

2023 CASEM Podium Presentations

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Activity and Concussion Management: Examining the Association Between 24-Hour Movement Behaviors and Concussion Outcomes

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Objective: To examine the influence of 24-hour movement behaviors (physical activity [PA], sleep, and sedentary behavior [SB]) on postconcussion symptom burden and length of recovery (LOR).

Study Design: Prospective cohort.

Participants: Youth (aged 10-18 years) sport participants enrolled in the SHRed Concussions Study at the Calgary, Alberta, and Winnipeg, Manitoba sites with a diagnosed concussion.

Intervention: Physician-diagnosed concussed participants were fitted with ActiGraphs (GT3x-waist and GT9x-wrist) to objectively quantify PA (Evenson algorithm) and sleep metrics (Sadeh algorithm) in the acute (1-week) injury recovery phase.

Outcome Measures: Change in symptom score and severity from initial injury to 1-week postconcussion and LOR [time-to-medical clearance (days)].

Results: Low versus high volumes of SB were associated with a shorter LOR [26.00 vs 46.73 days (95% CI, 1.21 – 4.36; HR = 2.30; $P = 0.008$)]. Moderate versus low and high volumes of moderate PA elicited a shorter LOR [25.96 vs 44.71 (95% CI, 0.24-0.86; HR = 0.94; $P = 0.01$) and 39.33 days (95% CI, 0.91-3.51; HR = 1.80; $P = 0.04$), respectively]. High versus low TST elicited a shorter LOR [16.25 vs 41.40 days (95% CI, 0.03-1.63; HR = 0.22; $P = 0.003$)]. No significance was found between LOR and light ($\chi^2 = 0.30$, $P = 0.74$) and vigorous PA ($\chi^2 = 1.70$, $P = 0.18$), or frequency ($\chi^2 = 0.20$, $P = 0.82$) and duration ($\chi^2 = 1.20$, $P = 0.31$) of activity bouts. A higher vs lower number of activity bouts elicited a greater decline in symptom score [-6.09 vs -1.96 (95% CI, -8.01 to 0.24, $P = 0.03$; $d = 0.73$)]. Moderate vs low volumes of moderate PA elicited a greater decline in symptom severity [-23.43 vs -10.38 (95% CI = -23.53 to -0.58); $P = 0.003$; $d = 0.75$].

Conclusions: Daily movement behaviors within the acute phase of concussion recovery is associated with postconcussion symptom burden and LOR. Increasing TST and decreasing SB by breaking up the wakeful day with a higher number of activity bouts and increased MPA seem to elicit a

positive effect on concussion recovery trajectories among concussed youth.

Complex Motor Imagery in Elite Female Ice Hockey Players: Neural Basis Revealed by Magnetoencephalography

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Objective: Complex sports imagery, or visualization, is a well-known sports psychology tool used by athletes to improve performance. We sought to investigate the neurophysiologic effects of visualization, grounded in the concepts of functional equivalence and the PETTLEP (Physical, Environment, Task, Learning, Emotional, Perspective) approach, in a group of elite ice hockey players using magnetoencephalography (MEG).

Study design: Observational study, original research.

Subjects: Eight right-handed elite female ice hockey players who were familiar with visualization for sport performance.

Intervention/observation technique: Athletes visualized a specific PETTLEP-guided 2-on-1 ice hockey play while their neural activity was recorded using MEG. Three minutes of baseline recording was followed by 10 trials of 30 seconds of imagery, alternated with 30 seconds of mental counting. Imagery and control (baseline and counting) conditions were segmented into 1-second epochs and power spectra of the different sets were compared.

Outcome measures: A frequency-domain beamformer was calculated at the frequencies of interest (FOI) for the different conditions and the results were expressed as the relative change in power of control versus imagery. A cluster-based permutation test was subsequently applied to assess significance.

Results: The FOI were determined to be in the beta frequency range from 15 to 21 Hz with a maximum at 18 Hz. At the FOI, prominent desynchronization during the imagery condition was identified in the region of the left intraparietal sulcus, extending to the inferior aspect of the superior parietal lobule and the superior aspect of the inferior parietal lobule ($P < 0.01$). Significant desynchronization was also present during the imagery condition in the left > right precentral and postcentral gyri.

