Graduate Student Oral Presentations

SESSION #1: FRIDAY 2:30 – 3:20

***SYSTEMIC CARDIOVASCULAR AND BAROREFLEX SUPPORT OF BLOOD PRESSURE DURING RECOVERY FROM PASSIVE HEAT STRESS***

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Heat stress may promote a distinct recovery period marked by sustained reductions in blood pressure. The mechanisms supporting blood pressure regulation in the post-heating recovery period are unknown. PURPOSE: To evaluate the systemic cardiovascular and carotid baroreflex support of blood pressure during recovery from whole-body, passive heat stress. METHODS: Mean body temperature, blood pressure, cardiac output (open circuit acetylene wash in), and heart rate were assessed in six healthy participants (4 F, 25±4 yrs) at baseline (PRE), at the end of 60 min of passive heating (HT), and for 120 min of normothermic recovery (REC). The neck pressure technique was used (*n* = 4, 2 F) to assess carotid baroreflex control of heart rate, mean arterial pressure, and brachial vascular conductance (Doppler ultrasound). Repeated measures one-way ANOVAs were used to compare PRE to HT and REC responses. Values are reported as mean ± SD. RESULTS: Heating increased mean body temperature (PRE: 36.6±0.3 HT: 37.6±0.3°C, *p* < 0.01), cardiac output (PRE: 4.9±1.9 HT: 6.2±1.5 L∙min⁻¹, *p* = 0.02), systemic vascular conductance (PRE: 57±19 HT: 77±16 mL∙min⁻¹∙mmHg ⁻¹, *p* < 0.01) , and heart rate (PRE: 70±8 HT: 101±14 bpm, *p* < 0.01) and reduced mean arterial pressure (PRE: 85±6 HT: 80±8 mmHg, *p* = 0.01). Cardiovagal (Δ heart rate PRE: +9±4 HT: +5±2 bpm, *p* = 0.14) and integrated (Δ mean arterial pressure PRE: +7±6 HT: +6±2 mmHg, *p* = 0.95) responses to neck pressure were maintained and the brachial vascular response was attenuated during HT (%Δ brachial vascular conductance PRE: -23±13 HT: -12±3%, *p* = 0.04). After 60 min REC, mean body temperature remained elevated (36.9±0.3°C, *p* < 0.01) and mean arterial pressure was depressed (80±11 mmHg, *p* = 0.02), while cardiac output (4.8±1.5 L/min), systemic vascular conductance (60±15 mL∙min⁻¹∙mmHg⁻¹) and heart rate (73±9 bpm) did not differ from PRE (all *p* > 0.05). Cardiovagal (Δ heart rate +8±6, *p* = 0.88), integrated (Δ mean arterial pressure +7±4, *p* = 0.91), and vascular responses (%Δ brachial vascular conductance -28±13%, *p* = 0.29) to neck pressure did not differ from PRE after 60 min REC. By 120 min REC, all variables did not differ from PRE (all *p* > 0.05). CONCLUSIONS: Baroreflex control may be reset to lower pressures during the post-heating recovery period with no change in reflex sensitivity.

NIH R01HL144126, NIH F31HL158087

***EMPAGLIFLOZIN HAS DIRECT EFFECTS ON SKELETAL MUSCLE THAT IMPROVE INSULIN ACTION***

**E.M. McGowan**, P.M. Batterson, M.C. Murphy, M.M. Robinson, S.A. Newsom

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Sodium-glucose cotransporter-2 inhibitors (SGLT2i) are a frontline treatment for type 2 diabetes with a primary action to increase urinary glucose excretion. Mounting evidence indicates SGLT2i also improve skeletal muscle insulin action, yet the mechanism is unresolved. PURPOSE: The objective of this study was to identify how SGLT2i treatment (empagliflozin) can improve insulin action in skeletal muscle, which does not express SGLT2 protein. METHODS: To investigate the effect of SGLT2i on skeletal muscle insulin action *in vivo,* male C57BL/6J mice were provided western diet (WD) or low-fat diet (LFD) for 8 weeks, then randomized to empagliflozin (EMPA) treatment (10mg/kg diet) or no treatment for 4 weeks (n=10/group). We tested insulin action via portal vein insulin infusion prior to tissue harvest and determined muscle glucose uptake using tritiated 2-deoxyglucose. Subsequent experiments were conducted in C2C12 skeletal muscle cells to test direct effects of EMPA on skeletal muscle and further determine mechanisms of action. RESULTS: As expected, glucose tolerance was impaired with WD compared with LFD, and EMPA improved glucose tolerance in both diet conditions (main effect of drug *P*<0.05). Portal vein insulin infusion identified that EMPA improved insulin-stimulated glucose uptake in skeletal muscle (main effect of drug *P*<0.05). EMPA treatment increased skeletal muscle insulin signaling via pAktThr308 and pAktSer473 in both WD and LFD mice (main effect of drug *P*<0.05). There was a tendency for increased pAMPKThr172 in EMPA-treated mice, aligning with previous evidence of impaired mitochondrial respiration and energetic stress as a potential off-target effect of SGTL2i. EMPA treatment of 5-500μM in C2C12 cells had a dose-dependent inhibition of complex I respiration in mitochondria (measured via high-resolution respirometry). Furthermore, EMPA treatment resulted in dose-dependent phosphorylation of AMPKThr172 compared with vehicle (DMSO). CONCLUSION: Our evidence indicates EMPA treatment improved skeletal muscle glucose uptake and enhanced insulin signaling. Our findings also support that SGLT2i have direct actions on skeletal muscle, including inhibition of mitochondrial complex I and activation of AMPK, which may enhance insulin signaling and improve glucose metabolism.

Supported by Medical Research Foundation New Investigator Award F1176A awarded to SAN

***NO EFFECT OF NITRIC OXIDE ON PULMONARY PRESSURE REGULATION DURING RECREATIONAL SCUBA DIVE***

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Some SCUBA diving time and depth profiles have been shown to increase pulmonary artery systolic pressure (PASP) post-dive. SCUBA diving while breathing compressed air results in a hyperoxic fraction of inspired oxygen and SCUBA divers are not hypoxic following a dive, so hypoxic pulmonary vasoconstriction is not responsible for the observed increase in PASP. In addition, no studies to date have examined whether the increased PASP is due to vasoconstriction or increased cardiac output (Q) following the dive. PURPOSE: The purpose of this study was to examine whether nitric oxide availability post-dive is associated with the increased pulmonary pressure following SCUBA diving. METHODS: 26 subjects completed the study (6 female). Subjects completed two dives (18meters of sea water, 47 minute bottom time) on back-to-back days. Subjects were given sildenafil or placebo in a randomized and balanced crossover design upon resurfacing from their dive. Cardiac ultrasound for measurements of PASP and Q were done before diving and 1 hour after drug ingestion upon resurfacing. Total pulmonary resistance (TPR) was calculated as PASP/Q. RESULTS: PASP (p=0.0186) and TPR (p=0.0156), but not Q (p=0.779), increased on day 1 in the sildenafil group only. Irrespective of drug treatment, PASP was significantly higher by 2.58 mmHg at pre-dive on day 2 compared to pre-dive day 1 (p = 0.031). CONCLUSIONS: The increase in pulmonary pressure with SCUBA is likely independent of nitric oxide bioavailability. In addition, pulmonary pressure may remain mildly elevated for up to 24 hours after a SCUBA dive at 18m for 47 minutes.

Supported by PADI Foundation Diving Physiology Grant, Fulbright Scholars Program, University of Oregon College of Arts & Sciences International Research Travel Grant, and Global Oregon Faculty Research Travel program

***COMPARISON OF ACUTE CARDIOVASCULAR AND THERMOREGULATORY RESPONSES TO DIFFERENT PASSIVE HEATING MODALITIES***

**J.K. Atencio**, E.L. Reed, E.A. Larson, B.M. Gibson, L.N. Comrada, K. Wiedenfeld Needham, J.R. Halliwill, FACSM, C.T. Minson, FACSM

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The repeated use of passive heating has gained popularity as a therapeutic approach toward promoting health and wellness. Passive heating elicits a rise of core body temperature and cardiovascular demands that can result in physiological adaptations beneficial to health. Hot water immersion, traditional sauna, and far-infrared sauna are three common modalities of passive heating; however, current literature lacks a direct comparison between these modalities. PURPOSE: The purpose of this study is to characterize and compare the acute thermoregulatory and hemodynamic responses to a single bout of hot water immersion (HWI), traditional sauna (TRAD), and far-infrared sauna (FIR). METHODS: In a randomized cross-over study design, six healthy adults (1F; age 24±3 years; body mass index 22.8±11.6 kg/m2) completed three sessions of acute passive heating: HWI (45 min at 40°C), TRAD (3x10 min at 80°C, separated by 5 min of thermoneutral rest), and FIR (45 min at 45-65°C) on separate days. Measurements of systolic and diastolic arterial pressure and core temperature (Tc) were collected at baseline and at 5-min intervals throughout passive heating. Cardiac output (Qc) was measured before and at the end of heating using the open-circuit acetylene wash-in method. One-way ANOVAs were performed to compare the changes in Tc, Qc, and calculated mean arterial pressure (MAP) from baseline to end of heating. Data are presented as mean or percent change from baseline with 95% confidence intervals. RESULTS: The change in Tc from baseline to end of heating was greater in HWI [+1.3°C (0.8, 1.7)] vs TRAD [+0.1°C (-0.1, 0.4), P=0.0002] and HWI vs FIR [+0.1°C (-0.4,0.5), P <0.0001]. Cardiac output increased in HWI [+78.2% (65.8, 90.5)] vs TRAD [+50% (39.5, 60.6), P=0.0069)] and HWI vs FIR [+30.1% (12.3, 48.0), P<0.0001). MAP decreased in HWI [-13 mmHg (-29, 2)], whereas MAP increased in TRAD [+7 mmHg (1, 12), P=0.0204)] and FIR [+3 mmHg (-8, 14), P= 0.0675]. There were no differences in TRAD vs FIR for Tc (P=0.9841), Qc (P=0.0598), or MAP (P=0.9133). CONCLUSION: Preliminary data suggest that HWI elicits the greatest thermoregulatory challenge and cardiovascular strain compared to both TRAD and FIR. This implies that HWI may elicit the greatest physiological adaptations with repeated exposure.

Supported by AHA (19TPA34890033) and NIH (R01HL144128)

***RELATIONSHIPS BETWEEN CENTER OF MASS HEIGHT AND CUTTING ANGLE DURING PLANNED AND REACTIVE SIDE-STEP CUTTING***

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In many sports, quickly changing direction is crucial. While lower center of mass (COM) height is associated with faster changes of direction in planned cutting, its relationship to cutting angle during planned and reactive cuts may also be important for performance. PURPOSE: To determine the relationship between COM height during the penultimate and final steps and cutting angle during planned and reactive side-step cuts. METHODS: Thirty-six females (Age: 20.9 ± 1.7 years, Height: 1.66 ± 0.07 m, Mass: 62.4 ± 8.7 kg) completed 5 planned and 5 reactive (i.e., in response to a light stimulus) 90° side-step cuts off their dominant limb. COM height and cutting angle were assessed using an optical motion capture system interfaced with two force plates. COM height for each step was defined as the vertical position of the COM at initial contact (IC) and normalized to body height. Cutting angle was quantified through the X and Y displacements of the sacrum between IC and toe-off of the final step. IC and toe-off were defined as the instant the vertical ground reaction force exceeded and went below 10 N, respectively. The relationships between average COM height and cutting angle of the 5 trials were assessed using Pearson correlations (α = 0.05). RESULTS: The mean cutting angles in planned and reactive conditions were 62.7 ± 6.7° and 52.0 ± 11.9°, respectively. Lower COM height during the final step was associated with a sharper cutting angle in both conditions. No relationship between COM height and cutting angle was identified during the penultimate step (Table 1). CONCLUSION: Lowering the COM during the final step, but not the penultimate step is associated with sharper cuts. Teaching athletes to lower their COM during the final step of cuts may enhance their performance.

Supported by the National Athletic Trainers’ Association Research and Education Foundation

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| Table 1: Means, standard deviations (Std. dev.), and correlation coefficients of COM height during the penultimate and final steps and cutting angle during planned and reactive side-step cuts. | | | | |
|  |  | COM Height x body height-1 Mean ± std. dev. | Pearson Correlation | p-value |
| Planned | Penultimate Step | 0.52 ± 0.03 | -0.12 | 0.51 |
| Final Step | 0.47 ± 0.03 | -0.39 | 0.02\* |
|  |  | | | |
| Reactive | Penultimate Step | 0.54 ± 0.02 | 0.20 | 0.27 |
| Final Step | 0.48 ± 0.02 | -0.44 | 0.01\* |

\*Significant correlation (α = 0.05)

SESSION #2: FRIDAY 3:30 – 4:20

***SEDENTARY BEHAVIOR AND SCREEN TIME ARE ASSOCIATED WITH HUMAN GUT MICROBIOME DIVERSITY***

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Human gut microbiome richness and diversity are associated with physical activity and impaired glycemic control; however, the associations with sedentary behavior and screen time are not as well established. PURPOSE: To evaluate associations of sedentary behavior and screen time with alpha diversity of the human gut microbiome in adults with and without impaired glycemic control. METHODS: Domain specific sedentary behavior and physical activity data and device specific screen time data were collected via survey from 47 adults (mean ± SD: 51 ± 16 years; 38% with impaired glycemic control) who were free from gastrointestinal related illness. Hemoglobin A1c, glucose and lipid levels were collected via finger stick blood draw. Alpha diversity of the gut microbiome was determined by DNA sequencing of a 16S-ITS-23S rRNA marker for fecal samples and expressed as observed operational taxonomic units (OTUs), Shannon Index, and Fisher’s Alpha. Linear regression analyses, controlling for moderate-to-vigorous physical activity (MVPA), body mass index (BMI), blood glucose, high-density lipoprotein cholesterol (HDL), and triglycerides were used to assess associations between sedentary behavior, screen time and alpha diversity. RESULTS: Sedentary behavior (476 ± 163 min/d) was negatively associated with the number of observed OTUs (169 ± 31 OTUs, β = -0.426, p < 0.01) and Fisher’s Alpha (27.6 ± 5.3, β = -0.404, p < 0.01). These associations were slightly attenuated but remained significant (β = -0.335 and β = -0.314, p < 0.05) when controlling for MVPA (6030 ± 5965 METmin/wk), BMI (29.6 ± 7.2 kg/m2), glucose (108 ± 37 mg/dL), HDL (59 ± 19 mg/dL), and triglycerides (144 ± 96 mg/dL). Screen time (428 ± 186 min/d) was negatively associated with the number of observed OTUs (β = -0.343, p < 0.05), Shannon Index (3.2 ± 0.5, β = -0.328, p < 0.05), and Fisher’s Alpha (β = -0.301 p < 0.05); however, only the association with observed OTUs (β = -0.359, p < 0.05) was independent of all covariates. CONCLUSION: Our findings suggest that higher levels of sedentary behavior and screen time are associated with lower alpha diversity of the gut microbiome. This may be a potential mechanism linking sedentary behavior to increased risk of type 2 diabetes and cardiovascular disease.

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***TIME IN THE UNITED STATES CALCULATED BY THE SEDENTARY SPHERE METHOD: NHANES 2011-2014***

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The 2011-2012 and 2013-2014 cycles of the National Health and Nutrition Examination Survey (NHANES) implemented a wrist-worn accelerometer protocol to objectively assess physical activity among Americans. Unfortunately, there remains few validated approaches for translating wrist-worn accelerometer data into meaningful estimates of physical behavior which has limited opportunities to describe Americans’ physical activity and sedentary behavior using 2011-2014 NHANES accelerometer data. One previously validated method for assessing sedentary time (ST) via wrist-worn accelerometry is known as the Sedentary Sphere (SS) method. The SS method has yet to be used to describe ST in US adults. PURPOSE: To describe ST in US adults (age ≥ 18 y) using the SS method. METHODS: US adults (N = 9,298) who completed a wrist-worn accelerometer protocol during the 2011-2014 NHANES were included in analyses. ST was quantified using the SS method whereby participant posture is estimated from derived arm elevation and movement intensity. Wear-time adjusted means and standard errors of average daily ST were calculated and compared using survey regression procedures across groupings of sex (male vs. female), age (18-29y, 30-44y, 45-59y, 60+y), and quartiles of total physical activity (< 10,425.7, 10,425.7 – 12,874.6, 12,874.7 – 15,563.5, > 15,563.5 MIMS/day). Survey procedures were used for all analyses to account for the complex, multi-stage design of NHANES. RESULTS: Mean daily ST among American adults was 489 ± 1.5 min/day. ST was higher among males than females (510 ± 1.6 vs. 470 ± 1.8 min/day, *p* < 0.001). ST was positively associated with age. Those Americans 60+y had the highest ST while those 18-29y had the lowest values (511 ± 2.3 vs. 459 ± 2.1 min/day, *p* < 0.001). ST was inversely associated with total physical activity. ST in the most active grouping (> 15,563.5 MIMS/day: 422 ± 2.3 min/day) was dramatically lower than ST in the least active grouping (< 10,425.7 MIMS/day: 556 ± 3.3 min/day, *p* < 0.001). CONCLUSION: ST calculated by the SS method significantly varied across groupings of sex, age, and total physical activity among American adults. Future research should focus on examining associations between ST calculated by the SS method and health outcomes of interest.

***PASSIVE HEAT THERAPY COMPARED TO AEROBIC EXERCISE IN REDUCING ALBUMINURIA IN ADULTS WITH UNTREATED HYPERTENSION***

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Albuminuria is an independent risk factor for chronic kidney disease, cardiovascular disease, and all-cause mortality and is prevalent in 40% of adults with untreated hypertension, while urinary creatinine excretion above and below normal levels is associated with impaired renal function. Physical activity is recommended for improving cardiovascular and chronic kidney disease risk profiles but has poor adherence. Recent evidence suggests heat therapy may be a viable alternative to exercise for reducing urine albumin excretion. PURPOSE: To test the hypothesis that chronic hot water immersion (HWI) reduces urine albumin excretion in adults with untreated hypertension to a greater extent than aerobic exercise training (EX). METHODS: Participants (*n*=23, 6F; 47±7 years) were randomized and completed either 30 sessions of HWI (*n*=10, 2F) or EX (*n*=13, 4F) over 10 weeks. For HWI, participants were immersed to mid sternum in 40°C water for 45 min with a 5-min recovery. EX consisted of upright cycling at 60% of heart rate reserve (HRR) for 40 min, with a 5-min warm-up and cool-down at 30% HRR. Gold standard 24-hour urine collection protocol was completed before (PRE) and after completion of all 30 sessions (POST). Urine albumin excretion was quantified via ELISA, and urine creatinine excretion was quantified via colorimetric assay. Data were analyzed PRE vs. POST for EX and HWI using a two-way repeated measures ANOVA and are presented as mean ± SD.  RESULTS: There was no effect of time (*p*=0.67), group (*p=*0.61), or group x time interaction (*p=*0.16) for 24h urine albumin excretion PRE vs. POST for EX (10.6 ± 6.6 vs. 18.4 ± 25.6 mg/24h) or HWI (25.6 ± 49.9 vs. 10.3 ± 7.3 mg/24h). For 24h urine creatinine excretion, there was a significant interaction effect (*p=*0.034). EX was reduced at POST (1612 ± 485 vs 1443 ± 391 mg/24h, *p=*0.05), while HWI was not different (1518 ± 493 vs 1620 ± 465 mg/24h; *p=*0.25). CONCLUSION: Among adults with untreated hypertension, aerobic exercise training has a greater impact on reducing 24h urinary creatinine excretion than hot water immersion, with both PRE and POST within normal ranges. Neither intervention impacted urinary albumin excretion, suggesting these interventions may not reduce urine albumin excretion in adults with untreated hypertension

NIH R01HL144128; NIH F32HL164021

***HIGH-FAT DIET INCREASES ETF SYNTHESIS AND LIPID RESPIRATION IN MUSCLE DURING TRAINING IN FEMALE MICE***

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Aerobic training reverses the detrimental accumulation of muscle lipids during high-fat diet (HFD)-induced obesity through unclear mechanisms. The electron transferring flavoproteins (ETF) transfer reducing equivalents from beta-oxidation into the electron transfer system. A potential mechanism for benefits on lipid metabolism is that exercise may stimulate the synthesis of ETF proteins to increase lipid respiration. Female mice have a tendency for greater mitochondrial abundance and lipid respiration that may underlie resilience to HFD versus males. PURPOSE: Our purpose was to determine ETF synthesis and respiratory function to exercise and HFD in females. We hypothesized that exercise during HFD would increase ETF synthesis and abundance versus HFD or exercise alone. METHODS: Female C57BL/6J mice (n=15 per group) consumed HFD or low-fat diet (LFD) for 4 weeks then remained sedentary (SED) or completed 8 weeks of treadmill training (EX). Mice consumed D2O in drinking water during the final 14 days then we measured deuterium enrichment in targeted peptides to calculate the synthesis rates of ETF subunits. We determined lipid-supported respiration in isolated mitochondria and measured RNA and protein abundance for ETFA, ETFB and ETF dehydrogenase (ETFDH). RESULTS: HFD had a main effect for greater synthesis rates for ETFA and ETFDH (+71% and +75%, P<0.01 versus LFD) while EX had a main effect for greater synthesis of ETFB and ETFDH (+56 and +55%, P<0.01 vs SED). HFD had a main effect, without modification by exercise, for higher lipid respiration (+39%, P=0.018 vs LFD) when expressed in absolute units, but not after normalizing to mitochondrial protein abundance. There were no detectable changes to ETF protein abundance via targeted proteomics. There were small main effects of HFD for higher RNA abundance for ETFA (+5%, P=0.026), ETFB (+6%, P<0.01), and ETFDH (5%, P<0.01). CONCLUSION: Exercise did not modify the effect of HFD to increase lipid respiration in female mice. The greater synthesis of ETF during HFD indicates intrinsic remodeling of mitochondria to high-dietary fat availability. The exercise-induced benefits on lipid metabolism appears to be a net result of several oxidation proteins in addition to ETF.

