluate the prediction of handgrip quality on physical function, the participants were divided into three groups by values of handgrip quality 0.6382 and 0.7728. Either male or female, the One-Way ANOVA results showed that the lower handgrip quality the higher age, body weight (p<0.05). The performance of Timed Up and Go, 30 second Sitting-Standing, opened eyes one leg standing, and 5 times Sitting-Standing is better in the higher handgrip quality than low handgrip quality. **CONCLUSION:** Handgrip quality can be used to predict physical function of the elderly diabetic patients in clinical. Supported by grants VN107-07 and V108C-172.

1131 Board #257 May 27 2:30 PM - 4:00 PM

Quality Of Life In Spinal Cord Injury Patients Before And After Exercise Intervention

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More than 1 million people are living with a spinal cord injury (SCI) in the United States alone. Research suggests improvement in daily function as well as biochemical markers in SCI patients who participate in regular exercise. There is limited data on the specific impact of exercise as it pertains to Quality of Life (QOL), complications or general sense of wellbeing. **Purpose** To obtain objective QOL data using validated SCI questionnaire instruments before and after exercises intervention done at the Claremont Club Perfect Step Program. **Methods** The Claremont Club Perfect Step is a fitness facility that has been providing structured exercise programs for patients with SCI for 10 years. We completed a survey of 41 patients regarding their QOL before and after entering this program. The survey questions were drawn from a validated Spinal Cord Injury—Quality of Life (SCI-QOL) survey. A matched-pair t test was used to compare the 6-month answers to the baseline measures of QOL. **Results** Patients with spinal cord injuries who participated in this program reported statistically significant improvements in 83 of 92 survey categories, including improved mental health, reduced complications and fewer or lower doses of medication. With the QOL scores ranging from 1 (lowest) to 5 (highest), the average score increased by 0.72 (18.8%), from 3.82 to 4.54. Measures of mood, energy and confidence significantly improved. Measures of depression reduced. Measures of pain and pain interference on social and work life significantly decreased. Lastly, bladder accidents or disruption of daily life due to bladder incontinence significantly improved. There was also a trend toward reduced urinary tract infections as well as reduced pressure sores or pressure injuries. **Discussion/Conclusions** The depth, breadth, and magnitude in improved QOL scores is impressive. These results indicate that exercise intervention for patients with SCI should be not be the last step, once traditional medical care has been exhausted, but an early intervention to maximize QOL and potentially reduce complications from SCI.

Although structured exercise has often fallen outside the scope of traditional medical care for patients who experience SCI, it should be considered a first-line treatment that appears to be relatively safe and highly effective.

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Physical Activity Levels And Health Problems In Employees Of Stationary Nursing Homes: Is There An Association?

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(No relevant relationships reported)

Epidemiological data demonstrate that employees of nursing homes frequently suffer from illness and musculoskeletal disorders. Previous studies were mainly based on medical diagnoses and registered days of absence. The prevalence of pre-diagnostic health problems (HP) and resulting subjective impairments in participation and job-related performance are thus unclear. **PURPOSE:** Our study assessed these factors and their potential association with physical activity levels (PA). **METHODS:** Employees of two stationary nursing homes in Germany (n = 47, age: 47 ± 23 years, 42 females) once per week completed the OSTRC questionnaire over a total period of six weeks. The instrument captures the occurrence of HP (illness and musculoskeletal disorders) as well as related symptoms and restrictions in job participation. Accelerometers, worn on seven consecutive days, were used to assess PA. The association between PA and parameters indicating pre-diagnostic HP and their consequences was tested by means of point biserial correlations. **RESULTS:** About 85% of the participants reported a HP during the past six weeks. Musculoskeletal disorders were more prevalent than illness (66% vs. 47%). Almost one third of the employees (29.8%) had to reduce working time at least once due to a HP and more than 6 in 10 persons (63.8%) experienced restrictions in job performance. The most frequent locations of orthopaedic problems were the neck, lumbar spine, shoulder and knee. With 48 ± 23 MET h/week, the sample was highly active, all participants fulfilled the WHO's minimal recommendation of 7.5 MET/h per week. PA was not associated with the occurrence of HP and their consequences (all p<.05). **CONCLUSIONS:** The association of high PA levels and general/musculoskeletal health may not exist in employees of stationary nursing homes. The development of interventions aiming to tackle the burden of population-specific HP therefore retains high relevance in future research.

1133 Board #259 May 27 2:30 PM - 4:00 PM

Skeletal Muscle Mitochondrial Capacity Is Similar In Ambulatory And Non-ambulatory Children With Cerebral Palsy

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PURPOSE: Cerebral palsy (CP) is the most common childhood movement dysfunction secondary to a brain injury around birth. These children can be classified as ambulatory or non-ambulatory based on their functional abilities. Importantly, they expend significantly increased energy expenditure during movement. Muscle mitochondria, specifically the electron transport system are responsible for oxidative capacity, energy production and are associated with functional capacity. Unfortunately, mitochondrial oxidative capacity in children with CP and its association with different functional levels is not known. We measured maximum mitochondrial respiration rates directly from biopsies in children with CP, compared across ambulatory levels. **METHODS:** Twenty children (6-16 years, 10 M/6F, Ambulatory-12), undergoing surgery participated in this study. Twenty-nine biopsies were obtained from adductors, vastus lateralis, gastrocnemius. Carbohydrate and fatty acid respirometry substrate-uncoupler-inhibitor titration (SUIT) protocols were performed on permeabilized muscle fiber bundles. In addition, muscle homogenate was used to measure citrate synthase activity as a marker of mitochondrial content. Ambulatory capacity was measured using 6-minute walk tests (n=7), muscle strength, and gait velocity (n=15) during routine therapy visits. **RESULTS:** Surprisingly, maximal mitochondrial phosphorylation capacity was similar across between functionally ambulatory and non-ambulatory children (77.1±23.9 vs. 84.9±24.0 pmol O₂/s/mg). This was uncorrelated with mitochondrial content (p>0.1), as measured by citrate synthase. Mitochondria in children with CP still preferentially used carbohydrates over fatty acids based on state-3 respiration. Functionally ambulatory children showed positive associations between mitochondrial function and ambulatory capacity measures (r² values for gait velocity=0.50, 6-meter walk test=0.33, p<0.05).

CONCLUSIONS: Mitochondrial function are typically associated with activity level. Surprisingly, functionally ambulatory children with CP did not have greater mitochondrial function compared to non-ambulatory children and might even be lower. Importantly, within ambulatory children walking capacity was related to maximal mitochondrial function.

1134 Board #260 May 27 2:30 PM - 4:00 PM
Fall Risks Increase In Aging Women

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PURPOSE: Accidental falls are one of the leading causes of hospitalization for injury and result in a high death rate among older Canadians. There are about 30% of people over the age of 65 living in the community fall every year. In addition, aging process is related to individual decrease in physical and functional abilities that increase the risk of falls. Older women are more likely to experience more severe trauma after falling than men. The objective of this study is to evaluate the impact of aging on functionality, postural balance and falls risk in aging women. **METHODS:** 19 women formed two age groups (n = 7 in 45-54 years and n = 12 in 55-64 years) and performed three assessment tests: 1- Step Test to measure lower limbs speed, 2- Sit to Stand Test for lower limbs Strength and 3- Postural Balance Test using the force platform during semi-tandem position, with eyes open and eyes closed. Postural balance response was based in Centre of Pressure (COP) velocity sways in antero-posterior and in medio-lateral directions. **RESULTS:** A large effect size was observed (Hedge's $g = 1.447$), and a significant lower extremity speed ($p = 0.005$) in the older group compared to the younger group. The Lower-limbs Strength showed a large effect size ($g = -0.86$), however, not significant ($p = 0.075$) between groups. A large effect size and significant COP velocity increase was observed in the older group for both antero-posterior ($p < 0.05$, $g = -0.887$) and medio-lateral ($p < 0.05$, $g = -0.731$) directions as compared to the younger group. Finally, significant differences ($p < 0.001$) and a large effect size were observed between eyes open ($g = -1.506$) and closed ($g = -1.441$) conditions for COP velocity sway for both directions. **CONCLUSION:** Aging in women can significantly change the postural balance performance as well as speed adjustments of the lower limb. These findings add to the body of knowledge on aging women and should be considered when planning and developing services. Complication risks after a fall in aging women are deleterious suggesting that developing activities to improve speed and balance are favored to ensure a longer life expectancy in aging woman's health.

1135 Board #261 May 27 2:30 PM - 4:00 PM
People With Disabilities Perception Of Quality Of Life After Participation In A Student Service-Learning Program

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(No relevant relationships reported)

TITLE: People with Disabilities Perception of Quality of Life After Participation in a Student Service-Learning Program

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INSTITUTION: California State University, Northridge
ABSTRACT:

It is observed that there is a continuous decline in physical function and associated decline in quality of life (QoL) among individuals with disabilities. It has been documented that participating in physical activity significantly improves QoL. Despite many studies proving physical activity improves one's QoL, there is a limited amount of research showing how combining student service-learning with physical activity can improve the QoL of individuals with disabilities.

PURPOSE: The purpose of this study was to qualitatively investigate the perception of QoL of individuals with disabilities and physical activity during a student service-learning program.

METHODS: Semi-structured interviews were performed with 10 individuals with various disabilities. The interviews were designed to explore the perception of QoL and physical activity through each participants' experience working with university students for the first time. Interviews were audio recorded and transcribed verbatim. Thematic analysis was completed using NVivo qualitative analysis software.

RESULTS: Three main themes emerged from the qualitative thematic analysis: (1) peers and students were the motivational factors to physical activity with positive, non-judgmental, and supportive exercise environment, (2) increased adherence to physical activity, and (3) increased self-confidence performing activities of daily living.

CONCLUSION: Physical activity combined with student service-learning programs can potentially improve many different aspects of individuals with disabilities QoL. Our results show improvement in general well-being, as well as a positive experience

of working with students. This research, and future research in the field, will help establish a base of evidence to tailor this type of exercise program for individuals with disabilities.

1136 Board #262 May 27 2:30 PM - 4:00 PM

Harnessing Digital Health To Objectively Assess Motor Capacity In Patient With Chronic Obstructive Pulmonary Disease

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Purpose: Current motor-capacity assessment tools based on gait test is limited in patients with Chronic Obstructive Pulmonary Disease (COPD) because of the need to carry ventilator support, high fall risk, fatigue, and limited space to administer the test in busy settings. In this study, we proposed an alternative tool to determine motor capacity based on 20-seconds rapid repetitive elbow flexion-extension test, called frailty meter (FM) administrable during sitting. FM is based on a single wrist-sensor enables quantifying frailty phenotypes including slowness, weakness, exhaustion, and rigidity.

Methods: Thirty-nine COPD patients (age = 68 ± 8 years, BMI = 29 ± 6 kg/m²) and 49 age-matched controls (age = 70 ± 3 years, BMI = 29 ± 6 kg/m²) were recruited. In addition to FM test, conventional functional tests, including gait, balance, timed up & go, and 5-time sit to stance were performed.

Results: All participants achieved to complete FM test. While the feasibility for conventional tests ranged from 74% to 90%. When compared to the controls, COPD patients exhibited deteriorated motor capacity measured by conventional functional tests (Cohen's $d = 0.60-1.52$, $p < 0.050$). The most sensitive phenotypes associated with COPD was found to be slowness characterized by flexion time (42% deterioration, $d = 1.46$, $p < 0.001$) and rigidity characterized by range of motion (14% deterioration, $d = 0.73$, $p = 0.001$). Significant correlations were found between FM metrics and conventional functional tests with the largest effect observed between slowness and 5-time sit to stance ($r = 0.51$, $p < 0.001$).

Conclusion: This study demonstrated the feasibility of the FM test to quantify digital biomarkers associated with motor capacity in COPD patients. The proposed test could be served as an alternative to gait tests and thus may facilitate routine screening of motor-capacity in busy clinical settings. Future studies need to demonstrate sensitivity to change in response to intervention.

1137 Board #263 May 27 2:30 PM - 4:00 PM

Within Daily Analysis Of Physical Activity Behaviour In Adults With Multiple Sclerosis

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Little is known about the dynamic association between activity pacing and actual physical activity behaviour within the daily routines of persons with multiple sclerosis (MS). Understanding the association between activity pacing and actual physical activity behaviour is relevant to help optimise health promoting behaviour.

PURPOSE: To explore how activity pacing relates to actual physical activity behaviours in adults with MS.

METHODS: 21 persons with MS (mean age = 59 ± 9 years) wore an accelerometer for 7 days to assess physical activity behaviours and filled in questionnaires on their engagement in pacing and perceived risk of overactivity (5-point Activity Pacing and Risk of Overactivity Questionnaire), fatigue (7-point Fatigue Severity Scale), and Health-related quality of life (RAND-12). Physical activity behaviours were assessed by examining activity level (7-day average activity counts per minute) and activity variability (7-day average highest activity counts per minute each day divided by activity counts per minute on that day). The relationships between the variables were examined using hierarchical regression models.

RESULTS: Engagement in pacing, perceived risk of overactivity, activity level and variability were $2.25 \pm .74$, 2.38 ± 1.02 , 241.07 (144.68) and $3.96 \pm .72$ respectively. Lower activity level was related to higher engagement in pacing ($\beta = -.438$, $t = -2.66$, $p = .024$). Higher activity level was associated with higher perceived risk of overactivity

($\beta = .494, t = 2.84, p = .018$). No relations were found between activity variability and engagement in pacing ($\beta = -.225, t = -.96, p = .361$) and between activity variability and perceived risk of overactivity ($\beta = .149, t = .599, p = .562$).

CONCLUSIONS: The results indicate that those with lower activity levels may experience worsening symptoms with respect to physical disability, and may be more inclined and aware to pace their activities. Conversely, those with higher activity levels may experience less disruption through fatigue in daily life and may resort to the execution of too long periods of activity which may cause overactivity. Guidance on optimal use of pacing may be beneficial for persons with MS and improve their physical activity behaviour.

1138 Board #264 May 27 2:30 PM - 4:00 PM
Effects Of Aquatic-based Exercise On Perceived-fatigue In People With Multiple Sclerosis: A Systematic Review And Meta-analysis

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(No relevant relationships reported)

Multiple sclerosis (MS) is a chronic, immune-mediated and neurodegenerative disease of the central nervous system. Since signs and symptoms associated with MS extend to several dimensions, people with MS (PwMS) can experience symptoms at both physical and cognitive dimensions. Among them, perceived fatigue is one of the most disabling symptoms, affecting the majority of the MS population. Hydrotherapy is a novel therapeutic option to improve the perceived-fatigue in PwMS. **PURPOSE:** To analyze the effects of aquatic-based exercise on perceived-fatigue in PwMS using a meta-analytic procedures and systematic review. **METHODS:** Clinical trials comparing aquatic exercise to no exercise treatments were searched on four scientific databases up to June 2019. The standard mean differences (SMD +) was calculated for the outcome *perceived-fatigue*. Firstly, general fatigue was evaluated, from which three sub-dimensions were also assessed (physical, psychosocial, and cognitive). The methodological quality of the included studies was assessed employing the PEDro scale. **RESULTS:** A total of 148 articles were initially identified, from which only 5 fulfilled all the inclusion criteria, other than inclusion of a control group and an experimental group, and a hydrotherapy program. General fatigue, assessed mainly through the Modified Fatigue Impact Scale, showed a significant decrease ($SMD_+ = -2.15$ [95% CI = -3.44 to -0.87]; $p < 0.01$; $I^2 = 91\%$). Regarding fatigue sub-dimensions, physical fatigue achieved a significant improvement in the experimental group compared to the controls ($SMD_+ = -2.15$ [95% CI = -3.72 to -0.58]; $p < 0.01$; $I^2 = 92\%$). Psychosocial fatigue ($SMD_+ = -1.13$ [95% CI = -1.86 to -0.40]; $p < 0.01$; $I^2 = 76\%$) and cognitive fatigue were also significantly improved compared to the control group ($SMD_+ = -0.57$ [95% CI = -0.88 to -0.25]; $p < 0.01$; $I^2 = 0\%$). **CONCLUSIONS:** Aquatic-based exercise significantly decreases all dimensions of perceived-fatigue in PwMS. Based on these findings, it would be useful for future studies to address the dose-response characterization of aquatic-based exercise programs (i.e. intensity, volume, frequency, training length, etc.) in order to optimize the physical exercise interventions for PwMS.

B-77 Free Communication/Poster - Environmental/Occupational Physiology

Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
 Room: CC-Exhibit Hall

1139 Board #265 May 27 1:30 PM - 3:00 PM
Occupation-Specific Physical Demands And Physiological Strain Of American Football Referees While Officiating

Emily C. Colster, Anne M. Mulholland, Clifton J. Holmes, Brett C. Bentley, Jonathan E. Wingo, FACSM, James B. Robinson, Hayley V. MacDonald. *The University of Alabama, TUSCALOOSA, AL.* (Sponsor: Jonathan E. Wingo, FACSM) Email: ecolster@crimson.ua.edu

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Occupational incidences of sudden cardiac death (SCD) are greater among workers that experience high levels of physical exertion, physiological strain, and extreme thermal environments. American football referees fall under this distinction, yet are underrepresented in occupational research.

PURPOSE: To bridge this gap by quantifying the physical demands and physiological strain they experience while officiating. **METHODS:** Twelve male officials (mean±SD; age=43±11 y, body mass index [BMI]=31.9±7.2 kg/m², 67% white), across 3 games, provided urine samples for urine specific gravity (U_{SG}) determination, ingested core temperature (T_c) pills, and wore GPS-enabled performance monitoring systems. Outdoor conditions were monitored using a weather meter. Analyses included descriptive statistics and bivariate correlations. **RESULTS:** Games lasted ≈2.5 h and evening weather conditions were typical of the Southeastern US (wet bulb globe temperature: 23.5±2.2°C, relative humidity: 72.5±9.2%). Across all 3 games, 58% of officials were hypohydrated ($U_{SG} > 1.020$); they covered an average of 5.5±1.6 km (total distance) at a speed of 1.9±0.3 kmph, with corresponding T_c and heart rate (HR) values of 37.4±0.4°C (peak $T_c = 38.3±0.4°C$) and 132±16 bpm (peak HR: 169.2±17.5 bpm), respectively, across all referees and over the entire sampling period. Higher relative humidity at the start of each game was associated with greater physiological strain (average HR: $r = 0.61, P = 0.04$; peak HR: $r = 0.56, P = 0.06$). Pre-game hydration status ($r = 0.50, P = 0.09$) and BMI ($r = 0.50, P = 0.09$) tended to elicit greater physiological strain (defined as the proportion of the game spent above 85% of age-predicted maximal HR). **CONCLUSIONS:** Football referees experience elevated levels of physiological strain while performing officiating duties. Individual and environmental factors appear to influence levels of strain and should be explored in a larger and more diverse sample of referees to identify patterns and develop strategies to best mitigate strain and prevent SCD.

1140 Board #266 May 27 1:30 PM - 3:00 PM
Physiological Responses To Heat Stress In Groundskeepers

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(No relevant relationships reported)

PURPOSE: The extent to which groundskeepers experience heat strain, dehydration, and accompanying declines in kidney function during work in hot-humid conditions is unknown.

METHODS: Hydration, cardiovascular, and internal body temperature measures were assessed in 20 groundskeepers (18 men; mean±SD age=38±8 y, body mass index=32±8 kg/m²) during work on 2 summer days. Before (PRE) and after (POST) the work shift, resting blood pressure (BP) and heart rate (HR) were measured and urine and blood samples were collected. At POST, fluid intake was recalled for the previous 24 h. Gastrointestinal temperature (T_{GI}) was recorded every 5 min via ingestible telemetric sensor.

RESULTS: Average highest daily wet bulb globe temperature=39.1±3.5 °C. In 45% of subjects, PRE BP>130/80 mm Hg on Day 1 (D1) and Day 2 (D2). Highest HR and T_{GI} achieved across both days were 143±15 bpm and 37.7±0.3 °C, respectively. On D1 and D2, urine specific gravity (U_{SG} ; 1.021±0.1) and urine color (U_{COL} ; 6±1) did not change PRE to POST (all $P > 0.28$), but subjects began the workday “underhydrated” (concentrated urine but normal serum osmolality (S_{OSM})]—62% had $U_{SG} \geq 1.020$ and 95% had $U_{COL} \geq 4$ despite $S_{OSM} = 292 \pm 5$. Fluid intake=2.3±1.6 L during work and consisted of 70% water and 25% sugar sweetened beverages. No subject lost $\geq 2\%$ of body mass on D1 or D2. For 6 subjects, estimated glomerular filtration rate at PRE was ≤ 60 mL/min/1.73m² averaged across D1 and D2. Although serum creatinine did not change statistically from PRE to POST across days (all $P > 0.18$), 5 subjects had increases ≥ 0.3 mg/dL, signifying an acute kidney injury (AKI).

CONCLUSIONS: While hyperthermia was not prevalent, subjects began and ended the workday underhydrated. Hypertension, obesity, and low water intake may have contributed to the overall low kidney function and AKIs observed. Using urine color as a self-assessment tool could be a beneficial intervention improve hydration status and kidney function. Funded by NIOSH

1141 Board #267 May 27 1:30 PM - 3:00 PM
Effect Of A Hyperthermic Environment On Selected Physiological Variables During Occupational Stress In Police Cadets

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(No relevant relationships reported)

First responders (e.g., police) may be exposed to physical occupational stressors in the line of duty, which may place them at risk for acute cardio-metabolic events (e.g., myocardial infarction). Environmental challenges may exacerbate this risk. **PURPOSE:** To observe the impact of a hyperthermic versus thermoneutral environment on physiological responses in police cadets performing a simulated occupational task. **METHODS:** Using an environmental chamber, 10 police cadets

(22.2±2.3 years), completed two occupational task exercise conditions in hyperthermic (HT, 38°C) and thermoneutral (TN, 22°C) environments on separate days. During each condition, participants completed a 10-minute treadmill walk at 70%-80% of their maximal heart rate followed by a 5-minute 50lb sandbag lift. Participants had 10 seconds to lift the sandbag onto a table then another 10 seconds to place it back on the ground. The walk and lift were completed two times each per condition. Heart rate (HR), ratings of perceived exertion (RPE), and core temperature (T) were recorded immediately before entering the chamber (baseline), in the chamber at the conclusion of the occupational task (post-exercise), and outside the chamber after 10 min of rest (recovery). Two condition (HT, TN) by three time point (baseline, post-exercise, recovery) repeated measures ANOVAs were utilized to assess all dependent variables. Post-hoc analyses were performed using t-tests. **RESULTS:** Significant ($F \geq 8.6$, $p \leq 0.003$) condition by time interactions were observed for all dependent variables. There were no differences ($t \leq 2.0$, $p \geq 0.07$) across conditions in HR (76±11 bpm TN, 82±14 HT), RPE (6.4±1 TN, 7.1±2.4 HT), or T (37.2±0.3°C TN, 37.5±0.2°C HT) at baseline. However, each of these variables were significantly ($t \geq 2.3$, $p \leq 0.05$) greater post-exercise (104±12 bpm TN, 146±16 bpm HT; 8.9±2.4 RPE TN, 13.4±3.1 RPE HT; 37.6±0.3°C TN, 38.3±0.3°C HT) and during recovery (78±12 bpm TN, 92±13 HT; 6.7±1.2 RPE TN, 7.7±2.2 RPE HT; 37.4±0.2°C TN, 38.0±0.3°C HT) in the HT versus the TN condition. **CONCLUSION:** Concomitant occupational tasks and heat stressors increased physiologic and perceived measures of exertion and body temperature in police cadets beyond that of the occupational tasks alone.

1142 Board #268 May 27 1:30 PM - 3:00 PM
Physically Active Lifestyle Prevents Impairment Of Blood Pressure And Pulse Pressure Work-related To Stress In Police Officers

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PURPOSE: The police profession is a high-risk activity, as these professionals need to deal daily with violence, brutality and death, leading to high levels of stress. Classically, chronic exposure to situations causing stress may lead and facilitate the development of chronic diseases, such as cardiovascular and metabolic diseases. Increased pulse blood pressure (PP) is related to stiffness of large arteries predisposing to acute and chronic diseases, such as cerebrovascular stroke, coronary artery disease, heart failure and kidney diseases, which negatively affect morbidity and mortality, with significant consequences for public health. In addition, heart rate variability parameters are supposed to work as biomarkers of cardiovascular risk in response to stress as well. **METHODS:** We investigate the effects of regular practice of physical activity (moderate to high intensity, minimum of 5 years of regular practice and $\geq 4x$ /week) by police officers who regularly practice physical activity (PAc; 32,92±5,87 years old; n=25) from those who do not practice (PSed; 38,73±6,92; n=25) on systolic and diastolic blood pressure and on pulse blood pressure. The analysis of heart rate variability was performed by using 10 minutes of electrocardiography collection using the digital electrocardiography system (ECG PC, TEB®, Brazil). Body composition was analyzed using octopolar multifrequency bioimpedance (Maltron Inc, England). **RESULTS:** PSed presented increased systolic (136,81±21,31 mmHg x 123,56±10,92; $p < 0.01$) and diastolic blood pressure (81,68±13,80 x 75,37±9,66 mmHg; $p < 0.0123$) as well as pulse blood pressure (57,28±10,42 x 48,71±8,27 mmHg; $p < 0.0001$) when compared with physically active ones. In addition, PSed also presented increased levels of perceived stress ($p < 0.0008$), fat mass ($p < 0.0065$), visceral fat ($p < 0.001$) and reduced fat free mass ($p < 0.0055$), but not for resting heart rate neither for any parameter of heart rate variability (time and frequency domain: RSS, NNS, SDNN, RMSSD, VLF, LF, HF). **CONCLUSIONS:** We conclude that increased levels of stress in police officers impairs functional biomarkers of cardiovascular diseases, which can be partially attenuated by a physically active lifestyle.

1143 Board #269 May 27 1:30 PM - 3:00 PM
Implementation Of Physical Employment Standards For Physically Demanding Occupations

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PURPOSE: Workers in physically demanding occupations are often required to demonstrate appropriate levels of physical capability throughout their careers by undertaking routine in-service physical ability assessments. However, integrating physical employment standards (PES) and associated tests into organisational policies and procedures can be challenging for employers and there is a shortage of best practice guidance in this area. The aim of this study is to describe the process of integrating a developed PES into a physical capability management procedure, using a real-world example in the UK Fire & Rescue Service. **METHODS:** Using physical demands and performance data from a series of studies to investigate the cardiorespiratory, strength and muscular endurance requirements for endorsed UK firefighting activities, a physical capability management process was developed with industry stakeholders, including management, trade unions and subject matter experts. The procedure was designed to manage all levels of physical ability within a physically demanding workforce, prioritising employee safety and fairness. **RESULTS:** Occupational scientists and industry stakeholders defined performance standards relating to unacceptable, unclear, and acceptable performance of criterion tasks for UK firefighters. Cut-scores were identified for unacceptable (red), unclear (amber) and acceptable (green) performance standards related to each predictive test (Table 1). A process for triaging and managing all levels of workers physical abilities was agreed using the traffic-light system. **CONCLUSIONS:** This paper describes the processes involved in implementing a physical assessment procedure, for the administration of routine in-service PES and tests in a physically demanding occupation.

Table 1. Cut-scores for each predictive test and performance standard.

Criterion Task(s)	Predictive selection test	Physical employment standard		
		Unacceptable (red)	Unclear (amber)	Acceptable (green)
HR/SC/EC/CE	VO ₂ max (ml.kg ⁻¹ .min ⁻¹)	≤ 35.5	35.6 – 42.2	≥ 42.3
Ladder lift	Shoulder press (kg)	≤ 30	32.5	≥ 35
Ladder lower	Single rope pull (kg)	≤ 51	52-59	≥ 60
Ladder extension	Repeated rope pull* (reps)	≤ 14	15-22	≥ 23

HR hose run; SC stair climb; EC equipment carry; CE casualty evacuation; * 28 kg weight.

1144 Board #270 May 27 1:30 PM - 3:00 PM
Psychophysiological Responses Of Swat Team Members During Active Shooter Training: A Pilot Study

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 (No relevant relationships reported)

Law enforcement is considered a stressful occupation, special weapons and tactics (SWAT) team members confront situations of imminent danger, that include exposure to traumatic and/or violent events beyond that of typical law enforcement officer duties. The stress related hormonal response of SWAT team members to active shooter training drills has not been investigated. **PURPOSE:** To investigate psychophysiological responses of SWAT team members during an active shooter training drill. **METHODS:** Six SWAT team members (age = 32.5 ± 4.1 yrs.; SWAT experience = 28.0 ± 13.0 months) participated in a control condition wherein participants practiced building entry techniques and marksmanship drills. During this session, measures of state anxiety, salivary cortisol (SCORT) and testosterone (STEST) were collected prior to and after breaching techniques, and after firearm practice. Participants also engaged in an experimental condition that involved three active-shooter training (AST) scenarios during which measures of state anxiety, task load, SCORT and STEST were collected prior to and immediately after each training episode. The scenarios included a slow-and-deliberate (S&D) search, a S&D search accompanied by a tactical robotic vehicle (TRV), and a rapid deployment scenario with TRV. **RESULTS:** Increases in anxiety approached significance ($p = 0.06$) across time in the AST, but no differences in task load demands ($p = 0.17$) were reported. Measures of SCORT approached significance across time ($p = 0.07$), and differences between conditions ($p = .01$, $n_2 = 0.95$) with the AST resulted in elevated SCORT levels. STEST levels were different between conditions ($p = 0.03$, $n_2 = 0.83$), and

increased significantly ($p = 0.02$, $n_2 = 0.28$) across time in the AST condition only, with the greatest increases occurring after the S&D search. **CONCLUSION:** SWAT team members responded to three active shooter training scenarios with limited anxiety and cortisol responses, although testosterone increases did occur when compared to a control condition. The greater experience levels may have contributed to the lack of significant changes in measures of stress during the AST, whereas increases in testosterone might explain the benefit of increasing aggressive behaviors and fearlessness for SWAT team members.

1145 Board #271 May 27 1:30 PM - 3:00 PM
Heat Strain Assessment Under Three Different Wet Bulb Globe Temperatures With Protective Clothing

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 (No relevant relationships reported)

Personal protective clothing is an important part of personal protective equipment worn by health care workers and first responders. Wearing a vapor-barrier layer of protective clothing inhibits sweat evaporation and impairs physiological and perceptual responses. **PURPOSE:** To evaluate thermoregulatory responses and heat strain indices during simulated healthcare and first responders' tasks under three different wet bulb globe temperatures (WBGT). **METHODS:** Four men (25.8±6.8 yrs, 176.5±6.1 cm, 75.3±16.9 kg) wore an ensemble consisting of a loose-fitting powered air-purifying respirator, chemical resistant overall vapor-barrier ensemble, double gloves, boots, and an apron, while performing a battery of first receiver and health care simulation activities (walking, cutting and removing clothing, scrubbing, placing a splint and cervical collar, and weight carrying) for three repetitions under three different WBGT (18, 26, and 34°C) in counterbalanced order. These environmental conditions were intended to simulate healthcare workplace conditions during mass casualty incidents. Rectal temperature (Tre) and heart rate were continuously monitored and averaged during the last 1-minute of each activity and presented as mean ± standard deviation. Physiological (PSI) and perceptual strain index (PeSI) were calculated at the end of each activity. **RESULTS:** Over time, Tre, PSI, and PeSI all gradually increased. At the end of the trial, Tre was significantly higher in the 34°C condition (38.5±0.4°C) than the 18°C condition (37.8±0.4°C, $p=0.029$) but did not differ from the 26°C conditions (38.2±0.6°C, $p=0.104$). The PSI was significantly higher in 34°C (6.4±1.0) than 26°C (5.1±1.2, $p=0.002$) and 18°C conditions (2.6±1.1, $p=0.001$). The PeSI was significantly higher in 34°C (7.6±1.8) than 18°C conditions (3.3±1.8, $p=0.006$) but did not differ between 34°C (7.6±1.8) and 26°C conditions (5.7±1.4, $p=0.075$). **CONCLUSIONS:** Tre and heat strain indices gradually increased over time across all environmental conditions. Tre and PeSI did not differ between 26°C and 34°C WBGT conditions. Tre and PeSI responses may be blunted by wearing a vapor-barrier ensemble. Future studies should examine this hypothesis to clarify the current findings.

1146 Board #272 May 27 1:30 PM - 3:00 PM
Effect Of Skin Temperature On Dermal Absorption Of Anthracene

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Exposure to a variety of ubiquitous pollutants, including polycyclic aromatic hydrocarbons (PAHs), occurs during daily exposure to vehicular exhaust fumes, smoking, grilling, and in many occupations, including firefighting. Dermal absorption of potential carcinogens has received limited attention compared to respiratory routes due to the challenges with measurement *in vivo*. **PURPOSE:** Our aims were 1) establish the efficacy of microdialysis (MD) as a sampling technique for dermal absorption of PAHs and 2) determine the effect of skin temperature on dermal absorption of the non-carcinogenic PAH, anthracene (ANT). **METHODS:** Two MD fibers were inserted into the ventral forearm of 6 healthy participants (32 ± 5 yrs, 5 male, 1 female) and perfused with lactated Ringers and 10% 2-hydroxypropyl-β-cyclodextrin at a rate of 1 μl/min. 2% ANT cream was applied over each site, dialysate samples were collected and skin blood flow (SkBF) measured at a locally heated (HT, 43°C) and thermoneutral (TN, 33°C) site. The concentration of ANT from dialysate samples were measured via targeted tandem mass spectrometry. **RESULTS:** Dialysate ANT concentration was similar between the HT and TN sites (2.9 ± 0.4 vs. 3.5 ± 0.4 ppm, $P=0.26$). Absolute SkBF was significantly higher at the HT versus TN site (35.7 ± 11.8 and 7.2 ± 1.0 CVC, $P=0.001$). **CONCLUSIONS:** These data provide support for MD as a sampling technique for dermal absorption of PAHs. Despite similar ANT concentrations between sites, dermal absorption and sampling can be modulated by multiple factors. Further research is required to elucidate the influence of skin

temperature versus clearance on dermal absorption of ANT and other PAHs. This has important implications for understanding dermal absorption of potentially carcinogenic compounds in occupational workers and the general population.