Conclusions: This is the first study to investigate the neural correlates of complex, PETTLEP-guided, ice hockey imagery

in real-time. The results indicate that this type of visualization is predominantly associated with functional activation of dominant hemisphere parietal lobe areas involved in visuospatial processing, somatosensation, and multimodal sensory association, revealing a neuroanatomical basis for how this psychological tool may work to improve athletic performance.

Sex Differences in High School Rugby Players' Head Acceleration Events Based on Instrumented Mouthguard Data

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Objective: To determine head impact biomechanics and location for male and female adolescent club rugby players by sex and player position.

Study Design: Cross-sectional study.

Subjects: Twenty five adolescent club rugby players (9M/16F) fitted with instrumented mouthguards comprised 933 head acceleration events. Eighteen athletes were forwards and 7 were backs.

Outcome Measures: Validated Prevent Biometrics instrumented mouthguards fixed with a triaxial accelerometer and gyroscope measured peak linear acceleration (PLA), peak angular acceleration (PAA), and impact location for every head acceleration event exceeding a 5 g threshold on a single-axis accelerometer. Data were sampled at 3.2 kHz over a 50-minute time frame (10-minute pretrigger and 40-minute post-trigger).

Results: Mann-Whitney *U* tests revealed significant differences between males and females for PLA ($U = 93.0, P < 0.001$), PAA ($U = 122.7, P < 0.001$), and angular acceleration magnitude and duration (AAMxD) over a 50-minute period ($U = 60.7, P < 0.001$), with males demonstrating greater accelerations (median, range: PLA: 9.5 g, 48.4 g; PAA: 768 rad/s²; 7409 rad/s²; AAMxD: 13.4 krad/s², 86.1 krad/s²) compared with females (median, range: PLA: 6.1 g, 46.3 g; PAA: 213 rad/s²; 4653 rad/s²; AAMxD: 7.0 krad/s², 95.6 krad/s²). Mann-Whitney *U* tests also revealed female forwards experience greater AAMxD ($U = 35.26, P < 0.001$) compared with backs (median, range; Forwards: 6.0 krad/s², 43.7 krad/s²; Backs: 6.2 krad/s², 46.3 krad/s²). Impact frequency by location include front (M vs. F: 40% vs 40%), side (15% vs 7%), top (10% vs. 3%), and back impacts (34% vs 50%).

Conclusions: Male rugby players accrue greater in-game PLA and PAA during head acceleration events. Males also exhibit greater AAMxD than females. Female forwards experience higher AAMxD than backs. Although more data and video-verification is needed to verify impact information, preliminary data reveal differences exist in impact magnitude and duration according to sex, and between female player positions with implications for potential injury propensity in rugby players.

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Predictors of Radiographic Osteoarthritis Following Anterior Cruciate Ligament Reconstruction at 5 Years Postoperatively

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Objective: To evaluate the predictive factors of post-traumatic knee osteoarthritis (OA) in the medial, lateral, and patellofemoral compartments at 5 years post-ACL reconstruction.

Study Design: Predictive analysis within a prospective, randomized clinical trial.

Subjects: 330 patients (14-50 years) randomized to ACL reconstruction with a patellar tendon, single-bundle semitendinosus/gracilis tendon, or double-bundle semitendinosus/gracilis tendon autograft (110/group).

Intervention/Observation Technique: Standardized radiographs at baseline, 2 and 5 years were used to assess radiographic OA at 5 years postoperatively. For each knee compartment, individual predictor variables with $P < 0.1$ in a bivariate regression analysis were added to a multivariable logistic regression model. Odds ratios (OR) and 95% confidence intervals (95% CI) were reported.

Outcome Measures: Dependent Outcome Variable: Radiographic OA in each compartment, using the International Knee Documentation Committee scale. An independent, fellowship-trained orthopedic surgeon graded the radiographs for absence (A–Normal, B–Nearly Normal) or presence (C–Abnormal, D–Severely Abnormal) of OA.

