Likelihood of knee replacement surgery up to 15 years after sports injury.

A Victoria-wide study

MUSCULOSKELETAL AUSTRALIA

MONASH University

Project team

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Abbreviations

ACL	Anterior cruciate ligament
AR-DRG	Australian Refined Diagnosis-Related Groups
ARIA	Accessibility/Remoteness Index of Australia
CI	Confidence interval
HR	Hazard ratio
ICD-10-AM	International Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification
IQR	Interquartile range
OA	Osteoarthritis
PAR	Population attributable risk
SEIFA	Socio-Economic Indexes for Areas
VAED	Victorian Admitted Episodes Dataset
VEMD	Victorian Emergency Minimum Dataset

Executive summary

Participation in recreational and competitive sport is fostered from a young age in Australia. Sporting clubs form the heart of many suburban and regional communities, and individual and team-based sporting activities are firmly entrenched in our culture. However, while sports participation has a range of valuable health and social benefits, there is also a considerable risk of joint and soft tissue injury. Previous research has identified a significant increase in sports-related injury rates in Victoria from 2004 to 2010. Of great concern is that the frequency of knee and lower leg injuries rose by 27% over this 7-year period. Given that previous joint injury is a strong predictor of future knee osteoarthritis (OA), this growth in sports injury rates could manifest in increased rates of OA that may require surgical treatment.

While earlier studies provide preliminary evidence that links sports injury to an increased risk of subsequent knee replacement surgery, the full burden on health systems (including the costs of healthcare) is not well understood. This study is the first study to investigate, at the population level, the risk of knee replacement surgery and associated healthcare costs in people who have previously sustained a sports-related knee injury. We established a state-wide population-based cohort through linkage of two key administrative datasets: the Victorian Admitted Episodes dataset (which captures all public and private hospital admissions) and the Victorian Emergency Minimum Dataset (which captures public hospital emergency department presentations). We obtained data on all sports-related injuries between the years 2000 and 2005, where a person aged 18 years and over presented to a Victorian emergency department or was admitted to a Victorian hospital. These data were then individually linked to data on knee replacement surgeries performed from 2000 to 2015 in public and private hospitals, to examine the occurrence of knee replacement surgery up to 15 years after sports injury. The likelihood of knee replacement surgery was compared among different subgroups, with adjustment for specific patient factors. Hospital admission costs for knee replacement surgery were estimated from the perspective of the healthcare system using national hospital costs data.

Over the study period, we identified 64,038 sports injuries (including 7,205 knee injuries) that resulted in emergency department presentation or hospitalisation, as well as 326 knee replacement surgeries within the sports-injured cohort. Knee injuries were predominantly 'soft tissue injuries', such as meniscus tears, ligament injuries, articular cartilage tears, and other knee-related sprains or strains. After adjusting for patient factors, having a knee injury more than doubled the likelihood of having knee replacement surgery within 15 years, compared to all other sports injuries. Among the overall sports-injured cohort, 10.2% of knee replacements were associated with previous knee injury, rising to 13.5% for people aged 40 years or over at the time of their initial knee injury. The direct healthcare costs of knee replacement surgery exceeded $7.9 million for the overall sports-injured cohort.

This study shows that sports-related knee injury is associated with a significantly greater likelihood of knee replacement surgery, at considerable cost to society. An important strength of the study is the inclusion of data from both the public and private hospital systems and emergency presentations, to ensure that the findings are relevant to the broader population. These findings can be used to develop evidence-informed policy recommendations that support injury prevention and health promotion activities. In line with the shift towards preventative healthcare, the overarching goal is to reduce the frequency of knee injuries that could result in OA and ultimately require knee replacement surgery. Targeted interventions are needed to prevent sports-related knee injuries (such as anterior cruciate ligament ruptures and meniscal tears), and to rehabilitate sports-related knee injuries in their early stages. This must include effective implementation of injury prevention programs in sporting clubs and schools, as well as initiatives to raise awareness of knee injuries and their potential consequences at the population level (for example, through social media or mass media campaigns).

