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Incidence of Injuries in Canadian High School Rugby: A Pilot Study

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Introduction: Rugby is a popular international sport with approximately 3.2 million players registered with World Rugby. In Canada, rugby has a history dating back to 1850.

Rationale: Despite an increase of student participation in high school rugby in Canada, there are few studies describing injury rates in Canadian youth rugby. Furthermore, there are limited data on female rugby players. Therefore, the objective of this study was to describe the incidence of injuries in male and female rugby players participating in high school leagues in Calgary, Alberta.

Methods: During the 2018 high school rugby season, 15 teams (8 male, 7 female) from 6 schools were recruited to participate in a cohort study using a previously validated injury surveillance methodology. Consenting participants completed a preseason medical questionnaire and participation in practice and game sessions was recorded throughout the season by a team designate. Details regarding injuries that required medical attention, resulted in the inability to complete the session of activity, and/or led to the inability to do sporting activity for one day were collected using an injury report form validated by a certified athletic therapist. Match-related incidence rates (IR) with 95% confidence intervals (CIs) were estimated based on Poisson regression adjusted for cluster by team and offset by player match exposure hours (player-hours).

Results: There were 52 match injuries reported in 225 male rugby players [IR: 58.2 (95% CI: 35.4 to 95.9 per 1,000 player-hours)] and 71 match injuries reported in 214 female rugby players [IR: 100.3 (95% CI: 74.0 to 136.1) per 1,000 player-hours] throughout the season. The most common injury locations in matches were the head [IR: 23.5 (95% CI: 13.5 to 41.0 per 1,000 player-hours)], ankle [IR: 3.4 (95% CI: 1.3 to 8.9 per 1,000 player-hours)], and shoulder [IR: 5.6 (95% CI: 2.6 to 12.1 per 1,000 player-hours)] for males and the head [IR: 52.3 (95% CI: 34.2 to 79.8 per 1,000 player-hours)], ankle [IR: 11.3 (95% CI: 5.8 to 22.1 per 1,000 player-hours)], and knee [IR: 11.3 (95% CI: 5.5 to 23.2 per 1,000 player-hours)] for females.

Discussion: This study addresses a gap in the literature regarding the high injury rates in female rugby players. Injury rates in male Canadian high school rugby players were within the range of previously reported rates of amateur males in other countries.

Importance: Understanding the risk of injury can help inform and evaluate prevention strategies to help reduce injuries in rugby.

An Exploration of Concussion Assessment and Management Knowledge in a Sample of Athletic Therapy Students

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Introduction: Recent research has found substantial gaps in knowledge surrounding concussion diagnosis and management in various groups of Canadian health care professionals, including undergraduate medical students (Burke et al., 2012), physiotherapists (Yorke et al., 2016), chiropractic students (Kazemi et al., 2016), and family medicine physicians (Lebrun et al., 2013). Because many complications, both short-term and long-term, can arise from ineffective concussion care, it is imperative for health care practitioners to be familiar with current evidence-based principles of effective concussion assessment and management.

Rationale: The purpose of this project was to explore gaps in concussion knowledge in a sample of athletic therapy (AT) students and to use these findings to design educational tools to engage students in realistic concussion scenarios.

Methods: Forty-three AT students from a single Canadian Athletic Therapists Association-accredited institution participated in a concussion knowledge questionnaire, exploring student knowledge of assessment, management, and the role of ATs in managing concussions. These responses were analyzed for emerging trends, which were then used to design an interview schedule to further deconstruct student concussion knowledge. Three instructors/clinical educators (from the same accredited institution as the students) participated in individual interviews to further discuss trends that emerged from the questionnaire.

Results: Overall, the sample of students scored highly on the theoretical knowledge component of the questionnaire, recognizing signs and symptoms of a concussion,

and understanding potential dangers of multiple concussions. However, inconsistencies emerged from questions about specific concussion management scenarios and the role of an AT in concussion assessment and management. Similar discrepancies were also expressed during individual interviews with instructors/clinical educators. Those interviewed felt that there is often a large gap between theoretical knowledge and practical abilities in AT students and that many have difficulties in assessing for concussions in field settings and/or assisting in the management process. It was thought that students also often do not fully understand the role of the AT within the integrated support team and do not comprehend the proper referral process.

