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Abstract

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Serial Reaction Time in Adults Who Have Recovered from COVID-19

Proceedings of the Third Society for NeuroSports (SNS) Conference

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Introduction: The coronavirus disease (COVID-19), caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), is primarily known as a respiratory condition. However, COVID-19 has also been shown to lead to long-term cognitive dysfunctions referred to as long COVID. As secondary outcomes of the disease, infected individuals have been shown to develop central nervous system deficits, affecting primarily the frontal and temporal regions of the cerebral cortex. The prefrontal cortex is implicated with a myriad of cognitive-motor functions, such as implicit motor learning. Thus, one way to examine if COVID-19 survivors endured damage to the neurologic systems is through testing implicit motor learning. The main objective of this study was to investigate implicit motor learning through a serial reaction time task in adults who have recovered from COVID-19.
Methods: We assessed motor sequence learning of 34 college students through a Serial Reaction Time Task (SRTT). Participants were asked to press computer keys corresponding to visual stimuli appearing at fixed spatial locations on a computer screen as quickly as possible. The stimuli were presented in a fixed learning sequence. We investigated if impaired implicit motor learning was predicted by COVID-19 infection. We hypothesized that COVID-19 infection would predict impaired motor learning and reaction time. We also hypothesized that physical activity and vaccine status would have a protective effect. To assess physical activity levels, we administered the International Physical Activity Questionnaire - Short Form (IPAQ-SF). Performance of the SRT task (skill) was calculated by subtracting the mean reaction times of the last 50 random trials from the last 50 sequential trials. Reaction time was calculated by taking the mean reaction times from the last 50 random trials. We ran a hierarchical multiple regression specifying skill as a dependent variable; Covid, vaccine, and physical activity status as the major independent variables; and gender and age as covariates. We also ran a hierarchical multiple regression specifying reaction time as a dependent variable; Covid, vaccine, and physical activity status as the major independent variables; and gender and age as covariates.
Results: We analyzed data from 34 adults (17 females and 17 males, M age = 24.04, SD = 4.07 years). Of our participants, 18 individuals were vaccinated, and 23 were infected. The results from the hierarchical linear regression model indicated that skill was not significantly explained by the independent variables ($p = .323$). The results from the second model indicated that reaction time was significantly explained by our model $F(6, 22) = 4.804$, $p = .002$. In the first and second models, vaccine status ($p = .684$; $p = .108$) and physical activity level ($p = .089$; $p = .495$) were not significant in predicting reaction time after controlling for the other variables in the model.

Conclusions: Our findings suggest that individuals who recovered from a Covid-19 infection demonstrated poorer performance in a reaction time task, which requires higher visual sensitivity and information processing speed when compared to non-infected individuals. However, whether COVID-19 disease or its secondary outcomes affect implicit motor learning remains unclear.

Repeated mild traumatic brain injuries and increased dementia risk: A pilot study investigating cerebral amyloid angiopathy as a mechanistic link

Proceedings of the Third Society for NeuroSports (SNS) Conference

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Introduction: Traumatic brain injury (TBI) is estimated to affect ~69 million people worldwide each year. Mild TBI's are the most common form of brain injury (~70-90% of all cases), characterized by little-to-no time unconscious and minimal observable deficits immediately post-injury. Mild brain injuries are commonly attributed to participation in contact sports (e.g. boxing, football, soccer, hockey) and military service. Even mild TBIs, especially repeated injuries, have devastating long-term consequences, including an increased risk of stroke and dementia. Therefore, it is of great interest to determine the mechanisms that drive the relationship between different types of TBIs and various aspects of dementia-associated neuropathology, so that targets for intervention may be identified. Repetitive mild TBIs are most notably associated with chronic traumatic encephalopathy (CTE; a tauopathy), though some evidence suggests they may also contribute to Alzheimer's disease and other neurodegenerative conditions. However, less is known about whether cerebral amyloid angiopathy (CAA) may also be a mechanism linking TBI to dementia. CAA is the accumulation of amyloid protein (most commonly beta-amyloid, associated with Alzheimer's disease) within the cerebral vasculature, contributing to increased risk of dementia [both vascular contributions to cognitive impairment and dementia (VCID) and Alzheimer's disease], as well as ischemic and hemorrhagic stroke. Increased levels of CAA are observed in former athletes, who tend to have a history of repetitive mild brain injuries; however, animal studies are needed to experimentally determine whether and how repetitive mild TBIs influence the initiation and progression of CAA and related pathologies.
Materials and Methods: Male Tg-SwDI mice (mouse model of CAA) were subjected to sham (CAA-Sham; 1.5% isoflurane anesthesia for 5 minutes) or repeated mild TBIs (CAA-TBI; closed-head weight drop following 5 minutes of 1.5% isoflurane anesthesia; 1x/day for 4 consecutive days) at ~2 months of age. This age is roughly equivalent to late adolescence/young adulthood, when TBI is most common. CAA-Sham and CAA-TBI were compared to male C57Bl/6J wild-type control mice (WT). Cognitive-behavioral outcomes were assessed 1-month post-TBI.
Results: The repeated TBIs were mild in nature, demonstrated by no significant increase in time to righting following the TBI vs. sham procedure, as well as no appreciable difference in measure of general well-being (food intake, body weight). CAA mice exhibited decreased exploratory behavior and potential disorientation; this was unaffected by TBI history. Of note, while spatial working memory was intact in all groups, performance on a longer-term spatial memory task was impaired by CAA and TBI in an additive manner.
Conclusions: Taken together, these findings demonstrate that even mild repeated TBIs can exacerbate cognitive decline associated with CAA pathology. Future work will investigate

additional timepoints post-TBI, as well as whether biological sex moderates the relationship between repetitive mild TBI and CAA-associated outcomes. Our long-term goal is to identify mechanisms linking TBI and increased dementia risk, which may in turn reveal novel targets for treatment.

Effects of Forced Exercise on Brain Injury

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Introduction: Traumatic brain injury is a worldwide public health problem. In the United States, approximately 1.5 million people suffer traumatic brain injury (TBI) annually and 300,000 of those are sports-related. Many athletes suffer mild TBI during their workout. In this study, we examined how forced exercise effects brain injury. We exposed rats to stress and a mild traumatic brain injury and then ran behavioral tests: elevated zero maze, sucrose preference test, and novel object recognition. After the rats were euthanized, we conducted brain analysis.

Methods: This study examined the effects of forced exercise on brain injury in male and female rats using a 2 (control vs. forced exercise) x 2 (sham vs. TBI) x 2 (male vs. female) design. For this experiment, 46 Long-Evans rats will be used. At 45 days, male and female rats will be randomly divided into four groups. Rats from each group will be tested in the Elevated Zero Maze (EZM) to assess anxiety-like behavior in rats, a sucrose preference test (SPT) to assess anhedonia and the novel object recognition (NOR) to investigate memory.

Results: We analyzed sucrose preference test and found significant TBI + stress interaction $p = .0064$. In no TBI condition, stress did not have an effect but after the brain injury, there was less consumption of sucrose and stress made it even worse. Further, we found significant TBI + sex interaction $p = .0374$. In no TBI condition, females drank more sucrose solution compared to males. But after TBI, male drank more sucrose solution than females and more sucrose solution than in no TBI condition.

Conclusions: Our findings suggest that brain injury interacts with stress making it worse. Further, males are less anhedonic following brain injury than females and less anhedonic than males who did not receive TBI. These findings suggest that exercise in athletes and sex may modify the consequences and outcomes of TBI. This opens up room for further research as to why males who have a brain injury are less anhedonic than healthy males.

