

# 2016 CASEM Injury Prevention Poster Presentations

## The Effects of Neuromuscular Exercise Training on Dynamic Balance in Adolescent Females: A Pilot Study

Alison Longo, MSc, CAT(C)\*,† Christine Johnston, CAT(C)\*, Judy Anderson, PhD,\* Jeff Leiter, PhD\*,† Peter MacDonald, MD\*,† and Jason Peeler, PhD, CAT(C)\*,†

*Affiliations: \*University of Manitoba, Winnipeg, MB, Canada; and †Pan Am Clinic Foundation, Winnipeg, MB, Canada.*

**Objective:** To measure the effectiveness of neuromuscular exercise (NME) training on dynamic balance in adolescent females.

**Study Design:** Prospective Cohort Pilot Study.

**Subjects:** Recreationally active adolescent females with no recent trauma to the lower extremity.

**Intervention:** Participants completed a NME program according to previously described methodology. The program consisted of a series of destabilizing perturbations that are applied to the unstable surfaces (rockerboard, rollerboard and rollerboard/platform), with the subject in a unilateral stance. Subjects completed 10 supervised training sessions (2 times a week for 5 consecutive weeks).

**Main Outcome Measures:** The Y-Balance Test (YBT) is an instrumented measure of the level of dynamic postural control of the lower extremity. Maximal reach distance is measured in 3 reach directions: Anterior (A), Posteromedial (PM) and Posterolateral (PL). The average of 3 test trials for each direction and a composite score for each leg was used for data analysis. All measurements were normalized and expressed as a % of the stance limb length.

**Results:** Paired *t* tests were used to assess for differences in the YBT scores between right and left stance leg and between pre-NME and post-NME training. Five females (age  $13.7 \pm 0.5$  years, height  $165.0 \pm 6.5$  cm, BMI  $23.5 \pm 6.9$  kg/m<sup>2</sup>, right leg dominant) participated in the study. Initial scores for the right and left limb reach directions were similar, following the NME training the right leg had greater PM (R:  $110.1\% \pm 4.9\%$ , L:  $105.2\% \pm 4.9\%$ ,  $P = 0.016$ ) and composite scores (R:  $95.4\% \pm 4.0\%$ , L:  $93.7\% \pm 3.6\%$ ,  $P = 0.039$ ) than the left. All post-NME training scores were greater than pre-NME, although no statistical significance was noted the improvements may be clinically relevant.

**Conclusions:** Data suggests that the NME training program can increase performance on dynamic balance tests in adolescent females. These results will be used to conduct a prospective cohort intervention study to measure the effect of the NME program as an ACL-injury prevention program in the at-risk adolescent female population.

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**Key Words:** Y-balance test, ACL injury prevention, perturbation training

## Effects of a Functional Exercise Program on Injury Prevention in Young Male Soccer Players

Müge Bulat, MSc,\* Engin Dinç, MD,† Haris Begovic, PhD,‡ Yunus Z. Arslan, PhD,§ and Bülent Bayraktar, MD, PhD\*

*Affiliations: \*Istanbul University Faculty of Sports Sciences, Istanbul, Turkey; †Istanbul University Istanbul Faculty of Medicine, Istanbul, Turkey; ‡Hong Kong Science Park, Hong Kong, China; and §Istanbul University Faculty of Engineering, Istanbul, Turkey.*

**Objective:** To investigate effectiveness of a 9 weeks functional exercise program on sports injuries in young male soccer players.

**Study Design:** Randomized clinical trial.

**Subjects:** Sixty-six male soccer players 13 to 19 years of age from a Turkish Super League football academy participated in the study.

**Intervention:** Players were randomly selected into an intervention ( $n = 24$ ) and control ( $n = 42$ ) group. Intervention program was composed of 1 hour twice a week sessions in total of 9 weeks with 3 weeks of mobility, 3 weeks of stability, and 3 weeks of integration exercises. Mobility exercises were based on thoracic, shoulder, hip, and ankle mobility with stretching and self muscle releasing with foam rollers. Stability training focused on movement dysfunction with core stability exercises, deep squat, lunge, push up, rotatory stability, and balance exercises based on Functional Movement System correctives. Integration program included final corrections in their adaptations to functionality with neuromuscular, plyometric, and sports specific trainings. Control group resumed usual soccer training.