Discussion: The findings of this study identified challenges for AT students in applying their foundational concussion knowledge to practical application.

Importance: With this information, AT educators can design effective educational tools to help bridge the gap between foundational theory and practical competence. More specially, tools can engage students in realistic concussion assessment and management scenarios, allowing for targeted practice of skills required to demonstrate competence in these areas.

Role Conceptualizations of Athletic Therapy Practicum Supervisors

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Introduction: Practicum supervisors (herein supervisors) are central stakeholders in athletic therapy (AT) education. Competency-based education (CBE) will necessitate greater supervisor responsibility, beginning with increased workplace-based assessment. Therefore, optimizing support for these supervisors to effectively educate students is essential.

Rationale: Differentiating how the AT supervisory role is conceptualized may provide Canadian program directors with an understanding of how different supervisors approach their educational role. This understanding could also help to tailor relevant support for supervisors.

Methods: The authors purposively recruited AT supervisors (N = 14) to achieve representation from supervisors with “intermediate” and “advanced” supervisory experience (Stemmans, 2009) across seven Canadian programs. Semi-structured interviews were conducted with supervisors from field and clinical contexts across private practice, high school, and postsecondary environments. The authors used phenomenography (Marton, 1988) as

a qualitative methodology, following thematic analysis of the interviews, to construct a hierarchy illustrating the different conceptualizations of the supervisory role.

Results: The authors organized the different role conceptualizations expressed by AT supervisors into a hierarchy consisting of four levels or categories. Each category possessed distinct characteristics. Role conceptualizations, in ascending order on the hierarchy, centered on: demonstrating and role modeling correct practices and behaviors to students; facilitating an environment conducive for students to benefit from immersion in authentic real-world experiences; challenging the students to “critically think” about their practical experiences; and guiding the student as a developing professional. Each supervisor demonstrated a predominant role conceptualization consistent with one of the four hierarchical levels. However, the authors ordered the hierarchical categories purposefully to represent supervisors’ expression that a predominant role conceptualization and approach to practice would occasionally deviate to a lower hierarchical level if certain challenges presented in day-to-day practice.

Discussion: Each role conceptualization reflected an understanding of how students learn (ie, recognized learning theories). The corresponding learning theories, in ascending order on the hierarchy, were behaviorist, constructivist, cognitivist, and humanist. Humanist principles and the aim to offer students individualized opportunities for cognitive development are consistent with contemporary CBE principles. Therefore, disseminating CBE principles to supervisors and providing them with the appropriate skills, training, and resources to build their capacity to approach supervision with higher-level role conceptualizations are critical for effective implementation of CBE.

Importance: Disseminating these supervisory role conceptualizations may assist AT program directors with providing relevant supervisor support in CBE. Disseminating this hierarchy may also allow supervisors to envision what resources they require to potentially adapt their supervision approach to offer effective student education in CBE.

Feasibility of a Low-Cost Electromyography Unit for Biofeedback Training of the Transverse Abdominus and Pelvic Floor Musculature in an Athletic Therapy Setting

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Introduction: Biofeedback is a critical component to success in interventions that are aimed to reduce or rehabilitate injuries. Evidence suggests that effective biofeedback should be focused on the premise that athletes should focus on external consequences of their actions rather than anatomical positioning. Pelvic floor dysfunctions in nulliparous female athletes has become prevalent in the literature as of late. The inability of the of the pelvic floor muscles to resist increases in intra-abdominal pressure is the primary mechanism of dysfunction. The transverse abdominus (TrA) is one of the key spinal stabilizers. The TrA and pelvic floor have a synergistic relationship, specifically during core muscle strengthening exercises.

