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Validity and Test-Retest Reliability of a New Neurocognitive Functional Performance Test: The Choice-Reaction Hop Test

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Context: Recent research has highlighted changes in neurocognitive and central nervous system function among some of the most common injuries, particularly in those with chronic ankle instability (CAI). Functional performance tests (FPT) like the side-hop test (SHT) are often used to assess physical performance, however, minimally stress a patient's neurocognitive function. On the contrary, dual-tasking is often used to assess the interplay between physical and neurocognitive performance, however, these traditional laboratory tasks are minimally challenging on higher-level athletes. Modifying and adding a reactive component to an already proven FPT may provide clinicians with increased insight into neurocognitive performance. Therefore, the purpose of this study was two-fold, to validate a choice-reaction hop test (CRHT) by assessing differences in timing versus the SHT, and to determine the CRHT's test-retest reliability. We hypothesized that the CRHT would take longer to complete than the SHT and it would demonstrate good test-retest reliability.

Methods: Fourteen physically active (>90 minutes of physical activity/week) participants (5 female/9 male, 24.5±3.6 years old, 174.2±9.3 cm, 74.4±16.3 kg) with a range of ankle injury history completed the study. Participants were initially screened and completed injury history questionnaires followed by two hop tests in a randomized order. For the SHT, participants performed 20 hops on a single limb medially and laterally over a 30-cm distance as quickly as possible. For the CRHT participants similarly hopped on an instrumented mat 20 times on a single limb medially and laterally over a 30-cm distance, however, participants had to react to one of two squares on each side randomly indicated by flashing lights on a computer screen. Participants completed 3 trials of each hop test in a counterbalanced order. Participants returned one-week later to repeat the CRHT. To validate the CRHTs neurocognitive component, a paired t-test between the SHT and the CRHT was conducted. To assess the test-retest reliability of the CRHT, an ICC using a 2-way, random effects model for consistency of average measures was computed between day 1 and 2.

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Results: Participants took significantly longer to complete the CRHT (22.1±3.8s) compared to the traditional SHT (10.4±2.0s, $p<0.001$). The CRHT demonstrated good-excellent test-retest reliability across testing days ($r=0.873$, $p<0.001$).

Conclusions: Compared to the SHT, the CRHT took significantly longer to complete indicating its ability to stress neurocognitive function during an FPT. The CRHT also demonstrated adequate test-retest reliability, which may allow it to be a useful measure in serial evaluations such as during rehabilitation benchmarking. The CRHT may be an effective FPT to assess combined physical and neurocognitive function to assist clinicians in evidence-based decision making. Future research needs to assess differences in the CRHT in those with CAI versus healthy control participants to further validate its clinical utility.

Graduate Certified Athletic Therapists' Perceptions of the Biopsychosocial Model in the Overall Patient Management Care

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Context: The biopsychosocial model (BPS) has allowed health-care professionals like Athletic Therapists/Trainers to holistically examine patients, through the integration of biological, psychological, and social factors, addressing the complexity of pain and disability during musculoskeletal injury. Despite clinician's knowledge on the importance of the BPS model, especially in chronic pain, a biomedical approach to overall Athletic Training and Therapy education and clinical practice still exists.

Objective: to establish what Graduate Certified Athletic Therapists perceptions are on the importance of the Biopsychosocial Model in overall patient management within clinical practice? Secondly, examining what are Graduate Certified Athletic Therapists views on the Biopsychosocial Model in their undergraduate educational curriculum in Athletic Therapy?

Study Design: Cross-sectional study using an online survey was implemented.

Patients or Other Participants: 133 Athletic Therapists/Trainers completed the survey (completion rate = 89%).

Main Outcome Measure(s): Participants completed demographic, Biopsychosocial Model in Practice and Biopsychosocial Model in College/University Curriculum questions. The 14-item survey used a combination of multiple choice and Likert scale questions. Descriptive statistics characterised the participants; reliability/internal consistency was assessed using Cronbach's α , Chi Squared tests explored the relationships between BPS model and patient care and education. Spearman's Correlation assessed the relationships between Athletic Therapists/Trainers perceptions of BPS and patient care. Mann Whitney U identified the differences between BPS, sex, and education.

Results: There was a very strong positive correlation between implementation and the importance of the BPS model in patient management ($r=0.729$, $n=133$, $p<0.000$). A positive correlation was found between confidence levels and implementation of the BPS model in patient management ($r=0.364$, $n=133$, $p<0.000$). A weaker but positive correlation was found between confidence levels and effectiveness in incorporating the BPS model on patient outcomes ($r=0.264$, $n=133$, $p<0.002$). Descriptive statistics showed 82.7% of participants viewed BPS as very important, 71.4% reported very strong implementation with patients, while 56.4% of participants were very confident in their knowledge of the BPS model. A significant difference was found in the understanding of BPS model based on third level education in Athletic Therapists/Trainers and the transferrable skills of the BPS in clinical practice, $U=1208.000$, $z=-4.425$, $p=0.00$, $r=0.383$. Descriptive statistics

showed 61.7% of participants viewed having inadequate transferable skills of the BPS model to a clinical setting, where 27.8% of participants agreed that knowledge of the BPS model was important to ATs and that their educational curriculum was adequate. The survey was assessed for reliability, Cronbach's α score of 0.729.

Conclusion: Graduate Athletic Therapists positively view the importance of Biopsychosocial model in patient management, which will enhance clinical practice and patient outcome measures. However, the transferability of BPS from educational curriculum into clinical practice could be further enhanced and developed. Shifting educational curriculum from biomedical focus to a Biopsychosocial model is needed across all Athletic Therapy/ Training programs.

Certification Therapists' Perspectives of Membership Value in the Canadian Athletic Therapists Association and the Regional Associations

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Context: All Canadian based members of the Canadian Athletic Therapists Association (CATA) are required to be members of a regional association (RA). The CATA Board of Directors presented a bylaw change eliminating this requirement. This announcement was unexpected by many members, resulting in varied opinions. The Bylaw change has many implications, such as the role of the CATA and RA, membership fee changes, and questioning the value of memberships. The purpose of this research was to explore these issues, and gauge membership opinions of the value of the CATA and RAs.

Methods: An online-based survey was targeted to members of the CATA through RAs in Canada, social media, and snowball sampling. Reminders were sent through the same channels, and the survey was open for 1 month. The survey consisted of 50 questions including demographic data detailing membership status, RA affiliation, and membership length. We included questions about membership value and knowledge about association work. Data were tabulated and analysed for national and regional trends and differences. Primary analysis suggested examining Ontario members' opinions as a unique group.

Results: Of 682 who started, 61% (N=416) participants completed the survey, and incomplete surveys were deleted. Certified participants were as follows: ATABC (36), AATA (44), SATA (1), MATA (40), OATA (204), CTSQ (69), APATA (6). Provisional[ly] certified, retired, and associate members (N=5) were counted in the certified groups. The remaining participants were certification candidates (3.8%). Over half (57%) of ATs felt the CATA provided 70-100% of national advocacy for the profession. Less than half (44%) of the membership felt the RA provided 70-100% local advocacy, but that value increased to 57% when the OATA group was removed. Just under half (48%) of members credit the RA 70-100%, on advocating for regulation, but 24% were unsure. Removing the OATA group resulted RA regulation advocacy increasing to 63%. Eighty-three percent (83%) of OATA members value the CATA, but only 45% of other RA members share this value. Thirteen percent (13%) of OATA members value their RA, while this percent rises to 74% for other RA members.

Conclusion: In general, there is value associated with CATA and RA membership, but there is a strong divide between members of the OATA and other RA members. Regulation, an important issue for many members, is inconsistently viewed by members across the RAs. Most believe regulation is the responsibility of the RA. The dissatisfaction of OATA members skews the opinions of the national membership. This survey was completed with the goal of understanding membership knowledge and values to better inform all members of the CATA and RAs. The information obtained is of value beyond the bylaw change. A membership survey asking similar questions should be completed every five years.

Prevalence of Subsequent Injury or Recurrent Concussion Following Sport-Related Concussion Among Youth Ice Hockey Players

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Context: Recent estimates from Alberta, Canada suggests that one in four high school students will have sustained at least one sport-related concussion by the time they graduate and annual prevalence is one in nine. Sustaining a concussion likely increases an adolescent's risk of subsequent injury, yet few studies have quantified this risk across different populations. This study aimed to examine the prevalence of sustaining any subsequent injury and specifically a recurrent concussion following sport-related concussion in the same season among male and female youth ice hockey players ages 11-17 years.

Methods: These data are from a 5-year prospective cohort study including youth ice hockey players (n=4420) from British Columbia and Alberta (2013-2014 to 2017-18). We used validated injury surveillance methodology that included a preseason demographic and medical questionnaire, baseline evaluation of symptoms, cognitive function, and balance using the Sport Concussion Assessment Tool (v.3 or v.5), weekly hockey participation hours, and a standardized injury report form validated by a study clinician. All ice hockey injuries requiring medical attention, the inability to complete a session, or time loss from hockey were identified. All players with a suspected concussion were referred to a sport medicine physician and concussion diagnosis was based on the most current International Consensus Statement on Concussion in Sport. We identified participants with a suspected hockey-related concussion that returned to sport within the ice hockey season and reported 1) the estimated prevalence [95% confidence intervals (CI) adjusting for cluster by team] of players with a subsequent injury (including concussion) or recurrent concussion in the same season, and 2) the median (range) number of days to subsequent injury. Prevalence ratios (PR) to assess differences between males and females were estimated using robust Poisson regression adjusted for clustering by team.

Results: Of the 384 males and 64 females concussed in this sample, 72 males (18.8%, 95%CI: 15.1%-30.0%) and 7 females (10.9%, 95%CI: 0.4%-23.2%) sustained a subsequent injury before the end of their season. The median (range) days to subsequent injury was 101 (11-181) for males and 75 (7-123) for females. In total, 50 males (13.0%, 95%CI: 9.9%-17.1%) and 4 females (6.3%, 95%CI: 1.7-22.6%) sustained a recurrent concussion, specifically. The median (range) days to recurrent concussion was 96 (11-164) for males and 39 (12-75) for females. Males and females did not differ in the risk of sustaining a subsequent injury (PR=0.58, 95%CI: 0.21-1.60) or recurrent concussion (PR: 0.48, 95%CI: 0.13-1.76).

Conclusions: An estimated 1 in 5 male and 1 in 10 female hockey players sustained a subsequent injury within the same season following a sport-related concussion. While no significant differences were identified between males and females, results should be interpreted with caution due to the low number of females in this sample.

Baseline ImPACT Test Data for Interscholastic Athletes Stratified by Concussion History

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Context: Neuropsychological assessments are routinely used in the evaluation of concussion. Ideally, every athlete would have a baseline neuropsychological assessment for comparison in the event of a concussion, however many factors make it challenging to have these assessments on each athlete. Further, the datasets currently available do not stratify by concussion history which is known to

cause changes in neuropsychological performance. The purpose of this study is to provide a large normative dataset as a reference for interscholastic athletes, stratified by concussion history.

Methods: 36,360 interscholastic athletes (males $n=21,696$, females $n=14,664$) between the ages of 10-18 years old participated in preseason baseline concussion testing which included Immediate Post-concussion Assessment and Cognitive Test (ImPACT). ImPACT testing was conducted in groups prior to the start of sport participation by an ATC trained in ImPACT test administration. Outcome data obtained for Verbal (VEM) and Visual (VIM) Memory, Visual Motor Speed (VMS), Reaction Time (RT) and Impulse Control (IC) was stratified by number of previous concussions.

Results: Descriptive data are as follows; VEM (84.25 ± 10.263), VIM (73.69 ± 13.115), VMS (35.31 ± 7.102), RT (0.65 ± 0.101) and IC (6.31 ± 4.465). A one-way ANOVA compared the IMPACT outcomes based upon the number of reported concussions. A significant difference was noted for VIM ($F(9,36351) = 1.91$, $p < 0.05$), VMS ($F(9,36352) = 13.73$, $p < 0.05$), RT ($F(9,36352) = 7.39$, $p < 0.05$), and IC ($F(9,36352) = 8.73$, $p < 0.05$). No significant differences were found for VEM based upon number of concussions. Post-hoc testing revealed significant differences between athletes who sustained 0, 1, 2, and 3 concussions. No differences were noted for number of concussions greater than 3.

