2024 CASEM Poster Abstracts

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Psychological Impact and Perceptions of Cardiovascular Pre-Participation Screening: A Mixed-Methods Study of Young Canadian Athletes

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Objective: To evaluate the psychological impact of cardiovascular pre-participation screening (PPS) on young athletes.

Study Design: Explanatory sequential mixed-methods design.

Subjects: Two hundred twenty-two (40.1% female, 76.6% White) post-secondary athletes that underwent cardiovascular PPS at a Canadian university.

Observation Technique: Athletes completed a cardiovascular history questionnaire and obtained an electrocardiogram and physical examination within their primary care network. A comprehensive survey was concurrently administered to athletes using an online portal to evaluate the psychological impact and perceptions of PPS. A sub-sample of athletes (n = 12) participated in virtual focus groups or individual interviews to explore PPS experiences and identify barriers to the screening process.

Outcome Measures: Survey components were measured on a 5-point Likert scale, ranging from *strongly disagree* (−2) to *strongly agree* (2). Levels of anxiety, stress, and worry surrounding the PPS process were compared across subgroups of cardiovascular history, race, and sex using the Mann-Whitney *U* test. Themes and comments from qualitative data were summarized in line with a critical realist framework.

Results: Fifty-one athletes (23.0%) reported previous cardiovascular symptoms (ie, syncope, dyspnoea, angina) or a family history of cardiovascular conditions. Athletes did not report symptoms of anxiety ($M = -1.29$) or stress ($M = -1.41$) in relation to their participation in PPS. Athletes were not worried about the PPS process revealing a cardiovascular condition ($M = -1.12$) and agreed that PPS was beneficial for their safety ($M = 1.25$). Levels of anxiety, stress, and worry surrounding the PPS process were higher in athletes who reported a cardiovascular history ($M = -1.02$, $M = -1.24$, $M = -0.73$, respectively) than those who did not ($M = -1.41$, $P < 0.01$; $M = -1.50$, $P < 0.03$; $M = -1.27$, $P < 0.01$, respectively). No significant differences were observed by race or sex. Qualitative data confirmed that athletes exhibited minimal concern and anxiety surrounding PPS. Athletes found the screening process to be efficient and straightforward, without causing negative lifestyle implications. Physician availability was recognized as a barrier to the completion of PPS. Athletes desired post-screening educational materials and the opportunity for follow-up appointments to discuss screening results.

Conclusions: The PPS process does not cause anxiety, stress, or worry among Canadian post-secondary athletes. However, heightened levels of distress are observed for athletes who reported a cardiovascular history.

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The Effect of COVID-19 on Injury and Illness in the National Hockey League

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Objective: To determine the effect of the disruption of the competitive calendar due to the COVID-19 pandemic, compared to pre-COVID seasons, on injury and illness in professional hockey players.

Study Design: Retrospective cohort study.

Setting: Six seasons of public access injury, illness and performance data for National Hockey League players.

Participants: All players on active rosters in the NHL between 2016 to 2022.

Independent Variables: Time of season.

Main Outcome Measures: Incidence of injury/illness, point prevalence of injury, injury/illness severity (mean days lost; MDL). Incidence rate ratio (IRR) and point prevalence rate ratio (PR) comparing seasons since returning from COVID to pre-COVID seasons.

Results: IRR for illness peaked in December 2021 (IRR = 55.69, 95% CI 49.06-62.32). IRR for injuries was significantly higher in 2020-2021 (IRR = 1.18, 95% CI 1.07-1.31) and 2021-2022 (IRR = 1.20, 95% CI 1.10-1.30). Mean days lost to injury was significantly lower in the 2020-2021 season (MDL = 13.29, $P < 0.001$), and significantly higher in the 2021-2022 season (MDL = 19.04, $P = 0.002$), compared to pre-COVID seasons (MDL = 16.47).

Conclusions: Incidence of injuries increased in the 2020-21 and 2021-22 NHL regular seasons compared with the 4

seasons prior. Severity of injuries decreased in 2020-2021 while they increased in 2021-2022.

Clinical Relevance: Our analysis identified primary effects of COVID-19 (increased loss of time due to illness) as well as secondary effects (increased injury rates due to compression of schedule) on professional hockey players.

Discriminating Concussion Versus an Uninjured State—Development and Validation of a Diagnostic Accuracy Model

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Objective: To develop and validate a prediction model to classify sport-related concussion (SRC) versus uninjured adolescent ice hockey players.

Study Design: Diagnostic accuracy study.

Subjects: Adolescent ice hockey players (ages 10-17 years) who participated in 2 prospective cohort studies ("Elite hockey study" 2011-2012 ages 13–17; "Safe2Play" 2013-2018 ages 10–17 years) and completed at least 1 pair (preseason and post-SRC) of measures in the same year of play.

Observation Technique: Players completed a SCAT3/5 and clinical measures at (1) Preseason and (2) Post-SRC at time of diagnosis by a sport medicine physician.

Outcome Measures: SRC was defined as per fourth/fifth Consensus on Concussion in Sport. SCAT3/5 subcomponents [for example, symptom severity score (SSS,/132), modified balance error scoring system (mBESS/30), immediate (/15) and delayed memory (/5), concentration score/5], cervical range of motion (ROM; full/limited), cervical flexor endurance (CFE; seconds), cervical flexion rotation test (CFRT; positive/negative), anterolateral cervical spine strength (CSpStrength; lbs), head perturbation test (HPT;/8), extra-ocular motion (EOM; normal/abnormal), head thrust test (HTT; positive/negative), clinical dynamic visual acuity (DVA; logMAR), Functional Gait Assessment (FGA;/30), Walking while talking test (WWTT) were completed by a physiotherapist/athletic therapist. Stochastic imputation was used to impute outcomes for participants who had at least 14/18 paired outcomes. An estimation sample and a randomly drawn validation sample were created (70/30% split). Variables with an individual AUC of 0.6 or more were entered together in a generalized linear latent mixed model.

Results: Four hundred eleven youth hockey players (366 males, 45 females, ages 10–17) were included. SSS, CFE, HPT, strength, FGA and WWTT complex were able to discriminate between preseason state and SRC diagnosis similarly within sample (N = 340) and with a randomly drawn out of sample cohort (N = 146) [sensitivity = 0.68 and 0.78; specificity = 0.91 and 0.74; and area under the curve = 0.84 and 0.82 respectively).

Conclusions: A combination of SSS and commonly used clinical measures (CFE, HPT, cervical spine strength, FGA, WWTT complex) could accurately discriminate between preseason state and SRC-diagnosis in youth hockey players at least 82% of the time. The use of imputation for missing outcomes did not decrease the accuracy of the model.

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Case Study: Isolated Traumatic First Rib Fracture in a High School Football Player

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Objective: Isolated traumatic first rib fractures are rare injuries that can occur in various sports. Their management, particularly guidance on return to sport, is complicated by concerns of subsequent injury to the underlying brachial plexus, subclavian artery, and subclavian vein. The purpose of this case study was to describe the injury mechanism, signs/symptoms, imaging, and return to play decisions for an isolated first rib fracture with physical exam findings of subclavian artery compression in a 16-year-old high school football player.

Main Results: An initial XR following the injury demonstrated an isolated right first rib fracture with marked displacement. CTA (obtained on the advice of vascular surgery) did not demonstrate impingement of the subclavian artery or vein. Later clinical testing demonstrated positive Adson's, Wright's, and Roo's, likely secondary to impingement from callous formation. A repeat XR did not show bony healing. The plan for return to play was to obtain repeat XRs and to return once the patient was asymptomatic and imaging showed evidence of healing. The patient was then to monitor for symptoms suggesting arterial thoracic outlet syndrome which would require follow-up with the vascular surgeon. The patient returned to play 6 weeks following injury without seeking medical clearance.

Conclusions: Consider testing for arterial thoracic outlet syndrome with isolated first rib fractures. Callous formation may cause new symptoms and require monitoring for

progression or resolution. Evidence of bone healing should be demonstrated on repeat imaging prior to return to sport.

Attitudes Toward Chiropractic: A Survey of Canadian Sport and Exercise Medicine Physicians

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Objective: To determine the attitudes of Canadian sport and exercise medicine physicians (CSPs) toward chiropractic and its use for treatment of athletes and/or Canadians who are participating in sports or exercise (ACSE).

Study Design: Online survey.

Subjects: Active physician members of the Canadian Academy of Sport and Exercise Medicine (CASEM). Seventy CSPs completed the survey.