Rationale: Pelvic floor neuromuscular training is challenging for the therapist and patient because most experience difficulty activating and isolating these muscles due to their location. Electromyography (EMG) can provide information about muscle recruitment patterns and relative timing of muscle activation. EMG-based feedback can be used to improve muscle recruitment during neuromuscular training. As useful as EMG is, it is rare to have an EMG unit in an athletic therapy clinic due to the cost. Due to the nature of the location of the pelvic floor muscles and the fact that palpation is not suitable in the athletic therapy setting, non-invasive methods to aid with neuromuscular training programs should be investigated.

Methods: Ten healthy women (mean age: 21.6 ± 3.69 years) attended two sessions 5 to 7 days apart. Sessions were randomized between verbal feedback (VF) and verbal and visual feedback (VVF). During each session participants performed three repetitions of five exercises. They performed supine abdominal hollowing (AH), standing AH, seated on unstable surface AH, plank AH, and a double leg drop landing with anticipatory AH. During the VVF session, participants viewed live EMG TrA signals projected on a screen. Muscle activations for the TrA were collected using EMG bilaterally during both sessions. One-way multivariate analysis of variance with Bonferroni post-hoc tests were used to test differences in muscle activation between the sessions. Independent *t* tests compared participant ratings of training sessions.

Results: There was no statistically significant effect of the testing session on muscle activity of the TrA, but the mean muscle activation for each task increased by 25% to 37%. There were significantly different questionnaire responses, where 83% of the responses favored VVF training.

Importance: These preliminary data could highlight a potentially affordable neuromuscular training modality to be used in an athletic therapy setting.

Clarifying Competency Definitions to Help Frame the New CATA Competency Framework and Competencies

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Introduction: The Canadian Athletic Therapists Association (CATA) is approaching the 2020 target for nationally accredited athletic therapy (AT) programs to implement competency-based education (CBE) (Lafave et al., 2016). The CATA Competency Framework and Competencies document is important for guidance of CBE. Data collection is ongoing to revise and renew the CATA Competencies integrating feedback from the CATA membership. A prerequisite to this process was a glossary of definitions guiding the framework development.

Rationale: Overarching roles for a new competency framework have received initial consensus from a panel of athletic therapists with educational expertise (Lafave et al., 2018). These roles align with medical education and physiotherapy and chiropractic education in Canada, facilitating potential interprofessional communication. The new competency framework required a restructuring and update of the competencies to reflect the AT scope of practice at the entry-to-practice level while generating a common competency language to other Canadian health professions. The purpose of this study was to gain consensus on important competency-related definitions that provide a foundation for structuring and organizing the new CATA Competency Framework.

Methods: A scoping review of the literature was completed to amalgamate various definitions to help frame the new CATA competency framework. Definitions were sought for the following terms: competence, competency, competency-based education, milestones, and entrustable professional activities (EPAs). The scoping review results were shared with AT educational experts ($n = 8$) via videoconference and subsequently voted upon for adoption. Consensus for definition adoption was 80% agreement.

Results: Definitions for CBE and National Standards of Practice were approved previously by these educational experts. Definitions for competence, competency, EPA, and milestone were unanimously agreed upon by the expert panel and heavily guided by Englander et al. (2017).

Discussion: Obtaining consensus on a working glossary of definitions was a critical foundational project to facilitate development of the CATA competency framework.

Importance: The competency-related definitions will act as a guide in framework development for the re-

search team, a resource for the CATA membership who will vote and contribute feedback regarding the competencies, and by educational experts who will employ these definitions to guide their curriculum development considering/using the new competencies.

Seasonal Changes in Lumbar Multifidus Muscle Characteristics in College Rugby Players and Their Associations With Low Back Pain and Lower Extremity Injuries

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Introduction: The lumbar multifidus muscle (LMM) plays a critical role in stabilizing the lumbar spine neutral zone. Although smaller LMM was reported to be a strong predictor of lower extremity injuries during the preseason and playing season in professional Australian Football League players, whether similar LMM morphological changes are associated with low back pain (LBP) and lower extremity injuries in rugby players remains unknown.