**Main Outcome Measures:** Functional Movement Screen (FMS) assessment was made in order to determine injury risk, and movement dysfunctions for planning intervention program, and repeated after 9 weeks. Contact and non-contact sports injuries, number of injuries, duration of injury (days), and severity of injury were recorded in a season. Injury severity classification based on days of absence from sports participation; grade 1 (less than 7 days), grade 2 (7-21 days), and grade 3 (more than 21 days).

**Results:** In intervention group, the incidence of noncontact injuries was lower than control group ( $P = 0.042$ ). There was statistically significant difference in duration of injury which was higher in control group ( $P = 0.01$ ). The incidence of grade 3 injury was higher in control group ( $P = 0.02$ ).

**Conclusions:** In this study, 9 weeks functional exercise program showed effectiveness in preventing noncontact injuries. Intervention group had less noncontact injuries, whereas contact injury incidence didn't differ between 2 groups significantly. In control group, injured players lost more days from sports participation, and they had more severe injuries. In young football players, proper corrections with functional training could be beneficial in order to decrease injury risks in noncontact injuries.

## Preventing Ankle Sprain Injuries in Youth Soccer and Basketball: Effectiveness of Neuromuscular Training and Understanding Risk Factors

Oluwatoyosi B. A. Owuoye, PT, PhD,\* Luz M. Palacios-Derflinger, PhD\*,† Carolyn A. Emery, PT, PhD\*,†,‡

*Affiliations: \*Sport Injury Prevention Research Centre, Faculty of Kinesiology; †Alberta Children's Hospital Research Institute, Faculty of Medicine; and ‡Community Health Sciences, Cumming School of Medicine, University of Calgary, AB, Canada.*

**Objectives:** The primary objective of this study was to examine the effectiveness of neuromuscular training (NMT) in reducing the risk of ankle sprain injuries in youth soccer and basketball. The secondary objective included the examination of sex, age, sport, body mass index, and previous LE injury as independent risk factors for ankle sprain injury and as effect modifiers and confounders in the association between NMT and injury risk.

**Study Design:** Secondary analysis of 3 cohort studies and 2 cluster randomized controlled trials (RCT).

**Subjects:** Male and female youth (11-18 years) soccer players ( $n = 2,265$ ) in Alberta, Canada.

**Observation Technique:** A secondary analysis of pooled data from 3 cohort studies and 2 RCTs (study period: 2005-2011) was completed.

**Main Outcome Measures:** Ankle sprain injury was the main outcome and was recorded using a validated prospective injury surveillance system consistent through all the studies. NMT included sport-specific aerobic, strength, agility, and balance components. Multivariable Poisson regression analysis,

controlling for clustering by team, was used to estimate incidence rate ratios (IRR) with 95% confidence intervals (CI), considering confounding for all covariates and effect modification by sex, age and previous injury and evaluating all covariates as potential risk factors.

**Results:** A total of 188 ankle sprains were reported in 171 players. Though not statistically significant, the point estimate suggests that NMT had a protective effect on ankle sprain injury [IRR, 0.69 (95% CI, 0.45-1.05)]. Sex, age and previous LE injury did not modify the effect of NMT on ankle sprain (all  $P > 0.05$ ). Independent risk factors for ankle sprain injury included previous LE injury history [IRR, 1.77 (95% CI, 1.34-2.35)] and participation in basketball versus soccer [IRR, 1.98 (95% CI, 1.30-3.01)].

**Conclusions:** The point estimate in this study suggests a 31% reduction in ankle sprain injury risk with NMT in youth soccer and basketball. Independent risk factors for ankle sprain in youth sport include previous LE injury and basketball participation (vs soccer). Future research should focus on implementation research to identify NMT components most effective for preventing ankle sprain injuries specifically and maximizing adherence and maintenance of NMT programs in youth soccer and basketball.

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### The Relationship Between Body Composition and Injury History in Pre-Professional Ballet and Contemporary Dancers

Sarah J. Kenny, MSc,\*;† Clodagh M. Toomey, PT, PhD\*,† and Carolyn A. Emery, PT, PhD\*,†,‡

*Affiliations:* \*Sport Injury Prevention Research Centre, Faculty of Kinesiology, University of Calgary, Calgary, Alberta, Canada; †Alberta Children's Hospital Research Institute for Child and Maternal Health, Department of Pediatrics, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada; and ‡Department of Community Health Sciences, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada.