The Effects of Music and Exercise on Learning Rate and Memory

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Introduction: Research has consistently shown that exercise positively benefits cognition. Furthermore, music has also been shown to benefit cognitive processes. The current study compares the effect arousal and mood induced by exercise and music respectively, have on learning and memory. If the effects of exercise on cognition are due (whole or in part) to arousal and mood rather than physiological explanations, we should expect similar benefits for cognitive performance following both the music and exercise conditions.
Methods: 139 participants were randomly assigned one of four conditions: (1) exercise for 6 minutes, (2) exercise for 20 minutes, (3) listen to classical music for 6 minutes, or (4) listen to classical music for 20 minutes. Prior to each condition, participants were asked to complete a Physical Activity Questionnaire (PAR-Q) to determine their eligibility to exercise and an Affect Grid to self-report their levels of pleasure-displeasure and arousal-sleepiness prior to the condition. Following the condition, participants completed the Affect Grid again and then completed a Paired Associate Learning (PAL) task. This task includes 40 cue-target word pairs and participants were instructed to remember the target word associated with each cue. After each of the 40 pairs were presented, participants were given a cue word and were instructed to recall the target word. This was repeated 7 times. We recorded how many pairs they answered correctly each time they went through the PAL to measure learning rate. Participants then completed the Music Experience Questionnaire, the Behavioral Inhibition/Avoidance Scale, the Short Test of Music Preferences, and a Demographics Survey. Finally, participants completed a surprise recall test of the target words from the PAL task to measure retention.
Results: Preliminary analyses indicate that only participants in the 20 minute exercise condition showed a significant increase in arousal, as measured by the Affect Grid. Additionally, participants in the 20-minute exercise condition are showing a faster learning rate and better retention than the other conditions, though the difference is not significant.
Conclusions: Results indicate that the 20 minute exercise condition provided optimal levels of arousal, faster rates of learning, and better long-term recall. The music conditions showed minimal benefits, indicating that exercise more significantly influences memory and learning compared to music.

The Impact of Inadequate Sleep on Overtraining Syndrome in Intercollegiate Athletes

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Introduction: Student athletes experience acute fatigue and decrease in performance from intense training sessions. Continued cycles of training with inadequate recovery leads long term decline in performance, otherwise known as overtraining syndrome. Although there are psychological aspects as well, overtraining is generally defined as an excessive overload with an inadequate amount of recovery. Sleep is a critical component of rest and recovery essential for fatigue management in student athletes. As research has shown the impact of adequate sleep on improving memory and cognitive function, this may also be an effective component of prevention for overtraining syndrome in the intercollegiate athlete.
Methods: The study was designed as a systematic review of randomized controlled trials (RCTs). The authors only included articles detailing the discussion of overtraining, the role of sleep and athletes with increased load and inadequate sleep. Data was collected using PubMed and Google Scholar using keywords of "sleep", "recovery", "overtraining", "injury", and "intercollegiate athletes". Articles were searched within the past 20 years, excluding any case reports, proposals, literature reviews and articles that did not fit the study framework. The initial search included 241 articles of which 31 articles were selected to be included based on the inclusions and exclusion criteria.
Results: The results of the analysis of the articles gathered included several stressors related to overtraining syndrome, with lack of sleep playing a major role. According to the literature student-athletes require a minimum of 7-8 hours of sleep to prevent injury and for proper recovery when injured. Accumulation of high training load with insufficient repair time due to lack of sleep can lead to overtraining in athletes. When athletes suffer from inadequate levels of sleep with higher training loads, there are increased levels of fatigue. Athletes experiencing high levels of fatigue have a lack of energy, motivation, alertness, as well as hindering the immune system leading to further decline in performance from overtraining. Inadequate levels of sleep also affect glycogen metabolism, process of removing toxins, and Growth Hormone release further complicating the impact for student athletes. The lack of sleep an athlete experiences causes a decline in physiological functions leading to overtraining syndrome as well as worsening current symptoms they are experiencing.
Conclusions: The results of this study suggest the importance of adequate levels of sleep and its impact on overtraining syndrome in athletics. Future research may develop appropriate strategies to help coaches and physicians identify overtraining syndrome in athletes and ways to manage this throughout their season.

Post-activation Performance Enhancement Through Variable Loading Maintains Power Output Over Five Sets in Highly Trained Athletes

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Introduction: Postactivation performance enhancement (PAPE) is a phenomenon where acute improvements in power production (i.e. during a countermovement jump) occur after near maximal [>85% 1 repetition maximum] voluntary muscle contraction (i.e. during a heavy squat)]. Mechanisms of PAPE include increased phosphorylation of the myosin light chain, heightened sensitivity of actin and myosin to calcium availability, and increased excitability of α-motorneurons. PAPE may be induced with variable loading (VL) where resistance in the form of chains or bands is added to the bar as it displaces in the concentric phase. PAPE studies have primarily been laboratory based and testing across only three sets. Data from real-time, in-session training which involves more than three sets are lacking. Thus, we sought to examine the acute effects of five sets of VL on the PAPE response during a live training session in highly trained athletes.
Methods: We tested 12 American football players preparing for the 2023 National Football League draft representing a variety of field positions during a lower body training session (height =188 ± 0.01 cm, mass = 114.4 ± 24.3 kg). They performed a contrast PAPE protocol consisting of 2 baseline countermovement jumps with an arm swing (CMJ) followed by five sets of heavy VL half-squats using chains alternated with 2 CMJs. To determine potentiation effects, the CMJs were performed on dual force platforms 2-4 min. after each squat set where jump height (in), absolute peak power (W), normalized peak power (W/kg), and reactive strength (m/s) were recorded. Data were reduced using a Repeated Measures Analysis of Variance, $\alpha = 0.05$.
Results: Participants showed no significant changes in jump height, absolute peak power, normalized peak power, or reactive strength across the five sets, (p>.05) demonstrating stability in power output. PAPE did produce practical increases in reactive strength (baseline, 0.66±0.15, set 1, 0.67±0.19, set 2, 0.68±0.18, set 3, 0.67±0.20, set 4, 0.67±0.19, set 5, 0.67±0.17 m/s) and decreases in jump height (baseline, 20.3±2.9, set 1, 19.8±3.0, set 2, 19.9±3.1, set 3, 19.6±3.2, set 4, 19.6±3.4, set 5, 19.5±2.9 in), absolute peak power (baseline, 8125±1116, set 1, 7968±984, set 2, 7946±1140, set 3, 7885±989, set 4, 7900±902, set 5, 7988±1038 W), and normalized peak power (baseline, 72.0±6.3, set 1, 71.0±8.8, set 2, 70.8±9.2, set 3, 70.3±9.5, set 4, 70.8±10.7, set 5, 71.1±8.7 W/kg). Findings suggest that power is at least maintained over multiple sets of VL induced PAPE. These findings may be unique to highly trained athletes who may be less susceptible to fatigue.
Conclusions: Acute post-activation performance enhancement through variable loading appears to preserve power output across multiple sets and may be beneficial in lower body power development in highly trained athletes.