Funding by OHSU Medical Research Foundation and Nathan Shock Pilot Grant (NIH P30 AG050911).

***NORMAL WEIGHT OBESITY PREVALENCE AND DIETARY INTAKE AMONG MALE AND FEMALE ADOLESCENTS IN IDAHO***

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Normal weight obesity (NWO) represents individuals with normal body mass index (BMI) and excess adiposity. Previous literature has established associations between NWO and poor cardiometabolic health, however, literature examining NWO among adolescents is limited. PURPOSE: To determine the prevalence of NWO among adolescents in Idaho and compare nutritional behaviors between those characterized as normal weight lean (NWL), NWO, and obese (OB). METHODS: Participants (n=140) aged 14-19 years were recruited from high schools in Idaho. After completing an informed consent and parental assent, high school visits were scheduled. Height and weight, body composition (BIA), and dietary recall were assessed. Participants were grouped (NWL, NWO, OB) using BMI (World Health Organization BMI adolescent percentiles) and body fat (BF; %). A one-way ANOVA was used to assess differences in diet among NWL, NWO, and OB groups. Significant findings were further analyzed with Tukey’s post hoc test. RESULTS: Of the adolescents sampled, 11% were characterized as NWO. Females (n=70) had a significantly higher NWO prevalence rate (21%) compared to males (n=70; 0.01%). NWO had a significantly lower (22.8 ± 1.75) BMI compared to OB (32.5 ± 4.49; p<.001) and a significantly higher BMI than NWL (20.5 ± 2.20; p=.028). NWO also had a significantly higher percent body fat (30.6 ± 2.94) compared to NWL (15.4 ± 6.56; p<.001) and a significantly lower percent body fat compared to NWO (40.8 ± 7.70; p<.001). No significant dietary intake differences existed among male NWL, NWO and OB groups. Female OB calorie intake (kcal/kg) was significantly lower (13.1 ± 8.2) compared to NWL (30.2 ± 16.5; p=.006) but not NWO (28.7 ± 22.0; p=.053). The female OB group consumed significantly lower carbohydrate (g/kg) compared to both NWL (3.5 ± 2; p=.004) and NWO (3.3 ± 1.9; p=.038). No other significant dietary intake differences existed among groups. CONCLUSION: These findings suggest that NWO may be more prevalent among female adolescents, and that dietary intake differ most between NWL and OB and NWO and OB groups. Since NWO and NWL dietary intake values for calorie, carbohydrate, protein, and fat were similar, diet may not be a strong contributor to the development in NWO in adolescents.

Supported by the Mountain West Clinical Translational Research Infrastructure Network

Undergraduate Thematic Poster Sessions

SESSION #1: SATURDAY 1:30 – 2:20

***ASSOCIATION OF PATENT FORAMEN OVALE WITH METABOLIC HEAT PRODUCTION AND CORE TEMPERATURE RELATIONSHIP IN MEN***

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A patent foramen ovale (PFO) is an intracardiac shunt between the right and left atria that allows blood to flow directly from the right atrium to the left atrium. Previous studies have shown that men with a PFO (PFO+) had a higher core temperature (Tc) of ~0.3-0.4 °C during passive heating (hot tub immersion), passive cooling (cold tub immersion), and active heating (exercise) than men who do not have a PFO (PFO-). PURPOSE: The purpose of this study was to analyze the relationship between metabolic heat production (Hprod) and Tc in men with and without a PFO at rest, exercise, and passive heating and cooling. METHODS: During passive heating and cooling, PFO+ (n=13) and PFO- (n=14) men were immersed in hot (40.5 ± 0.2°C) and cold (19.5 ± 0.9°C) tubs, respectively. During active heating, PFO+ (n=15) and PFO- (n=15) men completed 2 exercise trials on a cycle ergometer in a thermoneutral environment (20.6 ± 1.0°C, humidity: 13 ± 4%): 1) a VO2max test and 2) a graded exercise protocol where subjects cycled at 4 workloads (25%, 50%, 75%, 90% of VO2max) for 2.5 min each. During all 3 conditions, Tc was measured via esophageal probe and metabolic data were measured with a metabolic cart. RESULTS: During passive heating and cooling there was a curvilinear relationship between Hprod and Tc. During passive heating, the rate of change between Hprod and Tc was higher after reaching the ventilatory threshold than before for both PFO+ men and PFO- men. During passive cooling, the relationship between Hprod and Tcore was positive until subjects reached their maximum Tc, and then exhibited a negative relationship. During active heating, there was a strong positive correlation between Hprod and Tc during stages 25% Max to 90% Max, indicating that the increase in Hprod due to increased exercise intensity contributed to the increase in the Tc in both groups (PFO-: R2 = 0.98, PFO+: R2 = 0.99). There were no differences in Hprod between PFO+ and PFO- subjects at any time point and there were no differences between PFO+ and PFO- for any of the relationships measured (P>0.05). CONCLUSION: Despite having a significantly higher Tc, PFO+ men had the same Hprod as PFO- men at each time point during all 3 conditions. Our results suggest that Hprod is not a mechanism contributing to the higher Tc in PFO+ men vs PFO- men seen during short duration exercise and passive heating and cooling.

This study was funded by American Physiological Society’s Giles F. Filley Memorial Award for Excellence in Respiratory Physiology and Medicine, the Eugene and Clarissa Evonuk Memorial Graduate Fellowship, the National Institute of Health (R25HD0708), the Defense Medical Research and Development Program (W81XWH-10-2-0114), and the University of Oregon Summer Program for Undergraduate Research.

***PROLONGED MILD HYPOHYDRATION ABOLISHES INCREASES IN CREATININE CLEARANCE DURING ORAL PROTEIN LOADING***

**S.C. Brazelton**, C.L. Chapman, S.M. Holt, K. Wiedenfeld Needham, C.T. O’Connell, H.N. Medved, W.A.B. Howells, E.L. Reed, J.R. Halliwill, FACSM, C.T. Minson, FACSM

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Oral protein loading increases glomerular filtration rate (GFR) via nephron recruitment and/or glomerular hyperfiltration. This response reflects renal functional reserve where filtration capacity is increased to maintain GFR at basal levels or increase GFR when stressed. Passive heating induced mild hypohydration (3% reduction in body mass) attenuates oral protein induced increases in creatinine clearance (CCr). It is not known whether mild hypohydration, independent of heat stress, also attenuates increases in CCr during oral protein loading. PURPOSE: To test the hypothesis that increases in CCr following oral protein loading are attenuated during prolonged mild hypohydration compared to euhydration. METHODS: In a block-randomized crossover design, twenty healthy adults [(9 females (F) and 11 males (M); age: 21 (3) years] completed 24 hours of fluid deprivation (HYPO) and 24 hours of normal fluid consumption (EUHY). The protocols were separated by ≥72 hours. After the 24-hour protocols, participants underwent oral protein loading by ingesting a whey protein shake (1.0 g protein and 10 ml water per kg body mass) within 10 minutes. Body fluid loss was estimated via the percent change in body mass (∆BM) over the 24-hour protocol. Blood and urine samples were collected at baseline and 150-min post-protein consumption (POST) to calculate CCr. Data are presented as mean with 95% confidence intervals. RESULTS: ∆BM was reduced in HYPO vs. EUHY [-2.6% (-3.0, -2.2) vs. 0.1% (-0.3, 0.4), P<0.0001]. Baseline CCr was elevated in HYPO vs. EUHY [261 ml/min (218, 303) vs. 143 ml/min (118, 168), P<0.0001]. There were no differences in CCr between conditions at POST [HYPO: 246 ml/min (212, 280); EUHY: 231 ml/min (196, 265), P=0.2691]. At POST, CCr was elevated from baseline in EUHY (P<0.0001) but not HYPO (P=0.2941). CONCLUSION: These findings suggest that CCr is not altered with oral protein loading during prolonged mild hypohydration. Whether our findings suggest that a ceiling effect was reached in the HYPO condition (i.e., maximum CCr was already achieved at baseline) or are influenced by increased tubular creatinine secretion during hypohydration requires further investigation.

Supported by NIH R01HL144128 and F32HL164021.

***DIAGNOSTIC ACCURACY OF URINE COLOR IN PREDICTING ACUTE KIDNEY INJURY RISK SCORE DURING PROLONGED HYPOHYDRATION***

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Hypohydration increases hospitalizations for acute kidney injury (AKI) during extreme heat events. A barrier to accurate self-monitoring of hydration status includes the impracticality of invasive methods. The 8-point urine color scale is a non-invasive assessment with potential use as a low-cost screening tool for elevated AKI risk during prolonged hypohydration. The AKI risk score (AKIrisk) has a U.S. Food and Drug Administration approved indication to screen for the risk of developing moderate-to-severe AKI. AKIrisk is calculated from the product of urinary insulin-like growth factor binding protein 7 and tissue inhibitor of metalloproteinase-2 ([IGFBP7∙TIMP-2]). PURPOSE: To determine the diagnostic accuracy of the 8-point urine color scale in assessing AKIrisk in healthy young males and females during prolonged mild hypohydration. METHODS: In a block-randomized crossover design, twenty-two healthy adults [11 females, 11 males; 21(3) years] completed 24 hours of fluid deprivation to induce hypohydration or 24 hours normal fluid consumption to remain euhydrated. Protocols were separated by ≥72 hours. Spot morning urine samples were collected immediately following each 24-hour protocol. Urine color was assessed using a validated 8-point visual scale by three independent investigators. AKIrisk was determined by urinary [IGFBP7∙TIMP-2] >0.3 (ng∙ml-1)2∙1000-1 via enzyme-linked immunosorbent assay. Contingency analyses were performed to calculate positive and negative predictive values for urine color ≥3, ≥4, and ≥5 a.u. in predicting AKIrisk. Data are presented as mean with 95% confidence intervals. RESULTS: Fisher’s exact test revealed an association between AKIrisk >0.3 (ng∙ml-1)2∙1000-1 and urine color ≥3 (P<0.0001), but no association with urine color ≥4 or ≥5 a.u. (P≥0.1327). The positive predictive value and negative predictive value for urine color ≥3 a.u. in predicting AKIrisk >0.3 (ng∙ml-1)2∙1000-1 were 0.91 (0.72, 0.98) and 0.73 (0.52, 0.87). CONCLUSION: These data indicate that values of three or greater on the 8-point urine color scale have excellent positive predictive value for AKIrisk and lend preliminary support for the utility of the color scale as a rudimentary screening tool during prolonged mild hypohydration.

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***EFFECTS OF L-CITRULLINE SUPPLEMENTATION ON LOCALIZED BLOOD FLOW AND POST-EXERCISE MUSCLE REOXYGENATION RATE***

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L-citrulline is an amino acid that is a common ingredient in many pre-workout supplements and is marketed as a vasodilator. Prior studies have shown L-citrulline promotes vasodilation in various clinical populations and older adults, but limited data exists on L-citrulline's efficacy in young, healthy adults. PURPOSE: To determine L-citrulline's effect on blood flow and muscle reoxygenation rate before, during, and after exercise in healthy, college-aged individuals. METHODS: Participants (n=12; 6 male and 6 female) supplemented with L-citrulline for 7 days (6g/day) and visited the lab twice (pre- and post-supplementation); the same experimental protocol was repeated for both visits. Brachial artery diameter and blood flow velocity were measured via ultrasound before, during, and after the completion of a handgrip exercise. Blood flow rate was calculated as area\*velocity. Subjects completed 15 forearm contractions at 1Hz with a resistance set to 15% of their maximum grip strength (MGS). Following recovery, subjects were instructed to complete as many reps as possible (AMRAP), also at 15% MGS. Muscle reoxygenation rate (%SmO2/second) was measured in forearm flexors via NIRS for 30 seconds immediately following the AMRAP. Paired t-tests were used to compare reoxygenation rate and the number of repetitions completed during AMRAP, while repeated measure ANOVA was used to compare blood flow rates using SPSS. RESULTS: Post-AMRAP muscle reoxygenation rate increased from 0.272 ± 0.251 %/sec to 0.602 ± 0.613 %/sec (p<0.05) following supplementation. There was no difference in recovery blood flow rate (16.3 ± 7.3 vs. 16.1 ± 8.2 mL/s, p=0.66), or in the in the number of repetitions completed during the AMRAP test (126.8 ± 60.2 vs. 161.5 ± 99.5 repetitions, p=0.07). There was no difference in mean arterial pressure (99.2 ±15.6 vs. 94.1± 15.7 mmHg, p=0.26) or blood flow rate before or during exercise. CONCLUSION: L-citrulline did not promote vasodilation or increase blood flow in our subjects. With no change in recovery blood flow rate, increased muscle reoxygenation rate may suggest that L-citrulline could improve muscle oxygen uptake via increased oxygen extraction rather than delivery. An increase in post-exercise reoxygenation rate may lead to increased endurance and shorter rest times needed between bouts of exercise.

***ELEVATED LUNG DIFFUSING CAPACITY (DLCO) DURING EXERCISE IN THE HEAT***

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Exercise elevates heart rate (HR) and oxygen consumption (VO2). Additionally, heat exposure causes shunting of blood toward the skin to allow for proper thermoregulation. PURPOSE: The purpose of this study was to further understand the effects of exercise in the heat on the cardiopulmonary system, using lung diffusing capacity for carbon monoxide (DLCO) as the primary measure. METHODS: Nine (4F/5M, 20-45 years) moderately active and healthy adults participated in 3 visits. Visit 1 involved demographics, health screening, and a VO2 max test on a cycle ergometer to determine maximum workload (Wmax). Visits 2 and 3 involved exercise testing in the environmental chamber in thermoneutral (TN; 22.2 ± 0.6°C and 35.3 ± 4.8% RH) or heat (HT; 39.4 ± 0.4°C and 37.6 ± 2.6% RH) conditions. Exercise testing for visits 2 and 3 began with a 30-minute resting exposure in the chamber at testing conditions. This was followed by three 15-min stages of exercise at rest, 20%, and 40% of Wmax on a cycle ergometer. Measurement­­­­s collected at each stage included DLCO, minute ventilation (VE), VO2, HR, and core (Tc) and skin temperature (Ts). Ratings of perceived exertion (RPE; 6-20) and breathlessness (DYSP; 0-10) were collected twice per stage. Statistical analysis was completed using a 2-way repeated measures ANOVA test. RESULTS: DLCO was significantly higher in HT vs TN at 40% of Wmax (53.2 ± 10.6 vs 50.0 ± 10.3 mL/min/mmHg, P=0.003). VO2 showed no differences in HT vs TN. HR was overall higher in HT vs TN (P=0.012). VE values at 0, 20, 40% of Wmax were not significantly different in HT vs TN. VO2 values at 0, 20, 40% of Wmax showed no significant differences in HT vs TN. CONCLUSION: We found a significant interaction between exercise intensity and temperature as DLCO values were higher in HT vs TN at 40% Wmax only. While HR was higher in HT vs TN, VE and VO2 were not different, suggesting heat exposure increased gas exchange surface area in the lungs, as measured by DLCO, at the same work rate. We hypothesize that this is due to increased pulmonary capillary distension and recruitment, likely related to elevated HR and higher cardiac output (Q).

***ASSOCIATION OF PATENT FOREMEN OVALE AND RESPIRATORY HEAT LOSS AT REST AND DURING EXERCISE IN MEN***

**E.M. Castillo1**,K.E. Bradbury1-3, A. W. Betts1, N. Charkoudian2, A.T. Lovering1

1University of Oregon, Eugene, OR; 2United States Army Research Institute of Environmental Medicine, Natick, MA; 3ARCS program, Oregon Chapter

During exercise in the heat, approximately 14 - 20% of heat loss occurs via respiration, termed respiratory heat loss (RHL). RHL involves components of both evaporative (Eres) and convective (Cres) heat loss from the upper respiratory tract. Previous research has shown that men with a patent foramen ovale (PFO) have higher core temperatures (Tc) at rest and during exercise. It is unknown whether differences in RHL contribute to the differences seen in Tc between PFO+ and PFO- men. PURPOSE: The purpose of the study was to test whether there are differences in RHL (Eres, Cres, and total RHL (Tres)) between PFO+ and PFO- men at rest and during 60 min of exercise at a workload eliciting a heat production (Hprod) of 7 W/kg. METHODS: Twenty one healthy males (11 PFO+, 10 PFO-, 18-36 y/o). Visit 1 included an ultrasound screening to test for the presence or absence of a PFO. Visit 2 involved a graded exercise protocol to determine the workload that would elicit a heat production of 7 W/kg, followed by a VO2peak test. During the graded exercise protocol, subjects cycled at 4 different workloads for 5 min each. For visit 3, subjects completed 60 min of cycling exercise at a previously determined workload eliciting a Hprod of 7 W/kg in a thermoneutral laboratory environment (22°C, 39% rh). Minute ventilation (VE) and inspired and expired temperature and humidity were measured. RHL was calculated at baseline (BL) and during min 0-10, 25-30, and 55-60 of exercise. Tc was measured using a telemetric pill ingested ~10 hr prior to testing. RESULTS: There were no differences in RHL (Cres, Eres, or total RHL) between PFO+ and PFO- men at rest or during exercise (p>0.05). Using a two-way ANOVA (Tres RHL X Exercise), there was a main effect of exercise on RHL (p<0.01), with RHL being greater at all 3 time points compared to rest and at min 55-60 vs min 0-10 (p < 0.01). Tc was significantly higher in PFO- vs PFO+ men at rest and during exercise (PFO- 37.13 ± 0.18 °C, PFO+ 36.89 ± 0.19 °C at rest vs. PFO- 37.62 +/- 0.16°C, PFO+ 37.44 ± 0.16°C during exercise; p < 0.05). CONCLUSION: While RHL increased from rest to exercise due to increases in VE and metabolic heat production, RHL is not likely the mechanism to explain the differences in Tc seen between PFO+ and PFO- men. Why the PFO- subjects had a higher core temperature in this study remains unknown.