**Objective:** To determine the association between injury history and anthropometric measures in pre-professional ballet and contemporary dancers.

**Study Design:** Cross-sectional.

**Subjects:** Convenience sample of 154 dancers registered in full-time pre-professional ballet [ $n = 88$ , 78 females, mean age 14.95 years (95% CI, 14.41-15.39), range 11-19 years] and contemporary training [ $n = 66$ , 64 females, 19.95 years (95% CI, 19.38-20.52), range 17-30 years].

**Observation Technique:** Pre-participation screening was conducted prior to full-time training (September 2015).

**Main Outcome Measures:** Participants reported 1-year history of medical attention or time loss injury (yes/no), age (years) and years of dance training  $\geq 3$  times/wk. Body mass index (BMI; kg/m<sup>2</sup>) and total bone mineral density (BMD; g/cm<sup>2</sup>) were measured via dual-energy x-ray absorptiometry. Categorizations of BMI and total BMD were normalized for age and sex: "underweight" = BMI < fifth percentile for <20 years or <18.5 kg/m<sup>2</sup> for  $\geq 20$  years; "low BMD" = Z-score < -2.0. Descriptive statistics [proportions, means, odds ratios (OR), 95% confidence intervals (95% CI)], Fisher's exact tests, and multivariable regression examined the association between injury history and body composition.

**Results:** Sixty-six participants (43%) reported an injury in the previous year. The mean years of previous dance training was 9.03 years (95% CI, 8.44-9.62). Mean BMI was 20.2 kg/m<sup>2</sup> (95% CI, 19.75-20.65) and mean total BMD was 1.05 g/cm<sup>2</sup> (95% CI, 1.03-1.07). There was no difference in the proportion of previously injured versus uninjured dancers who were underweight (6.1% vs 3.4%;  $X^2 = 0.61$ ,  $P = 0.463$ ) or had low BMD (0% vs 3.4%;

$X^2 = 2.18$ ,  $P = 0.223$ ). Underweight dancers were not more likely to report a previous injury than dancers with healthy BMI (OR, 1.83, 95% CI, 0.29-12.87). Dance style did not modify or confound this association.

**Conclusions:** Injury is common in pre-professional ballet and contemporary dancers. While those with a 1-year history of injury do not differ in anthropometric measures compared to uninjured dancers, further investigation of risk factors contributing to the high risk of injuries reported in dance is needed. Future studies should incorporate prospective injury surveillance and consider associations with changing body composition over one season.

### Neuromuscular Training Programs for ACL Tear Prevention in Young Female Soccer Athletes: A Health Technology Assessment of the Clinical Evidence and Cost-Effectiveness

Duong Nguyen, MD, MSc(c), FRCSC, FAAOS, DipSportsMed (ABOS/CASEM)

*Affiliation:* William Osler Health System, Toronto, ON, Canada.

**Purpose:** To determine if neuromuscular training programs (NTP), compared to routine care, prevent the occurrence of an ACL tear in young female soccer athletes.

**Methods:** A Health technology assessment of the clinical and cost-effectiveness of neuromuscular training programs in an outpatient clinic setting consisting of clinics, schools, and soccer clubs. The target population patients were young female soccer athletes between the ages of 10 and 18. The intervention was a neuromuscular training programs with the control group as routine care. The main outcome measure analyzed was a symptomatic, full thickness, complete ACL tear. The timeframe of analysis was 1 year, or 2 full seasons.

**Results:** Inclusion criteria were randomized controlled trials, systematic reviews, meta-analyses, and economic analyses. Seven systematic reviews, 6 prospective cohorts, and 5 randomized controlled trials were identified for full-text review to assess the methodological quality. Only 1 randomized controlled trial, 1 meta-analysis and 1 economic analysis focused specifically on neuromuscular training versus routine care in preventing ACL tears in the adolescent female subgroup. The optimal age window was before the age of 18 with a 72% risk reduction rate. A universal neuromuscular training program can lead to decreased ACL tears with costs as low as \$1.25 per player to as high as \$25 per player in a season. NTP is effective with a decreased incidence of injury from 3% to 1.1% per season and could save \$275 per athlete in injury-related costs.