Microglial responses to high fat diet vary in a sex-specific manner across diverse brain Regions

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Introduction: Microglia are the resident immune cells in the central nervous system. Microglia activate and release cytokines in response to immune challenges, mediating the innate response. Microglia also maintain brain homeostasis through phagocytosing cellular debris and apoptotic cells, pruning synapses, and secreting trophic factors. Microglia play a central role in several pathologies, such as neurodegenerative and psychiatric disorders. Consumption of a high fat diet and resulting metabolic disease (e.g. obesity and type 2 diabetes) alters microglial activity; however, studies to date have yet to explore sex differences in the effects of high fat diet/metabolic disease on microglia across several brain areas concurrently. This is vital given the heterogeneity of microglial distribution, morphology, and function across brain regions and in various pathological states.
Methods: Male and female C57Bl/6J mice were fed either a low fat (LF; 10% fat) or high fat (HF; 60% fat) diet from 2-6 months of age. Body weight was measured weekly, and glucose tolerance testing was performed to assess diabetic status. Immunofluorescence was performed to quantify markers of microglia (Iba1) and phagocytosis (CD68) across several brain areas, including subregions of the cortex, hippocampus, striatum, substantia nigra, amygdala, and hypothalamus, as well as white matter areas, such as the corpus callosum and fimbria.
Results: HF diet resulted in significantly increased weight gain and glucose intolerance (prediabetes) compared to LF diet to a similar degree in males and females. HF diet increased microglial activity in males, but decreased it in females, in the majority of regions assessed. Additionally, metabolic outcomes were often associated with microglial markers in a sex-specific manner (positive correlation in males and negative correlation in females).
Conclusions: Taken together, these findings demonstrate the contrast of microglial responses in males and females following chronic consumption of a high fat diet, which may contribute to the different rates of neurodegenerative and psychiatric diseases observed in men and women.

Sex differences in the physiological and cognitive-behavioral effects of high fat and ketogenic diets in mice

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Introduction: Consumption of high fat diet contributes to metabolic disease (e.g. obesity and Type 2 diabetes), as well as several neurological disorders. Our previous work has shown that a high fat diet results in sex-specific effects in C57Bl/6J mice, including adult hippocampal neurogenesis, neuroinflammation, and performance on cognitive-behavioral tasks. In general, females are more negatively impacted compared to males, even when the metabolic effects of high fat diet are similar amongst the sexes. The ketogenic diet is a popular fad diet and involves consumption of limited carbohydrates (<5%), moderate protein intake, and very high fat. Limiting the intake of carbohydrates induces a state of "nutritional ketosis" that promotes ketogenesis while reducing gluconeogenesis. This causes ketone bodies to replace glucose as the body's primary energy source. While the ketogenic diet is also very high in fat content, it appears to hold potential for neuroprotection against brain aging and neurodegenerative disorders (Alzheimer's disease, Parkinson's disease), as well as boost mood and cognitive function in young healthy individuals. Further research on the effects of the ketogenic diet remains to be underexplored in a sex-specific manner as the underlying mechanisms are poorly understood. Additionally, most prior research using animal models has generally used a very strict ketogenic diet that is not ideal for translational relevance (nearly 0% carbohydrates). Therefore, the goal of this study is to compare the physiological and cognitive-behavioral effects of both a high fat and translationally relevant ketogenic diet to a low-fat control diet in adult male and female mice.
Methods: Male and female C57Bl/6J mice were fed either a low fat (LF; 10% fat, 70% carbs), high fat (HF; 60% fat, 20% carbs), or ketogenic (Keto; 80% fat, 5% carbs) diet beginning at 2-3 months of age. Body weight, food intake, and fluid intake were measured weekly throughout the experiment. Five months into the diet intervention, mice underwent a battery of behavioral tests to assess potential changes in general activity levels, anxiety-like behavior, and several domains of cognitive function. Diabetic status and ketosis were assessed, and tissues and organs were collected and weighed at the end of the experiment to further determine physiological effects of the various diets.
Results: As expected, HF diet resulted in increased weight gain and glucose intolerance compared to LF diet in both males and females. Sex-specific changes in fat accumulation and organ mass were also noted in response to HF diet. Keto diet induced a state of mild ketosis to a similar degree amongst the sexes, with fewer physiological alterations compared to HF diet. While HF and Keto diets tended to reduce exploratory behavior in males, this effect was not seen or was even increased by Keto diet in females. Of note, preliminary data suggests that while spatial working memory is not affected by any of these diet interventions, Keto diet may improve long-term spatial memory in male mice only.

Conclusions: Taken together, these findings demonstrate the physiological and cognitive-behavioral effects of a high fat vs. ketogenic diet in males and females. Even a ketogenic diet that produces only a mild state of ketosis may improve some aspects of cognition in adulthood, albeit potentially in a sex-specific manner that favors males.

The relationship between self-reported sleep quality and mood, soreness, energy, and motivation during a 48-hour post-injury period in collegiate male soccer players

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Introduction: Sufficient sleep is essential for optimal cognitive and physical performance. Several studies have demonstrated direct links between sleep quality and quantity to sports performance and injury rates. Competitive student-athletes may experience more challenges to sleep health due to demanding training and class schedules, recurrent travel, and psychological stress related to competition. In turn, sleep quantity and quality can also have psychological and physical impacts and affect recovery from injury in this population. This study examines the relationship between self-reported sleep quality and mood, energy, motivation, and soreness ratings in the 48-hour period following injury in undergraduate male soccer players.
Methods: Nineteen undergraduate male soccer players completed daily Likert ratings (1 = poor, 5 =excellent) for sleep quality, mood, energy, soreness, and motivation via REDCap during a 3- month period which included pre-, mid-, and post-season. Injuries were also tracked during the same time.
Results: Mean ratings for sleep quality, mood, energy, soreness, and motivation were calculated
separately for self-reports completed within 48-hours preceding injury, within 48-hours following injury, and for the remaining time that fell outside of these two 48-hour windows. Changes in average ratings were then computed for each variable by subtracting the mean rating during the 48-hour period either preceding or following the injury from the mean rating during the time period outside of the injury window. Pearson correlations were then calculated to examine the relationships between sleep quality change scores and the change scores for the other four variables (i.e., mood, energy, soreness, motivation). Post-injury changes in sleep quality were positively correlated with post-injury changes in mood (r = .48, p < .05). Moreover, while not significant, medium effect sizes were noted between post-injury changes in sleep and post-injury changes in soreness (r = .40), and energy (r = .36).
Conclusions: Sleep can serve as a competitive advantage to help maximize energy, mood, decision-making skill, and reflex response (Samuels, 2015). Furthermore, attending to the importance of sleep may reduce the risk of overtraining and under-recovery, enhance resistance to illness and improve injury recovery. Our findings suggest that better sleep 48 hours following an injury is associated with better mood following an injury, and perhaps also be associated with improvements in energy and soreness ratings. The small sample size in the current study limits the conclusions that can be reached, and the correlational nature prevents us from determining the mechanism underlying these relationships. Further research is necessary to better understand the role that post-injury sleep may play in psychological and physical recovery from injury.

Assessment of Brain Function and Putting Performance in Collegiate Golfers

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Introduction: Electroencephalography (EEG) is a noninvasive method for assessing brain activity. Research indicates significant correlation between performance outcome and varying brain wave measures. Alpha waves are present when the brain is in a state of wakeful rest, beta waves are present while completing high-processing tasks, and theta waves are present during deep focus activities. Measured brain waves are indicative of the state of focus of the individual. During a putting sequence, a golfer requires significant focus and attention to successfully perform the skill. Therefore, alpha wave recordings are constant throughout the performance if the golfer is fully attentive to the task. According to previous literature, higher levels of alpha waves measured on the EEG would result in more successful putts, while higher levels of theta waves would result in less successful putts. The purpose of this assessment was to correlate a golfer's brain wave activity to the successfulness of putting performance.
Methods: Male and Female golfers (n = 11) from a National Collegiate Athletic Association (NCAA) Division II Program were asked to participate in an Institutional Review Board (IRB) approved research project. Each golfer completed 10 putts at 5 varied hole distances (total- 50 putts) on an outdoor putting surface. The Enchanted Wave "Wave-1 brainwave-sensing headband" was used to measure and record EEG data. All shots were recorded via GoPro. Measures of EEG and heart rate (HR) were taken throughout the experiment, with markers indicating the start of each swing.
Results: EEG was recorded in 4-second epochs. Each epoch was classified according to the golfer's performance on the putts preceding and following that epoch, resulting in each epoch falling into one of four categories: pre-success/post-success (n=460), pre-success/post-failure (n=553), pre-failure/post-success (n=453), pre-failure/post-failure (n=793). Hierarchical linear modeling assessed the extent to which power spectral density (PSD) in alpha, beta, and theta waves were associated with putting success/failure. Results indicated that alpha PSD was unrelated to putting performance. However, beta and theta PSD were significantly related to putting performance, with multiple successive putting failures (pre-failure/post-failure) associated with higher beta PSD and lower theta PSD compared to multiple successive putting successes (pre-success/post-success).
Conclusions: Our findings suggest that while alpha wave PSD showed no significant relationship to putting performance, beta and theta waves were significantly related to performance. Multiple consecutive unsuccessful putts are associated with higher beta and lower theta frequencies, compared to consecutive successful putts. The results further explore the importance of beta wave frequency in complex athletic performance.