Intervention: An invitation to complete the survey was included in the monthly newsletter emailed to all CASEM members in March and April 2023. A card with a link to the survey was distributed to all attendees of the 2023 CASEM symposium.

Outcome Measures: The survey included a 20-item section, referred to as the Chiropractic Attitude Questionnaire (CAQ), which allowed respondents to indicate their attitudes towards chiropractic care for ACSE using a 5-point Likert scale. The responses to the CAQ was the primary outcome measure.

Results: Overall, the summed CAQ scores ranged from 31 to 51 with a mean of 40.2 and a SD of 3.8. CSPs hold a similar opinion toward chiropractic compared to previously published data from surveyed medical specialties. When compared to family physicians (surveyed in 2010 and again in 2019) and obstetricians the mean CAQ is almost identical—40.2 compared to 40.45, 41.7 and 41.2. Those CSPs who currently work with or have worked with a chiropractor in various sports medicine settings (ie private clinic, national team, major games, etc.) hold a more positive opinion of chiropractic, as indicated by a higher CAQ score. An independent-samples *t* test indicated that there was a significant difference between CAQ scores for those with previous experience of working with a chiropractor in various settings ($M = 41.2727$, $SD = 4.32488$) and those without ($M = 39.2432$, $SD = 2.97588$); $t(68) = -2.308$, $P < 0.05$.

Conclusions: CSPs attitudes toward chiropractic and its use for treatment of ACSE were overall positive and were less diverse than those of previously surveyed medical specialties. CSPs who reported to have worked with a chiropractor in a sports medicine setting have more positive attitudes than those that have not.

An Assessment of Rehabilitation Progress Using IMU Sensors: A Comparative Study of Pre- and Post-ACL Surgery Step Counts at 6 Months

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Objective: Utilize inertial measurement units (IMUs) to assess the number of steps taken by participants who underwent anterior cruciate ligament (ACL) reconstruction, at standardized follow up assessments up to 6 months after surgery.

Study Design: Observational cohort study.

Subjects: Thirteen participants (7 males, 6 females) who underwent primary ACL reconstruction.

Intervention/Observation Technique: Participants were instructed to wear an IMU sensor on the ankle of their surgical leg during observational time points for as many waking hours as possible prior to follow up appointments.

Outcome Measures: The IMU readout representing ankle motion was recorded with sampling frequency of 128 Hz. The IMU readouts throughout the 6-month rehabilitation period was recorded and then translated to daily step counts and activity time while the sensor was recording, specifically at 1 week prior to surgery, 6- weeks post-surgery, and 3- and 6-months post-surgery.

Results: Participants during the 2-to-6-week post-operative time period demonstrated an average of 142 steps per recorded hour. This improved by 3 months, with an average of 343 steps per hour and further at 6 months with an average of 490 steps per hour. This is in comparison to a pre-operative recorded step count average of 625. A similar trend was observed with activity time for these participants. At 6 weeks post operatively, only 3% of the time the sensor was on did the participant reach the active threshold. This increased to 12% and 10%, respectively, at 3 and 6 months. The pre-operative percentage of time was 13%, similar to what was observed at the 3- and 6-month timepoints.

Conclusions: Postoperative, participants objectively had a similar level of daily activity when compared to their pre-operative levels, although their step counts during the time of being active was diminished. The utilization of IMUs provided objective activity data in the early post-operative period and warrants further objective research to better inform post-operative management.

Mapping the Gap: A Study on the Reporting of Relative Energy Deficiency in Sport (REDs) in USPORTS Coaches and Athletes

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Objective: To assess the knowledge and recognition of the signs/symptoms of Relative Energy Deficiency in Sport (REDs) both pre- and post-education session and panel discussion for USPORTS (Canadian University National Championships) cross-country (XC) athletes and coaches.

Study Design: Cross-sectional in-person survey; 39 pre- and 29 post-session questions, implemented around an education

session and panel discussion occurring the day before the USPORTS XC Championships.

Participants: Sixty-eight USPORTS XC athletes [50 women, 58 (85%) between the ages of 19-24 years, 17 (25%) in year 1 and 17 (25%) in year 3]. 20 USPORTS XC coaches [13 men, 5 (25%) between 31 and 35 years, 6 (30%) >50 years, 10 (50%) with >10 years coaching experience].

Intervention: Education session, panel discussion and survey on REDs at USPORTS XC.

Outcome Measures: Confidence in knowledge and recognition of REDs. Quantitative pre-post data and athletes were analyzed using t-tests and Wilcoxon Sign-Ranked tests.

Results: Pre-panel, 80% (n = 16) of coaches and 59% (n = 40) of athletes were able to correctly identify the underlying cause of REDs [low energy availability (LEA)] – not a significant difference between groups ($P = 0.08$). However, only 50% (n = 8) of coaches and 13% (n = 9) of athletes were completely confident in their answers. The most identified symptoms for both coaches and athletes were fatigue [coaches = 40% (n = 8), athletes 53% (n = 36)] and amenorrhea [coaches = 30% (n = 6), athletes = 57% (n = 39, 34 women)]. Additionally, only 20% (n = 4) of coaches and 7% (n = 5) of athletes were completely confident in identifying the signs/symptoms of REDs. After the panel, the confidence levels of coaches in identifying signs/symptoms did not change [$P = 0.52$; pre-panel complete confidence = 20% (n = 4), post-panel completely confidence = 20% (n = 4)]. Confidence significantly improved in athletes [$P < 0.001$; pre-panel complete confidence = 7% (n = 5), post-panel complete confidence = 32% (n = 22)] Low libido in males was a commonly identified new learned symptom.

Conclusions: An education session/panel discussion surrounding REDs significantly increased the confidence in REDs knowledge and recognition among USPORTS XC athletes, but not among coaches. Further educational modules and panels should be developed, along with exploration of knowledge dissemination strategies, to improve awareness of REDs in Canadian athletes and coaches.

Pain in Parasport Athletes With amputation or Limb Deficiency: A Scoping Review

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Objective: The primary objective of this study was to determine the prevalence and patterns of pain in parasport athletes with amputation or limb deficiency using a scoping review of the literature. A secondary objective was to determine what pain management strategies were used.

Data Sources: The databases Medline, CINAHL, EMBASE, Scopus and Cochrane were searched from inception through November 25, 2023.

Main Results: The search identified 24 articles; 10 underwent full-text review and 3 were included in the final scoping review. All of the included studies focused on parasport athletes; none discussed those with amputation or limb deficiency alone. In total, 366 subjects were included in the studies in this scoping review, and of those, 54 subjects were athletes with limb deficiency or amputations. Types of pain identified in parasport athletes with amputation or limb deficiency included general musculoskeletal pain, bone stress injuries, and fractures. One study also explored the burden of illness and psychological conditions in subjects. Main outcomes were measured utilizing questionnaires that asked subjects to describe their musculoskeletal pain; all studies included used different questionnaires. Two of the 3 studies included delineated the association between type of disability and pain prevalence; in each of these studies, pain prevalence was highest in athletes with limb deficiency and amputation compared to other impairment groups such as spinal cord injury, cerebral palsy, other neurological impairment, and "les autres." Only 1 study reviewed management strategies, however this was generic and only discussed medication use, physiotherapy, and diagnostic aids involved with sport-specific injuries.

Conclusions: In the current review, all included studies focused on parasport athletes as a broad category, with no study investigating amputation or limb deficiency alone. Two of the 3 included studies demonstrated that athletes with limb deficiency or amputation have a higher prevalence of musculoskeletal pain, injuries, and illness, compared to other parasport athletes. This review illustrates that there is a need for further high-quality research to determine possible reasons for increased pain prevalence in this population.

Three-Dimensional Modelling for Improved Injection Techniques

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Objectives: To develop a 3D shoulder model for teaching blind and US-guided injections.

Study Design: Descriptive Study.

Subjects: Thirty-seven-year-old male who had a right shoulder CT (consented to use of images).

Intervention: Three-dimensional (3D) printing of a shoulder joint and outer skin mould from re-formatted shoulder CT images.

Outcome Measures: 1. Production of a full-scale shoulder model consisting of a gel body around a 3D-printed shoulder joint. 2. Model accommodates blind injection as well as US-guided techniques.