1147 Board #273 May 27 1:30 PM - 3:00 PM
Familiarization With Ambulatory Sleep And Blood Pressure Monitoring

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 (No relevant relationships reported)

Purpose: Sleep is a life-sustaining action that has implications in aspects of physical, mental, and emotional health. One necessary event that occurs during sleep is nocturnal blood pressure dipping. Measurement of ambulatory sleep and blood pressure are gaining popularity as these can be completed in an individual's home. However, little is known regarding the reliability of data and the time it takes oneself to familiarize with the equipment. Therefore, the purpose of this study was to determine how many nights of wearing the monitoring equipment were required to restore sleep architecture and blood pressure data to baseline. **Methods:** Eight male and female subjects completed all 3 nights of both sleep and blood pressure readings. Visit 1 consisted of anthropometric and resting blood pressure measurements. The subjects were also familiarized with the equipment and instructed to wear the Sleep ProfilerTM and SunTech Medical Oscar2 ambulatory blood pressure cuff simultaneously for 3 consecutive nights. Visit 2 consisted of the subjects returning the equipment and the data being downloaded to a laboratory computer. **Results:** The percent of time spent in N1, N2, N3, and REM were not statistically different between nights 1, 2, and 3. Time for wake after sleep onset was not statistically different between nights 1, 2, and 3. Time for sleep latency was statistically greater from night 2 to night 3 ($p = 0.042$). Percent nocturnal systolic and diastolic blood pressure dips were not statistically different between nights 1, 2, and 3. Cortical and autonomic arousals were not statistically different between nights 1, 2, and 3. **Conclusions:** These data demonstrate that ambulatory sleep monitoring takes 3 nights before the data is reliable and the person is familiarized with the mode of measurement.

1148 Board #274 May 27 1:30 PM - 3:00 PM
Effect Of Aerobic Exercise And Different Levels Of Pm_{2.5} On Pulmonary Response In Wistar Rats

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 (No relevant relationships reported)

PURPOSE: Exposure of particulate matter of less than 2.5 μm (PM_{2.5}) has been associated with adverse respiratory and the risk of inflammation. While regular physical activity (PA) reduces the risk of many adverse health effects. This study aimed to examine the protection of exercise on adverse pulmonary health induced by PM_{2.5} exposures in rats. **METHODS:** 80 Wistar rats were randomly divided into 8 groups: Sedentary (S), Exercise (E), Sedentary+Low concentration PM_{2.5} exposures (S+LPM), Exercise+Low concentration PM_{2.5} exposures (E+LPM), Sedentary+Medium concentration PM_{2.5} exposures (S+MPM), Exercise+Medium concentration PM_{2.5} exposures (E+MPM), Sedentary+High concentration PM_{2.5} exposures (S+HPM), and Exercise+High concentration PM_{2.5} exposures (E+HPM). The rats in all E-related groups went through 8-week aerobic interval treadmill training (5 days/week, 1h/day). The PM-related groups of rats were exposed to different concentration PM_{2.5} exposure in Beijing. After one bout of PM exposure, the pulmonary function, structure of lung tissues and several pulmonary biomarkers were observed. **RESULTS:** 1) Compared with S group, following changes occurred in various S+PM_{2.5} exposure groups: lung tissues were seriously damaged, local bleeding, pus exudation, and inflammatory cell infiltration, as well as the decline of the SOD (S+LPM: $P=0.020$, S+HPM: $P=0.370$), and CAT (S+HPM: $P=0.012$) while the decline of Penh (S+MPM: $P=0.133$, S+HPM: $P=0.002$), MDA (S+HPM: $P=0.007$), TNF-α (S+MPM: $P=0.018$, S+HPM: $P=0.008$) and IL-1β (S+HPM: $P=0.014$) were observed. 2) Compared with the corresponding different concentration of S+PM_{2.5} exposure groups, the bleeding and inflammatory infiltration were improved, the Penh (E+HPM: $P=0.005$), TNF-α (E+HPM: $P=0.042$) and IL-1β (E+HPM: $P=0.036$) were decreased and CAT (E+HPM: $P=0.039$) and GSH (E+HPM: $P=0.040$) were increased in related E+PM groups respectively. **CONCLUSIONS:** The aerobic interval training improved the pulmonary function and impeded the lesion progression, which is due to effective in impeding the oxidative stress and inflammation.

1149 Board #275 May 27 1:30 PM - 3:00 PM

Effects Of Outdoor Exercise And Vitamin D3 Capsules Supplementation Interventions On Vitamin D Deficiency Of Swat Trainees

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(No relevant relationships reported)

BACKGROUND: The Chinese special weapons and tactics (SWAT) trainees came from high school graduates, who have often lived in an indoor life style in China so long that many of them suffered from vitamin D deficiency, which made them at high risk of health problems that instructors had to face. **PURPOSE:** To investigate the therapy effects of outdoor exercise and Vitamin D3 Capsules Supplementation, and their combination on vitamin D deficiency symptoms of SWAT trainees.

METHODS: 158 SWAT trainees with low Serum 25-hydroxyvitamin D levels were divided randomly into 3 groups: Outdoor exercise (O), Vitamin D3 Capsules group (C), and their combination (OC). Participants in O-group maintained the outdoor training for four months (4 hours per day) while C-group used oral Vitamin D3 Capsules, (2000IU per day) with indoor training (in the gym), finally OC-group took both outdoor exercise and Vitamin D3 Capsules at the same time. The healing rates (Serum 25-hydroxyvitamin D level went beyond 30ng/ml was considered as healing) were compared 4 months later. The Serum 25-hydroxyvitamin D levels, the whole body muscle mass increment (kg) and the heart rate change (beats per minute) on Head-up Tilt (HUT) were tested both before and after the intervention.

RESULTS: The healing rates of O, C and OC groups were 78.0, 90.9, 100%, respectively; the average Serum 25-hydroxyvitamin D levels in OC (32.28±5.74) group after the intervention was higher than O (26.99±7.83, $p < 0.05$, $\eta_p^2=0.58$) and C (31.11±7.59, $p < 0.05$, $\eta_p^2=0.20$), and the whole body muscle mass increment (2.28±0.54) was significantly higher than that in other two groups ($p < 0.05$, for OC vs O, $\eta_p^2=0.28$; for OC vs C, $\eta_p^2=0.21$). However, the heart rate change showed no statistically significant change.

CONCLUSIONS: A combination of outdoor exercise and Vitamin D3 capsules supplementation was effective for the 25-hydroxyvitamin D level in serum and could get a better result in the four-month vitamin D deficiency intervention.

1150 Board #276 May 27 1:30 PM - 3:00 PM

Association Between Insulin Resistance And Aerobic Power In Police Officers

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(No relevant relationships reported)

Insulin resistance (IR) increases the risk of adverse cardiovascular events. The triglyceride glucose index (TyG) is a simple IR marker. Low skeletal muscle mass is associated with IR. However, the relationship between muscle power and IR is not well known. **PURPOSE:** To investigate the relationship between TyG index and aerobic power in police officers. **METHODS:** Data from 716 police officers were analyzed (125 female and 617 men). They were classified by a TyG index >4.68 in IR (n= 417) and Control (n= 299) groups. All participants performed a graded exercise test in cycle ergometer to determine maximal heart rate (HR max), peak oxygen consumption (VO₂peak), and peak aerobic power (final watts obtained during GXT/ weight). Fasting blood glucose, cholesterol, and triglycerides were determined. Anthropometric and body composition measurements were obtained using bioelectrical impedance analysis.

RESULTS: Blood pressure, metabolic, and anthropometric variables were higher in the IR group than in the control group, except that exercise capacity was lower in the IR than control group (Table 1). TyG was inversely related with aerobic power ($r = -0.22$, $p < 0.01$) and VO₂peak ($r = -0.23$, $p < 0.01$) but directly related with fat mass ($r = 0.22$, $p < 0.01$).

CONCLUSIONS: Peak aerobic capacity and aerobic power are lower in individuals with IR. Aerobic power is negatively associated with metabolic control. Police officers need to improve aerobic power and fat mass in order to be metabolically healthier.

Table 1. General characteristics in police officers

	IR (n= 417)	Control (n= 299)	p
Age (yr)	34.6 ± 7.6	31.5 ± 7.6	0.00
SBP (mmHg)	125.7 ± 13.4	119.7 ± 12.9	0.00
DBP (mmHg)	79.2 ± 9.6	74.8 ± 9.7	0.00
Weight (Kg)	82.5 ± 12.1	75.6 ± 12.6	0.00
Height (M)	1.7 ± .06	1.7 ± .07	0.53
BMI (Kg/m ²)	28.8 ± 3.7	26.5 ± 3.9	0.00
Waist circumference (cm)	97.2 ± 8.9	90.5 ± 11.0	0.00
Free fat mas (Kg)	55.0 ± 12.3	51.5 ± 14.3	0.01
Fat mass (Kg)	24.4 ± 7.8	20.1 ± 8.4	0.00
Glucose (mg/dl)	102.7 ± 28.9	92.1 ± 12.4	0.00
Cholesterol (mg/dl)	196.4 ± 34.9	169.7 ± 28.6	0.00
HDL-C (mg/dl)	34.8 ± 8.2	39.9 ± 9.2	0.00
Triglycerides (mg/dl)	253 ± 138	99 ± 27	0.00
VO ₂ peak (ml/kg*min)	36.3 ± 6.4	40. ± 7.6	0.00
Aerobic Power (Watts/kg)	2.2 ± 0.5	2.5 ± 0.6	0.00

SBP= systolic blood pressure. DBP = diastolic blood pressure. BMI= body mass index.

1151 Board #277 May 27 1:30 PM - 3:00 PM

EFFECT OF RESPIRATORY PROTECTION ON FACIAL TEMPERATURE AND COMFORT AT REST AND DURING EXERCISE

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(No relevant relationships reported)

The role of personal protective equipment (PPE) worn by healthcare workers and first responders, including respiratory protective equipment, has received much attention over the past decade in response to outbreaks of prominent infectious pathogens (pandemic influenza, Ebola). **PURPOSE:** This study compared facial temperature, humidity, and comfort perception among different NIOSH approved respirators at standing rest and treadmill exercise. **METHODS:** Twelve participants (six men, six women) wore a one-piece work coverall and athletic shoes, walked on a treadmill at a speed of 5.6kmh (3.5 mph) and 0% grade for one hour in thermoneutral ambient conditions (20-22°C, 40-50% relative humidity). Participants were randomly assigned to four different types of respirators: filtering facepiece respirator (N95), half-facepiece elastomeric respirator (HFER), loose-fitting powered air-purifying respirator (LPAPR), and tight-fitting PAPR (TPAPR) with the same filter media. Facial temperature, respirator microclimate temperature, and humidity were continuously monitored. Subjective perceptions of facial heat and overall body comfort were recorded at 20-minute intervals. Measured results were compared using factorial repeated measures ANOVA. **RESULTS:** Compared to rest, respirator microclimate temperature and humidity increased over time in all respirators, but at a significantly larger degree in N95 (+7.33°C/52.74%) and HFER (+6.38°C/36.13%) compared to LPAPR(+1.91°C/23.43%) and TPAPR (+2.69°C/24.15%) ($p < .001$). As a result, facial temperature was also significantly higher in N95(+1.62°C) and HFER(+1.01°C) than LPAPR (-.54°C) and TPAPR (-.79°C) ($p < .001$). However, end point subjective perceptions of facial heat and overall body comfort (rated slightly warm - warm) were not different between respirators. In addition, no differences were found between genders in all measurements. **CONCLUSION:** Subjects who wore PAPRs in our study had lower microclimate temperature, humidity and thus facial temperature, compared to other models, possibly due to the effect of forced air flow. However, these differences in measured parameters were not subjectively perceived and may be further offset for workers in hot, humid conditions and may lead to escalating factors for heat stress.

B-78 Free Communication/Poster - Military Physiology

Wednesday, May 27, 2020, 1:30 PM - 4:00 PM

Room: CC-Exhibit Hall

1152 Board #278 May 27 1:30 PM - 3:00 PM

Evaluation Of The New Army Combat Fitness Test In ROTC Cadets

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(No relevant relationships reported)

In 2020, the U.S. Army will replace the Army Physical Fitness Test (APFT) with the Army Combat Fitness Test (ACFT). Little is known on how this change may impact evaluating Army personnel, particularly Reserve Army Officer Training Corp (ROTC) cadets.

PURPOSE: To evaluate the ACFT in U.S. Army ROTC cadets.
METHODS: Eighteen ROTC cadets volunteered to participate in the study (mean ± SD; age = 21.9 ± 3.4 y, height = 172.4 ± 7.9 cm, mass = 75.1 ± 10.4 kg, % fat = 16.3 ± 7.4%). Participants performed the APFT & ACFT seven days apart. Physiological data were collected for the ACFT using a bioharness monitoring device which included: physiological load (PL), physiological intensity (PI), maximal heart rate (MHR), and average heart rate (AVGHR). Pearson moment correlation coefficients were calculated to determine relationships between selected variables.
RESULTS: Mean ACFT scores were 453.7 ± 88.1 with a 72% pass rate and APFT scores were 265.4 ± 26.9 with a 100% pass rate. Significant relationships were found between scores for the ACFT hand-release push-up and standard APFT push-ups ($r = 0.75, p < 0.01$) as well as the ACFT and APFT 2-mile runs ($r = 0.96, p < 0.01$). There was not a significant relationship between total scores of the ACFT and APFT ($r = 0.28, p > 0.05$). Body fat percentage and total ACFT score were significantly related ($r = -0.55, p < 0.05$). Physiological data for the ACFT were: MHR = 197 ± 18, AVGHR = 123 ± 29, PL = 454.5 ± 141.8, and PI = 6.1 ± 2.0.
CONCLUSIONS: The results demonstrate that high performance in the APFT may not translate to high performance in the ACFT. In addition, the ACFT requires moderate to vigorous effort throughout the duration of the test. The results of this study are useful as Army leaders prepare to train cadets and soldiers for successful completion of the new ACFT.

1153 Board #279 May 27 1:30 PM - 3:00 PM
Characterizing The Bioenergetic Profile Of White Blood Cells For Utility In Assessing Mitochondrial Dysfunction In Gulf War Illness

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 (No relevant relationships reported)

PURPOSE: Gulf War Illness (GWI) is a chronic multi-symptom illness that affects veterans who served during the 1990- 1991 Gulf War. Similar symptoms between GWI and known mitochondrial disorders have sparked investigations into the health of mitochondria in veterans with GWI. The objective of this study is to characterize the bioenergetic profile of peripheral blood mononuclear cells (PBMCs) in veterans with GWI (GWI+) and controls (GWI-) and assess the relationship with symptom severity and physical activity. **METHODS:** 55 Gulf War veterans (85.5% male; 55.0±6.7 years) volunteered for this study. GWI case status and symptom severity were determined via the Kansas-Steele Questionnaire (KQ). Self-reported fatigue (Fatigue Severity Questionnaire; FSS) and physical activity (International Physical Activity Questionnaire; IPAQ) were obtained via questionnaire. PBMCs were isolated from whole blood to determine bioenergetic profiles (Seahorse XFp), parameters of which are listed in the table. Between-group differences and associated effect sizes for each parameter and symptom/activity scales were assessed via Mann Whitney U and Hedges' *d*, respectively. Spearman's rank correlation was used to evaluate the relationship between reserve capacity and GWI symptom severity (KQ total score), physical activity (IPAQ kcal/week) and fatigue severity (FSS mean score). **RESULTS:** 38 of 55 veterans met case definition for GWI. Self-reported symptom severity, physical activity level, and the profile parameters are reported in the table (mean±SD). Reserve capacity was associated with FSS ($\rho = -0.29, p = 0.04$), but not for KQ ($\rho = -0.26, p = 0.05$) nor physical activity ($\rho = 0.18, p = 0.18$). **CONCLUSIONS:** We observed differences in bioenergetic profiles between veterans with and without GWI. GWI+ veterans demonstrated a profile consistent with mitochondrial dysfunction and one that can be potentially used as a diagnostic tool. Supported by CDMRP GWIRP W81XWH-16-1-0663

Variables and Symptom Severity	GWI- (n = 17)	GWI+ (n = 38)	p value	Effect size (d)
Basal	124.1 (37.6)	103.9 (35.2)	.04	-.57
ATP-linked	100.9 (30.8)	83.5 (28.5)	.04	-.59
Proton leak	23.1 (10.5)	19.6 (10.4)	.23	-.33
Maximal Capacity	326.7 (117.2)	240.9 (79.5)	.01	-.91
Reserve Capacity	202.6 (88.1)	137.7 (57.1)	.01	-.94
Non-Mitochondrial	47.3 (16.6)	41.6 (15.9)	.11	-.35
Kansas Score	4.7 (5.4)	34.47 (14.4)	.00	2.37
FSS Score	1.8 (1.2)	4.43 (2.0)	.00	1.44
IPAQ Score	4636.1 (7560.1)	2847.5 (2679.8)	.83	-.37

1154 Board #280 May 27 1:30 PM - 3:00 PM
Poor Soldier Medical Readiness In The Year Following Return To Unrestricted Duty After Musculoskeletal Injury

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 (No relevant relationships reported)

Not all Soldiers cleared for full unrestricted duty are without injury just because they do not seek medical attention. Using medical care-seeking as proxy for medical readiness & deployability has limitations. Efficient injury detection & long-term management can improve if surveillance begins before patients make decisions to seek care. **PURPOSE 1)** determine proportion of Soldiers reporting new or recurring injuries for which they did not seek medical care, & 2) report perceived ability to perform full military duty when injured & not seeking care. **METHODS** This was a secondary analysis of a cohort of Soldiers (n=469) recently cleared to return to full duty (RTFD) without limitations. Monthly adaptive text messages queried about any new or recurrent injuries for 1 yr after clearance to RTFD after spine or lower extremity injury. Presence of MSK pain, care-seeking behavior, & perceived ability to perform military duties were assessed. **RESULTS** 424 soldiers had at least 1 response over the 1-yr follow-up & a mean response rate of 45.5% (at least 5 months). 315 participants reported injury-related MSK pain at least once. Of those, 276 (87.6%) reported not seeking care during at least 1 pain episode. When care was not sought, 89 (32.2%) reported it affecting their ability to perform military duties. On at least one occasion, 127 individuals believed they would not pass an annual fitness test due to pain, deconditioning, or fear of injury. **CONCLUSIONS** Soldiers do not always seek care for MSK injuries, & thus, many are not confident in their ability to complete military duties. Early indicators & improved surveillance strategies could identify problematic injuries before they reach a threshold of needing to seek care. Equally important is the ability to predict which individuals can self-manage without adversely affecting ability to perform military duties. This research was supported by the Department of Defense Military Operational Medicine Research Program under program number (W81XWH-13-MOMJPC5-IPPEHA). The view(s) expressed herein are those of the author(s) and do not reflect the official policy or position of Brooke Army Medical Center, the U.S. Army Medical Department, the U.S. Army Office of the Surgeon General, the Department of the Army, the Department of the Air Force, the Department of Defense, or the U.S. Government.

1155 Board #281 May 27 1:30 PM - 3:00 PM
Participation In Sports During Adolescence Positively Impacts Bone Health In Recruits Entering Basic Combat Training

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 (No relevant relationships reported)

It is well documented that participation in sports during childhood is beneficial to skeletal health. Almost 40% of bone mineral content is attained during years of peak height velocity (females 10-14y; males 12-16y). Improving bone development during these years may be beneficial in mitigating musculoskeletal injuries (MSKIs) in Soldiers. **PURPOSE:** To evaluate the relationship between participation in sports during adolescence and baseline bone microarchitectural parameters in recruits entering Basic Combat Training (BCT). **METHODS:** Survey data on sport participation from 840 Army recruits entering BCT were analyzed (611M, 25.0±3.7 kg/m², 20.6±3.6y; 229F, 23.6±2.7 kg/m², 20.4±3.5y). Low impact (LI) and high impact (HI) sports were categorized according to effective load stimulus scores. Middle school (MS) was defined as grades 6-8 (11-14y) and high school (HS) as grades 9-12 (14-18y). Baseline bone characteristics were measured at the ultradistal tibia using a high resolution CT scanner. Linear models were used to evaluate the association between bone microarchitecture and timing and impact category of sport played. Models were adjusted for ethnicity, BMI, age, and parents' education. Effect estimates (EE) and p values for bone parameters compared to recruits who did not play sports (98M, 46F) are presented. **RESULTS:** Table 1 shows that participation in both low and high impact sports during adolescence had a significant effect on baseline bone measures in male and female recruits compared to those who did not participate in sports. While male sports participation in HS had a greater effect than MS sports participation, the opposite was observed in females. We found no significant effects in trabecular thickness, spacing or

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number. **CONCLUSION:** Promoting sports participation in children and adolescents, particularly during peak growth years, is important in providing long term skeletal health benefits and may help to reduce MSKIs in Soldiers.

Table 1: Baseline bone measures in recruits who played sports during peak growth years

Male	N	Total vBMD	Trabecular vBMD	Trabecular BV/TV	Cortical vBMD	Cortical Thickness	Cortical Area
LI MS	231	EE=-0.91; p=0.81	EE=-1.42; p=0.65	EE=0.00; p=0.49	EE=3.27; p=0.43	EE=0.00; p=0.84	EE=0.35; p=0.86
LI HS	374	EE=5.10; p=0.15	EE=5.86 [^] ; p=0.05	EE=0.01 [*] ; p=0.04	EE=-0.41; p=0.92	EE=0.00; p=0.99	EE=-0.34; p=0.86
HI MS	377	EE=6.53; p=0.11	EE=7.57 [*] ; p=0.03	EE=0.01 [*] ; p=0.02	EE=-3.73; p=0.42	EE=0.01; p=0.54	EE=2.91; p=0.19
HI HS	417	EE=7.67 [*] ; p=0.02	EE=6.60 [*] ; p=0.04	EE=0.01 [*] ; p=0.06	EE=3.61; p=0.39	EE=0.04 [*] ; p=0.03	EE=5.30 [*] ; p=0.01
Female	N	Total vBMD	Trabecular vBMD	Trabecular BV/TV	Cortical vBMD	Cortical Thickness	Cortical Area
LI MS	76	EE=13.19 [*] ; p=0.02	EE=9.30 [^] ; p=0.06	EE=0.01 [*] ; p=0.08	EE=7.85; p=0.27	EE=0.05 [*] ; p=0.07	EE=2.69; p=0.26
LI HS	110	EE=-0.43; p=0.93	EE=-2.54; p=0.57	EE=0.00; p=0.59	EE=1.04; p=0.87	EE=0.03; p=0.14	EE=4.83 [*] ; p=0.02
HI MS	128	EE=3.42; p=0.57	EE=10.74 [*] ; p=0.04	EE=0.02 [*] ; p=0.05	EE=-2.93; p=0.68	EE=-0.03; p=0.22	EE=-1.05; p=0.67
HI HS	153	EE=5.10; p=0.38	EE=3.34; p=0.50	EE=0.01; p=0.50	EE=-2.93; p=0.68	EE=0.02; p=0.50	EE=0.86; p=0.71

*p<0.05; [^]p<0.10

1156 Board #282 May 27 1:30 PM - 3:00 PM

Army Combat Fitness Test & The APFT; The New Frontier

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(No relevant relationships reported)

The Army Combat Fitness Test (ACFT) will replace the ~40 year-old Army Physical Fitness Test (APFT) as the Army's record fitness test in 2020. **PURPOSE:** Investigate performance relationships of U.S. Service Academy Cadets (USSAC) on both the ACFT & APFT. **METHODS:** 551 fit subjects (433 men; 118 women) participated in two testing sessions during a 6-month period. The ACFT focuses on combat readiness components of Strength-Dead Lift (DL), Power-Power Throw (SPT), Muscular Endurance-Hand Release Push-ups (HRPU); Leg Tuck (LTK), Mobility/Speed-Sprint Drag & Carry (SDC), & Cardio-Respiratory Endurance-2-Mile Run (2MR). Specific data analysis & criterion determination (APFT > 285; ACFT %'s 60-90%) were utilized. **RESULTS:** Overall, top 10 ACFT performers, APFT > 285 & ACFT percentiles revealed a stable metric identifying higher end physical performance cadets respectively. Women can score ~72% of the men's ACFT ability versus 103% of the men's APFT ability. Descriptive data:

Group n ()	APFT Pts (±SD)	PU reps	SU reps	2MR secs	DL lbs	SPT meter	HRPU reps	SDC secs	LTK reps	2MR secs	ACFT Pts	Old ACFT Pts
Women (118)	285.1 (34.8)	44.1 (9.6)	74.4 (9.9)	947.5 (95.2)	169.4 (27.5)	5.8 (1.1)	15.7 (9.3)	127.3 (13.4)	3.7 (4.2)	994.9 (103)	367.8 (72.9)	367.7 (73.2)
Men (433)	275.6 (30.7)	67.8 (10.8)	75.5 (9.5)	823.9 (65.7)	272.7 (45.4)	9.8 (1.6)	35.9 (9.1)	96.6 (11.3)	5.1 (5.1)	899.4 (93.1)	510.4 (33.4)	509.5 (32.4)
Women Top 10	337.9 (13.5)	57.4 (8.1)	86.1 (4.7)	834.1 (58.9)	208 (37.7)	7.1 (1.6)	24.4 (7.4)	109.9 (6.7)	10.7 (5.9)	873.8 (64.4)	469.8 (19.6)	469.3 (19.8)
Men Top 10	310.8 (25.9)	76.8 (4.6)	81.6 (8.6)	758 (41.4)	345 (15.8)	12.0 (1.5)	50.4 (7.7)	86.7 (6.1)	19.7 (4.5)	822.8 (50.3)	577.5 (2.9)	571.6 (3.8)
Women (58) APFT >285	312.2 (22.0)	49.9 (8.3)	81.3 (6.5)	894.2 (56.9)	173.0 (31.2)	6.0 (1.3)	18.8 (8.2)	124.2 (11.5)	5.7 (4.6)	948.9 (83.2)	406.8 (54.2)	405.9 (54.2)
Men (143) APFT >285	308.1 (21.1)	76.4 (7.4)	83.6 (6.6)	766.9 (39.2)	285.6 (44.0)	9.8 (1.4)	42.0 (7.8)	93.1 (7.7)	14.5 (4.4)	843.8 (83.6)	532.6 (25.1)	530.9 (23.8)
% of Men Performance	103.4	65.0	98.5	85.0	62.1	59.2	43.7	68.2	32.7	89.4	72.1	72.2

DISCUSSION: The ACFT appears to accurately assess important combat readiness components. Further, the raw data performances and composite ACFT score appear sensitive in discriminating overall performance abilities as opposed to the previous composite APFT score. For soldier-athletes desiring success on the five combat readiness components; strength, endurance, mobility, power/speed, cardio-respiratory realm, the ACFT appears to be a comprehensive combat fitness assessment & soldier-athletes should train and increase their overall physical capabilities. **CONCLUSIONS:**

The ACFT appears to be a reliable field test which can classify, indicate one's physical strengths and weaknesses, and assist in selecting personnel for more arduous military applications. Given the demand & robust nature of military applications coupled with the multi-dimensional ACFT assessment, increased physical performance metrics & thus an overall enhanced physical profile should be the goal of any soldier-athlete.

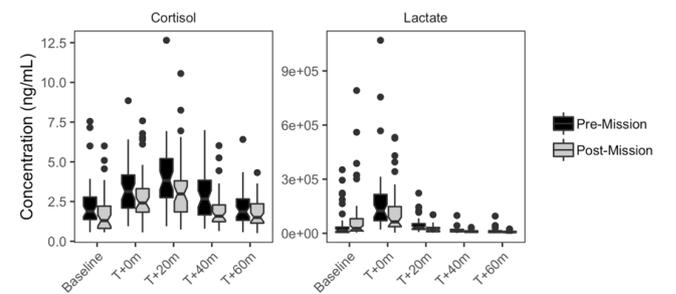
1157 Board #283 May 27 1:30 PM - 3:00 PM
Distinguishing Acute And Mounting Stress Responses Among Active Duty Military

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(No relevant relationships reported)

PURPOSE: To characterize acute vs. mounting cognitive and physical stress responses within a tactical timeline. Biomarkers of stress were extracted from saliva samples taken during a Live-Fire "Stress Shoot" (LFSS), eliciting acute stress. The LFSS was completed prior to (Pre) and following (Post) a 3-day intensive combat training exercise, eliciting mounting stress. **METHODS:** 46 active duty Soldiers (24.47 ± 4.13 years old, 4 women) completed the 3-day mission and 2 runs of the LFSS. The LFSS involved a marksmanship course with complex rules of engagement (high cognitive load) and physically taxing activities (shuttle run test, kettlebell presses). Salivary biomarkers were collected before (Baseline) and after the LFSS at 4-time points: at LFSS offset (T0) and in 20-minute intervals thereafter (T20, T40, T60). Biomarkers included cortisol to capture cognitive stress and lactate to capture physical stress. The main effects of Sample Time (T0 vs T20 vs. T40 vs T60) and of Mission Phase (Pre vs. Post) were analyzed with non-parametric repeated measures analyses (Friedman Test) with Bonferroni-corrected posthoc pairwise comparisons. **RESULTS:** Cortisol peaked at T20 (Pre DC=3.39, p<0.001; Post DC=4.47, p<0.001), while lactate peaked at T0 (Pre DC=7.54, p<0.001; Post DC=2.72, p=0.007). There was also a main effect of Mission Phase for cortisol at T20 (DC=2.12, p=0.36) and for lactate at T0 (DC=2.72, p=0.007). Both biomarkers showed decreased concentrations after the 3-day mission (Cortisol at T20: Pre = 4.30ng/mL, Post = 3.47ng/mL; Lactate at T0: Pre = 193745ng/mL, Post = 114346ng/mL). **CONCLUSION:** The present results reveal heightened acute stress responses through peaks in salivary cortisol and lactate following an acute tactical stressor (LFSS). Together, this suggests that the primary stress responses experienced by active-duty Soldiers are due to acute stress, rather than mounting stress. [1927 of 2000 characters]



1158 Board #284 May 27 1:30 PM - 3:00 PM
Comparison Of Body Composition Indices For Men And Women At Two Air Force Bases

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Assessment of body composition and its effect on the performance of military tasks is ongoing. Various branches of the military have relied on different techniques to assess

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body fat (%fat), fat mass (FM), and fat-free mass (FFM) in both men and women. A widely accepted technique is air displacement plethysmography (ADP), which using a mass-to-body volume ratio to determine %fat. Owing to the standard measurement procedures and accepted validity of this method, it would be beneficial to compare military personnel at different bases to evaluate continuity of FFM and %fat in Air Force personnel. **PURPOSE:** To compare body composition components among Air Force men and women at two different bases. **METHODS:** Men ($n = 604$) and women ($n = 343$) were evaluated using ADP to identify FM, FFM, and %fat. Participants were stratified into 4 age groups, determined by decade, with individuals <20 yrs ($n = 21$) combined with the 20-29 yr-old group. Self-appraised activity groups were denoted as sedentary, low active, active, and very active based on standard criteria. Height and weight were used to calculate BMI = kg/m². Fat-free mass index (FFMI) and fat mass index (FMI) were determined for each component relative to height (m²). **RESULTS:** A base x activity (2×4) MANOVA in men revealed weight, BMI, FFM, and %fat were not significantly different ($p > 0.21$) between bases, while active and very active groups were significantly better than sedentary and low activity groups. In women, BMI, FFM, and %fat were not significantly different ($p > 0.14$) between bases but active and very active groups were significantly better than sedentary and low activity groups. BMI had a significantly higher correlation ($p < 0.001$) with %fat in women ($r = 0.79$) than in men ($r = 0.68$). Discriminant analysis identified %fat as the best separator of activity groups, with a better success rate for discerning between sedentary (61%) and very active women (62%) than between low active and active groups (<40%). In men, %fat was better for identifying those in the very active group (72%) compared to those in the other 3 groups (<53%). **CONCLUSION:** Body composition indices do not appear to differ greatly among Air Force personnel at different bases.

1159 Board #285 May 27 1:30 PM - 3:00 PM
Characterization Of Energy Expenditure, Body Composition, And Androgen Status During Summer And Winter Marine Mountain Warfare Training

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BACKGROUND: Military operations occurring in austere environments result in declines of androgen status and physical performance, which has been associated with the severity of negative energy balance. However, whether negative consequences of military operations differ between environmental conditions has not been well described.

PURPOSE: To characterize energy expenditure, body composition, and androgen status during Marine mountain warfare summer and winter training.

METHODS: Sixty seven healthy US Marines taking part in summer ($18 \pm 3^\circ\text{C}$, $n = 46$) or winter ($2 \pm 4^\circ\text{C}$, $n = 21$) training at Marine Corps Mountain Warfare Training Center participated in this longitudinal observation study. Doubly labeled-water was used to determine energy expenditure throughout summer and winter training. Body composition (InBody 770) and blood draws were performed before and after 15 days of mountain warfare training. Data presented as mean \pm SD.

RESULTS: Energy expenditure was 3782 ± 688 kcal/d during summer and 4596 ± 688 kcal/d during winter Marine mountain warfare training. Summer training resulted in a decline ($P < 0.01$) in body mass (-2.7 ± 1.5 kg), fat mass (-1.1 ± 1.0 kg), lean mass (-1.6 ± 1.3 kg), total body water (-1.2 ± 1.0 kg), and dry lean mass (-0.5 ± 0.4 kg). Winter training resulted in a decline ($P < 0.01$) in body mass (-2.2 ± 1.1 kg), lean mass (-1.7 ± 1.1 kg), total body water (-1.3 ± 0.8 kg), and dry lean mass (-0.4 ± 0.3 kg). There was no difference in fat mass (-0.5 ± 1.2 kg) following winter training. Following summer training a decline ($P < 0.01$) in IGF-1 (-28 ± 27 ng/mL), but not testosterone (36 ± 124 ng/dL) was observed, while in both IGF-1 (-51 ± 38 ng/mL) and testosterone (-111 ± 135 ng/dL) declined ($P < 0.01$) following winter training.