Conclusions: The outcomes support the use of stratified norms for concussion history in interscholastic athletes. Further, healthcare professionals should use caution when comparing post-injury data to standard normative data as concussion history is not taken into account and may impact the outcome. Future research should evaluate ImPACT data in athletes who have sustained more than 3 concussions. The current dataset, while robust, was limited to mostly athletes who had sustained 3 or fewer concussions.

Baseline Analysis of ImPACT Test Data in Interscholastic Athletes

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Context: Concussions in interscholastic athletes pose a challenge for athletic trainers as the brain of adolescents is growing and developing, which can make the diagnosis and management of those injuries increasingly difficult for healthcare providers. While having a baseline measure for each athlete is recommended, the time and resources required to administer baseline tests for all athletes is not always feasible. Therefore, having access to a large baseline dataset will provide healthcare professionals a reference point to compare when individuals sustain a concussion. The purpose of this study is to provide ImPACT normative data as a reference for athletes of different ages and genders.

Methods: More than 36,000 interscholastic athletes (males $n=21,696$, females $n=14,664$) between the ages of 10-18 years old participated in pre-season baseline concussion testing. Traditional computer based Immediate Post-concussion Assessment and Cognitive Test (ImPACT), was utilized as a measure of neuropsychological assessment. Athletes were tested in a group environment prior to the start of sport participation. All testing was supervised by an Athletic Trainer trained in ImPACT test administration. Outcome data obtained for Verbal (VEM) and Visual (VIM) Memory, Visual Motor Speed (VMS), Reaction Time (RT) and Impulse Control (IC) was stratified by age and gender.

Results: Outcomes for all participants are as follows; VEM (84.25 ± 10.26), VIM (73.69 ± 13.12), VMS (35.31 ± 7.10), RT (0.65 ± 0.10) and IC (6.31 ± 4.47). A one-way ANOVA was used to determine difference in outcomes based upon age. Significant differences were found for: VEM ($P(8,36307) = 82.77$, $p < 0.05$), VIM ($P(8,44177) = 71.00$, $p < 0.05$), VMS ($P(8,44178) = 776.66$, $p < 0.05$), RT ($P(8,44178) = 360.26$, $p < 0.05$), and IC ($P(8,44178) = 68.99$, $p < 0.05$). Tukey's HSD was used to determine the nature of the differences between ages, multiple significant differences were noted between each age for each outcome. An independent t-test

found significant differences between gender for; VEM ($t(44245) = 23.79$, $p < 0.05$), VMS ($t(44246) = 20.83$, $p < 0.05$), RT ($t(44246) = 7.33$, $p < 0.05$), IC ($t(44246) = 13.33$, $P < 0.05$).

Conclusions: While standard ImPACT baseline norms do stratify by age, gender stratifications are not currently published. It is important that healthcare professionals use the appropriate stratifications to compare post-concussion data in interscholastic athletes, as there are differences between gender and between age groups.

Towards Restoring Scapular Position and Motion Through Mapping Muscle Excitation in the Trapezius

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Context: Alterations in scapular position and motion (*scapular dyskinesis* [SD]) are a prevalent clinical finding in symptomatic and healthy individuals that increases the risk of shoulder pain and pathology. Given the multi-directional muscle fibres of the trapezius, differences in excitation within a region likely influence scapular position and motion. The purpose of the study was to examine muscle excitation in the three regions of the trapezius in those with and without SD during shoulder flexion to determine if differences in the mean location of excitation (i.e. barycentre) exist.

Methods: Fifty-six healthy right-handed participants were assessed for SD using the SD test: 28 had normal scapular motion (CON: 15 Female, 27±9 years) and 28 had dyskinesis (DYS: 22 Female, 24±7 years). Participants completed five repetitions of weighted shoulder flexion. Kinematics of the upper extremity were collected to determine glenohumeral angle, while high-density surface electromyography of the upper [UT], middle [MT], and lower [LT] trapezius was collected using 3, 32-electrode grids. Barycentre within 30-degree ranges (30°-60°, 60°-90°, 90°-120°) was extracted during elevation [UP] and lowering [DOWN] phases for each grid. A two-way ANOVA was conducted for each grid in each range, resulting in six ANOVAs to examine the interaction of group and angle.

Results: Barycentre location is expressed as a percentage of grid position from 0% (most cranial) to 100% (most caudal). A significant interaction was found for LT-UP ($p = .025$, $\eta^2 p = .079$). Barycentre was located more cranially in DYS at each range, with differences of 4.6% (CON=35.2±6.6%, DYS=30.6±7.9%, $p = .022$) for 30°-60°, 5.0% (CON=35.1±6.7%, DYS=30.1±8.2%, $p = .015$) for 60°-90°, and 5.8% (CON=35.7±7.3%, DYS=29.9±8.4%, $p = .008$) for 90°-120°. Simple main effect of angle was significant for DYS ($p = .042$, $\eta^2 p = .132$) but not CON. A significant interaction was found for LT-DOWN, ($p = .041$, $\eta^2 p = .073$). Barycentre was located more cranially in DYS at 120°-90° and 90°-60°, with differences of 5.9% (CON=36.3±6.9%, DYS=30.4±8.5%, $p = .006$) and 4.5% (CON=36.1±6.2%, DYS=31.6±7.9%, $p = .021$), respectively. Simple main effect of angle was significant for CON ($p = .030$, $\eta^2 p = .157$) and DYS ($p < .001$, $\eta^2 p = .404$). No significant interactions were found for UT or MT during UP or DOWN phases.

Conclusion: Mean location of excitation in the LT was more cranial in DYS at various angles of shoulder flexion compared to CON, which may contribute to alterations in scapular kinematics observed in individuals with SD. Future research is needed to determine if selective excitation of sub-regions of the trapezius is associated with deviations in scapular kinematics, and whether the location of excitation within a muscle can be altered, both acutely and chronically, by targeted rehabilitation strategies to improve scapular kinematics and reduce the risk of shoulder pathology.

The Musculoskeletal Transformation (MSK-T) Program: Development of a Standardized Primary Care Decision-Making Tool for Shoulder Conditions

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Context: Shoulder conditions are among the most common reason for visiting primary point of care services such as family physicians and allied health professionals (i.e. athletic therapists, physiotherapists), resulting in an overwhelming high demand for services. The current system, however, is plagued with variations in patient care, inappropriate or unnecessary treatment, inaccurate diagnoses, and greater use of healthcare resources. For instance, there is a lack of consistency and awareness with respect to appropriate imaging criteria by ordering physicians. This results in a high volume of magnetic resonance imaging (MRI) that continues to be ordered at the primary care level when not indicated. Standardized clinical decision-making tools improve patient access and quality of care. Standardized care pathways provide guidance on best practice and aim to decrease variance in practice across the continuum of care, while reducing unnecessary wait times and healthcare expenditures.

Methods: Development of the tool underwent: 1) completion of a rapid review; 2) selection of experts, and 3) implementation of a modified Delphi voting process.

Results: The rapid review initially yielded 6,451 articles after duplicates were removed. After title, abstract, and full-text review, 88 articles provided evidence and generated 271 voting statements. Fifty-five experts were selected to participate in three rounds of Delphi voting. Experts were chosen to represent different health disciplines and geographical locations across Alberta. Rounds 1 and 2 voting occurred via email using Research Electronic Data Capture (REDCap) survey distribution tools; Round 3 voting occurred “face-to-face” using the video-conferencing web-based platform, Zoom Video Communications (version 5.1.0). Consensus was reached for a standardized primary care decision-making tool for the following shoulder conditions: rotator cuff disease, biceps pathology, superior labral tear, instability, adhesive capsulitis, and osteoarthritis of the glenohumeral and acromioclavicular joints.

Conclusion: This tool is intended to provide a province-wide standardized approach for managing shoulder conditions in primary care. This tool consists of a clinical examination algorithm for assessing, diagnosis, and managing shoulder pain; recommendations for history-taking and identification of red flags or additional concerns; recommendations for physical examination and neurological screening; and stepwise approaches for clinical decision-making. Development of this tool was an Alberta Health Services' Bone and Joint Health Strategic Clinical Network (BJH SCN) initiative of the Musculoskeletal Transformation (MSK-T) Program. The MSK-T Program is a province-wide initiative aimed to improve quality of care; standardize MSK care across Alberta; and support innovating models that shift the burden of care and dollars from downstream management (i.e. surgery) towards prevention, early detection, and appropriate community management. This initiative is also supported by the Alberta Bone and Joint Health Institute.

Injuries and Illness in the 2019 Canada Games: Moving Towards Improving the Surveillance System

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Context: The Canada Games (summer and winter) have been held since 1967. Injury and health surveillance systems are important for understanding the burden, causes, and potential prevention opportunities of injuries and illnesses during major sporting events. This study aimed to examine sport-related injury and illness rates during the 2019 Canada Games and determine potential improvements for future injury surveillance.

Methods: This is a retrospective cohort study using data extracted from registration information and incident reports by medical staff from the 2019 winter Canada Games. All medical reports were independently coded by two researchers with sports

medicine backgrounds, based on the Orchard Sports Injury and Illness Classification System (OSIICS) and the International Olympic Committee (IOC) consensus statement on methods for recording and reporting of epidemiological data on injury and illness in sport. Conflicts were discussed with the research team. All registered athletes (ages 12-30) were included in this analysis. Injury incidence proportions (IP) per 100 registered athletes with 95% confidence intervals (CI) were calculated for male and female by sport based on injuries classified as index injuries directly or non-directly related to sport during the Canada Games. The incidence proportion of all illnesses are also reported.

Results: In total, 2,346 unique athletes (1,110 males, 1,235 females, 1 non-disclosed) participated in 2019. There were 2,249 medical incident reports, of which 562 were identified as index injuries either directly or non-directly related to sport during the games [IP: 23.9 injuries (95% CI 22.0-26.0) per 100 athletes] and 97 illnesses [IP: 4.1 illnesses (95% CI 3.4-5.0) per 100 athletes]. The sporting events with the highest incidence of injuries included, men's and women's freestyle skiing [IP: 62.8 injuries (95% CI 41.4-91.4) per 100 athletes and IP: 56.0 injuries (95% CI 30.6-94.0) per 100 athletes respectively], men's boxing [IP: 46.3 injuries (95% CI 27.0-72.4) per 100 athletes], women's snowboarding [IP: 44.1 injuries (95% CI 24.7-72.8) per 100 athletes], women's biathlon [IP: 40.5 injuries (95% CI 22.7-66.9) per 100 athletes] and men's gymnastics [IP: 36.1 injuries (95% CI 23.6-52.9) per 100 athletes]. Despite standardized coding procedures, many of the medical reports lacked sufficient detail, resulting in many cases requiring discussion prior to coding (e.g. 23% of injury pathology type cases, 40% of OSIICS injury diagnoses).

Conclusion: Approximately 1 in 5 athletes sustained at least one injury requiring medical attention during the 2019 Canada Games. The IOC consensus statement on methods for recording and reporting of epidemiological data provides sport organizers with guidelines and best practices on how to collect and report injury rates, but these strategies have yet to be implemented. Implementing more standardized reporting can improve the reliability of monitoring injury and illness burden and inform prevention strategies at future Canada Games.

The Child Focused Injury Risk Screening Tool (ChildFIRST) for 8–12-Year-Old Children is Positively Correlated With Physical Activity Levels

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Context: The Children Focused Injury Risk Screening Tool (ChildFIRST) was developed to identify children who present poor movement competence and may have increased risk of lower limb injury. The correlation of movement competence and physical activity levels has been widely studied; however, the correlation between physical activity levels and a tool that evaluates movement competence and injury risk has not been explored. The purpose was to evaluate the correlation between the ChildFIRST scores and physical activity levels in 8–12-year-old children.

Methods: We conducted a cross-sectional study to evaluate apparently healthy, injury free, 8-12-year-old children. After conducting a power analysis, we used convenience sampling to recruit participants from local schools and sport academies. We evaluated movement competence using the ChildFIRST which is a valid and reliable tool that consists of ten movement skills (i.e., bodyweight squat, vertical jump, horizontal jump, walking lunge, running, leaping, single-leg hop, single-leg sideways hop and hold, two to one hop and hold, and 90-degree hop and hold) each with four evaluation criteria for a total score of 40 points. Demographic data, self-reported physical activity, and ChildFIRST scores analyzed in this study were collected as part of the continued validation ChildFIRST study using 3-dimensional motion analysis. We computed a Pearson correlation coefficient (r) with 95% confidence intervals (CI) and an alpha level of 0.05 to study the correlation

between the ChildFIRST and physical activity levels. We determined the physical activity levels by adding the number of physical activity sessions (excluding physical education classes) and sport practices per week.