Results: CT images were reformatted to STL files and subsequently used to print a 3D model at approximately 215°C. The model was printed using a mixture of polylactic acid filament and acrylonitrile butadiene styrene on a Stratasys Fortus 360. The 3D-printed mould was initially permeable to poured gel, but this was corrected using a liquid rubber product (Flex Seal Liquid) that was applied to the interior. The gel product was made from 7 cups of gelatin mixed in 7 L of cold water with 400 mL of hydrogen peroxide (as preservative and transparency additive) and slowly heated and mixed to 41°C. This was then poured into the closed mould from the opening at the top above the joint inside. The result was a 3D-printed shoulder joint consisting of upper 1/3 humerus, scapula and distal 2/3 of clavicle

surrounded by a gelatin body. This model accommodated both blind injection techniques of the shoulder allowing visualization of injection vectoring and US- guided injections of the shoulder.

Conclusions: A 3D teaching shoulder model was created by pouring homemade gelatin into a life-sized 3D printed shoulder mould created from re-formatted CT images. Limitations include a lack of musculotendinous and neurovascular anatomy and injection of injectate. Although needle introduction leaves track marks, the gelatin can be reused by removing from the model and reheating and repouring into the mould. This is an important step to making musculoskeletal joint injection teaching more accessible and improving injection techniques before injecting patients. Future adaptation can be used for alternative joints and to allow for injection targets and accommodation of injectate.

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Variability in Patient-Incurred Costs and Protocols of Regenerative Medicine Procedures for Musculoskeletal Conditions in Canada

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The submitting author (Alexandre McDougall) is currently modifying a protocol similar to previous publication with similar authors, but now with Canadian context. The protocol and survey are currently under review at the Hospital for Special Surgery regenerative medicine IRB.

The survey has been discussed and tentatively approved for distribution to CASEM members (among other Canadian societies) by Dawn Hawthorn. The goal of a podium and/or poster presentation would be to increase study visibility and participants.

Charnoff, Jesse, et al "Variability in patient-incurred costs and protocols of regenerative medicine procedures for musculoskeletal conditions in the United States." *HSS Journal* 19.1 (2023): 77-84.

Original Research Abstract

Background: The use of regenerative medicine as an "off label" treatment for musculoskeletal conditions continues to increase in prevalence, however, the literature is sparse regarding their associated costs.

Purposes: We sought to determine the patient-incurred costs for regenerative medicine treatments performed by physicians for musculoskeletal conditions in Canada, according to primary specialty, geographic region, practice setting, and years in practice. We also sought to characterize pre- and posttreatment protocols and image guidance use.

Methods: We performed a cross-sectional study with data collection occurring between January 2024 and April 2024. It began with the distribution of an online survey through an email campaign by the Canadian Academy of Sport and Exercise Medicine to its members. Survey data included physician demographics, practice/training information, types/costs of regenerative medicine treatments performed, and pre-/post-procedure protocols.

Results: Pending.

Highlighting Female Athletes' Lived Experiences and Perceptions on Menstruation in Sport: It's About Time!

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Objective: To qualitatively: (1) investigate varsity female athletes' lived experiences regarding the impact of their menstrual cycle (MC) on sport performance, (2) explore their perceptions and unmet needs regarding varsity staff communication and education to optimize sport participation and performance.

Study Design: Individual semi-structured phenomenological interviews including a short survey were performed on Zoom. A thematic analysis was conducted using NVivo through inductive and theoretical coding. Agreement and inter-coder reliability were ensured as 2 coders (K.T., A.P.) established a Cohen's kappa value of $\geq$0.81 across shared transcripts.

Subjects: Ten female athletes between the ages of 17 to 25 on women's teams at Western University who have previously had or currently have an established MC.

Intervention/Observation Technique: Individual interviews.

Outcome Measures: Qualitative themes as described.

Results: Four overarching themes emerged through thematic analysis: (1) *symptoms* (2) *perceived impact on sport performance,* (3) *communication and support, and* (4) *education and next steps*. All athletes reported experiencing symptoms (eg cramps, fatigue), typically occurring before and during menstruation. Many athletes perceived that their symptoms negatively impacted their performance as well as their willingness and/or ability to participate in sport. Regarding communication and support, 7 athletes reported that they never communicated with varsity team staff regarding their MC due to feelings of discomfort and the perceived lack of understanding, particularly by male staff. Those that discussed their MC with staff did not feel that they received adequate guidance. Regarding education and next steps, all athletes perceived that varsity coaches and staff were not equipped to support their needs and desired a greater understanding and acknowledgement of the MC. Overall, athletes believed that team staff would benefit from education on symptoms, potential performance impact of the MC and recommended strategies to support their needs (eg, freely available menstrual products and pain relievers, adapted training programs).

Conclusions: This study highlighted the variability between athletes' perceptions of the impact of the menstrual cycle on participation and performance and emphasized the need for an individual-based approach to coaching and training. Greater education may improve dialogue between athletes and staff and decrease the stigmatization of the menstrual cycle.

Unchanged Cognitive Motor Integration in Male Youth Athletes During 8 Weeks of Soccer

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Objective: To assess the relationship between cognitive motor integration (CMI) task performance and cumulative head impacts in male youth soccer players.

Study Design: A prospective cohort study of elite male youth soccer players from a single team during 1 season of play.

Subjects: A convenience sample of 18 male youth players (under-13 year old).

Intervention: Frequency, peak linear acceleration (PLA), and peak rotation velocity (PRV) of head impacts experienced during practices and games were measured via instrumented mouthguards. Eight weeks of head impacts including 3 CMI testing sessions (baseline and 2 follow-ups) were used for this analysis.

Outcome Measures: Reaction time, total movement time, peak velocity, full path length, and direction reversal errors were measured during the CMI tasks. Outcome measures are summarized using mean and SD for normally distributed parameters, or median and interquartile range for non-normally distributed parameters. Relationships between the number of head impacts and the 5 CMI performance variables were assessed using linear mixed effects modeling performed in R.

Results: Over 8 weeks, a total of 169 head impacts occurred during 12 games and 344 during 32 practices with players averaging 0.8 head impacts per game and 0.6 head impacts per practice. The median (25-75 percentile) PLA and PRV for head impacts were 14.7 (11.3-18.7) g and 7.0 (4.3-10.2) rad/s, respectively. Cumulative head impacts were not significantly associated with changes in any of the 5 CMI performance variables.

Conclusions: Players experience twice as many head impacts during practices than games. Low doses of head impact exposure do not result in measurable changes in cognitive motor integration tasks over a short period of soccer participation. Given the potential short- and long-term consequences of head impacts, soccer coaches should emphasize controlling the ball with the feet, and structure practices to reduce head impact exposure.

Age-Related Differences During Specific Athletic events Highlighting Strength and Speed Characteristics in Well-Trained Male and Female Adolescents

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Objective: To investigate any age-related differences during specific athletic events highlighting strength and speed characteristics in well-trained adolescents.

Study Design: Cross-sectional observational study.

Subjects: Six hundred young track and field athletes (300 females and 300 males) aged 10 to 15 year old.

Observation Technique: From each year group (U10, U11, U12, U13, U14, U15) the top 50 performance results from the final round of the national annual athletics tournament "Shipovka Yunykh" in 2017 to 2019 were analyzed. The winners were determined by the sum of 3 sporting disciplines, namely: 60-m sprint, 600-m, and long jump.

Outcome Measures: The outcome measurements were results in 60-m sprint, 600-m run and long jump. The results were measured by FinishLynx electronic timing system. ANOVA was used to compare the results for boys and girls of the same age, followed by (if necessary, the number of compared variables is more than 2 and the differences are significant) Tukey post-hoc analysis.

Results: Statistically significant differences are evident in boys at 12 year old from the 60-m sprint. However, in strength qualities as measured by the long jump, differences are contradictory. In boys, at 11 to 12 and 14 to 15 years, there are statistically significant differences, however, in girls statistically significant differences were only observed at 13 year old. However, the effects of chronological age in boys and girls were significantly different in several age groups and in varying athletic events, thus the current results may be affected. For example, in boys at 13 years, the best physical performance was in the 60-m sprint, on average 4 months older than girls. While the best long jump performance in girls was observed at 13 year old, on average 2 months older than male peers.

Conclusions: In this current cohort of well-trained adolescents, differences in strength and speed commenced at 11 to 12 year old. For an accurate interpretation of the data, it is important to consider the exact chronological age at the time of performance rather than the year of birth.

Risk of Subsequent Concussion in Adolescent Ice Hockey Players with ≥2 Concussions

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Objective: A first concussion does not increase the risk of second concussion in adults who follow recommended concussion protocols. Our objective was to determine if a first concussion causally increases the risk of a second concussion among adolescents with ≥2 concussions who do not necessarily follow recommended concussion protocols.

Study Design: Five-year prospective cohort.

Subjects: Male and female adolescent ice hockey participants (age 11-17) with ≥2 concussions playing in either body-checking or non-body-checking leagues throughout both concussions, with valid data on number of practices and games.