Caffeine use and anxiety between collegiate softball players and non-softball college Students

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Introduction: Caffeine has become a widely used ergogenic aid in sports. Most athletes consume caffeine daily in a variety of forms. When the caffeine consumption is high enough it can result in caffeine-induced anxiety. Anxiety affects human execution when the pressure is high, especially in sport competition. The purpose of the study was to examine multiple variables including caffeine usage and anxiety in collegiate softball players. We hypothesize that collegiate softball players will use more caffeine and display more anxiety when compared to non-softball college students.
Methods: This study investigated the relationship between college students and collegiate softball players and their caffeine consumption. A survey was distributed among college students who have never played a collegiate sport and softball players who are currently playing in college or have played in college within the past five years. 22 past and present college students (mean age=21.0±0.82) recorded their answers within the survey that assessed caffeine intake and a variety of different questions about anxiety. Independent samples T-tests were utilized to analyze group differences in survey reporting.
Results: A non-significant difference existed between collegiate softball players and non-softball college students in caffeine consumption ($p = 0.303$), anxiety ($p = 0.435$), worrying ($p = 0.361$), relaxation ($p = 0.081$), restlessness ($p = 0.122$), and irritability ($p = 0.485$). However, there was a significant difference between the two groups when analyzing fear ($p = 0.029$).
Conclusions: Contrary to our hypothesis, the data showed no significant differences between collegiate softball players and non-softball college students in caffeine consumption and anxiety. Further investigation is currently underway analyzing the relationships that may or may not exist between caffeine consumption and anxiety in collegiate softball players.

Effects of a Combined Proprioceptive and Kinesthetic Awareness Intervention on Running Efficiency in Full-Time Army National Guard Soldiers.

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Introduction: Running is a ubiquitous modality of fitness in the Armed Forces. Musculoskeletal injuries account for 65 percent of the Medically non-deployable force in the United States Army and has been reported as nearly 60 percent of the mechanisms resulting in limited duty status for Soldiers. Injury rates of runners range from 17.8 incidents per 1000 hours to 7.7 incidents per 1000 hours depending on runners' experience level. The running strategy of heel striking has been seen in upwards of 85 percent of the population and has been suggested to not only decrease movement efficiency but also to increase injury rates for runners. It has been posed that running form strategy can be modified through intervention addressing both kinesthetic awareness and proprioception. If injury rates can be decreased through modification of running form, then it is reasonable to infer that long-term adaptation in running form could increase readiness and deployability of the Armed Forces.
Methods: We conducted a pre- and post- video analysis of 15 Full-Time (Active Guard Reserve) Army National Guardsmen that attended a 60-minute intervention for their running form. The sample included membership from the rank categories of senior-enlisted, company grade officers, and field grade officers with representation of both sexes. Pre- and post-video analysis was conducted using 24 frames per second video. Analysis of impact angle and falling angle were established using angle measurement from ground contact to center of gravity for both the first contact with the ground and falling position. The intervention consisted of 10 minutes of education on running form with discussion of injury mechanics, 15 minutes of dynamic range of motion addressing the central nervous system, proprioception, and kinesthetic awareness. Finally, they received 35 minutes of skills and drills further targeting proprioception and kinesthetic awareness.
Results: The comparison outcomes between video analysis time points were as follows: The average rate of change in landing angle improved by 3.33 degrees and the average rate of change in angle of acceleration improved by 2.80 degrees. The sample demonstrated a pre-intervention average impact angle of -14.2 degrees and post-intervention impact angle of -10.87 degrees; they also demonstrated a pre-intervention average falling angle of 7.60 degrees and post-intervention impact angle of 10.40 degrees. When statistical analysis was conducted to compare the mean values, a statistically significant change was discovered for both landing angle -3.33 (SD=4.83), $T(1,14)=3.11$, $p=0.008$ with a Pearson Correlation value of 0.67 and angle of acceleration 2.80 (SD=3.75), $T(1,14)=3.50$, $p=0.004$ with a Pearson Correlation value of 0.62 further supporting a high degree of correlation between the intervention and both the improved landing angle and improved angle of acceleration.
Conclusions: Our findings suggest that a short intervention (60-minutes) using a combined strategy of proprioception and kinesthetic awareness can improve running efficiency. The validity of these findings is currently appropriate for inclusion in interventions for full-time Army National Guard Soldiers.

This is Your Brain on Green Exercise: A Psychophysiological Study

Proceedings of the Third Society for NeuroSports (SNS) Conference

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Introduction: Literature supports that physical activity in the presence of nature can lead to distinct mental health benefits such as lower stress and anxiety levels when compared to indoor physical activity. Additionally, the brain mechanisms underlying the effects of green exercise (GE) and virtual green exercise (VGE) on psychological responses are still under-researched. The present study sought to deepen our understanding of the brain mechanisms that underlie the effects of GE and VGE during self-paced walking.
Methods: Thirty participants were recruited for the present study. Two experimental (i.e., GE and VGE) and a control condition (CO) were administered in a randomized and counterbalanced order. The participants were asked to walk for ¼ mile at self-selected speeds while they self-reported their psychological states throughout the exercise trials. Heart rate variability and the brain's electrical activity were monitored continuously throughout the experimental protocol, and an accelerometer was used to identify the walking phases. The biological data were analyzed using spectral decomposition methods to asses the patterns of activity and connectivity in the brain.
Results: The results indicated that both experimental manipulations had an influence on the majority of the psychological and psychophysiological measures. The most pronounced effects were identified for GE when compared to CO and VGE. VGE also evoked positive emotions and reallocated the participants attention externally, but the observed effects were less pronounced than those observed for GE condition. The authors hypothesize that the brain mechanisms underlying the abovementioned psychophysiological responses may be associated with a significant upregulation of theta activity throughout the cerebral cortex as well as increased connectivity in the frontal and parietal areas.
Conclusions: Participants walked faster when they exercised outdoors and their parasympathetic activity was lower when compared to CO and VGE. Additionally, participants reported more dissociative thoughts and positive affective responses in GE, meaning that the additional psychophysiological stress was insufficient to cause displeasure. The EEG data also revealed that low-frequency components of the power spectrum were upregulated throughout the cerebral cortex for the GE condition, and the same effect was not observed for CO and VGE. The psychological effects of GE during exercise appear to be associated with the activity of the default mode network, which could induce relaxation and make individuals more aware of their surroundings and emotional states.

Medium-chain triglycerides may improve memory in non-demented older adults: a systematic review of randomized controlled trials.