CONCLUSION: Findings from this investigation indicate that both summer and winter mountain warfare training result in declines in body mass and dry lean mass, while only winter training results in a decline in both circulating IGF-1 and testosterone.

This material is based on the work supported by DHP JPC-5/MOMRP; authors' views not official U.S. Army or DoD policy.

1160 Board #286 May 27 1:30 PM - 3:00 PM
Effects Of Precooling On Recreationally Active Individuals During Loaded Carriage Foot Marches In Heated Conditions

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Over the past 20 years, the literature has demonstrated that military members are prone to exertional heat illness due to a combination of heavy loads and physical exertion. Solutions such as Cold Water Immersion or Convective Cooling Vests help ease this physiological strain; however, these methods are not always practical for use. These methods require either time, space, equipment or are not cost efficient. A relatively new approach known as precooling, is when an individual either applies a cooling method or ingests a cold substance preemptively to lower core temperature before an activity.

PURPOSE: The aim of this study was to investigate the effects of a precooling protocol employing ice slurry ($0 \pm 1^\circ\text{C}$) vs. cold water (4°C) on core body temperature and time to exhaustion (minutes) during a simulated military full combat gear foot march in males aged 18 to 35 years. **METHODS:** This study consisted of 6 college aged males, (23.5 ± 1.0 y/o, 91.0 ± 9.3 kg, 183.3 ± 8.1 cm), who engaged in two separate simulated army ruck march trials in heated conditions ($33 \pm 2^\circ\text{C}$). The researchers used a precooling protocol of 7.5g/kg of bodyweight of both water (control) and ice-slurry (experimental) administered over a 30-minute period prior to activity. Following the precooling protocol, the participants self-selected a pace from 3.0-4.0 MPH and walked for up to 90 minutes or until volitional fatigue inside a heat tent while wearing full army combat gear. Core temperature, heart rate and RPE were collected every 5 minutes. Blood pressure was collected pre and post exercise. **RESULTS:** This is preliminary data of an on-going study. There was no significant difference in time to exhaustion ($p = 0.227$; $t = -1.37$), heart rate ($p = 0.763$; $f = 0.001$) or core temperature ($p = 0.876$; $f = 0.20$) between conditions. **CONCLUSION:** The precooling protocol was ineffective at lowering core temperature vs. control and thus did not increase time to exhaustion. Additional research on precooling with military equipment is needed to further elucidate the potential benefits of precooling on exercise performance and decreasing the risk of exertional heat illness.

1161 Board #287 May 27 1:30 PM - 3:00 PM
Simulated Military Operational Stress Negatively Impacts Psychomotor Vigilance And Neurocognitive Biomarkers In Men And Women

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 (No relevant relationships reported)

Military operations often require sustained alertness in the presence of physical fatigue, caloric deprivation, and sleep restriction, stressors that may affect men and women differently. **PURPOSE:** To identify differences in psychomotor vigilance and neurocognitive biomarkers based on sex during simulated military operational stress (SMOS). **METHODS:** Forty-nine Soldiers (25.8 ± 5.2 years, 174.6 ± 9.5 cm, 80.0 ± 16.2 kg, 21.3 ± 7.0 BF%, 11 women) completed a 5-day/night SMOS protocol. Subjects completed physical and cognitive evaluations from 0900-2230. Nights 3 and 4 included restricted sleep from 0100-0300 and 0500-0700, with psychomotor evaluations between 0300-0500. Subjects were given 50% of caloric demands on Days 3-4. Fasted blood was drawn each morning at 0800, followed by psychomotor vigilance test (PVT). Concentrations of insulin-like growth factor I (IGF-1), α -Klotho, and brain-derived neurotrophic factor (BDNF) were analyzed using standard immunoassays. PVT performance was based on accuracy and response time correlated to a percentile position within a normative distribution. Two-way mixed ANOVA with Bonferroni correction for multiple comparisons were used appropriately ($p < 0.05$). Day 1 PVT was excluded from the analysis to account for learning effect. **RESULTS:** There were no sex*time interaction effects for PVT ($p = 0.950$), BDNF ($p = 0.285$), IGF-1 ($p = 0.103$), or α -Klotho ($p = 0.091$). Main effect of time was observed for PVT ($p < 0.001$), IGF-1 ($p < 0.001$), and α -Klotho ($p < 0.001$). PVT performance decreased from D2 to D3 ($D2 = 417.45 \pm 248.5$, $D3 = 302.0 \pm 252.5$; $p = 0.01$), and from D2 to D4 ($D4 = 261.6 \pm 256.2$; $p < 0.001$) and rebounded after one night of recovery sleep ($D5 = 482.0 \pm 257.3$). IGF-1 and α -Klotho decreased from D1 to D5 by 13.1% ($p < 0.001$) and 12.0% ($p < 0.001$), respectively. There was a main effect of sex for BDNF ($p = 0.020$). On average, BDNF concentrations were 4,368.5 pg/mL higher in women during SMOS. **CONCLUSION:** SMOS has a similar negative impact in men and

women on psychomotor vigilance and neurocognitive biomarkers IGF-I and α -Klotho. However, women demonstrate higher concentrations of BDNF in the presence of SMOS.

Department of Defense (Award # W81XWH-16-PHTBIRP-CR3A). The results and opinions herein are those of the authors and do not necessarily constitute endorsement of the Department of Defense.

1162 Board #288 May 27 1:30 PM - 3:00 PM
The Cardiopulmonary Effects Of Thoracic Load Carriage While Resting

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(No relevant relationships reported)

PURPOSE: To investigate the cardiopulmonary effects of thoracic load carriage (LC) while sitting and standing. **METHODS:** Eight males and one female (Age: 21.0 \pm 1.4 yr; Height: 178.9 \pm 5.8 cm; Mass: 86.1 \pm 13.2 kg; Body Fat: 20.2 \pm 7.2%) without LC experience participated in the study. On separate days, subjects completed four trials of sitting quietly for 5 minutes, and then standing quietly for 5 minutes without assistance. Testing sessions included an unloaded (UL) trial, which served as the control, and wearing a light load (LL; 24lb = 10.9kg), moderate load (ML; 48lb = 21.8kg) and heavy load (HL; 80lb = 36.4kg) weighted vest. The testing order of the weighted vest trials was determined by counterbalanced assignment. Vest weights were selected to approximate common gear of tactical populations: law enforcement (LL), firefighter (ML), and military personnel (HL). Minute ventilation (V_E), respiratory rate (RR), Tidal volume (T_V), oxygen consumption (VO_2), heart rate, and ratings of perceived exertion (RPE) were assessed during all trials. An average value from the last minute was calculated for V_E , RR, T_V , VO_2 , and heart rate and used in a repeated measures ANOVA for statistical comparison. **RESULTS:** While sitting, there were no differences observed across trials in any of the aforementioned variables. While standing, V_E was significantly higher during ML ($p = .013$) and HL ($p = .005$) compared to unloaded (UL = 12.6 \pm 3.2, LL = 12.2 \pm 1.9, ML = 14.8 \pm 3.7, HL = 14.9 \pm 4.1 l \cdot min⁻¹). RR, T_V and heart rate were not different during any of the standing trials. Relative VO_2 while standing was significantly higher for ML ($p = 0.038$) and HL ($p = 0.001$) compared to UL (UL = 4.3 \pm 0.6, LL = 4.6 \pm 0.6, ML = 5.0 \pm 0.7, HL = 5.3 \pm 0.8 ml \cdot kg⁻¹ \cdot min⁻¹). Standing RPE was significantly higher for ML ($p = 0.050$) and HL ($p = 0.014$), compared to UL (UL = 6.1 \pm 0.3, LL = 6.9 \pm 1.6, ML = 7.6 \pm 1.9, HL = 7.9 \pm 1.7). **CONCLUSION:** Sitting while under thoracic load carriage did not elicit any significant changes. While standing, ML and HL elicited an increase in V_E , although it is unclear if this response was due to RR, T_V , or a combination of both. ML and HL increased oxygen consumption by 16% and 23% respectively while standing, as well as increased the perceived effort.

Supported in part by LHU Faculty Professional Development funds.

1163 Board #289 May 27 1:30 PM - 3:00 PM
Comparison Of United States Marine Corps Physical Fitness Test And Combat Fitness Test Results

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(No relevant relationships reported)

For active duty United States Marines physical and combat fitness is essential to be battle-ready and is necessary for day-to-day effectiveness. To help instill habits of self-discipline and maintain physical and combat fitness the United States Marines Corps (USMC) have installed a Physical Fitness Test (PFT) to measure physical fitness levels and a Combat Fitness Test (CFT) to assess a Marine's functional fitness as it relates to the demands and rigors of combat operations. The USMC PFT involves three events; pull-ups/push-ups (PU), two-minute timed abdominal crunches/sit-ups (AC), and a timed three-mile run (RUN). The USMC CFT also involves three events; Movement to Contact (MTC), two-minute timed Ammunition Lift (AL), and Maneuver-Under-Fire (MANUF). **PURPOSE:** The purpose of this study was to investigate relationships between PFT (PU, AC, and RUN) and CFT (MTC, AL, and MANUF) scores assessed by active duty Marines. **METHODS:** The PFT and CFT scores from 19,678 active duty enlisted USMC males (age 22.5 \pm 1.3 years, height 1.77 \pm 0.07 m, body mass 79.4 \pm 10.3 kg) were analyzed. Pearson correlation coefficients (r) were calculated between the PFT and CFT total scores as well as individual events. **RESULTS:** The PFT mean \pm sd scores were as follows: PU = 18.0 \pm 5.0 (pull-ups), AC = 111.2 \pm 9.0 (repetitions), RUN = 1377.0 \pm 131.4 sec, PFT total = 249.6 \pm 29.6. The CFT mean \pm sd scores were as follows: MTC = 172.5 \pm 16.3 sec, AL = 113.2 \pm 10.4 repetitions, MANUF = 138.3 \pm 17.2 sec, CFT total = 271.6 \pm 25.6. Moderate significant ($p < 0.01$) correlations were found between: the PFT total and MTC ($r = -0.47$), PFT total and MANUF ($r = -0.42$), PFT total and CFT total ($r = 0.50$), RUN and MTC ($r = 0.46$), RUN and CFT total ($r = 0.43$), & PU and CFT total ($r = 0.41$). All other correlations between variables yielded "no to low" association. **CONCLUSION:** Within the parameters

of this study, PFT and CFT event scores ranged from "no" to "moderate" correlations suggesting that different fitness aspects are being assessed and supports the need for both the PFT and CFT assessments.

1164 Board #290 May 27 1:30 PM - 3:00 PM
Abstract Withdrawn

1165 Board #291 May 27 1:30 PM - 3:00 PM
Performance Aspects Of Operational Preparedness Differ Between Marine Raider Operators And Support Personnel During Deployment Training

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(No relevant relationships reported)

The tactical demands of Marine Corps Forces Special Operations Command (MARSOC) personnel require high levels of physical performance. During combat deployments, Operators are supplemented with Combat Support personnel who specialize in mission specific tasks. Operators and Support personnel complete portions of tactical training and combat deployments together, often enduring similar training and tactical demands. Previous research comparing Operators and Support personnel has identified significant overall performance gaps, but research has yet to examine performance characteristics during a consistent training phase time point. **PURPOSE:** To examine performance characteristics of Marine Operators and Support personnel prior to completing unit deployment training together. **METHODS:** Operators (N: 39, Age: 28.8 \pm 3.11 years, Height: 1.78 \pm 0.08 m, Mass: 87.1 \pm 8.7 kg) and Support personnel (N: 16, Age: 27.9 \pm 4.6 years, Height: 1.77 \pm 0.07 m, Mass: 83.03 \pm 13.8 kg) completed agility, speed, lower/upper body power, anaerobic capacity, strength, aerobic power, and body composition assessments. Differences between groups were evaluated using independent samples t-tests, or Mann-Whitney U tests ($p \leq 0.05$). **RESULTS:** Operators demonstrated better performance in agility (4.85 \pm 0.21 s, 5.04 \pm 0.21 s; $p = 0.005$), anaerobic capacity (190.58 \pm 16.24 yd, 174.82 \pm 18.11 yd; $p = 0.006$), upper body power (185.03 \pm 23.52 cm, 172.26 \pm 27.39 cm; $p = 0.044$), strength (2,932.85 \pm 639.59 N, 2,443.75 \pm 706.99 N; $p = 0.019$), aerobic power (1,114.83 \pm 66.12 yd, 1,033.7 \pm 100.1 yd; $p = 0.001$) and significantly lower body fat (17.63 \pm 4.06 %BF, 21.01 \pm 7.09 %BF; $p = 0.035$). No significant differences were found in lower body power ($p = 0.069$) and speed ($p = 0.051$). **CONCLUSION:** Performance deficits in Support personnel during active deployment training could have deleterious effects on tactical training, leading to increased risk of injury and potentially affecting subsequent deployment status. The significant discrepancies in key performance outcomes suggest the need for Support personnel to incorporate additional performance training focused on improving overall strength, anaerobic and aerobic capacity, prior to unit training, in order to achieve adequate levels of operational preparedness, similar to their Operator counterparts.

1166 Board #292 May 27 1:30 PM - 3:00 PM
Pulmonary Capillary Blood Volume And Membrane Conductance In Iraq And Afghanistan Veterans With Deployment-related Exposures

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Purpose: We have previously observed an isolated reduction in diffusing capacity of the lung for carbon monoxide (DL_{CO}) to be a common pulmonary function pattern among symptomatic Iraq and Afghanistan Veterans. DL_{CO} measurement reflects both alveolar capillary membrane diffusion (DM_{CO}) and pulmonary capillary blood volume (V_C); therefore, additional techniques (i.e., simultaneous measurement of diffusion of nitric oxide [DL_{NO}]) are necessary to separately examine DM_{CO} and V_C components. The purpose of this preliminary study is to evaluate the utility of the double-gas diffusion technique in Iraq/Afghanistan veterans to better understand the physiological basis of reduced DL_{CO} . **Methods:** 20 Iraq/Afghanistan non-smoking veterans (90% male; Age: 36.65 \pm 7.3 years; BMI: 30.37 \pm 3.8 kg/m²) volunteered for this study. Complete pulmonary function testing was performed, including the double-gas diffusion technique (DL_{NO}/DL_{CO}) and forced oscillation technique (FOT). Combined reference equations for DL_{CO} , DL_{NO} , DM_{CO} , V_C from the ERS DL_{NO} Task Force were used to calculate predicted and lower 2.5th percentile (LLN). FOT-derived frequency dependence of resistance (R4-R20) and reactance area (AX) were calculated

to reflect distal airway function. Spearman's rank correlation was used to examine the relationship between DM and V_c with R4-R20 and AX. **Results:** Double-gas diffusion testing results are provided in the table. Reduced V_c (\leq LLN) was observed in 8 of 20 (40%) and DM_{CO} was reduced (\leq LLN) in 2 of 20 (10%) veterans. V_c (% predicted) was inversely associated with distal airway measures (R4-R20: $\rho = -0.72$, $p < 0.001$; AX: $\rho = -0.50$, $p = 0.03$), but DM_{CO} (% predicted) was not (R4-R20: $\rho = 0.45$, $p = 0.05$; AX: $\rho = 0.36$, $p = 0.13$). **Conclusion:** In our preliminary analysis, we observed that 40% of our sample demonstrated reduced V_c , which appears to be associated with distal airway dysfunction. Continued investigation in this population appears warranted. Funded by VA: I01CX001515-01.

	Observed Mean \pm SD [range]	Predicted (%) Mean \pm SD [range]
DL_{NO} (mL·min ⁻¹ ·mmHg ⁻¹)	148.5 \pm 24.5 [105.0 – 199.9]	88.9 \pm 12.6 [66.0 – 113.0]
DL_{CO} (mL·min ⁻¹ ·mmHg ⁻¹)	28.5 \pm 5.9 [16.3 – 39.0]	83.6 \pm 13.6 [58.0 – 108.0]
DL_{NO}/DL_{CO} ratio	5.3 \pm 0.6 [4.1 – 6.4]	-
DM_{CO} (mL·min ⁻¹ ·mmHg ⁻¹)	211.0 \pm 83.7 [103.4 – 478.6]	117.0 \pm 35.9 [59.0 – 222.0]
V_c (mL)	57.7 \pm 14.6 [30.0 – 85.0]	73.2 \pm 17.0 [47.0 – 110.0]

1167 Board #293 May 27 1:30 PM - 3:00 PM
Physiological Stress Response During Force-on-Force Training With Simunitions
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 (No relevant relationships reported)

PURPOSE: Close-quarters combat (CQC) engagements activate the “fight-or-flight” response; which activates the sympathetic-nervous system (SNS) and hypothalamic-pituitary-adrenal (HPA) axis to respond to the perceived threats. Currently, the objective assessment of a force-on-force CQC environment on the physiological response has not been quantified, nor has it been shown whether training will impact the physiological response.
METHODS: United States Marines and Army infantry personnel (n = 24; 26.3 \pm 0.3 yrs, 177.2 \pm 0.3 cm, 85.4 \pm 0.5 kg) participated in a 15-day CQC training program. The CQC program focused on increased lethality, including large amounts of force-on-force training with the use of simunitions. Data collections occurred on training Days 1 and 15, during a simulated force-on-force, hostage rescue scenario. Participants were instructed to clear the shoothouse, rescue the hostage, and only engage (shoot) hostile threat(s) with simunitions. Salivary alpha-amylase (sAA) and cortisol were obtained immediately prior to entering and exiting the shoothouse. A linear mixed effects model was used to determine the differences between time points and days. **RESULTS:** There was a main effect of day for cortisol indicating that cortisol was higher on Day 15 compared to Day 1 (0.121 \pm 0.075 vs 0.187 \pm 0.075 μ g/dL; $p < 0.0001$). However, there was no main effect of time points for cortisol ($p > 0.05$); nor were there any interaction effects of day and time point for cortisol ($p > 0.05$). There was no main effect of day for sAA ($p > 0.05$); nor was there an interaction between day and time point for sAA ($p > 0.05$). Nevertheless, there was a time point effect for sAA indicating that post-scenario sAA was higher than pre-scenario sAA (168.25 \pm 100.93 vs 118.95 \pm 90.25 U/mL; $p < 0.0007$). **CONCLUSIONS:** Cortisol increased stepwise across the pre- and post-scenario time points on Days 1 and 15; most likely indicative of the cumulative stress effects on the HPA axis. Conversely, sAA increased acutely in response to the stress of the hostage scenario, likely due to its association with norepinephrine and the acute SNS response. Despite training, there is still an increased SNS response during force-on-force drills; it remains to be seen if this response enhances or hinders performance in high-stress situations.

B-79 Free Communication/Poster - Concussion I

Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
 Room: CC-Exhibit Hall

1168 Board #294 May 27 2:30 PM - 4:00 PM
Long Term Implications of Contact Football Head Trauma

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 (No relevant relationships reported)

Effects of head trauma experienced in contact football is a growing health concern. Limited research has been conducted to assess exposures to later concussion related symptoms among former college football players. **PURPOSE:** To quantify the amount of contact football participation, diagnosed concussions, non-diagnosed self-reported head trauma, and the frequency of symptoms associated with post-concussion syndrome among former college football players. **METHODS:** We surveyed 275 former college football players who were at least 10 years post competition. Respondents provided data on their youth, high school, and college playing experience, undiagnosed head injury, diagnosed concussions, and concussion related symptoms (CRSs). CRSs included cognitive impairment, impulsive behavior, depression, short term memory loss, difficulty planning, emotional instability, substance abuse, and suicidal thoughts, were combined into a frequency of symptoms score (range 0-8). A Poisson regression was conducted to examine the association between playing experience and reported head trauma with reported symptom count. **RESULTS:** The majority of participants reported no diagnosed concussions in college (80%), but a large number reported non-diagnosed football related head injuries (67%) that might have resulted in a concussion. A majority of participants (59%) reported no concussion related symptoms. After controlling for age, youth and high school football participation, playing time, non-football concussions, and participation in post-college football (pro, semi-pro), diagnosed concussions in high school or college did not significantly predict concussion symptoms later in life. However, non-diagnosed head injury significantly predicted concussion symptoms ($b = .47$, $p < .001$) as did post-college play ($b = .71$, $p < .001$). **CONCLUSIONS:** Diagnosed concussions were not associated with later self-reported concussion related symptoms. Non-diagnosed head injuries, which are less likely to be managed by a healthcare professional, were significantly associated with CRSs later in life. These findings suggest that proper identification and management of concussions may prevent later symptoms, but more data are needed to test this conclusion.

1169 Board #295 May 27 2:30 PM - 4:00 PM
Influence Of Demographic Factors On Concussion-related Decision-making By Certified Athletic Trainers

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PURPOSE: This study aimed to identify demographic variables relating to factors influencing concussion-related decision-making (CRDM) by certified athletic trainers (ATC). Understanding these factors will better inform interventions on improving the CRDM abilities of ATCs.
METHODS: A cross-sectional study of ATCs (n=1,029; age = 26.0 \pm 3.7) completed a validated questionnaire on demographic variables and theory-based (Integrated Behavior Model) factors about CRDM. Multivariable linear regression models (*a priori* alpha level = 0.05) estimated the effect of each independent variable (scales: knowledge – 25 to 100; attitudes – 14 to 98; perceived behavioral control – 3 to 21; self-efficacy – 2 to 14; intentions – -45 to 45). The predictive factors were: gender (male vs. female), race (non-Caucasian vs. Caucasian), years of experience as an ATC, employment setting (high school vs. college), and sport coverage responsibilities (non-collision vs. collision). Knowledge, attitudes, perceived behavioral control, and self-efficacy were also included as predictors in the model for intentions.
RESULTS: Most participants were female (n=724, 70.2%), Caucasian (n=874, 84.7%), and recent graduates (mean = 3.1 \pm 1.8 years of experience) and half were employed in high schools (n=519, 50.3%) and responsible for collision sport coverage (n=533, 51.6%). Demographic factors were not significantly related to factors associated with CRDM. However, safer attitudes were associated with better intentions to remove concussed individuals ($\beta = 0.17$; $p < 0.001$).
CONCLUSION: Intentions to make appropriate concussion-related decisions are a vital step in removing concussed individuals from play. ATCs may have diverse backgrounds and carry diverse professional responsibilities immersed in their own

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team cultures and experiences; however, these variables, as measured in this study, do not appear to impact their decision-making capabilities regardless of personal and professional background. There does not appear to be a need to develop specific initiatives for different types of ATCs. As such, it is important that educational initiatives focus on creating safer concussion-related attitudes and the need for appropriate decision-making of all ATCs.

Supported in part by a NATA Research and Education Foundation Doctoral Grant.

1170 Board #296 May 27 2:30 PM - 4:00 PM
Changes On ImPACT And ClearEdge In Women's Collegiate Soccer From Pre-season To Post-season

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Sports are the second most common cause of mild traumatic brain injury (mTBI) in young adults. Even when the athlete does not sustain mTBI, he/she may sustain subconcussive impacts, which are of unknown significance. Purdue University conducted a study in which half of the football players who did not display symptoms of mTBI showed changes in brain function on by the middle of the season impeding their ability to learn. None of these players had symptoms of mTBI. Therefore, subconcussive impacts may lead to neurocognitive decline and changes in balance.

PURPOSE

We hypothesized athletes who received a higher quantity and magnitude of impacts throughout the season would have increased symptoms, neurocognitive, and balance scores from pre- to post-season, as shown by ImPACT and ClearEdge testing.

METHODS

We examined 14 NCAA Division II Collegiate Women's soccer players at pre- and post-season using ImPACT and ClearEdge. Both tests assess neurocognitive function, and ClearEdge also examines balance. Subjects wore an accelerometer in their headband to record number and magnitude of impacts during all full contact practices and games throughout the season.

RESULTS

The data was analyzed by comparing the athletes' mean scores on ImPACT and ClearEdge testing and correlated with number of impacts, cumulative impact, and cumulative rotation. There were no significant correlations between the components of testing and the number or magnitude of impacts. From pre- to post-season, there was a statistically significant decrease in visual motor speed score, as measured by ImPACT from 42.5 to 39.5 (p value = 0.014). On ClearEdge testing, there was a statistically significant increase in multiple balance testing scores from pre- to post-season, including an increase in score on eyes closed standing side by side on foam 86.4 to 89.5 (0.013), eyes open tandem stance on foam from 87.6 to 89.4 (0.005), and aggregate stability measurement from 86.6 to 87.9 (0.009).

CONCLUSION

Neurocognitive and stability measures improved throughout the season on ImPACT and ClearEdge testing. These results do not support our hypothesis. The data could not be correlated accelerometer data, possibly due to an issue with compliance. The results of this study suggest further investigation in subsequent seasons is warranted.

1171 Board #297 May 27 2:30 PM - 4:00 PM
Rugby Union Concussions-recognize And Rugby Union Concussions-recognise Andremove:do We Over-call Suspected Concussions?

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(No relevant relationships reported)

PURPOSE: To determine if the World Rugby (WR) management guidelines of recognize and remove suspected concussions could lead to over-recognition of suspected concussion **METHODS:**

RESULTS: A retrospective analysis of head injuries in a cohort of Stellenbosch University collegiate rugby players ($n = 407$), age (mean \pm SD; 24.6 \pm 4.3), height (mean \pm SD; 1.83 \pm 0.07), weight (mean \pm SD; 90.7 \pm 14.4) and BMI (mean \pm SD; 26.5 \pm 5.7) for the period 2014-2018. All 407 players were removed from the field of play upon suspicion of a concussion according to World Rugby's "recognize and remove" guidelines. Indicators that a player might be concussed on the "recognize and remove" guidelines include seizure, loss of consciousness, confused, dazed, balance problems and behavioral changes. Each of the players with a suspected concussion returned for a clinical assessment performed using the Sports Concussion Assessment Tool (SCAT)-3 ($n = 362$) and/or SCAT-5 ($n = 45$) within 48 hours and was subsequently clinically diagnosed with or without a concussion by a qualified medical doctor. The SCAT questionnaire includes questions on red flags, mechanism of injury, symptom severity -, cognitive- and physical-evaluation, and neck examination,

balance, and standardized assessment of concussion (SAC) delayed recall and concussion injury advice. Out of the 407 suspected concussions, 90% were confirmed clinically within a 48 hours period, while 10% of suspected concussions were not clinically confirmed as a concussion. In addition, of the reported mechanism of injury ($n = 300$) the tackle was reported as the main mechanism of injury, accounting for over 70% of all concussion injuries.

CONCLUSIONS: It appears that World Rugby's "recognize and remove" guidelines is accurate in the eventual diagnosis of concussion. Therefore, we are not "over-calling" concussions in collegiate rugby in Stellenbosch. There is also a greater understanding by collegiate rugby medical staff as to how to diagnose and recognize concussion.

1172 Board #298 May 27 2:30 PM - 4:00 PM
Randomized Controlled Trial (RCT) Of A Precision Vestibular Treatment In Adolescent Athletes Following Sport-related Concussion

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Reported Relationships: A.P. Kontos: Royalty; Royalties from APA Books. Industry contracted research; Research contract from the NFL through the University of Pittsburgh.

Concussion care continues to evolve to incorporate more active treatments such as prescribed exercise (Leddy et al., 2019) and vestibular therapy (Broglio et al., 2015). Consensus statements advocate for randomized controlled trials (RCT) to determine the effectiveness of treatments. To date, there has not been an RCT of precision vestibular treatment in athletes following sport-related concussion (SRC) with vestibular symptoms/impairment. **PURPOSE:** To determine using an RCT the effectiveness of precision, vestibular treatment compared to standard of care for reducing recovery time, symptoms, and impairment in adolescent athletes with vestibular symptoms/impairment following SRC. **METHODS:** This study involved an RCT in 50 adolescent athletes with a diagnosed SRC with vestibular symptoms/impairment within 10 days of injury. Participants were randomized to vestibular treatment (i.e., gaze stability, visual motion habituation, dynamic balance, gait) (VEST) or control (i.e., behavioral management) (CTRL), and completed the Dizziness Handicap Inventory (DHI), Modified Balance Error Scoring System (mBESS), Vestibular/Ocular Motor Screening (VOMS), Post-concussion Symptom Scale (PCSS), Immediate Post-concussion Assessment and Cognitive Testing (ImPACT) at enrollment and 2- and 4-weeks post-enrollment. Recovery time was recorded using time of medical clearance for full return to activity. Compliance was monitored using daily text messaging. **RESULTS:** Groups were similar on demographics, initial injury characteristics/severity, and risk factors (all $p > .05$). mBESS total scores for VESTIB (-1.5) improved more from enrollment to 2-weeks than CONTROLS (-0.3) ($p = .04$). VESTIB was 8.6x (95% CI= 1.2 - 20.2) more likely to be recovered by 4-weeks than CONTROLS ($p = .01$). Survival analysis indicated that recovery for VESTIB (45 days) was significantly ($p = .04$) faster than CONTROLS (57 days). **CONCLUSION:** The current study provides the first RCT empirical evidence to support the effectiveness of a precision vestibular treatment in adolescent athletes following SRC. Future research should focus on determining the most effective frequency, intensity, and timing for vestibular precision treatments following SRC. Supported by a grant from the Chuck Noll Foundation.

1173 Board #299 May 27 2:30 PM - 4:00 PM
Oculomotor Fatigue Is Present In Some Adolescent Student-athletes Following Sport-related Concussion

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Upwards of 70% of adolescent concussion patients present with visual dysfunction. Total time on the King-Devick (K-D) Test or average distance on the near point of convergence (NPC) test contributes to clinical decision-making. However, performance deterioration across multiple trials or cards has not been previously reported and may require consideration for a targeted rehabilitation program.

PURPOSE: To determine if oculomotor fatigue (OMF) was present following a sport-related concussion (SRC) in adolescents. **METHODS:** 121 Student-athletes (15.3 \pm 1.4 years; 51 Female/70 Male) were administered Cards 1-3 of the K-D and then three trials of the NPC during their initial concussion evaluation (3.6 \pm 1.8 days post-injury). OMF was defined as exceeding the sample mean difference from Trial 1 to Trial 3

for the NPC and Card 1 to Card 3 for the K-D. Descriptive statistics, Mann-Whitney U tests, Independent-samples Median Tests, and Cronbach's α were performed using SPSS 25. **RESULTS:** 33% and 26% of the cohort presented with OMF on the NPC and K-D, respectively. The sample mean difference from Trial 1 to 3 for the NPC was 4.33cm and 4.72s for K-D Card 1 to 3. Using the cutoff of 4.33cm on the NPC, the OMF group exhibited worse median performance for all NPC trials ($p \leq 0.002$) and all K-D cards ($p \leq 0.029$), except Card 1 ($p = 0.52$). Internal consistency was high for the OMF group on the NPC (Cronbach's $\alpha = 0.967$) and K-D (Cronbach's $\alpha = 0.860$) and non-fatigue group for NPC (Cronbach's $\alpha = 0.987$) and K-D (Cronbach's $\alpha = 0.960$). **CONCLUSIONS:** It appears that there was a decline in performance on the NPC (33%) and K-D (26%) in a subset of our cohort. Interestingly, internal consistency remained high for the measures, even when OMF group performance was significantly worse. Future research is warranted to determine if OMF is a clinical biomarker for underlying attentional, cortical, cerebellar, or vestibular disorders. Our findings are specific to adolescent, sport-related concussion patients seen within a week of their injury using clinician-administered NPC and version 1 of the K-D plastic cards and should not be generalized.

1174 Board #300 May 27 2:30 PM - 4:00 PM
Dynamic Exertion Testing (EXIT): A New Approach To Inform Return To Play Following Sport-related Concussion

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A multifaceted assessment to inform clinicians of an athletes' readiness to return to play (RTP) following sport-related concussion (SRC) includes symptoms, and neurocognitive, vestibular, and ocular function. Athletes must also complete a progressive exertion protocol that systematically increases exercise intensity and sport-specificity. However, ambiguous exercise parameters and reliance on subjective symptom reports limit the current approach and there is a need for a brief, clinical assessment to better inform RTP decisions. A novel dynamic exertion test (EXiT) that incorporates ACSM exercise prescription recommendations to replicate physiological demands from a variety of sport types and provides objective criteria can address these limitations. A comparison of EXiT outcomes between athletes recently cleared to RTP (RTP-A) and matched healthy controls (CON) is warranted to determine the clinical feasibility and interpretation of EXiT. **PURPOSE:** Compare heart rate (HR), endorsed symptoms, rating of perceived exertion (RPE), and performance outcomes during the completion of a 1) aerobic treadmill protocol, and 2) 5 hand-timed agility tasks between RTP-A and CON groups completing EXiT. **METHODS:** Twenty-eight ($F=9$, 32.1%) athletes (ht.: 172.3±10.5 cm; wt.: 68.7± 14.5 kg) completed the EXiT test at RTP evaluation and were age-, gender-, and sport-matched to healthy controls (ht.: 171.1±9.0 cm, wt.: 64.1±17.5 kg). Participants wore an Equivital Lifemonitor physiological monitoring system, reported symptoms and RPE, and were timed by independent raters during completion of Box drills, Zigzag, Pro-agility, and Arrow agility EXIT tasks. Independent samples t-tests were conducted to compare HR, symptoms, RPE, and EXIT agility task completion time between RTP-A and CON groups. **RESULTS:** RTP-A and CON groups had similar post-EXIT HR (176.7±22.5 vs. 184.7±12.4), symptoms (0.93±3.56 vs. 2.00±5.92), RPE (15.7±2.8 vs. 15.0±2.9), and agility task completion time across EXIT outcomes. ($p>.05$). **CONCLUSIONS:** EXiT clinical outcomes were similar to athletes recently cleared to RTP following SRC and matched healthy controls. The new EXiT provides a multidomain, ACSM exercise criteria-based evaluation to inform RTP clinical decision making.