Observation Technique: Secondary analysis of data collected using a validated injury surveillance methodology, including preseason baseline, weekly exposure, and injury data.

Outcome Measures: The probability of a concussion over time. We used Cox proportional hazard models to estimate hazard ratios (HR) with 95% CI using the number of games and practices as exposure time at risk. We included a random effect for participants to account for repeated measures. We also stratified analyses by body-checking versus non-body-checking leagues.

Results: Of 4430 participants in the cohort study, 30 participants (28 males, 2 females) met our eligible criteria. Overall, there was an 80% increased risk for a second versus first concussion (HR 1.80, 95% CI 1.12-2.88 $P = 0.015$). Participants in body-checking leagues (n = 18) had a >2-fold increased risk for a second concussion compared to first concussion (HR 2.20, 95% CI 1.16-4.16, $P = 0.016$). Participants in non-body-checking leagues (n = 12) had minimal increased hazard (HR 1.14, 95% CI 0.57-2.28, $P = 0.713$). Although these results suggest playing in a body-checking versus non-body-checking league modifies the effect of the first concussion, the uncertainty in the estimates was too large to be definitive ($P = 0.08$).

Conclusions: A first concussion causally increases the risk of second concussion in community adolescent ice hockey players with ≥2 concussions. The increased risk may be higher in body-checking leagues and minimal in non-body-checking leagues, but the uncertainty was considerable, and larger sample sizes are required for more definitive conclusions.

From Lineout to Lab: Comparability of Youth Rugby and Laboratory Simulated Head Impact Kinematics

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Objective: To compare the head impact kinematics obtained through several laboratory drop-test methods, representing common drop-test conditions for assessing the impact mitigation of rugby headgear, to head impacts measured during youth rugby.

Study Design: Observational cohort study, Experimental/simulation study.

Subjects: Forty male and 18 female club rugby union players (age range: 13–17 year old). Dataset of physically simulated drop test head impacts using a Hybrid III headform and corresponding Hybrid III neck impacting a 1-inch MEP pad angled at 0 and 45 degrees.

Observation Technique: Participants were fitted with instrumented mouthguards over 2 seasons of gameplay to measure head impact kinematics. Three laboratory drop-test variations were carried out. The first 2 involved the headform with and without the neck impacting the 0° MEP pad. The third included the neck and used a 45 degrees MEP pad. Four impact locations (forehead, front boss, side, and rear boss) were impacted at 5 impact velocities (1.2–3.4 $m \cdot s^{-1}$).

Outcome Measures: Bootstrapped 95% confidence intervals (CI) quantified the differences in peak linear and rotational acceleration and rotational velocity (PLA, PRA, and PRV) and their respective durations along with the peak kinematics at a given change in linear velocity between drop tests and field impacts.

Results: Drop tests without the neck showed significantly lower PLA (CI [−6.2, −3.1 ms]), PRA ([−6.4, −2.3 ms]), and PRV duration ([−26.8, −21.5 ms]) compared to the rugby impacts. Drop tests with the neck (0° MEP pad) resulted in significantly lower PLA (CI [−5.9, −3.2 ms]), PRA ([−8.2, −5.3 ms]), and PRV duration ([−6.7, −1.2 ms]) compared to the rugby impacts. Drop tests with the neck (45 degrees MEP pad) resulted in significantly lower PLA (CI [−5.3, −2.6 ms]) and PRA duration ([−4.9, −0.5 ms]), but similar PRV duration compared to the rugby impacts. All drop-test peak kinematics increasingly diverged from those of the rugby impacts with increasing linear velocity.

Conclusions: Current drop testing requires a more compliant impact surface to reduce peak accelerations while extending their duration for a given impact velocity. Developing laboratory-based head impact standards, such as the Law 4 trial assessment for rugby headgear, requires greater scientific rigour to assess headgear as a medical impact mitigation device.

Hey Doc I Use Steroids: Exploring the Relationship between Family Physicians and Anabolic Steroid Users

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Objective: To identify current levels of knowledge, approaches, and experiences that primary care physicians have towards managing and discussing anabolic steroid use and anabolic steroid use disorder with patients.

Study Design: Qualitative study using online semi-structured interviews.

Subjects: Licensed family physicians (FP), previously or currently practicing outpatient family medicine in Alberta were eligible and recruited via convenience and snowball sampling techniques. Demographics included gender, age, and years practicing.

Intervention/Observation Technique: Participants were interviewed on Zoom about their experiences, perceptions, and understanding of anabolic steroid use.

Outcome Measures: Interviews were transcribed, coded by a study member and checked by at least 1 other member. The team discussed the codes and aggregated them into overarching themes. Thematic Analysis was used to explore experiences (NVivo 14 software).

Results: Practicing FPs (N = 7) were recruited and 6 agreed to participate. Key themes include the following. Participants agreed that medical school and family medicine residency training is insufficient for preparing to serve this population. Currently available resources on anabolic steroids specific to improving FPs' education are not easily accessible. Most FPs have minimal experience providing tailored care for anabolic steroid use, and those with more experience are typically self-taught or have experience in a related area (ie, gender clinics). A consensus on the increasing prevalence of steroid use was due to easy access to information on the internet and social media. Often misinformation surrounding body image, potential risks, and social pressures (gym) to use were noted. Family physicians perceived that many users likely felt stigmatized therefore concealing their steroid use. Steroid users may not have understood the reasons for follow up on

lab work and testing requests. To avoid negative health outcomes FPs should consider supportive but affirmative approaches in their conversations.

Conclusions: Increased education and training on anabolic steroid use in medical school and residency, decreasing stigma surrounding anabolic steroid use, and adopting a harm reduction approach are all essential for FPs to better serve this population.

Acknowledgements: The authors would like to thank the participants for their contribution and the Calgary Medical Students Association and the Doyle-Baker Lab for funding support.

Introducing a Foot Orthosis Design Innovation to Reduce Medial Compartment Load and Knee Osteoarthritis Pain

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Objective: To evaluate the clinical effectiveness of a novel foot orthosis design, the variable-density osteoarthritis orthosis (V.D.O.O) in patients presenting with knee osteoarthritis.

Study Design: Retrospective case series.

Subjects: Fifty-five subjects diagnosed with medial knee osteoarthritis (63.35 ± 11.25 years, 169.61 ± 10.20 lbs, 84.86 ± 19.42 kg).

Intervention: A comprehensive history and biomechanical and footwear assessment followed by a 3D digital foot impression for custom V.D.O.O preparation. V.D.O.O were dispensed 2 weeks post-assessment and symptoms were evaluated at follow-up.

Outcome Measures: The outcome measures were patient reported symptoms, knee pain, and foot orthosis comfort at follow-up (61.64 ± 82.31 days) compared to baseline (initial assessment). Pain score (1-no pain, 10-worst pain imaginable) and foot orthosis comfort (1-extremely uncomfortable, 10-extremely comfortable) were measured on a 10 pt numerical scale.

Results: At follow-up, 80% (44/55) of V.D.O.O patients reported symptom improvement or complete recovery with a change in pain score (pain at assessment—(minus) pain at follow-up) of 1.33 ± 2.63. Furthermore, 80% (44/55) of V.D.O.O patients reported increased comfort (<7/10) when wearing the orthoses during activities of daily living.

Conclusions: Short term outcomes suggest V.D.O.O can be a successful addition to conservative care for reducing pain and improving comfort in patients suffering from knee osteoarthritis.

Predicting Adherence to Brace-wearing for the Non-Surgical Management of the Medial Collateral Ligament of the Knee

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Objectives: To explore the predictors of brace-wearing adherence throughout a medial collateral ligament (MCL) bracing treatment.

Study Design: Exploratory quantitative cohort study.

Subjects: Fifty-nine patients (27 males, 32 females) aged 18 to 65 with an acute moderate or severe isolated MCL or combined anterior cruciate ligament (ACL) and MCL injury were part of a randomized clinical trial (RCT) examining the effectiveness of 2 different bracing techniques (0-90 degrees or 30-90 degrees) (REB17-1699).

Methods: All patient followed a 6-week bracing protocol divided into 3 Phases. Patients were prescribed constant brace wearing for 4 weeks (~23 h/d), then daytime wear only (~15 h/d) until brace discontinuation at 6 weeks. Rehabilitation exercises were prescribed from 2 weeks onwards. Patients were followed for 12 weeks, as part of the RCT. Adherence to the bracing protocol was measured using a daily self-reported log. Clinical and patient-reported outcome measures were collected as part of the RCT and were used as predictor variables in this exploratory study, with adherence as the outcome.