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Introduction: Ketosis has been exploited for its neuroprotective impact and treatment of neurological conditions via ketone production. Exogenous medium-chain triglyceride (MCT) supplementation may induce nutritional ketosis. The aim of this systematic review is to explore the effects of MCTs on memory function in older adults without cognitive impairment.
Methods: A systematic literature search of PubMed, Cochrane Library, Scopus, and Web of Science was employed from inception until April 2022 for randomized controlled trials (RCTs) in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, investigating the impact of MCT oils on components of memory. Risk of bias (RoB2) tool was utilized for quality assessment.
Results: Six trials were included for qualitative synthesis, in which two studies examined the effect of MCTs through a ketogenic meal. MCT supplementation compared to controls was associated with improved indices of memory function in 4 out of 6 studies, particularly working memory. A meta-analysis was not employed due to the low number of studies, therefore, a true effect measure of MCT supplementation was not explored.
Conclusions: MCT supplementation may enhance working memory in non-demented older adults. These effects may be more prominent in individuals with lower baseline scores, from short and long-term supplementation. Further studies are warranted to confirm these findings in terms of optimal dose and MCTs composition, which may protect from memory decline during aging.

A Perfect Match? Coach Intended and Runner Perceived Training Loads

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Introduction: For collegiate distance runners summer training is the base period where coaches prescribe training loads of varying intensity to enhance conditioning. How the athlete should "feel" or perceive the training to be is important. Training loads are commonly prescribed as a combination of pace (miles per minute) and subjective intensity [rate of perceived exertion (RPE)]. Overtraining or undertraining can occur when there is a mismatch between the intended training load (ITL) of the coach and the perceived training load (PTL) of the athlete. This mismatch may negatively affect performance results. This study sought to examine the relationship between ITL and PTL in a group of competitive collegiate distance runners during their summer 5-week base training period.
Methods: During a 5-week summer base training period, coach-intended and athlete-perceived training intensity (RPE) and pace (miles per minute) were monitored for 1 coach and 5 (2 male, 3 female) collegiate distance runners, respectively. Weekly training load was calculated by multiplying RPE by pace. Both the coach and the athletes used the Borg RPE Scale (6 – 20). Runners used the Strava App to calculate pace during training runs. Weekly ITL and PTL, arbitrary units (AU) were examined for differences using Paired t-Tests, $p<.05$.
Results: While ITLs were greater than PTLs, these differences were not statistically significant for total training loads (391.7±18.6 vs.364.2±83.7 AU) or for Week 1 (68.2±5.8 vs. 61.1±30.2 AU), Week 2 (85.9±4.3 vs. 85.9±19.0 AU), Week 3 (79.1±6.2 vs. 77.7±16.9 AU), or Week 4 (78.7±6.6 vs. 57.3±25.1 AU). For Week 5, ITL was less than PTL, but not statistically significant (79.8±7.7 vs. 82.2±31.5 AU).
Conclusions: Coach-intended and athlete-perceived training loads measured as a combination of physiological (pace) and psychological (RPE) variables appear to be well matched in distance runners partaking in a summer base conditioning program. However, large variation in PTL warrant coach attention to ensure adequate adaptation by all athletes.

Empowering Self-Efficacy in Army National Guard Soldiers to make healthy decisions for body composition

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Introduction: One's self-efficacy has been linked to their ability to make decisions supporting healthy behaviors to achieve goal satisfaction. Self-efficacy is broadly defined as a non-fixed property that functions as an enabling factor of one's belief in their ability and capacity to reach a desired outcome and has been shown to significantly impact self-control towards goals, achievements, desires, and actions. The concept of self-control is supported by self-efficacy and has been shown to be the lowest character strength across the U.S. population. The Army National Guard Health of the Force Report established that of the 54 States, Territories, and National Guard units, 23% of the Total Force was obese and 4.6% (17,102 Soldiers) of the force was administratively flagged and at risk of separation. It costs an average of $180,000 to replace a Soldier separated from service, suggesting a potential fiscal risk of $3.078 billion associated toward obesity in the Army National Guard alone.
Methods: We conducted a pre- and post- screening of 20 traditional Army National Guardsmen that attended an intervention for their perception of self-efficacy using the General Self Efficacy Scale (GSE). The sample included membership from the enlisted rank category and representation of both sexes. Pre- and post- body composition was also established using the Army's doctrinal method. The intervention consisted of a seven-day fully embedded exposure to Resilience Theory using the Adult Learning Model and Active Teaching and Learning Strategies to improve healthy decision making and long-term lifestyle changes in support of favorable outcomes in body composition.
Results: The comparison outcomes between screenings were as follows: total body weight change for all participants pre- vs post-screening was -102 lbs with an average body composition change of -2% body fat. The sample reported a pre-intervention mean GSE score of 3.16 and a post-intervention GSE score of 3.43. When statistical analysis was conducted to compare the two mean values, a statistically significant change was discovered in perception of self-efficacy 0.27 (SD=0.46), $T(1,19)=2.81$, $p=0.011$ with a Pearson Correlation value of 0.58 further supporting a high degree of correlation between the increase in perception of self-efficacy.
Conclusions: Our findings suggest that an intervention using a combined framework of Resilience Theory, Adult Learning Model, and Active Teaching/Learning Strategies targeting healthy behaviors, specifically nutritional lifestyle changes, can improve self-efficacy. The validity of these findings is currently appropriate for inclusion in interventions for Army National Guard Soldiers that struggle to meet the Army's body composition requirements.

Training Load, VO2max and Weight Changes Predicts Neuromuscular Fatigue Throughout a Division I Basketball Season.

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Introduction: The purpose of the study was to assess if training load, preseason peak oxygen consumption, weight changes and, or time spent playing at intensities > 85% HRmax, contribute to decrements in power throughout a competitive basketball season. Neuromuscular power assessed via countermovement jump (CMJ) is considered an indicator of neuromuscular fatigue in competitive sports.
Methods: Female athletes (N=13) participated and were tested for maximal oxygen uptake (VO2max) and heart rate (HRmax). Athletes were monitored daily for 21 weeks with heart rate-based wearable devices (Polar Team Pro). CMJ performance and body weight were tested weekly and workloads were averaged weekly to correspond to weekly tests. Countermovement jump power (Watts) was calculated using the validated Sayers equation (60.7 * Height (cm) + 45.3*Body Weight (kg) – 2055). Playing intensities > 85% HRmax, and summated heart training load (SHRZ) were calculated for all games and practices.
Results: A regression was utilized to create a model best fit to predict variables that contributed to changes in fatigue throughout the season. A forward regression model revealed the SHRZ, VO2max, and body weight changes from week one of the season can significantly ($R2$ .188 = F = 15.545, $P < 0.001$) predict neuromuscular fatigue measured via power. Interestingly, weekly body weight and playing intensity greater than 85% HRmax was not a contributing factor in the model ($P = 0.182$).
Conclusions: Using training load such as SHRZ has been found to be more sensitive to overall workload than using heart rate variables alone. The results demonstrate that SHRZ, preseason aerobic capacity and weight changes based on the start of a season are valuable to monitor as it can be a contributing predictor of neuromuscular fatigue and power.

Summated Heart Rate Training Load and Preseason Oxygen Consumption as a Predictor of Large, Moderate and Minimal Changes in Neuromuscular Power Throughout a Division I Basketball Season.