SESSION #2: SATURDAY 2:30 – 3:20

***TORSO AND PELVIS BIOMECHANICS ASSOCIATED WITH PITCH VELOCITY IN BASEBALL***

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Higher pitch velocities (PV) in baseball often coincide with a greater risk of elbow and shoulder injuries due to the link of elbow varus torque (EVT) and shoulder internal rotation torque (SIRT) with injury. Exploring alternative parameters that impact PV may help limit these injuries. While peak torso and pelvis rotational velocities (RV) have been previously associated with PV, these parameters do not account for the mass of the athlete. It is possible that segment rotational kinetic energies (RKE), which do include mass, may have a stronger association with PV. PURPOSE: To determine if peak torso and pelvis RKE are associated with PV and how peak torso and pelvis RKE compare to other traditional variables associated with PV. METHODS: Male baseball pitchers at the youth, high school, college, or professional level (n = 7824) were fitted with reflective markers and performed a pitching assessment at maximal effort. PV was measured with a radar gun, while motion capture cameras tracked the reflective marker positions. Torso, pelvis, shoulder, and elbow biomechanical parameters were subsequently calculated and the strength of their association with PV was assessed using statistical software. RESULTS: There were strong significant associations between EVT and PV (R2 = 0.75, p < 0.001), SIRT and PV (R2 = 0.75, p < 0.001), and peak torso RKE and PV (R2 = 0.65, p < 0.001). There was also a significant association between peak pelvis RKE and PV (R2 = 0.29, p < 0.001). Peak torso and pelvis RV had little to no association with PV (R2 = 0.13, p < 0.001 and R2 = 0.00, p < 0.001, respectively). CONCLUSION: PV was most strongly associated with EVT and SIRT, likely because high velocity throws place enormous stress on the upper extremity. PV was more strongly associated with peak segment RKE than with peak segment RV, likely because RKE values account for the mass of the athlete while RV values do not. PV was more strongly associated with torso parameters than with pelvis parameters, likely because the torso accounts for a large proportion of the athlete’s total body mass. Given the findings of this study, future research is warranted to investigate whether athletes can be trained to increase PV via increases in peak torso and pelvis RKE rather than other traditional variables previously linked with injury.Supported by McCormick Student Research Grant. Davenport

***BICYCLING POWER OUTPUT DIFFERENCES FOR INDIVIDUALS UTILIZING DIFFERENT HAND GRIPS***

**C. C. Davenport**, Lopez, S, Walker, M.E., Del Pozzi, A.T., Katica, C.P.

Pacific Lutheran University, Tacoma, WA

Depending on the level of amputation there are differing types of classifications within paralympic cycling. However, there is no research assessing upper limb amputations’ impact on lower body cycling power output. PURPOSE: To investigate the impact of hand grip on power output for cycling with simulated ﻿amputated and non-amputated arms. METHODS: 10 participants were recruited for this research study [7 males (22 yrs±2 yrs; 75.88 kg±10.23 kg) and 3 females (20 yrs±0.5 yrs; 67.0 kg±8.48 kg)]. Participants reported to complete four (4) experimental trials. One familiarization trial and three experimental trials. Following familiarization, the remaining three trials were counterbalanced and included a simulated limb amputation (AMP), residual-limb trial (RESID) trial, and a complete limb (COMP) trial. Heart rate monitors were used to assess rest, warm-up, and maximum HR. Each participant completed a 5-min warmup on the cycle preceding each Wingate Anaerobic Test (WANT). Following the warm-up, each individual performed a 30s WANT utilizing different hand grips, with the resistance equating to 7.5% of the participant’s body mass. Following the 30s WANT, each participant was asked to assess their rating of perceived exertion (RPE) to provide a subjective measure of exertion during each WANT. Everyone then underwent a 5-min cooldown on the cycle ergometer. Each experimental trial was scheduled with at least 48 hours of rest between trials to ensure recovery.﻿﻿ RESULTS: No significant differences were found between trials (P = 0.988); however, statistical analyses found moderate to large effect sizes between the three different grips (P = 0.14) CONCLUSION: Overall, we did not see a difference between power output and the three different hand grips; however, there may be practical significance, due to the large effect size found in the analysis.

***ACUTE CENTRAL HEMODYNAMIC RESPONSES TO THREE DIFFERENT HEATING MODALITIES***

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Hot water immersion, traditional sauna, and far infrared sauna are commonly utilized modalities of passive heating that provide a multitude of health benefits. The cardiovascular demand imparted by passive heating may lead to beneficial cardiovascular adaptations with repeated use. Passive heating is known to elicit increases in cardiac output via increased heart rate, but the change in stroke volume remains poorly understood. Furthermore, it is unknown how the acute central hemodynamic responses compare between these heating modalities. PURPOSE: The purpose of this study is to characterize and compare the acute changes in cardiac output (Qc) heart rate (HR), and stroke volume (SV) between a single bout of hot water immersion (HWI), traditional sauna (TRAD), and far infrared sauna (FIR). METHODS: In a randomized, cross-over study design, six healthy adults (1F; age 24±3 years; body mass index: 22.8±11.6 kg/m2) completed three sessions of acute passive heating: HWI (45 min at 40°C), TRAD (3x10 min at 80°C, separated by 5 min of thermoneutral rest), and FIR (45 min at 45°C to 65°C) on separate days. HR was measured at baseline and every 5 minutes via chest strap (Polar). At baseline and end of heating, Qc was measured using an open-circuit acetylene uptake method. SV was calculated as Qc/HR. One-way ANOVAs were performed to compare the hemodynamic responses between heating modalities from baseline to end of heating. Data are presented as mean and percent change with 95% confidence intervals. RESULTS: Qc increased more in HWI [+78.2% L (65.8, 90.5)] than TRAD [+50% (39.5, 60.6), P=0.0069)] and FIR [+30.1% (12.3, 48.0), P<0.0001). The increase in HR was greater in HWI [+43 bpm (39, 48)] than TRAD [+23 bpm (12, 33), P=0.0036] and FIR [+24 bpm (13, 35), P=0.0057]. There were no differences in SV between all conditions [HWI: +6 mL (-1, 6); TRAD: +11 mL (2, 19); FIR -1 mL (-13, 11); P=0.0976]. There were no differences in TRAD vs FIR for Qc (P=0.0598) and HR (P=0.9944). CONCLUSION: Preliminary data indicate that HWI elicits the most marked changes in acute central hemodynamic responses compared to other modalities, likely driven by the hydrostatic effect of water immersion supporting venous return in combination with greater heat loading.

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***COMPARING PEAK ANTERIOR-POSTERIOR GROUND REACTION FORCES BETWEEN RECREATIONAL RUNNERS IN MAXIMAL AND TRADITIONAL SHOES***

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Peak posterior ground reaction force (PPGRF) during running results from rapid deceleration or “braking” and is a biomechanical variable associated with injury. Peak anterior ground reaction force (PAGRF) represents the forward propulsion force during running. Previous research has suggested that maximal shoes can increase vertical ground reaction force metrics related to injury, but there is little research on how maximal shoes affect anterior-posterior ground reaction forces, and whether this may depend on an individual’s shoe preference. PURPOSE: To compare PPGRFs and PAGRFs between maximal and traditional shoes in both runners that prefer traditional shoes and runners that prefer maximal shoes. METHODS: 30 participants were recruited (18 traditional-preferred and 12 maximal-preferred shoe runners) for a single testing session. Three-dimensional lower extremity biomechanics were captured during running using a 10-camera motion capture system and three force plates in two shoe conditions: maximal shoes (rearfoot: 37mm, forefoot: 33mm) and traditional shoes (rearfoot: 32mm, forefoot: 22mm). Variables of interest included peak posterior and peak anterior ground reaction forces. For both variables, a mixed-effects ANOVA compared data between shoes and between shoe preference groups (α = .05). RESULTS: No interaction effect or main effect of preference were noted for either variable. For the main effect of shoe, PAGRF values were lower in maximal shoes (.296 .062 BWs) compared to traditional shoes (.319 .062 BWs, p < .001). PPGRF values were trending but not significantly different between maximal shoes (-.416 ± .101 BWs) and traditional shoes (-.403 .101 BWs, p = .055). CONCLUSION: Our findings suggest that participants who preferred maximal running shoes exhibited lower PAGRF values which could conclude that the thicker, “rocker-shaped” midsole of the maximal shoe requires less propulsion force. PPGRF values in the maximal shoe were trending but not significantly lower, which may increase risk of injury related to deceleration. Further research is needed to confirm these conclusions.

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***THE INFLUENCE OF EXECUTIVE FUNCTION ON MOVEMENT FUNCTION IN PEOPLE WITH PARKINSON’S DISEASE AND UNIMPAIRED ADULTS***

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People with Parkinson’s disease (PD) often experience impaired motor (i.e. balance) function that limits community engagement. Commonly, assessment of motor function includes only forward movement, despite difficulty changing directions and lateral stability. Additionally, non-motor impairment including executive function (i.e. memory, concentration) is associated with PD. Impaired executive function is exacerbated when completing dynamic balance tasks such as walking in people with PD. Improved understanding of the association between motor and non-motor function is important for maintaining quality of life for people with PD. PURPOSE: To determine the influence of executive function on movement function during a novel movement task in people with PD and unimpaired adults. METHODS: Unimpaired young adults (YA), unimpaired older adults (OA) and people with PD completed non-motor tests including the Montreal Cognitive Assessment (MoCA) and Trail Making test. Participants also completed a novel walking task (Walking Trail Making Test, WTMT) that included 12 floor targets arranged to replicate the Trail Making Test. Participants started at target 1 then navigated to target 2, tapping on each target with their foot to activate the next target. MoCA score and time to complete TMT were recorded as well as time to complete the WTMT and average velocity between targets. Data analysis was conducted using one-way ANOVA to identify differences between groups with an alpha value p< 0.05. Correlational analysis was conducted to determine associations between motor and non-motor tasks. RESULTS: Time to complete the WTMT differed between groups (YA:34.8 ± 5.73sec, PD:43.2 ± 11.1sec, OA:48.5 ± 9.93sec; p=0.024). A negative association between MoCA score and time to complete the WTMT (*r* =-0.63, p=0.001) was found for all participants. Differences in average velocity between pods were found between YA and older adults (PD and OA). CONCLUSIONS: Individuals with lower MoCA score required more time to complete the WTMT. Differences in walking velocity between groups suggest older adults (PD and OA) required more time to identify and process target location in addition to walking to targets. Future research should investigate the use of the WTMT to maintain or enhance executive function in people with PD.

Supported by McKinstry Fellows Research Program.

Graduate Student Posters:

President’s Cup Only Presentations

(Some participating in the President’s Cup are also in the Graduate Student Oral Presentations above)

***SPIRIT SQUAD PROFILING: AN EVALUATION USING UPDATED METHODS FOR SPATIAL AWARENESS, FORCE VELOCITY, AND BODY CONTROL***

**T.Espinosa**, G. Reyes

Linfield University, McMinnville, OR

Current data on athleticism characteristics are unique and limited for spirit squad teams (SS), which consists of cheer and dance, such as their neuromuscular and cognitive abilities. PURPOSE: To create profiles and benchmarks of neuromuscular aspects (reactive hopping & kinesthetic body awareness) and cognitive aspects (spatial awareness, peripheral vision, and dynamic vision) of athleticism for SS athletes. METHODS: Active participants on NCAA Division III cheer (n=13) and dance teams (n=18) were profiled and compared to athletes of a non-SS population, like tennis (n=16). Neuromuscular profiles were collected via maximal 1-leg vertical jumps where jump height (JH), power (P) and body control (BC) were recorded. Cognitive abilities such as spatial awareness (SA), spatial memory (SM), peripheral vision (PV), perception scan (PS), multiple object tracking (MOT), and dynamic vision (DV) were assessed and collected on a cognitive sensory station, which consisted of a large touchscreen and tablet. RESULTS: No statistically significant differences were observed between the dance team and cheer team in almost all neuromuscular and cognitive metrics, except for SA and SM (*p* < 0.05) where dancers scored better than cheerleaders. Significant neuromuscular differences were also reported when comparing SS to tennis, with tennis players displaying more JH and P (*p* < 0.05), but SS displaying better BC (*p* < 0.005). No significant cognitive differences were reported between tennis and SS, except for PS where tennis scored better (*p* < 0.05). CONCLUSION: A few cognitive differences in athleticism profiling between SS and non-SS existed, specifically spatial awareness and perception span. In addition, non-SS players exhibited higher neuromuscular qualities, yet SS members displayed better body control during movement. The results can explain how specific training stimuli produces different neuromuscular and cognitive profiles. Future research should aim to expand cognitive and neuromuscular profiles and benchmarks for SS for use in developing functional training programs to improve reactive strength and kinesthetic body awareness, especially in areas of perception span and jump height and power, to help minimize injury and improve competitive performance in these athletes.

***EXAMINATION OF DIFFERENT FOOTWORK ON REACTIVE AGILITY: A SPLIT STEP INCREASES REACTIVE AGILITY IN A SPORT SIMULATED SITUATION***

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In most sports, reactive agility is crucial, as athletes must cognitively respond to a stimulus, then organize a movement pattern to move the body quickly to a specific location. Critical components of reactive agility in athletics are response time and recognizing how to react to certain stimuli. PURPOSE: To investigate which footwork technique is optimal for reactive agility time (RA). Secondly, to determine if there is a correlation between countermovement jump height (CMJ) and (RA). METHODS: Sixteen current competitive NCAA Division III tennis players (5 females, 11 males) were recruited as participants. One testing session for each participant recorded RA time across two conditions: starting the run with a split-step (SS), where a small jump preceded movement, or a no-split-step (NSS) where no small prep step was allowed prior to movement. The order of each condition was randomized for each participant. Finally, each subject performed maximal countermovement jumps on a force plate to collect jumping metrics to use in correlations to RA performance. RESULTS: Analysis of variance revealed a significant difference in reaction time, with the SS being quicker than the NSS (p < 0.0001). Meanwhile, the NSS resulted in significantly faster movement time compared to the SS (p < 0.001). A significant predictive relationship was displayed between RA and CMJ height (r2 = 0.47, p < 0.01). No significant differences were seen in total time between the SS and NSS. CONCLUSION: There was no significant difference in total movement time between the SS and NSS. Although reaction time was lower with the SS, movement time was lower with the NSS, making total time equal and indifferent. The footwork used when reacting to a stimulus should be based on preference and body anthropometrics. In addition, an athlete’s CMJ height could be a predictive quality for RA time, so when profiling, the qualities needed for a high CMJ could parallel what is needed for RA, so training protocols could be properly administered to improve both.

***THE EFFECT OF EXERCISE WITH OR WITHOUT PALM COOLING ON NAPPING BEHAVIOR IN ENDURANCE ATHLETES***

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Current data suggests that athletes may not obtain adequate sleep while maintaining rigorous training and competition schedules. Daytime napping is a potential strategy to increase total daily sleep time. However, prior exercise and associated increases in core temperature may interfere with napping opportunities. The impact that prior exercise with or without palm cooling has on a daytime napping opportunity has not been investigated. PURPOSE: To determine the impact of prior exercise with or without palm cooling on polysomnography measured variables during a post exercise napping opportunity. METHODS: Twenty male endurance trained athletes were recruited for this randomized cross over study. Participants were involved in a larger protocol examining palm cooling during intermittent and continuous exercise. One-hour daytime napping opportunities followed the continuous exercise bouts (30 min at lactate threshold) with or without cooling and were compared to a control no exercise condition. Polysomnography was used to determine sleep onset, total sleep and slow wave sleep time. Napping opportunities occurred in an environmentally controlled sleep laboratory. Values were reported as mean difference from control [95% CI] while significance was set at p < 0.05. RESULTS: Palm cooling significantly lowered core temperature during exercise but similar core temperatures were observed prior to the napping opportunity. All polysomnography measurements were not different between exercise with and without cooling prior to a nap. When both exercise conditions were compared to the control condition, core temperature and sleep onset were not different, while total sleep (palm cool: 10.7 min [1.1 - 20.3]; no cool: 12.9 min [3.2 - 22.5]) and slow wave sleep time (palm cool: 10.8 min [1.2 - 19.5]; no cool: 14.8 min [4 - 21.3]) were significantly longer. CONCLUSIONS: Exercise with or without palm cooling prior to a one-hour daytime napping opportunity did not impact sleep onset in endurance trained athletes but resulted in increases in total sleep and slow wave sleep time compared to the control napping opportunity. Sleep behaviors were not different between the non-cooling and cooling conditions. These results suggest that prior exercise improves napping behaviors in endurance athletes.

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***ACUTE FATIGUE PARADOXICALLY INCREASES VELOCITY AND POWER IN A SEX AND MYOSIN ISOFORM DEPENDENT MANNER***

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Muscle fatigue is the acute reduction in contractile function following repeated or prolonged muscle activation, primarily driven by the accumulation of intracellular metabolites. However fatigue persists after recovery of metabolic homeostasis. Because muscle contractile function depends on the interrelated function of multiple intracellular proteins, fatigue-induced post-translational modification of these proteins might explain the temporal dissociation of fatigue from metabolic homeostasis. PURPOSE: Our study explored the potential for protein modification to acutely influence contractile function by measuring the effects of in vivo fatigue on single fiber contractile performance in vitro. METHODS: Seven elite athletes (3 male, 4 female) performed a single bout of unilateral fatiguing knee extensions to task failure. Immediately after, bilateral percutaneous needle muscle biopsy was performed on the vastus lateralis muscle to provide a fatigued and control sample. Tissue divided at time of biopsy for phosphoproteomic analysis (western blot) and single fiber contractile mechanics. Myosin heavy chain (MHC) isoform was determined for fiber following mechanical assessment (SDS-PAGE). RESULTS: We found that fatigue did not affect isometric tension (143.35±31.57 mN/mm2; 146.0±28.6 mN/mm2; p=0.55). However, maximum shortening velocity was increased with fatigue (0.95±0.49 ML/s; 1.28±0.65 ML/s; p<.001) along with contractile power (7.75±4.16 W/L; 9.60±5.36 W/L; p<.001). Surprisingly, our results varied by sex and fiber type, such that velocity was increased primarily in MHC IIA/X fibers in males, whereas females demonstrated a blunted response to fatigue. While baseline variation in regulatory protein phosphorylation (Myosin Binding Protein C) was significantly correlated (R2=0.63, p=0.03) with contractile power in fast isoforms (MHC IIA, MHC IIA/X) we did not detect significant alterations in phosphorylation with fatigue (control: 1.4±1.0%; fatigue: 1.3±0.9%; p=748). CONCLUSION: Fatigue causes paradoxical increases in velocity and power that are particularly evident in males. While our measurement of MyBP-C phosphorylation did not detect effects of fatigue, other sarcomeric proteins may explain this response.