Outcome Measures: The outcome measure was adherence to the bracing protocol at each of the 3 Phases, interpreted as a dichotomous variable (ie, adherer, or non-adherer). Adherers were defined as those patients who wore their brace according to the protocol and only removed it as allowed. Predictor variables included patient characteristics (age, body mass index (BMI), sex, affected knee, diagnosis (MCL or ACL-MCL) and bracing group) as well as patient-reported pain on VAS, overall knee score, and brace satisfaction. Predictor measures were collected at baseline, 2, 4, and 6 weeks. Exploratory logistic regression analyses were performed.

Results: Pain (Phase 1 and 2), having a left-sided injury (Phase 2), and being braced 30 to 90 degrees (Phase 3) were identified as statistically significant predictors of adherence to bracing ($P < 0.05$). However, there were preliminary trends to suggest that being female, of older age, having a higher BMI, a combined ACL-MCL injury, or reporting higher brace satisfaction may improve adherence.

Conclusions: Several factors affect adherence to brace-wearing. However, pain, affected knee, and brace range-of-motion settings were the primary predictors. This study is the first to provide insight into bracing adherence and could help clinicians manage MCL injuries.

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Long-Term Sustained Benefits of Viscosupplementation With Different Molecular Weight Intra-Articular Hyaluronic Acids in the Treatment of Osteoarthritis of the Knee. HAV-OAK

A Retrospective Indian Cohort study of more than 15 years.

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Background: Knee osteoarthritis (OA) is a progressive degenerative condition resulting in functional loss, pain, and discomfort.[1] Viscosupplementation (VS) with Intra-articular hyaluronic acid (IAHA) injections has been shown to have protective physiochemical functions and may confer disease-modifying, long-term effects in OA.[2,3] The lack of confidence in Intra-articular hyaluronic acid injections (IAHA) used in osteoarthritis (OA) may result from conflicting guidelines and pooling of results for different molecular weight products.

Objectives: The objectives were to determine responder rates to the first injection and duration of sustained response to repeat injections of very high molecular weight—20 mg/mL—3 mL (VHMW-HA)—versus high molecular weight—6 to 8 mg/mL—6 mL (HMW-HA) injections for knee OA and treatment efficacy measured by the interval between follow-up injections.

Study Design, Subjects, Intervention/Observation Technique, and Outcome Measures: This is a retrospective analysis of a 15-year cohort from a single centre. Inclusion criteria were adults with KL Grade III or IV knee OA treated with non-animal sourced hyaluronic acid injections. Subjects were stratified into 2 groups based on the molecular weight of the hyaluronic acid. Outcome measures were responder rates with improvement in WOMAC scores of $> 30\%$ from baseline versus non-responders; those with a response lasting >6-months after each injection were considered sustained responders.

Results: A total of 2037 (female 1467 (72.02%), and male 570 (27.98%)) patients were treated. The overall primary responder rate was 73.44% (1496). VHMW-HA had significantly higher primary responders versus HMW-HA (75.21% vs 70.22%, $P = 0.015$) and significantly lower non-responders (24.79% vs 29.78%, $P = 0.015$). The sustained responder rate was greater with VHMW-HA versus HMW-HA (85.54% vs 67.06% $P < 0.0001$). The average interval between the first and the third injections was longer for VHMW-HA versus HMW-HA - 5.67 (Median 25th-75th percentile—5.392-6.036) versus 1.95 (Median 25th-75th percentile—1.753-2.24) years. P-value <0.0001.

Conclusions: Overall, 73.44% of subjects responded to treatment with IAHA. The sustained response was greater in VHMW-HA versus HMW-HA and treatment with VHMW-HA has a longer duration of effect than HMW-HA.

Keywords: Osteoarthritis, Viscosupplementation, intra-articular, hyaluronic acid, VHMW-HA, HMW-HA, sustained responders.

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"Physique of My Dreams": Perspectives of Anabolic Steroid Users on Primary Care, Social Media & Societal Stigma

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Objective: To identify insights of anabolic steroid users (ASU) into their knowledge and patterns of anabolic steroid use, interactions with the healthcare system and their unique needs as a population.

Study Design: Participant-centered-qualitative research using semi-structured interviews.

Subjects: ASU of various ages ≥ 18 and sexes were recruited through gyms in Alberta with convenience and snowball sampling techniques.

Observation Technique: Participants discussed their experiences as a user and shared their understanding of anabolic steroids, details of usage and their relationship with primary care providers through one-on-one interviews of varying durations.

Outcome Measures: Interviews were coded using NVivo 14 Software prior to Thematic Analysis. Resulting codes were organized into overarching themes based on researchers' consensus.

Results: Seven anabolic steroids (AS) users were confidentially interviewed over Zoom. Several important themes emerged. Negative stigma surrounding individuals using anabolic steroids is prevalent, with perpetrators of stigma including family physicians and individuals outside of the "gym-goer" ingroup. Individuals using AS actively seek health advice regarding use outside of the traditional healthcare system, including alternative health practitioners, body-building forums, word of mouth & social media influencers. Many begin using to improve physical appearance and to achieve a better physique, with some users seeking to compete in professional bodybuilding. Social media plays a large role in the decision to use anabolic steroids, namely due to the "naturally" unattainable physiques and rampant AS use by social media influencers. Lastly, many users avoid discussing AS use with their family physician due to fear of stigma or because of perceived lack of AS side effects.

Conclusions: This study identifies the vital need for education and research in exploring a vulnerable subpopulation with major health needs that experiences negative stigma from primary care providers. Exploration of harm reduction options and a non-judgmental approach in primary care

physicians is warranted. Further exploration as to the impact of social media on anabolic steroid use incidence must also be conducted.

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Study of the Impact of Physical Activity on Cardiovascular Disease Risk Factors and Quality of Life of Persons With Transplanted Organs at the First All-Russian Transplant Games in 2022

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Objective: Study the quality of life and risks of CC3 in recipients of donor organs and dialysis patients who participated in the First All-Russian Transplant Games.

Study Design: Case–control study.

Subjects: Forty-two subjects (23 females and 19 males), who underwent organ transplantation with satisfactory graft function from.

Intervention: A quality of life study using SF36 and a survey were conducted to identify risk factors for cardiovascular diseases. Blood pressure was measured before the start of the games.

Outcome Measures: The average age was 42.6 + 12.09 years. At the time of the competition, the recipients had a minimum of 6 months after kidney transplantation and a maximum of 18 to 19 years also after kidney transplantation (3 people), dialysis periods ranged from 3 to 19 years. All participants were surveyed using the questionnaire developed by us and the SF 36 questionnaire (QoL assessment). The SF-36 quality of life questionnaire includes 8 scales assessed from 0 to 100 points: physical functioning (PF), role functioning due to physical condition (RFP), pain intensity (PI), general health (GH), mental health (MH), role functioning due to emotional state (RFE), social functioning (SF), vital activity (VA).

Results: After analyzing the questionnaires we developed, we found that patients participating in transplant games regularly go in for sports and walk outside every day. Also, most (80%) of them have a normal body weight and adhere to nutritional recommendations. Only 2 admitted to occasional smoking, the rest do not smoke. Blood pressure (BP): BP sys. 124.4 + 11.4 and BP diast. 77.5 + 8.4, which corresponds to the norm. All participants were surveyed using the SF 36 questionnaire. According to the results of the questionnaire analysis: all participants have high scores in the scales of GH 70%, VA 75% and MH 73%, as well as physical functioning 85.5%, RFP 78.9% and RFE of 84.5%, which is associated with regular physical education and sports.

Conclusions: Thus, high quality of life indicators among patients with transplanted organs and on dialysis who participated in competitions confirm the role of an active lifestyle, physical education and sports in reducing the risk of cardiovascular diseases and require further study in this area in this category of patients.

Preseason Cervical Spine, Vestibulo-Ocular Reflex, and Oculomotor Measures: Do History of Concussion and Sex Matter?

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Objective: To examine the association between concussion history and preseason cervical spine, vestibulo-ocular reflex, and oculomotor measures in male and female adolescent (10-19 years) sport participants.

Study Design: Cross-sectional.

Subjects: One thousand six hundred fifty-three adolescent sport participants [males = 988 (59.77%); females = 653 (39.50%); undisclosed = 12 (0.73%)].