Results: Seventeen (17) children completed the tests (82.35% male, years = 10.46 ± 1.33, BMI = 17.13 ± 1.58). The children participated in 4.53 ± 1.59 physical activity sessions and 2.88 ± 1.87 sports practices for a total of 7.41 ± 2.47 sessions per week. These sessions lasted less than 30 minutes for 12.50% of the participants, between 30 and 60 minutes for 56.25% of the participants, and more than 60 minutes for 31.25% of the participants. The mean of ChildFIRST scores was 30.18 ± 4.96, and the correlation between physical activity and ChildFIRST scores was positive ($r = 0.49$; 95%CI [0.02, 0.79]) and significant ($p = 0.044$).

Conclusion: Consistent with the literature, there is a moderate positive correlation between ChildFIRST scores and physical activity levels. Including an injury prevention approach to movement competence assessment is congruous to promoting safe physical activity. Focusing on the development of movement skills should continue to be advocated by practitioners working with pediatric populations. Improved movement competence may lead to increased motivation and confidence that may lead to increased physical activity levels. The ChildFIRST can provide information to assist stakeholders in designing individualized movement-based interventions associated with long term physical activity levels.

Comparing Visual Sensory Performance Outcomes in Special Operations Forces Combat Soldiers With or Without Concussion History

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Context: Special Operations Forces (SOF) combat Soldiers endure various occupational exposures including blunt and blast head trauma. These exposures may result in occupational injuries, which may negatively affect human performance. Vision contributes to human performance, and existing data support two premises: 1) concussions adversely affect vision, and 2) visual deficits are associated with increased head impact frequency and severity, and decreased impact anticipation. These premises affect athletes and Soldiers alike. Thus, this study's objective was to compare visual sensory performance outcomes in SOF combat Soldiers with and without concussion history.

Methods: This cross-sectional study consented 336 Special Operations Forces combat soldiers (age=33.0±4.4 years) self-reporting their lifetime concussion history (No history=148; History=188). The Senaptec Sensory Station (SSS) was then used to collect visual sensory performance in a clinical research center. The SSS is a computer-based unified testing platform (touchscreen tablet, responsive large screen, smartphone interface, and stereoscopic glasses) that evaluates ten different vision domains, including the dependent variables we studied: 1) Near-Far Quickness (NFQ) (overall score, reaction time to near targets, reaction time to far targets), 2) Perception Span (correct targets), and 3) Go/No-Go (total score). Separate Wilcoxon rank-sum analyses compared our outcomes between concussion history groups due to data non-normality. Analyses were performed using SAS 9.4.

Results: The NFQ overall score significantly differed ($Z=2.04$; $P=0.043$) between those with (median=26 cycles; IQR=7) and without (median=27 cycles; IQR=8) concussion history. The NFQ reaction times to near targets were significantly slower ($Z=-3.61$; $P<0.001$) in those with concussion history (median=1222.07ms; IQR= 317.07) compared to those without concussion history (median=1129.00ms; IQR=320.25). Likewise, NFQ reaction times

to far targets were significantly slower ($Z=2.56$; $P=0.011$) in SOF combat Soldiers with concussion history (median=852.43ms; IQR=209.81) compared to those without concussion history (median=817.46ms; IQR=243.24). Correct targets (Perception Span) were significantly higher ($Z=2.27$; $P=0.024$) in SOF combat Soldiers without a concussion history (median=48 targets; IQR=22) compared to those with previous concussion (median=39 circles; IQR=21). SOF combat Soldiers without concussion history (median=10.50; IQR=13.00) had significantly better overall Go/No-Go total scores ($Z=-2.19$; $P=0.029$) than those with a concussion history (median=8.00; IQR=11.00).

Conclusion: We observed decreased visual sensory performance outcomes in SOF combat Soldiers with a concussion history. These outcomes evaluated a Soldier's ability to change focus between near and far threats (Near-Far Quickness), perceive and retain a broad range of visual information to make quick and accurate decisions (Perception Span), and to inhibit motion in response to intentional distracting stimuli (Go/No-Go). Taken together, these findings may point to diminished occupational performance and add to the recent literature intersecting concussion history with human performance declines. These data may offer insights into rehabilitation and training mechanisms aimed at optimizing warfighters for their occupational responsibilities following injury.

Relationships Between Cadence and Ground Reaction Forces in Adolescent Long-Distance Runners

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Context: High school cross-country runners with a low cadence are at greater risk of sustaining a shin injury. Increasing cadence is reported to reduce running-related injury risk factors like ground reaction forces (GRFs). However, it is unknown if running with a low cadence predisposes adolescent long-distance runners to experience larger GRFs. This study investigated the relationship between cadence and GRFs in adolescent long-distance runners. It was hypothesized runners with a lower cadence would demonstrate larger GRFs.

Methods: Adolescent long-distance runners ($F=47$, $M=44$, age=14.7±2.0y, BMI=19.5±2.3kg·m⁻²) participated in this study. Participants completed a single lab visit and underwent a 3-dimensional running analysis while instrumented with retroreflective markers. Following a 5-minute treadmill warmup at a self-selected velocity, participants completed 5-10 practice runs over a 20m runway with embedded force plates. Participants were instructed to run at a comfortable velocity that was "not too hard or too easy." Timing gates were placed 2.8m apart to monitor the participant's running velocity. The average velocity during the practice runs was set as the participant's self-selected velocity for the data collection. Participants repeated trials over the 20m runway until a minimum of 5 successful trials were recorded for the left and right foot (i.e., striking the force plate, within 5% of self-selected velocity). Marker trajectory data were collected at 120Hz using a 12-camera system and force plate data were collected synchronously at 1800Hz. Initial contact and toe-off events were detected when the vertical GRF exceeded and dropped below 20 N and GRFs were normalized to body weight (BW) and extracted using a custom MATLAB script. Partial correlations compared the relationship between peak braking force (GRF_b [BW]), peak vertical GRF (GRF_v [BW]), vertical impact peak (VIP [BW]), vertical instantaneous loading rate (VILR [BW/s]), and vertical average loading rate (VALR [BW/s]) while controlling for self-selected running velocity (m/s) using RStudio. Correlation strength was classified as none ($r < 0.1$), poor ($r=0.1-0.3$), fair ($r=0.3-0.6$), moderate ($r=0.6-0.8$), and very strong ($r ≥ 0.8$).

Results: Running speed ranged from 2.43-5.84 m·s⁻¹ (mean=3.69±0.71 m·s⁻¹) A significant negative relationship was observed between cadence and GRF_b ($r=-0.30$, $p < .01$). No significant

relationships were observed between cadence and the remaining GRFs ($-0.09 \leq r \leq 0.12, p \geq .27$).

Conclusions: Running with a higher cadence was fairly associated with lower peak braking forces, but there were no significant relationships between cadence and vertical GRF peaks or rates of loading. Larger peak braking forces are a predictor of running-related injury in recreational adult female runners. While running with a lower cadence did not predispose our participants to experience larger vertical GRFs, the larger braking forces may contribute to higher shin injury risk previously reported in high school runners with lower cadences.

Reliability and Validity of Different Handheld Dynamometry Techniques When Measuring Hip Muscle Strength and Power

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Context: Hip strength measured isometrically using belt-stabilized hand-held dynamometers (BS-HHD) is inexpensive, portable, reliable, and valid. Hip power, however, has not been assessed utilizing BS-HHD. Set-up limitations exist for BS-HHD, but tension HHD (T-HHD) has been proposed instead. Limited research has examined the reliability and validity of T-HHD. Our purpose was to investigate the reliability and validity of hip strength and power measured with BS-HHD or T-HHD techniques. We hypothesized that both techniques would be reliable and valid measures.

Methods: Our study included 16 healthy participants (F=12, M=4, age=21.9±2.4 years, height=1.70±0.10m, mass=80.5±24.8kg) who completed two visits at least one week apart. Hip strength and power (abduction, internal rotation, external rotation) were assessed on both days using both the BS-HHD and T-HHD (Hoggan ErgoFET2). Continuous force data were sampled at 100Hz using ErgoPAK software. Order of testing was randomized among muscle groups and techniques, and consistent between the two visits. An isokinetic dynamometer (Biodex System4, sampling rate=1000Hz), was used as the reference standard; two muscle groups were randomly tested on one of the visits the remaining muscle group was tested during the other visit. Participants completed three maximal contractions for each muscle group. Overall peak torque (Nm) and peak rate of torque development (RTD; Nm·s⁻¹) were extracted for each muscle group. A 200ms moving time window was used for RTD and the time window with the steepest slope was recorded as peak RTD. Between visit test-retest reliability of hip strength and power were analyzed with Intraclass Correlation Coefficients (ICC). Validity was assessed using Pearson correlations between the HHD techniques and isokinetic dynamometer. Relationships were categorized as poor (< 0.50), moderate (0.50-0.74), good (0.75-0.89), or excellent (≥ 0.90).

Results: We observed good-to-excellent reliability (ICC=0.82-0.94) of peak torque for all hip muscle groups with BS-HHD and T-HHD (Table 1). We observed moderate-to-good relationships ($r=0.50-0.87$) between HHD and isokinetic dynamometry. We observed moderate-to-excellent reliability (ICC=0.53-0.91) of peak RTD for all hip muscle groups with BS-HHD and T-HHD and poor-to-moderate relationships ($r=0.44-0.69$) between HHD and isokinetic dynamometry.

Conclusions: HHD is a reliable tool for assessing isometric hip abduction, internal rotation, and external rotation strength and power using HHD techniques. While isokinetic dynamometers are the gold standard for assessing muscle strength and power, the equipment is expensive and immobile. BS-HHD or T-HHD techniques may be used as an alternative to isokinetic dynamometer for assessing isometric hip abduction, internal rotation, and external rotation strength and power in the clinic or field.

Editor's note: Table 1 not provided.

Exploring the Impact of the Athletic Therapy Interactive Concussion Educational (AT-ICE) Tool in Athletic Therapy Education

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Context: Previous research has identified a considerable amount of variability in how healthcare professionals are taught to recognize, assess, and manage concussions. This suggests a need for educators to critically analyze how they currently teach about concussion assessment and management, while also exploring how innovative pedagogical strategies could be implemented to enhance concussion care. Responding to these findings, we developed an innovative pedagogical tool known as the athletic therapy interactive concussion educational (AT-ICE) tool. The purpose of this project was to explore the impact of this tool within a sample of athletic therapy students.

Methods: 22 students (20.7±1.2 years; 14 females, 8 males) participated, representing five different CATA Accredited Institutions. Each participant reviewed the AT-ICE tool independently, then completed an online questionnaire that explored student perceptions about using technology for learning, and about the educational tool itself. The questionnaire also included open-ended questions asking students to reflect on potential ways to implement such a tool within formal academic settings. Descriptive statistics (means ± standard deviations) were calculated for all Likert-scale questions (responses ranging from 1 = strongly disagree to 5 = strongly agree), while open-ended responses were analyzed for emergent themes.

Results: Overall, the sample expressed an appreciation for using technology as a part of their learning. Participants strongly agreed (4.67±0.49) with the statement "I feel that technology, when used the right way, can empower student learning" and disagreed (1.80±0.77) with "using technology to learn is distracting". Furthermore, every participant agreed or strongly agreed with the statement "I enjoyed using the AT-ICE tool" (4.67±0.49) and felt it helped to stimulate their critical thinking about the entire continuum of concussion care (4.8±0.41). Students also reported that the tool was easy to navigate, provided sufficient detail, and was not too difficult for their current knowledge base. Several important themes also emerged from the open-ended questions. Students expressed an appreciation for the critical reflection questions, sharing of personal experiences, and structured peer activities as it was described that these important components are often neglected in similar online educational resources. The majority of participants also recommended integrating this tool within a formal classroom setting where the students can complete the questions autonomously and then participate in a larger class discussion with their instructor.

Conclusions: The findings from this study demonstrated that the AT-ICE tool was considered to be an effective tool by the sample of athletic therapy students, by stimulating critical thought throughout the entire continuum of concussion care. Participants also expressed the potential for the AT-ICE to be embedded within formal academic settings with interactive discussions with course instructors. Future research should be expanded by involving athletic therapy educators, to explore various ways of how to implement such an interactive tool in formal athletic therapy educational settings.