1175 Board #301 May 27 2:30 PM - 4:00 PM
Concussion History And Contact Sport Participation Influence Post-concussion Psychological Distress: Active Rehab Study Findings

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Understanding how concussion history and contact sport participation influence perceived psychological distress may improve management and provide opportunities for early intervention.

PURPOSE: To examine how prior concussion history and contact sport participation influence college and high school athletes' change in perceived psychological distress following concussion compared to pre-season baseline.

METHODS: Student-athletes ($n = 2629$) from 6 Canadian and US colleges and 8 US high schools completed a concussion baseline assessment including the Brief Symptom Inventory-18 item scale (BSI-18). The same battery was completed by 165 participants that suffered a concussion. The BSI-18 items were summed to create a total score (higher=greater psychological distress). BSI-18 change score (post-injury minus pre-injury) was the primary outcome. Primary predictors were concussion history and contact sport participation. Covariates included age, sex, and participation level (college vs. high school). The association between concussion history, contact sport participation, and BSI-18 change score was examined using linear regression models clustered on study site using generalized estimating equations (a priori $\alpha \leq 0.05$). **RESULTS:** Analysis included 145 participants with complete predictor, outcome, and covariate data [45 females (30.8%); median age = 18 years (IQR: 18-20); 66 (45.5%) with 1+ prior concussions; 121 (83.4%) played a contact sport]. Concussion history, when adjusting for all covariates was not statistically associated with BSI-18 change score ($p>0.05$). Participants in non-contact sports (6.0±8.0) compared to contact sport participants (2.1±7.4) reported a greater BSI-18 change score (Adjusted Mean Difference=3.1, 95%CI: 0.9, 5.4; $p=0.06$).

CONCLUSIONS: These data suggest individual participants in non-contact sports may have greater increases in reported post-concussion psychological distress. These findings highlight psychological distress measures as an important consideration in concussion management. Participants in contact sports may respond to concussion differently than those in non-contact sports. Future research should investigate how this relates to overall quality of life post-concussion.

Supported by a grant from the National Football League

1176 Board #302 May 27 2:30 PM - 4:00 PM
How Do Concussions Affect National Basketball Association Player Performance Measurements?

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 (No relevant relationships reported)

Following a concussion, athletes typically display increased reaction time, compensatory gait mechanics, and altered postural control. Although commonly studied in collegiate athletics, there is a lack in the literature regarding post-concussive effects in the National Basketball Association (NBA), and how they affect player performance outcomes. **PURPOSE:** The purpose of this study was to determine if NBA player performance statistics were different 28 days post-concussion compared to their pre-concussion metrics. **METHODS:** NBA player performance statistics were obtained from a public website for thirty-six NBA players (age = 24.22±5.44 years, years in league = 4.08±3.38 years) who sustained a concussion between 2014 and 2018. Players were excluded if they played less than five games pre-injury, or if they did not return to play within four weeks post-concussion. Performance statistics included both attempted and made field goals, three-pointers, and free throws. Additional performance metrics included total points scored, turnovers, rebounds, gamescore and plus/minus scores. Within-subjects performance metrics were compared from 28-days prior to concussion to 28-days after the date of injury. All variables were normalized by seconds played per game to reduce variability between bench, rotational, and starting players. To compare differences in player performance measures before and after concussion, we utilized paired t-tests with alpha levels set to 0.05.

RESULTS: Our analyses produced mostly nonsignificant mean differences between groups ($p's > 0.05$), however, we found a decrease in mean attempted free throws post-concussion (mean difference: -0.37±0.36 free throws, $p=0.042$). Although the remainder of the performance metrics did not yield significance, a majority of the variables indicated a negative trend post-concussion. **CONCLUSIONS:** Our

results suggest player performance is not significantly affected up to 28-days post-concussion as compared to their pre-injury measures. Because we chose to compare 28-days before and after concussion, we potentially missed greater changes in player performance during the acute phase of recovery. Future analyses will stratify these findings by blocking time into seven day series to determine differences throughout typical recovery timelines.

1177 Board #303 May 27 2:30 PM - 4:00 PM
Concussion Management Among Speech-Language Pathologists: A Comparative Survey Of Placement And Practices

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 (No relevant relationships reported)

PURPOSE: The goal of this study was to examine the differences between medical and school-based Speech-Language Pathologists (SLP) knowledge, experience, and competence in pediatric concussion.

METHODS: A 34-question, anonymous web-based survey was sent to school and medically-based, practicing SLPs in the United States. Portions of the survey were adapted with permission from a preliminary study by Duff and Stuck (2015) which focused on pediatric concussion knowledge of school-based SLPs. The instrument consisted of six broad topics: demographics, concussion knowledge, referral, assessment, treatment, and clinical experience. Participants were recruited in three ways: (1) via posting the on-line message board for the American Speech-Language-Hearing Association; (2) sent to regional SLP associations or (3) via the "snowball" recruitment method. Descriptive statistics were used to analyze the data in SPSS.

RESULTS: The survey had 48 responses (46 females and 2 males). Out of the responders, 85% possessed a master's degree and 15% hold a doctoral degree (PhD or SLPD). Out of the 12 questions regarding concussion knowledge, SLPs had about an 85% correct response rate. Exceptions to this high accuracy were found regarding knowledge of minor concussion symptoms resolving in 14 days and injury to the brain occurring at the instant of contact. SLPs were noted to receive most of their concussion referrals from physicians (25%). 96% of SLPs agreed it was within their scope of practice to provide therapy to a concussed individual. However, 73% of these clinicians have never been involved in the assessment of pediatric concussion cases. In addition, only 50% received TBI education in school.

CONCLUSIONS: Concussion is an international public health concern that continues to receive increasing attention. A common theme of the results we reviewed suggests a recent interest in highlighting the value of SLPs in concussion care, although their role is not yet well understood. Results showed that both medical and school-based SLPs who work in concussion care are generally knowledgeable despite the vague guidelines for SLPs in concussion management. In order to further prepare SLPs for their role in concussion care, guidelines need to be developed to consistently incorporate concussion education in SLP graduate programs.

1178 Board #304 May 27 2:30 PM - 4:00 PM
Reliability Of The King-devick Test In Baseline Concussion Evaluations In A Mexican Professional Soccer Team

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 (No relevant relationships reported)

There is a need for a reliable and quick method to help screen for concussions in professional soccer. The last 2014 and 2018 FIFA World Cups have demonstrated that concussions during soccer matches pose a challenge for team physicians to diagnose and treat in a timely manner. King Devick (KD) is a rapid sideline screening test used for concussion diagnosis that relies on individual's baseline measurement.

Purpose: To assess the test re-test reliability of the KD test in a cohort of professional soccer athletes. **Methods:** 24 professional soccer players from a Mexican First Division Professional Soccer League (Liga MX) team were evaluated. A baseline KD test as well as a SCAT3 Test was conducted before the 2017 season. The tests were repeated 1 year later as a baseline for 2018 season. 10 players transferred to other clubs after the first year were excluded from data analysis, 14 remaining athletes were included in the study. Correlations of year on year KD and SCAT3 measures of individuals were assessed. Statistical analyses were performed with IBM SPSS.

Results: Mean KD baseline test time for 2017 (KD1) = 41.71 seconds and for 2018 (KD2) = 41.66 seconds. KD1 and KD2 were strongly and positively correlated (0.93, p value <0.001). 1 player was evaluated for concussion during the season (KD1 = 41.7s, KD after trauma = 44.2s, KD2 = 41.4s). 5 players had slowing of KD2 without having history of concussion during the previous year. 1 player with a self-declared learning disability had significantly slower KD time in follow up test (KD1 = 69.4s, KD2 = 77s). 2017 and 2018 SCAT3 demonstrated positive and significant correlation

for balance scores (0.601, p = 0.023), and delayed recall scores (0.596, p = 0.024).

Conclusion: Mean KD baseline test results showed a significant correlation between first and second year evaluations. The high correlation suggests that KD testing has adequate reliability for use as a diagnostic test. Of note, 5 players had slower times despite not having a history of concussion during the previous year. It may not be useful when establishing baseline test results in players with learning disabilities due to the considerable variation from KD1 to KD2 in player we evaluated. Further studies need to be done with professional soccer athletes in order to establish quick and efficient methods of diagnosis and management of concussion.

1179 Board #305 May 27 2:30 PM - 4:00 PM
Documenting The Prevalence Of Symptom Exacerbation Following The Completion Of A Computerized Neurocognitive Testing Battery In Athletes With Concussion

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(No relevant relationships reported)

Symptom exacerbation following computerized neurocognitive testing (CNT) has been documented at the acute and subacute time points after concussion; however, the prevalence and indications of clinically significant symptom exacerbation following CNT is currently unknown.

PURPOSE: 1) To document the prevalence of symptom exacerbation following CNT in concussed athletes and 2) explore factors that may predict symptom increases associated with the completion of CNT.

METHODS: Two hundred and five concussed athletes ($M = 16.48 \pm 1.97$ yrs; 47% female) completed a standard clinical visit that included a health and injury history, CNT (The Immediate Post-concussion Assessment and Cognitive Testing: ImPACT), Post-Concussion Symptom Scale (PCSS), and the Vestibular and Ocular-motor Screen (VOMS) within 30 days of injury ($M = 7.73 \pm 5.54$ days). The PCSS was administered immediately before and after CNT, and changes on symptom total were used as outcome scores. To account for normal variation in symptom reporting, minimal clinically important differences (MCID) were calculated from the current sample. Two logistic regressions (LR) were used to explore the association between demographic (age, sex, history of SRC, migraine, anxiety, LD, ADHD) and injury-related factors that included vestibular/ocular motor impairment, symptom burden, time until first clinical visit, and removal from play status on post-CNT symptom exacerbation. Statistical significance was set at $p < .05$.

RESULTS: Approximately 33% (68/205) of concussed athletes exhibited clinically significant increases in total PCSS symptoms after CNT. The LR examining demographic variables and post-CNT symptom exacerbation was not significant ($\chi^2(7, 203) = 2.62, p = .92$), however the LR using injury-related predictors was significant ($\chi^2(7, 195) = 17.29, p = .02$). More specifically, a significant relationship between the ocular component of the VOMS and symptom exacerbation was revealed (adjusted OR= 0.43, $p = .04$).

CONCLUSIONS: The majority of the sample did not exhibit increased symptoms following CNT; however, the participants that do experience increases in post-concussion symptoms after completing CNT are more likely to have a co-morbid ocular impairment associated with their concussion. Clinicians should examine pre and post CNT symptom scores.

1180 Board #306 May 27 2:30 PM - 4:00 PM
Measuring Changes In Attention Task And Hemodynamic Oxygenation In Post-Concussion Patients Using Functional Near-infrared Spectroscopy

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(No relevant relationships reported)

Current concussion assessment protocols rely on clinical functioning and thus may not be sensitive to underlying neural deficits. **PURPOSE:** The purpose of this study was to measure hemodynamic response changes using functional near-infrared spectroscopy (fNIRS) in asymptomatic, post-concussion participants (CON) compared to healthy controls (CTL). **METHODS:** CON participants ($n=9$, age=18.44±1.51 years, sex=66% female) diagnosed with a concussion at a Midwestern emergency department were recruited from 2018-2019. CTL participants ($n=22$, age=23.63±4.55 years, sex=54% female) were recruited through electronic postings and classroom announcements. During the first study visit, participants completed a demographics questionnaire, pain

and symptom severity scores, and an attention task. Participants were then fitted for a silicon headband with two fNIRS diode arrays consisting of eight emitters and ten detectors over each hemisphere's temporal and frontal cortices, superior and middle temporal regions and the parietal cortex. The computerized behavioral attention task consisted of 144 trials spread over six 24-trial task blocks. Mean accuracy (%) and reaction times (s) were recorded, while the fNIRS device measured hemoglobin response. After the first visit, participants were monitored daily for symptom resolution, and completed a second lab visit once symptom count and severity scores reached normative baseline values. Behavioral and neuroimaging fNIRS data from the attention task were analyzed using independent t-tests, with alpha levels set to $p < 0.05$. **RESULTS:** Once asymptomatic, attention task analyses yielded no significant differences between CON and CTL groups for both mean reaction time (0.003 ± 0.040 s, $p = 0.953$) and accuracy ($-0.50 \pm 0.40\%$, $p = 0.47$). Analysis of fNIRS data indicated hyperactivity in the pre-frontal cortex, temporal lobe and frontotemporal region of the CON group's left hemisphere compared to the CTL group ($q < 0.05$, false discovery rate corrected). **CONCLUSIONS:** Our results suggest post-concussion participants may require additional cognitive resources during attentional tasks in order to maintain normative vigilance. Researchers should continue to evaluate hemodynamic changes, and how these effects may influence making a safe return to activity decision.

1181 Board #307 May 27 2:30 PM - 4:00 PM

Whole-body Reactive Agility Testing Reveals Modifiable Impairments Among Elite Athletes With Sport-related Concussion History

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PURPOSE: Assess the potential for training-induced improvement of whole-body reactive agility (WBRA) performance among elite athletes with a history of sport-related concussion (HxSRC).

METHODS: A cohort of 16 elite athletes (25.3 \pm 5.8 years; 10 males: 69.0 \pm 3.8 cm, 160.7 \pm 27.4 kg; 6 females: 63.8 \pm 2.0 cm, 144.47 \pm 28.7 kg) representing 5 Olympic sports participated in 12 training sessions over 26 \pm 9 days. A virtual reality motion analysis system measured whole-body responses to targets presented on the right and left sides of a monitor. A second dual-task (DT) trial simultaneously presented targets on both sides of the monitor, with correct response direction indicated by the center arrow of flanker test displays (<<<<<, >>>>>, <<<<, >>>>). Measures of WBRA included total distance of excursion, reaction time, speed, acceleration, and deceleration. Performance in right versus left directions was calculated for the latter 4 measures, as well as an average of asymmetries (Asym). Performance values were combined to create 3 training phases of 4 sessions each. The association of phase 1 measures with HxSRC status was assessed through ROC analysis. Repeated measures ANOVA was used to assess improvement from phase 1 to phase 3.

RESULTS: Self-reported HxSRC at 3.0 \pm 2.2 years prior to testing (range: 0.3 - 8.0 years) represented 56% of the cohort (9/16; 5 males, 4 females). Total distance \geq 27.3 m for DT demonstrated good discrimination between no SRC (NoSRC) and HxSRC cases (AUC = .714; OR = 7.5). A significant DT group X phase interaction effect was evident ($P = .038$) for total distance, with greater improvement for HxSRC (28.6 \pm 4.0 to 24.4 \pm 2.5; SRM = 2.06) than NoSRC (25.9 \pm 1.5 to 24.2 \pm 1.1; SRM = 0.93). Single-task (ST) WBRA Asym \geq 13.4% demonstrated good discrimination (AUC = 0.698; OR = 5.0), and thresholds of \geq 10% and \geq 15% demonstrated remarkable similarity to the results of our previous studies. Significant ST-WBRA Asym reduction was observed ($P = .049$; SRM = 0.57), but the magnitude was similar for HxSRC (15.7 \pm 4.7% to 12.6 \pm 2.4%) and NoSRC (12.9 \pm 3.7% to 10.2 \pm 2.5%).

CONCLUSIONS: Measures of WBRA may identify subtle impairments in brain network connectivity. The WBRA training appeared to induce a visual-spatial calibration improvement that was greater among HxSRC athletes, which may reduce injury risk.

1182 Board #308 May 27 2:30 PM - 4:00 PM

Between Trial Reliability Of The King Devick Test In Male High School Athletes

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(No relevant relationships reported)

The need for concussion-related safety programs in high-school athletics is well recognized. To that end, valid-baseline assessments are compulsory in order for medical staff to identify athletes suspected of having a concussion and best inform

appropriate medical-treatment protocols. **PURPOSE:** To determine the between-trial reliability of the King-Devick Test (KD) as part of a pre-season concussion-safety program in young-male high-school athletes. **METHODS:** KD baseline score data from high-school, male athletes ($n = 377$, aged 16 ± 1 years) were recorded on electronic tablets and later analyzed. The testing required participants to complete two, error-free trials, which were reported to the nearest 0.0 s. For both trials, descriptive data were reported, mean differences were examined via paired-samples t-tests, Cohn's d effect sizes were considered, and two-way mixed-effects intraclass correlations (ICC) were implemented. **RESULTS:** The KD test showed strong reliability between trials (Trial 1 = 56.0 ± 15.2 s; Trial 2 = 53.3 ± 13.8 s; single-measure ICC = 0.93; 95% CI 0.91 - 0.94). Furthermore, similar reliability was observed when KD scores were grouped by Best score and Worst score (Best = 52.8 ± 13.6 s; Worst = 57.6 ± 15.3 s; single-measure ICC = 0.95; 95% CI 0.94 - 0.96). Paired-samples t-test identified small-differences between both pairings (Trail 1 vs. Trial 2, $p < 0.001$, $d = 0.25$; Best vs. Worst, $p < 0.001$, $d = 0.33$). Most participants (78.5%) recorded their Best score on Trial 2. **CONCLUSIONS:** The KD test showed excellent reliability between trials in this population of young-male athletes. However, additional research is warranted with respect to how many valid baseline attempts are needed to acquire a stable KD score to best support safe-monitoring practices.

1183 Board #309 May 27 2:30 PM - 4:00 PM

Changes In Trait Anxiety Throughout Concussion Recovery

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Trait anxiety is the predisposition to perceive situations as threatening and higher levels lead individuals to frequently experience anxiety. Although concussion recovery is individualized, post-injury anxiety is an indicator of prolonged recovery. Therefore, high levels of trait anxiety following concussion may alter recovery trajectories by increasing the likelihood of developing post-injury anxiety.

PURPOSE: To examine the level of trait anxiety in concussed athletes throughout recovery compared to healthy controls.

METHODS: Eighty-five high school and college-aged individuals (concussed [Cx]: age = 18.56 ± 2.55 years; healthy controls [HC]: age = 18.10 ± 2.56 years) were enrolled. The State Trait Anxiety Inventory (STAI) measures trait anxiety using a 20-item inventory scored on a 4-point Likert scale (score range: 20-80), where higher scores indicate a greater level of trait anxiety. All concussed participants were administered the STAI within 72 hours of injury (day 0), 5 days post-injury (day 5), and at the time they received full medical clearance (FMC). Healthy controls were tested at similar time points. A 2 x 3 repeated measures analysis of variance was used to compare the level of trait anxiety between each group across recovery. A prior p value was set at 0.05.

RESULTS: There was no significant group x time interaction ($F_{(1,79,82)} = 1.20$, $p = 0.31$). Although, significant main effects for time ($F_{(1,79,82)} = 29.10$, $p < 0.001$, $\eta^2 = 0.26$) and group ($F_{(1,82)} = 29.10$, $p = 0.02$, $\eta^2 = 0.07$) were observed. Specifically, scores decreased across time (day 0: Cx = 38.81 ± 11.17 , HC = 32.74 ± 10.00 ; day 5: Cx = 36.95 ± 11.83 , HC = 31.24 ± 10.23 ; FMC: Cx = 34.65 ± 11.37 , HC = 29.98 ± 9.05), and concussed athletes had higher trait anxiety (Cx = 36.81, SE = 1.61; HC = 31.32, SE = 1.63).

CONCLUSIONS: Concussed participants experienced the highest levels of trait anxiety at day 0 and declined as recovery progressed. This indicates that initial post-injury anxiety may be a result of increased trait anxiety. Healthcare professionals should be aware that concussed individuals may be more susceptible to anxiety immediately following injury which could negatively influence recovery outcomes.

1184 Board #310 May 27 2:30 PM - 4:00 PM

Concussion History's Impact On Instrumented Bess Scores In Division I Contact-Sport Athletes

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Purpose: The purpose of this study was to determine if concussion history has an impact on sway velocity. A concussion injury can disrupt proper functioning of the vestibular system, and chronic disruption of this system can increase the chances of subsequent musculoskeletal or concussive injury. Athletes with a history of concussion injury who present with balance deficits, should be targeted for interventions to decrease the risk of sustaining a musculoskeletal or concussive injury.

Methods: 175 healthy Division I football & men's lacrosse players (age = 19.8 ± 1.2 ; ht = 71.9 ± 2.2 "; wt = 202.1 ± 33.9 lbs) participated in this study. Players were provided with a brief, 1-on-1, concussion discussion and then answered the questions "have you ever sustained a concussion? If yes, how many?". All players underwent a

balance assessment as part of their preseason screening and were medically cleared to participate in sports. Players performed the BESS test (double leg, single leg, & tandem) on firm & foam surfaces while standing on the VSR Sport™ force plate by NeuroCom®. **Results:** No difference was found between those with and without a previous concussion injury on any of the instrumented BESS stances (Table 1). To further analyze the data, a Spearman Rho correlation determined there was a smaller than typical correlation between number of concussions sustained and sway velocity measurements; double leg firm ($r_s = 0.02$), single leg firm ($r_s = 0.09$), tandem firm ($r_s = 0.08$), double leg foam ($r_s = 0.01$), single leg foam ($r_s = 0.01$), tandem foam ($r_s = 0.02$), & composite ($r_s = 0.06$).

Conclusion: Concussion history does not appear to have an impact on sway velocity measurements in contact sport athletes. The vestibulospinal system may be resilient to long-term deficits associated with concussion injury. In the absence of individualized baseline data, normative data may be used to determine balance deficits in those with a suspected concussion, regardless of previous concussion history.

Stance	Mean ± SD		p Value	Effect Size
	(+) Concussion Hx	(-) Concussion Hx		
Double Leg, Firm	0.69 ± 0.20	0.69 ± 0.18	0.924	0.01
Single Leg, Firm	2.31 ± 1.28	2.55 ± 1.45	0.243	0.18
Tandem, Firm	1.67 ± 1.19	1.81 ± 1.35	0.444	0.12
Double Leg, Foam	1.85 ± 0.46	1.86 ± 0.53	0.878	0.02
Single Leg, Foam	5.25 ± 2.02	5.45 ± 1.9	0.495	0.10
Tandem, Foam	5.02 ± 3.42	4.93 ± 3.14	0.863	0.03
Composite Score	2.80 ± 0.97	2.86 ± 0.94	0.710	0.05

B-80 Free Communication/Poster - Medical Management of the Athlete

Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
Room: CC-Exhibit Hall

1185 Board #311 May 27 2:30 PM - 4:00 PM Injuries And Injury-related Pain Relationships To NSAID Use And Abuse In Collegiate Athletes

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Non-steroidal anti-inflammatory drugs (NSAIDs) are commonly used by athletes to treat musculoskeletal pain and injuries. The relationship between NSAID use and current pain and injuries in collegiate athletes is unknown. Understanding this relationship is important due to the potential for athletes to improperly obtain and abuse NSAIDs.

PURPOSE: To investigate how pain and injury effects current collegiate athlete NSAID use during both in and out of season.

METHODS: Athletes from all 3 NCAA Divisions self-reported data on in and out of season NSAID use, purchase, and dosage. The Oslo Sports Trauma Research Center Overuse Injury Questionnaire (OSTRC) was used to evaluate current level of participation and pain. Logistic regressions were used to assess the relationship between current NSAID use and OSTRC total score. Models were adjusted for age, gender, NCAA division, history of orthopaedic surgery, and history of major injury, with unadjusted and adjusted Odds Ratios (OR) with 95% confidence intervals (95% CI). χ^2 and Kruskal Wallis tests assessed the relationship between NSAID use and OSTRC overuse and substantial overuse injuries in and out of season.

RESULTS: 252 athletes (age of 19.43 ± 1.2 years; Male: 28%; D1: 101, D2: 74, D3: 77) completed the survey. 33% currently used NSAIDs, 48% self-purchased, and 53% took two pills per dose. 36% did not answer where NSAIDs were obtained and 34% did not answer what dosage was taken. The OSTRC median score was 0 (IQR: 0-22). 53% had overuse injuries, while 20% had substantial overuse injuries. Current NSAID users had greater odds of having increased OSTRC scores (1.03 (95% CI: 1.02, 1.04), $p < 0.001$). OSTRC overuse and substantial overuse injured athletes were more likely

to use NSAIDs (over use: $\chi^2 = 34.0$, $p < 0.001$; substantial overuse: $\chi^2 = 28.2$, $p < 0.001$) and use them out of season (over use: $\chi^2 = 24.4$, $p < 0.001$; substantial overuse: $\chi^2 = 21.4$, $p < 0.001$) as compared to non-overuse and non-substantial overuse injured athletes.

CONCLUSION: NSAID use is high and the majority of athletes purchase their own NSAIDs, instead of receiving them from a medical professional. Injured athletes are more likely to use NSAIDs both in and out of season. Sports medicine professionals needs to monitor NSAID use and abuse in order to mitigate potential NSAID-related negative health impacts.

1186 Board #312 May 27 2:30 PM - 4:00 PM Division 1 Football Players And Metabolic Syndrome Risk Factors: A Three Year Observational Study

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Professional football players, especially linemen are at increased risk for early Metabolic Syndrome (MetS) leading to cardiovascular disease and death. There are no longitudinal studies examining MetS to determine if risk factors are present during college and if the risk factors change over time. **PURPOSE:** The purpose of this longitudinal study was to follow MetS risk factors in Division 1-FCS players over three years. MetS is defined by the NCEP ATP III standards. **METHODS:** Players were tested in the fall prior to the start of each season. Of the 39 players tested the first fall, eight players completed all tests every year of the study. Testing included waist circumference (WC), systolic blood pressure (SBP), diastolic blood pressure (DBP), fasting blood glucose (BG), high density lipoprotein (HDL), and triglycerides (TG). Descriptive statistics and comparisons were analyzed. A repeated measures ANOVA was used to compare the means of each dependent variable across the three years. A Bonferroni correction was used to adjust for multiple comparisons. **RESULTS:** One participant met the criteria for MetS during all three years with the same risk factors, low HDL, elevated TG and WC. Another participant met the MetS criteria during the second year (low HDL, elevated TG and WC), but not during the first and third years. Both players were offensive linemen. There were no significant differences in SBP, DBP, BG, or HDL across the three years. There was a significant difference in TG over time ($F [1.122, 7.852] = 6.355$, $p = .034$). Pairwise comparisons indicated a significant difference between year one-two, one-three, and two-three ($p = .001$, $p = .001$, $p = .05$; respectively). **CONCLUSIONS:** These findings suggest that nonskill football positions have a higher incidence of MetS risk factors. Additionally, TG varied across the three years, indicating that nutrition may be a primary influencing factor as players maintain fitness training year-round. A primary limitation of this study was the small sample size based on players completing testing all three years. Pre-season evaluation for early detection of MetS with follow up for early intervention is recommended. Further research should explore the nutrition practices of collegiate football players.

1187 Board #313 May 27 2:30 PM - 4:00 PM EVALUATION OF BIOMARKERS OF MUSCLE DAMAGE AND BONE FORMATION IN BALLET DANCERS DURING THE NUTCRACKER

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There is evidence that rehearsals and performances among ballet dancers induce physiological stress. However, few studies have attempted to quantify muscle damage or changes in bone metabolism. **PURPOSE:** The present study was a cross-sectional examination of changes in biomarkers of muscle damage and activity of osteoblasts from the beginning of dress rehearsal to the final performance during the Nutcracker season. **METHODS:** Professional and amateur male and female dancers, ages six and up, were recruited from two ballet companies that participated in the Nutcracker series. The cohorts were divided into three age groups: 6-12yrs (n=6), 13-18yrs (adolescents n=7), >18yrs (adults n=24). Blood draws were performed in the morning prior to the beginning of rehearsals and the day after the last performance. Blood samples were analyzed for creatine kinase MM isoform (CKM) and bone-specific alkaline phosphatase (BAP). Individuals with pre-existing medical conditions (i.e. juvenile idiopathic arthritis) and non-dance participants were excluded from this study. **RESULTS:** CKM significantly increased ($t=3.2$, $p < 0.001$) from baseline to post performance (Pre: 34.3 U/L ± 5.5, Post: 39.0 U/L ± 8.1). When examined by age group, both the adolescents ($t=2.99$, $p=0.024$) and adults ($t=2.55$, $p=0.018$) showed significant elevations, however no differences were noted in the youngest performers. No differences were noted in (BAP) concentrations across all groups ($t=-1.0$, $p=0.318$). However, a trend in the data was noted in the youngest performers ($t=-2.17$, $p=0.08$) with decreased concentrations post performance (Pre: 3.81 ng/ml ± 2.2, Post: 2.02 ng/ml ± 1.3). **CONCLUSIONS:** The data from the study demonstrate an increase in

muscle damage and a trend towards decreased bone formation activity of osteoblasts among young performers. Dancers and choreographers should be aware of these changes and implement appropriate periodization techniques and nutritional strategies to avoid overtraining these performing artists.

1188 Board #314 May 27 2:30 PM - 4:00 PM
Body Fat In Short And Tall: Comparisons Of The 3D-Infrared Vs. DXA Scanner

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Three-dimensional (3D) infrared scanners, which estimate body composition via measurements of circumference, are gaining popularity. Since participants rotate 360° on a scale in front of a full-length mirror, visual changes in body shape are quickly assessed while numerical values are generated. **PURPOSE:** The aim of this study is to compare total body fat percentage (BF%) in participants using both the 3D-infrared and dual energy x-ray absorptiometry (DXA) scanner. **METHODS:** Non-pregnant individuals were invited to participate in total body composition measurements using both the 3D-infrared and DXA scanners within the laboratory. Participants wore the same compression clothing and scanned within 30 minutes of each other. After height and weight were obtained, a whole body DXA scan was performed and analyzed by trained technicians. For the 3D-infrared scan, participants stood on a rotating scale in a standardized position in front of a full-length mirror. Data are expressed as mean±SD, with significance set at $p < 0.05$. **RESULTS:** Seventy participants (4 females; age=21±5years; weight=96±21kg; height=1.80±0.07m) successfully completed both scans, in a randomized order. Significant difference was noted between the DXA vs. 3D-infrared scans in BF% (23.7±5.1 vs. 19.5±8.6%; $p < 0.0001$). A significant positive correlation was noted between the DXA versus 3D-infrared scan for BF% ($r = 0.93$; $p < 0.0001$). However, the slope of the regression line was not in alignment with the line of identity, with the 3D-infrared scanner underestimating BF% at low levels (<30%) while overestimating BF% at high levels of BF%. The mean difference (Bland-Altman) was 4.2%, with the limits of agreement (LOA) between -4.3% to 12.7%. **CONCLUSION:** Although the correlation between the 3D-infrared versus DXA scan for BF% was high (87% of variance), the underestimation of BF% in smaller individuals and overestimation of BF% in larger individuals makes the 3D-infrared scanner not suitable for individuals outside of the normal range for BF% (~30%). Therefore, we do not believe the 3D-infrared scanner is a surrogate measure of BF%, compared with the DXA, for lean or obese persons.

1189 Board #315 May 27 2:30 PM - 4:00 PM
Geographic Disparity Of Female Athlete Triad Awareness And Access To Resources In The NCAA

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The Female Athlete Triad is a pervasive, multifactorial morbidity among college athletes. The geographic disparity of female athlete triad awareness and access to resources in NCAA is unknown. **PURPOSE:** To determine geographic disparities in awareness of Triad components and resource access in the National Collegiate Athletic Association (NCAA).

METHODS: Division I-III NCAA compliance officers were sent an email containing a request to disseminate a web-based survey to cross country coaches in their respective conferences. The web-linked instrument included: a study synopsis; an informed consent statement, and; the IRB-approved survey tool. Respondents were grouped geographically based upon conference headquarters location, regions included; Northeast, Midwest, South, and West. Statistical analysis, using JMP software, included frequency distributions and chi-square tests for categorical association.

RESULTS: Coaches (n = 143; age = 40.7 ± 11.9 years; coaching experience = 14.1 ± 10.3 years) from 45 conferences participated. Location impacted coaches' awareness of the term "female athlete triad" ($p = 0.0183$), which was highest in the West (90%), and lowest in the South (74%). Geography did not influence Triad component recognition ($p = 0.3907$) (i.e. low energy availability, amenorrhea, low bone mineral density), however; only 54% of coaches correctly identified all Triad components. Coaches who had Triad awareness were more likely to possess understanding that menstrual irregularities are not a normal result of exercise ($p < 0.001$). No relationship was identified between location and access to body composition technology ($p = 0.2031$), or; a registered dietician ($p = 0.4869$). However, only 30% and 53% of coaches had

access to these biometric and dietetic resources, respectively. Western cross-country athletes ($p = 0.0276$) had the highest access to sport psychologists (50%); lowest access was in the Midwest (20%).

CONCLUSIONS: Triad awareness and geographic resource disparities exist: Western coaches have a higher level of Triad awareness and superior access to psychological counseling, whereas; the South and Midwest had the lowest, respectively. Greater uniform access to resources amongst NCAA schools, regardless of geographic region, may positively impact Triad prevalence and outcomes.

1190 Board #316 May 27 2:30 PM - 4:00 PM
Refinement Of Breathing Reserve Estimates In Fit Individuals

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 (No relevant relationships reported)

Breathing reserve as a cardiopulmonary exercise test metric has been used to ascertain a pulmonary mechanical limit to exercise. In athletes, breathing reserve estimates are often found to be abnormal (<10% or negative) and are typically attributed to enhanced effort and a desire to achieve peak performance.

Purpose: The purpose of this study was to determine how to accurately measure breathing reserve in fit individuals, like athletes, during a cardiopulmonary exercise test (CPET). **Methods:** Using prospectively collected information, CPET data from over 1,200 patients was analyzed to refine breathing reserve estimates in fit individuals. Fit individuals were defined as having a peak oxygen consumption (VO_{2peak}) greater than 120% predicted based on normative data. CPET results of 680 fit individuals ($VO_2 > 120\%$) were compared to findings from the general population ($PP < 120\%$). **Results:** A third of fit individuals (33%) are labeled with abnormal breathing reserve without overt lung disease as compared to the general population (4.6%). This finding is likely due to the fact that fit individuals achieve a significantly greater ventilatory rate with average respiratory rates of 50 b/min as compared to 38 b/min in the general population ($p < 0.0001$). **Conclusion:** The results demonstrate that current algorithms used to predict exercise breathing reserve need to be refined to distinguish health from disease in fit individuals.

