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Knee confidence in youth and young adults at risk of post-traumatic osteoarthritis 3–10 years following intra-articular knee injury

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ABSTRACT

Objectives: To examine differences in knee confidence between individuals with a history of youth sport-related knee injury and uninjured controls.
Design: Historical cohort study.
Methods: Participants include 100 individuals who sustained a youth sport-related intra-articular knee injury 3–10 years previously and 100 age-, sex- and sport-matched uninjured controls. Outcomes included: Knee confidence (Knee Osteoarthritis and Outcome Score); fat mass index (FMI; dual-energy X-ray absorptiometry); and weekly physical activity (modified Godin–Shephard Leisure Time Questionnaire). Mean within-pair differences (95% CI) were calculated for all outcomes. Unadjusted and adjusted (FMI and physical activity) conditional (matched-design) logistic regression (OR 95% CI) examined the association between injury history and knee confidence.
Results: Median age of participants was 22 years (range 15–26) and median age at injury was 16 years (range 9–18). Forty-nine percent (95% CI; 39.0, 59.0) of previously injured participants were bothered by knee confidence, compared to 12% (5.5, 18.5) of uninjured participants. Although there was no between group difference in physical activity, injured participants had higher FMI compared to controls (within-pair difference; (95% CI): 1.05 kg/m^2; (0.53, 1.57)). Logistic regression revealed that injured participants had 5.0 (unadjusted OR; 95% CI; 2.4, 10.2) and 7.5 times (adjusted OR; 95% CI: 2.7, 21.1) greater odds of being bothered by knee confidence than controls.
Conclusions: Knee confidence differs between individuals with a previous youth sport-related knee injury and healthy controls. Knee confidence may be an important consideration for evaluating osteoarthritis risk after knee injury and developing secondary prevention strategies.

1. Introduction

While physical activity (PA) participation and sport are considered essential for healthy adolescent development,[1] injuries sustained during these activities can have serious long-term consequences, including the development of post-traumatic osteoarthritis (PTOA).[2,3] PTOA is a sub-type of osteoarthritis (OA). It is a chronic disabling disease characterized by pain, joint stiffness, and mobility limitations. Meta-analyses indicate that the relative risk of developing PTOA within 10 years of a significant knee injury is 3.9 (95% CI; 2.7, 5.6).[4] Unlike idiopathic OA, which is associated with older age, PTOA onset occurs in middle-aged adults when the impact of the disease on quality-of-life and work productivity can be devastating and costly at both individual and societal levels. Representing 12% of the overall OA incidence, the aggregate annual financial affliction of PTOA in the United States is estimated at $3.06 billion.[5] Given this enormous burden associated with PTOA, it is imperative to investigate and understand potentially modifiable risk or protective factors that could influence the long-term consequences of knee injury in high-risk PTOA populations in order to

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develop strategies aimed at delaying or preventing progression to PTOA.

Knee confidence is one such modifiable factor that has been previously examined in individuals with OA and those at increased risk of OA. These studies have reported that up to 99% of individuals with knee OA are bothered by knee confidence.[6–8] Further, low knee confidence in individuals with knee OA is associated with poorer self-reported outcomes (i.e., increased fear of movement, greater pain on walking, and poorer general health),[9] and reduced physical function (i.e., lower quadriceps strength and increased dynamic valgus–varus joint motion).[8] Accordingly, it has been postulated that a lack of knee confidence may reduce self-efficacy and decrease engagement in various PA behaviours in persons with OA.[6] Therefore, it is possible that lowered knee confidence may have a role in the development, trajectory, and symptomatic severity of PTOA via its influence on PA participation.

In adults (34–56 years) with a history of anterior cruciate ligament (ACL) tear, knee confidence was poorer ($p = 0.01$) in those with symptomatic radiographic OA compared to those without any OA symptoms or radiographic changes.[9] Further in a recent study, 70% of adults 3-years after ACL reconstruction reported being bothered by knee confidence, with lower confidence being related to reduced muscle power and hop performance.[10] We hypothesize that the traumatic injury, which underlies PTOA development that is not necessarily a precursor to other sub-types of OA, may have a unique influence on knee confidence in this sub-group. Additionally, it is possible that knee confidence may act as a psychological barrier in return to sport decisions and impact lifestyle choices that could have long-term implications for PTOA development and symptom management.