**Conclusions:** Neuromuscular training programs are safe, efficacious in the real world, cost-effective, impact the quality of life of patients, and impact government budgets on a minimal basis.

### The Impact of a Neuromuscular Training Injury Prevention Program on Body Composition and Physical Fitness Outcomes in Junior High School Students

Carla A. van den Berg, BSc,\*;† Patricia K. Doyle-Baker, Dr. PH,†,‡ Sarah A. Richmond, PhD\*,§ Brent Hagel, PhD\*,†,¶,|| and Carolyn A. Emery, PT, PhD\*,†,¶,||

*Affiliations:* \*Sport Injury Prevention Research Centre, Sport Medicine Centre, University of Calgary, Calgary; †Faculty of Kinesiology, University of Calgary, Calgary; ‡Faculty of Environmental Design, University of Calgary, Calgary; §Clinical Research Services, Hospital for Sick Children, Toronto; ¶Department of Community Health Sciences, Cumming School of Medicine, University of Calgary, Calgary; and ||Department of Pediatrics, Alberta Children's Hospital Research Institute, Cumming School of Medicine, University of Calgary, Calgary.

**Objective:** To evaluate the impact of a neuromuscular training (NMT) injury prevention program in junior high school physical education classes on body composition and physical fitness outcomes.

**Study Design:** Cluster randomized-controlled trial.

**Subjects:** Students aged 11 to 15 years ( $n = 375$ ) from 4 junior high schools ( $F = 202$ ,  $M = 171$ ).

**Intervention:** The intervention was a teacher delivered NMT warm-up program including aerobic, balance, and strength components. The control program was a teacher-delivered standard of practice warm-up program including aerobic, static, and dynamic stretching components.

**Main Outcome Measures:** Body composition and physical fitness assessments were completed at baseline and following the program. These included height and weight to calculate body mass index (BMI) ( $\text{kg}/\text{m}^2$ ), waist circumference (cm), predicted  $\dot{V}\text{O}_2\text{max}$  [PACER 20-m shuttle run ( $\text{mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ )], vertical jump (VJ) height (cm), and eyes closed foam pad dynamic balance (seconds L and R). A preliminary analysis was conducted on year one data (4 schools) of a 3-year study (12 schools). Mean changes (follow up—baseline) were estimated for both groups for all 5 outcome measures (99% CI), adjusting for age, sex, and clustering by school.

**Results:** There were no differences in mean change between follow-up and baseline for BMI z-score in the intervention [0.02 (99% CI, -0.18 to 0.26)] or control group [0.02 (99% CI, -0.17 to 0.22)]. There were no differences in mean waist circumference change [intervention: 0.4 cm (99% CI, -6.1 to 7.0), control: -0.3 (99% CI, -4.9 to 4.2)]. Mean VJ height increased in the intervention group [2.5 cm (99% CI, 2.3-2.6 cm)] and there was no change in the control group [1.5 cm (99% CI, -4.0 to 7.0)], however the between group difference was not significant. Predicted  $\dot{V}\text{O}_2\text{max}$  scores increased in the intervention group [2.27  $\text{mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$  (99% CI, 0.48-4.05)] and not the control group [1.66  $\text{mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$  (99% CI, -7.62 to 10.9)], however the between group difference was not significant. Right and left foot dynamic balance did not change in either group.

**Conclusions:** Results from year one of this RCT demonstrate that the NMT warm-up program may improve functional lower body strength (VJ height) and aerobic fitness (predicted  $\dot{V}\text{O}_2\text{max}$ ). Future analyses will consider physical activity participation and warm-up program adherence.

### Evaluating the Implementation of a Sport Injury Prevention Program in a School Setting

Sarah A. Richmond,<sup>\*,†</sup> Oluwatoyosi Owoeye,<sup>\*</sup> Alberto Nettel-Aguirre,<sup>\*</sup> Alison Macpherson,<sup>†</sup> Carla van den Berg,<sup>\*</sup> Brent Hagel,<sup>\*</sup> Evert Verhagen,<sup>‡</sup> Caroline Finch,<sup>§</sup> and Carolyn Emery<sup>\*</sup>

*Affiliations:* <sup>\*</sup>University of Calgary Sport Medicine Center, Calgary, AB, Canada; <sup>†</sup>York University, Faculty of Kinesiology and Health Science, Toronto, ON, Canada; <sup>‡</sup>VU Medical Center, Netherlands; and <sup>§</sup>Monash University, Victoria, Australia.