1191 Board #317 May 27 2:30 PM - 4:00 PM
Using EVH Challenges To Objectively Monitor The Long Term Management Of Elite Swimmers With EIB

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Eucapnic voluntary hyperpnoea (EVH) challenges can provide objective evidence to support the diagnosis and long term management of athletes exercise-induced-bronchoconstriction (EIB). However, the repeatability of the EVH challenge has been questioned.

PURPOSE: To investigate the use of EVH challenges to objectively monitor the long-term management of elite swimmers with EIB. **METHODS:** Twenty-seven elite-international swimmers (14 males, 13 females; 20±2yrs) completed EVH challenges, separated by a calendar year. Following initial assessment, EIB^{positive} athletes were prescribed appropriate inhaler therapy in accordance to greatest fall in FEV₁ (FEV_{1max}) and asked to maintain therapy throughout the year. Athletes were grouped dependent on adherence to inhaler therapy (Non-adherent = EVH¹→EVH²; n=15; adherent = EVH_{OFF}→EVH_{ON}; n=12). Differences between screening visits were analysed using paired sample *t*-tests and presented as mean ± SD. The test-retest repeatability between EVH¹ and EVH² was expressed as mean bias with 95% limits of agreement (LOA) and Pearson's correlation coefficient (r). **RESULTS:** FEV_{1max} was significantly lower in EVH_{ON} (-11.8 ± 3.8%) than EVH_{OFF} (-24.0 ± 11.3%; $p < 0.01$). Baseline FEV₁ was greater in EVH_{ON} than EVH_{OFF} ($p = 0.04$). EVH¹→EVH² FEV_{1max} did not differ significantly between screening visits (EVH¹: -13.1 ± 4.6% and EVH²: -12.3 ± 5.6%; $p = 0.32$). There was agreement between FEV_{1max} in EVH¹→EVH² (mean bias 0.6%, 95% LOA = -5.9, 7.1), and significant strong positive correlation ($r = 0.813$, $p < 0.001$). **CONCLUSION:** Elite swimmers with EIB adherent to inhaler therapy increased baseline FEV₁ and reduced FEV₁ fall post-EVH. The EVH challenge demonstrated acceptable long-term test-retest repeatability in elite swimmers. EVH challenge is clinically useful to assess elite swimmers for EIB, and as a follow-up assessment to evaluate the effectiveness of inhaler therapy.

1192 Board #318 May 27 2:30 PM - 4:00 PM
Sexual Behaviors And Birth Control Use In Collegiate Student-athletes

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(No relevant relationships reported)

In 2017, the Center for Disease Control reported 2.3 million new cases of sexually transmitted diseases in the United States. Specifically, in sports medicine, collegiate student-athletes (SA) are considered an at-risk population due to the risk-taking behaviors associated with athletics.

Purpose: To describe birth control (BC) methods used by female and male collegiate SA.

Methods: As part of a larger 5-year study, collegiate SA (n=862; females: n=552; males: n=310; 17-23 years old) from a NCAA Division I institution completed a web-based survey containing a 30-item tool exploring sexual health behaviors. Partial data were used for all descriptive analyses.

Results: Over half (n=314, 57.4%) of females reported currently taking oral contraceptives or female hormones prescribed mostly for irregular menses (n=78, 14.3%) or pregnancy control (n=106, 12.3%). Participants reported having vaginal (females=172, 36.8%; males=143, 59.1%), oral (females=191, 40.2%; males=155, 63.3%), and anal (females=5, 1.1%; males=6, 2.7%) intercourse in the past 30 days. Interestingly, many participants reported never using condoms or other protective barriers during oral (n=490, 82.1%) or anal (n=376, 78.3%) sex; however, 33.3% of participants (n=203) stated they always used protection for vaginal intercourse. When exploring their most recent sexual encounter, 60.2% (n=429) of participants reported using a form of BC to prevent pregnancy. The most frequent types of BC included oral contraceptive pills (n=345), male condom (n=327), and "pull out" (n=152). Finally, 10.7% (n=77) of participants reported using emergency contraceptives. Despite the lack of consistent BC use, only 2 individuals reported a pregnancy in the last 12 months, both unintentionally.

Conclusions: Participants reported using oral contraception to prevent pregnancy, but mainly for menstrual dysfunctions. Female SA should be educated on all their BC options as it can affect sport performance. While many of the participants are engaging in sexual activity, the use of protective barrier is less for oral and anal intercourse which could be due to sexual education in the United States. However, the infrequent use of protective barriers, regardless of intercourse type, does pose a threat to a SA health for sexually transmitted infections.

1193 Board #319 May 27 2:30 PM - 4:00 PM
Sleep Problems As A Predictor Of Gastrointestinal Symptoms During Endurance Competition

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PURPOSE: Gastrointestinal (GI) disorders like irritable bowel syndrome and functional dyspepsia are more common in people with sleep problems. No research, however, has examined the relationships between sleep problems and GI disturbances in endurance athletes, particularly symptoms that occur during competition.

METHODS: Within 24 hours of finishing an endurance race (minimum of 1-hour duration), 73 participants (27 men, 46 women; 39.2 ± 11.0 years) completed the Medical Outcomes Study Sleep Scale (MOSSS) and reported the amount of time (min) slept the night before the race. In addition, participants reported the severity (0-10 scale) of four upper (nausea, regurgitation/reflux, fullness, bloating) and three lower (abdominal cramps, flatulence, urge to defecate) GI symptoms experienced during the races. Individual symptom scores were added together to obtain overall, upper, and lower GI symptom scores. Spearman's rank-order correlations were used to examine whether scores on the Sleep Problems Index-(SPI)-I of the MOSSS were associated with GI symptom scores. Partial correlations were also calculated to control for age, gender, body mass index, race duration, and trait anxiety levels.

RESULTS: There were significant correlations between scores on the SPI-I and total GI symptom scores (rho = 0.24, p = 0.045) as well as upper GI symptom scores (rho = 0.30, p = 0.011). Lower GI symptoms were not significantly correlated with SPI-I scores (rho = 0.14, p = 0.135). Only the correlation between upper GI symptoms and SPI-I scores remained significant (rho = 0.24, p = 0.049) after controlling for age, gender, body mass index, race duration, and trait anxiety levels. Sleep duration from the night before the race was not significantly correlated with any of the GI-symptom variables.

CONCLUSIONS: These results suggest that chronic sleep problems, but not acute pre-event sleep duration, is modestly associated with the severity of upper GI symptoms during endurance races.

1194 Board #320 May 27 2:30 PM - 4:00 PM
Association Between Sleep Complaints And Musculoskeletal Injuries In Adolescent Athletes

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(No relevant relationships reported)

Sleep is a physiological process that plays a crucial role in human metabolic functions, being fundamental in muscle recovery.

PURPOSE: To associate sleep complaints with musculoskeletal injuries in adolescent track and field athletes. **METHODS:** The sample consisted of 30 athletes, who are part of the athletics team of the Sports Training Center, aged between 13 and 22 years and average BMI of 21.21 ± 1.37 kg / m². Participants completed the Sleep Complaints Questionnaire and retrospective data were collected on musculoskeletal injuries in the team's Physical Therapy sector (last six months). Spearman's correlation coefficient was used to obtain the association between the variables of the Sleep Complaints Questionnaire and the injuries. Finally, the linear regression model was used. The adopted significance level was $\alpha \leq 5\%$. **RESULTS:** The results showed that 23.3% of athletes reported having bad sleep, 40% reported good sleep and 36.7% reported very good sleep. The average total sleep time of participants was 07h22min ± 63.55 min (recommended 9 to 10h sleep for athletes) and the average severity of injuries was 1.47 ± 1.24 AU (1=no clearance and 5=severe or withdrawal over 28 days). Significant negative correlations were found between the variables sleep complaint and total sleep time (r=-0.438; p=0.016), sleep complaint and sleep quality (r=-0.472; p=0.009) and significant positive correlation between sleepwalking and injury severity (r = 0.577; p=0.006). Linear regression data showed that sleep complaints influence 45% of total sleep time (R=0.456; β =-0.456; p=0.011); that sleep complaints have a 49% influence on sleep quality (R=0.494; β =-0.494; p=0.006); and that sleepwalking has a 64% influence on the severity of injury (R=0.646; β =0.646; p=0.002). **CONCLUSION:** The presence of sleep complaints has negative implications on the duration and quality of sleep of the adolescent athlete, as well as increasing the severity of injury. Supported by CTE/EEFFTO/UFMG, FAPEMIG, CAPES and CNPQ.

1195 Board #321 May 27 2:30 PM - 4:00 PM
A Qualitative Assessment Of Return To Sport In Elite Athletes: The Impact Of Gender

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PURPOSE: Participation of female athletes in Division I sports continues to rise, but there remains a significant underrepresentation of this growth in the literature. Our goal was to explore differences in how collegiate female and male athletes perceive and approach injury and return to sport.

METHODS: Semi-structured, open-ended interviews were conducted with Division I varsity athletes from a single institution who underwent orthopaedic surgery following injury with at least 2 years follow-up. Athletes were asked about factors influencing recovery, rehabilitation, and their return to or retirement from sport. Codes, categories, and themes were derived within and across genders.

RESULTS: Fifteen athletes (6 females and 9 males) were interviewed individually. Athletes shared similar experiences following injury, citing similar motivations, supportive factors, and difficulties. Athletes stressed the importance of the athlete role to their identity regardless of gender. Our analysis revealed two gender-related challenges: male athletes commonly felt weight gain/loss was a barrier to successful recovery and often led to self-consciousness; while females expressed frustrations in lack of empathy from those they turned to for support.

CONCLUSIONS: Female and male athletes shared common motivating, enabling, and challenging factors in return to sport following injury, though some challenges did differ by gender: females found difficulty with interpersonal relationships, while males experienced greater internal struggles. This qualitative study provides a nuanced look at the experience of varsity athletes returning to sport following surgery and adds understanding of the historically under-investigated perspective of female athletes.

1196 Board #322 May 27 2:30 PM - 4:00 PM
Effects Of Aerobic Exercise On Leptin, Sex Hormone In Rats With Polycystic Ovary Syndrome

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 (No relevant relationships reported)

PURPOSE: To investigate the influence of aerobic exercise in rats with polycystic ovary syndrome (PCOS).

METHODS: 32 23-day-old SD female rats were randomly assigned into 4 groups, i.e. normal control group (NC, n=8), exercise control group (EC, n=8), PCOS control group (PC, n=8) and PCOS exercise group (PE, n=8). PC group and PE group were modeled by injecting DHEA. EC group and PE group simultaneously implemented Masashi exercise intervention (unloaded free swimming, 20 min/time, 6 d/week for 15 d). Measure the serum testosterone (T), estradiol (E₂), follicle-stimulating hormone (FSH) and leptin (LP) of rats by ELISA. Observe ovarian histological changes through the hematoxylin-eosin stain, the P450arom expression (optical density, OD) in ovarian by immunohistochemistry.

RESULTS: There were obvious cystic dilated follicles in the ovarian tissue of the PC group, and compared with the, there are many normal follicles in the ovary of the PE group. The PC group exhibited a higher serum level of FSH, T, E₂ and the P450arom expression in ovarian than NC group (P < 0.05). Compare with the PC group, the serum level of LP, T, E₂ were decreased in the PE group (P < 0.05). However, compared with the NC group, the EC group showed no difference in the serum level of FSH, T, E₂, and the P450arom expression in ovarian (P > 0.05). Besides, the PE and PC group showed no difference in the serum level of FSH and the P450arom expression in ovarian (P > 0.05). The serum LP level in rats was positively correlated with T (r=0.893), E₂ (r=0.612), FSH (r=0.620) level and the P450arom expression (r=0.501) in ovarian.

CONCLUSION: Aerobic exercise can reduce the LP levels of PCOS rats, relieve leptin resistance, alleviate high estrogen blood disease and abnormal P450arom expression in ovarian, but cannot eliminate the sex hormone disorder.

The Changes of T, FSH, E₂, LP, And OD among 4 groups(x̄±SD)

Group	Sample	FSH (mIU/mL)	T (pg/mL)	E ₂ (pmol/L)	LP (ng/ml)	OD
NC	8	3.349±0.421	26.507±0.856	4.414±0.234	2.239±0.069	0.1812±0.0036
EC	8	3.113±0.272	25.829±0.823	4.603±0.421	1.981±0.005*	0.1822±0.0073
PC	8	4.252±0.591*	31.549±1.475*	5.582±0.789*	3.446±0.639*	0.1922±0.0090*
PE	8	4.104±0.056	29.462±0.894*	4.899±0.487*	2.474±0.802*	0.1866±0.0074

*P < 0.05, compared to NC; # P < 0.05, compared to PC

1197 Board #323 May 27 2:30 PM - 4:00 PM
Self-reported Sleep Habits Of Adult Athletes, A Comparison Between Sports And Competitive Level.

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Reported Relationships: R.K. Randell: Salary; PepsiCo International: The views expressed in this abstract are those of the authors and do not necessarily reflect the position or policy of PepsiCo, Inc.

PURPOSE: The purpose of this study was to quantify self-reported current sleep habits in a range of athletes, and to compare these with self-reported ideal sleep habits. In addition, to determine any differences in sleep duration and sleep quality, depending on the sport type and competitive level.

METHODS: 313 athletes (243 males, 70 females; age 27 ± 8 y), competing in a variety of sports and competitive levels (recreational to elite), completed the Pittsburgh Sleep Quality Index (PSQI), and a questionnaire which assessed current and ideal sleep habits. Sleep quality was calculated using the PSQI global score, with a score of ≥ 5 indicative of poor sleep quality. A paired t-test was used to compare current and ideal sleep duration. A one-way ANOVA test was performed to determine differences in sleep duration and quality between sports (sports with N ≥ 20) and competitive level.

RESULTS: Mean sleep duration was 7 h 34 min ± 1 h (range 4 h - 11 h), with 19% of athletes achieving < 7 hours of sleep, and 50% achieving < 8 hours. The average global PSQI score was 5.0 ± 2.4, with 55% of athletes having poor sleep quality. Mean ideal sleep duration was 9 h 26 min ± 58 min, which was significantly more than current sleep duration (p < 0.001, 95% CI (-2.0, -1.7) h). Sleep duration differed between sport types, with runners sleeping significantly less than basketball, soccer and rugby players (p < 0.05). Furthermore, recreational athletes slept significantly less (7 h 08 min ± 54 min) than competitive (7 h 32 min ± 1 h), national (7 h 50 min ± 1 h) and elite level athletes (7 h 49 min ± 51 min). At all competitive levels and sport types, ideal

sleep duration was significantly greater than current sleep duration (p < 0.001). No differences in sleep quality were found between athletes competing at different levels or sport.

CONCLUSIONS: Half of the athletes failed to achieve 8 hours of sleep per night. Runners appear to sleep less than team sports athletes. Recreational athletes sleep less than athletes who compete at higher levels however, sleep quality does not seem to be compromised. Regardless of competitive level and sport type all athletes reported a higher ideal sleep duration compared to current duration.

B-81 Exercise is Medicine®/Poster - EIM: EIM Programs, Vital Signs, and Medical Knowledge

Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
 Room: CC-Exhibit Hall

1198 Board #324 May 27 1:30 PM - 3:00 PM
Exercise Is Medicine On Campus (EIM-OC): State Of The Literature

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Exercise is Medicine - On Campus (EIM-OC) was created in 2009. Over the last 10 years, the number of registered schools has risen to 267. At the Annual Meeting in 2019, there were 139 schools recognized for the work they performed on their campus. Purpose: In an effort to determine the scope of EIM-OC grant and research projects, the EIM-OC committee members have undertaken a meta-analysis and systematic review of the EIM-OC literature. Methods: Data was collected using multiple methodologies to ensure a complete capture of the work in this area. This included an email to EIM-OC registered schools to request publication, poster, and oral presentations titles, dates, and authors. As well as request to ACSM journal and meeting coordinators to review published and unpublished abstracts. Members of the writing team performed independent literature searches across 10 databases using defined keywords ("Exercise is Medicine" or EIM and campus* OR University* OR college* OR academ*). Search results returned 772 articles. Two members then reviewed all abstracts to ensure it contained information on methods, program analysis, or outcome data related to EIM-OC. The bibliography of each of the included manuscripts and posters was reviewed to capture articles not found in the original search. Results: To date, no article of this type have been published in the area of EIM-OC, even though EIM-OC is one of the most robust EIM program initiatives. This important research will document what has been done in this area and highlight gaps in the literature. Conclusion: The data collected will be used by EIM Staff, Committee Members, and Registered Schools to obtain internal and external research support. Schools looking to develop EIM-OC programs will also benefit from this research.

1199 Board #325 May 27 1:30 PM - 3:00 PM
Exercise Is Medicine Day On Campus: A Survey Of Physical Activity And Nutrition Habits

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Exercise is Medicine (EIM) is a global joint initiative between the American Medical Association and the American College of Sports Medicine (ACSM). West Chester University (WCU) was recognized by the ACSM in 2018 as an EIM-On Campus Gold Campus, indicating that WCU actively attempts to engage the campus community in physical activity. **PURPOSE:** The purpose of this study was to assess opinions related to the second WCU EIM Day. This event was hosted by the College of Health Sciences (CHS) at WCU and included participation from all six departments in the CHS, student groups, faculty and staff, alumni, and community stakeholders. **METHODS:** Sixty-five participants (19 M, 46 F), (77% 18-21 years old, 15% 22-25 years old, 8% 26 years or older) that visited the event responded to an 8-question program evaluation survey. **RESULTS:** The data did not have a normal distribution due to the

small sample size. Therefore, non-parametric data analyses were applied. Spearman non-parametric correlations were utilized to determine the relationship between enjoyment levels and perceived helpfulness of the event for increasing physical activity (PA) and improving nutrition habits (NH). Results indicated a significant positive strong association between enjoyment levels and perceived helpfulness of the event for increasing PA ($r(46)=.66, p<.05$). There was a medium association between enjoyment levels and perceived helpfulness of the event for improving NH but this association was not significant, ($r(25)=.30, p>.05$). To examine differences between male and female participants, the Mann-Whitney U-test was applied for enjoyment levels, perceived helpfulness for PA and for NH items. Results indicated differences in enjoyment levels between males and females, ($U=-2.02, p<.05$) but no significant differences in perceived helpfulness of the event for PA and for NH items between females and males, ($U_{PA}=-2.04, p=.09$ and $U_{NH}=-1.9, p=.08$). **CONCLUSIONS:** These results suggest that participants that attended EIM Day found it beneficial for increasing PA habits. This may be due to activities throughout the day that included yoga, boot camp fitness, and Tai Chi. While there were food stands and information disseminated by nutrition students, in the future it will be important to provide more offerings related to proper nutrition habits.

1200 Board #326 May 27 1:30 PM - 3:00 PM

Assessing EIM-On Campus Physical Activity Programs: Lessons Learned

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Assessing campus physical activity programs (CPAPs) is important for making decisions regarding their benefits and value. However, determining the most reliable and cost-effective assessment tools is challenging. **Purpose:** To evaluate the usefulness of specific health and wellbeing assessment tools for evaluating the benefits of CPAPs. **Methods:** Health and wellbeing information were collected from participants in two CPAPs (Active Aggie Mobile (AAM) [N=165] and Fit Break (FB) [N=65 in one session, 40 in another]) over approximately 6 months. AAM brings physical activity (PA) instructors to campus neighborhoods twice a week for one hour to facilitate PA engagement of students, staff and faculty in those neighborhoods. FB provides 15 minute exercise sessions (breaks) twice a week to non-represented staff in departments with high workers' compensation claims and absenteeism. AAM and FB attendance was recorded. Participants completed an SF36 survey (a set of generic, coherent, and easily administered quality-of-life measures) at the start and end of each program. Sick leave and Worker's Compensation claims were compared between FB participants and controls. **RESULTS:** There was a significant ($p<0.05$) improvement in energy/fatigue in one AAM group, but no other changes were observed in either AAM group. FB participants had an increase in their perceived health in 8 categories surveyed (energy/fatigue, physical functioning, role limits due to physical health, role limits due to emotional health, emotional well-being, social functioning, pain, and general health), but these changes were only significantly different ($p<0.05$) from controls in emotional well-being. There were no significant differences in sick leave hours between FB participants and controls. Testimonials were favorable for both programs. **CONCLUSIONS:** It is difficult to show improved health and well-being outcomes through surveys of perceived health during short duration programs of this nature. Long-term health metric tracking systems are needed to thoroughly assess the cost to health benefit associated with various CPAPs. We are exploring the feasibility of collecting more specific information such as flexibility, balance, weight, resting heart rate, blood pressure and even blood panels from controls and participants in CPAPs.

1201 Board #327 May 27 1:30 PM - 3:00 PM
Implementation Of Exercise Is Medicine On Campus At California State University, Monterey Bay

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PURPOSE Exercise is Medicine On Campus (EIM-OC) aims to establish physical activity (PA) as a vital sign & integrate PA into the lifestyle of university campuses. The EIM-OC initiative was launched at Cal State University, Monterey Bay (CSUMB) in Fall 2019 with the goal of integrating PA into the campus lifestyle. EIM-OC at CSUMB aimed to achieve this by providing exercise classes for employees & offering peer health consultations (PHC) for students. The purpose of this project is to discuss the implementation of EIM-OC & identify the successes & challenges.

METHODS The launch of EIM-OC at CSUMB included exercise classes, student PHC program & additional campus events. Circuit Training (CTC) and Resistance

Training (RTC) classes for employees took place in September and October 2019 respectively. Participants for the CTC were 15 females (average age 43.80 + 12.66) & 14 females (average age 40.71 + 10.51) for the RTC. The EIM-OC provided PHC which involved a group of Health Mentors providing education & support to students looking to improve health behaviors. Participants were 7 males & 11 females (average age 21.61 + 4.54). The EIM-OC Run Walk and Roll Club (RWRC) provided an opportunity to be physically active in a group atmosphere. The team provided free Otter Sports Center orientations, yoga & resistance training classes during October's EIM-OC Week.

RESULTS The inaugural semester of EIM-OC was successful in launching these programs for CSUMB. The launch gained support in the form of social media following via Instagram and participation from University employees & students in the programs. The program encountered challenges including the retention of students in the PHC and gaining participation/interest from the campus during the EIM-OC week. **CONCLUSIONS** The most successful part of EIM-OC at CSUMB were the employee exercise programs & will continue to be a major part of EIM-OC. Marketing of the RWRC & other events could be stronger to gain more participation. Strategies to improve retention for the PHC program are necessary. Based on recommendations, an afternoon RWRC will be added in the future. Overall, the first semester of EIM-OC at CSUMB was successful in making PA a part of the campus culture. Improving the programmatic efforts & troubleshooting challenges encountered, will ensure a sustainable EIM-OC program on campus.

1202 Board #328 May 27 1:30 PM - 3:00 PM

Exercise Is Medicine On Campus: Employee Circuit Training Course Increases Physical Activity

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PURPOSE: Exercise Is Medicine On Campus (EIM-OC) is a global health initiative with over 200 participating college campuses. EIM-OC was implemented at California State University, Monterey Bay in Fall 2019, with offerings for both students and employees. Employee programming included exercise classes, including a four week circuit training course. The purpose of this pilot study was to evaluate physical activity participation among employees participating in the EIM-OC circuit training course.

METHODS: The research design was pre-post and tracked participants in the EIM-OC circuit training course. Twelve female employees who were participating in the class volunteered for the study. The Godin Leisure Time Physical Activity Questionnaire was administered online before and after the course. Paired sample t-tests were performed on Godin Scale Score, and number of strenuous, moderate, and light intensity activity days per week. Significance was set at $\alpha = 0.05$.

RESULTS: There was a significant increase ($t=-1.787, df=11, p=.05$) in Godin Scale Score following the course ($M=38.50\pm 16.9; M=49.17\pm 23.95$). There was a significant increase in moderate physical activity days per week ($t=-2.419, df=11, p=.02$) following the course ($M=2.5\pm 1.17; M=3.33\pm 1.30$). There were increases in strenuous physical activity days and light physical activity days per week, although they were not statistically significant.

CONCLUSIONS: The inaugural EIM-OC circuit training class was effective in increasing physical activity among female employees. Future EIM-OC programs should work to expand their offerings to increase participation among employees, especially those who are inactive. Larger and longer studies could also be helpful to the growing body of knowledge on the EIM-OC initiative.

1203 Board #329 May 27 1:30 PM - 3:00 PM

Exercise Is Medicine® On Campus: evaluating Self-efficacy Levels Through An Employee Circuit Training Course

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PURPOSE: The American College of Sport Medicine created the Exercise is Medicine® (EIM) initiative to improve health through the promotion and prescription of physical activity. The EIM-On Campus (EIM-OC) initiative uses physical activity as a vital sign for promoting healthy behaviors among students and employees on a college campus. The EIM-OC initiative was launched at California State University, Monterey Bay (CSUMB) in Fall 2019. The purpose of this pilot study was to evaluate exercise self-efficacy levels among employees participating in a EIM-OC circuit training course.

METHODS: The research design was pre-post and tracked participants in the four week EIM-OC circuit training course. Fifteen female employees who participated in the circuit training course volunteered for the study. The Self-Efficacy for Exercise (SEE) scale was administered online through an intake form before and after the employee circuit training course. A dependent t-test was performed to test for differences in exercise self-efficacy pre and post participation in the circuit training course. Significance was set at $\alpha = 0.05$. We hypothesized to see significant improvements in exercise self-efficacy among participants.

RESULTS: Average age was 43.80 ± 12.66 years, 93.3% of the participants were University staff. There was a significant increase ($t=2.87$, $df=11$, $p=.008$) in self-efficacy for exercise score ($M=52.33 \pm 20.63$; $M=62.75 \pm 17.34$) following the EIM-OC circuit training class.

CONCLUSIONS: The inaugural EIM-OC circuit training class was effective in increasing exercise self-efficacy among participants. University employees felt more efficacious about exercising after the four week circuit training course. Larger and longer studies could be conducted to better understand how and why participation in a campus offered circuit training course influences participants' self-efficacy to continue exercising and if participants continue to exercise independent of the course offering. Evaluating exercise self-efficacy in EIM-OC exercise related programs could provide valuable insight into the adherence to and maintenance of exercise in University employees.

1204 Board #330 May 27 1:30 PM - 3:00 PM
Influence Of Aerobic Fitness And Obesity Status On Cardiometabolic Risk In College Students

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Little examination of cardiometabolic risk in college students has occurred; the number of studies exploring the influences of aerobic fitness and percent body fat on this topic are fewer still. **PURPOSE:** The purpose of this study was to determine the impact of aerobic fitness and obesity status on cardiometabolic risk in college students separately by gender. **METHODS:** Undergraduate students ($n=5,986$) completed an assessment battery which included an estimate of cardiorespiratory fitness (VO_2max), BMI, percent body fat, blood lipids and glucose and blood pressure. **RESULTS:** In males ($n=3634$) low aerobic fitness (LAF) and elevated percent body fat (FAT) increased odds of dyslipidemia (LAF OR: 1.6 95%CI 1.4-1.9, FAT OR: 3.4 95%CI 2.5-4.5), low high-density lipoprotein (HDL) cholesterol (LAF OR: 1.7 95% CI 1.4-2.0; FAT OR: 3.4 95% CI 2.6-4.5), elevated low-density lipoprotein (LDL) cholesterol (LAF OR: 1.6 95% CI 1.3-2.0; FAT OR: 3.0 95% CI 2.2-4.3), elevated total cholesterol (LAF OR: 1.7 95% CI 1.2-2.4; FAT OR: 1.5 95% CI 1.2-1.9), elevated triglycerides (LAF OR: 1.8 95% CI 1.4-2.2; FAT OR: 2.7 95% CI 1.9-3.6), and hypertension (LAF OR: 1.6 95% CI 1.4-1.8; FAT OR: 3.0 95% CI 2.2-4.0). Odds of prediabetes (OR: 2.1 95% CI 1.4-3.2) were only higher in FAT. Among females ($n=2352$), LAF and FAT were associated with increased odds of dyslipidemia (LAF OR: 1.5 95% CI 1.2-1.8; FAT OR: 1.4 95% CI 1.1-1.7), and hypertension (LAF OR: 1.3 95% CI 1.1-1.6; FAT OR: 2.2 95% CI 1.7-2.7). Odds of low HDL (OR: 2.1 95% CI 1.3-3.5), elevated LDL (OR: 2.2 95% CI 1.4-3.4) and total cholesterol (OR: 1.7 95% CI 1.3-2.2), and prediabetes (OR: 1.6 95% CI 1.0-2.4) were significant only in females with FAT. Odds of elevated triglycerides (OR: 1.6 95% CI 1.3-2.0) were significant only in those with LAF. **DISCUSSION:** Although the consequences of obesity and low aerobic fitness in young adulthood may not lead to clinical symptomatology for decades, both increase the likelihood that an individual will meet cardiometabolic risk factors. The odds are higher in those with elevated percent body fat compared to the unfit. **CONCLUSION:** Interventions in this population should focus on lowering body fat percentage, not on improving fitness, for the most health benefits.

1205 Board #331 May 27 1:30 PM - 3:00 PM
The Effect Of A Four Week Walking Intervention On Faculty And Staff At The University Of Arkansas

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 (No relevant relationships reported)

The Exercise is Medicine On Campus initiative promotes physical activity (PA) on campus. Although faculty and staff are campus role models, limited research has been performed on the importance of PA promotion in this population. Unique strategies are needed to promote PA in faculty and staff. Social support is an evidence-based behavioral strategy for increasing PA intervention adherence. Technology removes the need for in-person interaction by allowing virtual communication. **PURPOSE:** (1) Assess the feasibility and acceptability of a virtual social walking group and an in-person social walking group (2) Determine preliminary effects of both walking interventions on faculty and staff fitness.

METHODS: This is a sub-study of the Exercise is Medicine initiative on the University of Arkansas campus in an effort to track PA and its association with health, student success, and work satisfaction. Twenty-nine faculty and staff members (47.3 years ± 12.6) walked for 150 minutes per week for 4 weeks. The virtual group ($n=16$) used a fitness tracker to log PA and virtual messaging for group interaction. Research staff provided little facilitation of virtual group interaction. The in-person group ($n=13$) met 5 days per week, walked for 30 minutes, and was encouraged to perform walking tasks when unable to attend. A research aide led each walk and facilitated conversation.

RESULTS: Three participants were excluded due to missing data. At baseline, BMI for males ($n=5$) was 28.9 ± 3.7 and was 31.5 ± 8.1 for females ($n=21$). 50% of participants were classified as obese. The average aerobic capacity (VO_2 max) of males was 28.5 ± 6.1 ml/kg/min, and average VO_2 max of females was 24.2 ± 6.9 ml/kg/min. On average, virtual participants walked 177.1 ± 46.7 (range 101.4 to 267.3) minutes per week. 37.5% of participants met recommendations all 4 weeks. In-person participants attended an average of 82% (range 60 to 100%) of walking sessions. A paired t-test showed VO_2 max of participants significantly improved ($p=0.035$) after intervention. Participants reported high satisfaction with the program.

CONCLUSIONS: Both walking groups were feasible and acceptable among university faculty and staff, and aerobic fitness improved. Future research should assess long-term effects of PA interventions on all components of fitness of faculty and staff.

1206 Board #332 May 27 1:30 PM - 3:00 PM
Medical Student Knowledge Of The Federal Physical Activity Guidelines

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PURPOSE: The purpose of this study is to assess medical student knowledge of the 2008 Health People Federal Physical Activity Guidelines.

METHODS: 254 Medical Students completed a voluntary survey assessing knowledge of the 2008 Healthy People Federal Physical Activity Guidelines.

RESULTS: Of the 254 respondents, 38% of respondents correctly knew the adult aerobic PA guidelines, 72.44% correctly identified the adult muscle strength PA guidelines, 31.10% correctly identified guidelines for pediatric aerobic PA guidelines, 55.12% correctly identified the pediatric muscle and bone strength PA guidelines and 24.80% of respondents correctly identified a form of vigorous physical activity amongst a list of moderate physical activities. Amongst the 254 survey respondents, 201 gave examples of how they incorporate physical activity into their lives, 26% of the responses included solely exercise examples. Walking to work/class was the most common non-exercise response.

CONCLUSIONS: Medical student knowledge of federal physical activity guidelines and the difference between physical activity and exercise is lacking. More emphasis on PA guidelines in medical education curriculum could enhance medical student knowledge and ultimately influence future patient education, health and wellness.

1207 Board #333 May 27 1:30 PM - 3:00 PM
Evaluating Physician Assistant Student Knowledge And Application Of "Exercise Is Medicine" And Follow-up In Practice

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Methods of educating healthcare professionals on the principles of "Exercise is Medicine" (EIM) is challenging. Seminars are an efficient means of educating students about EIM. However, their effectiveness in translating EIM to clinical practice is unknown. **PURPOSE:** This present study assessed the effectiveness of an EIM educational seminar on improving knowledge and attitudes about prescribing exercise of student Physician Assistants. A secondary purpose was to compare the use of EIM between graduates who received EIM seminars with graduates who have not received training. **METHODS:** Second year Physician Assistant students from the classes of 2017-2019 were given a 45-minute EIM seminar focusing on the evidence for the prevention and treatment for chronic diseases as well as exercise prescription based off the FITT Principle. A pre- and post-survey was administered to evaluate the effectiveness of the seminar. To evaluate the translation to clinical practice, an email survey was sent to the classes of 2017-2019, who received EIM seminars, and the classes of 2014-2016, who did not. **RESULTS:** There was a 27% increase in the number of students that believed exercise is a part of their daily career. Following the EIM seminar, there was a 32% increase in student's confidence to prescribe exercise. Additionally, their ability to correctly prescribe exercise increased by 31% when evaluated with a case study. With respect to the follow-up of clinicians, only 64% of the respondents asked about their patient's physical activity habits (vital sign) with no difference between groups. While all respondents felt that physical activity can

prevent chronic diseases, there was no difference between trained (67%) and untrained (63%) groups in respects to believing that Physician Assistants should know how to prescribe exercise to their patients. **CONCLUSION:** A short seminar presentation can increase the knowledge and attitudes of Physician Assistants students with respect to EIM practices. When students who received EIM seminars were compared to students who did not, there were very few differences. Therefore, a 45-minute presentation is not enough to translate to an increase in physical activity counselling and exercise prescription.