Study supported by the Wu Tsai Human Performance AllianceJames Scott

***IMPACT OF APPARENT TEMPERATURE AND AGE ON HYDRATION-RELATED ILLNESS DURING ULTRA-ENDURANCE TRIATHLON COMPETITION***

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Hydration-related illnesses (HRI) (Dehydration, Electrolyte Imbalance, and Hyponatremia) are prevalent in ultra-endurance triathlon competitions and may impact athlete safety and race completion. Minimal research currently exists on the impact of apparent temperature (AT) and athlete age on HRI illness. PURPOSE: To determine the incidence of HRI for age ranges (18-29, 30-49, ≥50) at various AT (31.7-37.1, 37.2-38.5, 38.6-45.7) over 20 years of Ironman World Championships competition in Kona, HI. The secondary purpose of this project was to investigate the relationships among age, AT, and race incompletion (DNF) for athletes suffering from HRI. METHODS: Of all athletes who participated in this competition (n=37,335) individuals diagnosed with HRI (n=2,600), were included in our secondary data analysis. Some athletes were excluded from study analyses due to missing age data (n=212). Data from medical records for these athletes were analyzed using two-way analysis of variance with statistical significance set at <0.05. RESULTS: In general, the 30-49 age category had a greater incidence of HRI (4.9%), compared to low and high age ranges (1.3% and 1.2%). Age was found to significantly predict incidence of HRI (p<0.01), while AT did not. Likewise, age was found to significantly predict DNF (p=0.03) while AT did not. HRI and DNF incidence did not significantly differ by AT range. Overall, DNF rate for athletes with HRI was 16.7%. CONCLUSION: Our findings indicate AT does not significantly influence HRI or DNF incidence at the Ironman World Championships competition. However, age appears to significantly impact the risk of both HRI and DNF. Future research in ultra-endurance triathlon competition should focus on possible predictors of HRI within specific age groups of various competition levels, and across varying environmental conditions.

***INFLAMMATORY CYTOKINES ASSOCIATED WITH BLUNTED HYPOXIC PULMONARY VASOCONSTRICTION IN APNEA DIVERS***

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PURPOSE: Our lab has previously reported blunted hypoxic pulmonary vasoconstriction in apnea divers (Kelly *et al*, Exp Physiol 2022). Why this occurs remains speculative but may relate to interactions between inflammatory cytokines and nitric oxide availability. We hypothesized that in apnea divers there would be a positive correlation between levels of inflammatory cytokines and degree of hypoxic pulmonary vasoconstriction. METHODS: 16 (4 women) apnea divers and 16 (4 women) non-diving age and sex-matched controls were recruited from diving camps in and around Split, Croatia and Eugene, Oregon. Serum was collected from each participant, then transthoracic ultrasound measures were made to calculate cardiac output (QT) and pulmonary artery systolic pressure (PASP). Total pulmonary resistance (TPR) was calculated as PASP/QT and converted to dynes/sec/cm-5. After baseline ultrasound measures, participants breathed on a dynamic end-tidal forcing machine targeting an end-tidal O2 ~50mmHg (corresponding to O2 saturation of ~80%) while clamping end-tidal CO2 at baseline value (~40mmHg). Ultrasound measures were repeated after 20 to 30-minutes of hypoxic breathing. ΔTPR was calculated as the change in TPR from baseline to the end of the hypoxic challenge. Serum was analyzed for cytokines using a flow cytometry bead-based multiplex assay. RESULTS: Data were analyzed by Pearson correlation. In apnea divers there were significant correlations between ΔTPR and levels of IL-8 (r = -.8151, r2 = .6644, p = .0481), IFN-a2 (r = -.8344, r2 = .6962, p = .0052), and IL-12p70 (r = -.9209, r2 = .8481, p = .0264). There were no significant correlations in Controls. CONCLUSION: We report strong negative correlations between ΔTPR in response to a 20 to 30-minute hypoxic challenge and several inflammatory cytokines. Our results suggest that apnea divers may have an altered inflammatory cytokine profile which is related to reduced hypoxic pulmonary vasoconstriction.

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***THE EFFECTS OF STRESS LEVEL ON PHYSICAL ACTIVITY AND MOTIVATION IN FIRST YEAR UNDERGRADUATE STUDENTS***

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First-year university students have an increased risk of elevated stress due to changes in their environment, routines, and responsibilities. While research provides evidence for the benefits of physical activity (PA) on stress, it is less clear how stress may affect PA behavior, motives, and support for PA. PURPOSE: This study examined differences in PA behavior, PA motives, and social support for PA based on first year university students’ stress levels. METHODS: First year university students (*N* = 441, 77.3% female 21.9% male) completed validated measures of their stress, PA behavior, PA motives, and social support for PA during the fall quarters from 2018-2021. Students were categorized into low, moderate, and high-stress groups based on their Perceived Stress Scale scores. A MANCOVA controlling for sex with Bonferroni correction was conducted for all variables. A Kruskal-Wallis test was used for items that violated homogeneity. RESULTS: A significant multivariate effect was observed for students’ perceived stress (WL = 0.87, F (12, 864) = 5.1, *p* < 0.001)such that students with low levels of stress reported significantly lower appearance/weight management (AWM) based PA motives (*M*=27.1, SD=6.9) as compared to their peers with high stress (*M*=30.9, SD=6.5). Moreover, students with moderate stress levels *(M*=28.4, SD=7.0) also reported significantly lower AWM motives than those with high stress. Kruskal-Wallis tests examined differences between stress groups and PA behavior revealing that students with low stress levels engaged in significantly more minutes of moderate-to-vigorous PA (*M* =379.2 SD=390.6) than students with moderate stress (*M* = 268.2 SD=279.3) and high stress (*M* =332.6 SD=473.9). No significant differences were observed across stress groups for social support or any other PA motives. CONCLUSION: These findings suggest that undergraduate students with higher stress levels engaged in less PA than those with lower stress which may support prior evidence suggesting that greater levels of PA are associated with lower levels of stress. Since AWM was the only PA motivator with significant differences between groups, it is also possible that the motivation to use exercise to manage one’s appearance may contribute to the elevated stress levels observed in first-year undergraduate students.

***COMPARISON OF FULL AND HALF IRONMAN DISTANCE TRIATHLON HEAT-RELATED ILLNESS***

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Elite athletes compete annually at the Ironman and half Ironman World Championships in Kona, Hawaii. An immense degree of metabolic stress during these events is induced in competitors due to their long durations, multisport nature, and rigorous environmental conditions. This presumably results in increased risk of heat-related illness (HRI) ranging from dehydration to heat stroke, causing more frequent medical tent visits. PURPOSE: To determine and compare incidence levels of HRIs for full Ironman and half Ironman championship competitors. METHODS: Medical records for athletes receiving treatment from 2013 to 2019 were examined, including complaints, illnesses, and treatments. For this study, HRIs included dehydration, hypotension, hyponatremia, hypokalemia, and heat stroke. Rates of athlete withdrawal from competition (DNF) as well as intravenous (IV) fluid administration were also investigated. Data were examined for 2,329 medical tent visits (*n*=333±45 per year) for the full Ironman and 425 visits (*n*=61±8 per year) for the half Ironman. RESULTS: The mean percentage of competitors reporting to the medical tent was greater for the full Ironman (15±2%) than the half Ironman (4±0.5%). However, the athlete DNF percentage was greater for the half Ironman (7±2%) than the full Ironman (5±1%). Differences were observed between the full Ironman and half Ironman for incidences of dehydration (30±4% vs. 13±6%), hypotension (12±2% vs. 9±5%), hyponatremia (5±1% vs. 1±1%), hypokalemia (6±3% vs. 0.5±0.8%), and IV administration (32±7% vs. 27±10%). All recorded cases of heat stroke were found in the full Ironman; however, serious heat illness was observed and likely common in competitors that did not report for treatment. CONCLUSION: These findings indicate that the full Ironman competition may carry a greater risk of HRI compared with the half Ironman. However, the remarkably greater DNF rate in the half Ironman may point to greater HRI severity. These findings may assist competition organizers and medical professionals in accommodating and providing treatment for medical tent visitors.

***ASSOCIATIONS BETWEEN COMMON PHYSICAL ACTIVITY ACCELEROMETER METRICS: NHANES 2011-2014***

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Researchers have a variety of metrics to choose from when summarizing raw data obtained during accelerometer-based physical activity assessments. Common metrics include activity counts, mean amplitude deviation (MAD), Euclidean norm minus one (ENMO), and monitor independent movement summary (MIMS) units. Associations between these metrics have yet to be fully explored in diverse and nationally representative samples. PURPOSE: To examine associations between commonly used accelerometer-based physical activity metrics. METHODS: We performed a secondary analysis of 13,485 US participants (age ≥ 3; 48.1% male) with wrist-worn accelerometer data collected during the 2011-2014 National Health and Nutrition Examination Survey (NHANES). Linear regression and correlations were used to quantify the nature and magnitude of associations between mean daily vector magnitude (VM) activity counts, MAD, ENMO, and MIMS units. Survey procedures were used for all analyses to account for the complex, multi-stage design of NHANES. RESULTS: Regression-based graphical depictions indicated linearity between all potential variable combinations (see Figure). All variables were significantly correlated (all *p* < 0.001). Association magnitudes for VM activity counts were highest with MIMS units (r = 0.995, 95% CI: 0.995-0.996) and lower for MAD (r = 0.874, 95% CI: 0.869-0.879) and ENMO (r = 0.770, 95% CI: 0.761-0.778). MAD demonstrated similar association magnitudes with ENMO (r = 0.904, 95% CI: 0.900-0.909) and MIMS units (r = 0.889, 95% CI: 0.885-0.894). The association for ENMO and MIMS units was among the lowest observed (r = 0.788, 95% CI: 0.779-0.795). CONCLUSIONS: All quantified accelerometer-based physical activity metrics were strongly and significantly associated with each other. Future research is needed to better understand the comparability of these accelerometer-based metrics as exposures in physical activity epidemiological research.

***ASSOCIATION BETWEEN ULTRASOUND-DETERMINED CHARACTERISTICS OF THE DIAPHRAGM AND RESPIRATORY FUNCTION IN YOUNG ADULTS: PRELIMINARY STUDY***

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Ultrasound (US) is a non-invasive imaging technique that can be used to examine functional and morphological characteristics of the diaphragm. This technique is utilized to predict weaning success in mechanically ventilated patients, however, to what extent US-determined characteristics of the diaphragm are related to respiratory function in healthy adults is much less explored. PURPOSE: To examine the association between US-determined characteristics of the diaphragm and measures of respiratory muscle strength (maximal inspiratory and expiratory pressures). METHODS: Seventeen healthy individuals volunteered (10M, 7F; 23±3yr; 174±8cm; 74±15kg). While lying supine, US (Terason 3200T) images of the right hemidiaphragm were obtained to determine diaphragm thickness (B-mode, mid-axillary line) and diaphragm excursion (m-mode, between mid-clavicular and axillary lines, below right costal margin) during tidal expiration, tidal inspiration, and maximal inspiration. Respiratory muscle strength was assessed by maximal inspiratory (MIP) and expiratory pressures (MEP, Cosmed Pony FX). All measures were collected on the same day. RESULTS: Collapsed across both sexes, diaphragm thickness assessed at end of expiration and at end of maximal inspiration showed moderate correlations with MIP (r=0.556 and 0.489, respectively, *P*<0.05). While a moderate association between maximal diaphragm excursion and MIP was observed, this did not reach statistical significance (r=-0.466, *P*<0.1). Diaphragm thickness at end of expiration was moderately correlated with MEP (r=0.491, *P*<0.05), however, no other US-determined characteristic correlated with MEP. Interestingly, males showed greater diaphragm thickness at expiration compared to females (2.1±0.3 vs.1.5±0.3 mm, *P*<0.05) and stronger correlations between US-determined diaphragm thickness and MIP. CONCLUSION: These preliminary findings suggest that US-determined characteristics of the diaphragm are related to respiratory muscle strength in healthy young adults (primarily MIP), and that US may be capable of identifying sex-based differences. Future research is needed to identify the impact of exercise or other interventions on morphological and functional characteristics of the diaphragm.

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***DIFFERENCES IN DECELERATION BETWEEN THE PENULTIMATE AND FINAL STEPS OF REACTIVE AND PLANNED CROSSOVER CUTS***

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Oregon State University

Penultimate and final step deceleration profiles during side-cuts differ under planned and reactive conditions which may impact performance. However, it is unclear how these steps are utilized in a crossover cut (XOC). PURPOSE: To determine whether deceleration is different between the penultimate and final steps of XOC and if those differences are modified by planning time. METHODS: Thirty-six females (Age: 20.9±1.7years; Height: 1.66 ± 0.07 m, Mass: 62.4 ±8.7 kg) completed 5 reactive (i.e., through a light stimulus) and planned 60o XOC off their dominant leg. Penultimate and final steps were captured using an optical motion capture system interfaced with two force plates. Braking impulse (i.e., area under the posterior ground reaction force curve) and the change in center of mass velocity (ΔCOMv) during the deceleration phase (initial contact to peak knee flexion) were quantified for each step. Within Subjects ANOVAs and planned, pairwise comparisons with a Bonferroni correction were used to compare the effects of condition, step, and their interaction on outcome variables (α≤0.05). RESULTS: We identified a significant interaction for braking impulse and ΔCOMv (p<.001). During reactive cuts, participants generated more braking impulse and decelerated more during the penultimate step compared to planned cuts (Table 1). CONCLUSION: Athletes employ an XOC to maintain a higher percentage of their approach velocity. However, greater deceleration during the penultimate step of reactive cuts could negatively impact performance, resulting in slower changes of direction or lesser cutting angles. Future research should investigate if the greater deceleration during reactive conditions influences determinants of performance in XOC.

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|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table 1. Within Subjects ANOVA Results for Braking Impulse and Change in Center of Mass Velocity during a 60o Crossover Cut in Healthy Females | | | | | | | | | | | |
|  | | | Planned | Reactive | Step\*Condition | | Step | | Condition | | |
|  |  | Step | Mean ± SD | Mean ± SD | *p* | ηp2 | *p* | ηp2 | *p* | ηp2 |
|  | Braking Impulse (Ns) | Penultimate | -0.04 ± 0.02c | -0.05 ± 0.02d,e | <.001a | .37b | <.001a | .47b | .01a | .21b |
| Final | -0.03 ± 0.01 | -0.03 ± 0.01c |
| Change in Center of Mass Velocity (m/s) | Penultimate | 0.08 ± 0.30c,f | -0.24 ± 0.27d,e | <.001a | .44b | <.001a | .69b | <.001a | .47b |
| Final | -0.43 ± 0.20e | -0.42 ± 0.17c |
| a Significant effect identified (*p* < 0.05)  b Indicates large effect size (ηp2 > 0.14)  c Significantly different than reactive penultimate (*p*.<.05)  d  Significantly different than reactive final (*p*.<.05)  e Significantly different than planned penultimate (*p*.<.05)  f  Significantly different than planned final (*p*.<.05) | | | | | | | | | | | |

***EFFECTS OF TRADITIONAL, MINIMAL, AND MAXIMAL RUNNING FOOTWEAR ON HIP AND KNEE BIOMECHANICS DURING RUNNING***

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Throughout the years, running footwear have evolved in an attempt to reduce the risk of injury, including maximal and minimal shoes. Despite the recent increase in popularity of maximal and minimal shoes, researchers have identified risk factors that may increase injury risk when analyzing ankle kinematics and vertical ground reaction forces. However, there is little research examining the effects of shoe cushioning on knee and hip kinematics. PURPOSE: The purpose of this study was to compare knee and hip kinematics between traditional, minimal, and maximal shoes during running. METHODS: Twenty-seven healthy experienced runners (8 men and 19 women) between the ages of 18-45 who ran at least 10 miles per week were recruited to participate in this study. An 8-camera motion capture system and two embedded force plates were used to collect three-dimensional kinematic data at the hip and knee in all three shoes which were custom designed for this study by adding (maximal shoe) or removing (minimal shoe) cushioning from the traditional shoe (traditional: 22mm rearfoot, 18mm forefoot; maximal: 33mm rearfoot, 29mm forefoot; minimal: 10mm rearfoot, 6mm forefoot). A repeated measures ANOVA (α = 0.05) was used to compare hip and knee kinematics (peak angles and excursions) in all three planes between shoe conditions. RESULTS: There was a trending but not significant difference in knee flexion excursion between shoes (maximal: 25.84 ± 6.25°, minimal: 22.89 ± 6.56°, traditional: 26.71 ± 5.31°, *p* = 0.059). No other significant differences were found for any peak angles or excursions at the hip and knee, most notably for peak knee flexion (maximal: 39.48 ± 5.45°, minimal: 37.53 ± 5.91°, traditional: 39.78 ± 3.73°, *p* = 0.223), peak knee valgus (maximal: 1.97 ± 2.83°, minimal: 1.70 ± 2.65°, traditional: 1.87 ± 2.85°, *p* = 0.935), peak hip adduction (maximal: 11.12 ± 3.85°, minimal: 10.33 ± 3.67°, traditional: 11.28 ± 3.71°, *p* = 0.608), and peak hip internal rotation (maximal: 5.05 ± 5.46°, minimal: 5.21 ± 3.78°, traditional: 6.14 ± 4.05°, *p* = 0.632). CONCLUSION: No significant differences in knee and hip kinematics were noted between shoes. Thus, the findings of this study suggest that altering midsole stack height has little effect on proximal biomechanics at the hip and knee.

***THE MONITORING OF COUNTERMOVEMENT JUMP METRICS THROUGHOUT A COLLEGIATE SOCCER SEASON***

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Neuromuscular fatigue should be monitored during a competitive season as indicators could provide physiological insight into training progress and possible movement compensations. A common method of monitoring neuromuscular fatigue is through consistent countermovement jump testing (CMJ) throughout a season. PURPOSE: The purpose of this study was to track changes to CMJ kinetic and kinematic variables throughout a collegiate competitive soccer season. METHODS: The first team (n = 15) of an NCAA Division III male collegiate soccer program were participants for this study. Each player performed CMJs every 3-days-before-gameday (GD+3) and 1-day-before-gameday (GD+1) during their competitive season (5.5 weeks long). All CMJ were completed at the beginning of each of their normal team in-season strength training sessions. All CMJ performances and metrics were recorded on a force plate. The specific CMJ metrics tracked regularly were peak power (PP) and jump height (JH). RESULTS: PP on GD+1 jumps produced a change in their jump versus their GD+3 jumps. GD+3 jumps had an average power of 1783.5 Newtons (N) and GD+1 jumps had an average power of 1818.3 N. On average game day +3 jumps increased 34.8 Newtons (2% increase). Jump height had a less consistent change throughout the season. There was a change of +/- .23 inches per jump. There was a performance change of +/- 1.8% per jump. CONCLUSION: CMJ can be an effective way of monitoring neuromuscular function during the competitive season of soccer players. Data showed PP to be significantly higher in GD+1 than GD+3, providing evidence that recovery takes several days post-gameday for the neuromuscular system to return to baseline. CMJ data like the ones presented in this study could help coaches and practitioners make informed decisions to adjust practice and training programs to ensure fitness outweighs fatigue for improved performance and decreased chance of injury.

**Free Communication Posters**

FRIDAY 2:30 – 3:20

***THE EFFECT OF A FALSE STEP ON THE INITIATION OF SPORTS MOVEMENT: A BIOMECHANICAL ANALYSIS***

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Athletes seek advantages over competitors, especially at movement initiation, when athletes tend to have the largest change in velocity. A false step (FS), defined as a backwards step before moving in the intended direction, is a debated starting technique for athletes. Prior research has focused on kinematic factors for straight sprints, however, most sports movement is multiplanar. PURPOSE: This study examined biomechanical changes of an athlete when performing a FS to initiate a forward sprint, from both parallel and lateral starts, and a jump. METHODS: Athletes (N=34, 21.0 ± 0.8 yr) had electromyography (EMG) for the quadricep, hamstring, gluteus medius and gastrocnemius for both legs, and ground reaction forces in the ant/post and vertical direction recorded. Three types of trials performed: straight run with parallel start (feet shoulder width apart), straight run with lateral start (facing perpendicular to run direction), and vertical jump. Three FS and 3 non-false step (NFS) trials were performed for each direction. The foot hitting the force plate (Strike foot: S) remained consistent and the foot performing the false step (non-strike foot: NS) remained consistent. Paired t-tests were used for EMG (% MVIC), maximum force, and impulse. p< .05 was significant, and p<.1 was a trend towards significance. RESULTS: Straight run: NS quadricep activation was significantly larger for FS trials (mean difference (MD)=5.75 % p<.001) and impulse for FS (MD=5.71 Ns, p=.004). Lateral: Higher S quadricep activation during FS trials (MD=5.1 %, p=.003), with a trend for the impulse (MD= 2.3 Ns, p=.089). Jump: S hamstring (p=.004) NS hamstring (p=.058) created more activation during the FS trials, and there was a larger maximum force for the FS (p=.026) and significantly larger impulse for NFS (p=.027). CONCLUSION: Larger quadricep activation for lateral and straight trials was attributed to the propulsion while performing the FS. Recruitment of this large muscle group resulted in a powerful push off phase in the first few steps of performing FS, as evidenced by higher horizontal impulses. There were no notable differences in jump performance with a FS. Our results suggest implementing the FS into an athlete’s repertoire when initiating explosive running movements from a straight or lateral start, to benefit overall performance.