**Objective:** To understand the context within which a neuromuscular training program was implemented in a school setting.

**Study Design:** Qualitative design within a prospective, randomized controlled trial.

**Subjects:** Males and females (grades 7-9) from junior high school physical education classes.

**Intervention:** Students from the intervention schools were randomly chosen to participate in focus groups.

**Main Outcome Measures:** This study proposes 2 frameworks [RE-AIM and the Consolidated Framework for Implementation Research (CFIR)] to evaluate the implementation of a neuromuscular training program (iSPRINT) to reduce sport injury and improve health-related measures in a junior high school population. The 5 dimensions of the RE-AIM and CFIR frameworks will be used.

**Results:** A total of 245/320 students were willing to participate in the program (68% reach). There was a lower risk of injury in intervention schools ( $n = 2$ ) compared to controls ( $n = 2$ ) [RR = 0.52 (95% CI, 0.33-0.81)]. Seventy-six percent of students and 83% of teachers reported positive attitudes towards the program, 60% of students reported they believed the program could reduce the risk of injury, and 74% reported the program could improve fitness. Fourteen percent of the schools approached agreed to participate in the program (adoption). For students, the most frequently reported reason for participating was the belief that the program would reduce injury and increase fitness. Factors related to successful implementation of the

program in schools included clear explanation and demonstration of the program, and barriers included difficulty in executing certain program components. Finally, 88% of teachers reported interest in maintaining the program. Ongoing formative evaluation will be collected via focus groups using CFIR constructs (2015-2016).

**Conclusions:** Teachers were able and keen to continue to use the iSPRINT program. We will provide further discussion on the dimensions of REAIM, and report the specific constructs that facilitated and impeded implementation of the iSPRINT program.

### Barriers and Facilitators of Appropriate Concussion Management Among Parents and Coaches in Youth Ice Hockey

Amanda M. Black, CAT(C), MSc,<sup>\*,‡</sup> Onutobor Omu, BScPT, PhD,<sup>\*</sup> and Carolyn A. Emery, PT, PhD<sup>\*,†,‡</sup>

*Affiliations:* <sup>\*</sup>Sport Injury Prevention Research Centre, Faculty of Kinesiology, University of Calgary, Calgary, AB, Canada; <sup>†</sup>Alberta Children's Hospital Research Institute, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada; and <sup>‡</sup>Hotchkiss Brain Institute, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada.

**Objective:** The objective of this study was to understand the barriers and facilitators associated with coaches removing a player from play and parents taking their child to see a physician following a suspected concussion in youth ice hockey.

**Study Design:** Qualitative research study.

**Subjects:** There were 24 participants interviewed for this study. Participants included 9 male parent-coaches, 3 non-parent coaches, 5 fathers without coaching experience, and 7 mothers of players in Bantam (ages 13-14) across all divisions of play.

**Observation Technique:** One-on-one interviews were conducted with participants at the beginning of the 2015 to 2016 hockey season. Using thematic analysis, key barriers and facilitators to coaches appropriately removing a player from play and parents taking their child to see a physician were identified.

**Main Outcome Measures:** The interview guide included questions that explored: (1) participants' experience with hockey concussion; (2) participants' understanding and beliefs about signs and symptoms, prevention and management of concussion; and (3) beliefs around the need for concussion education in youth ice hockey.

**Results:** Some of the barriers to a coach removing a player from a game included; not having enough time to perform an assessment when their role is to coach and relying on the player to report their symptoms. Having access to medical professionals on the bench, perceiving the mechanism as a "big hit," and association protocols that reinforce the coach's decisions were identified as facilitators to a coach removing a player with a suspected concussion from play. Barriers to physician follow-up included; parents' beliefs that the concussion was not serious, concussion symptoms resolving prior to a physician visit, and physician availability. Facilitators of physician follow-up included; team personnel explaining the importance of physician visits at time of injury and a team protocol that enforces physician-based management.

**Conclusions:** Concussions are a significant burden in youth ice hockey that can have serious health consequences if not identified and managed appropriately. Coaches and parents play a vital role in facilitating identification and appropriate concussion management. Understanding the barriers and facilitators of appropriate concussion management behaviour may assist with developing solutions that can reduce the consequences that can arise due to mismanagement.