Background

Knee OA commonly affects older age groups, although it is increasingly recognised that younger people are also impacted by this condition.[1] Knee OA is associated with pain and other symptoms that can impact profoundly on quality of life in both older and younger people.[2,3] While there is no 'cure' for knee OA, knee replacement surgery is the treatment of choice for severe joint disease where non-surgical management options have been exhausted. Knee replacement surgery can include full replacement of the joint surfaces (this is termed 'total knee replacement') or partial replacement of the joint surfaces (for example, 'unicompartmental knee replacement'). Knee replacement surgery is a cost-effective intervention that can significantly reduce pain and improve function.[4,5] In Australia, over 53,000 primary knee replacement procedures are performed each year,[6] with an estimated lifetime risk of 21% for females and 15% for males.[7] Ninety-eight per cent of primary knee replacement procedures in Australia are performed for a diagnosis of knee OA.[6]

The greatest risk factor predicting the development of knee OA in younger people is previous traumatic knee injury.[8] The majority of knee injuries occur in adolescents and young adults, with subsequent knee OA presenting in young adulthood and middle age. A recent study examining sports injuries in Victoria between 2004 and 2010 reported a significant rise in the number of injuries over the 7-year study period, even after accounting for increasing rates of sports participation.[9] The overall number of sports injuries increased by 37%, while the number of knee and lower leg injuries rose by 27% during this time. Direct hospital costs for the treatment of knee and lower leg injuries exceeded $82 million over the study period, highlighting the substantial burden that sports injuries place on healthcare systems. Given the strong link between injury and accelerated OA development, it is anticipated that rising sports injury rates may lead to a marked increase in future knee OA cases.[9]

It has been suggested that an increase in sports-related injuries may have contributed to rising rates of knee replacement in the United States,[10] although little research has been conducted in this area. To date, only three studies have looked at the risk of knee replacement in relation to previous sports involvement and none have investigated the risk of knee replacement at the broader population level.[11-13] Most recently, a computer simulation model was used to estimate the lifetime risk of knee replacement in the United States after anterior cruciate ligament (ACL) tear in early adulthood.[14] While these studies provide preliminary data indicating that sports injury is associated with an increased risk of knee replacement surgery, the full population burden (including the burden on health systems) remains unclear.

Overview of study methods

The full study methods have been published elsewhere.[15] This section of the report provides an overview of the methods used.

Aim

This study aimed to quantify the burden of knee replacement surgery up to 15 years after sports injury, in terms of the likelihood of knee replacement and the direct healthcare costs of knee replacement.

Study design

A population-based cohort study using data linkage.

Ethics approval

Ethics approval was obtained from The University of Melbourne Human Research Ethics Committee (#1545763). The study was also registered with the Monash University Human Research Ethics Committee (project ID 2888).

Establishment of the cohort

This cohort study was performed through linkage of two key administrative data sources, the Victorian Admitted Episodes Dataset (VAED) and the Victorian Emergency Minimum Dataset (VEMD). The VAED is maintained by the Victorian Department of Health and Human Services and includes all hospital episode data compiled by public and private hospitals, including day procedure units. The VEMD is also maintained by the Victorian Department of Health and Human Services and it captures emergency department presentations to all Victorian public hospitals.

After ethics approval was obtained, a data request application was submitted to the data custodian for access to the required VAED and VEMD data. De-identified data were obtained for people aged 18 years and over who had an emergency department presentation or hospitalisation involving a sports-related injury in a Victorian hospital between 1 June 2000 and 31 December 2005. The hospitalisation data included both public and private hospital admissions. All subsequent hospital admissions coded to an orthopaedic specialty were also obtained for each patient up to 30 June 2015. Within the VAED, sports-related injuries were identified using International Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (ICD-10-AM) activity and injury codes, similar to the methods described previously.[9] Patients with planned follow-up visits to emergency departments were excluded from further analyses, to avoid injury double-counting.

Data linkage procedures

Three linkages were undertaken as part of these analyses. Person-level linkage was undertaken between the VEMD and VAED to identify emergency department presentations that resulted in a hospital admission. Person-level linkage was also undertaken to longitudinally link episodes over time and identify subsequent orthopaedic admissions. To preserve individual patient privacy, the linkages involving person-level data were undertaken by the Victorian Data Linkages team within the Department of Health and Human Services using a stepwise deterministic linkage process based on personal identifiers.[16] The de-identified linked dataset was then provided to the researchers for analysis. The researchers then linked each patient's statistical local area code to available datasets (the Socio-Economic Indexes for Areas (SEIFA) Index of Relative Socio-economic Disadvantage[17]) and the Accessibility/Remoteness Index of Australia[18] (ARIA) in order to classify socio-economic status and residential remoteness.