Rationale: Given the high prevalence of LBP and lower extremity injuries in rugby players, a better understanding of LMM characteristics and implications may provide valuable insight for preseason-screening assessment and more effective and targeted rehabilitation.

Methods: Ultrasound examinations of the LMM were performed in 21 rugby players (12 females, 9 males) from the Concordia University varsity teams during the preseason and at end of the playing competitive season. LMM cross-sectional area (CSA), thickness at rest, and thickness during submaximal contraction (eg, contralateral arm lift) measurements in the prone and standing positions were obtained bilaterally at the L5-S1 level. The percent change in LMM thickness during contraction was calculated as: $[(\text{thickness}_{\text{contracted}} - \text{thickness}_{\text{rest}}) / \text{thickness}_{\text{rest}} \times 100]$. Self-reported questionnaires were used to acquire data on LBP and lower extremity injuries.

Results: There was no significant change in LMM CSA, side-to-side CSA asymmetry, or the thickness at rest and during contraction (in the prone or standing position) between the preseason and end season measurements. A significant decrease in the percent thickness change during contraction (prone position) occurred during the season (preseason = $16.23\% \pm 7.51\%$; end season = $13.79\% \pm 8.21\%$). Preseason LMM CSA, side-to-side CSA asymmetry, and thickness at rest or during contraction (in the prone or standing position) were not associated with LBP or lower extremity injuries status during the preseason or playing season. How-

ever, a lower percent thickness change in the standing position was significantly associated with having LBP during the preseason ($P = .01$) and playing season ($P = .001$). Similarly, a lower percent thickness change in the standing position was also significantly associated with having had a lower extremity injury during the preseason ($P = .03$).

Discussion: A significant decrease in the ability to voluntarily contract the LMM in the prone position occurred during the season. Furthermore, a lower ability to voluntarily contract the LMM in the standing position was associated with having a history of LBP and lower extremity injuries during the preseason and playing season.

Importance: This study is the first to provide preliminary evidence of an association between the voluntary dynamic stabilization role of the LMM in standing with LBP and lower extremity injuries in athletes.

Sex Differences in the Fundamental Movement Skills of 5- to 8-Year-Old Children After a 3-Year Intervention

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Introduction: Fundamental movement skills (FMS) such as running, jumping, and balancing are considered the foundation for physical activity and sport participation. Because high school and college-aged females are at greater risk of an anterior cruciate ligament injury compared to males, determining sex differences in FMS may be important. The Champions for Life (C4L) program strives to improve FMS in children aged 5 to 8 years through a 10-week after-school program.

Rationale: Evaluating FMS sex differences at an early age may help identify injury risk factors leading to improved interventions to reduce injury risk. The purpose of this study was to determine if FMS sex differences exist in children enrolled in the C4L program after participation for 3 years.

Methods: Twenty-eight children (12 boys, 16 girls) aged 5 to 8 years were assessed on 8 FMS using the “FMS Tracker tool,” after participating in the C4L program for 3 consecutive years (pretest kindergarten, post-test grade 2). The FMS were airplane balance (APB), single-leg balance (SLB), horizontal jump (HORJ), one-leg hop (OLH), run (RUN), skip (SKIP), underhand catch (UHC), and underhand toss (UHT).

Results: Group differences were determined by independent t tests, with significance reported at $P < .05$. Girls improved in APB: $1.66 \pm 0.98 < 3.20 \pm 1.26$; $t = 3.62$, OLH: $1.40 \pm 0.99 < 3.13 \pm 0.74$, $t = 1.73$, SKIP: $2.25 \pm$