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### Effect of Previous Concussion on Sport-Specific Skills in Youth Ice Hockey Players

Paul H. Eliason, MSc,\* Carly D. McKay, PhD,\*† Willem H. Meeuwisse, MD, PhD,\*‡ Brent E. Hagel, PhD,\*§,|| Luc Nadeau, PhD,\*\* and Carolyn A. Emery, PT, PhD\*†,‡

*Affiliations:* \*Sport Injury Prevention Research Center, Faculty of Kinesiology, University of Calgary, Calgary, Alberta, Canada; †Department for Health, University of Bath, Bath, United Kingdom; ‡Hotchkiss Brain Institute, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada; §Alberta Children's Hospital Research Institute, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada; ¶Department of Community Health Sciences, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada; ||Department of Pediatrics, Alberta Children's Hospital Research Institute, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada; and \*\*Department of Physical Education, Faculty of Education, Laval University, Quebec City, Quebec.

**Objective:** To investigate the effect of previous concussion on sport-specific skill performance in youth ice hockey players.

**Study Design:** Cross-sectional.

**Subjects:** In total, 596 participants [525 males and 71 females, ages 11-17, representing elite (upper 30% by division of play) and non-elite (lower 70% by division of play)] were recruited from minor ice hockey teams in Calgary, Alberta over 3 seasons of play (2012-2015).

**Observation Technique:** Players completed a baseline questionnaire including the number, date of occurrence, and length of recovery for any previous concussions.

**Main Outcome Measures:** On-ice skill performance was based on the Hockey Canada Skills Test (HCST) battery, which included forward agility weave, forward and backward speed skate, forward to backward transition agility, and a 6-repeat endurance skate. Testing occurred at arenas in Calgary, Alberta. Multiple linear regression (adjusted for relative age, level of play, position, elite/non-elite play, and previous MSK injury in the last year) accounting for clustering by team was conducted to explore the effect of history of concussion, the number of previous concussions, time since most recent concussion, and severity of most recent concussion on sport-specific skill performance.

**Results:** Previous history of concussion and time since most recent concussion were not associated with any HCST component. Players with 2 or more concussions were found to be faster than those with no history of concussion performing the forward agility weave with the puck. A player's time on the forward agility weave with and without the puck, transition agility without the puck, and backward speed with and without the puck was significantly faster for every additional day of recovery post-concussion.

**Conclusions:** Those with a history of concussion have similar HCST performance scores to those who do not. However, longer post-concussion recovery was associated with better performance. These results provide reference values for HCST component scores, which will allow for the assessment of risk and provide a foundation for injury prevention studies.

**Acknowledgments:** The Sport Injury Prevention Research Centre is one of the International Research Centers for Prevention of Injury and Protection of Athlete Health supported by the International Olympic Committee. We acknowledge the funding from Canadian Institutes of Health Research, Alberta Innovates Health Solutions, Hotchkiss Brain Institute, and Alberta Children's Hospital Foundation. We would like to acknowledge Hockey Canada, Hockey Calgary, and all coaches, players, and parents involved for their time and support in completing this research project.

### Reliability of Child SCAT 3 Scores in Children at Rest and Following Exercise

Jeff Billeck, BPE, CAT(C),\* Mike Ellis, MD,† Jeff Leiter, PhD,‡ Joanne Parsons, PhD, BPT,‡ and Jason Peeler, PhD, CAT(C)§

*Affiliations:* \*University of Winnipeg, Winnipeg, Manitoba, Canada; †Pan-Am Clinic, Winnipeg, Manitoba, Canada; ‡College of Rehabilitation Science,

University of Manitoba, Winnipeg, MB, Canada; and §College of Medicine, University of Manitoba, Winnipeg, MB, Canada.

**Objective:** The main objective of this study was to evaluate the test-retest reliability of the Child Sport Concussion Assessment Tool 3 (Child SCAT 3) in healthy, non-concussed adolescent females. Test-retest reliability of scoring was evaluated in 2 situations: (1) Baseline testing; (2) After aerobic exercise.