Comparing Two Methodologies of Knee Flexor Strength Assessment in Patients One-Year Following Primary Anterior Cruciate Ligament Reconstruction

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Context: There is debate as to the magnitude and persistence of knee flexor strength deficits following harvest of the semitendinosus and gracilis tendons (STG) for anterior cruciate ligament (ACL)

reconstruction (ACLR). Persistent deficits have been found at long-term follow-up (14 years) during the eccentric Nordic Hamstring curl that were larger than concentric isokinetic deficits and related to the ACL quality of life (ACL-QoL) patient reported outcome measure. It is unknown whether this relationship occurs at earlier timepoints, or in patients of differing grafts. The purpose of this study was to assess knee flexor strength during an eccentric Nordic Hamstring curl against isokinetic concentric knee flexion in patients of varying grafts (STG, bone-patellar-tendon-bone (BPTB), quadriceps tendon (QT)) at one-year post-operative alongside a measure of quality of life (ACL-QoL).

Methods: 104 patients (27.8 ± 8.4 years, 174.5 ± 9.2 cm, 79.6 ± 17.0 kg) were assessed at 12 months following primary ACLR with varying grafts (STG ($n = 31$), BPTB ($n = 35$), QT ($n = 38$)). A performance assessment was completed including five repetitions of isokinetic concentric knee flexion at 90 degrees per second in the seated and supine positions (Biodex System 4). Three repetitions of an eccentric Nordic Hamstring Curl were then completed on the NordBord dynamometer after familiarization. The ACL-QoL was completed during rest intervals. Statistical analyses were completed with ANOVA considering limb (affected, unaffected), graft and test type as both raw scores and as a limb symmetry index (affected/unaffected * 100%).

Results: Affected limb force during the Nordic Curl was reduced (206.9 ± 80.4 N) relative to the unaffected limb (263.7 ± 86.2 N) in STG but not QT or BPTB (graft $p = 0.008$, limb $p = 0.066$). Differences in isokinetic torque did not reach statistical significance in seated (graft $p = 0.068$, limb $p = 0.086$) or supine (graft $p = 0.512$, limb $p = 0.141$). For LSI across all tests, STG was reduced against BPTB (mean difference -13.5%, $p < 0.001$) and QT (mean difference -12.6%, $p < 0.001$). While there was no main effect of graft on ACL-QoL, scores were lower and approached the minimally clinically important difference (MCID) in STG relative to BPTB (mean difference -8.4%, $p = 0.048$) but not QT (mean difference -5.25%, $p = 0.217$).

Conclusion: Deficits in knee flexor strength are larger at one-year post-operative in patients with STG versus BPTB or QT grafts, and these may be greater in eccentric contraction modes, or during the Nordic Hamstring curl. Further research is required to clarify whether these observed deficits are a characteristic of the Nordic curl itself or the differing contraction modes between tests.

The Evaluation of Between-Limb Centre of Pressure Synchrony as a Diagnostic Tool for Sport-Related Concussion in Young Ice Hockey Players

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Context: Between-limb temporal and spatial coordination of centre of pressure (CoP) displacements are important component of balance control, which may be altered by sport-related concussion (SRC). This work explored the potential to detect such changes in interlimb coordination following SRC among young male hockey players. We hypothesized athletes who have sustained SRC over the season would show a reduced magnitude of between-limb CoP spatial symmetry and temporal synchrony, which will suggest greater instability post-concussion.

Methods: A modified nonequivalent pretest-posttest control group study design was completed with a convenience sample of 104, 12–17-year-old elite male ice hockey players with 146.63 ± 12.75 days between tests. Participants were grouped based on whether they sustained a SRC between the pre- and post-season data collection time points, with 12 sustaining a SRC. Participants performed one 60 second trial of quiet standing with eyes open on force plates. Participants who sustained a SRC participated in post-season balance testing 77.25 ± 27.94 days after time of injury. Based on when the quiet stance trial was conducted during the testing session, players were allocated into a fatigue status group. Participants were placed in the fatigued group if they

had completed performance testing prior to the balance test. The ratio of left and right limb root-mean-square CoP displacements were calculated from the anteroposterior (AP) and mediolateral (ML) CoP time series, to assess spatial symmetry. Further, the cross-correlation of right and left limb CoP time series was used to obtain between-limb temporal synchrony of CoP displacements in AP and ML directions. Participants who had transient ML weight shifts or ML loading asymmetries that exceeded 20% of the participant's body weight were excluded from the statistical analysis. An analysis of covariance ($p < 0.05$) on post-season temporal and spatial synchrony measures was conducted - SRC and fatigue status were the dependent variables, and pre-season measures were controlled.

Results: There were no statistically significant differences in post-season ML ($p = 0.949$) and AP temporal synchrony ($p = 0.567$) between the SRC groups, nor in post-season ML ($p = 0.817$) and AP symmetry scores ($p = 0.904$) between SRC groups. There was no effect of fatigue in post-season ML ($p = 0.791$) and AP between-limb temporal synchrony ($p = 0.780$), or in ML ($p = 0.566$) and AP ($p = 0.958$) scores for spatial symmetry.

Conclusions: Deficits in temporal and spatial between-limb synchrony do not exist long-term in young male ice hockey players who have sustained a SRC. As well, fatigue has little effect on these measures which has clinical relevance in when this test may be conducted. Further research is required to clarify whether deficits exist closer to time of injury, and when those deficits resolve.

Current Injury Prevention Exercise Programme Practices and Attitudes in Post-Primary PE Class

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Context: The extent to which injury prevention exercise programmes (IPEPs) are utilised in schools is currently unknown, despite recent calls to implement them in these settings. To develop an effective and sustainable IPEP for schools, knowledge of existing practices and the attitudes of teachers towards IPEPs is crucial. The aim of this study was to establish the current IPEP practices in post-primary Physical Education class in Ireland.

Methods: Post-primary PE teachers ($n=287$, 9.6% of all PE teachers in Ireland) completed an anonymous online survey using the software Qualtrics (SAP America Inc., Seattle, USA). A 33-question survey was adapted from an existing survey and validated for question clarity, comprehension, and appropriateness by 7 experts ($n=3$ PE teachers, $n=2$ PE academics, $n=2$ injury prevention academics). The survey was then piloted by 12 current Post-primary PE teachers. Outcome measures included current IPEP practices in PE class, comprising of programme implementation, contents, and sources of IPEP. PE teachers' attitudes towards IPEPs, willingness to implement IPEPs, and self-perceived ability to implement an IPEP were also captured. Data were analysed using descriptive statistics and Mann Whitney U tests were used to compare differences between groups.

Results: Less than 1 in 5 teachers implemented an IPEP in PE class ($n=54$). Of those who did, none implemented an entire IPEP, with teachers either adapting an existing programme ($n=25$) or self-designing an IPEP ($n=24$). The most frequent components of PE class IPEPs included gentle running (92.6%), flexibility (88.9%), and bodyweight exercises (79.6%). Most teachers were willing to implement an IPEP in PE class (80.5%), while almost 75% ($n=199$) believed implementing IPEPs in PE class would reduce the number of injuries among students. Only 6.5% of PE teachers felt IPEPs were only suitable for those who played sport ($n=17$). Almost half of teachers (48.8%) felt they lacked sufficient knowledge to implement an IPEP. PE teachers who were previously aware of an existing IPEP (median=17.00, IQR=15.75-19.00) were less willing to implement an IPEP than those who were unaware (median=18.00, IQR=16.50-19.00), with a medium effect size ($p=0.02$, $g=0.29$).

Conclusion: Despite a strong willingness amongst PE teachers to implement IPEPs in PE class, less than 1 in 5 currently do. This suggests PE class may be an underutilised environment for adolescent injury prevention. However, the findings indicate a large proportion of teachers feel they lack sufficient knowledge to implement IPEPs, and that a more tailored IPEP may be required.

Concussion Assessment and Management Practices Among Canadian Athletic Therapists

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Context: Concussions contribute a significant proportion of sport-related injuries in Canada each year. Certified athletic therapists (ATs) in Canada play a vital role in concussion healthcare and must remain current with evidence-based guidelines to continually improve injury management. Canadian AT concussion-related knowledge and healthcare practices are presently understudied. This study examined 1) current concussion assessment and management techniques across practice settings, 2) if clinical practices differed based on years of clinical experience and education, and 3) knowledge among Canadian ATs. We hypothesized: 1) ATs would partially meet international concussion consensus guidelines; 2) Respondents with more clinical experience and education would demonstrate better practices; and 3) ATs would have adequate knowledge.

Methods: Canadian ATs who were members of the Canadian Athletic Therapists Association (CATA) were invited to complete a 20-minute, online, cross-sectional cohort survey study. ATs reported their demographics, the number of concussions assessed annually, the assessment and return-to-play (RTP) tools used, and concussion knowledge (symptom recognition, patient-clinician scenarios) using a modified, previously validated survey. Multidimensional assessment battery use was examined based on at least two-battery key domains (symptoms, balance, neurocognitive) being endorsed. Descriptive statistics were used to describe AT practices. Univariable binary logistic regressions with odds ratios (OR) and 95% confidence intervals (95%CI) were calculated to examine the relationship between the use of two concussion assessment domains and clinical experience and education.

Results: The response rate was 10.1% (211/2090). Respondents averaged 12.6±7.5 years clinical experience. The majority of ATs (90.1%[190/211]) had a bachelor's degree and provided sport medical care (83.5%[176/211]). The minority (31.1%[66/211]) of ATs worked primarily in a sports medicine clinic. Standardized sideline assessments were the most commonly endorsed concussion assessment method (95.3%[161/178]), and computerized neurocognitive testing was the least used (26.4%; n=47/178). Two-domain and three-domain (symptoms, balance, neurocognitive) concussion assessments were used by 73.6% (131/178) and 19.7% (35/178) of ATs, respectively. ATs with a Master's degree had greater odds of completing two-domain assessments at initial evaluation than those with a Bachelor's degree (OR=1.80, 95%CI: 1.41-1.95). Education and clinical experience did not associate with altered odds for any other two-domain minimum assessment use (p≥0.068). for Managing RTP using formal RTP guidelines was the most common method (93.4%; n=155/166). Only 37.2% (61/164) of ATs were primarily responsible for RTP decision-making. Symptom recognition was adequate among ATs (76.6±17.0%), and 89.0%(138/155) of AT responses to scenario-based questions aligned with current consensus guidelines. However, 39.5%(62/

157) indicated an athlete would be allowed to return to play if the player reported "I am fine, I just got my bell rung".

Conclusion: Canadian ATs demonstrated acceptable concussion knowledge, but did not fully comply with international consensus concussion assessment or Canadian concussion guidelines. Canadian ATs should aim to implement multidimensional concussion assessments to ensure safe and appropriate diagnosis and RTP.

Student Athletic Therapists (SATs) Knowledge of Pain-Relieving Medications: A Nationwide Study

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Introduction: Misuse of pain-relieving medications (PRM), including opioids, among athletes is increasing with rates reported between 1-50% depending on sport, level of play, sex, and previous use. Athlete's misuse PRM to mitigate pain but will consult SATs for pharmacological and non-pharmacological methods to manage pain, who possess expertise to manage athlete injuries. Opioid misuse can result in cognitive impairment, psychological and physical dependency, as well as death. Based upon reported misuse in the literature, it is reasonable to assume that SATs have managed athletes who have misused PRMs and opioids and have potentially missed important symptoms thereby potentially placing athletes in harm. . The purpose of the study was undertaken to uncover what Canadian SATs know about PRMs and opioids as well as discover the origins of such knowledge. A second purpose was to uncover program directors (PDs) understanding of where SATs acquire their knowledge as well as reveal issues that SATs may experience related to athletes PRM and/or opioid misuse.

Methods: SATs currently studying in an accredited Athletic Therapy program (AATP) as well as recent graduates (<1 year of graduation from AATP), over the age of majority within their respective province, were sent a survey link via their institutions, CATA, and social media. . Ethical approval was granted by Sheridan College, CATA, and participating institutions. PDs (or designates) at AATPs were recruited for a focus group to determine their thoughts related to SATs knowledge of PRMs and opioids. .