Independent Predictor Variables: age, sex, knee alignment, Lachman, pivot shift, meniscal treatment and chondral condition at surgery, graft type, graft failure, reinjury, and secondary surgery.

Results: Grades were available for 302 patients (91.5%) at 5 years. Medial OA was assessed in 35 patients (10.6%). Meniscectomy (OR, 5.8; 95% CI, 2.7-12.6; $P < 0.01$) and varus knee alignment (OR, 2.4; 95% CI, 1.1-5.1; $P = 0.03$) significantly predicted medial OA.

Lateral OA was assessed in 67 patients (20.3%). Patellar tendon graft (OR, 2.4; 95% CI, 1.2-4.8; $P = 0.02$), meniscectomy (OR, 2.6; 95% CI, 1.3-5.2; $P \leq 0.01$), meniscal repair (OR, 3.3; 95% CI, 1.5-7.4; $P \leq 0.01$), and chondral damage (OR 2.0; 95% CI, 1.0-3.9, $P = 0.04$) significantly predicted lateral OA.

Based on a bivariate analysis with 9 patients (2.7%) with patellofemoral OA, chondral damage (OR, 5.7; 95% CI, 1.5-21.8; $P = 0.01$) was a significant predictor of OA.

Graft failure, traumatic reinjury, and secondary surgery were not predictive of OA.

Conclusions: Varus alignment and medial meniscectomy significantly increase the risk of developing medial OA. Use of a patellar tendon graft, lateral meniscectomy, meniscus repair, and chondral damage significantly increase the risk of developing lateral OA. Graft failure, traumatic re-injury, or secondary surgery were not predictive of radiographic OA in any compartment. Higher proportions of patients

with OA are required to increase confidence in these associations.

High Rates of Bodychecking, Head Contacts, and Suspected Injuries Found in Youth Ringette Through Video Analysis

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Objective: Ringette is a popular team ice sport in Canada, primarily played by females. Bodychecking is prohibited at all levels of play. This study used video analysis to evaluate physical contact (PC), head contact (HC), and suspected injury and concussion incidence rates (IR) in youth ringette.

Study Design: Cross-sectional.

Subjects: Youth ringette players from the 2021 to 2022 season playing in the U16 (ages 14-15) or U19 (ages 16-18) age groups (A or AA levels). Games were filmed from regular season, provincials, and nationals (AA only).

Observation Technique: Game video-recordings were analyzed using Dartfish video-analysis software. Validated criteria were used to assess trunk PC intensity (levels 1-3 = lower-intensity PC, levels 4-5 = higher-intensity bodychecking), HC type (HC1 = direct player-to-player, HC2 = indirect), suspected injury (concussion, non-concussion), and penalty enforcement.

Outcome Measures: Multivariable Poisson regression analyses (adjusted for cluster by team-game, offset by game-minutes) were used to estimate PC, HC, and suspected injury and concussion IRs. Incidence rate ratios (IRR) were used to compare IR across age groups, levels of play, and game types. Proportions of bodychecks and HC1s penalized were reported.

Results: Seventy eight team-games were included (U16 n = 40, U19 n = 38; A n = 30, AA n = 48; regular season n = 30, provincials n = 32, nationals n = 16). The overall bodychecking IR was 17.34/100 team-minutes (95% CI, 14.80-20.33), HC 19.09/100 team-minutes (95% CI, 16.74-21.78), suspected injury 1.53/100 team-minutes (95% CI, 1.13-2.09), and suspected concussion 0.74/100 team-minutes (95% CI, 0.48-1.13). Only 29% (95% CI, 24.97-32.59) of bodychecks

and 7% (95% CI, 4.76-9.70) of HC1s were penalized. No differences were found in bodychecking, HCs, or suspected injury and concussion IRs between age groups or levels of play. Bodychecking IRs were 64% (IRR = 1.64; 95% CI, 1.13-2.39) higher in provincials and 24% (IRR = 1.24; 95% CI, 1.02-1.50) higher in nationals than regular season games. A 31% (IRR = 0.69; 95% CI, 0.49-0.97) lower rate of HCs was reported in national games compared with provincial games. Bodychecking was the most common mechanism for concussion (70%) and nonconcussion injuries (67%), with concussions most often associated with HC2s (62.5%).