Key variables of interest

The data variables used for this study included:

- Patient and injury characteristics: age group, sex, insurance type (generated from VAED variables)
- Bodily region of injury (generated from either VAED or VEMD variables)
- Emergency department length of stay in minutes (generated from VEMD variables)
- Hospital length of stay in days (generated from VAED variables)
- Socio-economic status at time of injury(approximated using SEIFA Index quantiles)
- Remoteness (classified using the ARIA Index)
- Knee replacement surgery: comprising hemiarthroplasty, patellofemoral joint replacement, unilateral total knee replacement, or bilateral total knee replacement (identified using VAED procedure codes)

Time to knee replacement surgery was the primary outcome of interest. This was calculated as the number of days between the sports injury admission date and the knee replacement admission date. Where patients had multiple knee replacement procedures over the follow-up period, the first knee replacement was used for analysis.

Data analysis

All analyses were performed using Stata version 14.2 (College Station, Texas, USA). Descriptive analysis was used to summarise demographic, sports injury and knee replacement characteristics. Age group, sex, insurance type, socio-economic status, residential remoteness and bodily injury region were treated as categorical variables. Emergency department length of stay, hospital length of stay, time to knee replacement, and cost data were treated as continuous variables. Differences between knee replacement and non-knee replacement groups were tested for statistical significance using chi-square, Fisher's exact or Wilcoxon signed-rank tests.

The population attributable risk (PAR) of knee replacement performed in individuals with knee injury (as compared to other sports injuries) up to 15 years after injury was also calculated. The PAR provides a measure of knee replacement incidence that would be avoided if knee injuries were eliminated among sports-injured patients. A standard formula for PAR was used for these calculations.[19] Separate PAR calculations were also performed according to sex (males and females) and age category (<40 years and ≥40 years).

A Cox proportional hazards model was used to calculate hazard ratios (HRs) and 95% confidence intervals (95%CI) for time to knee replacement admission, with adjustment for patient-level risk factors (for example, age group, sex, patient insurance type). All variables that showed a significant relationship to the outcome in univariate analysis ($p<0.05$) were included in the multivariate proportional hazards model. The largest category was used as the reference group for each variable.

To account for patients who had multiple sport-related injuries over the study period, all analyses were clustered on patient identifier. Patients without a linked knee replacement episode were censored as at the end of the follow-up period (30 June 2015). A HR of greater than 1.00 indicates an increase in the hazard (or likelihood) of knee replacement surgery for that particular group, compared to the reference group. For example, an HR of 1.50 would indicate a 50% increase in the hazard of knee replacement surgery, compared to the reference group (which has a HR of 1.00). A HR less than 1.00 indicates a reduction in the likelihood of knee replacement surgery, compared to the reference group (which has a HR of 1.00). For example, an HR of 0.50 would indicate a 50% reduction in the hazard of knee replacement, compared to the reference group. The HR point estimate is considered statistically significant if the 95%CI does not contain the number '1.00' within its upper and lower limits.

Hospital admission costs were estimated from the perspective of the Australian healthcare system and do not include out-of-pocket costs borne by patients and their families. For the costs analysis, Australian refined diagnosis-related groups codes (AR-DRG) were extracted from the VAED data for each surgical episode. The relevant AR-DRG cost weights in public and private hospitals were obtained from the most recent version of the National Hospital Cost Data Collection (Round 18, 2012-13 and Round 13 was used for AR-DRG code I04Z, which was replaced with AR-DRG codes I04A and I04B after 2009).[20-22] To obtain a current price for knee replacement procedures, the national efficient price for 2016-2017 was used.[23] All costs are reported in Australian dollars.