***THE INFLUENCE OF KINESIOPHOBIA ON BALANCE IN THE FRONTAL PLANE OF ACLR PATIENTS*T.**

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PURPOSE: A large number of anterior cruciate ligament (ACL) injuries occur every year requiring reconstructive surgery. Reinjury risk is very high, especially for females. A common outcome of (ACLR) surgery is the presence of kinesiophobia, a fear of physical movement resulting from the potential of reinjury or pain. This study aimed to analyze the connection between kinesiophobia and balance performance in ACLR. METHODS:Subjects aged 18-25 (N=12, 9F, 3M) with an ACLR in the past two years completed the International Knee Documentation Committee (IKDC) to assess knee function, and the Tampa Scale of Kinesiophobia (TSK-17) to assess kinesiophobia. Electromyography (EMG) was recorded for the vastus lateralis, vastus medialis, gastrocnemius, and the bicep femoris on the ACLR and unimpaired legs. Single-leg (SL) and double-leg (DL) movements were measured on a force plate for center of pressure sway (COP Sway). EMG was normalized to maximum voluntary isometric contraction (%MVIC). p <0.05 was statistically significant. p <0.1 was trending towards significance. RESULTS*:* Muscle activation of the gastrocnemius in the unimpaired limb was greater than the ACLR leg during the SL Baseline (Mean difference (MD)=0.46 %) and SL Squat (MD=0.371 %) movements, respectively (p<0.001). Muscle activation for the vastus lateralis in the unimpaired limb was higher than the ACLR leg for all movements (p<0.05), except for SL Squat which trended toward significance (p=0.053). During all movements, the vastus medialis in the unimpaired limb showed significantly greater muscle activation (p<0.05) with the SL Squat (MD= -0.31 %, p=0.086) and wobble board (WB) Squat (MD=-0.26 %, p=0.062) trending toward significance. Through all movements, there was a negative correlation between IKDC and TSK-17 scores (r=-0.796, p=0.002). During SL Baseline, there was a trend toward negative correlation between COP and the IKDC of the ACLR leg (r=-0.565, p=0.055). CONCLUSION*:* Our findings suggest that in individuals with ACLRs, balance on their affected limb is shifted to their ankle joint, and quadriceps recruitment is shifted to their other limb. Given the prevalence of ACL injuries, clinical rehabilitation plans for ACLR that focus more on strengthening the vasti muscles and less on the activation of the gastrocnemius could prove highly beneficial.

***INFLUENCE OF HIP EXERCISE ON GROUND REACTION FORCES DURING SINGLE LEG DROP TEST***

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Anterior cruciate ligament (ACL) tears are a leading knee injury in athletes, often occurring when fatigued. Fatigue increases risk for injury as control of lower limbs is compromised and may lead to biomechanical disadvantages at the knee as adductors and abductors reduce load in the medial lateral compartment of the knee. Single-leg drop tests assess knee stability and strength during plyometric movements and are common in rehab settings post ACL tear. A drop test onto a force plate allows for analysis of ground reaction forces (GRF) to determine magnitude of forces and loading patterns during a landing. PURPOSE: To determine the influence of the frontal plane hip exercise on GRFs during a single leg drop test in unimpaired young adults. METHODS: Participants (n=11) completed two sessions that included single leg drops from a 20 cm tall box onto a force plate. Participants exercised dominant limb hip abductors and adductors separately during individual sessions using an isokinetic dynamometer. Hip adductors and abductors were isometrically activated maximally until torque output was less than 50% of individual peak torque. Once torque was less than 50%, three single-leg drop tests were completed. Participants returned within 10 days for second session. Components of vertical ground reaction force including acceptance slope, absorption slope, balance slope, and mediolateral force range were calculated. Data was analyzed using a repeated measures ANOVA to determine influence due to exercise and between muscles. RESULTS: Abductors demonstrated greater mediolateral range (PRE: 194.9±40.6N, POST: 185.4±83.3N) compared to adductors (PRE:150.1±63.8N, POST: 136.7±51.8N, p=0.006). Adductor absorption slope magnitude increased post exercise (PRE: -7191±2258.1N, POST: -8353±3476.2N) while abductor absorption slope magnitude decreased post exercise (PRE: -8210±2845.80N, Post: -7173±3667.10N, p=0.020). Peak vertical force of the hip adductors increased after exercise (PRE: 2301±649.9N, POST: 2413±673.7N) while peak vertical force of abductors decreased after exercise (PRE: -2512.3±625.4N, POST: -2241.4±711.4N, p=0.014). CONCLUSION: Hip adductors contribute to absorption of vertical GRF moreso than hip abductors although abductors may influence mediolateral stability.

***THE EFFECT OF DUAL MOTOR TASK ON LEG EXTENSION MAX FORCE OUTPUT***

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The ability to split attentional demands is important for a variety of everyday tasks, however this is of particular importance during athletic competition. Although it is understood that dual tasking is associated with impaired motor performance, it is not known if different sources of dual task attentional demands alter motor performance differently. PURPOSE: To determine the influence of visual, cognitive, motor, and mixed motor tasks on peak torque, time to peak torque, and average torque during a maximal isometric leg extension. METHODS: 12 young, unimpaired adult participants completed maximal isometric leg extensions for 3 seconds under different conditions of dual task: a gross motor (MOT) task, a visual (VIS) task, a cognitive (COG) task, and a task combining the three (COMBO). For each condition, torque production was recorded using a HUMAC isokinetic dynamometer. Data was analyzed using a repeated measures ANOVA to determine differences between conditions (p<0.05). RESULTS: Baseline peak torque (75.40+19.84Nm) was lower than dual task conditions including the MOT task (66.17+23.50 Nm, p=0.007), the VIS task (68.08+21.39 Nm, p=0.003), the COG task (63.92+22.69 Nm, p=0.007), and COMBO task (58.96+24.75 Nm, p<0.001). Average torque at during conditions of dual task (MOT 50.21+19.11 Nm, p<.001; COG 52.86+20.17 Nm, p=.006; COMBO task 47.42+21.78 Nm, p<.001) were lower than baseline average torque (62.08+15.80 Nm). No differences were found in time to peak torque between baseline and conditions of dual task. CONCLUSIONS: Conditions of dual task was associated with reduced torque production compared to baseline condition. Motor and cognitive dual task conditions influenced torque production moreso than the visual dual task condition. Torque production (peak and average torque) was most influenced by the combination dual task condition suggesting that as attentional task demands increased, participants prioritized performance on non-motor tasks to the detriment of motor performance. Future research should examine the influence training with conditions of dual task to determine if motor performance can be maintained when exposed to dual attentional demands.

***EXPLORING THE RELATIONSHIP BETWEEN HAND DEXTERITY AND HOBBIES THAT USE FINE MOTOR SKILLS***

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Hand dexterity is vital for carrying out activities of daily living and some career-specific tasks. Existing methods to improve hand dexterity are mainly focused on children, disease populations, and those in specific careers. While some methods to improve hand dexterity have been researched, there may be more methods than those identified in the literature. Frequent engagement in hobbies that use fine motor skills may improve an individual’s hand dexterity. PURPOSE: The purpose of this study was to examine the relationship between hand dexterity and frequency of engagement in hobbies that use fine motor skills in college-aged students ranging from 18 to 23 yrs. METHODS: Fifty-seven 18 to 23 yrs undergraduate students without finger, hand, or arm injuries completed this study. To start each session, subjects completed a questionnaire about their age, sex, hand preference, and average hours per week they engage in various fine motor skill hobbies. Thereafter, subjects completed the Purdue Pegboard Test (PPBT), which consisted of four subtests that evaluated how quickly and accurately subjects could use their hands. A Spearman’s rank-order correlation for each subtest was used to determine whether a statistically significant relationship existed between the dependent variables. RESULTS: A significant weak positive correlation was identified for assembly score (38.8 ± 6.2 points) and hours of engagement in hobbies that use fine motor skills (4.9 ± 6.3 hours; *r* = 0.265; *p* = 0.046). There were non-significant weak relationships between hours of engagement in hobbies that use fine motor skills (4.9 ± 6.3 hours) and left hand score (13.4 ± 1.7 points; *r* = 0.018, *p* = 0.897), right hand score (14.0 ± 1.9 points; *r* = -0.046, *p* = 0.736), and both hands score (11.2 ± 1.3 points; *r* = 0.179; *p* = 0.183). Alternative analysis of the data, which factored in hand dominance, produced similar results. CONCLUSION: The primary explanation for the main finding may be that the assembly task required skills that were more closely connected to the types of hobbies subjects engaged in. Future research that investigates whether engaging in some hobbies can improve an individual’s hand dexterity is needed.

***TRIMP AND sRPE AS USEFUL TOOLS FOR DESCRIBING ACUTE TRAINING LOAD IN ELITE DISTANCE RUNNERS***

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Successful athletic preparation balances periods of increased training load that stimulate physiological adaptation, with periods of reduced training load that allow growth and repair in response to that stimulus. To this end, practitioners must have a reliable measure of training load, as well as an understanding of the training load produced by prescribed training sessions. PURPOSE: To determine the utility of Edwards’ training impulse (TRIMP) and Foster’s session RPE (sRPE) in describing training load across three different types of training sessions in female Division I collegiate distance runners. METHODS: Female Division I collegiate distance runners were recruited to participate in this study (n=4). Participants completed 12 training sessions (workout type, WT) that could be classified as an easy run (eWT), a hard unstructured run (huWT), or a hard structured run (hsWT). Heart rate values were recorded via a chest strap with internal memory, and sRPE values were recorded via written questionnaire immediately upon workout completion. Data were analyzed using a 2-way repeated measures ANOVA, with sRPE as the predicted variable, and TRIMP and WT as predictor variables. A Tukey post-hoc comparison was used to examine difference in sRPE among WT. RESULTS: TRIMP was strongly related to sRPE across participants (p<0.001). WT did not differentiate sRPE across individuals (p=0.11); closer examination showed sRPE associated with hsWT to be significantly different than sRPE huWT (p<0.01) or sRPE eWT (p<0.001), with no difference in sRPE between huWT and eWT (p=0.68). The TRIMP:WT interaction effect was not significant across individuals (p=0.70). CONCLUSION: These findings indicate that training load values produced by TRIMP and sRPE are closely related across individuals and are not affected by workout type. As such, sRPE may be a more useful measure of training load than TRIMP, as it requires a lower investment in equipment cost, as well as less preparation and processing time. The similar training load values produced by huWT and eWT warrant additional investigation, as it is possible that the training load elicited by huWT is not large enough to elicit the training response desired of a “hard” WT.

***THE EFFECT OF KINESIO TAPE ON RETURN TO PLAY READINESS IN INJURED COLLEGE ATHLETES***

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There is evidence that Kinesio Tape (KT) can facilitate pain reduction and proprioception across a range of movements. It remains unknown whether KT can affect psychological factors, such as confidence and fear avoidance, that influence return to play readiness following injury. PURPOSE: The purpose of this study was to examine the effect of KT on the readiness to play for college student-athletes. METHODS: Undergraduate student-athletes between the ages of 18-23 years old who sustained an injury in the preceding two years were identified as the target population. Forty-three eligible student-athletes consented to participate in a survey that included retrospective questions regarding the use of KT, confidence for return to play with the use of the Injury-Psychological Readiness to Return to Sport Scale (I-PRRS), and fear avoidance with the use of the Athlete Fear Avoidance Questionnaire (AFAQ). An independent groups *t*-test (*p* ≤ 0.05) was used to determine significant differences between those who did and did not use KT. RESULTS: There was no significant difference in I-PRRS scores (confidence) between those who reported KT use (39.67 ± 8.84) and those who did not (32.00 ± 13.55; F = 3.889, *p* = 0.055). There was no significant difference in AFAQ (fear avoidance) between those who reported KT use (28.60 ± 7.68) and those who did not (33.82 ± 8.92; F = 3.672, *p* = 0.0562). Small effect sizes (*d* = 0.082-0.087) and moderate observed beta (*ꞵ* = 0.52-0.54) for I-PRRS and AFAQ indicated a moderate probability that a Type II error was committed for both comparisons. CONCLUSION: Under the present research circumstances, KT use did not appear to significantly influence confidence or fear avoidance in return to play situations. The retrospective aspect of questioning, and disproportionate representation of certain sports and injuries may have introduced too much variance in I-PRRS and AFAQ scores to elucidate a clear benefit of KT use. It also is possible that the sample of participants was too small to definitively rule out a beneficial effect of KT on confidence and fear avoidance. Future research studies in this area should incorporate a larger sample of athletes from several different sports, a larger variety of injuries, and more recent survey recall to build upon these findings.

***CORRELATIONS BETWEEN A PERCEIVED KNOWLEDGE SURVEY AND KNOWLEDGE ASSESSMENT REGARDING FACTORS THAT INFLUENCE SPORT PERFORMANCE***

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Eastern Oregon University, La Grande, OR

Universities may not provide athletes and coaches with staff who provide services including performance testing, nutrition, mental health, conditioning, and recovery. Thus, athletes rely on personal understanding and coach input for areas of performance where their knowledge and application may be lacking. PURPOSE: To assess the potential need for additional staff who are focused on sport performance by comparing a self-perceived knowledge survey to a knowledge-based exam on non-game related factors in coaches and athletes at Eastern Oregon University (EOU). METHODS: Coaches (n=15) and athletes (n=103) at EOU participated in an online survey where they were asked to rate their confidence using a rating scale of 0-100 (0-Not Confident, 100-Very Confident) regarding 5 non-game related aspects of sports performance. Each subject then completed a 36-question exam on the 5 non-game related factors. Test questions consisted of Sports Nutrition (n=10), Sports Performance Testing (n=5) Strength and Conditioning (n=7), Recovery from Training (n=6), and Mental Health (n=8). Self perceived survey data and exam scores were averaged. The correlation between the self perceived survey scores and performance on the exams was calculated. RESULTS: The average rating of self-perceived knowledge for coaches was 75.6±5 and 74.8±3.4 for athletes. Coaches scored an average of 63%±17 on their knowledge exam, whereas athletes' average score was 58%±18.2. The correlations between topic exam scores and self-perceived knowledge were low. The relationship between self-perceived rating and area exam score were highest in both coaches and athletes for the nutrition section, with R=0.24 and R=0.28, respectively. Of note, the lowest correlations for both coaches and athletes were in the topic area of Mental Health (R=-0.32 coaches and R=0.00 athletes). CONCLUSION: These results suggest a need for increased resources and /or knowledge in areas of sports performance for coaches and athletes at EOU.

***FUELING STRATEGIES IN ULTRA TRAIL RUNNERS***

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It has been suggested that ultra-runners may fail to meet hourly carbohydrate intake guidelines during training and competition due to improper knowledge around fueling, higher reliance on fats as fuel, lack of dietary strategies, and gastrointestinal stress (Stellingwerff 2016, Costa 2013). However; the consequences could include poor performances as well as an increase the risk of low energy availability (LEA) in ultra-endurance athletes. PURPOSE: The purpose of this study was to examine self-reported fueling habits during training and competition in male and female ultra-trail runners. METHODS: Trail runners between the age of 18-40 (males: n= 510) completed a Qualtrics survey that included training and racing characteristics. Questions regarding carbohydrate intake during training and competition were compared to current evidence-based recommendations. RESULTS: 45.6% male and 47.6% female reported incorporating fueling with carbohydrates during their workouts. 47.5% of males and 45.2% only sometimes incorporate carbohydrate fueling into their workouts. 7.1% of female athletes and 6.9% of male athletes do not incorporate any Carbohydrates into their workouts. 25% of male ultra-trail runners intentionally eat less during their easy training days and 36% of female’s athletes. However, 35.9% of males intentionally train in a fasted state and only 19.7 % of females train in a fasted state. Furthermore, 36.2% of female ultra-trail runners intentionally eat less on their easy days compared to only 25.7% of male ultra-trail runners intentionally restrict fueling during their easy days. CONCLUSION: Athletes should seek guidance from a sports dietitian to help with fueling plans that meet carbohydrate needs during training runs and races. The guidance should be focused on both male and female athletes.

***ASSESSING THE MENSTRUATION-RELATED CHANGES OF HEMATOCRIT AND ITS INFLUENCE ON MAXIMAL EXERCISE PERFORMANCE***

**Heenan R**, Goodheart C, Brady G, Albers M, Crosswhite, P.

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Hematocrit (Hct) is a ratio of red blood cells to plasma in a blood sample. When this ratio increases, the ability to carry oxygen increases. When biological females go through the menstrual cycle, time durations of blood loss result in a reduced oxygen-carrying capacity. PURPOSE: This study aimed to investigate whether a change in hematocrit due to menstruation-associated blood loss significantly affects maximal exercise performance. METHODS: We conducted VO2max tests on four moderately trained females ages 18-22 yr. Each subject completed three VO2maxtests on a bike: a familiarization day and two test days. Test day 1 corresponded to day 7 of their cycle, when hematocrit was predicted to be the lowest. Test day 2 corresponded to day 14 of their cycle when hematocrit was predicted to be fully recovered. RESULTS: Statistical significance was found between absolute VO2max on test day 1 and test day 2 (p=0.004). This was further supported by a significant difference in end wattage between test day 1 and test day 2 (p= 0.037 ) and final time between test day 1 and test day 2 (p=0.041). As anticipated, there was a significant difference in hematocrit between test day 1 and test day 2 (p=0.038). No statistically significant difference was found between relative VO2maxon test day 1 and test day 2 (p= 0.068). CONCLUSION: We concluded that menstruation-associated blood loss points to significant changes in hematocrit which further affects maximal exercise performance in college-aged females.

***NCAA GOLF COACHES’ USE OF PSYCHOLOGICAL SKILLS TRAINING: A SURVEY OF THE FIELD***

**K. G. Drugge,** H. Papodoulos

Pacific Lutheran University, Tacoma, WA

Studies have shown that coaches in a position to use Psychological Skills Training (PST) with their athletes refrain because of a lack of understanding how to implement them effectively (Gould, Damarjian, et al., 1999). Furthermore, there is a lack of understanding around the use of PST by NCAA golf coaches with their golf athletes. Robust evidence has shown that psychological skills training (PST) can improve performance outcomes, especially when administered by a coach (Brown & Fletcher, 2017). Self-talk (Hatzigeorgiadis et al, 2011; Tod et al., 2011), imagery (Simonsmeier et al., 2020), and concentration strategies such as pre-performance routines (Rupprecht et al., 2021) all have positive effects on athletic performance. PURPOSE: To examine NCAA golf coaches’ use of PST with their athletes, how they implement PST, their confidence in administering PST with their athletes, and their perceived importance and effectiveness of PST. The authors also investigated common barriers and facilitators that NCAA golf coaches reported experiencing in regard to implementing PST. METHODS: NCAA Division I, II, and III golf coaches (N = 42) were surveyed with an original survey developed by the authors. The survey was 35 questions with a mix of questions that require quantitative, Likert-scale type responses, and some questions that offered qualitative open-ended responses from the participants. The authors searched for themes from the open-ended responses and statistical analysis was utilized with the quantitative-focused questions to reveal any significant correlations. RESULTS: Most respondents viewed PST as important or very important, but their reported confidence in teaching these skills did not match. Also, there is a positive significant correlation between coaches’ education in sport psychology and their confidence to teach imagery to their athletes (p = .019, r = .41). Coaches commonly expressed that education is a barrier to teaching psychological skills. CONCLUSION: Golf coaches' current use of psychological skills is unstructured and informal. NCAA golf coaches may benefit from more education in the form of workshops with hands-on training to learn how to effectively implement PST with their athletes.