Conclusions: Bodychecking and HC1 IRs were high among youth ringette players, despite rules prohibiting them. Future research should target prevention strategies aimed to reduce HC1s and bodychecking to reduce injury and concussion IRs in youth ringette.

Modification of the Tendon Integrity in Midportion Achilles Tendinopathy During and After Alfredson's Eccentric Strengthening Protocol Monitored With Quantitative Ultrasound Imaging

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Objective: The first objective was to assess the responsiveness of quantitative ultrasound imaging (QUI) biomarkers that characterize the biological integrity of the Achilles tendon in adults affected by midportion Achilles tendinopathy treated with eccentric strengthening exercises. The second objective was to determine whether the Achilles tendon integrity change correlates with (1) Achilles tendon pain improvement and (2) adherence to eccentric strengthening exercises.

Study Design: Prospective observational study.

Subjects: Thirty-one adults affected by midportion Achilles tendinopathy diagnosed clinically and confirmed with ultrasound imaging who were symptomatic for more than 6 weeks and less than 2 years.

Intervention/Observation Technique: Participants performed Alfredson's eccentric strengthening protocol for 12 weeks and stopped doing the exercises for another 12 weeks. Ultrasound assessments were performed at week 0, week 12, and week 24 to follow the tendon integrity evolution. In parallel, we created a mobile app that participants used to collect weekly data about their Achilles tendon pain according to the Visual Analog Scale and daily data about their eccentric strengthening exercise adherence.

Outcome Measures: The QUI biomarkers obtained at each of the 3 ultrasound assessments in the longitudinal plane were the thickness, echogenicity, variance, and homogeneity, and in the transverse plane were the thickness, echogenicity, and homogeneity. These biomarkers have been validated by Lalumière et al, 2018 and can precisely differentiate healthy and injured tendons.

Results: Over the 24-week study, the average longitudinal homogeneity decreased from 0.612 to 0.591 ($P = 0.02$), and the average transverse echogenicity increased from 64.5 to 74.1 ($P < 0.0001$), which represent an improvement in the tendon integrity. The other biomarkers also varied in the hypothesized way, but did not reach statistically significant differences. The

Pearson correlation coefficient was low (<0.30) for the longitudinal homogeneity and the transverse echogenicity when compared with the pain improvement or the treatment adherence.

Conclusions: The tendon biological integrity in midportion Achilles tendinopathies seems to improve over time according to our QUI analysis, and the most responsive biomarkers were the longitudinal homogeneity and the transverse echogenicity. A greater pain improvement or treatment adherence did not translate into a superior tendon integrity improvement.

Period Perspectives From Pitch to Podium: Menstrual Cycle Considerations From the Athletes' Perspective

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Objective: To understand concepts that the athlete believes are important regarding their menstrual cycle (MC) while competing.

Study design: Participant-centered qualitative research using semistructured interviews.

Subjects: Canadian female athletes (n = 19) currently competing nationally (52.6%) or internationally (47.4%).

Observation Technique: One-on-one interviews (60 minutes). The interview guide included prompts on MC experiences, awareness/tracking, impact on training and during competition, perceived knowledge, support systems, education, and important considerations.

Outcome Measures: Participants discussed their MC experiences as an athlete and shared perspectives on important MC-related topics for consideration by researchers and health care practitioners. A grounded theory framework was used to identify key concepts.

Results: Participants included athlete representation from 13 sports: 47.4% individual and 52.6% team sports. Key MC considerations identified by participants included (1) the impact of their MC on training and performance, (2) the impact of hormonal contraceptive use on training and performance, (3) the relationship between the MC and injury risk, (4) strategies for MC symptom management, and (5) the importance of team support staff (eg, physiotherapists, physicians, registered dietitians) in playing a positive role toward MC-related supports. Participants acknowledged the necessity to compete irrespective of the cycle phase. The lack of coach support regarding their MC was a common concern, specifically; negative dialogue from male coaches and low coach knowledge. Participants also reported that they did not receive MC education opportunities through their sport pathways.