Outcome Measures: Generalized estimating equations were used to examine the association between number of previous concussions (0, 1, 2+) and measures of the cervical spine [Range of motion (ROM), flexor endurance (CFE), flexion-rotation (CFRT), head perturbation test (HPT)], vestibulo-ocular reflex [Head thrust test (HTT), dynamic visual acuity (DVA)], and oculomotor function [Symptom provocation/performance on smooth pursuit (SP), horizontal saccades (HS), vertical saccades (VS), near-point-convergence (NPC)]. Covariates included age, sex, baseline symptom severity score, and sport-type. Effect modification of concussion history by sex and sex by age were also evaluated.

Results: Sex specific differences by concussion history were observed with VOR and oculomotor measures. Relative to females with no previous concussions, females with 1 and 2+ concussions had a greater-odds of an abnormal HTT ($OR_{Females\ 1concussion}$ = 3.40; 95% CI: 1.24-9.31; $OR_{females\ 2+concussions}$ = 4.64; 95% CI: 1.03-20.80). Males with 2+ concussions relative to males with no previous concussions had a reduced-odds of an abnormal HTT (OR = 0.20; 95% CI: 0.14-0.68). Additionally, relative to females with no previous concussions, females with 2+ concussions had a 4-fold greater-odds of HS symptom provocation (OR = 4.08;

95% CI: 1.56-10.65), 2.25-fold greater-odds of abnormal VS performance (OR = 2.25; 95% CI: 1.30-3.92). Irrespective of sex, compared to adolescents with no previous concussion, adolescents with 1 previous concussion had a 2-fold greater-odds of VS symptom provocation (OR = 2.02; 95% CI: 1.09–3.76) and adolescents with 2+ concussions had a 1.89-fold greater-odds of convergence insufficiency (NPC >6 cm) (OR = 1.89; 95% CI: 1.24–3.16). Irrespective of concussion history, compared to males, females had a 2.66-folds greater-odds of SP symptom provocation (OR = 2.66; 95% CI: 1.15–11.62). Females relative to males also had a 59% reduced-odds of decreased ROM (OR = 0.41; 95% CI: 0.25–0.65), yet had a reduced CFE time (−5.47 seconds; 95% CI: −8.40 to −2.34). Additionally, the odds of an abnormal HPT (<7/8) decreased for every one-year increase in age for males (OR = 0.78; 95% CI: 0.63–0.97), while no differences were seen for females (OR = 1.03; 95% CI: 0.87–1.23).

Conclusions: Differences based on concussion history and sex existed across all preseason clinical domain. Future research is needed to better understand the relationship between concussion history, sex, and clinical outcomes.

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Ready or Not: The Menstrual Cycle's Impact on Athletes' Experiences and Perceptions of Readiness to Perform

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Objective: To understand how the menstrual cycle (MC) impacts high performance Canadian female athletes' lived experiences of training and perceptions of readiness to perform.

Study Design: Qualitative research conducted with semi-structured interviews.

Subjects: High performance Canadian female athletes competing at national level or above and 18 years of age or older.

Observation Technique: Online interviews using the Zoom platform (40-60 minutes) investigated participants' experiences and impact of the MC on training and competing, their definition of readiness and perceptions of readiness to perform.

Outcome Measures: Nine participants shared insightful experiences as athletes and the impact of the MC on readiness and performance. Athletes discussed what helped them feel ready, how the MC impacts them (if at all), if the MC impacts their readiness and/or performance or both, and how they manage their MC during training and competing. Reflexive thematic analysis was used to explore their experiences.

Results: Seven sports were represented across 9 athletes. Key considerations and thematic concepts included: (1) confidence in an athlete's ability to overcome the impact of the MC, (2) competition is untouchable by the MC, (3) a decrease in readiness may translate into negatively impacted performance and this is influenced by the athletes ability to cope, (4) the stronger/more severe an athlete perceives their "symptoms" to be, the more their readiness can be negatively impacted and performance level placed at risk.

Conclusions: When considering training and athletic performance, the MC requires individualized planning and adaptation, which continues to be observed in the literature. Athlete mental performance support is critical in aiding the athlete's management of the MC to achieve optimal performance. Readiness and performance are not equally impacted by the MC, neither are all athletes impacted by it and individual conversations with Canada's representative athletes about what they need to perform should be a priority for the team support staff.

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Efficacy of Hands-On Musculoskeletal Physical Exam Training for Family Medicine Residents—A Quality Improvement Project

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Objective: Most family medicine trainees cite a perceived lack of confidence with their musculoskeletal (MSK) physical examination skills. Our goal was to design a seminar for trainees at the Mount Sinai Academic Family Health Team to improve their overall confidence and competency when utilizing common MSK physical exam tests.

Study Design: Quality improvement project for educational training of family medicine residents.

Subjects: Eleven PGY1 and PGY2 trainees at the Mount Sinai Academic Family Health Team.

Intervention: We selected high-yield MSK special tests used for diagnosing common patient presentations in family medicine as our focus. Individual stations were designed for 3 anatomical regions: shoulder, hip, and knee exams. Each 20-minute station included a short presentation on the relevant anatomy, a review of the selected physical exam skills, and hands-on practice time. Each participant completed a pre-seminar and post-seminar survey.

Outcome Measures: Our primary outcome assessed diagnostic competency of 9 common MSK pathologies. Participants rated their level of comfort with performing physical exam maneuvers to diagnose specific pathologies using a 1-to-5 point Likert scale. Scores from the pre-seminar and post-seminar surveys were linked to allow for paired statistical analysis. Our secondary outcome involved a thematic analysis of participant feedback regarding the strengths and weaknesses of the seminar.

Results: The MSK condition with the lowest pre-seminar diagnostic confidence rating was femoroacetabular

impingement ($\mu = 2.0$). A within-group comparison using the Wilcoxon Rank Sign Test for paired samples found a statistically significant improvement in the post-seminar score for all 9 MSK pathologies tested. A qualitative analysis of participant feedback found the most beneficial component of the seminar to be the hands-on practice component.

Conclusions: Overall, the seminar improved residents' competence with using MSK physical exam skills to diagnose common MSK pathologies. One notable limitation reported in participant feedback was the time constraints of the individual stations. Moving forward, a similarly designed seminar-series could be beneficial as part of future regularly scheduled Academic Half Days for family medicine trainees.

Diagnostic Performance of Artificial Intelligence for Detection of Shoulder Pathology: A Systematic Review

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Objective: The purpose of this study was 2-fold: (1) assess the diagnostic performance of artificial intelligence (AI) in detecting common shoulder pathology and (2) compare the performance against human observers.

Data Sources: The query was performed using the Cochrane Central Register of Controlled Trials, PUBMED, EMBASE, and MEDLINE databases on October 5, 2023. Modified Methodological Index for Non-randomized Studies scoring criteria were used to assess quality. Information regarding AI model, prediction accuracy/area under the curve (AUC), sample sizes of testing/training sets, and imaging modalities were recorded.

Main Results: Overall, 32 studies were identified consisting of 128,809 images. Imaging modalities used were x-ray (n = 15), MRI (n = 13), ultrasound (n = 5), CT (n = 1), with some studies using multiple imaging modalities. Pathologies assessed were rotator cuff tears (RCT) (n = 15), fractures (n = 8), multiple pathologies (n = 3), labral tears (n = 2) and instability (n = 2), subacromial impingement (n = 1), and Hill-Sachs (n = 1). The AUC of AI models ranged from 0.71 to 0.98 for RCTs, 0.9 to 1.0 for fractures, 0.8 to 0.95 for multiple pathologies, 0.849 to 0.98 for labral tears, 0.93 to 1.0 for instability, 0.839 for subacromial impingement, and not reported for Hill-Sachs. The prediction accuracy ranged from 56.5% to 100% for RCTs, 80.0% to 100% for fractures, 67% to 90% for multiple pathologies, 75.9% to 96% for labral tears, and 82.25% to 98.43% for Hill-Sachs. Of these studies, 4 of them compared AI to humans. In one study, AI demonstrated superior performance compared to orthopedists, while the remaining 3 studies indicated either comparable or superior performance to humans, depending on level of expertise.

Conclusions: Currently, AI models are being used to detect various shoulder pathologies via image analysis. AI demonstrates good to excellent performance for detecting shoulder pathology, and performs best for RCTs and fractures. Further, our review highlights that AI models can perform comparably to humans in detecting shoulder pathology. Collectively, this highlights the diagnostic utility of AI in the clinical setting. Future studies are required to classify pathologies based on already existing, standardized grading systems.

Assessment of the Collaborative Management of Concussions Led by Team Physiotherapists: A Prospective Cohort Study

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Context: In Québec, since 2020, the Order of physiotherapy and the Medical college allow physiotherapists to play an extended role in the detection and management of concussions.