Proceedings of the Third Society for NeuroSports (SNS) Conference

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Introduction: Basketball requires a high-level of aerobic and anaerobic energy system development. Basketball athletes frequently engage in high intensity jumps, shuffles, change of directions and repetitively sprint throughout practices and games to compete at a high level. The purpose was to identify if fatigue can be predicted based on summated heart rate training load, VO2max, and playing intensities > 85% HRmax throughout a season.
Methods: A total of 13 female athletes participated and were tested for maximal oxygen uptake (VO2max) and heart rate (HRmax). Athletes were monitored daily for 21 weeks with heart rate-based wearable devices (Polar Team Pro) and CMJ performance was tested weekly after one day of recovery. Maximum height jumps (CMJmax) were measured and recorded. Playing intensities > 85% HRmax, and summated heart training load (SHRZ) were calculated for each day training and games. After the season, data was grouped as changes in CMJ power from week one: Large (≤ -4.39% change), Moderate (-4.4% to -0.62% change), and Minimal (≥ -0.61% change) changes.
Results: A regression was utilized to create a model best fit to predict which variables best contributed to changes in neuromuscular jump performance throughout the season. A forward regression model revealed SHRZ and VO2max can significantly (R2 .073= $F = 8.013$, $P < 0.001$) predict large, moderate and minimal changes in power. Interestingly, weekly body weight and playing intensity greater than 85% HRmax was not a contributing factor in the model ($P \geq 0.459$).
Conclusions: Minimal changes in power throughout a competitive season is ideal to optimize athletic performance and reduce excessive fatigue. Monitoring workload via SHRZ and enhance aerobic capacity in the offseason may help safeguard athletes from decrements in weekly CMJ power. Using > 85% HRmax as an indicator of training workload is valuable for conditioning protocols, it may not be the best metric to monitor neuromuscular fatigue.

Resilience in active women participating in the physical activity programs of the Instituto Distrital de Recreación y Deporte (IDRD) in the city of Bogotá

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Introduction: Mental health (MH) has been identified by the World Health Organization as a fundamental and integrating component of well-being and health in general, where resilience, is an inference based on evidence, that some individuals have a better outcome than others who have experienced a comparable level of adversity (Rutter 2012) and has been considered a protective factor in MH. In this sense, physical activity practice can promote resilience by processes related to strengthening self-regulation of top-down control over bottom-up. Therefore, the aim of this study was to assess the levels of resilience in physically active women who participate in the programs offered of IDRD in the city of Bogotá.
Methods: One thousand two hundred and ninety women over 18 years of age participating in IDRD programs (mean age: 48 ± 17.3 years) were part of this cross-sectional study. The protocol included the application of: International Physical Activity Questionnaire (IPAQ), Connor and Davidson Resilience Scale (CD-RISC 10), Height, Weight, Mass Index Body (BMI), abdominal circumference (CA), Handgrip Strength by dynamometry (Takei T.K.K.5401), Course – Navette test and Senior Fitness Test, and identification of participation time in the programs offered by the IDRD.
Results: Results are presented in percentages: 69% of the women evaluated were under 60 years of age, 54.6% of the respondents registered a stay time of less than one year, 89.5% report compliance with the physical activity recommendations according to the IPAQ, 57% of the women were overweight, handgrip strength was good in 57% of the participants, cardiorespiratory fitness was low in 54% of the women. Regarding the levels of resilience as an indicator of emotional well-being in MH, high levels were obtained (mean 32.4 ± 5.6 out of 40 possible points). In a comparative analysis to the time spent in the programs, it was established that women who attended for more than one year presented better scores (mean 32.98 ± 5.46) compared to those who attended less than 1 year (mean 31.91 ± 5.73) ($p=0.001$) as well as those women who met the activity practice recommendations (mean 32.56 ± 5.5) compared to women who did not meet recommendations (mean 30.74 ± 5.9) ($p=0.001$).
Conclusions: Our results suggest that women who meet the global recommendations for physical activity and with greater adherence to physical activity obtain mental health benefits, which reinforces the importance of implementing community physical activity programs.

Position Specific Training Differences in Coordination Dynamics of NFL Draft Prep Football Players

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Introduction: Well-coordinated lower limb movements may improve linear speed ability. Linear speed is less sport-specific for Big (i.e. lineman) versus Skill (i.e. ball carriers) players, but is required by all players seeking to be drafted by the National Football League (NFL). Using a dynamical systems theoretical framework in sports neuroscience provides nonlinear data analysis techniques to assess movement coordination. For example, coordination dynamics may be examined by plotting the movement pattern of one joint (e.g. knee flexion/extension) relative to the simultaneous movement pattern of an adjacent joint (e.g. ankle plantarflexion/dorsiflexion) illustrating the interrelationship between the two. Coordination patterns change as skillful movement emerges. These angle-angle plots may provide insight into the viability of enhancing interlimb and intralimb movement coordination in already skillful athletes, and in particular in particular how Big players develop linear speed. Therefore, we sought to describe intralimb and interlimb coordination changes in speed running between elite Big and Skill American football players undergoing a 6-week draft preparation camp.
Methods: Nineteen participants representing two position groups, Big (n=10; height, 1.89±0.04 m; mass, 113.55±11.41 kg) and Skill (n=9; height, 1.83±0.04 m; mass, 94.34±7.98 kg) volunteered for this study. Pre and post angular kinematics were collected using a 10-camera motion capture system sampling at 120 Hz during a 5 sec treadmill run at 6.5 m/s. Five consecutive steps from each limb were analysed. Angle-angle plots of relative sagittal plane hip-knee, knee-ankle and hip-ankle motion were inspected for linearity and compared between position groups before and after 6 weeks of training. The plots were examined with the running gait critical instances of initial contact (IC), midstance (MS), and push-off (PO) in mind.
Results: The intralimb phase characteristics of the joints before and after training and between limbs were generally similar. The hip-knee was in-phase from IC to midstance MS, anti-phase from MS to push PO and decoupled from PO to IC. Knee-ankle was in-phase IC to MS, turning point in-phase MS to PO and decoupled PO to IC. Hip-ankle was in-phase IC to MS, turning point decoupled MS to PO and in-phase PO to IC. However, there were interlimb differences between Big and Skill players in the gradient of the hip-knee plots. Big players had greater variability and flatter slopes and were more constrained than Skill players. While both groups enhanced interlimb coordination after six weeks, Big players demonstrated the greatest improvements.
Conclusions: Big position American football players made the greatest changes in interlimb coordination dynamics during speed running becoming more consistent and less restricted, especially in hip-knee relative motion. This is beneficial for linear speed development for NFL draft preparation.

Predictors of attention and attention control failures: The role of arousal, stress, mindfulness, and exercise.

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Introduction: The ability to control our attention is critical for daily life. However, mind wandering, or experiencing Task-Unrelated Thoughts (TUTs), has been associated with impaired attention control (Kane et al., 2006;2016). Several factors predict episodes of mind wandering including stress (Banks et al. 2015), ADHD(Jonker et al., 2017), and negative mood (Poerio et al., 2013). Less attention has been paid to the impact of physiological state on mind wandering rates. The current study examined the role of measures of physiological and neurophysiological measures of arousal on mind wandering rates and sustained attention, at a baseline session and following either a brief mindfulness induction, a brief relaxation induction, or a brief bout of exercise and then all participants completed a stress manipulation.
Methods: 84 participants were assigned to a Mindfulness (n=31), Relaxation (n=31) , or Exercise (n=22) conditions. Participants completed a screener and Body composition measure. Participants were fitted with a single channel EEG band, Empatica e4 wristwatch, and completed a Sustained Attention to Response Task (SART) with 24 thought probes and a series of self-report measures of dispositional mindfulness and rumination. Based on condition, participants completed either a 15 minute mindfulness induction, a 15 minute relaxation induction, or ran on the treadmill for 20-minutes (with a 5 minute warm-up and cool down). All participants completed a stressor writing task for 10 minutes, followed by a SART task with 24 thought probes.
Results: To examine the relationship between arousal (Heart rate, Galvanic Skin Conductance (EDA), Interbeat interval, and EEG measures of neurophysiological arousal-alpha, delta, sigma, beta power), SART performance (as measured by reaction time variability and d'), and mind wandering rates, we examined the correlations between these constructs at baseline and following the stressor. At baseline, only heart rate was correlated with TUT frequency ($r(80) = .23$, $p = .039$) and TUT frequency was correlated with SART reaction time variability ($r(82) = .42$, $p < .0001$). Following the stress manipulation, SART reaction time variability was correlated with galvanic skin response ($r(75) = -.32$, $p = .005$), beta power ($r(49) = .37$, $p = .008$), delta power ($r(49) = -.29$, $p = .040$), and sigma power ($r(49) = .28$, $p = .045$) but not heart rate, $p > .05$. Examining relationships by group revealed a relationship between galvanic skin response and TUT frequency in the relaxation group ($r(28) = -.39$, $p = .032$). TUT frequency was only correlated with reaction time variability on the SART in the relaxation group ($r(29) = .36$, $p = .047$), but not in the exercise or mindfulness condition, all p's > .05.
Conclusions: We examined the relationship between measures of arousal, sustained attention, and mind wandering at a baseline session and following a stress manipulation. Further we were interested in the impact of mindfulness, relaxation, and exercise interventions on the effect of the stressor. Baseline findings suggest that higher heart rates predict poor sustained attention due to increased mind wandering. However, following the stressor galvanic skin response predicted greater mind wandering but only in the relaxation condition. Consistent with prior findings of acute mindfulness training (Banks et al., 2019) the exercise and mindfulness condition