Results: 96 surveys were completed from SATs with all AATP represented. . Three PDs participated in the focus group. . Results indicated that SATs believed they lacked sufficient knowledge related to PRMs including opioids with most of their knowledge coming from curriculum as well as personal use. Over half of the SATs indicated that they have previously been approached by athletes and coaches to provide PRMs. Data analysis revealed statistical significance (p<0.05) between SATs with previous experience with PRM and comfort with discussing PRMs with athletes. . SATs reported experiencing considerable pressure to provide athletes with correct information, as well as reporting stigma toward athletes who misuse opioids. . PDs reported similar knowledge sources and understood the pressure that SATs experienced when providing the message to SATs to work within their knowledge.

Conclusion: PRM and opioid dispensing is not within the scope of SATs, however, recognition and referral are. Although SATs reported that they were able to recognize an athlete who is misusing opioids, they were unsure of how to manage the athlete when faced with a quick decision, thereby feeling tremendous pressure to provide correct information. . It is recommended that AATP as well as clinical educators address the pressure SATs experience and reinforce identification and management of athletes who misuse PRMs.

Evidence-Informed Practice Knowledge in Athletic Therapy

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Context: Athletic therapy competencies were updated in 2019 and officially implemented in Canadian Athletic Therapists Association (CATA) accredited curricula in 2020 (Lafave et al, 2021). The

“Scholar Role” is new to athletic therapy education in Canada and was not officially required prior to this iteration of the athletic therapy competencies in Canada. Many programs had been teaching many of the competencies that were officially adopted in 2020, but current programs must now account for covering these competencies to the CATA program accreditation committee. There is little understanding of Certified Athletic Therapists’ knowledge of the Scholar Role competencies in Canada since graduates of CATA accredited curricula were not required to address this prior to 2020. Therefore, the purpose of this study was to establish the baseline knowledge and attitudes of certified athletic therapists in Canada related to evidence informed practice (EIP).

Methods: The Evidence Based Concepts: Knowledge, Attitudes and Use (EBCKAU) tool was employed to survey the CATA certified membership as a measure of their EIP competence. The EBCKAU was designed to measure student athletic training knowledge, attitudes and use of EIP concepts (Manspeaker et al, 2011). Only the six knowledge items are reported in this abstract. An electronic version of the EBCKAU was created in Qualtrics © (2020) and sent out via an email distribution list to the entire CATA membership (n = 2700) where certified members (n = 2000) were invited to participate in the survey. The study was approved by the Mount Royal University Human Research Ethics Board (#101909).

Results: Ninety-five certified members or approximately 4.8% of the related CATA membership answered the survey (24.2% male, 72.6 female, 3.2% preferred not to report). 3.2% of survey respondents had a PhD, 30.5% had a master’s degree and 66.3% had an undergraduate degree. Correct responses among the six knowledge items ranged from 56.8% (Q3) to 98.9% (Q4), with an overall mean of 75.8%.

Conclusions: The response rate was a significant limitation that should frame the results. The total number of certified members that possess a post-graduate degree in Canada is unknown, so the relative proportions of each that participated in this study may have skewed the results. However, the mean knowledge score of 75.8% identifies opportunity for improvement in EIP knowledge for Canadian certified athletic therapists if these results were to be considered representative of the entire population. Future research should continue to measure EIP knowledge after educational interventions.

Associations of Age of First Exposure Across Age Decades on Cognitive, Behavioral, and Physical Function Among Former National Football League Players

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Context: American football is a widely played youth sport. However, the repetitive head impacts experienced and the age of first exposure (AFE) to impacts during brain maturation periods is a growing concern for late-life function. Mixed evidence exists surrounding AFE associating with late-life function, and may be due to the age groups (e.g., college athletes, mid-life general population) being examined. Our study examined the associations between AFE and self-reported measures of cognitive, behavioral, and physical function across age decade bands among former National Football League (NFL) players.

Methods: We conducted a cross-sectional survey among 1,784 former NFL players (age:52.3±16.3yrs, AFE: 11.3±2.9yrs, years of

football:17.5±4.5yrs, 58.4% Caucasian, 84.8% with at least a bachelor’s degree, 86.9% with ≥1 lifetime concussion). Players completed a general health questionnaire capturing demographics and football playing history, which were used to derive AFE and age decade. For age decade, players were binned into 10-year age categories (e.g., 20-29 years-old), with the reference group and oldest binned in a 70-99 years-old category. Players then completed Patient-Reported Outcomes Measurement Information System (PROMIS) measures (Adult Cognitive Function short form-4a, PROMIS-29 Profile V2.0, Neuro-Quality of Life emotional and behavioral dyscontrol short form V1.0) to assess cognitive and physical function, anxiety, depression, sleep disturbances, pain interference, and emotional-behavioral dyscontrol. PROMIS outcomes were derived from summed 5-point Likert items and transformed to T-scores. Higher T-scores indicated higher construct endorsement. Multivariable linear regressions examined the associations of AFE, age decades, and their interaction with each PROMIS outcome using β and 95% confidence intervals (95%CI).

Results: No AFE by age decade interaction was present for any PROMIS outcome ($p \geq 0.076$); therefore, only main effects were reported. Younger AFE was associated with higher anxiety ($\beta = -0.22$, 95%CI: -0.40, -0.04, $p = 0.016$), depression ($\beta = -0.22$, 95%CI: -0.39, -0.05, $p = 0.010$), sleep disturbances ($\beta = -0.16$, 95%CI: -0.27, -0.04, $p = 0.007$), pain interference ($\beta = -0.19$, 95%CI: -0.35, -0.03, $p = 0.014$), and emotional-behavioral dyscontrol ($\beta = -0.22$, 95%CI: -0.40, -0.04, $p = 0.019$). There were no associations between AFE and cognitive ($\beta = 0.14$, 95%CI: -0.03, 0.31, $p = 0.116$) or physical function ($\beta = -0.01$, 95%CI: -0.14, 0.16, $p = 0.860$). Age decade was associated with all PROMIS outcomes ($p \leq 0.042$), with varying PROMIS score change as age decade increased. Relative to the 70-99 year-old cohort, the 50-59 year-old group had the least adaptive cognitive, anxiety, depression, sleep disturbances, and emotional-behavioral dyscontrol scores independent of AFE (β -range: -1.41, -3.27; p ’s ≤ 0.024), while the 20-29 and 30-39 year-old groups collectively had the most adaptive PROMIS outcomes (β -range: 1.77, 4.95; p ’s ≤ 0.022).

Conclusions: AFE statistically associated with PROMIS outcomes, but demonstrated low-strength associations and was not age decade-dependent. Thus, our findings indicate AFE was a minor factor for overall cognitive, behavioral, and physical function in this cohort. Future research should use objective cognitive, behavioral, and physical measures rather than self-reported PROMIS outcomes to fully understand the effects of early American football exposure.

Concussion Assessment and Management Practices Among Irish Athletic Therapists

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Context: Certified athletic therapists (ATs) in Ireland serve essential concussion assessment and management roles. Therefore, it is important for ATs to remain current with evidence-based concussion assessment and management guidelines, and to continually improve their concussion recognition capabilities. To date, Irish ATs’ concussion healthcare practices and concussion knowledge are unestablished. This study examined 1) current concussion assessment and management techniques across all practice settings, 2) if practices differed based on years of clinical experience and education, and 3) concussion knowledge among Irish ATs. We hypothesized ATs would: 1) partially meet interna-

tional concussion consensus guidelines, 2) increased clinical experience and education would associate with better clinical practice, and 3) display adequate knowledge.

Methods: We conducted a cross-sectional study among 49.7% ($n=91/183$) of all certified ATs in Ireland from the Athletic Rehabilitation Therapy Ireland (ARTI) membership in 2021. ATs completed an anonymous 20-minute online survey on their demographics, annual concussions assessed, assessment and return-to-play (RTP) measures used, and concussion knowledge (symptom recognition, patient-clinician scenarios) using a modified, previously validated survey. Symptom recognition consisted of 20 (8 true, 12 false) signs and symptoms recognition questions scored as total correct. Multidimensional assessment battery use was examined based on at least two-battery key domains (symptoms, balance, neurocognitive) being used. Descriptive statistics were calculated to describe AT practices. Univariable binary logistic regressions with odds ratios (OR) and 95% confidence intervals (95%CI) were used to examine the relationship between two-domain minimum concussion assessment, clinical experience, and education.

Results: On average, respondents had 6.6 ± 4.5 years of clinical experience, 89% ($n=81/91$) had a bachelor's degree and provided sport medical care, and 30.8% ($n=28/91$) worked in their own private practice). Standardized sideline assessments were the most frequently endorsed concussion assessment method (91.2%; $n=52/57$), while computerized neurocognitive testing was the least used (5.3%; $n=3/57$). Approximately 38.6% ($n=22/57$) and 3.5% ($n=2/57$) of Irish ATs used a 2-domain and 3-domain (symptoms, balance, neurocognitive) concussion assessment, respectively. The use of a 2-domain concussion assessment did not associate with education or clinical experience ($p \geq 0.24$). Return-to-play (RTP) guidelines were the most commonly used approach for determining RTP (86.8%; $n=46/53$), and 73.1% ($n=38/52$) were primarily responsible for RTP decision-making. Symptom recognition was adequate ($72.8 \pm 17.0\%$) and 93.7% ($n=45/48$) or greater patient-clinician scenario responses aligned with current consensus guidelines, except for 58.3% ($n=28/48$) Irish ATs indicating an athlete would be allowed to RTP if the player reported "I am fine, I just got my bell rung".

Conclusions: Irish ATs reported acceptable concussion knowledge, but many did not completely adhere with international consensus concussion assessment guidelines as evidenced by low two-domain assessment use. Low neurocognitive testing use was reported and may be attributed to financial barriers or infrequent pre-injury baseline assessment implementation. Our findings emphasize areas for Irish AT concussion assessment and management improvement.

Relationship and Latent Factors Between Current Clinical Assessments and the Functional, Standardized Assessment of Reaction Time (StART): A Prospective Cohort Study

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Context: Reaction time is commonly impaired following concussion. . Most clinically employed reaction time measures are isolated, as opposed to the functional movement reaction time required for sports. We developed the Standardized Assessment of Reaction Time (StART) to emulate the rapid, concurrent cognitive and whole-body movement needed in sport. Before implementing START into post-concussion assessments, it is important to understand whether redundancy exists both among START outcomes and between START and current clinical measures to optimize clinical assess-

ment implementation. We aimed to 1) examine the relationship between StART outcomes and other clinical assessment measures and 2) explore the latent factors within StART and between StART and clinical assessments among healthy collegiate student-athletes.

Methods: We conducted a cross-sectional cohort study of 89 healthy collegiate student-athletes (62.9% male, age: 19.5 ± 0.9 yrs, 71.9% no concussion history) who completed StART, Sport Concussion Assessment Tool (SCAT) symptom checklist, Standardized Assessment of Concussion (SAC), tandem gait (single- and dual-task), and the Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) during pre-season testing. StART consists of 3 conditions (standing, single-leg balance, cutting) under 2 cognitive states (single-task, dual-task [subtracting by 6's or 7's]) for 3 trials each condition. The StART outcomes were reaction times during single- and dual-task standing, single-leg balance, and cutting separately. We examined the relationship between clinical measures and StART using Pearson r correlation. For our second aim, we used two separate exploratory factor analyses with promax rotations and maximum likelihood model fitting to independently assess the StART outcomes, and the other model among StART and all clinical measures with $\alpha=0.05$ and factor loading ≥ 0.40 a priori. .

Results: Moderate correlations were observed between single- and dual-task cutting ($r=0.70$), single-task standing and single-leg balance ($r=0.51$), and dual-task standing and single-leg balance ($r=0.60$), but only null to small correlations within all other StART comparisons (r -range: 0.06-0.50). Null to small correlations existed between any StART and clinical assessment outcome (r range: -0.16, 0.34). The three-factor model for StART independently explained 70.6% total variance: functional movement (cutting tasks), static dual-task (standing, single-leg balance), and static single-task (standing, single-leg balance). The five-factor model for StART and clinical measures explained 65.8% total variance: gait (single- and dual-task tandem gait), functional movement (StART single- and dual-task cutting), static dual-task (StART standing, single-leg balance), neurocognitive (ImPACT verbal memory, visual memory, visual-motor speed), and static single-task (StART standing, single-leg balance). All other outcomes did not meaningfully load onto a factor.