1208 Board #334 May 27 1:30 PM - 3:00 PM
Exercise Is Medicine Greenville®: Blood Pressure And Body Weight Outcomes From The First Two Years

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Many non-communicable chronic diseases (NCD) such as cardiovascular disease are largely mediated by lifestyle behaviors which include physical activity (PA). Exercise is Medicine Greenville® (EIMG®) is a clinic-to-community, experiential lifestyle behavior change model that partners physicians with qualified community exercise professionals for optimal patient care. Patients not currently meeting national PA guidelines and/or have or are at-risk for NCDs are physician-referred to the EIMG® program. Of particular interest for this pilot study were patients with elevated body weight and/or blood pressure (BP > 130/80) upon referral.

Purpose: To investigate the effect of the EIMG® program on body weight and systolic and diastolic BP (SBP and DBP, respectively) in referred patients.

Methods: Patients not meeting PA guidelines or at-risk for or with a controlled NCD were referred to the 12-week EIMG® exercise training program. Each patient followed a supervised, personalized exercise training program developed and facilitated by an EIMG® certified professional. A single group pre-test, post-test experimental design was utilized when collecting body weight and BP measurements before and after the exercise training program. A paired sample t-test was utilized to determine statistically significant changes (p<0.05) in each variable due to the exercise intervention.

Results: To date, a total of 150 patients have graduated from the 12-week intervention with complete pre-and post-intervention measurements. Fifty-nine percent (n=89) of the patients were hypertensive upon referral. Analysis of the whole group resulted in a significant decrease in body weight (2.6 kg, p<0.000) with no significant decrease in SBP or DBP. The 89 hypertensive patients lost 1.4 kg (p=0.001) and significantly decreased SBP by 8 mmHg (p<0.000) and DBP by 3 mmHg (p=0.003).

Conclusions: EIMG® may be beneficial in assisting patients with or at-risk for NCD by improving body weight and decreasing BP. Greater cardiovascular benefit may be recognized in those referred to the program with hypertension by decreasing both SBP and DBP. Since previous research indicates that exercise does not account for body weight loss, further research is needed to better understand the results of body weight loss observed during the EIMG® program.

1209 Board #335 May 27 1:30 PM - 3:00 PM
Implementing Exercise Medicine Tools In Primary Pediatric Care - A Call To Action

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PURPOSE: Despite the demonstrated health benefits of physical activity for children and adolescents, surprisingly few primary care pediatricians discuss, evaluate or prescribe physical activity (PA) for children and their families. The aim of this study was to examine pediatricians' views on child PA in order to inform the development of tools and resources to be implemented in the pediatric primary care clinics. **METHODS:** 27 pediatricians participated. The Consolidated Framework for Implementation Research was used in a mixed-method design combining qualitative and quantitative data. Qualitative data were collected through focus groups, addressed pediatricians' current approaches to PA for their patients as well as factors facilitating practice change. Quantitative data were collected (online questionnaire) to explore perceptions implicated in the implementation of PA tools, approaches, or guidelines. **RESULTS:** Analyses of the qualitative data highlighted that pediatricians and patients and their families strongly believe that PA is important and beneficial. However, there is wide practice variability in current approaches to initiating PA discussions and promotion and identified barriers that included: lack of knowledge and training; managing time and multiple demands; the need for team approach in implementation and adherence; and the need for simple tools and resources. Quantitative data highlighted additional factors including evidence-based, cost-effective tools; tailoring the message to patient needs and resources; access to knowledge and information;

and champions to engage, advocate and help implement PA best practices.

CONCLUSION: Together, the qualitative and quantitative results begin to facilitate a strategic plan to improve the implementation of PA best practices in pediatric practices. While it is encouraging that both pediatricians and families strongly believe that PA is important for good health across the lifespan, the following key elements are needed: 1) rigorous training in exercise science at the medical school and residency level; 2) effective tools to assess and discuss PA as well as implement and follow up adherence to PA prescription; 3) further, these tools must be inexpensive, minimally burdensome and conform to the time constraints faced by busy pediatricians.

1210 Board #336 May 27 1:30 PM - 3:00 PM
Validation Of Exercise Vital Sign (evs) Questions In A Pediatric Population

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Purpose: The purpose of this study was to determine which factors were associated with increased weekly moderate to vigorous physical activity (MVPA) measured by Exercise Vital Sign (EVS) questions. **Methods:** Patients presenting to a sports medicine clinic between the ages of 5-18 were asked "On average, how many days per week did you participate in MVPA" and "On average, how many minutes per day did you participate in MVPA". Weekly physical activity, age, sex, BMI percentile, as well as history of asthma, attention deficit hyperactivity disorder, depression and diabetes were recorded. A linear regression analysis was utilized in those who reported any physical activity to determine which factors were associated with increased MVPA. **Results:** Data were recorded on 14,440 subjects. Average age was 13.91±2.49 years and average BMI percentile was 65.50±27.74 percent. Females made up 54.1%. Asthma was reported by 2340 (16.2%), ADHD was reported by 818 (5.7%), depression was reported by 308 (2.1%), and diabetes was reported by 92 (.6%). Overall, 45.6% of subjects reported 420 minutes or more of weekly MVPA. Those who reported any physical activity (n=13,708) averaged 424.14±287.45 minutes per week of MVPA. Those with a history of depression had almost 60 minutes/week less MVPA when controlling for age, sex, BMI percentile, asthma, ADHD, and diabetes (p>.001). Females reported 45 minutes less MVPA than males when controlling for age, BMI percentile, asthma, ADHD, depression and diabetes (p>.001). **Discussion:** Physical activity is an important health determinant in children's current and future health. The majority of youth do not meet current physical activity recommendations. Children suffering from depression should be screened for MVPA to encourage meeting physical activity recommendations. As females continue to obtain significantly less MVPA than males, targeted interventions need to be developed for this population. Regular screenings of MVPA levels should be implemented for children to help identifying and counsel those who are insufficiently active.

1211 Board #337 May 27 1:30 PM - 3:00 PM
The Influential Factors Of 'Exercise Is Medicine' Initiative And Its Implementation In China Since The Publication Of Healthy China 2030

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PURPOSE: The study aims at unveiling key influential factors of the EIM in China and investigating the relationship among the factors through employing Interpretative Structural Model (ISM). **METHODS:** Twelve semi-structured interviews were conducted with experts (9male,3 female) with medical, sport and government background. Matrix questionnaires were also completed by the interviewees. **Data Analysis:** 1) Interpretative Structural Model (ISM) was designed following a consultation process with expert group, and key factors were selected to construct adjacency matrix $A=[a_{ij}]$, $i=1,2,3$, $j=1,2,3$ (R indicates S_i and S_j related); $A=[a_{ij}]$, $i=0,1,2,3$ (R indicates S_i and S_j related); 2) Calculate the reachability matrix by Boolean Calculation, $M=(A+I)^{n-1}+(A+I)^{n-2}+\dots+(A+I)^1+(A+I)^0$; 3) Decompose reachability matrix, $L_i=\{S_j|R(S_j)\cap A(S_j)=R(S_i)=R(S_j), i=0,1,2,k\}$, and then delete rows and columns corresponding to elements in L_i , the reachability matrix is obtained; 4) Establish multi-level directed graph and analysis SIM. **RESULTS:** The first level contains $R(S_2)\cap A(S_2)=R(S_2); R(S_1)\cap A(S_1)=R(S_1)$, so the factors are $\{S_2, S_1, \dots\}$, and then delete the row and column S_2, S_1, \dots in the matrix, we can get the second level of the factors, the second level is $\{S_7, S_8, S_{13}\}$, and so on, The third level is $\{S_2, S_8, S_{13}\}$, The fourth level is $\{S_1, S_3, S_9\}$; The fifth level is $\{S_2, S_{10}\}$. These factors of Exercise is Medicine in China can be divided into three layers by ISM analysis, including the surface factors, the middle factors and the decisive factors. **CONCLUSIONS:** As decisive factors, the policy system and economic environment, which are the significantly influential to the policy related to EIM, could be regarded as important contextual factors for the design

and implementation of EIM policy. The middle factors mainly focused on Governance capability and collaboration between sports and medical administration. Relatively, surface factors contains more but pays less attention.

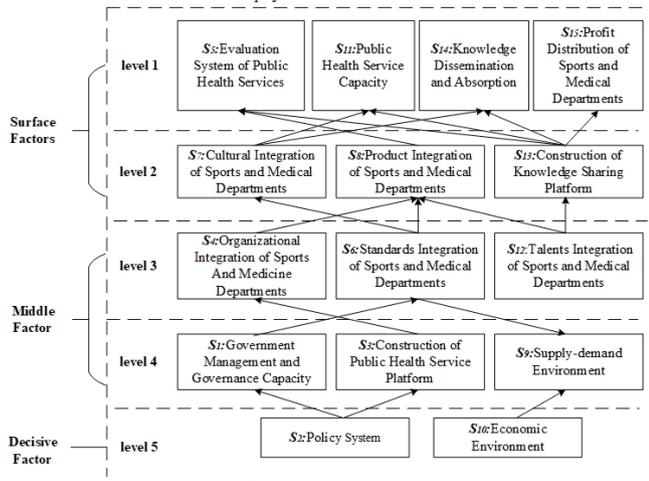


Chart1. The ISM of influencing factors of 'Exercise is Medicine' in China

PURPOSE: To understand key characteristics of ERSs and observe how schemes are currently designed, delivered, and evaluated across the UK.
METHODS: Across the UK, a total of 29 schemes with 73,000 patients were asked to complete a Consensus on Exercise Reporting Template (CERT)-guided questionnaire. The questionnaire evaluated exercise provider's qualifications, materials, delivery, location, tailoring, dosage, and compliance. Data collected were used solely for observations of scheme characteristics across the UK at the present time.
RESULTS: Schemes were typically 12 weeks in length (76%), offered patients two unsupervised exercise sessions in fitness gyms per week (79%), and used a combination of cardiovascular, resistance, free weights, and body weight exercises. Determining progression for resistance exercises was based upon the number of reps and sets completed (76%); for cardiovascular exercises progression was based upon the rating of perceived effort (38%); and for other exercises progression was based upon performance (45%). Just over half of schemes offered a variety of home based exercise components (52%), whether it was just advice or a full exercise programme. Adherence was typically measured through attendance (55%). Common motivational strategies used were goal setting (72%), goal achievement (69%), and acknowledgement of success (62%).
CONCLUSION: This research provides useful insights of schemes' characteristics across England and Scotland. This evidence can support the development of a larger-scale mapping exercise to review further schemes across the whole of the UK, which to date has been lacking. This research has also been insightful in providing initial evidence of what schemes offer and potentially how they can be improved over time.

1212 Board #338 May 27 1:30 PM - 3:00 PM
Molecular Mechanisms For Exercise Intervention On Health Promotion: Interpretation From Autophagy And Target Product Development
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PURPOSE: Exercise is a publically recognized and effective intervention strategy for a series of metabolic or aging-related diseases to accomplish health promotion. However, its molecular mechanisms for the beneficial prevention and rehabilitation of these diseases and health promotion are not explored and elucidated systematically.
METHODS: The animal models with metabolic or aging-related diseases or specific knockout of genes associated with autophagy were established to evaluate exercise intervention efficacy for these diseases, and explore underlying molecular mechanisms through HE staining, Western blotting, RT-PCR and TSM techniques, as well as RNA sequencing and microRNA screening analysis.
RESULTS: Our studies have clarified that appropriate exercise intervention as an inducer of autophagy can rescue the dysfunctional status of autophagy and abnormal mitochondrial energy metabolism under the conditions with these metabolic or aging-related diseases. Exercise-induced autophagy or exercise-mediated microRNAs regulates insulin sensitivity and promotes mitochondrial quality control, thereby executing the prevention and rehabilitation of these metabolic or aging-related diseases, even health promotion.
CONCLUSIONS: Exercise-induced autophagy or exercise-mediated microRNAs is benefit for the prevention and rehabilitation of these diseases and health promotion. The identified signal pathways and microRNAs can be used as the potential targets for the development of novel drug candidates, nutritional supplements, or mimic exercise nutrients for the prevention and treatment of metabolic or aging-related diseases, and health promotion.

1213 Board #339 May 27 1:30 PM - 3:00 PM
Observing Key Characteristics Of Exercise Referral Schemes In The United Kingdom.
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Exercise referral schemes (ERSs) within the United Kingdom (UK) offer individuals an opportunity to take part in an exercise prescription in a non-clinical environment, yet gain clinical health benefits. ERSs at present are heterogeneous in design, implementation, and evaluation; hence limited evidence of their effectiveness exists. Additionally, there has been no concerted effort to map program characteristics until very recently.

1214 Board #340 May 27 1:30 PM - 3:00 PM
The Health, Quality Of Life And Physical Activity Of Older Laos: A Pilot
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In the past decades the urbanization of the Lao people has been dramatic. All-cause mortality is shifting to chronic diseases. Social changes have exacerbated the challenges of caring for a growing elderly population. Little is known about Health Status, Quality of Life, Physical Activity, and Fall Risk/Falls of this population.
PURPOSE: This study (ASEAN Fulbright Scholarship) explored the feasibility of working with the Rural Development Agency (RDA) to collect survey data on health determinants of elderly Lao.
METHODS: Eight volunteers from the RDA were trained and solicited elders to be surveyed in Vientiane province (Demographic and Health Status Questionnaire, SF36, IPAQ & Thai-FRAT - fall risk).
RESULTS: During the 1-month effort, 399 (aged 55+) individuals were surveyed. Highlights include: Of the interviewees, 98.3% were ethnic Lao, 43% were men and 57% were women, with 60% living in urban settings, 31% suburban and 9% in a rural community. On average all age groups were classified as overweight, except men 71-80 yrs. Just over 20% were smokers with a large majority consuming alcohol on a regular basis. About 1/3 reported having high blood pressure; evenly distributed across age and gender. Type II diabetes was reported in 18% of the women and 8% in men. Over 40% experienced depression. On average a majority of women and men over 70 in the urban and suburban settings did not meet the ACSM minimum of 150 min/week of moderate/vigorous physical activity, while those in the rural setting exceeded this goal. Pain was a significant issue for younger urban men and all those living in the suburban setting. The lowest pain levels were reported by those living rurally. The domain of physical functioning showed those in the rural setting being the most active and healthy. Eighty participants reported having at least 1 fall in the past 6 months. No significant differences in fall rates were found between genders. All but 1 of the falls occurred in the urban or suburban environments. The vast majority of the falls occurred in those over 71 years of age.
CONCLUSION: This study was the first of its kind in Laos. While the sample size was beyond expectations, rural areas and those with health and mobility issues were underrepresented. Those approached to complete the surveys were eager to participate. The goal is to expand this study throughout Laos.

B-82 Exercise is Medicine®/Poster - EIM: Exercise and Various Diseases and Health Conditions

Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
Room: CC-Exhibit Hall

1215 Board #341 May 27 1:30 PM - 3:00 PM High Intensity Inspiratory Muscle Training In Individuals With Chronic Disease: A Systematic Review With Meta-analysis

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Inspiratory muscle training (IMT) is a strategy of treatment of patients with poor inspiratory muscle performance, with dyspnea, low exercise tolerance, and low functional status. Moderate loads are currently used (30 - 50% of maximal inspiratory pressure, MIP) and high-intensity IMT (HI-IMT) with 60% or more of MIP is being studied in randomized clinical trials. **PURPOSE:** To determine the effect of high intensity inspiratory muscle training (HI-IMT) on respiratory muscle strength in individuals with chronic diseases.

METHODS: For this meta-analysis, the sources were conducted in PubMed, Scopus, SciELO and Bireme, using different keywords and operators. The review was recorded in the systematic review registration base PROSPERO, under registration number CRD42019131984, and follows the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines. Two researchers carried out the search independently in July of 2019. The outcomes were the effect and characteristics of interventions with high intensity inspiratory muscle training in individuals with chronic diseases. The variables were inspiratory muscle strength (Pimax) before and after intervention or the difference between this, training load, number of sessions, numbers of sets, and number of repetitions chosen for the control and intervention groups.

RESULTS: Were found 166 studies in initial source. After excluded of duplicates (n=30) and reading of title and abstracts, five studies were included on meta-analysis. Populations analyzed included chronic pulmonary disease, cystic fibrosis and cancer patients. As characteristics of interventions, the mean duration was 8.8±5 weeks, 4.5±1.15 sessions per week, the most common effort intensity was 60% of MIP with 15.3±12.8 repetitions, 4.75±1.9 sets and 1.5±0.5 min of recovery between them. The results indicated that HI-IMT increases in 15.58 cmH₂O [CI95% = 2.40 - 28.75] the strength on inspiratory muscle when compared to control group (p=0.02)

CONCLUSIONS: High intensity inspiratory muscle training is able to increase the respiratory muscle strength of patients with chronic pulmonary disease, cystic fibrosis and cancer.

1216 Board #342 May 27 1:30 PM - 3:00 PM Exercise To Treat Women With Pulmonary Lymphangioleiomyomatosis (LAM)

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(No relevant relationships reported)

Lymphangioleiomyomatosis is an interstitial, cystic lung disease that destroys the lung parenchyma, ultimately leading to respiratory failure. This disease affects females almost exclusively. Only two long-term treatment options exist: 1) single or bilateral lung transplant, which only slows the disease as the newly-transplanted lungs will soon succumb to the disease, and 2) rapamycin (Rapamune), a costly mTOR inhibitor that may result in multiple side effects and is not always tolerated by users. We sought to examine if moderate- to high-intensity exercise could slow or reverse the pulmonary decline seen with LAM. **PURPOSE:** To determine if a three-month exercise intervention had a positive impact in women with LAM. **METHODS:** Eight women with LAM (aged 27-60) were recruited to participate in an in-person exercise training intervention consisting of moderate- to high-intensity aerobic and anaerobic exercise. Prior to the study VO_{2max} was assessed, as well as pulmonary function (FEV₁, FVC, FEV₁/FVC, and peak flow) and bone mineral density (BMD). After three months these measures were again tested. **RESULTS:** After three months of training, VO_{2max} increased 12% from baseline (p=0.06). FEV₁ improved by 4%. While this was not statistically significant (p=0.19) this is nonetheless substantial, as this is the primary clinical measure used to assess a decline in pulmonary function. This is also the first non-pharmaceutical study to demonstrate an increase, rather than a decline, in lung function. Peak flow also improved by 11% (p=0.18). BMD also slightly improved

over three months (p=0.12), also significant as LAM patients have been shown to demonstrate a loss of BMD at a five-fold increase compared with healthy females. Though underpowered, this is the first non-pharmaceutical intervention study to show improved exercise tolerance, lung function, and bone health in women with LAM.

1217 Board #343 May 27 1:30 PM - 3:00 PM Whole-body Vibration Exercise Improve Lumbopelvic Proprioception For Patients With Nonspecific Low Back Pain

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(No relevant relationships reported)

Purpose: Nonspecific low back pain (NSLBP) accounts for a large proportion of low back pain cases. The present study aimed to investigate the effect of the whole-body vibration (WBV) exercise on lumbar proprioception in NSLBP patients. It was hypothesized that WBV exercise enhances lumbar proprioception.

Methods: Forty-two patients with NSLBP performed an exercise program 3 times a week for a total of 12 weeks of WBV. The lumbar proprioception was measured by joint position sense. Outcomes were lumbar angle deviation and visual analogue scale (VAS) score.

Results: After the 12-week WBV exercise, lumbar flexion angle deviation was reduced from 3.65±2.26° to 1.90±1.07° (P=0.0001), and extension angle deviation was reduced from 3.06±1.85° to 1.61±0.75° (P=0.0001), significantly lower than baseline. After participating in the 12-week WBV exercise, a significant pain reduction was observed (P=0.0001). Men in the whole group (n=32) indicated significantly lower angle deviations in flexion and extension, whereas women (n=10) indicated significantly lower flexion angle deviation (P=0.037), and no significant difference was found in extension angle deviation (P=0.052). However, by subdividing the entire group (n=42) into poor and good proprioceptive groups, WBV exercise presented significant enhancement of lumbar proprioceptive ability in the poor flexion proprioception subgroup, poor extension proprioception subgroup, and good extension proprioception subgroup (each P=0.0001), but not in the subgroup with good flexion proprioceptive ability (P=0.165).

Conclusions: Lumbar flexion and extension proprioception as measured by joint position sense was significantly enhanced and pain was significantly reduced after 12-week WBV exercise in NSLBP patients. However, the patients with good flexion proprioceptive ability had limited proprioceptive enhancement.

Source of support: Fok Ying-Tong Education Foundation of China (161092); Shanghai Municipal Commission of Health and Family Planning (201840346); Shanghai Key Lab of Human Performance (Shanghai University of Sport) (11DZ2261100); the scientific and technological research program of the Shanghai Science and Technology Committee (19080503100).

1218 Board #344 May 27 1:30 PM - 3:00 PM Road To Zero Percent Low Back Pain At Work - 23-years Progress

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Background and Objective: Low back pain is approximately 80% of cause of job-related disability in Japan. Risk factors for developing low back pain have been well documented, which include occupational risk factors, types of job requiring heavy lifting, pushing, pulling, one's fitness levels, and mental health factors. In this long-term project, we have focused on these secondary risk factors of low back pain. We have designed and implemented *dynamic, comprehensive low back pain workshop*. The objective of this study was to examine how the company-based workshop has offered and reached to 0% low back pain at work.

Methods: The project period was from 1982 to 2004. In 1982, about 1,100 male workers at a soft-drink company participated in the project. Their mean age at the starting of the project was 29 ± 5.3 years. All healthy participants took the modified Kraus-Weber test measuring their strength and flexibility of key postural core muscles. The test was graded for each movement. Also, the participants took questionnaire survey on low back pain. The *dynamic, comprehensive low back pain workshop* included endurance exercise, strength training, stretching, safe work-related movement practices, lectures on low back pain, good posture, and implementing preventive workplace events.

Results: The total number of participants in this project was 24,289. The mean age of participants in 2004 was 42.6 ± 9.7 years. The results of the questionnaire survey revealed that low back pain which hinders work, decreased from 44.6% in 1982

to 0.2% in 2004. The number of absenteeism due to low back pain decreased from 480 days to 0 day a year. The perfect score of Kraus-Weber increased from 35.4% to 83.7%. A negative correlation was observed between low back pain and the Kraus-Weber test.

Conclusions: This study demonstrated that company-based *dynamic, comprehensive low back pain workshop* improved physical fitness and work movements over a long-term. The workshop was effective reducing low back pain at work. Further research is required to be assessed whether the reduction in low back pain at work is related to a range of key health and work-related outcomes, and how the *dynamic, comprehensive low back pain workshop* can be further improved.

1219 Board #345 May 27 1:30 PM - 3:00 PM

Association Between Physical Activity With Bone Mineral Density And Handgrip In Children With Osteogenesis Imperfecta

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Purpose: To evaluate the association between physical activity with bone mineral density and handgrip in children with osteogenesis imperfecta. **Methods:** The sample consisted of 8 children of both sexes (8.2±1.3) years old, with osteogenesis imperfecta (I, III and IV type), body weight (24.0±7.9) kg, height (116.9±14.1)cm, cycle of intravenous pamidronate therapy (7.2±4.9). These patients are linked to the Reference Center for Osteogenesis Imperfecta in Santa Casa Medical School. Weight (kg), height (cm), handgrip (kg) were evaluated by CELAFISCS standardization. Physical activity (MET's) [Barros et al., 1993], total bone mineral density (g/cm²), total body less head TBLH (g/cm²) lumbar bone mineral density (g/cm²) [Bishop et al., 2008] and bilateral handgrip (Matsudo, 2005). **Statistical Analysis:** Pearson's correlation (r) was used for association between usual weekly physical activity and the following variables: total bone mineral density (g/cm²), total body less head TBLH (g/cm²), lumbar bone mineral density (g/cm²), and bilateral handgrip (kg). It was used a significant level of p ≤ .05. **Results:** There was a positive and significant high intensity correlation between physical activity with lumbar bone mineral density, but not with total bone mineral density, total body less head TBLH, and bilateral handgrip (see table below). **Conclusion:** it seems that physical activity exert a positive effect on the lumbar bone mineral density. However, physical activity was not significantly associated with total bone mineral density, total body less head TBLH and handgrip in children with osteogenesis imperfecta.

Weekly Physical Activity n=8 (: 55,0 ± 32,7) MET's		r	p
Total Bone Mineral Density	(g/cm ²)	.199	.636
Lumbar bone mineral density	(g/cm ²)	.916*	.001
Total Body Less Head TBLH	(g/cm ²)	.109	.797
Right Handgrip	(kg)	-.240	.567
Left Handgrip	(kg)	-.136	.749

*p≤.05: Pearson Correlation

1220 Board #346 May 27 1:30 PM - 3:00 PM

The Effect Of Baduanjin Exercise On University Students With Neck/shoulder Muscle Strength Imbalance

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Muscular strength imbalance (MSI) on shoulder and neck is often a detonate for shoulder and neck postural diseases, for this reason, improving the neck/shoulder muscle imbalance could be a good method to prevent neck and shoulder problems. **PURPOSE:** This study tested the efficacy of Baduanjin exercise (BDJ), a traditional Chinese mind-body exercise, on shoulder and neck muscle strength imbalance, and see if it is possible through this method provide a new idea of sports rehabilitation for shoulder and neck diseases problems. **METHODS:** 40 sedentary university students, with either forward head posture and/or round shoulder posture were randomized to the BDJ intervention group (n=20) and control group (n=20), the same evaluation protocol was used before and after

the intervention. During six weeks of training, The BDJ group was given Baduanjin training combined with a basic health education program, and the control group was treated only with a basic health education program. Baduanjin training was conducted three times a week, every time 50 minutes. The contents of health education program include healthy lifestyle tips, postural education and muscle stretching method.

RESULTS: Significant changes were found within the BDJ group, specially on Forward Head Angle test, Maximal Internal/External Rotation test and upper quarter Y-balance test.

CONCLUSIONS: this randomized control trial provides some evidence to support the positive effect of BDJ exercise as a new method of sport therapy for rehabilitation among people with shoulder/neck MSI.

1221 Board #347 May 27 1:30 PM - 3:00 PM

Racerunning Training For 12 Weeks Improves Physical Fitness And Promotes Skeletal Muscle Hypertrophy In Adolescents And Young Adults With Cerebral Palsy

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PURPOSE: Individuals with cerebral palsy (CP) typically lead sedentary lives, predisposing this patient group to metabolic dysfunction and cardiovascular disease. There are currently not many exercise options for individuals with severe disabilities. A novel addition is the RaceRunner, a tricycle propelled forward by stepping on the ground. The purpose of this study was to investigate training adaptations following a 12-week Racerunning training protocol in individuals with CP.

METHODS: Fifteen adolescents/young adults (mean age 16, range 9-29, 8 males/7 females) with CP (GMFCS I-IV; 1-3-4-7) completed 12 weeks, 2 times per week, of RaceRunning training. Measurements of physical fitness (6-min RaceRunning test, average and maximum heart rate), passive range of motion (pROM) of hip, knee and ankle joints and skeletal muscle thickness in the thigh and lower leg were collected before and after the training period.

RESULTS: Distance covered during the 6-min RaceRunning test increased on average 36% (pre 576 ± 325 m vs. post 765 ± 428 m, p<0.001). Average and maximum heart rate during the 6-min RaceRunning test was not different pre vs. post training. Muscle thickness of m. gastrocnemius increased in response to training (p<0.05) on the more affected side. Dorsiflexion pROM in the more affected ankle decreased (p<0.05), while hip-flexion pROM in the less affected side increased (p<0.05).

CONCLUSIONS: Twelve weeks of RaceRunning training improves physical fitness in individuals with CP. Moreover, RaceRunning stimulates skeletal muscle hypertrophy of the calf muscle. These results speak in favor of RaceRunning as a powerful and effective training modality in individuals with CP promoting both central and peripheral adaptations.

1222 Board #348 May 27 1:30 PM - 3:00 PM

Supervised Physical Activity Is Important To Counteract Negative Impacts Of Cancer On Physical Activity Behavior

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PURPOSE: The theory of planned behavior (TPB) is used to document children's psychological parameters linked to their physical activity practice to better understand their physical activity behavior. The TPB model evaluates the informational and motivational parameters that contribute to the practice of physical activity. This study aimed to assess the evolution of children's physical activity levels (MVLPA) during the first months of their cancer, in addition to document the evolution of TPB measures, self-reported fitness and self-esteem in the physical domain to better understand children's physical activity behavior.

METHODS: A total of 16 children (8 boys and 8 girls) with cancer were recruited in the context of the VIE (Valorization, Implication and Education) study. Patients answered psychosocial questionnaires at their diagnosis of cancer (time 1), six to eight weeks following their diagnosis (time 2) and six weeks after the physical activity program (time 3). The physical activity program was composed of two physical activity sessions (≈45min) per week for six weeks at moderate intensity. The integration of the family in the physical activity process was taken into consideration.

RESULTS: A significant decrease of 41.2min/day of daily MVLP was observed between the time at cancer diagnosis (50.5±32.8min/day) and six to eight weeks after the first interview (9.3±9.1min/day). After the physical activity program (23.1±10.8min/day), we observed a significant increase of 13.8 min/day of daily MVLP. We found that time after the diagnosis of cancer negatively impacted children's TPB measures (mean in attitude, injunctive norms, identity, facilitating factors, self-confidence and intention) and MVLP levels, while that the time after the physical activity program positively impacted children's TPB measures (mean in attitude, injunctive norms, identity, facilitating factors, self-confidence and intention) and MVLP levels.

CONCLUSIONS: This study highlights the need to provide children with physical activity support as soon as the cancer is diagnosed and shows the importance of familial support by injunctive norms to improve children's physical activity behavior. These findings help to better understand the effect of cancer diagnosis on children's physical activity behavior

1223 Board #349 May 27 1:30 PM - 3:00 PM
Impact Of A Free-living Activity Intervention On Real-time Fatigue In People With Multiple Myeloma Treated With Autologous Hematopoietic Cell Transplantation

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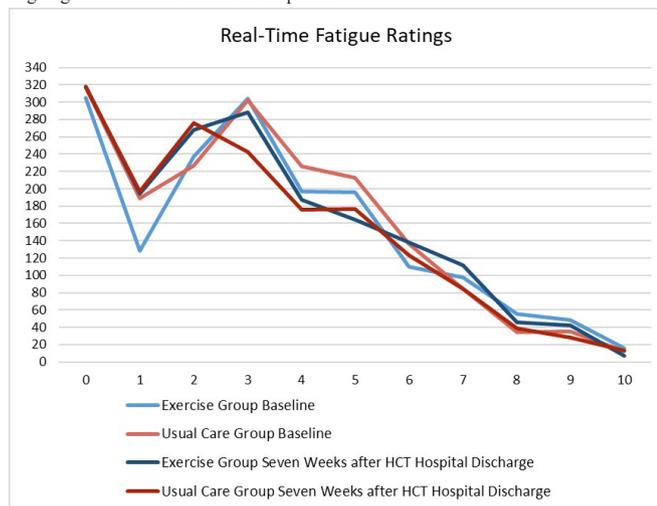
(No relevant relationships reported)

PURPOSE: Autologous hematopoietic cell transplantation (HCT) is commonly used to treat multiple myeloma (MM). Moderate to severe fatigue is associated with the treatment. Sustainable physical activity incorporated in daily activities may reduce fatigue. This study evaluated the impact of a free-living physical activity intervention (STEPS) compared to usual care on real-time fatigue.

METHODS: A two-group, randomized block, repeated measures design (n = 32) was used. The six-week STEPS intervention aimed to increase physical activity by 10% weekly through education, goal-setting, daily step tracking using wearable technology, and guided integration of physical activity into daily routines following HCT hospital discharge. Real-time fatigue was measured with a one-item fatigue intensity scale using computerized ecological momentary assessment eight times per day over seven days. Participants rated their fatigue intensity on a 0 (no fatigue) to 10 (worst fatigue) scale.

RESULTS: Participants provided 6906 ratings of real-time fatigue (3469 prior to HCT and 3437 seven weeks following HCT discharge). Prior to HCT, the STEPS group reported fatigue as mild (57.5%, n = 974 ratings), moderate (29.7%, n = 503 ratings) or severe (12.8%, n = 217 ratings). Following the intervention, the STEPS group reported fatigue as mild (60.5%, n = 1068 ratings), moderate (27.7%, n = 409 ratings) or severe (11.7%, n = 207 ratings). The usual care group reported fatigue as mild (58.3%, n = 1035 ratings), moderate (32.3%, n = 575 ratings) or severe (9.2%, n = 165 ratings) and mild (61.7%, n = 1033 ratings), moderate (28.5%, n = 476 ratings) or severe (9.8%, n = 164 ratings) after the intervention period.

CONCLUSIONS: Although preliminary, differential improvement in real-time fatigue following the STEPS intervention did not occur in the STEPS. Between 35% and 40% of real-time fatigue ratings were classified as moderate or severe demonstrating ongoing need for intervention development.