reduced the impact of mind wandering on sustained attention. These results suggest that arousal is an important predictor of mind wandering.

A Case Study on the efficacy of beta-blocker eye drops for patients experiencing PCS and TBI symptoms

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Introduction: Patients suffering from traumatic brain injury (TBI) and post-concussive syndrome (PCS) experience a multitude of symptoms, many of which are related to autonomic disruption. This autonomic disruption is linked to excitatory hormonal stressors causing severe headaches, vision impairment, and a decrease in their Quality of Life [QOL]. More than 80% of patients with post-concussion syndrome (PCS) and traumatic brain injury (TBI) suffer chronic conditions, often with unmet therapies to alleviate their condition impacting the autonomic nervous system (ANS). Post-concussion syndrome (PCS) and traumatic brain injury (TBI) impact the autonomic nervous system (ANS), and its resultant dysfunction may be a contributing factor to chronic, persistent PCS and TBI symptoms. During stress, the adrenal glands produce epinephrine, which increases heart rate and blood pressure, slows digestion, and causes pupil dilation, among other effects. These effects are designed to prepare the body for an immediate threat. However, current research indicates that during TBI and PCS induced ANS dysfunction, adrenal glands become hyperactive. This causes an overproduction of epinephrine which locks patients into a state of chronic sympathetic arousal 1. The excess epinephrine binds to β2 receptors on the ciliary body—the muscle which allows the lens of the eye to change shape when focusing on different distances—and prevents it from contracting. Hyperactive adrenal glands cause an over-production stress hormones locking patients into a "freeze" mode of the flight or fight response mechanism. Working from this hypothesis we theorized that beta blocker drops could be a viable adrenal-stressor treatment for symptoms of TBI and PCS thereby reducing these symptoms allowing patients to return to work, or school, and start vision therapy sooner.

Methods: To allow for this stimulation of the ciliary body, a cholinergic agonist eye drop was used in conjunction with the beta blocker to stimulate α1 receptors on the ciliary body, triggering it to contract in lieu of stimulation from the EW nucleus.

Beta-blockers are competitive antagonists for epinephrine and are therefore able to counteract the effects of the increased epinephrine production by binding to and blocking epinephrine receptor sites on the ciliary body. When the epinephrine is unable to bind, the ciliary body is now able to contract and focus on near tasks; the "brake" has been removed. One region of the brain which is frequently affected is the Edinger Westphal (EW) nucleus, which is responsible for pupil constriction and, via cholinergic stimulation, triggers the contraction of the ciliary body. When this area is damaged, the ciliary body may not contract even once the "brake", or excess epinephrine, is removed3. An accelerator is needed.

Results: A convenience sample of twenty-six patients were chosen to test this hypothesis and instructed to use prescribed beta blocker drops for 30 days, returning in 30 days for re-assessment. Forty-two percent (42%) reported improved near vision, 35% reported reduction in headache frequency and 46% reported a reduction in headache intensity. It appears that beta-blocker eye drops do offer some benefit for patients suffering from PCS or TBI, reducing their chronic TBI/PCS symptoms, allowing patients to maintain employment and an improved QOL.

Conclusions: Beta-blocker eye drops are a viable treatment option for TBI and PSC disorders.

Changes in the expression of the myokine, Irisin, over time following acute exercise in mice

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Introduction: Alzheimer's disease (AD) is one of the most common types of neurodegenerative disorders and as our population ages, its prevalence is expected to increase. There are currently no effective treatments for AD, thus emphasizing the need to identify and develop therapeutic solutions.
Physical activity promotes healthy aging and could be an effective non-pharmacological alternative to prevent or delay AD pathology. However, the mechanisms underlying such positive effects are not fully known. Irisin is a myokine that is secreted from skeletal muscle during exercise and has been associated with mechanisms that are dysfunctional in AD, such as glucose metabolism and hippocampal neurogenesis. Further, there have been contradicting reports on the changes in Irisin levels following exercise. While it is known that Irisin is degraded quickly when in circulation, its exact time course after release has not been fully determined. Contradictions might be a result of variability in the timing of tissue collection. For example, some studies report no change in circulating Irisin after exercise, but when blood is collected immediately or soon after the completion of exercise, serum Irisin concentration has been reported to increase ~15%.
Methods: To answer this question, we performed an acute exercise experiment (swimming for 20 minutes) in mice and measured post-exercise serum Irisin concentration at four different time points: 0, 30, 60, and 120 minutes after the conclusion of exercise. Serum was quantified by ELISA
Results: In male mice, circulating Irisin was higher immediately after exercise and subsequently decreased to baseline levels within 120 minutes. In females, there was no detectable increase in circulating Irisin.
Conclusions: These results suggest that consideration of the timing of tissue collection is necessary to detect changes in Irisin. This will also contribute to clarify previous contradicting reports. Further exploration of the activity of Irisin might yield new information that will potentially improve therapeutic strategies for AD.

Examining Sex Differences in Baseline and Post-Concussion ImPACT Scores

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Introduction: Immediate post-concussion assessment and cognitive testing (ImPACT) is a computerized measure used to aid clinicians in assessing concussions. Recent studies have investigated difference in ImPACT scores for individuals of diverse racial and ethnic backgrounds, as well as individuals with various diagnoses such as learning disorders or attentional difficulties. This study aims to examine the average difference between males and females on both baseline and post-concussion measures as measured by composite ImPACT scores.

Methods: Two samples were drawn from a deidentified outpatient concussion database. Baseline participants (N=1594) included both females (M_{age}=19.31 years, M_{edu}=12.92 years, and 22.8% diagnosed with a previous concussion) and males (Mage=20.06 years, M_{edu}=13.18 years, and 19.2% diagnosed with a previous concussion) who were administered ImPACT prior to the injury. Post-concussion participants (N=162) included females (Mage=20.00 years, M_{edu}= 13.29 years, and 30.7% diagnosed with a previous concussion) and males (Mage=20.46 years, M_{edu}=13.15 years, and 33.3% diagnosed with a previous concussion) who were administered ImPACT post injury-I. Comorbid conditions were included in both samples. Females and males in the baseline sample were significantly different on age and the presence of previous concussions, however this was not noted in the post-concussion group. ANCOVAs were used to compare females and males on baseline ImPACT composite scores controlling for age and the presence of previous concussions. ANOVAs were used on ImPACT post injury-I composite scores.