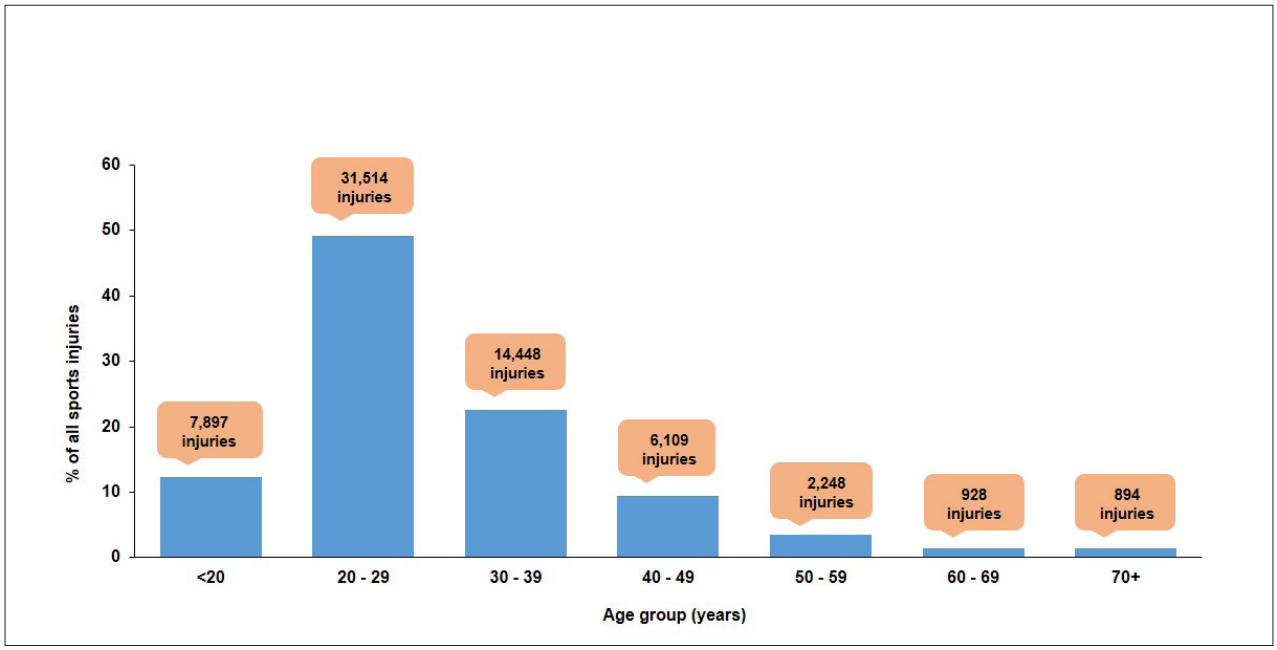
Results

Demographic characteristics

From 2000 to 2005, there were 64,038 sports-related injuries for 57,558 people that resulted in emergency department presentation or hospitalisation. These figures include 7,205 knee injuries for 6,591 people. Sports injuries were more common among males (representing 78% of all sports injuries) than females. Most sports injuries were sustained by people aged 20-29 years (representing 49% of all sports injuries) and those aged 30-39 years (23% of all sports injuries). People aged less than 20 years represented 12% of all sports injuries, while people aged 50 years and over constituted a relatively small proportion of the sports-injured cohort (Figure 1).

According to the ARIA Index, most of the sports-injured cohort lived in highly accessible (metropolitan) areas (90%), with less than 1% living in remote or very remote areas. However, there was a broad socio-economic distribution, with 13% and 21% of the cohort classified within the 'most disadvantaged' and 'least disadvantaged' SEIFA Index of Relative Socio-economic Disadvantage quantiles, respectively. Sixty-seven per cent of the cohort were classified as public patients at the time of injury admission.