0.93 < 3.25 ± 0.58, $t = 4.14$, UHC: 2.73 ± 0.79 < 3.60 ± 0.63, $t = 3.67$, and UHT: 2.08 ± 0.92 < 3.08 ± 0.92, $t = 3.89$. Girls improved more than boys in: APB: 1.54Δ > 1.42Δ, UHC: 0.87Δ > 0.58Δ, and UHT: 1.00Δ > 0.91Δ. Boys significantly improved in APB: 1.41 ± 1.08 < 2.83 ± 0.94, $t = 3.56$, OLH: 0.92 ± 1.00 < 2.92 ± 0.80, $t = 5.41$, RUN: 2.37 ± 1.21 < 3.55 ± 0.52, $t = 2.55$, SKIP: 1.41 ± 0.90 < 2.83 ± 0.83, $t = 3.96$, and UHT: 2.42 ± 0.79 < 3.33 ± 0.49, $t = 1.82$. Boys improved more than girls in SLB: 0.85Δ > 0.46Δ, HORJ: 0.56Δ > 0.20Δ, OLH: 2.00Δ > 1.73Δ, RUN: 1.18Δ > 0.38Δ, and SKIP: 1.42Δ > 1.00Δ.

Discussion: Boys and girls improved their FMS capabilities after 3 years of participation in the C4L program. Boys had greater improvement in more FMS compared to girls. Boys showed more improvement in locomotor skills and girls improved more at object manipulation. Future interventions should enhance locomotor skills in girls.

Importance: It is beneficial to monitor FMS development to determine important sex differences, improve skill development in girls, and identify possible injury risk factors.

Cardiorespiratory and Muscular Function Testing of a Child With Low-Risk Acute Lymphoblastic Leukemia During the Early Phases of Chemotherapy

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Introduction: In Canada, leukemia is the most prevalent cancer for children from 0 to 14 years old and acute lymphoblastic leukemia (ALL) accounts for more than 75% of the diagnoses. ALL is treated with chemotherapy and has three main phases: induction, consolidation, and maintenance. Chemotherapy has deleterious consequences, notably decreased cardiorespiratory fitness, muscle wasting and weight gain. Anthracyclines, a strong class of drugs, can induce cardiotoxicity in patients and survivors.

Rationale: Most studies have assessed the physical status of children in maintenance chemotherapy. The aim of this case study was to evaluate the cardiorespiratory and muscular fitness of a child undergoing the first 6 months of chemotherapy. The authors hypothesized that the patient's cardiorespiratory fitness would decline between testing sessions as a result of the cumulative dose of chemotherapeutic agents.

Methods: The participant was an 11-year-old girl with low-risk B-cell ALL. She took part in two test-

ing sessions: postinduction (T1) and consolidation 2 (T2) comprising a maximal uptake test (VO₂max) on an ergocycle and questionnaires on physical activity (Habitual Activity Estimation Scale) and quality of life (PedsQL-4.0). Muscular data were audited from the patient's physical therapy file.

Results: The patient's VO₂max increased by 54% from 884.6 mL/min at T1 to 1,366.9 mL/min at T2. Her maximal heart rate increased from 169.4 to 175.0 bpm and her maximal systolic blood pressure increased from 125.9 to 150 mm Hg from T1 to T2. There was an 89% and 123% increase in the left and right knee extensor moment of force, respectively, from T1 to T2. Her body mass index increased by 11% and her lean body mass decreased by 8% from T1 to T2. Her quality of life score improved by 35%. For the physical activity questionnaire, at T2 she reported spending 40% of her awake time being engaged in vigorous activities compared to none at T1.

Discussion: Contrary to our hypothesis, the participant's overall performance improved from T1 to T2. These results may be partly explained by an improvement in her motivation to give true maximal effort at T2 given her improved quality of life and positive response to chemotherapy.

Importance: Despite these improvements, the participant only reached 60% of her predicted VO₂max when considering her age and gender. The consolidation phase of chemotherapy, instead of maintenance, could be appropriate to start individualized cardiovascular and muscular exercises programs for children with ALL.

The Use of a High-Handle Hexagonal Barbell Deadlift for Female Athletes With Low Back Pain

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Introduction: Low back pain (LBP) occurs in approximately 30% of collegiate athletes, with females at a higher risk to experience LBP. Athletic therapists may abstain from using high-risk exercises, such as the conventional deadlift, to prevent reinjury. However, recent studies have indicated that the deadlift may be effective in decreasing pain intensity and increasing activity. A viable alternative to the conventional deadlift is the high-handle hexagonal barbell (HHHB), which was designed for individuals to execute a safer deadlift by moving the load toward the midline of the body.