Conclusions: Many topics identified by athletes as essential are aligned with current MC research directions. Specifically, high-quality objective research should continue to examine relationships between the MC and training, performance, and injury risk. Team support staff can play a key role in advocating for athlete MC health. Sport organizations should implement MC education for athletes and coaches. Athlete education is critical to empower athletes to better understand their own cycles, whereas coach education is imperative to create a more supportive health culture for female sport.

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Shoulder Check: Investigating Shoulder Injury Rates, Types, Severity, Mechanisms, and Risk Factors in Canadian Youth Ice Hockey

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Objective: To describe shoulder-related injury rates, types, severity, mechanisms, and risk factors in youth ice hockey players ages 10 to 17 during games and practices.

Study Design: Secondary analysis, 5-year prospective cohort study.

Subjects: Overall, 4419 individual players (representing 6585 player-seasons; 3806 males; 613 females) participated. During this period, 118 primary shoulder-related game injuries and 12 practice injuries were reported.

Outcome Measures: Injury surveillance data were collected from 2013 to 2018 (including time-loss or medical attention injuries). Measures included preseason baseline questionnaires (demographics and medical history), weekly exposure (individual participation), and injury report forms. Descriptive statistics were calculated, and injury rates with 95% CI were estimated using Poisson regression. An exploratory multivariable mixed effects Poisson regression model (clustering by team and offset by exposure hours) and adjusting for covariates examined risk factors. Injury specific data for females was not described because of low sample size (n = 6 injuries).

Results: The shoulder injury rate was 0.70 injuries/1000 game-hours (95% CI, 0.37-1.33) and 0.07 injuries/1000 practice-hours (95% CI, 0.04-0.12). The most common injury types were fractures (n = 38, 33%) and joint swelling/ligament sprain (n = 36, 29%). Sudden onset injuries associated with contact was the most common mechanism (n = 93, 82%). Most injuries occurred during games (n = 114 vs 10 practice injuries). Regarding severity, two-thirds of game-related injuries (n = 79, 69%) resulted in >8 days of time-loss, and more than one-third (n = 44, 39%) resulted in >28 days of time-loss. An 82% lower rate of shoulder injury

was associated with policy prohibiting bodychecking compared with leagues allowing bodychecking [IRR 0.18 (95% CI, 0.1-0.32)]. A 2-fold higher shoulder injury rate was observed for those who had reported a history of any musculoskeletal injury or concussion in the last 12 months compared with those with no history [2.32 (95% CI, 1.57-3.41)]. Biological sex, level of play, and weight were not associated with shoulder injury rates.

Conclusions: Most shoulder injuries resulted in more than 1 week of time-loss. Risk factors for shoulder injury included participation in a bodychecking league and history of injury in the previous 12 months. Further study of prevention strategies specific to the shoulder may merit further consideration in youth ice hockey.

Behind the Scenes of the Development of the IOC Reds Clinical Assessment Tool: Canadian Cohort

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Objective: To assess a wide array of Relative Energy Deficiency in Sport (REDs) related parameters in Canadian female and male development to elite athletes, which underpins some of the scientific support for the new International Olympic Committee (IOC) Clinical Assessment Tool version 2 (CAT2).

Study design: Cross-sectional assessment.

Subjects: Canadian varsity/collegiate to world-class female and male athletes (n = 101F, 36M; data collection ongoing) competing in Olympic or Paralympic sports.

Intervention/observation technique: Cross-sectional study design.

Outcome measures: Measurements included: (1) an online survey [for example menstrual function, sex drive, sleep, mood, bone stress injuries (BSI, low energy availability in females and males questionnaires)]; (2) resting metabolic rate (RMR) measurements; (3) bone density (BMD) via Dual-energy X-ray Absorptiometry; (4) venous blood samples [for example free triiodothyronine (FT3), sex hormones, lipids]. We created a four-tier REDs severity and/or risk assessment of green, yellow, orange, and red light based on the accumulation of key REDs indicators. Statistical differences were tested using one-way analysis of variance with significance set at $P < 0.05$. Odds ratios (OR) were calculated to determine further REDs severity/risk prevalence for key outcomes.