Figure 1. Age at time of sports injury



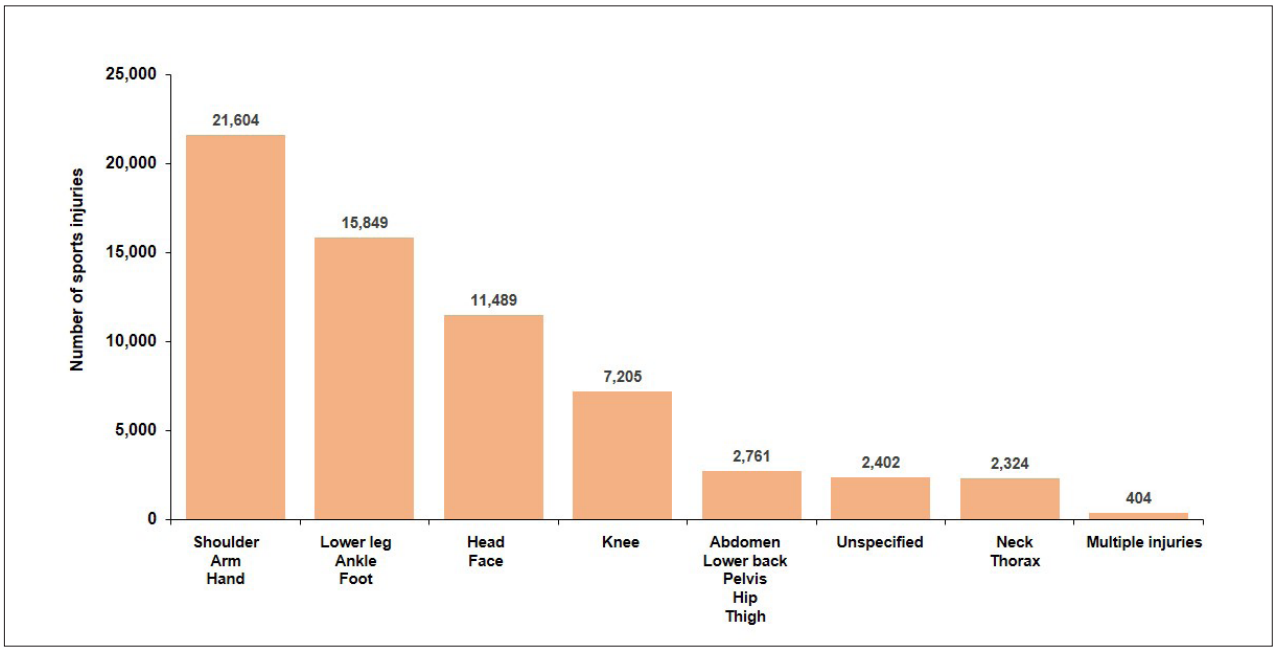
Injury characteristics

As shown in Figure 2, the most commonly injured bodily regions were the shoulder, arm or hand (representing 34% of all sports injury presentations), the lower leg, ankle or foot (25%), the head or face (18%) and the knee (11%). Sports injuries resulted in 28,131 hospital admissions over the study period.

On average, length of stay in the emergency department was brief (median 124 minutes, interquartile range (IQR) 77-192 minutes). For patients who were admitted to hospital, the average length of stay was also short (median 1 day, IQR 1-2 days).

Some differences in demographic and injury characteristics were identified between patients who had subsequent knee replacement and those who did not. Patients who had subsequent knee replacement were more commonly older, female, had sustained a knee injury, and had been hospitalised for their sports injury ($p<0.01$ for each analysis). There was also a greater proportion of privately-insured patients among those who had subsequent knee replacement, compared with those who did not have knee replacement (40% vs 28%, $p<0.01$).

Figure 2. Frequency of sports injuries from 2000 to 2005 by bodily region



Knee replacement surgery characteristics

In total, 326 knee replacement procedures were performed for the sports-injured cohort between the years 2000 and 2015. Of these, 67 procedures were performed for the knee injury group (1.02% of the knee injury group) and 259 were performed for people who had sustained sports injuries affecting other bodily regions (0.51% of the 'other injury group'). The majority of knee replacements were performed for males (58%). Knee replacement surgery was more common among the 50-59, 60-69, and ≥70 year age groups, with each of these age groups representing 29% of all knee replacement procedures. The majority of patients who received knee replacement were privately-insured (65%).

The median hospital length of stay for knee replacement admissions was 5 days for the overall cohort (IQR 4-7 days). For patients who received knee replacement, there were no differences in sex (p=0.43), age group (p=0.28), patient insurance type (p=0.14), hospital length of stay (p=0.05), or primary diagnosis (p=0.47) for the subgroup who sustained a knee injury compared with those who sustained other injuries.

Time to knee replacement surgery

The average time from sports injury to knee replacement admission for the overall cohort was relatively short (median 8.8 years, IQR 5.6-11.2 years). This was comparable to the average time to knee replacement for the knee injury subgroup (median 8.8 years, IQR 4.7-11.2 years) and the other injury subgroup (median 8.8 years, IQR 5.7-11.1 years) (p=0.46).