**Study Design:** Prospective, Clinical-based Test-Retest Reliability.

**Subjects:** Thirty healthy 9 to 12 year old female athletes.

**Intervention/Observation Technique:** This study consisted of 2 testing sessions. Within each session the Child SCAT 3 was administered once prior to exercise and once after a bout of exercise.

**Main Outcome Measures:** Child SCAT 3 scores were recorded and the reliability of these scores were investigated using the intra-class correlation coefficient, method error, coefficient of variation, as well as the Kappa statistic. The presence of correlations between heart rate recovery values and Child SCAT 3 scores were also investigated.

**Results:** Moderate to good reliability was found for total Child SCAT 3 scores. Individual component scores displayed a wide range of reliability and response stability values. Two positive correlations existed between symptom scores and rates of heart rate recovery after exercise.

**Conclusions:** Overall, the Child SCAT 3 appears to be a moderately reliable assessment tool when used to evaluate uninjured female children at baseline and following exercise. However, further research is required to clarify the exact sources of method error within individual component scores. Future studies could now utilize the data from uninjured children in order to aid in the examination of the validity of the Child SCAT 3 in the assessment of children who have sustained a concussive injury.

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### Multi-Disciplinary Management of Pediatric Sports-Related Concussion: Early Experience of the Pan Am Concussion Program

Michael J. Ellis, MD,\*†,¶,\*\*,††,‡‡ Lesley J. Ritchie, PhD,‡,\*\*, Patrick J. McDonald, MD, MHSc,\*†,¶,\*\*,††,‡‡ Dean Cordingley, MSc,\*\*,‡‡ Karen Reimer, BMR, PT, MSc,§,\*\*,†† Richard Girardin, CAT(C),\*\*,†† Sara Vis,\*\* Erin Selci, BSc,†,†† Peter MacDonald, MD,\*||,\*\*,†† Jeff Leiter, PhD,\*,\*\*,†† and Kelly Russell, PhD†,††,‡‡

*Affiliations:* Departments of \*Surgery; †Pediatrics and Child Health; ‡Clinical Health Psychology; §Rehabilitation Sciences; ¶Section of Neurosurgery and ||Orthopedics, University of Manitoba; \*\*Pan Am Concussion Program; ††Childrens Hospital Research Institute of Manitoba; and ‡‡Canada North Concussion Network, Winnipeg, Manitoba, Canada.

**Objectives:** To summarize the clinical characteristics and outcomes of pediatric sports-related concussion (SRC) patients who were evaluated and managed at a multi-disciplinary pediatric concussion program and examine the healthcare resources and personnel required to meet the needs of this patient population.

**Study Design:** Retrospective cohort study.

**Subjects:** Six hundred four patients, including 423 pediatric SRC patients were evaluated at a multi-disciplinary pediatric concussion program.

**Main Outcome Measures:** Initial assessment and diagnosis were carried out by a single neurosurgeon. Return-to-Play decision-making was carried out by the multi-disciplinary team. SRC diagnosis and recovery were defined according to the 2013 Zurich Consensus Guidelines. PCS was defined according to the International Classification of Diseases-10 as 3 of more concussion symptoms for at least 1 month (30 days). Primary outcomes included demographic and injury data, healthcare resources and personnel utilized by this cohort, and patient outcomes including duration of symptoms.

**Results:** The mean age of study patients was 14.30 years (SD 2.32, range, 7-19 years) and 252 (59.57%) were males. Hockey (182; 43.03%) and soccer

(60; 14.18%) were the most commonly played sports at the time of injury. Overall, 294 (69.50%) of SRC patients met the clinical criteria for concussion recovery, while 75 (17.73%) were lost to follow-up, and 53 (12.53%) remained in active treatment at the end of the study period. The median duration of symptoms among the 261 acute SRC patients with complete follow-up was 23 days (IQR, 15-36). Overall, 25.30% of pediatric SRC patients underwent at least one diagnostic imaging test and 32.62% received referral to another member of our multi-disciplinary clinical team.

**Conclusions:** Comprehensive care of pediatric SRC patients requires access to appropriate diagnostic resources and the multi-disciplinary collaboration of experts with national and provincially-recognized training in TBI.