Rationale: This study aimed to determine if female collegiate athletes with a history of LBP have similar lower body strength compared to their healthy counterparts.

Methods: Twenty-seven female collegiate athletes were recruited from the University of Central Arkansas. Athletes completed the Nordic Questionnaire to identify if they had a history of LBP (LBP group = 10, healthy controls = 17). Athletes with a short-term history (< 3 months) of LBP were excluded. To determine pain levels, athletes completed a visual analogue scale (VAS): before, immediately after, then 24, 48, and 72 hours following a 1-RM deadlift protocol using the HHHB. An independent *t* test was used to identify group differences with 1-RM normalized to bodyweight. An analysis of covariance was used to detect differences in LBP between groups, using the baseline VAS pain scores as a covariate.

Results: There were no significant differences between groups for 1-RM normalized by weight ($\mu_{LBP} = 0.96 \pm 0.22$ kg, $\mu_C = 0.82 \pm 0.14$ kg, $P > .05$). There were no significant between-group differences observed for LBP during the study protocol ($P > .05$, $\eta_p^2 = 0.005$).

Discussion: Female collegiate athletes with a history of LBP have similar lower body strength compared to healthy control athletes. The HHHB deadlift can be used with an athlete who has a history of LBP pain without causing an acute increase in LBP.

Importance: Athletic therapists should consider using the HHHB for strength measurements and rehabilitation purposes when working with female collegiate athletes with a history of LBP.

Submaximal and Maximal Scapular Retraction Activates Similar Regions of the Middle Trapezius: A Pilot Study

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Introduction: The trapezius muscle is the largest and most superficial muscle of the upper back and neck. It is considered to have three differentiated anatomical regions and fiber orientations (upper, middle, lower) due to performing several mechanical actions, including stabilization of the scapula. To allow full range of motion and protect the structures of the glenohumeral joint, the trapezius muscle must continually contract at low intensities. Investigations examining activation of the upper trapezius muscle at low intensities suggest that the loca-

tion of motor unit recruitment is dependent on contraction intensity. Specifically, an inferior shift in activation has been reported as contraction intensity increases.

Rationale: Previous studies have provided insight into the neuromuscular mechanisms employed by the upper trapezius muscle during contractions less than 25% maximal voluntary contraction (MVC). However, it is unknown whether the middle region of the trapezius muscle employs a similar strategy during maximal and submaximal contractions.

Methods: Twelve right-handed male participants (age: 23 ± 2 years) performed isometric scapular retraction in a seated position. High definition surface electromyography was collected from the middle trapezius muscle during three 5-second repetitions of MVC (100%) and submaximal contractions at 30% MVC using a 32 electrode (8 row \times 4 column) grid. Barycenter location (x- and y-coordinate indicating the center of activation of the grid) and root mean square (RMS) of electrode rows (parallel to muscle fiber direction) were compared using paired-samples *t* tests.

Results: No significant difference ($P > .05$) in barycenter location in the y-plane between contraction intensities was revealed. Mean RMS of each row during MVC was significantly higher than the corresponding row during 30% MVC, with alpha levels ranging from $P < .001$ to $P < .001$.

Discussion: Barycenter location appears to be unaffected by contraction intensity, indicating a similar location of motor unit recruitment for each intensity. However, there was a tendency for the barycenter location to shift superiorly during contractions at 30% MVC. The addition of fatiguing contractions may also reveal an inferior or superior shift in the barycenter that is not present in the current study. Not surprisingly, the magnitude of activation produced in the middle trapezius muscle is much greater during MVC than 30% MVC in both the superior and inferior rows.

Importance: Due to the small sample and tendency for the barycenter to shift superiorly during submaximal contraction, future research is needed using a larger sample. Doing so will inform future exercise prescription for the treatment of abnormal or pathological movement of the glenohumeral joint and scapula.

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