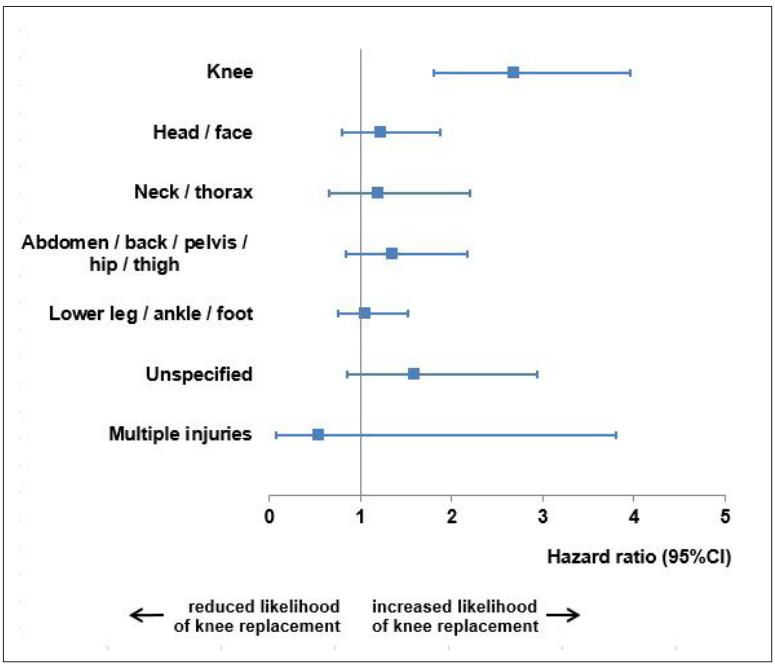
Likelihood of knee replacement surgery

In the univariate analysis, sports-related knee injury was associated with an increased likelihood of having knee replacement surgery (unadjusted HR 1.88; 95% CI 1.37 to 2.58), compared to all other sports injuries (comprising head/face injuries, neck/thorax injuries, shoulder/arm/hand injuries, abdomen/lower back/pelvis/hip/thigh injuries, lower leg/ankle/foot injuries, unspecified injuries and multiple injuries). Multivariate analysis showed that having a knee injury more than doubled the likelihood of subsequent knee replacement (hazard ratio 2.41, 95%CI 1.73 to 3.37), compared to all other sports injuries.

We also examined the likelihood of knee replacement for specific bodily injury regions, using shoulder/arm/hand injuries as the reference category. As shown in Figure 3, knee injury was the only bodily injury region to be associated with a significantly increased hazard of knee replacement in the multivariate model, compared to upper limb injury (representing the most prevalent sports injury category). Having a knee injury more than doubled the hazard of subsequent knee replacement, compared to the reference group. In particular, thigh, hip or pelvis injuries (p=0.21) and lower leg, ankle or foot injuries (p=0.73) were not significantly

associated with knee replacement.

Figure 3. Hazard ratios for time to knee replacement by bodily region



Hazard ratios were derived from multivariate analysis, with upper limb injury as the reference group (HR=1.00)

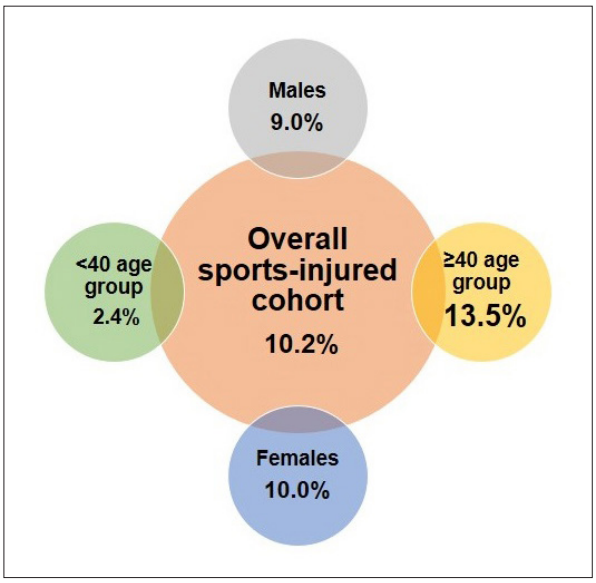
Patients aged 30-39 years, 40-49 years, 50-59 years, 60-69 years and ≥70 years were all significantly more likely to have knee replacement, compared to those aged 20-29 years ($p<0.01$ for each age group). No statistically significant gender differences were evident, with males and females demonstrating a similar likelihood of knee replacement after sports injury ($p=0.05$).