Results: Females had significantly higher baseline scores for Verbal Memory Composite Score [F(1,1594)= 7.929, p=.005] and Total Symptom Score [F(1, 1281)=8.696, p=.003]. Males had significantly higher baseline scores for Visual Memory Composite [F(1,1594)=4.515, p=.034]. There were no significant differences on baseline Visual Motor Speed Composite, Reaction Time Composite, or Impulse Control Composite. Females has significantly higher post-concussion symptom scores [F(1,162)=7.585, p=.007]. Males had significantly higher scores post-concussion scores on Visual Motor Speed Composite score [F(1,162)=6.234, p=.014] and Visual Memory Composite score [F(1,162)=6.453, p=.012]. There were no significant differences for post-concussion Verbal Memory Composite, Reaction Time Composite, or Impulse Control Composite.

Conclusions: These findings suggest even at baseline sex may moderate ImPACT scores specifically on Verbal Memory, Visual Memory, and Total Symptoms. Females may have a relative strength in verbal memory prior to injury but not post-injury when compared to males. On the other hand, males performed higher on the visual memory task in both samples suggesting a relative strength in males. Regarding total symptomology, females on average reported higher symptoms scores across samples which is consistent with prior research indicating decreased neck strength and the role hormonal fluctuations may play in concussion outcomes. Given these findings, clinicians must be aware of how to best use ImPACT in their practice given the sex of their client when assessing return to play. Limitations to this study include a lack of information about the injury, lack of information on the time since injury for the post-concussion measure, and low sample size in the post-concussion group. Future

directions should consider a longitudinal design to investigate changes from baseline to post-concussion by sex.

The Influence of Sleep Duration on Cognitive Performance Following a Concussion

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Introduction: To investigate the influence of sleep duration on cognitive performance following a concussion in college athletes.
Methods: Participants (N=139) were selected from a deidentified sports medicine database consisting of test scores generated by the ImPACT cognitive screening tool. Participants were stratified into groups based on recommendations from the National Sleep Foundation: those receiving less than 7 hours (n=41, 75.6% female, Mage=19.9, Medu=13.3), 7-9 hours (n=80, 62.5% female, Mage=20.1, Medu=13.2), and greater than 9 hours (n=18, 77.8% female, Mage=20.5, Medu=13.5) on the night prior to testing. Data were included from the first post-injury testing session. Groups did not differ in gender, age, or years of education. Chi-square analysis indicated that the sleep duration groups did not significantly differ in reported symptoms except for "trouble falling asleep" ($X2(10, N=139)=30.77$, $p<.001$) and "sleeping less than usual" ($X2(12, N=139)=25.41$, $p=.013$). ANOVAs were used to test for differences between sleep groups.
Results: ANOVA indicated a significant main effect of sleep duration on visual-motor speed performance ($F(2, 136)=6.19$, $p=.003$, $\eta p2=.083$). Pairwise comparisons employing Bonferroni corrections indicated that athletes that slept less than 7 hours on the night before post-injury testing performed significantly lower on tests of visual-motor speed than those that slept between 7 and 9 hours ($p=.002$). No significant differences were found on verbal memory, visual memory, reaction time, or impulse control.
Conclusions: Results indicated lower performance on tests of visual-motor speed among athletes that slept less than the recommended duration. These findings align with a growing body of research suggesting a relationship between sleep duration and cognitive performance at baseline. However, more research is needed to determine the influence of sleep on cognitive testing following an injury. These findings highlight the importance of actively monitoring sleep duration throughout the recovery process. Furthermore, athletes recovering from concussion may benefit from psychoeducation or interventions such as Cognitive Behavioral Therapy for insomnia to improve sleep hygiene. Future research should investigate the influence of both sleep quantity and quality during the recovery process of sport-related concussion.

The impact of cognitive training and exercise on attentional resources in college athletes

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Introduction: Cognitive functioning, particularly executive functioning (e.g. online decision-making) are necessary for high level sports performance. Competing in athletics requires usage of precious cognitive resources, such as attention, decision making, and working memory, and expert athletes make better use of those resources. Because high achievement in sports requires task-specific skills, general Cognitive Training (CT) has emerged as an area of interest as a way to improve core cognitive processes which may fundamentally underlie performance. One training method, the Episodic Specificity Induction (ESI) has been observed to improve performance in the general population on tasks measuring divergent thinking, problem solving, and imagination skills. The present study examines the impact of an ESI as a CT method of improving vigilance and visual attentional processes in college athletes.
Methods: 21 college athletes participated in the present study. A 2 (Exercise vs Control) x 2 (ESI vs control) repeated-subjects design was implemented to examine 1) the effects of exercise, 2) the effects of cognitive training, and 3) the potential interaction between exercise and cognitive training on cognitive functioning. D', a measure of signal detection accounting for hits (correct responses) and false alarms, was calculated for each of the three dependent measures. Three dependent measures of cognitive functioning were used: 1) the Mackworth Clock measure of vigilance, a visual search task, and a sustained attention to response task (SART2). All experiments were conducted in-person, using PSYToolkit software. In the exercise condition, participants rode an exercise bicycle for 20 minutes.
Results: Data collection is on-going. As such, inferential statistics (i.e. Repeated Measures ANOVA) are under-powered (N = 21). However, preliminary results suggest that compared to baseline, that is the no exercise and control induction conditions (M = 0.03, SE = 0.11), participants vigilance detection scores increased in the exercise condition (M = .49, SE = .20), the ESI + no exercise condition (M = 0.50, SE = .34), and the ESI + exercise condition (M = 0.40, SE = .13). There was no impact of induction or exercise condition on the visual search task.
Conclusions: Preliminary findings suggest that both cognitive training and exercise increase vigilance attentional processes in college athletes. However, further research is necessary, with differences in attentional demands, to determine the efficacy of ESI as a cognitive training method for athletes.

Investigating potential neuroprotective effects of running exercise in an Alzheimer's Disease (AD) Mouse Model

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Introduction: Lifestyle interventions such as exercise and beneficial diet can promote healthy aging and reduce the likelihood of neurodegenerative disease pathology. However, the mechanisms associated with these positive effects are not entirely understood. Therefore, we used a well-established AD mouse model (CRND8 mouse line) and provided ad libitum access to a running wheel for 8 weeks, to investigate specific pathways associated with exercise.
Methods: To measure the effect of voluntary running, we documented mouse body weight weekly and used Arduino devices to record the overall distance ran during an 8-week period. We used 6–7-month-old male AD transgenic (Tg) and non-transgenic (NTg, i.e., control) mice, divided into Sedentary (i.e., housed with a locked running wheel) or Exercise (i.e., housed with a freely spinning running wheel) groups. At the end of the 8-week period, the memory function was tested using a NOR test. After this test, mice were processed for brain tissue, organs, and blood collection for further studies.
Results: Our results show that the AD Tg mice ran more during the 8-week period than the other groups. Tg mice that exercised showed more rearing behaviors and less anxiety-like behavior (i.e., spent more time in the center of the Open Field) compared to their sedentary counterparts. All organs measured (liver, kidneys, thymus, fat deposits) were comparable in weight amongst all groups. The only difference was found in the adrenal glands which were smaller in NTg mice subjected to exercise compared to Tg mice. An ELISA test was conducted to detect the skeletal muscle derived Irisin in plasma, but no difference was found between groups. Furthermore, the novel object recognition test did not differentiate improvements in memory function between groups.
Conclusions: Overall, these results indicate that 8-week voluntary running in AD mice cause an improvement in anxiety-like behaviors compared to sedentary mice. Thus, our results still support the idea that exercise can protect brain function in AD mice. However, we were not able to accurately evaluate memory function under these conditions. Future experiments will evaluate other types of memory tests and different experimental conditions.