To the best of our knowledge the construct of knee confidence has yet to be examined in a prospective fashion in youth and young adults with a history of knee injury in relation to an uninjured comparison group. Knee confidence warrants special examination in this age group for multiple reasons. It is unknown if knee confidence concerns may be a much greater or lesser problem in youth and young adults compared to middle and older aged individuals. Further, if knee confidence is a problem in youth and young adults it may have more significant influences on their choices for sport and PA participation in the longer term, given the importance of adolescence time period in shaping life long health behaviours. If knee confidence is indeed a modifiable treatment target for PTOA it should be addressed at the earliest possible stage before the development of severe joint disease. As well, the influence of PA participation and body composition (factors directly linked with the development of OA) on the relationship between injury history and knee confidence have yet to be examined. Therefore, the purpose of the current study is to examine knee confidence in youth and young adults, aged 15–26 years old, with a history of youth sport-related intra-articular knee injury in comparison to age, sex and sport matched uninjured controls, controlling for the potential confounders of PA and body composition.

2. Methods

This analysis involves the first year data (June 2013–April 2015) from the Alberta Youth Prevention of Early OA (PrE-OA) longitudinal historical cohort study. In this study, 100 youth and young adults who sustained a youth (<18 years) sport-related intra-articular knee injury in the past 3–10 years and 100 age-, sex- and sport-matched (at the time of injury) uninjured controls are being followed annually on a diverse range of outcomes. Recruitment and injury definition have been described in detail previously.[11] Briefly, participants were recruited from three sources: previous studies examining injury risk factors and prevention strategies in youth sport conducted at the University of Calgary; the University of Calgary Sports Medicine Centre database; or through personal distribution of study material by study investigators or participants. Injured participants had a previous history of intra-articular knee injury, defined as a clinical diagnosis of knee ligament, meniscal, or other intra-articular tibio-femoral or patella-femoral injury that required a medical consultation and resulted in missed sport participation. Injury diagnoses were obtained from injury report forms (completed by physiotherapists) or medical records (from physician clinical examination), and confirmed by the participant. At study entry, injured participants were considered 'at high risk of OA' compared to uninjured participants, but were not screened for the presence of PTOA. Uninjured controls reported no previous time loss from sport due to knee injury. Exclusion criteria for all participants included pregnancy, non-steroidal anti-inflammatory use, cortisone injection or a musculoskeletal injury that resulted in time loss (work, school or sport) within the previous 3-months, diagnosis of other arthritides, or any current medical problem that prevented participation in the functional testing aspect of the study. Ethical approval for this study was received from Conjoint Health Research Ethics Board at the University of Calgary (ID# 25075) and the Children's and Women's Health Centre of British Columbia Behavioural Research Ethics Board (H13-00720). All participants provided consent at study entry.

All data were collected in one testing session at the University of Calgary. Participants had their height (cm) and weight (kg) measured, underwent a dual-energy X-ray absorptiometry (DXA) scan, and completed a study questionnaire (demographic details, medical and knee injury history [if applicable]), the Knee Injury and Osteoarthritis Outcomes Score (KOOS)[12], a modified Godin–Shephard Leisure Time Questionnaire (GLTQ).[13]

The KOOS is a validated self-report outcome measure developed to examine knee-related symptoms and function in active individuals with a knee injury or OA.[12] It consists of 42 items in five subscales. Within each subscale, questions are scored on a 5-point Likert scale (not at all, mildly, moderately, severely, or extremely). Subscales are summed and the total transformed into a 0–100 scale, with lower scores indicating worse outcomes. Knee confidence was assessed using question 3 from the KOOS knee related quality-of-life subscale: "How much are you troubled by lack of confidence in your knee?" Responses on the 5-point Likert scale were dichotomized into 'bothered' (mildly, moderately, severely, or extremely) or 'not at all bothered.' This question has been used to quantify knee confidence in numerous previous studies.[6–9]

Self-reported total weekly minutes of PA participation (strenuous, moderate, and mild intensities) was assessed using the modified GLTQ.[13] The GLTQ has been previously validated against accelerometers in an adolescent population.[13] It was decided that total PA best represented the most comprehensive measure of PA, compared to a variable that included only moderate and vigorous PA, therefore minimizing residual confounding by PA in the relationship between injury history and knee confidence.

Body mass index (BMI; kg/m^2) was derived from anthropometric measurements of participants' height (to the nearest 0.1 cm; shoes removed) and body mass (to the nearest 0.1 kg), assessed using a medical scale and stadiometer (Model 402KL, Pelstar, USA). BMI is a well known measure to describe participants' body composition within a sample by giving a crude indication of adiposity. However, it fails to distinguish between fat mass and lean mass, which can be problematic in an athletic population. Given there is a specific link between obesity, defined as excessive fat mass that may impair health,[14] and the development of OA,[15] a more accurate measure of fat, fat mass index, was justified to include in the main analysis.

Fat mass index (FMI; kg/m^2) was calculated from whole body composition scans acquired with a Hologic Discovery A (Hologic,

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