Objective: To analyze the efficiency and safety of collaborative concussions management led by team physiotherapists in a varsity sport program.

Methodology: This is a 1-year observational prospective cohort study of a university-based sport program. Participants were student athletes and the physiotherapists associated with each team. The main outcome measures were the efficiency and safety of concussion management by physiotherapists. Efficiency was assessed by the percentage of autonomous detection and return-to-play decisions made by physiotherapists compared with repeated medical assessments for diagnosis and return-to-play, respectively. Safety was evaluated based on: (1) accurately identifying red flags during the initial assessment, (2) subsequent management according to the protocol, (3) the incidence of early recurrences, and (4) the appropriate documentation of decisions and evaluations.

Results: During the fall and winter university sessions of 2022 to 2023, 12 concussions were identified. Physiotherapists independently made 92% of initial diagnoses and 82% of return-to-play decisions. Among the concussed athletes, 58.3% exhibited neck tenderness, which the physiotherapists did not consider indicative of a medical emergency due to a reassuring cervical assessment. None of these patients were later found to have a severe cervical injury, and no other red flags were present at the initial evaluation. At the return-to-play visit, 64% of athlete files documented a normal neurological and cervical examination. Only one recurrence of concussion occurred on day 89 after clearance.

Discussion: Based on a limited sample, the findings suggest that team physiotherapists can efficiently and safely manage the majority of concussions. Their evaluations are deemed safe, with no overlooked complications and no early recurrence of concussion. The results suggest that, for protocols involving physiotherapists, the consideration of the red flag "neck tenderness" should be reviewed with consideration for the scope of practice of physiotherapist that allows them to screen for more severe C-spine injuries using existing clinical decision rules. The study underscores the importance of documenting neurological and cervical examinations in the return-to-play evaluation for medico-legal purposes.

The Association Between Age and Symptom Reports, Cervical Spine, Vestibulo-Ocular Reflex, Dynamic Balance and Divided Attention Outcomes in Uninjured Adolescent Ice Hockey Players

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Objective: To evaluate the association between age and preseason clinical measures of SCAT5 symptom reports, cervical spine, vestibulo-ocular reflex (VOR), dynamic balance, and divided attention among adolescent ice hockey players who completed measures over multiple seasons of play.

Study Design: Prospective cohort study (2013-2018; "Safe2Play").

Subjects: Ice hockey players (aged 10-17 year old) who completed clinical measures over a minimum of 2 seasons of play (maximum of 5) and who did not have a concussion within 60 days of testing.

Outcome Measures: Separate mixed effects linear or logistic regression was used to examine the association of age on SCAT3/5 [symptom severity score, worse symptoms with physical/mental activity, orientation score, immediate memory score, digits reversed, correct months reversed, modified balance error scoring system (mBESS) (double/single/tandem)], numeric pain rating scale (neck pain, headache, dizziness), range of motion (ROM), cervical flexor endurance (CFE), cervical flexion rotation test (CFRT), anterolateral cervical spine strength (strength), head perturbation test (HPT), Functional Gait Assessment (FGA), Walking While Talking Test (WWTT), head thrust test (HTT), computerized Dynamic Visual Acuity testing (compDVA; 85 and 120°/second), perception time, and clinical DVA. An alpha level of 0.05 was used for all models.

Main Results: The number of observations in each outcome varied from 2598 (symptom severity) to 796 (digits reversed). Age was significantly associated with increasing values of orientation score, immediate score, digits reversed, correct months reversed, baseline neck pain rating, positive CFRT, strength, HPT, and FGA scores ($P < 0.05$). Significantly lower values were seen with increasing age for: symptoms worse with physical activity, number of errors mBESS, CFE, WWTT, compDVA 85/120 scores, and clinical DVA ($P < 0.05$). No association was noted between age and symptom severity, symptoms with mental activity, delayed recall, headache pain, dizziness, cervical ROM, perception time and HTT.

Conclusions: Several associations between age and clinical outcomes were noted for adolescent ice hockey players who completed measures over multiple seasons of play. This suggests that developmental and/or maturation changes should be taken into consideration when interpreting these tests in this population.

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The Effect of Bye-Weeks on Injury Event Rates in the Canadian Football League

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Objective: To determine the effect of bye-weeks on injury rate in the Canadian Football League (CFL).

Study Design: Historical cohort study.

Subjects: CFL athletes between 2011 and 2018.

Intervention: CFL pseudo-random assignment of bye-weeks each season (2011-2014: 1; 2014-2017: 2; 2018: 3).

Outcome Measures: Game injury incident rate ratio (IRR) in the week following a bye-week compared to non-bye-weeks. Sensitivity analyses: IRR for the 2 and 3 weeks following a bye-week. We conducted exploratory analyses for combined game and practice injury events because we did not have the number of players exposed during practice.

Results: The IRR was 0.96 (0.87-1.05), suggesting no meaningful effect of a bye-week on the post-bye-week game injury event rate. We obtained similar results for cumulative game injury events for subsequent weeks: IRR was 1.02 (0.95–1.10) for the 2 weeks following the bye-week, and 1.00 (0.93-1.06) for the 3 weeks following the bye-week. Results were similar with 1, 2 or 3 bye-weeks. However, the combined game and practice injury rate was increased following the bye-week [IRR = 1.14 (1.05–1.23)]. These results are expected if the break period results in medical clearance for pre-existing injuries; increasing pain in these locations following the bye-week would now be considered new injuries instead of "exacerbations."

Conclusions: Bye-weeks do not appear to meaningfully reduce the injury rate. further, there was no injury reduction when adding additional bye-weeks to the schedule.

Keywords: Sport Injuries, Bye Week, Longitudinal design, Football.

Comprehensive Osteoarthritis Management Education and Treatment (comet) Virtual Session: An Evaluation of Patient Satisfaction, Patient Self rated Knowledge and Self-Management of Osteoarthritis (OA)

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Objective: To evaluate the efficacy of the physician led COMET seminar delivered virtually in improving patient reported self-rated knowledge of OA, OA symptoms, and self-efficacy in managing OA.

Design: Prospective program evaluation utilizing patient surveys.

Subjects: Patients between 30 and 85 years, who have been diagnosed with hip and/or knee OA and attended a SEM physician led virtual COMET seminar. (n = 41).

Intervention: COMET session includes information about osteoarthritis natural history, and emphasizes non operative treatment options including exercise, activity modification, weight loss and joint injection options. Participants were asked to complete Hip Disability and Osteoarthritis Outcome Score (HOOS). and/or Knee Injury and Osteoarthritis Outcome Score(KOOS) questionnaires, Arthritis self-efficacy (ASE) questionnaire upon registering for the COMET session and again at 1 month post seminar. COMET patient satisfaction survey was completed within 1 week post seminar.

Outcome measures: HOOS, KOOS, ASE, satisfaction survey.

Results: (n = 41), KOOS (Knee Injury and Osteoarthritis Outcome Score) n = 30 and HOOS (Hip Disability and Osteoarthritis Outcome Score) n = 15).

Statistically significant improvement in the KOOS "Quality of Life" section (Baseline 39.17 ± 16.32 vs 1 month 43.13 ± 19.65, *P* value = 0.024); in the "Sports and Recreation" section in the HOOS (baseline 30.83 ± 22.96 vs 1 month 42.92 ± 25.43, *P* value = 0.017). In ASE, "Pain" section showed statistically significant improvement (baseline 5.43 ± 2.51 vs 1 month 6.31 ± 2.00, *P* value = 0.007) and "Other Symptoms" section showed statistically significant improvement (baseline 6.65 ± 2.25 vs 1 month 7.25 ± 2.07, *P* value = 0.021). Satisfaction survey: At baseline, majority responses (61%) indicated 'a little' or "some" knowledge related to different aspects of OA and post seminar, majority responses (88%) indicated "adequate" or "significant" knowledge.

Conclusions: virtual physician led COMET increased patients' knowledge regarding OA. Patients' knee-related quality of life in KOOS and hip-related sports and recreation function in HOOS also improved. There was improvement in patients' self-efficacy for managing pain and other symptoms such as fatigue in ASE. This study offers quality evidence supporting the effectiveness of COMET.

Are Differences in Anthropometric Measurements, Speed, Strength and Sport-Specific Skills Evident in Young Sub-Elite Soccer Players with Different Skeletal Age?

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Objective: To examine any differences in anthropometric measurements, speed, strength and sport-specific skills of young sub-elite soccer players with different skeletal age in U11 and U12 teams.

Study Design: Cross-sectional study.