1224 Board #350 May 27 1:30 PM - 3:00 PM

The Influence Of A 12-week Home-exercise Program On Physical Fitness And Physical Functioning In Childhood Survivors Of Acute Lymphoblastic Leukaemia: Results Of A Randomised Clinical Trial

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PURPOSE: Positive effects of home-exercise programmes on physical fitness have been reported in studies with childhood malignancy. However, conclusive evidence on the impact of home-exercise programmes for physical fitness indicators or functional capacity during daily life activities outcomes in leukaemia is yet to be established. Therefore, the research question for this randomised controlled trial was: Does home-exercise programme improve the physical fitness and physical functioning outcomes more than usual care among children survivors of ALL? **METHODS:** A parallel-group, assessor-blinded, pilot randomised controlled trial was conducted at the Santa Creu i Sant Pau Hospital in Spain (NCT03005392). Twenty-four survivors of ALL were assigned to usual care (control group, n=12, 11.0±3.7 years) or to a home-exercise programme (intervention group, n=12, 11.8±4.3 years). Peak oxygen uptake (VO_{2peak} ml/kg/min), minute ventilation (VE L/min), output of carbon dioxide (VCO₂ L/min), respiratory exchange ratio (RER), peak heart rate (beats/min), maximal load (W), VO₂ at anaerobic threshold (VO₂ at AT, mL/kg/min), pulse oxygen (PO₂ ml/beat), heart rate at anaerobic threshold (beats/min), handgrip test (pounds), flexibility (cm), Timed Up & Go test TUG (s), and Timed Up and Down Stairs test (TUDS s) were measured at baseline and over 16 weeks of intervention.

RESULTS: Adjusted mixed linear models revealed a significant group-time interaction +6.7 (95% CI = 0.6-12.8 ml/kg/min; η² partial = 0.046, P=0.035) for VO_{2peak}. Similarly changes in mean values was observed after the home-exercise programme compared to baseline for VE (L/min) -8.8 (3.0) (P=0.035), VCO₂ -0.23 (0.08), (P=0.041), maximal load (W) -35.5 (12.8) (P=0.024), TUDS (s) 0.8 (2.6) (P=0.010), and TUG (s) 0.60 (0.1) (P=0.001), however the group-time interaction were not significant. **CONCLUSIONS:** The home-exercise program resulted in changes in measures of VO_{2peak}, VE, VCO₂ and functional capacity during daily life activities (TUDS and TUG test). This is an interesting and important study that surely adds to the current body of knowledge/ literature on the safety of exercise interventions, especially in children with haematological cancer.

1225 Board #351 May 27 1:30 PM - 3:00 PM

The Practice Of Physical Activity Protects The Lung Function And Mechanics In Hypertensive Elderly

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PURPOSE: Hypertension is still a growing problem in public health, presenting higher rates among elderly. Recent studies have pointed out that hypertension may be an independent factor impairing the lung function. In addition, several studies have demonstrated that physical activity promotes beneficial effects in hypertensive individuals, but never before the impact of physical activity on lung function and mechanics in hypertensive and non-hypertensive elderly have been evaluated.

METHODS: 110 physically active hypertensive elderly (ActH; 69.39 ± 5.49 years old) and 187 sedentary hypertensive elderly (SedH; 70.09 ± 7.51). The inclusion criteria: no respiratory diseases, unable to perform spirometry test, no respiratory infections in the last 30 days. Lung function (spirometry) and lung mechanics (by impulse oscillometry) was evaluated according to American Thoracic Society recommendations by using IOS Masterscreen Jaeger (Germany). Graph Pad Prism 5.0 was used to perform statistical analysis and p<0.05 were considered significant.

RESULTS: The analysis of lung function revealed that physical activity preserved the lung function (forced vital capacity - FVC) as demonstrated by comparison between ActH versus SedH group (3.65 ± 0.05 x 2.79 ± 0.07; p<0.01). Similarly, the forced expiratory volume in the first second (FEV1) was higher in ActH when compared with SedH elderly (2.96 ± 0.04 x 2.12 ± 0.05; p=0.02) as well as the FEV1/FVC relation (84.06 ± 0.77 x 75.99 ± 0.57; p=0.03). Concerning the lung mechanics, the results

revealed that physical activity was able to preserve the impairment of distal lung elastance (X5), when compared ActH with SedH elderlies (-1.60 ± 0.19 x -1.47 ± 0.10 ; $p < 0.02$) and also the impairment of proximal airways resistance (R20Hz), (2.58 ± 0.06 x 3.12 ± 0.09 ; $p < 0.0001$). **CONCLUSIONS:** Physical activity preserves the lung function and mechanics in elderlies in hypertensive elderlies.

1226 Board #352 May 27 1:30 PM - 3:00 PM
Hypertension Treatment And The Amount Of Physical Activity And Sitting Behaviour - First Blood Pressure Then Exercise Complain

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Physical inactivity is associated with many chronic diseases and premature mortality and increasing evidence also suggests that high levels of sedentary time may increase the risk of chronic diseases and mortality. All intensities of physical activity, including light intensity, are associated with a substantially reduced risk of death in a dose-response manner. A statistically significantly higher risk of death was observed for sedentary times of 9.5 or more hours daily.

PURPOSE: By conducting a pilot survey among people interested in sports concerning physical activity and sedentary lifestyle, we analyse the need to conduct a nationwide educational campaign on the risks of sedentary behaviours in Poland. **METHODS:** The survey was conducted during the largest fitness fair in Poland, "Go Active Show", bringing together people associated professionally and amateurically with sport. 1,000 questionnaires were conducted, including questions based on the IPAQ Short Form questionnaire and NATPOL 2011 survey. Demographic data, number of minutes per day of moderate and intensive physical activity and number of hours per day spent sitting were assessed. For the first time in Poland we asked a question about the number of minutes of exercise and time spent on sitting. **RESULTS:** The study involved 1000 people, 58% of whom were women and 42% men, 55% people with higher education and 44% living in large cities. 62% of the participants had normal body weight. Sitting - 256 people (25.6%) declared 9.5 or more hours of sitting per day. On average, they spend 41.8 minutes a day on moderate physical activity and 29 minutes a day on intensive exercise. **CONCLUSIONS:** The study group was highly aware of the healthy lifestyle, as the majority of people with higher education and living in large cities with more than 500,000 citizens. They also presented a high level of physical activity. However, they are still not aware of the risks of sedentary behaviours and increased risk of premature death. Therefore, it is necessary to launch a nationwide educational campaign in this area in Poland.

1227 Board #353 May 27 1:30 PM - 3:00 PM
Exercise Is Medicine For Hypertension: But What's The Prescription?

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PURPOSE: Exercise is an important therapy option for patients with chronic diseases. For the example of arterial hypertension, the study assessed the reporting quality of exercise-based interventions included in the latest meta-analysis on that topic in order to evaluate the transferability of findings into clinical practice.

METHODS: Reporting quality of 24 randomised controlled trials from a meta-analysis assessing blood pressure lowering effects of endurance training in 1,195 hypertensive patients was evaluated using TIDieR (Template for Intervention Description and Replication) and CERT (Consensus on Exercise Reporting Template) guidelines. Associations between reporting quality, publication year and impact factor of the publishing journals were examined.

RESULTS: None of the studies described all intervention components completely. On average 61% (95%CI: 52-69) (TIDieR) and 57% (95%CI: 49-64) (CERT) of core items required for replication were reported. Frequent shortcomings were the reporting of adherence, intervention provider, and adverse events. Details about exercise dosage were missing in 22% (95%CI: 4-40). Publication year was related to the adherence to TIDieR ($r = -0.549$, $P = 0.007$) but not to CERT. No associations with journal impact factor were found. **CONCLUSIONS:** Further work is required to establish the replicability and uptake of exercise interventions in clinical practice for common chronic diseases. Researchers should apply, and review authors, journal editors and reviewers should check adherence to reporting guidelines. To ensure an adequate quality of reporting of exercise interventions for different diseases, it might be useful to

develop guidelines which integrate indication-specific exercise-related parameters such as blood sugar for patients with diabetes, oxygen saturation for COPD, pain scales for musculoskeletal diseases.

1228 Board #354 May 27 1:30 PM - 3:00 PM
Sex Differences In Leptin And Cardiometabolic Profile After Exercise Intervention In Obese And Hypertensive Adults

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PURPOSE. To analyse the change on leptin, body composition, blood pressure (BP), cardiorespiratory fitness (CRF) and some biochemical parameters in overweight/obese and physically inactive women (W) and men (M) with primary hypertension (HTN), and to evaluate the potential sex differences in the change after intervention. **METHODS.** Participants (n=37 women, n= 40 men, 52.9±6.9 yrs) from the EXERDIET-HTA study were randomized into attention control group (physical activity recommendations) or one of three supervised aerobic exercise groups (two days/week). All participants received the same hypocaloric diet. All variables were assessed pre and post-intervention. A blood sample (12.5 mL) was collected from each participant following an overnight fast to determine the biochemical profile and leptin values. 24-h ambulatory BP monitoring was used to analyze systolic and diastolic BP. A cardiopulmonary exercise test was performed to determine peak oxygen uptake (VO_{2peak}). **RESULTS.** Following the intervention, there were significant increments ($P < 0.01$) in CRF by VO_{2peak} ($W = 21.1 \pm 3.7$ vs. 24.6 ± 4.4 mL·kg⁻¹·min⁻¹, $M = 26.3 \pm 6.0$ vs. 33.1 ± 10.2 mL·kg⁻¹·min⁻¹) and decreases ($P < 0.05$) in leptin ($W = 49.5 \pm 23.0$ vs. 41.8 ± 19.9 ng/mL, $M = 20.5 \pm 14.8$ vs. 12.9 ± 18.6 ng/mL), body mass ($W = 84.7 \pm 12.1$ vs. 80.3 ± 11.5 kg, $M = 97.9 \pm 14.4$ vs. 91.5 ± 13.3 kg), waist perimeter ($W = 97.3 \pm 10.7$ vs. 94.3 ± 10.9 cm, $M = 107.9 \pm 8.7$ vs. 101.5 ± 7.9 cm), fat mass ($W = 42.3 \pm 5.1$ vs. 38.6 ± 8.4 %, $M = 31.2 \pm 5.0$ vs. 28.0 ± 4.4 %), systolic BP ($M = 136.5 \pm 12.1$ vs. 129.3 ± 12.5 mmHg), diastolic BP ($W = 76.2 \pm 8.9$ vs. 74.1 ± 8.7 mmHg, $M = 79.3 \pm 7.2$ vs. 75.0 ± 8.2 mmHg), total cholesterol ($M = 216.1 \pm 44.5$ vs. 196.1 ± 35.0 mg/dL), insulin ($W = 13.4 \pm 7.9$ vs. 9.4 ± 4.2 mU/L) values. There were significant between-sex differences in body mass ($W = 5.2$ %, $M = -6.5$ %, $P = 0.023$), waist circumference ($W = -3.1$ %, $M = -5.9$ %, $P = 0.004$), and VO_{2peak} ($W = 14.2$ %, $M = 20.5$ %, $P = 0.036$). **CONCLUSIONS.** Aerobic exercise along with a hypocaloric diet is an effective non-pharmacological intervention to induce beneficial changes in W and M in BP and leptin as a mediator of obesity-induced HTN, and other regulatory mechanisms such as body composition, CRF and biochemical profile. The found sex-related differences could confirm the need for individual non-pharmacological strategies.

1229 Board #355 May 27 1:30 PM - 3:00 PM
Correlation Of Functional Capacity And Impact On Life Quality Of Type II Diabetes Patients

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(No relevant relationships reported)

Diabetes mellitus (DM) is a chronic progressive disease characterized by high blood glucose levels and stands out as an important and growing health problem worldwide, which can lead to reduced functional capacity (FC) and the quality of life (QOL). However, the association is still poorly studied. **PURPOSE:** To evaluate FC through Shuttle Walking Test Endurance (SWTE) and its association with QOL of type II diabetic (T2D) patients. **METHODS:** This is a cross-sectional study. Patients aged ≥18 years, sedentary, with medical diagnosis of T2D were included. Information such as gender, age, glycated hemoglobin and body mass index (BMI) were collected during an interview prior to the application of the physical test. The QOL was assessed by the Medical Outcomes Study 36 - Item Short - Form Health Survey (SF36) questionnaire, highlighting the "Pain", "Emotional Aspects" and total score domains. **RESULTS:** Forty-one patients (24 women/17 men) participated in the study, with a mean age of 57 ± 10 years. Most of them were overweight individuals with a BMI of 29.5 ± 3.8. The average distance achieved by patients in SWTE was 1020 (360-2200) meters. The mean scores on the SF36 questionnaire were 40 (2-100), 83 (0-100) and 543 (105-704) respectively for the "Pain", "Emotional Aspects" and Total Score domains. Significant correlations were found between the distance covered in SWTE and the domain "Pain", the domain "Emotional aspects" and the total score of the SF36 questionnaire, respectively ($R = 0.4$; $R = 0.4$ and $R = 0.4$; $p < 0.01$). Significant correlation was also

found between the distance covered in SWTE and age $R = -0.4$; $p < 0.01$ of T2D patients. **CONCLUSION:** The findings of the present study suggest that SWTE may be a simple and useful tool in clinical practice for FC measurement and performance in this field test may be strongly associated with QOL of T2D patients.

1230 Board #356 May 27 1:30 PM - 3:00 PM
Preparing For A Behavioral Physical Activity Intervention In Women With Gestational Diabetes Mellitus

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PURPOSE: In preparation for a behavioral physical activity (PA) intervention promoting walking/stepping in place in women diagnosed with gestational diabetes mellitus (GDM), this study sought to assess the accuracy of the Fitbit Charge 3 in recording steps during walking and stepping at three cadences in pregnant women. The study also sought to elicit women's thoughts and feelings on the proposed walking/stepping intervention.

METHODS: Women diagnosed with GDM (N=15) were recruited in the third trimester. Participants wore a Fitbit Charge 3 on the non-dominant wrist and completed a total of six 2-minute bouts that varied by mode (walking vs. stepping in place) and cadence (67, 84, and 100 steps/minute). Bout sequence was randomized. Actual steps were determined by hand-tally, the criterion, in duplicate. One-way and two-way ANOVA were used to examine differences in the mean percentage of steps recorded, by mode and cadence. Participants also completed a 20-minute semi-structured interview with questions on opportunities for PA, challenges to PA, PA preferences, and use of a FitBit to track steps and set goals during walking/stepping. Interviews were audio-recorded and transcribed, then analyzed using descriptive and interpretive coding to identify themes.

RESULTS: There was a statistically significant difference in the percentage of steps recorded by cadence ($p < .01$), but not by mode ($p = .23$); no interaction was detected between mode and cadence ($p = .17$). Analyses of cadence only suggested that 67 steps/minutes (lowest) may differ significantly from the other cadences (67 steps/minute = 113%, 84 steps/minute 97%, 100 steps/minute = 95%; $p = .05$). In the interviews, most reflected on the complexity of their lives making daily PA difficult, and indicated preference for three 10-minute bouts of walking/stepping over one 30-minute bout per day.

CONCLUSIONS: The Fitbit Charge 3 may overestimate steps at lower cadences. However, step count did not differ with respect to mode at the cadences examined. Results suggest that the Fitbit Charge 3's step count is suitable for use in a behavioral PA intervention promoting walking/stepping by tracking and goal setting. Interview data additionally suggested that walking/stepping interventions for women with GDM should afford convenience and flexibility to participants.

1231 Board #357 May 27 1:30 PM - 3:00 PM
The Cross-sectional Effect Of Abnormal Glucose Metabolism On Balance Ability, Muscle Strength, And Body Composition In Men

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PURPOSE: To investigate the association between balance ability, muscle strength, and body composition, and fasting blood glucose **METHODS:** 1) Subjects: 2693 men (aged 19-73 years old) were recruited from three health management central of hospitals in China, without any diagnosed diseases other than diabetes. 2) Measurements: People's grip strength was measured 3 times in dominant hand in a standing position and read the highest value; balance ability was measured by one-leg standing time with both eye-closed; body composition was measured by BIA; fasting venous blood was taken for blood glucose test. All subjects were divided into normal blood glucose group (Normal: < 6.1 mmol/L), impaired fasting glucose group (IFG: $6.1-7.0$ mmol/L), and diabetes group (DM: ≥ 7.0 mmol/L). 3) Statistics: Multivariate analysis of variance was used for comparison among groups; Pearson test was used for correction analysis; the significance level (α) for hypothesis testing was set to 0.05. **RESULTS:** Normal glucose men were significantly younger than those in the IFG and DM group (38.76 ± 9.45 vs. 44.57 ± 9.09 vs. 45.87 ± 4.79 yrs, $P < 0.05$). Normal glucose

men had significantly lower body weight and lower percent body fat than those in the IFG and DM group (BW: 70.70 ± 11.29 vs. 75.68 ± 10.40 vs. 77.23 ± 11.66 kg, $P < 0.05$; BF%: 15.55 ± 6.38 vs. 18.97 ± 5.82 vs. 25.12 ± 5.62 , $P < 0.05$). Balance ability, relative grip strength, and muscle percentage [(body muscle/ body weight)*100] were different in three groups ($P < 0.05$). There were inverse linear associations between incremental level of blood glucose and lower values of balance ability, relative grip strength, and muscle percentage ($r = -0.067$, $r = -0.158$, $r = -0.171$, $P < 0.05$ for each). After adjusted age, the blood glucose level was still correlated with balance ability ($r = -0.035$, $P = 0.068$).

CONCLUSIONS: The men's balance ability decreases with the increase of blood glucose level. There are inverse linear associations between muscle strength and muscle percentage and blood glucose level. **Acknowledgement:** 1) China Health Foundation Project "Multi-Center Application Research on Fitness Fitness Test and Exercise Management" (CHPF2014-FITEX); 2) National Key Research and Development Program Major Prevention and Control Research on Chronic Non-communicable Diseases (2016YFC1300202).

1232 Board #358 May 27 1:30 PM - 3:00 PM
Comparative Study Of Resistance And Aerobic Exercise In Pre-diabetes: An Rct

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PURPOSE: Although the benefit of aerobic exercise in IGR is proven, the impact of resistance exercise on IGR is still unclear. Therefore, the differences between aerobic and resistance exercise on IGR was analyzed to provide a theoretical and practical basis for DM prevention and IGR management.

METHODS: Single-blind RCT. IGR participants were divided into 3 groups randomly: aerobic exercise (A, n= 26), resistance exercise (R, n= 23), and control (C, n=21). The effect of aerobic and resistance exercise on IGR was analyzed and the relationship with obesity was investigated after 12-weeks intervention.

RESULTS: (1) FPG in groups A and R was decreased significantly by 6.17% and 4.81%, and OGTT 2h PG was also decreased significantly by 20.39% and 16.50%. 69.2% in group A showed a decrease in blood glucose level to normal value with a significant difference compared with group C. (2) HOMA2-IR in groups A and R was significantly decreased by 8.34% and 18.31%, with a significant difference compared with group C. (3) A significant decrease of BMI (3.1 ± 3.2 kg/m², showed a moderately positive correlation with the decreased FPG) and waist (3.1 ± 2.7 cm) was found in group A with a significant difference compared with group C. BMI (1.1 ± 2.9 kg/m²) and waist (1.5 ± 3.8 cm) also decreased significantly in group R, but no significant difference between groups. The change of body composition showed in figure 1.

CONCLUSION: (1) Both resistance and aerobic exercise lowered blood glucose and decreased blood glucose to normal level in a large percentage of IGR. (2) Both aerobic and resistance exercise improved IR in IGR. The effect of resistance exercise on IR improvement was superior to that of aerobic exercise. (3) Aerobic exercise lowered weight and waist significantly in IGR, and decreased blood glucose through weight loss. But the improvement of IR by both aerobic and resistance exercise might not be related to the control of obesity.

Supported by SGA China (2014B007), Sun Yat-sen University (1709089).

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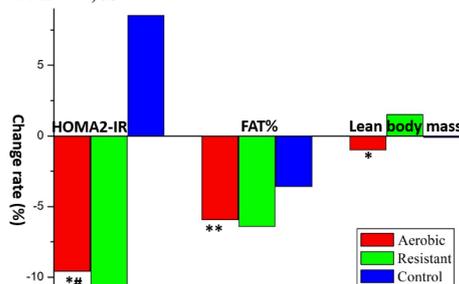


Figure 1 Change rate of HOMA2-IR, FAT%, lean body mass in 3 groups in IGR
 * $P < 0.05$, ** $P < 0.01$, compared with pre-intervention within group; # $P < 0.05$, ## $P < 0.01$, compared with group C

1233 Board #359 May 27 1:30 PM - 3:00 PM
Extreme Duration Low Intensity Exercise Not Cause Additional Weight Loss For Patients With Metabolic Syndrome

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Common medical advice for patients with obesity and metabolic syndrome (MS) is weight loss through negative energy balance: eat less and do more physical activity. Guidelines suggest that moderate to vigorous intensity physical activity (MVPA) is better than low intensity physical activity (LPA). However, patients with morbid obesity and metabolic syndrome have difficulties to achieve MVPA level, particularly when they take beta-blockers. **PURPOSE:** To monitor long-time weight loss of a patient with morbid obesity and MS who underwent regular exercise and energy-restricted diet. **METHODS:** This case study followed a male patient (age 65y, baseline weight 131,0kg, BMI 43,8) with MS (obesity, high blood pressure, dyslipidemia, prediabetes) for 12 months. He took medication for every disease and also beta-blockers. His program was assisted by medical doctor, nutritionist and exercise therapist, has regular blood tests. All the trainings (1628 sessions) were monitored by heart rate activity tracker (POLAR A300). **RESULTS:** In the first 7 months the patient's weight loss was variable but permanent (23,1kg, BMI decrease to 35,8). His energy intake was consistently 1800 kcal/day, training hours of the week increased from 13,3 hours to 22,6 hours, from which he spent in MVPA activity 182 minutes a week at the baseline, and 469 on the peak which resulted increase in energy expenditure. There were positive changes in resting heart rate, blood pressure, blood sugar, HgA1c, cholesterol levels. In the months 8-12 the bodyweight was constant despite of the extreme increase in training to 37 hours a week but with moderate decrease in MVPA to 195 minutes. Statistic analysis of weight loss and time spent in intensity zones shows positive significant correlation in case of MVPA ($r=0.52$, $p<0.001$) and negative in case of LPA ($r=-0.47$, $p<0.01$). **CONCLUSIONS:** The energy-restricted diet and exercise therapy caused large weight loss but the LPA (<60% max hr) exercise had no effect. It seems that after achieving higher fitness level, extreme duration of LPA is not capable of long term weight loss although it plays a huge role in negative energy balance. MVPA would be more effective for patients with metabolic syndrome, but beta-blockers and the risk of heart attack or hypoglycaemia make the intensity-increase difficult. Supported by TUDFO/51757/2019-ITM

1234 Board #360 May 27 1:30 PM - 3:00 PM
Cardiometabolic Benefit Of A Family-Oriented Exercise And Nutrition Intervention On Overweight And Obese Children

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One third of U.S. children are overweight or obese. Without intervention, they experience an elevated risk of developing type 2 diabetes and cardiovascular disease as adults. Poor blood glucose and lipid profiles are indicators of adult onset, and early intervention can reduce the likelihood of future diagnosis. Thus, it is important to identify programs capable of improving these parameters in at-risk children. **PURPOSE:** To examine the effect of a family-oriented exercise and nutrition intervention on blood glucose and lipid profiles in overweight and obese children. **METHODS:** 12 children (age 7-16 yr) were referred to a weight loss intervention by their primary care physician; 6 males and 3 females completed the program. They performed biweekly sessions of structured exercise (45 min) and nutritional counseling (30 min) for 18 weeks. At baseline and follow-up, blood samples were drawn, measuring triglycerides (TG), total cholesterol (TC), high-density lipoproteins (HDL), low-density lipoproteins (LDL), and blood glucose (BG). Paired-samples t-tests compared pre to post differences in these variables. **RESULTS:** At baseline, subjects were 12.3±2.4 years old with a body mass index of 29.8±4.5 kg/m². Blood samples revealed TG of 118.4±50.1 mg/dL, TC of 172.0±21.2 mg/dL, HDL of 52.6±10.2 mg/dL, LDL of 97.8±24.9 mg/dL, and BG of 117.25±5.4 mg/dL. From baseline to follow-up, non-significant improvements were detected in TG ($p=0.104$), TC ($p=0.085$), and LDL ($p=0.132$). Significant changes were detected in HDL (increased 6.8±2.2 mg/dL, corresponding to a 13.1% improvement; $p=0.009$) and BG (decreased 17.7±5.0 mg/dL, 14.8% improvement; $p=0.026$). **CONCLUSION:** Despite the absence of external incentives, the program's retention was 75% over 18 weeks. Children who completed the full duration of exercise training and nutritional counseling experienced significant improvements in HDL and BG. These findings support the growing evidence that earlier cardiometabolic interventions are warranted.

1235 Board #361 May 27 1:30 PM - 3:00 PM
COMBINED TRAINING IMPROVES LUNG MECHANICS AND LUNG INFLAMMATION IN OVERWEIGHT WOMEN

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PURPOSE: The prevalence of obesity has grown over the years around the world. The accumulation of fat in the abdominal region is strongly associated with changes in pulmonary function and mechanics, as well as pulmonary inflammation that can lead to the development of respiratory diseases. Several studies have evidenced that aerobic exercise and resistance training promote numerous benefits in the respiratory system. However, no study have evaluated the effects of combined training program (aerobic + resistance) on lung mechanics and inflammation of overweight women. **METHODS:** 100 overweight women were recruited, according to the classification of body mass index (BMI) proposed by the World Health Organization. The combined training protocol (aerobic + resistance) was performed 3x/week for 12 weeks, 1 hour/session. Inclusion criteria: no respiratory diseases, nonsmokers, no pyramidal infections in the last 30 days, without musculoskeletal diseases. Nitric oxide levels in exhaled air were evaluated using the NOBreath portable nitric oxide monitor. Lung mechanics (by impulse oscillometry) was evaluated according to American Thoracic Society recommendations by using IOS Masterscreen Jaeger (Germany). Graph Pad Prism 5.0 was used to perform statistical analysis and $p<0.05$ were considered significant. **RESULTS:** The data shown here are from 15 women, as the program is still ongoing. Combined training resulted in reduced pulmonary inflammation, as measured by the levels of exhaled nitric oxide (pre: 16.67±7.66 ppb; post: 8.27 ± 4.54 ppb; $p=0.0014$). In addition, combined physical training significantly improved the pulmonary mechanics of these obese women, as improvements in the impedance of the respiratory system (Z5 Hz, pre: 4.35 ± 1.41, post: 0.55 ± 0.15, $p<0.0001$), total resistance of respiratory system (R5 Hz, pre: 4.03 ± 1.28, post: 0.52 ± 0.14, $p<0.0001$) and proximal airway resistance (R20 Hz, pre: 3.00 ± 1.08, post: 0.41 ± 0.12, $p<0.0001$) were observed. In the distal region of the lung, the combined training protocol significantly reduced the elastance (X5, pre: -1.55 ± 0.67, post: -0.18 ± 0.05, $p<0.0001$) and the resistance of the small airways (R 5 Hz - R20 Hz, pre: 1.03 ± 0.45, post: 0.11 ± 0.06, $p<0.0001$). **CONCLUSIONS:** Combined training improved lung mechanics and inflammation of overweight women.

1236 Board #362 May 27 1:30 PM - 3:00 PM
Anti-Inflammatory Effects Of Different Types Of Physical Exercises In Adults

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A link between physical inactivity, central obesity, and inflammation likely exists suggesting physical activity and inactivity as critical regulators of systemic inflammation. **PURPOSE:** To investigate the responsiveness of a systemic inflammatory marker to different types of physical exercises. **METHODS:** A sample of 302 individuals from both genders was taken among (2013-2016) participants of the dynamic cohort "Move for Health", a lifestyle-modification program (LiSM) with supervised physical exercises and dietary counseling. The evaluation instruments were: IPAQ (long form-version 8); anthropometric, plasma analysis of high-sensitive C-Reactive Protein (hs-CRP) and physical fitness. After the clinical trial, the groups were assembled voluntarily in any of the exercise-protocols: hydro-gymnastics (HYD, 240min-400MET/week, $n=50$), high intensity interval training (HIIT, 240min-496MET/week, $n=63$), strength training in gym (ST, 360min-545MET/week, $n=43$) and mixed walking-strength (MIX, 30 min of walking 60-80% HRmax and ST, 540min-743MET/week, $n=146$). All groups received similar dietary counseling. Assessments were undertaken at baseline and after 10 weeks of supervised intervention. Continuous and categorized data were evaluated at 5% significance level. **RESULTS:** The 55.5 ± 10.8 years old sample, 88% females, 80.5% overweight, 91% reporting at least 150min/wk, 63% with good cardiorespiratory fitness, 78% good hand-grip strength but 73% presenting poor flexibility. At baseline, groups were similar and after intervention, all protocols incremented the baseline values of VO₂max; flexibility (except in the HIIT) and muscle strength (only in ST and MIX). The level of physical activity increased only in MIX. Waist circumference(WC) reduced 1.3cm(HYD) to 2.2cm(ST), significantly in all but HIIT group. Us-CRP decreased

significantly from 0.54(0.04-3.00) to 0.35(0.01-1.43) mg/dL, leading to a reduction of inflammatory stress (IS:CRP > 0.30mg/dL) from 44.7% to 29.8%. Except HYD, hs-CRP decreased in all other groups, while only HIIT reduced significantly(23%) the IS. CONCLUSIONS: The 10-wk LiSM was effective in reducing systemic inflammation, being more effective in HIIT and less in HYD, dissociable from WC changes and specific fitness improvements. Supported by CNPq and CAPES.

B-83 Free Communication/Poster - Measurement Studies in Exercise Oncology

Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
Room: CC-Exhibit Hall

1237 Board #363 May 27 2:30 PM - 4:00 PM Myocardial Fibrosis Impairs Exercise Capacity By Limiting Cardiac Output Among Anthracycline-treated Women With Breast Cancer

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(No relevant relationships reported)

PURPOSE: Physiologic reserve, the capacity for augmented function between rest and peak exercise, declines in organs and biological systems with aging. Chemotherapy can rapidly accelerate this decline, as noted by substantially lower exercise capacity in survivors of breast cancer (BC). We assessed cardiac function reserve and myocardial tissue characteristics and determined their contribution to exercise capacity reserve (VO_{2R}) in 16 anthracycline treated BC survivors and 16 age- and BMI-matched controls (CON). **METHODS:** Participants performed a maximal cardiopulmonary test on an upright cycle ergometer and also inside a 3T magnetic resonance imaging scanner using a horizontal, resisted, stepping device. Real-time, free-breathing, ungated cine images were acquired at rest and peak exercise. Left ventricular (LV) volumes and ejection fraction (EF) were calculated from a biplane model of 2- and 4-chamber long axis views. The reserve of LV volumes, EF, cardiac output, and VO₂ were calculated as peak minus rest values. Native T₁ mapping, a measure of myocardial fibrosis, was performed using the SASHA method. Groups were compared with independent t-tests and linear regression was performed between cardiac variables and relative VO_{2R}.

RESULTS: VO_{2R} was 25% lower in BC versus CON (18±7 vs 25±7 mL/kg/min, p=0.02). Hemoglobin, LV mass, resting LV volumes, cardiac output, and EF were similar between groups. Myocardial T₁ times were elevated in BC compared to CON (1535±32 vs 1503±28 ms, p=0.002). The reserve in heart rate, LV volumes, and EF did not differ between groups. A trend toward lower stroke volume reserve (14±8 vs 19±7 mL, p=0.08) resulted in lower cardiac output reserve in BC versus CON (+8.5±2.5 vs +10.3±2.4 L/min, p=0.05). As predicted by the Fick equation, indexed cardiac output reserve (β=3.0, 95% CI=1.2 to 4.8, R²=48%, p=0.003) was an independent predictor of VO_{2R} in the BC group, as was myocardial T₁ (β=-0.18, 95% CI=-0.25 to -0.10, R²=65%, p<0.001). Mediation analysis demonstrated that the relationship between cardiac output and VO_{2R} is mediated by the extent of myocardial fibrosis. **CONCLUSIONS:** Exercise intolerance following anthracycline treatment for breast cancer can be partially explained by reduced ability to augment cardiac output due to myocardial fibrosis.

1238 Board #364 May 27 2:30 PM - 4:00 PM Self-selected Walking Cadence After Light-intensity Physical Activity Intervention For Older Cancer Survivors

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(No relevant relationships reported)

PURPOSE

The MY Health randomized controlled trial evaluated the effectiveness of a wrist-worn activity monitor and health coaching to replace sedentary behavior with bouts of light-intensity physical activity among older cancer survivors. Participants were asked to 1) increase average daily steps ≥ 3000 above baseline and 2) disrupt sedentary

behavior at least twice per hour. No specific recommendations regarding intensity or minimum bout duration were provided. In this secondary analysis, we hypothesized that participants would self-select to walk faster to meet their daily step goal.

METHODS

Average daily steps and free-living walking cadence were measured in 41 participants (age 69±3.1 yr), using an ActivPAL activity monitor for 7 days pre- and post-intervention. Step accumulation patterns associated with intensity of ambulatory behavior were sorted in cadence bands of 20 steps/min from 40-59 (incidental movement) to ≥120 steps/min (fast locomotor movement). Repeated measures ANOVA was used to evaluate intervention induced changes in walking cadence; Wilcoxon rank-sum tests were used to highlight group differences within cadence bands. Medians and interquartile range are reported.

RESULTS

Intervention (n=24) and Waitlist Control (n=17) participants exhibited similar characteristics at baseline. The Intervention group increased average daily steps by 976 (IQR: -388 to 3532) from pre- to post-intervention; the control group increased by 354 steps/day (IQR: -658 to 1300); p=.19). There was a significant interaction of the intervention on cadence bands (p<.001). Steps taken in cadence bands denoting moderate intensity physical activity (MPA; 100-119 steps/min) increased by 478 (IQR: -121 to 1844) steps/day in the intervention group, compared to a decrease of 92 (IQR: -510 to 181) steps/day in the control group (p<.01).

CONCLUSION

While only 29% of intervention group participants met the daily step goal, there was a displacement of steps taken from cadence bands associated with lower to those of higher intensity of stepping, i.e., participants self-selected to walk faster. These findings may have important clinical implications as both duration and intensity have shown to offer cardioprotective and other health-related benefits.