Results: The new CAT2 categorized this cohort into 37% (38F, 13M), 49% (46F, 21M), 7% (8F, 1M) and 7% (9F, 1M) green, yellow, orange, and red light severity/risk clusters, respectively. Amenorrhea ($P < 0.0001$) and lower prolactin concentrations ($P = 0.002$) were more prevalent among higher severity/risk female groups. Total testosterone (males; $P = 0.042$), free T3 ($P = 0.001$) and RMR ratio ($P = 0.009$) were lower and total ($P < 0.0001$) and LDL ($P = 0.001$) cholesterol higher with increasing REDs severity/risk. Spine ($P < 0.0001$) and femur ($P = 0.009$) Z-scores were lower and prevalence of BSI ($P < 0.0001$) higher with increased severity/risk level in females and males. Amenorrhea was associated with higher incidence of low BMD (OR, 10.13), subclinically

low FT3 (OR, 5.33), and BSI (OR, 5.25). Subclinically low total testosterone (males) was associated with elevated lipids (OR 3.86), low BMD (OR, 2.09), subclinically low FT3 (OR, 2.00), and BSI (OR, 15.88).

Conclusion: Our traffic-light breakdown generally correlated with our clinical interpretation of severity/risk for individual athletes. This novel REDs CAT greatly enhances our ability to screen and stratify severity/risk of REDs for athletes.

Head Impact Exposure and Blood-Brain Barrier Dysfunction in University Football Players

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Objective: To examine the association between repetitive subconcussive impacts, concussion diagnosis, and blood-brain barrier integrity in university football players.

Study Design: Prospective observational study.

Subjects: One hundred thirty-three university male football players aged 18 to 25.

Observation Technique: Head impacts were tracked during 2 seasons of university football using ferroelectric trackers. Athletes with diagnosed concussion, and those sustaining impacts that alerted a sideline impact monitor, underwent dynamic contrast-enhanced MRI (DCE-MRI) to assess blood-brain barrier dysfunction (BBB-D). Subjects had MRI scans within 1 week of injury/alert, and 4 weeks after initial incident. Select athletes were also scanned preseason and postseason. Athletes with diagnosed concussion were tracked with daily symptom surveys based on the SCAT-5 to track symptomatology trends.

Outcome Measures: The primary outcome measures were head impacts and their association with clinically diagnosed concussion. Secondary measures included distribution and extent of BBB pathology 1 week after injury/alert and at 4 weeks.

Results: A total of 3765 impacts were registered from 133 contributing athletes. Most impacts were recorded by the front sensor (24.7%) and in the low-magnitude (15-28 g) category (85.6%).

The sideline impact monitor was alerted 20 times by 12 athletes, 3 of which were diagnosed with a concussion by team medical staff. There was a total of 8 concussions diagnosed in the study period. Average SCAT-5 symptom score after concussion was 23.6. Concussed athletes in the 2022 cohort (n = 6) had more high-magnitude impacts (1.3 vs 0.1, $P = 0.046$) and frontal impacts (14.0 vs 7.8, $P = 0.047$) compared with all other players (n = 55). Twenty-one athletes underwent DCE-MRI preseason (n = 11), postseason (n = 5), and after injury (n = 3). BBB-D% did not significantly vary between DCE-MRI subgroups.

Conclusions: This work highlights the use of a multifaceted approach to manage and study concussion microvascular pathology and symptomatology. High magnitude and frontal impacts were over-represented in concussed athletes. Ongoing work with this cohort will investigate spatial associations of BBB-D and measured impacts, and correlate BBB-D with concussion symptomatology.

Examining the Effect of Salbutamol Use in Ozone Air Pollution by People With Asthma And/or Exercise-Induced Bronchoconstriction (EIB)

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Objective: To determine whether using salbutamol increases airway inflammation in people with asthma and/or EIB while exercising in ozone air pollution.

Study Design: Experimental double-blind, randomized, placebo-controlled crossover design.

Subjects: Eight subjects (6 females, 2 males) diagnosed with EIB using an Eucapnia Voluntary Hyperpnea (EVH) test.