Subjects: One hundred three youth soccer players from 6 s division academies that participated in an experimental tournament (age 140 ± 6.8 months, height 150.2 ± 14.2 cm, weight 39.9 ± 12.5 kg, BMI 17.5 ± 3.8 km/m^2).

Intervention: Anthropometric measurements (height, weight, body mass index), maturity status (Khamis-Roche formula), and skeletal age (BAUSport Sonic Bone ultrasound device) were conducted. The physical qualities and sport-specific skill tests consisted of: 5-, 10-, 20- and 30-m sprint, countermovement jump, horizontal jump, agility *t* test, change of direction, and football specific dribbling circuit. All study participants were sub-divided into 4 groups depending on the skeletal age quartile.

Outcome Measures: The outcome measurements were anthropometric measurements data, skeletal age in months, physical qualities and sport-specific skill tests results.

Results: Skeletal age in the study sample ranged from 117 to 175 months (142 ± 12.1 months). Comparison of skeletal age percentile groups showed significant differences in chronological age ($P < 0.001$), height ($P < 0.001$), weight ($P < 0.001$) and BMI ($P = 0.008$). However, participants with the youngest skeletal age did not differ from more mature peers in terms of speed, strength and sport-specific skills ($P < 0.05$). A significant difference was only reported in the horizontal jump between the second and fourth quartile ($P = 0.004$).

Conclusions: A team may consist of young players whose skeletal age significantly differs by more than 30 months. However, compared to more mature players, less mature youth soccer players differ in stature and weight but are equal in speed and strength qualities. Thus, it is likely that the presence of other qualities, namely technical and tactical, contribute to soccer success allowing less mature young players to compete with larger peers and remain within academy systems.

Anterior Cruciate Ligament Injuries on Artificial Turf Versus Natural Grass in Collegiate and Professional American Football Players: A Systematic Review and Meta-Analysis

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Objective: This systematic review and meta-analysis aimed to investigate anterior cruciate ligament (ACL) injury rates among collegiate (NCAA) and professional (NFL) football players playing on artificial turf (AT) versus natural grass (NG).

Data Sources: Four electronic databases (MEDLINE [Ovid], Emcare, Healthstar [Ovid], and the Cochrane Database) were searched for studies comparing ACL injury rates on AT versus NG among collegiate and professional level football players in America. Two authors independently screened the title, abstract, and full texts of eligible studies and the references of these studies. Inclusion and exclusion criteria

were applied to the searched studies, and relevant data were extracted and analyzed.

Main Results: Seven studies were eligible for inclusion, reflecting a total of 1340 ACL injuries from which 641 occurred on artificial turf and 698 on natural grass. For each study, an incidence rate ratio (IRR) and its 95% confidence intervals (CI) were calculated. The overall rate of ACL injuries did not significantly differ between artificial turf and natural grass (pooled IRR = 1.26, 95% CI 0.92–1.72, $P = 0.1189$). However the findings diverged upon analysis by competition level. Among NCAA players, the ACL injury rate was higher on natural grass compared to artificial turf, however this was not statistically significant (pooled IRR = 0.80, 95% CI 0.00–815.57, $P = 0.7503$). Importantly, this conclusion was based on only 2 studies highlighting the need for additional research on NCAA football athletes. In contrast, among NFL players a significantly higher rate of ACL injuries on artificial turf compared to natural grass was observed (pooled IRR = 1.39, 95% CI 1.06–1.82, $P = 0.027$, n = 5 studies).

Conclusions: This review demonstrates an overall non statistically significant difference in the ACL injury rate between artificial turf versus natural grass among collegiate and professional football players. However, due to various limitations of this research, these findings should be interpreted with caution. Future research should focus on exploring variables that influence injury rates on these playing surfaces to advance our understanding and mitigate ACL injury risk in these athletes.

Breaking Bad: A Home-Cooked Solution to Improving Musculoskeletal Injection Education

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Objectives: 1. To determine the current methods used for joint injection education. 2. To determine the feasibility and effectiveness of teaching ultrasound-guided musculoskeletal injections using gel-encased anatomical models. 3. To determine the length of time the gel remains stable at room temperature.

Study Design: Experimental Study.

Subjects: 1. Fifty-one Sport and Exercise Medicine (SEM) physicians in the Greater Toronto Area (GTA); 2. Twenty participants at the fourth annual U of T Sport and Exercise Medicine Conference.

Intervention: SEM physicians were surveyed to assess the context of their first joint injection. Workshop participants practiced their approach to ultrasound-guided injections using gel-encased anatomical models. An ultrasound-capable gel was developed using gelatin, water, and hydrogen peroxide.

Outcome Measures: The proportion of survey respondents who completed their first joint injection on a patient, model or cadaver was calculated. Conference participants completed a post-workshop evaluation rating the session's effectiveness (1-5) and the mean was calculated. The gel was stored at room temperature in sealed and non-sealed containers and monitored for changes.

Results: 78% (39/51) of SEM physicians surveyed responded with 2 noting their first injection was on a model/animal rather than a patient. Overall, 80% (16/20) of participants completed evaluations with a mean rating of 5/5. The gel remained stable when stored in a sealed container at room temperature for 8 weeks without deterioration or mould. The gel dried out and hardened when stored in a non-sealed container, reducing its usefulness for injections.

Conclusions: Gel-encased models appear to be an effective method for teaching musculoskeletal injections under ultrasound guidance with high participant satisfaction. Transparent gel-encased models allow for both direct and ultrasound visualization of the needle tip and needle trajectory, improving spatial awareness during injections. Additionally, the homemade gel remained stable for upwards of 8 weeks making it easy to utilize in a wide range of educational settings. Limitations identified include the accumulation of needle tracks in the gel with repeated use that are visible on ultrasound and the limited ability to inject and/or aspirate during injection practice.

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Sports-Related Nerve Injuries

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Review Abstract

Objective: The high physiologic demands of sport create dynamic stress to joints, soft-tissues, and nerves that can lead to injuries in the athlete. A comprehensive assessment is important for sports-related neuropathies to identify the correct diagnosis, localization, and prognosis in order to guide management. A comprehensive review was performed to provide the sports medicine consultant with a practical approach to workup and management of the most common sports-related peripheral nerve disorders.

Sports-related neuropathies reviewed include the following: Transient traumatic irritation of the brachial plexus and/or cervical nerve roots (ie, "Burners and stingers"), traumatic and compressive suprascapular and axillary neuropathies, ulnar neuropathy at the elbow in throwers, ulnar neuropathy at the hand/wrist in cyclists, multi-ligamentous knee injury, and foot/ankle neuropathies including tarsal tunnel syndrome.

For each disorder, we discuss regional peripheral nerve anatomy with a focus on common sites for injury and entrapment. In addition, sport-specific epidemiology, risk factors and common presentations are reviewed. Recommendations for electrodiagnostic assessment and imaging are discussed, based on current available literature. Multi-modal management of each sports-related neuropathy is outlined, including physical rehabilitation techniques, equipment changes, return to play protocols, image-guided interventions, and surgical options.

Key words: sports medicine, electrodiagnosis, neuromuscular ultrasound, biomechanics, interventional

Use of Supplements and Medications by Athletes at the 2022 Birmingham Commonwealth Games

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Objective: To assess the prevalence of the use of dietary supplements and medications by athletes competing at the 2022 Birmingham Commonwealth Games.

Study Design: Completion of a self-report questionnaire (Substance Declaration Survey) regarding athletes' home nation, sport, and the medications and supplements in their possession at that time.

Subjects: Four hundred two athletes (from 35 nations and representing 23 sports), a subset of those competing at the 2022 Birmingham Commonwealth Games.

Intervention: Athletes attending the Commonwealth Games were approached during the accreditation process following their arrival at the Welcome Centre in the Birmingham National Exhibition Centre (NEC), and in 3 of the "Athlete Village" venues (NEC, Warwick, and Vale) between 21st July and 3rd August. Surveys were stored securely, and anonymised results were stored using Microsoft Excel, and coded for statistical analysis. Supplements reported by 10 or more athletes were grouped into categories based on their presumed function.

Outcome Measures: Prevalence of supplement and medication use among the study population.

Results: Forty-three percent of athletes reported at least 1 supplement and 47% reported at least 1 medication. The most reported supplements included protein products (19%), multivitamins (15%) and electrolyte products (12%). The most used medications were non-steroidal anti-inflammatory (NSAIDs, 26%) and Other Analgesics (24%).

Conclusions: The use of supplements and medications by athletes varies by sport and country. Supplement use does not reflect an understanding of the evidence regarding their efficacy, reflecting the need for further nutritional education.

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