### Googling Concussion Care: A Critical Appraisal of Online Concussion Healthcare Providers and Practices in Canada

Michael J. Ellis, MD, FRCSC,\*†‡§¶|| Lesley Ritchie, PhD,‡¶|| Erin Selci, BSc,†,|| Stephanie Chu, MSc,†,|| Patrick McDonald, MD, MSc, FRCSC,\*†‡§¶|| and Kelly Russell, PhD†,||

*Affiliations:* Departments of \*Surgery; †Pediatrics and Child Health; ‡Clinical Health Psychology; §Section of Neurosurgery, University of Manitoba; ¶Pan Am Concussion Program; and ||Children Hospital Research Institute of Manitoba, Canada North Concussion Network, Winnipeg, Manitoba, Canada.

**Objective:** To provide a critical appraisal of Canadian concussion healthcare providers that could be identified by patients and parents using online Google internet searches.

**Study Design:** Systematic review of online concussion healthcare providers. **Methods and Outcome Measures:** Independent, blinded, Google Internet searches were conducted for the terms “concussion” and “concussion clinic” and each of the Canadian provinces and territories. The first 10 to 15 concussion healthcare providers per province were identified. A critical appraisal of healthcare personnel and services offered on the provider’s website was conducted.

**Results:** Fifty-eight concussion healthcare providers were identified using this search methodology. Only 40% listed the presence of an on-site medical doctor (M.D.) as a member of the clinical team. Forty-seven percent of concussion healthcare providers advertised access to a concussion clinic, program, or center on their website. Healthcare professionals who offered concussion healthcare services at these sites included: neurosurgeons (5%), neurologists (7%), neuropsychologists (28%), sports medicine physicians (24%), physiotherapists (59%), chiropractors (22%), and osteopaths (9%). Services offered by providers included baseline testing (67%), physiotherapy (50%), and hyperbaric oxygen therapy (2%).

**Conclusions:** This study indicates there are numerous concussion healthcare providers in Canada offering diverse services with clinics operated by professionals with varying levels of training in traumatic brain injury. In some cases, the practices of these concussion clinics do not conform to current expert consensus guidelines.

### Concussions in Senior Canadian Rugby: Incidence, Knowledge, and Attitudes

R. Kyle Martin, MD,\*† Travis J. Hrubeniuk, BKin,\* Christopher D. Witiw, MD,‡ and Jeff Leiter, PhD\*

*Affiliations:* \*Pan Am Clinic, Winnipeg, MB, Canada; †Section of Orthopaedics, Department of Surgery, University of Manitoba, Winnipeg, MB, Canada; and ‡Division of Neurosurgery, University of Toronto, Toronto, ON, Canada.

**Objective:** To ascertain the estimated incidence of concussions among senior Manitoba rugby players and summarize the collective knowledge, and attitudes toward concussions.

**Study Design:** Survey.

**Subjects:** All 464 senior level rugby players registered in the province of Manitoba in 2015.

**Observation Technique:** An anonymous, voluntary survey was administered to all eligible participants, prior to the 2015 season.

**Main Outcome Measures:** Two primary domains were assessed: (1) concussion history from the preceding season which included occurrence, symptomatology and impact on daily activities; (2) knowledge and attitudes towards concussion risks and management.

**Results:** A total of 284 rugby players (171 males and 113 females) responded. Of the respondents who participated in rugby the previous season, 38% (105/277) reported symptoms of a concussion during the prior season. Proportionally more female players reported symptoms when compared with male participants (49% vs 30%, respectively;  $P < 0.05$ ). Headache was the most commonly reported symptom. Within the symptomatic subgroup, 50% were formally diagnosed with a concussion, and 25% missed school and/or work as a direct result of the symptomatic burden. While 94% of participants recognized that it is dangerous to continue playing while symptomatic, 29% endorsed that they would continue. Additionally, 39% felt they were letting others down if they stopped playing due to a concussion, yet only 2% stated that they would feel let down if a teammate stopped playing.

**Conclusions:** A substantial proportion of senior Manitoba rugby players reported experiencing symptoms of a concussion during the preceding season and this had a notable impact on daily activities outside of rugby. Furthermore, it appears that a high number of players recognized the dangers of playing while symptomatic, yet many suggested they would be willing to continue. The observed discord between knowledge and attitudes implicates the potential existence of an underlying culture of “playing injured” in the senior level rugby community. This tendency for players to underreport symptoms may warrant the institution of independent concussion spotters and standardized concussion protocols that mandate removal from play.

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