FRIDAY 3:30 – 4:20

***CORE AND SKIN TEMPERATURES IN INDIVIDUALS WITH AND WITHOUT A PATENT FORAMEN OVALE***

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During exercise, core (Tc) and skin temperatures (Tsk) increase due to a higher heat production from increased metabolism by exercising muscles. To maintain Tc and Tsk within a precise range the body increases skin blood flow to facilitate heat loss from radiation and sweating, and there is some heat released through exhalation. Individuals with a patent foramen ovale (PFO) do not release as much heat through respiration as individuals without a PFO because a fraction of their cardiac output bypasses the respiratory system (Davis *et al.* 2017). PURPOSE: The purpose of this study was to determine if the presence of a PFO is associated with higher Tc and Tsk at rest and during exercise in healthy adult men. METHODS: The study was completed in a thermoneutral environment (20 C, 39% rh). 21 men (11 PFO+ and 10 PFO-), ages 18-35 y/o completed the study. Participants completed 3 study visits. On day 1 they performed non-invasive pulmonary function tests and a cardiac ultrasound to determine the presence or absence of a PFO. On day 2, participants performed a graded exercise protocol at 4 workloads to determine what workload would elicit a heat production of 7 W/kg of body weight. They also completed a peak test. On visit 3, participants completed a 1 hour cycling protocol at the previously determined 7W/kg workload, which was confirmed using metabolic data during the 1 hr bout. Tc (telemetric pill) and Tsk (skin thermistors on 4 sites) were measured continuously. RESULTS: PFO- participants had significantly higher (P<0.05) Tc before and during exercise compared to PFO+ subjects (rest PFO- , rest PFO+ ) (exercise PFO- , exercise PFO+ ). No significant difference was observed in Tsk between PFO+ and PFO- participants. CONCLUSION: Contrary to our previously published work, these data suggest that the presence of a PFO is associated with decreased Tc at rest and during exercise. Reasons for these discrepancies are not yet understood.

Supported by the University of Oregon Human Physiology Department, the Human Physiology Excellence Fund, and USARIEM.

***PROLONGED MILD HYPOHYDRATION INCREASES ACUTE KIDNEY INJURY BIOMARKERS IN HEALTHY YOUNG MALES AND FEMALES***

**S.M. Holt**, C.L. Chapman, W.A.B. Howells, C.T. O’Connell, S.C. Brazelton, H.N. Medved, E.L. Reed, K. Wiedenfeld Needham, J.R. Halliwill, FACSM, C.T. Minson, FACSM

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The top causes of hospitalizations during extreme heat events are fluid and/or electrolyte disorders, and acute kidney injury (AKI) secondary to hypohydration. Prior to extreme heat exposure, people are likely mildly hypohydrated (approximate 2% body mass loss) during normal daily living due to inadequate fluid intake. In this context, an important knowledge gap exists as to whether mild hypohydration independent of heat stress increases AKI biomarkers that are suggestive of increased AKI risk. PURPOSE: To test the hypothesis that urinary AKI biomarkers are elevated in humans following prolonged mild hypohydration compared to euhydration. METHODS: In a block-randomized crossover design, twenty-two healthy adults [11 females, 11 males; 21(3) years; body mass index: 23(3) kg/m2] completed 24 hours of fluid deprivation (HYPO) or 24 hours normal fluid consumption (EUHY). Protocols were separated by ≥72 hours. Body fluid losses were estimated via the percent change in nude body mass over the 24-hour protocol. Spot urine samples were collected from participants immediately following the 24-hour protocol. Urinary AKI biomarkers insulin-like growth factor binding-protein 7 (IGFBP7), tissue inhibitor of metalloproteinase-2 (TIMP-2), kidney injury molecule-1 (KIM-1), and neutrophil gelatinase associated lipocalin (NGAL) were measured with enzyme-linked immunosorbent assays. The primary dependent variable was the U.S. Food and Drug Administration approved biomarker urinary ([IGFBP7∙TIMP-2]). Data are presented as mean with 95% confidence intervals. RESULTS: Body mass loss was greater in HYPO vs. EUHY [-2.5% (-2.9, -2.1) vs. 0.0% (-0.4, 0.4), P<0.0001]. HYPO caused marked increases in urinary [IGFBP7∙TIMP-2] [1.9 (ng/ml)2/1000 (1.0, 2.8) vs. 0.2 (ng/ml)2/1000 (0.1, 0.3), P=0.0011] and KIM-1 [1.0 ng/ml (0.8, 1.3) vs. 0.3 ng/ml (0.2, 0.4) P<0.0001] compared to EUHY. Urinary NGAL was not different between conditions [HYPO: 0.7 ng/ml (0.3, 1.1); EUHY: 0.8 ng/ml (0.3, 1.3), P=0.7524]. CONCLUSION: These data indicate that prolonged mild hypohydration increases biomarkers associated with potential renal tubular epithelial cell injury that are suggestive of increased AKI risk.

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***PROLONGED MILD HYPOHYDRATION REDUCES ORAL PROTEIN LOADING INDUCED RENAL HYPEREMIA***

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Oral protein consumption increases circulating amino acids that increase renal perfusion. Prolonged water deprivation evokes marked reductions in renal blood flow. Reduced renal perfusion during hypohydration is the primary mechanism of acute kidney injury of pre-renal etiology. It is not known whether the renal hemodynamic response to oral protein consumption is modified during prolonged hypohydration. This knowledge gap has implications for oral rehydration strategies following prolonged hypohydration. PURPOSE: To test the hypothesis that increases in segmental artery blood velocity following oral protein loading are attenuated during prolonged mild hypohydration compared to when euhydrated. METHODS: In a block-randomized crossover design, twenty-two healthy adults [11 males, 11 females; age: 21(3) years] completed 24 hours of fluid deprivation to induce hypohydration (HYPO) or 24 hours normal fluid consumption (EUHY). Protocols were separated by ³72 hours. Baseline measurements were obtained at the end of each 24-hour protocol. Participants then ingested a whey protein shake (1.0 g protein and 10 ml water per kg of body mass). Body fluid losses were estimated via the change in body mass over 24 hours (∆BM). Blood pressure (electrosphygmomanometer) and segmental artery blood velocity in the right kidney (Doppler ultrasound) were measured at baseline and 150-minutes post-protein. Segmental artery vascular conductance was calculated as blood velocity divided by mean arterial pressure. Data are presented as the change from baseline (∆) as mean with 95% confidence intervals. RESULTS: Reductions in ∆BM were greater in HYPO vs. EUHY [-2.5% (-2.9, -2.1) vs. 0.0% (-0.4, 0.4), P<0.0001]. At 150 minutes post-protein, increases in segmental artery blood velocity were attenuated [HYPO: 1.4 cm/s (0.4, 2.5); EUHY: 3.2 cm/s (1.7, 4.6), P=0.0061] and increases in vascular conductance were abolished [HYPO: 0.00 cm/s/mmHg (-0.02, 0.02); EUHY: 0.04 cm/s/mmHg (0.02, 0.06), P=0.0004] in HYPO vs. EUHY. CONCLUSION: These data indicate that prolonged mild hypohydration attenuates oral protein loading induced renal hyperemia. This suggests that a high protein beverage may not be advantageous for restoring renal blood flow following prolonged mild hypohydration.

Supported by NIH R01HL144128 and F32HL164021.

***PROLONGED MILD HYPOHYDRATION ABOLISHES DIFFERENTIAL BLOOD PRESSURE RESPONSE TO EXERCISE PRESSOR REFLEX BETWEEN SEXES***

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Females have attenuated increases in blood pressure to the exercise pressor reflex (EPR) compared to males. Mild hypohydration (~2% body mass loss) alters blood pressure regulation but increases in blood pressure to EPR are not modified by very mild hypohydration (~0.5% body mass loss). It is unknown whether mild hypohydration modulates the differential blood pressure responses to EPR. PURPOSE: To test the hypothesis that increases in blood pressure during EPR remain attenuated in females compared to males during mild hypohydration. METHODS: In a block-randomized crossover design, twenty-two healthy adults [11 females (F), 11 males (M); 21 (3) years] completed 24 hours of fluid deprivation (HYPO) or 24 hours of normal fluid consumption (EUHY). Participants underwent 2 min static handgrip exercise at 30% of maximum voluntary isometric contraction (HG) and 2 min arterial occlusion of the right arm (OCC). Body fluid losses were estimated by the change in body mass (∆BM) over 24 hours. Blood pressure was measured via finger photoplethysmography corrected to brachial artery blood pressure at baseline (electrosphygmomanometer). Data are presented as the change from baseline (∆) as mean with 95% confidence intervals. RESULTS: ∆BM was not different between sexes (P=0.5393) during HYPO [F: -2.2% (-2.9, -1.6); M: -2.8% (-3.4, -2.3)] or EUHY [F: -0.1% (-0.8, 0.5); M: 0.1% (-0.3, 0.6)]. At end HG and OCC, increases in systolic [HG, F: 14 mmHg (6, 21), M: 26 mmHg (16, 36); OCC, F: 7 mmHg (-1, 15), M: 23 mmHg (13, 33), P≤0.0500] and diastolic [HG, F: 14 mmHg (9, 19), M: 23 mmHg (16, 30); OCC, F: 6 mmHg (1, 10), M: 16 mmHg (10, 22), P≤0.0371] blood pressure were attenuated in females during EUHY compared to males. There were no differences between sexes at end HG and OCC in systolic [HG, F: 18 mmHg (12, 24), M: 25 mmHg (15, 35); OCC, F: 12 mmHg (4, 19), M: 16 mmHg (10, 22), P≥0.2029] and diastolic [HG, F: 16 mmHg (10, 22), M: 22 mmHg (16, 28); OCC, F: 16 mmHg (10, 22), M: 22 mmHg (16, 28), P≥0.1223] blood pressure. CONCLUSION: These findings indicate that mildly hypohydrated females do not retain the attenuated increases in blood pressure during EPR compared to males that is observed in euhydration.

Supported by NIH R01HL144128 and F32HL164021, and the UO Summer Program for Undergraduate Research.

***MILD PROLONGED HYPOHYDRATION ATTENUATES RENAL HEMODYNAMIC RESPONSE TO EXERCISE PRESSOR REFLEX ACTIVATION***

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Renal vasoconstriction supports the regulation of arterial pressure. Passive heat stress induced hypohydration abates both renal vasoconstriction and increases in blood pressure during sympathetic activation. However, it is not known if this effect is due to hypohydration independent of heat stress. PURPOSE: To test the hypothesis that prolonged mild hypohydration attenuates reductions in renal artery blood velocity (RBV) and increases in renal artery vascular resistance (RVR) during exercise pressor reflex activation compared to a hydrated state (euhydration). METHODS: In a block-randomized crossover design, twenty-two healthy adults (11 females, 11 males; age: 21(3) years) completed 24 hours of fluid deprivation (HYPO) or 24 hours of normal fluid consumption (EUHY). Protocols were separated by ≥72 hours. Body fluid losses were estimated via the percent change in body mass (∆BM) over 24 hours. Baseline RBV (Doppler ultrasound) and brachial artery blood pressure (electrosphygmomanometer) were measured. Participants completed 2 min static handgrip exercise (HG) followed by 2 min arterial occlusion (OCC) to activate the exercise pressor reflex. RVR was calculated as mean arterial pressure divided by RBV. Data are presented as the change from baseline (∆) with mean and 95% confidence intervals. RESULTS: Body mass was reduced in HYPO vs. EUHY [-2.5% (-2.9, -2.1) vs. 0.0% (-0.4, 0.4), P<0.0001]. Increases in mean arterial pressure during HG and OCC did not differ between conditions (P=0.8790). Reductions in RBV were attenuated in HYPO compared to EUHY at the end of HG [-0.8 cm/s (-2.5, 0.9) vs. -5.9 cm/s (-8.2, 3.7), P<0.0001] and OCC [0.7 cm/s (-0.6, 2.1) vs. -2.4 cm/s (-4.2, -0.6), P=0.0109]. Increases in RVR were also attenuated in HYPO compared to EUHY at the end of HG [0.5 mmHg/cm/s (0.4, 0.7) vs. 0.8 mmHg/cm/s (0.6, 1.1), P=0.0012] and OCC [0.2 mmHg/cm/s (0.1, 0.3) vs. 0.4 mmHg/cm/s (0.3, 0.6), P=0.0418]. CONCLUSION: Mild prolonged hypohydration attenuates both reductions in RBV and increases in RVR during exercise pressor reflex activation. Thus, these data suggest that the blunted renal vasoconstriction to sympathetic activation during passive heat stress induced hypohydration is only partially explained by hypohydration.

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***PROLONGED MILD HYPOHYDRATION DIFFERENTIALLY ALTERS HANDGRIP STRENGTH IN HEALTHY YOUNG FEMALES AND MALES***

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An overwhelming majority of the scientific literature investigating the effects of hypohydration on muscular strength has been performed in male participants. One study recently reported that passive heat-stress induced hypohydration reduces upper body muscular strength in females. To our knowledge, there are no data on whether prolonged mild hypohydration, in the absence of heat stress, similarly reduces upper body strength in females. This knowledge gap has implications for female athletes and workers in physically demanding occupations. PURPOSE: To test the hypothesis that maximum voluntary isometric handgrip strength is reduced in females following prolonged mild hypohydration compared to a hydrated state (i.e., euhydrated) and to investigate whether this response differs between males and females. METHODS: In a block-randomized crossover design, twenty-two healthy adults [11 females (F), 11 males (M); 21 (3) years] completed 24 hours of fluid deprivation (HYPO) or 24 hours of normal fluid consumption (EUHY). Protocols were separated by ≥72 hours. Body fluid losses were estimated via the percent change in body mass (∆BM) over 24 hours. Participants performed three maximal voluntary isometric handgrip strength on a hand dynamometer with one minute rest between sets. Data are presented as mean with 95% confidence intervals. RESULTS: ∆BM was not different between sexes (P=0.5393) during HYPO [F: -2.2% (-2.9, -1.6); M: -2.8% (-3.4, -2.3)] or EUHY [F: -0.1% (-0.8, 0.5); M: 0.1% (-0.3, 0.6)]. Maximal handgrip strength was reduced in HYPO vs. EUHY in males [48 kg (43, 54) vs. 51 kg (45, 57), P=0.0468)] but there were no differences between conditions in females [27 kg (24, 30) vs. 28 kg (25, 32), P=0.3166)]. During HYPO, there was a trend toward greater reductions in handgrip strength between the first to third attempts in females vs. males during HYPO [-2.7 kg (-5.2, -0.2) vs. 0.8 kg (-1.6, 3.3), P=0.0762]. CONCLUSION: These findings suggest that prolonged hypohydration caused by fluid deprivation causes modest reductions in maximum handgrip strength in males but not females. However, unlike males, our data suggest that females are not able to reproduce initial handgrip strength on subsequent attempts when mildly hypohydrated.

Supported by NIH R01HL144128 and F32HL164021.

***URINE CONCENTRATING ABILITY DURING PROLONGED MILD HYPOHYDRATION IS NOT ENHANCED BY ORAL PROTEIN LOADING***

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University of Oregon, Eugene, OR

Oral protein consumption in a hydrated state (i.e., euhydration) stimulates urine concentrating mechanisms, reducing free water clearance (CH2O) and conserving water. This response may be abated during a hyperhydrated state as evidenced by blunted post-prandial changes in renal hemodynamics with oral protein consumption. On the other end of the hydration spectrum, it remains unknown whether urine concentrating ability is altered when oral protein is consumed during mild hypohydration, a physiological state associated with negative CH2O. PURPOSE: To test the hypothesis that oral protein loading during mild hypohydration attenuates reductions in CH2O compared to during euhydration. METHODS: In a block-randomized crossover design, twenty healthy adults [9 females, 11 males; age: 21 (3) years] completed 24 hours fluid deprivation (HYPO) and 24 hours normal fluid consumption (EUHY). Protocols were separated by ≥72 hours. Participants ingested a whey protein shake (1.0 g protein and 10 ml water per kg body mass) within 10 minutes. Body fluid loss was estimated via the percent change in body mass (∆BM) over 24 hours. Blood and urine samples collected at pre- (baseline) and 150-min post-protein consumption (POST) were analyzed osmolality for the calculation of CH2O. Data are presented as mean with 95% confidence intervals. RESULTS: ∆BM was reduced in HYPO vs. EUHY [-2.6% (-3.0, -2.2) vs. 0.1% (-0.3, 0.4), P<0.0001]. Baseline CH2O was lower in HYPO vs. EUHY [-1.6 ml/min (-1.8, -1.4) vs. 4.8 ml/min (3.5, 6.1), P<0.0001]. There were no differences in CH2O between conditions at POST [HYPO: -2.4 ml/min (-2.7, -2.1); EUHY: -2.1 ml/min (-2.4, -2.1), P=0.0758]. Compared to baseline, CH2O at POST was reduced in EUHY (P<0.0001) but was not different in HYPO (P=0.1464). CONCLUSION: These findings indicate oral protein loading does not enhance urine concentrating ability during prolonged mild hypohydration. It is unclear whether the lack of further reductions in CH2O during HYPO, as opposed to EUHY, reflect a “ceiling effect” of having reached the physiological maximal ability to concentrate urine whereby the already negative CH2O is not able to be further reduced with oral protein loading.

Supported by NIH R01HL144128 and F32HL164021.

***THE INFLUENCE OF EXERCISE AND AEROBIC FITNESS LEVEL ON PRESSURE-PAIN SENSITIVITY***

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In healthy individuals, pain sensation has been shown to decrease after a bout of moderate-to-vigorous exercise, a phenomenon termed exercise-induced hypoalgesia (EIH). However, it is unclear if aerobic fitness level influences EIH. PURPOSE: Firstly, determine if 10 minutes of cycling at 50% intensity is sufficient perturbation to induce EIH. Secondly, investigate the relationship between aerobic fitness level and EIH magnitude. METHODS: Using within-subjects design, 34 healthy adults (age = 20.8 ± 1.4 yrs, 21 female, 13 male) completed a Forestry Step Test to estimate VO2max, followed by 10 minutes of stationary cycling. The cycle ergometer workload (W) was scaled to individual fitness level, using 50% VO2max translated into watts. Estimated VO2max for subjects ranged from 31 to 61 ml·kg-1·min-1 (mean = 47.18 ± 9.25 ml·kg-1·min-1). Pain sensation was measured via pressure-pain threshold test (PPT) pre- and post-exercise. Using a digital dolorimeter, incrementally increasing pressure (kg·cm-1) was applied in repeated measures on either forearm or quadriceps, with the pressure recorded when the subject reached their perceived pain threshold. Forearm represented the non-exercised site whereas quadriceps represented the directly-exercised site. Dependent t-tests analyzed differences between pre- and post-exercise PPT values, determining if EIH was induced. Pearson correlation described the relationship between the magnitude of EIH and est. VO2max. RESULTS: Exercise did not induce EIH at the forearm site, with no difference between pre-exercise and post-exercise PPT (2.89 ± 1.43, 3.02 ± 1.51 kg·cm-1 respectively). However, EIH was induced at the quadriceps site (PPT pre = 3.87 ± 2.17, post = 4.42 ± 2.50 kg·cm-1; t33 = -4.306, p<0.001). Magnitude of quadriceps EIH (pre-post PPT difference) showed a moderate positive correlation with estimated VO2max (r = 0.447, p = 0.008). CONCLUSION: Although the exercise protocol did not induce EIH in the non-exercised area (forearm), it successfully induced EIH in the local musculature (quadriceps). Most importantly, aerobic fitness, as represented by estimated VO2max, was shown to modestly influence EIH. Higher aerobic fitness was positively associated with increased magnitude of EIH.