Intervention: Subjects completed 30 minutes of exercise at 60% of peak wattage achieved on a $\dot{V}O_2$ max test in 4 conditions each separated by a 48-hour washout period. The 4 conditions were: (1) ozone plus salbutamol; (2) room air plus salbutamol; (3) ozone plus placebo medication; and (4) room air plus placebo medication. Subjects were randomized to 1 of 4 exposure orders following a Latin square design: ABCD, BDAC, CADB, DCBA.

Outcome Measures: The outcome measures included spirometry (FVC, FEV₁, and FEF₂₅₋₇₅), fraction of exhaled nitric oxide (FeNO), and symptoms (dyspnea, cough, sore throat, headache, chest pain, and chest tightness). Spirometry, FeNO, and symptoms were measured before, immediately after, 30 minutes after and 1 hour after exercise. Measurements between the 4 conditions were compared using percent change from preexercise to postexercise. In addition, graded FVC maneuvers were measured to generate maximal expiratory flow volume (MEFV) curves before and immediately after exercise. Inspiratory capacity maneuvers were measured before, 5 minutes into, and 25 minutes into exercise so tidal volume loops could be plotted under the MEFV curves to assess for expiratory flow limitation.

Results: There was a statistically significant difference between the salbutamol and placebo medication groups for FEV₁ and FEF₂₅₋₇₅, where a smaller decrease in these spirometry measures after exercise was observed with salbutamol use. No differences were observed between ozone and room air exposures. Despite seeing a large variation in response for FeNO, there was no significant differences between experimental conditions. Expiratory flow limitation during exercise was not evident in any of the 4 conditions.

Conclusion: We found that, in the acute setting, salbutamol improved pulmonary function in individuals with asthma and/or EIB when exercising in ozone and did not increase pulmonary inflammation as indicated by FeNO.

Sleep Disturbance and Injury Risk in NCAA and NAIA Collegiate Soccer and Basketball Players

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Objectives: (1) To assess sleep disturbance, characterized by sleep difficulty, sleep inadequacy, poor sleep quality, and evening sleep chronotype in collegiate soccer and basketball players. (2) To examine the association between sleep metrics and injury risk in players.

Study Design: Cross-sectional.

Subjects: One hundred twenty-seven collegiate soccer and basketball players [48.8% female; mean age (SD) of 20.1 (1.6) years].

Observation Technique: Using a mobile app, we administered questionnaires to players during the preseason (2020/2021) to collect demographic, injury history, medical history, and sleep (Athlete Sleep Screening Questionnaire; ASSQ) information. Sleep disturbance was determined based on the sleep difficulty score (SDS) of ≥ 5 based on 5 items addressing sleep quantity, sleep quality, sleep latency, sleep disruption during the middle of the night, and use of sleep medications. Additional sleep metrics including inadequate sleep, defined as < 7 hours, were derived from the ASSQ.

Outcome Measures: The study outcome measure was all-complaint knee and ankle injury prevalence through the competitive season. Knee and ankle injuries were collected postseason using a modified version of a previously validated Oslo Sports Trauma Research Center-Patella Tendinopathy Questionnaire through self-report. Specific sleep metrics were analyzed using descriptive statistics and sleep-injury relationships were analyzed using multivariable logistic regression models.

Results: Overall, 21% (95% CI, 11%-33%) of players had sleep difficulty; 33% (95% CI, 25%-42%) had sleep inadequacy; 9% (95% CI, 4%-16%) had poor sleep quality, and 9% (95% CI, 5%-16%) had "eveningness" sleep chronotype. Players with inadequate sleep quantity had significantly higher odds for knee and ankle injury risk (OR, 5.9; 95% CI, 9.7-20.5; $P = 0.005$). No association (OR, 1.6; 95% CI, 0.3-8.8; $P = 0.607$) was found between sleep quality and injury.

Conclusions: One in 5 players reported a sleep difficulty problem and 1 in 3 players reported a sleep inadequacy problem. Sleep quantity and not quality predicted injury risk. These findings suggest a substantial sleep problem in collegiate soccer and basketball players and warrants that players are regularly screened, and timely interventions applied.

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