1239 Board #365 May 27 2:30 PM - 4:00 PM Relative Reliability Of A CT-Based Measurement System To Assess Body Composition In Colon Cancer Patients

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Body composition is associated with important clinical and functional outcomes in colon cancer patients. Colon cancer patients often undergo computed tomography (CT) in routine clinical care. These images may then be used to assess body composition to potentially identify individuals who may benefit most from physical activity (PA) intervention. Developing reliable and accurate ways to measure body composition is a prerequisite to using CT-generated body composition to inform disease management.

Purpose: To determine inter- and intra-rater relative reliability of CT to measure body composition in colon cancer patients in a randomized controlled trial (PA vs. usual care). **Methods:** 25 CT scans were randomly selected from 10 men and 8 women (59.1±9.7yrs), all post-primary treatment for stage II-III colon cancer. Manual image analysis was conducted for each single CT image slice using SliceOmatic software (Tomovision, Montreal, Canada) to mark the third lumbar vertebra and segment/quantify muscle (MUS), intramuscular adipose tissue (IMAT), visceral adipose tissue (VAT), subcutaneous adipose tissue (SAT), and the muscle attenuation coefficient (MA). Inter-rater reliability was assessed by estimating the agreement between measures from a) 2 trained manual analysts and b) a manual analyst and automated software (Voronoi Health Analytic ABACS L3 Module), respectively. Intra-rater reliability was evaluated by estimating the agreement between measures by the same manual analyst one month apart. Inter- and intra-class correlation coefficients (ICCs) were calculated with ICC ≥ 0.9 deemed excellent reliability. **Results:** ICCs were excellent for both measures of inter-rater reliability (analyst 1 vs. 2: MUS=0.999, IMAT=0.928, VAT=1.000, SAT=0.999, MA=0.999; manual vs. automated: MUS=0.981, IMAT=0.710, VAT=0.997, SAT=0.992, MA=0.992), and intra-rater reliability (MUS=1.000, IMAT=0.971, VAT=1.000, SAT=0.999, MA=1.000) (all p<0.01). **Conclusion:** Body composition analyses using clinical CT scans, SliceOmatic software, and a trained analyst is feasible for a single analyst across time, between two separate analysts, and between a manual analyst/automated software. Relatively reliable CT analyses of body composition is possible in stage II-III, post-primary treatment colon cancer patients.

1240 Board #366 May 27 2:30 PM - 4:00 PM
Evaluating The Suitability Of A Graded Exercise Test In Patients With Acute Leukemia Or Lymphoma

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Several studies demonstrate the beneficial effect of exercise on side effects and well-being during high dose/induction chemotherapy in patients with acute leukemia. Nevertheless, not only the chosen intervention and the exercise intensity vary between these studies but also the operationalization of exercise intensities differ. Although advices to use a graded exercise test in cancer patients exist, the suitability of this exercise testing in this specific group of patients has not been examined yet as far as the author knows.

Purpose: Investigate whether maximal effort of the participants has been generated during the graded exercise test.

Methods: As part of a bigger randomized controlled trial, 53 participants took part at the graded exercise test after being hospitalized to start high dose/induction chemotherapy treating acute leukemia or aggressive lymphoma. A graded exercise test starting at 20 watt increasing 10 watt per minute was performed. The ACSM criteria for a maximal exercise test were reviewed to determine whether the effort was maximal. These criteria are (1) a plateau in $\dot{V}O_2$ with increased workload, (2) failure of heart rate to increase with increases in workload (3), a post-exercise venous lactate concentration > 8.0 mmol/l, (4) a rating of perceived exertion at peak exercise > 17 on the 6-20 scale (Borg-Scale), and (5) a peak RER \geq 1.10.

Results: Criteria one and five could not be tested, due to the study design. Only one participant fulfilled the first criteria. Lactate concentration was measured right after the test and three minutes later. 15.4% (6 participants) and 21.4% (9 participants) respectively, reached a lactate concentration > 8.0 mmol/l and thus fulfilled the third criteria. A higher value than 17 on the Borg-Scale was stated by 66.0% (35) of the participants fulfilling the fourth criteria. Five (16.7%) and seven (23.3%) participants respectively met both the third and fourth criteria simultaneously.

Conclusion: Following the ACSM criteria, this investigation states that the majority of the participants did not reach the limit of exhaustion, suggesting that the graded exercise test might not be suitable for this group of patients.

1241 Board #367 May 27 2:30 PM - 4:00 PM
Comparison Of The Cancer And Modified Bruce Treadmill Protocols To Measure $\dot{V}O_2$ Peak In Cancer Survivors

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INTRO: The physical decrements associated with cancer and its treatments can be attenuated with exercise. For this reason, exercise testing is essential to purposeful and individualized exercise prescriptions. Currently, the only treadmill protocol validated in cancer survivors is the University of Northern Colorado Cancer Rehabilitation Institute (CANCER) Treadmill Protocol. The Modified Bruce Treadmill Protocol (MB) is widely used for exercise testing in clinical settings and has been validated in healthy populations, but not cancer survivors. It is unknown whether the MB is an appropriate assessment tool compared to the validated cancer treadmill protocol. Multiple peak oxygen consumption ($\dot{V}O_{2peak}$) predictive equations for the MB exist, however the accuracy of these equations in cancer survivors is unknown. **PURPOSE:** To determine whether the MB yields as accurate $\dot{V}O_{2peak}$ values as the CANCER protocol in cancer survivors. The secondary purpose was to examine which MB predictive equation, if any, most accurately estimated $\dot{V}O_{2peak}$ in cancer survivors. **METHODS:** Twenty-two cancer survivors completed two $\dot{V}O_{2peak}$ treadmill tests, the CANCER and the MB protocol. One protocol was performed once per week in a randomized order. $\dot{V}O_{2peak}$ values were obtained via gas analysis using a research-grade metabolic cart. A paired samples t-test was performed to determine if differences occurred between the CANCER and MB $\dot{V}O_{2peak}$ values. A repeated measures ANOVA was performed to determine differences between four MB predictive $\dot{V}O_{2peak}$ equations. **RESULTS:** Due to its difficulty, one subject could not complete the MB, but completed the CANCER protocol. There were statistically significant differences between $\dot{V}O_{2peak}$ values ($\text{mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$) found between the MB (26.38 \pm 7.90) and CANCER protocol (28.65 \pm 7.91) ($p = 0.037$). Furthermore, the American College of Sports Medicine (ACSM) walking/running equation from the last completed stage was the only predictive $\dot{V}O_{2peak}$ equation that was not statistically different than actual $\dot{V}O_{2peak}$ ($p = 0.930$) for the MB. **CONCLUSION:** Findings from this preliminary

data suggest the MB underestimates $\dot{V}O_{2peak}$ in cancer survivors and may be too difficult for some to complete. This data proposes the MB may not be suitable to determine $\dot{V}O_{2peak}$ in cancer survivors.

B-84 Free Communication/Poster - Observational Research in Exercise Oncology

Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
 Room: CC-Exhibit Hall

1242 Board #368 May 27 2:30 PM - 4:00 PM
Correlates Of Exercise Behavior In Korean Cancer Patients: KNHANES 2014-2016

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PURPOSE: Most Korean cancer patients do not participate in sufficient physical activity. Understanding the determinants of exercise behavior is important to improve their physical activity level. The purpose of this study was to examine the correlates of meeting exercise guidelines in Korean cancer patients.

METHODS: Data were obtained from the Korea National Health and Nutrition Examination Survey 2014-2016. We included 640 cancer patients who had been diagnosed with any type of cancer. Moderate and vigorous physical activity time and frequency of resistance exercise were assessed. Participants were categorized as meeting (1) aerobic only, (2) resistance only, (3) combined, or (4) neither exercise guideline based on the American College of Sports Medicine's aerobic and resistance exercise guidelines for cancer survivors. Correlates included demographic, medical, and health-related fitness/quality of life variables. Univariate and stepwise multinomial logistic regression were used for statistical analyses.

RESULTS: The percentage of participants meeting the combined, aerobic only, resistance only, and neither guideline were 7.5%, 11.4%, 13.0%, and 68.1%, respectively. In univariate analyses, age ($p < 0.001$), sex ($p = 0.030$), region ($p = 0.011$), marital status ($p = 0.003$), education level ($p < 0.001$), and income ($p < 0.001$) were associated with meeting the exercise guidelines among demographic variables. Time since cancer diagnosis ($p = 0.027$) and the number of comorbidities ($p = 0.030$) were associated with meeting the exercise guidelines among medical variables. Hand-grip strength ($p < 0.001$), quality of life for mobility ($p < 0.001$), quality of life for self-care ($p = 0.047$), quality of life for pain/discomfort ($p = 0.004$), and total quality of life index ($p < 0.001$) were associated with meeting exercises guidelines among health-related fitness/quality of life variables. In stepwise multivariate multinomial logistic regression, younger age, higher education level, more hand-grip strength, and better quality of life for mobility independently predicted exercise behaviors.

CONCLUSION: Physical activity level is insufficient in Korean cancer patients and their exercise behaviors were correlated with age, education level, muscular strength, and quality of life.

1243 Board #369 May 27 2:30 PM - 4:00 PM
Exercise Recommendations For Adults With Bone Metastases: Outcomes Of A Delphi Consensus Process

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PURPOSE: To understand the current views of an expert panel on exercise screening, assessment, and prescription in adults with bone metastases.

METHODS: Medical doctors, researchers, and exercise professionals with expertise in providing medical and/or exercise advice to cancer patients with bone metastases were identified. A 3-round modified online Delphi survey was used to establish consensus with a priori consensus set to 70%.

RESULTS: Response rates were 68% (73/107), 81% (59/73) and 97% (57/59) for each round. Key consensus points were: (a) as part of pre-exercise screening, information should be collected on the number, location, and type of bone lesion(s), level of bone pain, and any other bone-related symptom (100% consensus); (b) medical guidance (i.e. communication and medical information from a Physician) is recommended for patients with the following: bone lesions that are unstable (or unknown stability), bone pain, past medical treatment for bone pain, or history of disease-related fractures (90%

consensus); (c) exercise testing and prescription in lower risk patients is thought to be safe provided caution is used with any protocol that results in stress on the bone lesion site (74% and 93% consensus, respectively); (d) exercise can be prescribed to higher risk patients but caution is recommended with exercises that place significant load on lesion sites and additional considerations may be required (77-82% consensus, varying by exercise type); (e) for patients classified as 'unsafe to exercise', advice on safe activities of daily living was seen as appropriate (91% consensus); (f) professionals best suited to prescribe exercise to lower and higher risk patients with bone metastases were exercise physiologists and Physiotherapists, who have additional cancer exercise training (>70% consensus). Consensus was not reached on the need for medical guidance in lower risk patients, suitable exercise testing protocols for higher risk patients, and the need to limit any specific exercise prescription practices for higher risk patients.

CONCLUSIONS: This represents the current views of a range of professionals who provide medical and exercise advice to adults with bone metastases and will inform the guidance document of the International Bone Metastases Exercise Working Group (IBMEWG).

1244 Board #370 May 27 2:30 PM - 4:00 PM
A Scoping Review Of Cardiac Rehabilitation Use By Adults With Cancer

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Purpose: Cardiac rehabilitation (CR) improves recovery from cardiac events and may aid in the recovery from cancer. We conducted a scoping review to systematically describe research on CR use by adults with cancer and examined acceptability and benefits of CR for adults with cancer.

Methods: We searched 4 databases through September 16, 2019. Studies were required to have enrolled adults with cancer into CR or into a CR-based rehabilitation program.

Results: We identified 780 articles. Ten articles from 9 studies met inclusion criteria. Studies occurred in the United States (n=3), Canada (n=4), and the United Kingdom (n=2). Five studies used a quasi-experimental pre-post design, 3 used a retrospective cohort design, and 1 was a randomized control trial. In total, 662 adults with cancer were included: 74% were female and most had breast cancer (breast 60%, prostate 7%, hematologic 7%, lung 3%, other 23%). The average age at baseline was 55 years for 5 studies and 59, 65, 66, and 74 years for the other studies. Race/ethnicity was reported in 2 studies for 82 adults and the majority of adults were white. Two studies included adults that were post-treatment, 6 included adults that were during treatment or post-treatment, and 1 did not report treatment status. Six studies used an existing CR program, 2 developed a new cancer rehabilitation program based on a CR model, and 1 did not report CR program details. In 2 studies, adults with cancer were interviewed about acceptability of CR. Adults liked the peer support of CR and believed that CR increased their motivation and confidence to be active. Barriers to attending CR were travel distance and lengthy recoveries from surgery/treatment. Seven studies measured changes in outcomes before and after CR. The most frequently measured outcomes were cardiorespiratory fitness (n=4), walking speed (n=3), body composition (n=3), depression (n=3), and quality of life (n=3); in most studies these outcomes improved after rehabilitation. Three studies monitored safety and reported no adverse events.

Conclusion: CR may safely improve physical and psychosocial health of adults with cancer. Future studies would benefit from the use of more rigorous study designs with a control group, inclusion of a diverse sample of adults with cancer, and more feedback on acceptability of CR from adults with cancer.

1245 Board #371 May 27 2:30 PM - 4:00 PM

Physical Activity In Colorectal Cancer Patients 12 Months After Resection: Results From The Colocare Study

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While several studies have objectively measured physical activity (PA) and sedentary behavior (SB) in colorectal cancer survivors, the time between cancer diagnosis and accelerometer wear within these studies was highly variable. **PURPOSE:** To quantify PA and SB in colorectal cancer survivors at a fixed time-point (12 months) after primary tumor resection. **METHODS:** The ColoCare Study is an international, longitudinal, prospective cohort study in newly-diagnosed colorectal cancer patients that collects questionnaires and biospecimens at regular intervals from diagnosis to 5 years post-resection. For this analysis, participants with stage I-III colorectal cancer from the German Cancer Research Center (DKFZ, Heidelberg, Germany) and the Huntsman Cancer Institute (HCI, Salt Lake City, UT) were provided an Actigraph GT3X+ accelerometer 12 months after primary resection and asked to wear the monitor 24 hours per day for 4+ consecutive days. PA volume and intensity were derived from raw accelerometer data using ActiLife software (v6.16.3) and Freedson (1998) activity cut-points. Pearson correlations were used to evaluate associations between PA, SB, and clinicodemographic characteristics (e.g. BMI). **RESULTS:** Sixty-eight ColoCare participants (DKFZ n=43; HCI n=25) met valid accelerometer wear criteria (>10 h/day for 4+ days) at the 12 month time-point and were thus included in analysis. Participants spent 8.2 ± 5.8% of monitor wear time in moderate-to-vigorous physical activity (MVPA) and 73.3 ± 9.7% of monitor wear time sedentary. Additionally, participants accrued 168 ± 243 weekly exercise minutes (MVPA in bouts >10 minutes) and 38% were meeting the PA guidelines. Participants enrolled at HCI were significantly more active than those enrolled at the DKFZ (Steps/day: 10,008 ± 2,947 vs. 6,188 ± 3,815, p<0.05) and those patients who did not receive adjuvant chemotherapy were more active than those who underwent chemotherapy (Steps/day: 8,585 ± 4,160 vs. 6,350 ± 3,349; p<0.05). **CONCLUSIONS:** PA levels 12 months after primary colorectal cancer resection were greater than expected, and may be influenced by geographic location and adjuvant chemotherapy use. Supported by the ACSM Paffenbarger-Blair Fund for Physical Activity Epidemiology, the Lackas Foundation, and NIH U01 CA206110

1246 Board #372 May 27 2:30 PM - 4:00 PM

Impact Of Physical Activity Trajectories On Colon Cancer Risk

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Colon cancer is a major public health and clinical concern, as it is the third leading cause of cancer death in the United States. Numerous types and intensities of physical activity (PA) are shown to reduce risk of colon cancer, however research is inconclusive on what time point in life (early, later, or maintaining throughout life) PA is most important to reduce colon cancer risk.

PURPOSE: To evaluate whether the maintenance of and changes in PA levels over time, as measured over the life course as trajectories, are associated with colon cancer risk.

METHODS: We used PA and health data from 334,905 generally healthy men and women in the NIH-AARP Diet and Health Study to test whether various PA patterns over the life course impacted colon cancer risk. Using latent class trajectory models,

we identified seven distinct PA trajectories using four time points across the life course from teenage years through middle age. We used cox proportional hazard regression to assess the association between the PA trajectories and colon cancer incidence.

RESULTS: In adjusted analyses (age, sex, education, smoking, alcohol, and red/processed meat intake), compared to those with consistently low PA levels, we found that those who maintained PA through life significantly reduced risk of colon cancer by about 13% (HR = 0.87, 95% CI 0.80-0.94; 0.87, 95% CI 0.76-0.99), and those who increased PA levels significantly reduced colon cancer risk by about 11% (0.89, 95% CI 0.78 - 1.03). However, those who decreased PA levels had a significantly higher risk of colon cancer (1.13, 95% CI 1.03-1.23).

CONCLUSIONS: Our results suggest that consistent participation in PA and increasing PA from low levels in the life course may be most protective of colon cancer risk. Promotion of PA throughout life for all ages and abilities is critical to minimize colon cancer risk, develop effective interventions, and disseminate prevention messages.

1247 Board #373 May 27 2:30 PM - 4:00 PM

Effect Of Exercise Intervention On Insulin, Igfs And Igf1 In Cancer Patients

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PURPOSE: Increased level of insulin and insulin like growth factor (IGF) have not only been associated with increased risk of different cancers but also with poor prognosis after cancer diagnosis. Aerobic exercise training lowers the levels of insulin and IGF in healthy people. Research looking at the effects of different exercise interventions on insulin, IGF and Insulin Growth Factor Binding Protein (IGFBP) is newly emerging. The purpose of this study is to systematically review the effects of exercise on insulin, IGF and IGFBPs in cancer patients.

METHODS: An electronic literature search was conducted using PubMed database up to July 2019, with search terms: cancer, exercise, insulin-like growth factor, IGF, and IGFBP. Eligible studies included peer-reviewed, randomized clinical trials (RCTs) that utilized either exercise or physical activity as their intervention for cancer survivors. All study design, participant characteristics, intervention, IGF related outcomes, and key findings were evaluated systematically and summarized.

RESULTS: Eight articles were deemed eligible for the systematic review. Cancer types included breast cancer, colorectal cancer, prostate cancer, non-small cell lung cancer, and endometrial cancer. Mean age of the sample population included in our study was 60.3± 6.9 years (n, intervention group= 184; n, control group= 160). Mode of exercise consisted of either aerobic, strength training, combination of aerobic and strength training, endurance exercise, or Tai chi. All but one study showed that exercise resulted in significant reduction or no change in circulating levels of IGF-1 and IGF-2. Results were inconsistent with exercise on IGFBP-3 levels. **CONCLUSIONS:** The literature is inconsistent of the impact of exercise to lower IGF levels and that could be because of the different duration and type of exercise intervention in different studies. Because of the inconsistency, meta-analysis could not be performed. Large randomized control trials with different exercise interventions are required in this area to reach a firm conclusion. A greater understanding of the impact of exercise and dosing of exercise can empower physical therapists to play a greater role in cancer survivorship programming.

B-85 Free Communication/Poster - Preclinical Exercise Oncology

Wednesday, May 27, 2020, 1:30 PM - 4:00 PM
Room: CC-Exhibit Hall

1248 Board #374 May 27 2:30 PM - 4:00 PM

Resistance Training Attenuates Cancer Cachexia-induced Cardiac Remodeling

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Cancer-induced cachexia is a state of ill health characterized by cardiac and skeletal muscle atrophy that has profound impacts on cardiovascular function and quality of life. Resistance training (RT) during treatment has been shown to improve cardiac function via cardiac hypertrophy. **PURPOSE:** To assess the capacity for RT to minimize cachexia-induced cardiac remodeling. **METHODS:** All procedures were done in accordance with an IACUC approved protocol. Male-Wistar rats (n=48) were

randomly assigned to a sedentary (SED), RT, SED+cancer, and RT+cancer group. Animals assigned to RT groups trained for a total of 13 wk using an elevated food model to simulate low intensity RT. SED animals were placed in standard animal housing for an equivalent amount of time. At week 10, animals were injected with Walker-256-mammarycarcinoma cells (10⁶ cells) or an equivalent amount of 0.9% saline. Left ventricular morphology was measured using echocardiography prior to injection and at the end of the 13 wk experiment. Differences in cardiac morphology (i.e. thickness and diameter) between groups were analyzed using a one-way ANOVA (p < 0.05). **RESULTS:** There was a significant (p < 0.05) difference in posterior wall thickness during systole of SED animals (0.30±0.04 cm) compared to of RT (0.34±0.05 cm). Posterior wall thickness during diastole was significantly (p < 0.05) increased in RT+cancer (0.21±0.03 cm) animals compared to SED+cancer (0.18±0.04 cm). SED+cancer animals had a significantly larger left ventricular diameter (LV) (0.72±0.04 cm) than SED controls (0.67±0.06 cm). The combination of RT+cancer significantly attenuated the increase in LV diameter (0.67±0.034 cm). **CONCLUSIONS:** The results suggest that the posterior wall is susceptible to cachexia induced remodeling. however, RT attenuated the degree of cardiac remodeling.

1249 Board #375 May 27 2:30 PM - 4:00 PM

Effects Of Exercise Training On Cachexia In Mice Bearing The Colon-26 Carcinoma

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Colorectal cancer (CRC) is the third most prevalent cancer in the U.S. and risk is increased by lifestyle factors such as poor diet and physical inactivity. Also, CRC patients are highly susceptible to developing cachexia, which is characterized by muscle wasting, fatigue, weakness, and immune function impairments, that lead to increased morbidity and mortality. Studies have shown that aerobic and resistance training, independently, can effectively attenuate the deleterious effects of cachexia, and though research on concurrent training is limited, studies are reporting that combined exercise positively affects muscle wasting. **PURPOSE:** The purpose of this study was to examine the effects of exercise training on markers of cachexia to determine if aerobic training (TM), resistance training (RT), or combined training (TM+RT) would be most effective. **METHODS:** Male Balb/c mice were randomly assigned to SED (n = 24) or EX (n = 36) groups. EX mice were further allocated to either TM (n = 12), RT (n = 12), or TM+RT (n = 12). After 5 weeks of EX, 12 SED and all EX mice were inoculated with C26 cells; EX continued for 3 additional weeks before mice were sacrificed. Cachexia was assessed via histochemical/biochemical analyses and forelimb grip strength. **RESULTS:** Cachexia was induced in Sed+Tumor, evidenced by significant changes in body mass (P < 0.05; -14%), gastrocnemius mass (P < 0.01; -16%), gastrocnemius cross sectional area (CSA) (P < 0.05; -35%), forelimb grip strength (P < 0.01; -18%), splenomegaly (P < 0.01; +83%), and plasma IL-6 (P < 0.01; +211%). Moreover, MHCIIa and IIb atrophied similarly in Sed+Tumor mice. All exercise groups had significant improvements in all examined markers of cachexia when compared to Sed+Tumor, with the exception of gastrocnemius mass (P > 0.05). Additionally, RT significantly improved relative grip strength versus all other groups (P < 0.05). Overall myofiber CSA increased significantly with all EX modes (P < 0.05). Finally, systemic inflammation was significantly decreased in all EX groups, as evident by decreases in spleen mass and plasma IL-6 (P < 0.01). **CONCLUSIONS:** These data support past literature in that exercise provides significant benefit to cachectic mice, and this may be due, in part, to decreased systemic inflammation. Specifically, RT, alone and with TM, provided the most benefit.

1250 Board #376 May 27 2:30 PM - 4:00 PM

The Effect Of Creatine And Creatinine Supplementation On Doxorubicin Treatment Of Walker 256 Mammary Carcinoma Cells In Vitro

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Doxorubicin (DOX) is a powerful chemotherapeutic agent with potent cytotoxic effects that result in increased rates of cell death and reduced viability. Recent evidence has shown that creatine (Cr) may minimize DOX-induced cytotoxicity to non-cancerous tissues; however, few studies have investigated the effect of Cr on tumor proliferation with or without DOX. **Purpose:** To determine if supplementation with Cr or creatinine (CrN) alters cell viability in a tumor model when combined with DOX over a 48 hr time period. **Methods:** Walker 256 mammary carcinoma cells were cultured in growth medium (90% DMEM 10% FBS) until they reached 90-95% confluency. Cells were seeded on to a 96-well plate at a density of 10,000 cells/ml with fresh growth media and incubated for 24 hr. Cells were then exposed to growth media containing either 10 µM of DOX, 10 mM of Cr, 10 mM CrN, 10 µM DOX + 10 mM Cr, 10 µM DOX + 10 mM CrN, or regular growth media as a control for an additional 48 hr. Cell viability

was assessed at 0, 12, and 48 hr using an EarlyTox™ Cell Integrity Kit and analyzed via a Nikon live cell confocal imaging system. **Results:** At 12 hr post-treatment, DOX and DOX+Cr had significantly lower cellular viability compared to baseline ($P < 0.05$). At 48 hr, Cr, CrN, and DOX+CrN had significantly lower cellular viability compared to baseline ($P < 0.05$). No significant differences in viability were found in the control group. **Conclusion:** The addition of Cr or CrN did not affect the cytotoxic effects of DOX.

1251 Board #377 May 27 2:30 PM - 4:00 PM
Cd8+ T-cell Depletion Abolishes The Anti-metastatic Effects Of Voluntary Running In A Mouse Model Of Breast Cancer

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PURPOSE: Regular physical exercise provides a significant risk reduction for breast cancer and recent studies suggest beneficial effects also on disease specific recurrence and mortality. However, little is known about how exercise exerts its protective effects. The primary aim of this study to evaluate the effect of voluntary running on tumor progression and metastasis in the PyMT mouse model of breast cancer.

METHODS: From 4 weeks of age, female MMTV-PyMT mice on the FVB background were housed with access either to wirelessly recording running wheels or locked control wheels. Tumor growth was monitored continuously, tumor stage and pulmonary metastases were determined histologically at the 12 week endpoint. In a follow up study, pre-trained female FVB mice were injected intravenously with 2×10^5 PyMT derived tumor cells (IC3) and after an additional 10 weeks of voluntary running, pulmonary metastases and immune cell infiltration was quantified (histologically and with flow cytometry). The CD8+ T-cell population was deleted using weekly administration of CD8 specific antibodies.

RESULTS: PyMT mice average running distance was 6.4 ± 2.4 km/day. No significant effects of voluntary running on tumor-initiation, volume or stage were found.

However, a reduced number of metastases were observed in mice with access to running wheels (Ctrl 22.0 ± 6.8 and Runners 9.1 ± 1.7). Significant reductions in pulmonary metastasis frequency were also found in runners after intravenous injections of tumor cells (Ctrl 5.2 ± 1.1 and Runners 1.9 ± 0.7) and running mice had a lower number of metastases with a high proliferation score. Metastatic lesions from running mice showed higher content of Granzyme B positive cells (Ctrl 1.2 ± 0.5 and Runners 4.9 ± 1.1), indicating an increased infiltration of cytotoxic T-cells. Depletion of CD8+ cells abolished the reduction in metastatic burden found in running mice compared to non-running mice. All data is presented as Mean \pm SEM.

CONCLUSIONS: In this highly aggressive, genetic, breast cancer model, an average of 6 km/day of voluntary running showed little effect on tumor formation and growth. However, the findings suggest that physical activity reduced outgrowth of metastatic lesions through an increased infiltration of cytotoxic immune cells.

1252 Board #378 May 27 2:30 PM - 4:00 PM
Exercise Reduces Tumor Growth And Burden In A Mouse Model Of Non-small Cell Lung Cancer

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(No relevant relationships reported)

Introduction: Exercise has been shown to reduce the prevalence of certain cancers. Moderate-intensity exercise has been shown to have significant effects on tumor initiating mechanisms in mice resulting in decreased tumor incidence for a variety of cancers including pancreatic, gastrointestinal, and mammary. This is the first report of the role that exercise plays in the suppression of spontaneous murine lung cancer.

Methods: CCSPCre/LSL-KrasG12D mice were generated by crossing a mouse with the LSL-K-rasG12D mutant allele with a mouse harboring Cre recombinase inserted in the Clara cell secretory protein (CCSP) locus. Tumor-bearing progeny were assigned to either exercise (EX) or sedentary control groups. At tumor onset (4wks of age), 10wks of moderate exercise training was conducted for the EX group on a motor-driven treadmill (13.5m/min) for 45min/day, 5days/wk. Tumor burden was assessed by two variables: (1) visual count of lung surface tumor numbers; and (2) internal tumor volume established from H&E stains. Homogenized spleen samples were analyzed via ELISA for IL-6 and TNF- α protein levels. **Results:** For sedentary mice (N=14) lung tumor count was 40.57 ± 3.483 tumors (mean \pm SEM). Lung tumor count in the exercised mice (N=10) was significantly reduced to 21.80 ± 1.705 tumors ($p < 0.001$). Sedentary mice (N=6) tumor percentage of lung volume was $12.34 \pm 0.528\%$. Percent lung tumor volume in exercised mice (N = 8) was significantly reduced to $6.913 \pm 0.262\%$ resulting in a 44% reduction of tumors within lung tissue. IL-6 and TNF-alpha spleen data did not show any significant changes due to exercise in relation to lung cancer. **Conclusions:** These results demonstrate that moderate exercise can slow the

progression of tumorigenesis in a mouse model of lung cancer. However, the exercise mechanism of action remains unclear; while we did see a trend toward decreased levels of IL-6, no significant changes were seen in systemic pro-inflammatory cytokines IL-6 and TNF-alpha. Lung cancer is the leading cause of cancer mortality worldwide with current treatments resulting in an average 17% five year survival rate. Moderate exercise may be a practical method for patients to help suppress tumor progression.

1253 Board #379 May 27 2:30 PM - 4:00 PM
Impaired Protein Synthesis And Elevated Methylarginines May Contribute To Cancer-associated Cachexia

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(No relevant relationships reported)

Cachexia, an illness-associated syndrome characterized by muscle wasting that cannot be reversed with nutritional support, is a significant contributor to cancer-associated morbidity and mortality. The mechanisms driving the loss of muscle mass are not well defined, and predictive or early diagnostic biomarkers have not been identified.

PURPOSE: To determine factors that may contribute to cancer-associated losses in muscle mass and to identify potential biomarkers indicative or predictive of the severity of muscle wasting. **METHODS:** Lewis lung carcinoma (LLC1) cells or vehicle (CON) were injected subcutaneously into the left flank of seven week-old C57BL/6 male and female mice. After 21 days, skeletal muscle mass and function were assessed. Mitochondrial energetics were assessed in permeabilized muscle fibers using high-resolution respirometry, and fractional protein synthesis rates following the administration of $^{13}C_6$ -phenylalanine were measured by mass spectrometry. To explore potential mechanisms and biomarkers of cachexia, untargeted metabolomics was performed using plasma and skeletal muscle from LLC1 and CON mice. **RESULTS:** Tumor-bearing mice showed evidence of cachexia, with 6.8% lower body mass ($p < 0.001$), 10.0% lower quadriceps mass ($p = 0.010$), 9.7% lower gastrocnemius mass ($p = 0.001$), and 9.6% lower grip strength ($p = 0.004$) at day 21. Mixed muscle protein synthesis was impaired in LLC1 mice (-18.6%, $p = 0.0279$). Synthesis of both the sarcoplasmic and myofibrillar proteins was lower in LLC1 mice (-34.4%, $p < 0.0001$ and -24.5%, $p = 0.0039$, respectively). Mitochondrial protein synthesis was not significantly affected, and no differences in mitochondrial energetics were observed between LLC1 and CON mice. Untargeted metabolomics revealed significant increases in asymmetric dimethylarginine (ADMA) and N-monomethyl L-arginine (L-NMMA) in both the skeletal muscle and plasma of LLC1 mice. **CONCLUSION:** The synthesis of contractile and sarcoplasmic proteins was inhibited in cachectic, tumor-bearing mice. Elevations in ADMA and L-NMMA, endogenous nitric oxide synthase inhibitors formed during proteolysis, may both serve as biomarkers of cachexia and play a mechanistic role in the loss of muscle mass.

Project supported by the Andersen Corporate Foundation and T32AR056950.

1254 Board #380 May 27 2:30 PM - 4:00 PM
Use Of Creatine And Creatinine To Improve Cell Viability In Doxorubicin-treated Cardiac Myoblasts, Skeletal Muscle Myoblasts, And Aortic Myoblasts

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 Doxorubicin (DOX) is a powerful chemotherapy agent that is associated with a number of deleterious side effects, including cardiac, smooth, and skeletal muscle loss. Although the mechanisms behind the observed myotoxicity are not fully understood, the bulk of muscle loss is attributed to the generation of reactive oxygen species (ROS) and interference with DNA replication. Conversely, creatine (Cr) supplementation has been shown to have a therapeutic role in several disease states characterized by high ROS generation and metabolic dysfunction, which are common with DOX treatment.

PURPOSE: To investigate the effects of Cr and creatinine (CrN) treatment on cell viability in DOX-treated myoblasts. **METHODS:** Skeletal muscle cells (RKSMC), H9C2 cardiac myoblasts, and A10 aortic smooth muscle myoblasts were cultured in growth medium (10% FBS and 90% DMEM) until they reached 90-95% confluency. Cells were then collected and seeded on a 96-well plate at a density of 10,000 cells/ml containing fresh skeletal muscle growth media and allowed to recover for 24 hours. Cells were then exposed to fresh growth media containing either 25 μ M of DOX, 10 mM of Cr, 10 mM CrN, 25 μ M DOX + 10 mM Cr, or 25 μ M DOX + 10 mM CrN for an additional 24 hours. Rates of apoptosis were assessed using a cell viability kit (Molecular Devices) and analyzed via a Nikon live cell confocal imaging system. **RESULTS:** DOX treatment resulted in significantly lower viability regardless

of cell type ($P < 0.05$). On average, viability was $46.3 \pm 7.1\%$ for DOX treated cells. The addition Cr or CrN with DOX significantly increased viability to $78.4 \pm 8.1\%$ and $79.9 \pm 14.6\%$, respectively ($P < 0.05$). **CONCLUSION:** Initial evidence from this investigation provides direct evidence to support the use of Cr and CrN to improve cell viability with DOX treatment.