Conclusions: StART displayed three distinct latent factors (functional movement, static dual-task, static single-task) and suggests minimal redundancy within its outcomes. StART outcomes did not meaningfully correlate with current clinical outcomes, suggesting StART provides unique information by examining more functional, reactive movement post-concussion. Future research should replicate this study with a concussed sample to optimize START for clinical use.

Examination of Postural Control in Individuals With and Without Concussion History Across Static and Dynamic Dual Tasks

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Context: Individuals that have sustained a concussion may have increased risk for musculoskeletal injury after recovery. Postural control deficits in individuals can be objectively assessed using clinical balance tests. Existing test protocols involve mostly static tests that manipulate the base of support and proprioceptive inputs. There is a lack of balance assessments that have specificity to sport regarding dynamic dual task conditions. Considering the high level of integration of sensory systems in sport, clinical balance assessments should target replicating the demands in sport to guide clinical decision making. This study was designed to examine existing clinical balance tests as well as novel tests designed to represent the somatic and sensory requirements of athletic activity among groups with and without concussion history. We hypothesized that the novel tests will be able to detect differences in postural control between the two groups. .

Methods: Fifty-one volunteer participants with equal representation of sex participated in one laboratory assessment for an observational study. Twenty-nine participants had a history of one or more diagnosed concussions (CONhx) and 22 had no diagnostic history of concussion (NOHx). Participants were healthy university aged students (21.18 ± 2.16 years). Participants performed clinical balance tests on force platforms for repeated trials and the dependent measure was mean center of pressure sway velocity. Participants performed existing clinical balance tests (BESS and COBALT) and four novel clinical balance assessments. The novel dynamic balance tests included a variety of upper and lower extremity movement tasks combined with head and neck movements, stance positioning, and responses to visual cues using FitLight technology. A two-way repeated measures MANOVA determined the effect of clinical balance test on sway velocity between groups.

Results: The multivariate analysis revealed a statistically significant difference in mean sway velocity between the clinical balance tests $F(5, 45) = 53.778, p < .001$; Wilks' $\Lambda = .143$. There was a significant main effect of clinical balance test and between subject effect of group on mean sway velocity $F(1, 49) = 4.620, p < .037$. Pairwise comparisons revealed that mean sway velocity did not differ between groups during BESS (NOHx 71.73 ± 13.32 , CONhx 73.56 ± 21.02) and COBALT (NOHx 68.24 ± 17.30 , CONhx 71.78 ± 17.30). Sway velocity was significantly different during two of the novel dual task tests (NOHx 103.68 ± 26.28 , CONhx 123.80 ± 38.42) and (NOHx 89.54 ± 20.47 , CONhx 102.40 ± 22.97). The concussion history group had increased sway velocity during the novel tests, suggesting decreased postural control.

Conclusion: Groups included in this study had different mean sway velocity on the balance tests performed. Two of the novel tests which involved dual tasks were able to identify differences in mean sway velocity between individuals with concussion history and those without. Utilization of these new protocols could have implications for assessing postural control deficits in individuals who have sustained a concussion.

The Impact of COVID-19 on National Hockey League Players' On-Ice Performance Metrics Following Clearance to Return-to-Play

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Context: The COVID-19 pandemic has impacted all levels of sport and has resulted in modifications to training and health-related protocols. While COVID-19-related symptoms are typically innocuous, the impact on performance for elite hockey players is unknown. At present, there remains a paucity of research investigating the impact of COVID-19 and the time away from sport on performance following a successful return-to-play (RTP) in professional ice hockey players. The purpose of the study is to examine on-ice performance metrics in professional ice-hockey players pre- and post-COVID-19 diagnosis.

Methods: A retrospective cohort study consisting of NHL players (males; ≥ 18 years of age) diagnosed with COVID-19 during the 2020/21 season was conducted. Positive cases of COVID-19 in NHL players were identified using various online media sources (newspaper articles, press releases, etc.). On-ice metrics for these individuals were accessed using the NHL's online statistics website. Statistics were calculated and reported as means \pm standard deviations. Primary outcome variables included average time on ice (TOI) per game, average TOI per shift, and points per game (PPG). Comparisons were made using one-way repeated measures ANOVA. Significance was set at $p < 0.05$.

Results: We identified a total of 75 NHL hockey players diagnosed with COVID-19 during the 2020/21 NHL season, with 49 players (11 defencemen; 38 forwards) having complete datasets. Players had a mean age of 27.2 ± 4.2 years, with no difference in age between the two player groups (defencemen: 27.3 ± 4.6 years;

forwards: 27.2 ± 4.1 years; $p = .980$). Players missed an average of 4.8 ± 3.2 games (14.7 ± 7.4 days) due to COVID-19 diagnoses. Average TOI/game was 15.8 ± 3.9 min prior to COVID-19 diagnosis, 15.8 ± 4.0 min in the first week following RTP, and 15.9 ± 3.8 min in week two following RTP ($p = .925$). Similarly, average TOI/shift was 46 seconds for all three time points ($p = .854$). No differences were identified between career PPG (0.44 ± 0.18), pre-COVID-19 PPG (0.38 ± 0.25), and post-COVID-19 PPG (0.41 ± 0.25) ($p = .274$).

Conclusion: A positive COVID-19 diagnosis was not associated with a change in average TOI/game, average TOI/shift, or PPG in a group of professional ice hockey players upon RTP. Future research should investigate the short- and long-term effects of COVID-19 using specific physiological measures (VO_{2max} , lactate threshold, etc.) to determine if RTP protocols need to be enhanced to maintain elite athletic performance.

Does Quadriceps Strength Explain Drop Vertical Jump Ground Reaction Force Asymmetry in Patients With Anterior Cruciate Ligament Reconstruction at 12 Months Post-operative?

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Context: Compensatory movements patterns can persist following anterior cruciate ligament (ACL) reconstruction (ACLR) as patients shift loading to the unaffected limb or across unaffected joints of the affected limb to shield the knee. These compensations result in differing or reduced ground reaction forces (GRF) on the affected limb during athletic movements, that may also limit the effectiveness of rehabilitative exercises. It remains to be determined whether these compensations are the result of underlying impairments including reduced quadriceps strength, persistent alterations in motor control and kinematics, or psychological factors (i.e. confidence, kinesiphobia) in isolation or combination. The purpose of this study was to assess the relationship between isokinetic, concentric quadriceps strength and between-limb symmetry in GRFs during a drop jump task (DVJ) in patients at one-year following primary ACL reconstruction.

Methods: 75 patients (78.3 ± 17.9 kg, 175.3 ± 9.4 cm) of varying grafts ($n = 26$ bone-patellar-tendon-bone, 27 quadriceps tendon and 22 hamstring grafts) were assessed at 12 months following ACLR. After a clinical exam and warmup, three repetitions of a DVJ from a 30 cm box to two forces plates at 50% of the patient's height from the platform were completed. Five repetitions of concentric isokinetic knee extension at 90°/s were completed thereafter. Peak vertical GRFs were determined during the initial landing, subsequent take-off, and secondary landing phase of each DVJ and averaged over three trials. One- and two-way ANOVAs were used to determine the effect of graft type on quadriceps torque, DVJ GRF and limb symmetry index (LSI) values, and linear regressions were completed to define the relationship between quadriceps strength and DVJ GRF asymmetry.

Results: Quadriceps strength was reduced on the affected limb ($p < 0.001$) and LSI did not vary by graft type ($p = 0.173$). Similarly, affected limb DVJ GRF was reduced ($p < 0.001$) with no interaction of limb, graft, and DVJ phase. The LSI of DVJ GRFs did not vary by graft or phase of the jump ($p = 0.872$). Affected limb quadriceps torque and concentric quadriceps LSI explained 8.1% ($p = 0.008$) and 9.7% ($p = 0.004$) of take-off phase LSI variance, respectively, but not in the initial or subsequent landing phases of the DVJ.

Conclusion: Concentric quadriceps strength and symmetry hold limited explanatory power in GRF patterns at one-year following ACLR in the DVJ. Future work should consider alternate contraction modes given the lack of explanatory power of concentric quadriceps strength to GRFs during the landing phases (i.e. eccentric). Other outcomes may be of greater relevance to the persistence of compensatory movements during the DVJ task, including task-specific measures of confidence or other psychological outcomes.

Leadership Literacy: Exploration of Contextual Intelligence in Athletic Training Education

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Context: Healthcare is one of the most complex environments in the world, as such it requires consistent leadership literacy. Contextual intelligence (CI) has been reported to be an asset to leadership literacy during turbulent times and in complex situations. No research has yet explored how frequently CI behaviors are practiced by AT's. The objective of this research was to use the Contextual Intelligence Profile™ to delineate practice frequency of CI by AT's in the U.S. and describe any differences between respondents.

Methods: Using purposive homogenous sampling strategy, a nonexperimental descriptive design was initiated to explore CI practice frequency using the Contextual Intelligence Profile™ (CIP™), a 48-item questionnaire that assesses the practice frequency of 12 behaviors organized around three time-orientations. Differences between respondents were evaluated using independent samples t-tests and one-way analysis of variance (ANOVA) with Games-Howell post hoc comparisons. The Cronbach coefficient α with Item Analysis was used to test the internal consistency-reliability of the CIP™. The Pearson r correlation coefficient was calculated to determine associations between scale items. Paired samples t-tests were used to compare aggregate means of the time orientations.

Results: 2143 clinical AT's were invited to participate. 284 completed the survey (13.2%); 229 were usable (81%). Most participants were female (59%) with a professional master's degree (44%); the most frequently reported age range was 26 – 30 years old (29%); and 59% had ≥ 10 years of experience, 82% were Caucasian/White. The CIP™ psychometric analysis yielded satisfactory internal consistency ($\alpha = .935$). Kaiser–Myers–Olkin's (KMO) Measure of Sampling Adequacy for the means of the CIP's™ 12-behaviors was 0.927 and Bartlett's Test of Sphericity was significant ($X_2 = 1195.04(66)$, $p = .001$), indicating construct validity. AT's reported practicing all 12 CI behaviors. However, no CI behavior was practiced with high frequency ($M \leq 1.50$). One-way ANOVA indicated significant differences between multiple respondent groups including ethnicity, education, and experience levels, and dual credentialed. For example, five (42%) CI behaviors. *Diagnosis context* ($F = 5.464_{(2, 169)}$, $p = .005$), *mission minded* ($F = 9.802_{(2, 169)}$, $p = .001$), *influencer* ($F = 5.776_{(2, 169)}$, $p = .004$), *change agent* ($F = 5.820_{(2, 169)}$, $p = .004$), and *constructive use of influence* ($F = 4.395_{(4, 169)}$, $p = .014$) were practiced at different frequencies according to experience/education levels. Paired samples t-tests found that two CI behavioral clusters, *Foresight* ($M = 1.82 \pm .66$) and *Hindsight* ($M = 1.80 \pm .61$) were practiced more frequently than *Insight* ($M = 2.19 \pm .86$); ($t_F = 8.486(172)$, $p = .001$; $t_H = 8.303(171)$, $p = .001$, respectively).

Conclusions: Despite all 12 CI behaviors being practiced by AT's, none were practiced with high frequency. AT's in different demographic categories practiced individual behaviors with different frequency. *Insight* behaviors were practiced less than *Hindsight* and *Foresight*. These findings indicate AT's should be encouraged/instructed how to practice contextual intelligence behaviors more frequently as they are aspects of leadership literacy that may impact career trajectory and job satisfaction.

The Effect of an Online 8-Week, Core Training Program on Postural Stability in Older Adults Assessed With Kinovea 2D Motion Capture Software

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Context: Aging is a complex process impacting cardiorespiratory fitness, muscular strength, flexibility, and balance/stability. Age related declines in balance and stability greatly contribute to increased falls amongst older adults (65 years and older), with 1

in 3 community-dwelling older adults falling at least once per year. Core musculature exercise interventions can improve balance, but in the older adult population, access to exercise programming can be challenging, especially for individuals in remote areas, affected by pandemic restrictions, or those experiencing other obstacles. Virtual meeting platforms could help reduce barriers for older adults experiencing lack of access to exercise. The purpose of this study is to examine the effects of an 8-week core exercise intervention on postural stability in older adults using a completely virtual platform.