Supported by a grant from Pacific University College of Arts & Sciences.

***EFFECTS OF GUAYAKI YERBA MATE CONSUMPTION ON COGNITIVE PERFORMANCE IN COLLEGE STUDENTS***

***MUSCLE FATIGUE REDUCES ACTIVE STIFFNESS***

**J.D. Cooper**, G.E. Privett, A.W. Ricci, D.M. Callahan

Muscle stiffness impacts, flexibility, force production, and soft tissue injury risk. Past studies suggest fatiguing exercise reduces whole muscle passive stiffness, but the origins of fatigue-induced compliance are unclear. Furthermore, similar measures of stiffness in actively contracting muscle are non-existent. Evidence from pre-clinical studies of skeletal and cardiac muscle suggest fatigue modifies the muscle protein titin, and these modifications reduce mechanical stiffness. However, these possibilities have not been explored in human skeletal muscle. Therefore, the PURPOSE of this study was to evaluate how acute fatigue modifies active cellular mechanics in humans and to test the hypothesis that fatigue reduces stiffness while not affecting active force generation. METHODS: Two males and two females completed repeated maximum voluntary knee extensions with their dominant leg until task failure. Immediately following, the volunteers underwent a bilateral percutaneous needle muscle biopsy of the Vastus Lateralis, providing a fatigued and non-fatigued sample. Individual fibers were dissected from the biopsy samples and mounted to a permeabilized single fiber force measurement apparatus (Aurora Scientific, ON Canada). Active stiffness was measured by submerging single fibers in activating solution (pCa 4.5) and measuring peak isometric force at steady-state. Immediately after, fiber length was briefly shortened then returned to original length. Stiffness was defined by the resultant change in force per unit length change (mN/mm). RESULTS: Fatigue reduced stiffness in activated single fibers (12.9 ± 4.8 mN/mm and 11.1 ± 4.8 mN/mm; p < 0.01, n= 175). There was no main effect of sex, nor a sex/fatigue interaction. There was no difference in active isometric tension between non-fatigued and fatigued fibers (139.3 ± 29.3 mN/mm2 and 136.2 ± 32.0 mN/mm2). CONCLUSION: Our findings suggest fatigue reduces active stiffness, but not isometric force generating capacity, at the cellular level. Active stiffness reduction may be due to intracellular protein mechanisms. Therefore, these data could influence future research into the mechanisms explaining fatigue induced musculotendinous stiffness reduction.

This work was supported by the Wu Tsai Human Performance Alliance.

***ASSOCIATION OF PFO, INFLAMMATORY CYTOKINES, AND WHITE BLOOD CELL COUNT WITH HEMOGLOBIN MASS IN MEN***

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University of Oregon, Eugene, OR

A patent foramen ovale (PFO) is a source of intracardiac shunt, and preliminary data suggests that those with a PFO have higher concentrations of inflammatory cytokines. Cytokines and white blood cells (WBCs) negatively impact red blood cell (RBC) regulation, but no studies have examined the effect of the PFO on this relationship. PURPOSE: The purpose of this study was to investigate the relationship between the presence of a PFO, inflammatory cytokine concentrations, and white blood cell counts on RBC mass. METHODS: Twenty healthy, male participants completed the study (10 with and 10 without a PFO). Participants underwent a comprehensive ultrasound screening with saline contrast echocardiography to determine the presence or absence of a PFO. Hemoglobin (Hb) mass was measured twice on the same day via the 10-minute CO-rebreathe method and venous blood samples drawn for measurements of WBC counts and inflammatory cytokines. WBC counts were analyzed by QUEST diagnostics. Cytokine analysis was done using the BioLegend 13-plex human inflammation panel. RESULTS: No differences were found for absolute (g) (p = 0.1096) and relative (g/kg) (p = 0.1382) Hb mass between PFO+ and PFO- participants. No differences were found for WBC count (p = 0.8680) between PFO+ and PFO- participants and for each of the respective immune cells; neutrophils (p = 0.5418), lymphocytes (p = 0.6721), monocytes (p = 0.5388), eosinophils (p = 0.5603), basophils (p = 0.2539). The only inflammatory difference detected was elevated levels of MCP-1 in PFO- participants (p = 0.0332). There was no significant relationship between WBC count and absolute or relative Hb mass. There was a relationship between MCP-1 levels and absolute Hb mass in PFO+ participants, but not in PFO- participants (R2 = 5389). There was a relationship between IL-10 levels and absolute Hb mass in PFO- participants, but not in PFO+ participants (R2 = 6096). No significant difference was detected for the other cytokines for either absolute or relative Hb mass. CONCLUSION: Although there were no PFO differences in Hb mass or WBC counts. differences in cytokine levels for MCP-1 and IL-10 may play a role in modulating Hb mass within a PFO group.

Supported by Partnership for Clean Competition, Peter O’Day Fellowship in Biological Sciences

***EFFECTS OF AROUSAL ON ATTENTION AND REACTION TIME IN COLLEGIATE STUDENT ATHLETES***

**K. Greenawalt**, G. Reyes

Linfield University, McMinnville, OR

With athletic skills in sports requiring quick reaction times, accurate hand-eye coordination, and the ability to make decisions quickly, the cognitive side of athletic profile should be given attention. PURPOSE: To measure changes in reaction time (RT), hand-eye coordination (HEC), and decision-making (DM) when increasing an athlete’s arousal (via increased heart rate and sound stimulus). METHODS: Eleven participants were recruited to participate in the study. All eleven of them were current competing student-athletes at the NCAA Division III level across a variety of sports. The participants reported to the lab on three separate occasions to have their RT, HEC, and DM measured with three different arousal conditions: low arousal (no sound or elevated heart rate), medium arousal (no sound but with elevated heart rate), and high arousal (sound and elevated heart rate). Heart rate was elevated to 75-85% of their age-predicted maximum using a standardized graded walking protocol on a treadmill. Sound was administered via noise-cancelling headphones that played simulated crowd noise. The three conditions were administered in a randomized order for each participant. RT, HEC, and DM were measured by completing tasks on a cognitive sensory station that consisted of a large touchscreen and tablet. RESULTS: Fourteen different metrics that quantified RT, HEC, and DM were recorded across the three different conditions. No statistical differences were reported across the metrics and the three arousal conditions (*p* > 0.05). CONCLUSION: The activities designed to increase arousal in this study did not appear to significantly change cognitive function within the collegiate student-athletes participants. This could possibly provide evidence that athletes have learned through practice and competition to not let changed arousal levels effect their reaction time, hand-eye coordination, and decision-making.

SATURDAY 10:30 – 11:20

EFFECTS OF GUAYAKI YERBA MATE CONSUMPTION ON COGNITIVE PERFORMANCE IN COLLEGE STUDENTS

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Approximately 61% of college age students report consuming beverages with glucose at least once a week. Students also regularly consume glucose beverages before or during exams. Guayaki Yerba Mate is an increasingly popular beverage with approximately 28 g of sugar and 150 mg of caffeine. PURPOSE: To assess whether there is an optimal time to consume a Guayaki Yerba Mate prior to a cognitive test. METHODS: Thirty college participants ages 18-22, were asked to fast 3 hours prior to the study. Participants were randomly divided into three groups and instructed to consume a Guayaki Yerba Mate either 20-, 40-, or 60-minutes prior to administration of a cognitive test. RESULTS: There was no significant difference between the three groups' fasting blood glucose levels prior to taking the test (p=0.588). The 20-minute group demonstrated the highest blood glucose (151.30 mg/dL) at the time of administration of the cognitive test and recorded the highest accuracy on the cognitive test (99.75%). There was no significant difference however between the three groups cognitive test accuracy (p=0.256). CONCLUSION: Although the 20-minute group demonstrated the highest accuracy on the cognitive test, it was not statistically advantageous compared to the other two groups. Our results indicate there consuming a Guayaki Yerbe Matte beverage before an exam may not provide any clear cognitive benefit when taking an exam.

***EFFECTS OF BODY WEIGHT AND COMPOSITION ON BONE MINERAL CONTENT***

**A. Wong1**, S. P. Shultz1,2

1Seattle University, Seattle, WA; 2Monmouth University, West Long Branch, NJ

Increased bodyweight (BW) is considered a protective condition for bone mineral content (BMC) in individuals with obesity due to the absorption of larger forces. However, little research has considered the effects on BMC based on stratified weight class and by body composition variables including lean mass (LM) and fat mass (FM). PURPOSE: To determine the relationship between BMC and BW normalized by LM and FM when stratified by weight class. METHODS: A dataset was amalgamated using DXA-measured variables that included BMC, BW, LM, and FM. A total of 32,066 adults from 13 datasets were included in the study. BMI classes were stratified based on WHO classifications. BW was normalized to LM (BW/LM) and FM (BW/FM). Paired t-tests were conducted to determine the differences between body tissue (LM vs FM) as well as normalized BW (BW/LM vs BW/FM). Pearson’s correlations were conducted for each BMI class to examine relationships between BMC and BW, BW/LM, and BW/FM. RESULTS: The paired t-tests produced significant differences between FM with LM (p<0.001) and BW/LM with BW/FM (p<0.001). For each BMI class, BW (p<0.01) and BW/FM (p<0.01) were positively correlated to BMC, while BW/LM (p<0.01) was negatively correlated to BMC (Table 1). CONCLUSION: Positive correlations indicate that increases in total BW and BW/FM can be protective for BMC. Mechanisms driving the negative correlation between BMC and BW/LM need to be explored.

Table 1. Correlations of BMC against total and normalized BW by BMI class

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| BMI Class | N | BMC vs BW | BMC vs BW/LM | BMC vs BW/FM |
| UW | 932 | 0.63\* | -0.41\* | 0.33\* |
| HW | 13,035 | 0.73\* | -0.51\* | 0.49\* |
| OW | 9,771 | 0.73\* | -0.51\* | 0.54\* |
| OB1 | 4,510 | 0.73\* | -0.48\* | 0.52\* |
| OB2 | 2,104 | 0.73\* | -0.42\* | 0.40\* |
| OB3 | 1,714 | 0.67\* | -0.34\* | 0.09\* |
| Total | 32,066 | 0.59\* | -0.16\* | 0.22\* |

\*Correlation is significant at the 0.01 level (2-tailed).

***APPERENCE OF GLUCOSE AND TRIGYCERIDE IN THE BLOOD FOLLOWING CONSUMPTION OF DIFFERENT NUTRITION BARS***

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Carbohydrates (CHO) are preferably oxidized when energy turnover occurs at a high rate, so increasing CHO intake may be beneficial during high-intensity exercise when higher rates of energy turnover occur. Higher intakes of triglycerides (TG) have been suggested to increase fat oxidation which could benefit endurance athletes. PURPOSE: To discover how ingestion of two nutrition bars with differing macronutrient content will impact blood TG (BTG) and blood glucose (BG) concentrations. We hypothesize that after ingesting a bar higher in CHO (HC), the BG will be greater, and that BTG will be greater after HF ingestion. METHODS: 6 female and 3 male healthy participants aged 20-22 years arrived fasted for two experimental trial days where they ate either the HC or the HF bar. The order of bar consumption was randomized. Capillary blood samples were obtained via finger stick while fasted and every 15-minutes for 90-minutes following consumption to measure BG and BTG concentrations. Respiratory exchange ratio (RER) was measured via indirect calorimetry for 5-minutes following finger sticks (while fasted and following consumption). The percent change in BG and BTG concentrations from fasted to peak post-consumption values were calculated and compared between bars using a paired t-test. RER throughout was analyzed using a two-way repeated measures ANOVA. RESULTS: Ingestion of both HC and HF bars resulted in significant increases in BG expressed as percent change from fasted to peak post-consumption concentration, with HC (50.5 ± 28.9 %) resulting in a larger increase than HF (32.8 ± 8.8 %), p = 0.05. Similarly, ingestion of both bars resulted in a significant increase in BTG, but there was no difference in percent increase between the two bars; HC (41.7 ± 65.5 %) and HF (72.0 ± 58.8), p = 0.408. There was no impact of the HC (0.83 ± 0.01) and HF (0.83 ± 0.01) on RER following consumption, p = 0.381. CONCLUSION: Our findings suggest that ingesting a HC bar could be more beneficial for short duration, high intensity workouts. While not statistically significant, the mean data may suggest that ingesting a HF bar could benefit longer duration, low intensity workouts that might benefit from an elevated BTG. Further research should aim to deduce how exercise metabolism is affected after consuming the bars during exercise.

***THE INFLUENCE OF ANXIETY LEVELS ON PHYSICAL ACTIVITY AND MENTAL HEALTH DURING THE FIRST YEAR OF UNIVERSITY***

**Lee, N. Y.** & Rauff, E. L.

Seattle University, Seattle, Washington

The transition to university exposes students to a multitude of stressors and increases their risk for poor mental health and a reduction in behaviors such as physical activity (PA). PURPOSE: This study examined the influence of anxiety level on differences in stress, depression, PA, and social support for PA in first-year university students. METHODS: First-year university students (*N*= 475; 22% male; 77% female) completed validated measures of their anxiety, stress, depression, PA, and social support for PA each quarter of their first year of university. Students were categorized as having low to moderate anxiety (LMA) or high anxiety (HA) based on their scores from the State-Trait Anxiety Inventory-Trait version. Three MANCOVA’s with Bonferroni correction controlling for biological sex were conducted across study measures. Kruskal-Wallis tests were utilized for variables that violated homogeneity. RESULTS: Significant multivariate effects for anxiety levels were observed at each time point (fall: WL = 0.5 F(4, 469) = 118.6, *p* < 0.001; winter: WL = 0.5 F(4, 149) = 36.5 *p* < 0.001; spring: WL = 0.5 F(4, 81) = 23.9 *p* < 0.001). During the fall, students with LMA reported significantly lower stress (*M* = 14.2, SD = 4.7) and higher minutes of moderate-to-vigorous PA (*M* = 332.7, SD = 344.6) compared to students with HA *(M’s* = 23.1, 252.6; SD’s = 5.0, 304.0)*.* In winter and spring, students with LMA reported significantly lower stress (*M’s =* 13.6, 13.9; SD’s = 5.3, 5.2) than students with HA (*M’s* = 23.3, 23.0; SD’s = 5.4, 5.2). Kruskal-Wallis tests examined depression, revealing that students with LMA reported significantly lower depression scores at each time point (*M* =13.0, 12.8, 11.6; SD = 5.7, 5.3, 5.1 respectively) when compared to students with HA *(M’s* = 28.2, 28.0, 26.8; SD’s = 9.5, 9.7, 9.5 respectively)*.* No significant differences were observed for PA behavior at additional time points. Social support for PA was not significant across groups at any time point. CONCLUSION: These preliminary findings indicate that first-year students who experience LMA are also more likely to report other positive mental health outcomes (i.e., lower stress and depression) throughout the year. PA may be an effective strategy for reducing students’ anxiety levels; however, social support for PA was not influenced by students’ anxiety levels.

***POWER SPECTRAL ANALYSIS DURING SLEEP AND DEVELOPMENT OF SPACEFLIGHT ASSOCIATED NEURO-OCULAR SYNDROME (SANS)***

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Approximately 70% of astronauts returning from 4-6 months of spaceflight present lasting neuro-ocular changes including retinal thickening, cotton wool spots, and optic disc edema among others. This syndrome of findings is termed Spaceflight Associated Neuro-Ocular Syndrome (SANS). Although the underlying mechanism leading to SANS is unclear, reduced metabolic clearance of neuro-ocular structures may play a role, and neurometabolic clearance occurs primarily via the glymphatic system that is most active during sleep. Sleep is known to be disrupted in spaceflight despite hypnotic drug use. Recently our group utilized a strict head-down tilt bed rest model (spaceflight analog) to induce findings of SANS.  We found that 5/11 subjects developed optic disc edema and, those who developed these ocular changes were shorter sleepers prior to, during, and after bed rest. Differences in sleep duration and sleep intensity are expected to result in unique electroencephalographic (EEG) activities. Thus, examining the EEG activity in those who do and do not develop optic disc edema may provide an electrophysiological biomarker to identify those at risk for developing SANS during long duration spaceflight. METHODS: Power spectral density (psd) was calculated using the MNE psd function in Python. Power values were averaged over conventional frequency bands (delta: 1-4 Hz, theta: 4-8 Hz, alpha: 8-13, low beta: 13-21, high beta: 21-35). A three-factor repeated measures ANOVA was used to test differences in sleep stages for each frequency range and channel across all participants and compared to a *Bonferroni* adjusted alpha. RESULTS: There were significant differences during non-rapid eye movement (NREM) stage 2 sleep in alpha power, in addition to low and high beta power. CONCLUSION: Blunted alpha and beta activity during N2 sleep could suggest increased risk for developing SANS.

***RELATIONSHIP BETWEEN EXERCISE VOLUME AND BODY APPRECIATION IN UNDERGRADUATE STUDENTS***

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Participation in physical activity, exercise, and sports has been previously linked to self-body image. However, the influence of exercise volume, specifically, is less well known. PURPOSE: The purpose of this study was to examine the relationship between exercise volume and self-body image amongst undergraduate students. METHODS: 500 full-time undergraduate students aged 18-23 years old were recruited via random and pseudo-random sampling to participate in an online survey. Of these, 119 eligible respondents (Nmale = 43, Nfemale = 72, Nnon-binary = 4) volunteered to participate in the survey. Preliminary survey questions prompted respondents to describe exercise volume and patterns. The remaining portion of survey consisted of the Body Appreciation Scale-2 to assess self-body image. Questions within this section were based on a 5-point Likert scale and a total body appreciation score was calculated based upon the sum of those responses. Due to the ordinal nature of exercise volume data, a Spearman correlation coefficient was used to determine the relationship between the measured dependent variables. RESULTS: There was a moderate, positive correlation (*r* = 0.41, *p* < 0.05) between exercise volume (0-150 min/week = 44 respondents, 150-300 min/week = 37 respondents, 300+ min/week = 38 respondents) and body appreciation scores (55.5 ± 10.7). Further analysis indicated that exercise volume and body appreciation scores varied across gender which elicited different relationships (males: *r* = 0.22, females: *r* = 0.43). CONCLUSION: As a whole, exercise volume was positively linked with body image for this sample population. However, the present results should be cautiously interpreted due to differences between genders. Males tended to report higher body appreciation scores and disproportionately higher exercise volumes than females, yet males demonstrated a weaker relationship between these variables. Further research may be necessary to better understand how other aspects of exercise, such as frequency or intensity may influence self-body image in undergraduate students.

EXPLORING A ROLE FOR CHROMATIN-REMODELING ENZYMES IN OXIDATIVE STRESS AND CARDIOVASCULAR DISEASE.

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Cardiovascular disease (CVD) is the leading cause of death in the United States and oxidative stress is one contributing factor to dysfunction of the cardiovascular system. Chromatin remodeling complexes (CRCs) are enzymes that aid the regulation of DNA-histone binding to alter gene expression. Two CRCs, brahma (BRM) and brahma-related gene 1 (BRG1), are known to increase oxidative stress in cancer models but their role in the adult vasculature is poorly understood. PURPOSE: To measure the expression of oxidative stress markers after knockdown of BRG1/BRM in human vascular smooth muscle cells (SMCs). METHODS: Adult human SMCs were cultured and BRG1 and BRM were knocked down via an interfering RNA approach. Total RNA was isolated and quantitative polymerase chain reaction was used to measure the expression of several oxidative stress-related genes. RESULTS: Analysis of gene expression of oxidative stress-related markers including cellular-myleocytomatosis (c-MYC), superoxide dismutase (SOD), NADPH oxidase 4 (NOX4) and human SHC‐transforming protein 1 (SHC1) are ongoing and will be discussed. Based on literature, we expect that the levels of c-MYC and SOD will increase, while NOX4 and SCH1 will decrease. CONCLUSION: Our attempts to establish preliminary evidence linking CRC regulation of oxidative stress in adult human SMCs. This would be the first report of CRC-mediated oxidative stress in the adult vasculature and may open novel research opportunities for studying oxidative stress and CVD.