Methods: 26 older adults (73.7 ± 5.76 years, Males = 2, Females = 24), participated in this pre-test, post-test intervention. Participants were recruited through convenience and snowball sampling. Inclusion criteria was anyone over the age of 65, exclusion criterion was if a medical reason prevented participation in physical activity. Postural stability was assessed in the frontal and sagittal plans pre and post intervention by recording six 30-second trials of quiet standing. Hip and shoulder displacement were measured over the six trials using Kinovea, a sports analysis software. After pre-testing, participants began the exercise intervention. One athletic therapist and two kinesiologists designed this 8-week exercise intervention targeting core strength. The intervention was completed 3-times per week, 20-minutes per session, with no equipment except a chair. At the end of the study, sagittal and frontal plane displacement at the hips and shoulders was recorded again. A non-parametric Wilcoxon signed-rank test was used to compare displacement pre- to post-intervention. Significance was set at $p \leq .05$.

Results: All means indicate decreased postural sway, but there were no significant differences from pre- to post-intervention sagittal plane displacement at the hips (pre = 1.99 ± 0.92 , post = 1.84 ± 1.02 , $Z = -.800$, $p = .424$) or shoulders (pre = 2.26 ± 1.26 , $Z = -.755$, $p = .439$), nor in frontal plane displacement at the shoulders (pre = 3.60 ± 1.22 , post = 3.23 ± 1.39 , $Z = -1.562$, $p = .118$). There was a significant difference pre- to post-intervention frontal plane displacement at the hips (pre = 2.79 ± 1.13 , post = 2.31 ± 0.88 , $Z = -2.451$, $p = .014$).

Conclusion: An at home, virtual exercise program is feasible and effective at reducing frontal plane displacement at the hips in the older adult population. The use of Kinovea offers a free alternative to expensive, lab-based, motion analysis software. This research suggests that older adults (and other populations) can access athletic therapists, and other health care professionals, using a virtual platform to reduce barriers to exercise access (i.e., remote living, difficulties in transportation, pandemic public health guidelines etc.).

An Exploration of Concussion Knowledge, Attitudes, and Behaviours in the Pediatric Population

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Context: Concussion knowledge, attitudes, and behaviours are suggested to have a substantial impact on concussion reporting and concussion care. Despite the recent growth in awareness, concerning gaps in concussion knowledge have been found in groups of physicians, coaches, parents, high school, and collegiate athletes. However, limited studies have examined concussion knowledge in the pediatric population, particularly those below the high-school age range. Therefore, the purpose of this study was to explore the concussion knowledge and attitudes in a sample of children between grades 5-9 who were currently involved in organized sport.

Methods: The study used a cross-sectional observational design. Twenty youth sport participants between grades 5-9 formed a convenience sample. A total of 11 females and 9 males enrolled in the study. The primary sport of participants surveyed was hockey ($n = 17$), followed by swimming ($n = 2$), and basketball ($n = 1$). The average number of concussions experienced by each participant was 0.84 ± 0.70 . A 51-item, online, anonymous questionnaire, consisting of factual and scenario-based questions was used to explore beliefs, knowledge of, and attitudes towards concussions.

The questionnaire was designed using previously validated concussion knowledge surveys, then merged and adapted to the fit the target population. The adapted questionnaire was reviewed and validated by three certified athletic therapists familiar with questionnaire development.

Results: The most commonly identified symptoms were having headaches (100%), feeling dizzy (95%), trouble concentrating (85%), and feeling like the room is spinning (80%). Commonly misidentified symptoms were having trouble falling asleep (30%), feeling like you are going to faint (35%), having problems finishing tasks (35%), and having a hard time learning new things (35%). Participants also displayed inadequate knowledge of proper concussion management protocols (both return-to-play and return-to-learn), with 80% believing they must stay in a dark room until all concussion symptoms had subsided. Additionally, only 40% of participants believed that social time was an important aspect of recovery. Furthermore, 40% believed that if you hit your head during a game it was okay to return to play in the same game, and only 25% of participants thought it was “Very Important” to avoid participating in both school and sports when experiencing the signs and symptoms of a concussion.

Conclusions: Despite having adequate knowledge of the signs and symptoms of concussions, participants demonstrated a lack of knowledge surrounding proper concussion management protocols. Furthermore, participants displayed attitudes that showed a decreased understanding of the return-to-play and return-to-learn protocols. Based on these findings, future concussion education programs that are designed for use with the pediatric population should focus on up-to-date concussion management protocols, return-to-play and return-to-learn protocols, and the importance of social support during concussion recovery.

Associations of Health-Promoting Behaviors With Factors Related to Well-Being Among Former National Football League Players

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Context: Health-related behaviors (e.g., physical activity, sleep, dietary intake) are related to cognitive function and mood-related symptoms in former athletes, but it is unknown whether these behaviors are associated with other dimensions of well-being. The purpose of this study was to observe relationships between health-promoting behaviors and measures of meaning and purpose, self-efficacy, and social participation in a sample of former National Football League (NFL) players.

Methods: In this cross-sectional study, former NFL players ($n=1784$; aged 52.3 ± 16.3 years) completed a general health survey inquiring about their health-history, well-being, and current health-related behaviors. Participants reported the number of days each week they participated in moderate-to-vigorous aerobic exercise, resistance training, other wellness activities, sedentary behaviors, time looking at a screen, and the number of hours they slept each night in the past week. Additionally, they completed a standardized questionnaire regarding their diet quality (Rapid Eating Assessment for Participants, short-version [REAPS]), where higher scores indicated better diet quality in a range from 13–39), reported their monthly frequency of alcohol intake, and completed multiple Patient-Reported Outcome Measurement Information System (PROMIS) measures: sleep disturbance; physical function; pain interference;

emotional support; meaning and purpose; self-efficacy; and ability to participate in social roles and activities. Separate multivariable linear regression models were fit for each outcome to examine the effects (standardized betas [β]) of exercise participation (moderate-to-vigorous activity and resistance training, separately), sleep quantity and quality, and diet quality on PROMIS meaning and purpose, self-efficacy, and social participation T-scores while controlling for the aforementioned behavioral and PROMIS factors. Missing data were handled using multiple imputation methods (MCMC).

Results: Overall, meaning and purpose (mean $SD=53.1 \pm 10.9$), self-efficacy (49.8 ± 11.8), and ability to participate in social roles and activities (51.3 ± 9.1) approximated normative values (50.0 ± 10.0). Participants reported engaging in moderate-to-vigorous exercise 3.0 ± 1.9 days per week, resistance training 2.3 ± 1.8 days per week, nightly sleep duration of 7.7 ± 1.4 hours, average sleep disturbance score of 52.6 ± 6.5 , and a REAPS (diet quality) score of 28.0 ± 4.3 . Moderate-to-vigorous exercise frequency was significantly associated with meaning and purpose ($\beta=0.102$; $p<0.001$) and social participation ($\beta=0.065$; $p<0.001$); sleep disturbance was significantly associated with meaning and purpose ($\beta=0.203$; $p<0.001$), self-efficacy ($\beta=-0.176$; $p<0.001$), and social participation ($\beta=0.143$; $p<0.001$); sleep duration was significantly associated only with self-efficacy ($\beta=0.050$; $p=0.014$). Resistance training and diet quality were not significantly associated with any well-being outcome. Overall variance explained by each multivariable model was: meaning and purpose ($R^2_{adjusted}=0.366$); self-efficacy ($R^2_{adjusted}=0.359$); and, social participation ($R^2_{adjusted}=0.650$).

Conclusions: More frequent moderate-to-vigorous exercise and less disturbed sleep were each related to more adaptive outcomes in multiple dimensions of well-being. These modifiable behaviors may be important therapeutic targets for improving well-being. Further study is needed to understand the directionality of these relationships and to identify specific intervention points to promote long-term and optimal whole-person health in former athletes.

Impact of Forward Shoulder Posture Severity on Scapular Protractor and Retractor Excitation

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Context: Forward shoulder posture (FSP) is a common postural deviation where the scapulae are protracted, anteriorly tilted, and upwardly rotated, and is proposed to alter the level of muscle excitation of the scapular protractors and retractors. Specifically, the protractors (i.e. pectorals) are shortened and hypothesized to be hyperactive, while the retractors (i.e. trapezius) are lengthened and inhibited. Musculoskeletal therapists are taught that asymptomatic FSP predisposes individuals to shoulder pathology, yet it is not known if the severity of FSP alters excitation of the scapular protractors and retractors. The purpose of this study was to determine if a relationship exists between FSP severity and level of excitation of the scapular protractors (pectoralis major [PM]) and retractors (upper, middle, lower trapezius [UT, MT, LT]) in those with FSP. It was hypothesized that increased FSP would be positively correlated with UT and PM excitation, and negatively correlated with MT and LT excitation.

Methods: A cross-sectional design with a convenience sample of 35 right-handed participants (27 years \pm 9, 21 female) with various degrees of FSP, but otherwise healthy shoulders, was conducted. Participants attended one session at a research laboratory where FSP was measured via photograph prior to completing a seated reaching task during which excitation of UT, MT, LT, and PM was measured. ImageJ software measured the photograph of the participants’ right shoulder by dividing the acromion distance to C7 by the distance from the sternal notch to C7. A Pearson correlation was conducted, comparing FSP to the excitation of each muscle during the reaching task. Correlation coefficients (r) were interpreted as: Low $<.3$, moderate $.3-.49$, high $>.5$. Additionally, an

intraclass correlation (ICC) was completed with a second rater to determine inter-rater reliability on the analysis of FSP in ImageJ.

Results: There were no significant correlations between FSP before the reaching task and the excitation of any muscles during the task. A trend towards a moderate positive correlation was observed between FSP and UT excitation ($p = .064$; $r = .317$). Correlations between FSP and MT excitation ($p = .693$; $r = .069$), LT excitation ($p = .150$; $r = .249$), and PM excitation ($p = .426$; $r = .139$) were low and did not approach statistical significance. An ICC value of .98 revealed a highly reliable FSP measurement between raters.

Conclusion: Increased FSP is not associated with changes of UT, MT, LT, and PM excitation in asymptomatic shoulders during a reaching task. It is possible the proposed alterations may occur at rest or during different tasks; thus, future research should examine these and compare muscle excitation of those with and without FSP to see if alterations exist with non-pathological FSP. Therapists should be aware that changes in asymptomatic shoulder posture may not affect the level of excitation in the protractors and retractors.

Pigmented Villonodular Synovitis (PVNS) in the Knee of a 18-Year-Old Female Collegiate Soccer Player

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Background: An 18-year-old female collegiate soccer athlete removed herself from soccer practice complaining of anterior knee pain. Previous history included a platelet-rich-plasma (PRP) injection for a posterior horn tear of the medial meniscus approximately one year prior. A pain scale of 7/10 during soccer drills such as running, sprinting, decelerating, and kicking was noted. No mechanism of injury (MOI) or traumatic incident was described other than the painful activities during soccer practice. Increased pain at the end range of motion (ROM) of flexion and extension and during resistive ROM was found. Orthopedic stress tests were inconclusive with no noticeable joint effusion or discoloration. A conservative treatment plan for patellofemoral pain syndrome (PFPS) for the next two weeks consisted of various therapeutic modalities (i.e., cryo/thermotherapy, electrical stimulation, and ultrasound) to decrease pain, ROM exercises, proprioceptive techniques, and lower extremity resistance exercises.

Differential Diagnosis: Chondromalacia, meniscus tear, osteochondral defect, ligamentous sprain.

Treatment: The athlete was referred to the team orthopedic following the unsuccessful conservative treatment and failure to return to sport. Mild joint effusion and an increased signal at posterior horn of the medial meniscus was revealed during magnetic resonance imaging (MRI). A second MRI was reordered the following week with a more powerful magnet and different parameters which revealed an inflammatory condition that was noted as pigmented villonodular synovitis (PVNS). A resection of the PVNS was performed with-in 2 weeks following the MRI. Post-surgical rehabilitation protocol was initiated the following day. At the time of this abstract, daily therapeutic rehabilitation protocol consists of 1) therapeutic modalities to decrease swelling and pain, 2) aggressive active and passive ROM exercises, 3) progressive lower extremity proprioceptive exercises, and 4) open and closed chain lower extremity progressive resistance exercises. A gradual return to sport specific activity is expected to begin approximately postoperative week 4 and a full clearance to participate in all sport related activities without restriction by postoperative week 6.

Uniqueness: PVNS is a rare benign proliferative disorder affecting the synovium of joints, tendon sheath, and bursas^{1,2} with an annual incidence rate of 1.8 cases per million cases.³ PVNS affects large joints, such as the hip, knee, and ankle, destroying surrounding the soft tissue and bone which results in functional deterioration of the joint and the extremity.² The non-specific

symptoms contributes to a challenging diagnosis.^{3,4} Total resection of the affected tissues is the treatment of choice for PVNS.¹

Conclusions: This case describes the history of a 18-year-old female college soccer athlete with a seemingly generalized PFPS. Although uncommon, this isolated finding in a non-traumatic knee highlights the importance of remembering various differential diagnoses when dealing with any seemingly straightforward injury in the athletic population.

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Professional Athletic Training Students Knowledge and Perception of Cannabis in the USA

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Context: Marijuana, specifically Cannabis, use is becoming more popular with the legalization of medical marijuana. Currently, 36/50 states and the District of Columbia have legalized marijuana for medical purposes. Additionally, cannabidiol (CBD), a product of the cannabis plant, is available to the general public despite formal government-approved regulation in the US. Recently, more cannabis-related research has been conducted due to the changes in marijuana's categorization. With these changes, it is unclear of athletic training student's knowledge of cannabis and if they are being formally educated on the topic. Therefore, the purpose of this study is to understand the student's perception and knowledge of medical marijuana.

Methods: A descriptive survey was used to understand the perceptions and knowledge of athletic training students. An email was sent to all program directors of athletic training in the US with a Qualtrics survey link for them to forward to students for completion. A response rate was not calculated due to the snowball sampling. The 23-item questionnaire included closed and open-ended questions on demographics ($n=5$), perceptions of cannabis ($n=10$), and knowledge of cannabis ($n=8$). The survey was developed using previous literature and anecdotal experiences and was evaluated by three content experts. The survey was modified based on expert feedback prior to data collection. Two reminder emails were sent out to increase participation. Frequencies were calculated of cannabis-related questions and a total score was calculated for knowledge-based questions. Open ended question themes were organized into categories and frequencies were calculated.

Results: Overall, 100 individuals responded to the survey and 7 were removed due to incomplete surveys. A total of 35 Males and 57 Female completed the survey with 81 of participants stating they were in the 20-30 age range. 72 participants were Masters level students. Seventy-six (81.7%) participants stated they have not received formal education related to cannabis even though 69 (74.2%) students felt it was an important topic to include in the curriculum. Additionally, only 30 (32%) participants stated they felt somewhat confident or confident in their ability to

educate patients about cannabis products even though 54 (58%) students believed their patients are using some type of cannabis related product. None of the participants answered all 8 knowledge questions correctly and only 23 participants scored a 6 (25%) or better.

Conclusion: Athletic training students have limited exposure to cannabis-related information despite believing it is an important topic that should be taught in their curriculum. Additionally, students did not feel confident in educating patients on cannabis related topics. Therefore, integrating cannabis and its related products into formal training or program curriculum may improve student's confidence and knowledge.

The Design and Implementation of a Novel Mental Health Literacy Educational Intervention Programme in Gaelic Footballers

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Context: Mental health issues are prevalent in Gaelic football, with 37–48% of elite and collegiate players reporting symptoms of anxiety or depression (Sheehan et al., 2018; Gouttebauge et al., 2016). Players may be exposed to over 600 distinct stressors that can initiate or exacerbate symptoms of a MH issue (Gouttebauge et al., 2016), such as injury, pressure to perform, family/relationship issues or the burden of study requirements/professional life. However, a current disparity is evident between the rate of help-seeking and the prevalence of symptoms of a mental health issue (Rickwood and Thomas, 2012). Education, stigma and attitudes to seeking help have been acknowledged as key factors inhibiting and facilitating mental health help-seeking in Gaelic footballers post-injury (O'Keeffe et al., 2021). The current study aims to design and implement a novel educational intervention programme to increase mental health literacy (MHL) in Gaelic footballers.

Methods: A novel educational intervention programme specific for Gaelic footballers was designed to address the key components of MHL; recognition, knowledge and attitudes. The Theory of Planned Behaviour (TPB), combined with the help-seeking model, were utilised as the theoretical framework. The intervention group (N=70; 25.1±4.5 years) participated in the online 'GAA and Mental Health – Injury and a Healthy Mind' MHL educational programme. Self-Stigma of Seeking Help (SSOSH), Stigma Scale for Receiving Psychological Help (SSRPH), Attitudes Towards Seeking Professional Psychological Help Short Form (ATSPPH-SF) and Mental Health Literacy Scale (MHLS) were completed at baseline, immediately post-attendance at the MHL educational programme and 1-week and 1-month post-intervention. Intervention group participants provided feedback after the completion of all follow-up measures. The control group (N=75; 24.4±6.0 years) completed measures at baseline and after a 1-week period, with follow-up measures repeated after 1-week and 1-month.

Results: SSRPH and SSOSH scores significantly decreased and ATSPPH-SF and MHLS significantly increased in the intervention group from baseline to post-intervention (P<0.05), with significant differences sustained at 1-week and 1-month follow-up. Significant differences were evident in outcome measures between groups (P<0.05). Positive feedback was received from intervention participants and the programme was rated to be informative.

Conclusion: Remote online delivery of a novel MHL educational programme, designed specifically for Gaelic footballers, can effectively decrease mental health stigma, improve attitudes to help-seeking and increase the recognition and knowledge of mental health issues. Gaelic footballers with improved MHL may be better equipped to manage their mental health and cope with stressors, leading to improved mental health outcomes and overall mental wellbeing of Gaelic footballers.

Certification Candidates' Perspectives of Membership Value in the Canadian Athletic Therapists Association and the Regional Associations

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Context: Currently all members of the Canadian Athletic Therapists Association (CATA) are required to maintain a membership with their respective regional association (RA). The CATA Board of Directors announced a Bylaw change eliminating the mandatory regional membership to be voted on by CATA members. This surprising announcement evoked a variety of opinions regarding the value of association membership. The Bylaw change will affect certification candidates who are not regular voting members but are permitted to vote on this issue. The purpose of this research was to explore certification candidates' beliefs of membership in the CATA and their RA.

Methods: An online-based survey was distributed through Canadian Athletic Therapy (AT) RAs for distribution to their membership, social media and snowball sampling. The survey consisted of a total of 50 questions, including 21 questions on opinions of association work including promoting the AT profession, best interest for ATs and value of membership. We examined aggregate and regional responses.

Results: Fifteen (15) certification candidates commenced the survey and fourteen (14) completed the survey. Half the participants were affiliated with the Ontario RA (OATA) (n=7). Most candidates (n=9) felt that the CATA contributed more than their RA when promoting the AT profession internationally. On a local level no difference was found in promoting the profession between candidates, with the CATA (n=6) and their RA (n=6) being equivalent. OATA candidates were slightly in favour of the CATA (n=4) promoting the AT profession whereas candidates from the rest of the country favoured their RA (n=5). Most candidates (n=10) believe that the CATA provides value for their membership dues. Regarding RAs, 85.7% (n=6) of OATA candidates don't believe their RA provides value whereas 85.7% (n=6) of the rest of the candidates consider their RA as valuable. Most candidates (n=11) believe that the CATA has their best interest in mind. Candidates across the country (n=6) believe their associations have their best interest in mind with the exception of OATA members (n=4).

Conclusion: The findings of the survey suggest that certification candidates feel confident the CATA will provide support for the AT profession and their needs as a therapist. OATA candidates appear to be displeased with their RA compared to the rest of Canada. OATA candidates would be in favour of eliminating the mandatory regional membership which matches the value they place in membership. The rest of Canada values their RA and the CATA indicating uncertainty in their opinions towards the Bylaw change. We recommend that candidates receive effective communication to ensure robust information to then make informed decisions.

Barriers and Facilitators to Implementing a National Injury and Health Surveillance System for Varsity Athletes in Canada

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Context: Approximately 20,000 varsity athletes participate in U SPORTS universities across Canada, but there is currently no national injury surveillance system to provide evidence-based data on injury burden. An understanding of the barriers and facilitators can enhance implementation of a surveillance system. This project aims to 1) understand the barriers and facilitators to implementing an injury and health surveillance system at the varsity level in university institutions across Canada, and 2) develop resources to facilitate sustainability.

Methods: We conducted a qualitative study framed within a pragmatic worldview. We recruited male and female athletic

therapists/physiotherapists (n=11) and athletic department staff (n=1) who expressed interest in participating in the first year of surveillance for the Canadian Integrated Injury and Health Surveillance System (Can-IIHSS) to participate in semi-structured interviews via Zoom. The interview guide was informed by the Consolidated Framework for Implementation Research (CFIR) and focused on barriers and facilitators to implementing the Can-IIHSS, and potential resources that could assist with implementation. Qualitative content analysis was used to analyze the data deductively to CFIR constructs (key domains included inner and outer setting, intervention characteristics, individual characteristics, and process) and code inductively into themes.

Results: Examples of constructs from CFIR identified by participants as important were relative advantage, evidence strength & quality, cost, compatibility, adaptability, and structural characteristics. Examples of specific barriers identified included not having enough time to implement all the components of the Can-IIHSS and chart efficiently because of the limited number of therapists to number of athletes, not being able to chart injuries properly because of the lack of injury codes available, difficulty identifying athletes who consent to having their data transferred versus those who did not, and lack of clear expectations of data collection requirements. Additionally, the COVID-19 pandemic was a barrier due to the uncertainty around sports being cancelled, the need to perform virtual assessments, treatments and onboarding, and a reported perceived increase in injuries potentially due to lack of training from the previous season. Facilitators of surveillance implementation included access to students to help with recording exposure, receiving annual aggregate data reports to explore trends of Canadian varsity data, and resources to help select and implement a compatible, low cost, and accessible electronic injury documentation system. Specific resources targeted for development to increase uptake and sustainability included, increased detail in standard operating procedures, training on clinical measures collected as part of the system and detailed description of study purpose, and resources to help explain importance of the project to the athletes.

Conclusions: There are several structural and behavioral barriers and facilitators when implementing a national injury surveillance system. Findings from this study will improve the design and ease of implementation and encourage successful long-term sustainability.

Dynamic Neck Strength as a Potential Screening Tool for Concussion Risk in Female Soccer Players

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Context: Women's soccer is one of the highest risk sports for sport related concussion. Research has shown the strongest predictor for future concussion risk is a prior history of concussion. There is also mounting evidence to suggest increased neck strength and function may be protective against concussion, and that neck strength measures may be useful in screening for an athlete's concussion risk. The objective of this study is to determine if female varsity soccer players with a prior history of concussion, and hence known to be at higher concussion risk, also demonstrate decreased measures of neck strength and function. Further, if a relationship does exist, to explore the deterministic properties of these measures as a potential screening tool for future concussion risk.

Methods: This was an observational cohort study involving 28 university level female soccer players (average age = 19.3 years, range 18-21 years). During post-season baseline testing, the athletes had their static multi-planar composite neck strength in pounds force (lbf) measured using a handheld dynamometer and dynamic neck strength measured in pounds*force per second (lbf/s) using TopSpin360. Self-declared concussion history was used to separate players into two groups: high risk group (history of concussion) and low risk group (no history of concussion). Independent samples t-tests were used to compare differences between groups.

Results: Ten players declared a prior history of concussion (HxCon) at some point during their playing career, while 18 players self-declared with no history of concussion (NoHxCon). There was no significant difference in static neck strength between the groups (NoHxCon = 30.4 lbs, 95%CI 27.6-33.2, HxCon = 29.8 lbs, 95%CI 24.8-34.8). There was a significant difference in dynamic neck strength between the groups (NoHxCon = 7.1 lbf/s, 95%CI 5.2-9.1, HxCon = 3.8 lbf/s, 95%CI 2.5-5.2, $p < 0.01$). In this cohort, using area under the curve graph demonstrated a sensitivity of 80% and specificity of 72% at a cutoff value of 4.5 lbf/s to distinguish players with a history of concussion from those without. Using 7.0 LBF/s as the cutoff value provides 90% sensitivity and 50% specificity. The total area under the curve (AUC) value was 0.82. This indicates dynamic neck strength as a good measure for differentiating concussion history and therefore athletes at a higher future concussion risk.

Conclusion: In this small study of collegiate female soccer players, dynamic neck strength was able to differentiate players with a history of concussion, and hence at a known higher risk of future concussion, from those with no history of concussion and relatively lower risk. Future studies should explore using dynamic neck strength as a potential screening tool to assess athletes' risk of concussion.