***DIFFERENCES BETWEEN PERCEPTIONS OF HEALTH CARE IN URBAN AND RURAL COMMUNITIES***

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Whitworth University, Spokane, WA

Access to healthcare in rural areas has been shown to be a health disparity in the United States. Despite the research on rural health access, the perception of access between rural and urban populations among younger populations is poorly understood. Younger populations may provide insight on how to influence future health care in rural areas. PURPOSE: The purpose of this study was to compare perceptions of healthcare affordability, accessibility, and receptivity between rural, small, and urban areas. METHODS: Full-time undergraduate and graduate students (18-30 years old) were identified as the target population. An email was sent out to 500 students through random sampling which invited them to participate in a survey. The survey instructed participants to identify their perceptions of healthcare accessibility, affordability, and receptivity in their home community. Answers were based upon a Likert scale from one to five. Data was compared between three participant groups: those who were from rural (R; < 20,000 people), small (S; 20,000-250,000), and urban (U; >250,000) communities. An analysis of variance ANOVA (*p* ≤ 0.05) was used to calculate the differences between perceptions of accessibility and affordability. However, a Kruskal-Wallis test (*p* ≤ 0.05) was used to compare perceptions of receptivity due to non-parametric data distributions. RESULTS: There was a significant difference in perceptions of receptivity between population sizes (R: 9.4 ± 3.5, S: 12.4 ± 3.0, U: 9.9 ± 4.9, *p* = 0.018). There was no difference between population sizes for perceptions of accessibility (R: 11.1 ± 2.1, S: 12.9 ± 2.8, U: 11.5 ± 3.8, *p* = 0.140) and affordability (R: 10.1 ± 3.1, S: 10.8 ± 2.9, U: 9.8 ± 3.3, *p* = 0.607). CONCLUSION: Participants from rural and urban areas had lower perceptions of receptivity to healthcare than those from small areas. According to another report, 89% of physicians in the United States practiced in urban areas and 2.6% practiced in small rural areas. In both situations, more patients than providers may mean greater demand and long waits for care, shorter visit times, and less chance of building trust with a provider. Additional participants and refined lines of questioning are needed to improve the generalizability and applicability of further research on perceptions of healthcare in younger populations.

***EFFECTS OF HEARTMATH INTERVENTION ON UNDERGRADUATE STUDENT PERCEIVED STRESS AND WELL-BEING***

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PURPOSE: To evaluate the effectiveness of an online educational program on reducing perceived stress and improving well-being for undergraduate students through learned coping skills. Two hypotheses were developed: 1) pre/post-test scores for the Perceived Stress Scale (PSS) will be significantly different, and 2) pre/post-test scores for the Flourishing Scale (FS) will be significantly different. METHODS: Twenty-one undergraduate students participated. A mixed methods approach was used, making pre-post quantitative comparisons using the PSS and FS scales, followed by structured open-ended survey questions. Questions were asked in the same order with identical follow-up prompts for all participants. Co-researchers individually coded survey items first through open coding, followed by group axial coding to ensure consensus, develop higher level concepts and sub-themes. RESULTS: There was no significant difference in pre (M=19.191, SD=7.39) and post PSS scores (M=18.91, SD=7.50); t(20)=-.202, p = 0.842. There was no significant difference in pre (M=44.14, SD=8.82) and post FS scores (M=45.52, SD=10.00); t(20)=-1.09, p = 0.29. Interpretative themes were identified through interview responses to the question “Would you say skills were useful, and why:” 83% indicated yes, with holistic relaxation, stress and anxiety minimizer, and partially useful as rationale. Additionally, interview responses to the question “List life moments in which you have found the coping skills beneficial to you” were grouped into the following themes: emotional distress, life transitions, and performance-based situations. Finally, all participants reported they knew someone who would benefit from the program, and 93.1% said they would recommend it to that person. CONCLUSION: Our findings indicate there were no differences in overall perceived stress following the intervention. However, significant increases in three PSS items showed less perceived control and greater emotional distress for unexpected inconveniences, but perceived well-being remained unchanged. Notably, participants reported they were able to apply learned techniques to various situations, and 93% responded they would recommend the educational program to someone they knew would benefit.

***ACCURACY OF A WRIST-WORN CLINICAL ACTIVITY MONITOR FOR PREDICTING WALKING ACTIVITY ENERGY EXPENDITURE***

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Wrist-worn electronic devices are common for everyday monitoring of many biophysical metrics (e.g., heart rate, SpO2, physical activity, energy expenditure (EE), and sleep quality). Without exception, these devices always include an accelerometry-based physical activity monitor (AM) for indirectly sensing whole-body motion and EE metrics. Due to the need for FDA clearance, however, AMs for clinical assessments have had less attention than their non-clinical commercial counterparts. PURPOSE: This study’s purpose is to determine the accuracy of a clinical wrist-worn AM to predict energy expenditure during steady-state walking in both lab (treadmill, TM) and free-living (overground, OG) settings. METHODS: Twenty college-aged women (Mean±SD: 21±3 yrs; 22.3±2.3 kg/m2 BMI; 21.9±5.6 %BF; n=11) and men (19±1 yrs; 24.2±1.9 kg/m2 BMI; 14.3±7.2 %BF; n=9) were recruited to participate in a one-hour visit to the MSU Human Performance Lab. For each subject, direct measures of EE (portable indirect calorimetry) and measures of predicted EE from a wrist-worn AM designed for clinical environments were collected simultaneously during 10-mins of quiet sitting (RMR), 5 mins each of self-selected slow, medium, and fast-paced TM walking, and 5 mins each of the same speeds during outdoor OG walking, paced with a pacer using GPS. After collection, predicted measures of activity EE (PAEE, kcals/min) from the AM were then compared directly with calculated measures of AEE (EE for walking activity - EE for RMR; kcals/min) using paired t-tests for all 6 TM and OG walking conditions (𝞪=0.01 after Bonferroni adjustment). RESULTS: Predicted mean AEE for TM walking was higher than mean AEE for all TM speeds (Mean difference = +0.9 to +1.4 kcals/min; P=0.01-0.03), but this difference was only significant at the fast TM speed (P=0.01). Additionally, both the slope and y-intercept values for the regression of TM PAEE on AEE differed significantly from those of the line of identity (P<0.001). In contrast, PAEE was statistically similar to AEE at all speeds for OG walking (Mean differences = +0.3 to -0.5 kcals/min; P=+0.34 to +0.53). CONCLUSION: Our findings indicate that this clinical wrist-worn AM was accurate for OG walking, but tended to overpredict AEE for TM walking. This AM should predict AEE relatively well for free-living walking activities.

**Professional Abstracts**

***ASSESSING THE VALIDITY OF THE GARMIN VENU SQ FOR ESTIMATING VO2MAX***

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Low cardiorespiratory fitness is associated with an increase in risk of developing cardiovascular disease (CVD) and premature death. However, while recognized as an important risk factor to consider when assessing health, it is not routinely assessed in clinical settings. PURPOSE: To assess the accuracy and validity of the Garmin Venu SQ’s VO2maxestimations. METHODS: Healthy, college-aged students (n=13) completed three exercise trials while wearing the Garmin Venu SQ. Participants first ran two trials of the 1.5-mile standardized run test to produce a watch estimation of VO2max before completing a VO2max test on a treadmill in a laboratory using a metabolic analyzer (Parvo Medics TrueOne 2400). The watch estimation of VO2max was then compared to the VO2max attained in the laboratory to assess the level of agreement between the two measures. RESULTS: The mean estimated VO2max from the Garmin watch was 53.3 ± 6.2 ml/kg/min, while the mean VO2max measured in the laboratory was 54.6 ± 11.7 ml/kg/min. A Bland-Altman plot shows “good agreement” (all case-wise differences lie within ±2 SD of the mean difference) between the watch estimation and the measured VO2max values, but also shows a proportional bias in high-fitness (near or above a measured VO2max of 60 ml/kg/min) participants. The Garmin watch tends to produce a lower VO2max estimation for those with higher fitness, relative to measured VO2max, and vice versa. In addition, the spread among the data points is higher among those with higher fitness. CONCLUSIONS: Our findings indicate that the estimated VO2max produced by the Garmin Venu SQ has good overall agreement with actual VO2max values measured in a laboratory setting. However, the fitness tracker may underestimate VO2max in highly-fit individuals.

***THE DEVELOPMENT OF INCREMENTALLY GRADED EXERCISE TEST (GXT) PROTOCOLS FOR PARA NORDIC ATHLETES***

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Para cross-country skiing and para biathlon – collectively referred to as para Nordic – are sports that have been Paralympic events since 1976 and 1988, respectively. PURPOSE: Given the complete lack of published VO2MAX testing protocols reported in the literature for para Nordic athletes, the purpose of this pilot study was to document the development of treadmill-based roller skiing graded exercise test (GXT) protocols for para Nordic athletes. METHODS: 3 women and 5 men (Mean±SD: 22±3 yrs age), including 3 sit (LW 12 disability classifications) and 5 standing (4x LW 8; 1x LW 5-7) skiers, volunteered and were training with the U.S. Paralympics Nordic Skiing Team at the time of testing. First, skiers warmed up roller skiing for 10-20 mins on an oversized treadmill (2.44 m wide x 3.05 m long belt size) using either skate roller skis (standing skiers) or roller skis mounted to their sit-ski buckets (sit skiers). Skiers were protected from falls with an overhead harnessing system during warm-up and testing periods. The GXT protocol, which was modelled after a protocol used with able-bodied skiers, started with the treadmill at a fixed grade (2-4%) and then increased in speed by 0.8 KPH (0.5 MPH; variable starting speed 6.4-8.0 KPH) for each stage until “threshold”, after which speed dropped by 0.8 KPH and grade increased by 1.0% for each stage until volitional exhaustion. Without metabolic testing, test success was based upon satisfying at least 2 of 3 criteria: 1) HRMAX ≥95% age predicted HRMAX; 2) Immediate post-blood lactate ≥8.0 mmol/dl. 3) RPE ≥9 (0-10 scale). With metabolic testing, test success was based upon satisfying at least 3 of 4 criteria: Same first two criteria; 3) RER≥1.15; 4) VO2 “plateau”. RESULTS: For the tests without metabolic testing, 2 satisfied all 3 criteria, 1 with 2 criteria, and 1 test failed with 0 criteria. For tests with metabolic testing, 2 satisfied all 4 criteria, 1 with 3 criteria, and 1 test failed with 1 criterion. CONCLUSIONS: Use of standardized test completion criteria, as well as a modified roller-skiing treadmill GXT, were successful at taking 6 of the 8 para Nordic athletes to volitional exhaustion. Further testing and exploration of testing protocols is needed to determine how both maximal and submaximal GXT testing may be beneficial to training and performance enhancement of para Nordic skiers.

***PRELIMINARY ANALYSES OF HOME AND AWAY GAME RECOVERY IN STUDENT-ATHLETES USING A HOLISTIC COACHING APP***

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Collegiate basketball athletes have a season of ~80 games with half of these played on the road. Research has shown that road games result in different psychological approaches for athletes as well as nutritional changes. However, little is known about the ability to recover from road games compared to those played at home. Wearable technology allows us to understand physiological metrics for recovery by using heart rate variability, resting heart rate, sleep performance, and respiratory rate. Further, athlete-facing coaching apps partnered with wearable devices may offer additional benefits to recovery following competition. PURPOSE: To determine differences in recovery metrics after home and away games in collegiate basketball athletes using a wearable device with and without a holistic coaching app. METHODS: Division I basketball athletes (n = 11; 64% female) were randomized to either the wearable-only group (W; n = 5) or the wearable and coaching group (WC; n = 6). All athletes wore a wearable device continuously for 8 weeks that recorded heart rate, heart rate variability, and sleep performance. Athletes in the WC group also received coaching from a holistic, athlete-facing coaching app. Recovery metrics were provided from the wearable device using a proprietary algorithm. Games were categorized as played at home or away. A 2 (game) x 2 (group) repeated measures ANOVA was used to determine differences in recovery. RESULTS: There was no significant interaction between game and group (p = 0.09). No significant differences were detected in recovery metrics due to game location (p = 0.62) or group (p = 0.89). Average recovery scores at home games were 54.6 ± 17.0% and 51.4 ± 21.2% for the W and WC group, respectively. The W group had a non-significant decline in recovery after away games (45.5 ± 13.0%) while the WC group saw a non-significant increase (62.8 ± 18.2%). CONCLUSION: Preliminary analyses showed there were no significant differences in recovery metrics between home and away games for the two groups. However, there were some notable, non-significant changes in recovery scores that may be important for athlete well-being and overall performance. Further research is needed in a larger sample of collegiate athletes to determine the effects of a holistic coaching app on recovery metrics after home and away games.

***CHANGES IN PSYCHOSOCIAL FACTORS TO A HOLISTIC COACHING APP IN DIVISION I BASKETBALL ATHLETES***

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Psychosocial factors, such as grit, resilience, and mental toughness, are shown to correlate with athletic performance and overall athlete well-being. Recently, personalized wearable technology has been highlighted to enhance athlete well-being; yet there is little evidence to support this. Further, research has indicated that wearable devices may be more effective when partnered with individual coaching. PURPOSE: To determine the effects of wearable devices and a holistic, athlete-facing coaching app on psychosocial factors in Division I basketball athletes. METHODS: Division I basketball athletes (n = 12; 58% female) reported their grit, resilience, and mental toughness using validated surveys before and after 5 weeks of wearable device use. Athletes were randomized to either a wearable only (W; n = 6) or wearable and coaching (WC; n = 6) group. The WC group received 4 weeks of individualized coaching through an athlete-facing coaching app. Differences in psychosocial factors were analyzed using ANCOVA with baseline values as covariates. RESULTS: There was a significant difference in perseverance grit between the two groups (W: 4.1 ± 0.2 vs. WC: 4.3 ± 0.5; p = 0.01). There was no significant difference in passion grit between the two groups (W: 3.1 ± 0.3 vs. WC: 3.8 ± 0.4; p = 0.15). Further, there were no differences in resilience (p = 0.65) or mental toughness (p = 0.34) between the two groups after controlling for baseline values. Resilience (W: 78.8 ± 6.3 vs. WC: 88.7 ± 8.5) and mental toughness (W: 37.3 ± 3.2 vs. WC: 40.2 ± 2.1) levels were slightly, but non-significantly, higher in the WC group compared to the wearable only. CONCLUSION: Perseverance grit is significantly higher in athletes who use a wearable device combined with a holistic coaching app than those only using a wearable device. There were no significant differences in passion grit, resilience, or mental toughness. However, scores were ~10% higher in the WC group compared to the wearable only, which may be meaningful for athlete well-being and success. Notably, these findings are limited by a small sample size and a short intervention duration (i.e., 4-5 weeks). Further research is needed to determine the long-term effects of wearable device use and coaching on psychosocial factors in a larger, diverse sample of college athletes.

***PHYSICAL THERAPY AFTER MILD TRAUMATIC BRAIN INJURY DOES NOT IMPROVE EYE MOVEMENT FUNCTION DURING WALKING***

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Vestibular and ocular motor impairments after mild traumatic brain injury (mTBI) may lead to protracted recovery and potentially affect coordination. Ocular motor function is typically measured in a static seated position. Mobile eye-tracking can measure eye movements while performing dynamic tasks. Recently, we showed that people with mTBI had decreased saccade frequency, velocity, and duration while walking. It is currently unknown if vestibular rehabilitation after mTBI improves saccade function while walking. PURPOSE: To compare changes in saccadic function pre-post physical therapy to those recovering naturally without intervention. METHODS: All participants were symptomatic from an mTBI (2-12 weeks post-injury). Subjects completed baseline and 6-week follow-up testing either after rehabilitation (rehab, n = 43, age = 33.6 ± 12.1) or no intervention (non-rehab, n = 50, age = 34.5 ±1 2.4). The rehab group received 8 sessions of physical therapy that included cervical, aerobic, and vestibular therapy. At both testing timepoints, participants did a continuous 1-minute walking task over a straight 9m path while wearing a mobile eye-tracking system to record gaze coordinates. A validated algorithm calculated saccade duration, peak velocity, and frequency. Linear mixed effect models were used that included fixed factors for group, time, and their interactions. RESULTS: There were no significant effects on saccade duration or peak velocity during the 1-minute walk for either group at the baseline and follow-up tests (*p’s*>0.05). The rehabilitation group significantly increased saccade frequency after rehabilitation while the non-rehab group did not change (βgroupXtime = 0.29 [95%CI: 0.08, 0.51]). However, the rehab group had significantly reduced saccade frequency at baseline compared to the non-rehab group (βgroup = -0.37 [95%CI: ‑0.66, ‑0.08]). CONCLUSIONS: While we observed significant effects of rehabilitation on saccade frequency, other saccade measures did not show similar improvements. Furthermore, baseline group differences on saccade frequency suggest this finding should be interpreted with caution. The overall null findings on saccade function may be attributed to the lack of ocular motor exercises in the physical therapy program.

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***VALIDITY, SENSITIVITY, AND RELIABILITY OF REMOTELY ADMINISTERED PUSH-UP AND PLANK TESTS***

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PURPOSE: To measure validity, sensitivity, and reliability of push-up and plank tests when administered remotely with videoconferencing. METHODS: We administered an in-person strength measure and two remote field-based tests of muscular fitness in adult clinical exercise trial participants (*n*= 150; mean age 61.6 ± 12.8 years; 77 (51.3%) female; 77 (51.3%) cancer survivors). Tests were administered at baseline and after a 6-month strength training program. To assess reliability of remotely-administered tests they were repeated one week after baseline measures by the same (intra) or different (inter) assessors. Maximal upper body strength was assessed in-person by 1-repetition maximum bench press (1RMBP). Muscle fitness tests included a push-up (standard or modified knee) and plank test. Pearson’s correlation coefficients were used to determine validity of the push-up and plank tests to 1RMBP. Paired, one-sided t-tests evaluated the sensitivity of the 1RMBP, push-up, and plank tests to detect change over 6-months. Intraclass correlation coefficients (ICC) and 95% confidence intervals (95% CI) were used to determine intra- and inter-rater reliability—one-way random models for inter-rater and two-way mixed for intra-rater. RESULTS: Standard push-ups showed a medium correlation to 1RMBP at baseline (*r*(50) = .39, *p* = .01) and 6-months (*r*(21) = 0.45, *p* = .03). Modified push-ups showed a small correlation to 1RMBP at baseline (*r*(44) = .29, *p* = .05), but less at 6-months (*r*(26) = .16, *p* = .43). Plank showed a small correlation to 1RMBP at baseline (*r*(105) = 0.23, *p* = .02) and 6-months (*r*(53) = .30, *p* = .03). Increases in muscle fitness over 6 months were detected by 1RMBP (*M* = 15.3 lbs, *SD* = 13.6, *t*(40) = 7.23, *p* < .001), push-ups (*M* = 4.9 repetitions, *SD* = 6.7, *t*(32) = 4.19, *p* < .001), and plank (*M* = 32.9 sec, *SD* = 37.8, *t*(38) = 5.44, *p* < .001) tests. Intra-rater (push-up: ICC = .97, 95% CI [.92, .99] and plank: ICC = .87, 95% CI [.58, .96]) and inter-rater (push-up: ICC = .93, 95% CI [.84, .97] and plank: ICC = .95, 95% CI [.89, .98]) reliability were excellent. CONCLUSION: A remotely-administered standard push-up test is a moderately valid, yet sensitive and reliable alternative measure to an in-person test of maximal upper body strength. Remotely-administered knee push-up and plank tests are less valid, but still sensitive and reliable.

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