With regard to hospital and insurance factors, presentation to the emergency department only (without hospitalisation) was associated with an increased hazard of knee replacement ($p=0.03$). However, neither patient insurance type (public, private, or other) nor hospital length of stay for the injury admission was associated with an increased hazard of knee replacement ($p=0.79$ for private vs public, $p=0.77$ for other vs public; $p=0.86$ for hospital length of stay).

Population attributable risk

The PAR findings are summarised in Figure 4. Among the total sports-injured cohort, 10.2% of knee replacement procedures from 2000 to 2015 can be attributed to having a previous knee injury within the study period. Among sports-injured females, 10.0% of knee replacements within the 15-year study period can be attributed to having a previous knee injury within the study period. Among sports-injured males, the PAR for knee replacement associated with knee injury was 9.0%. Among people aged ≥40 years at the time of their initial injury, 13.5% of knee replacements can be attributed to having a sports-related knee injury within the study period. Among people aged <40 years at the time of injury, 2.4% of knee replacements can be attributed to knee injury within the study period

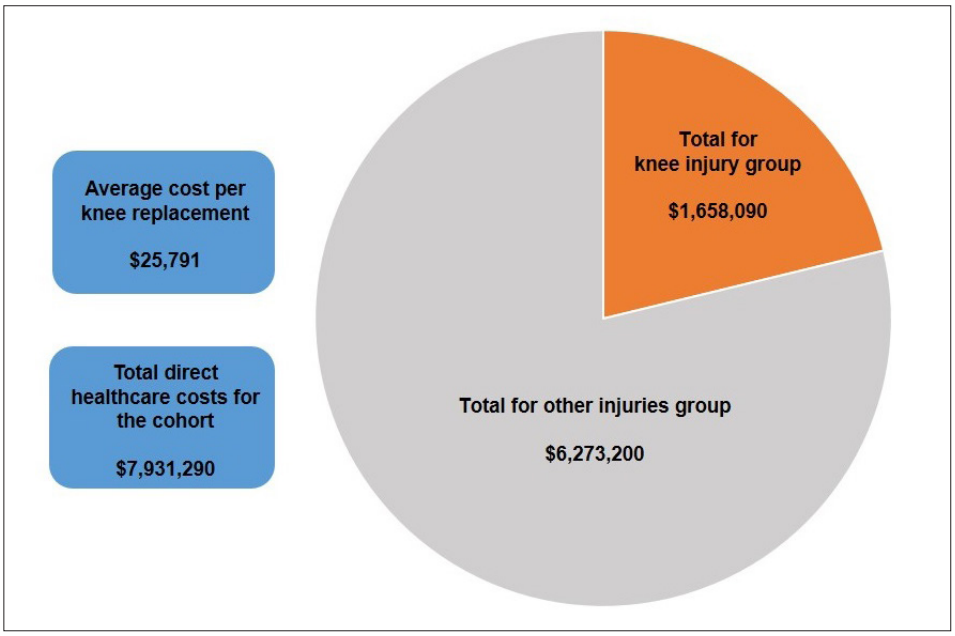
Figure 4. Population attributable risk for the overall cohort and subgroups



Direct healthcare costs for knee replacement following sports injury

The estimated direct healthcare costs for knee replacement surgery are summarised in Figure 5. The median cost of knee replacement was $25,791 per procedure (IQR $22,169-$25,791). The estimated direct healthcare costs for knee replacement specifically for the knee injury subgroup were $1,658,090, representing 21% of knee replacement costs for the overall sports-injured cohort.

Figure 5. Estimated direct healthcare costs for knee replacement surgery



Key findings

- To our knowledge, this study is the first to evaluate the population-level burden of knee replacement in people who have previously sustained a sports-related knee injury
- We identified 7,205 sports-related knee injuries in Victoria between the years 2000 and 2005 that resulted in emergency department presentation or hospitalisation
- After adjusting for patient factors, having a sports-related knee injury more than doubled the likelihood of having knee replacement surgery within 15 years, compared to all other sports injuries
- Among the total sports-injured cohort, 10% of knee replacements performed between 2000 and 2015 could be associated with having a previous knee injury
- Among people aged 40 years or over at the time of initial injury, 13.5% of knee replacements could be associated with having a previous knee injury
- The average time from sports injury to knee replacement admission was relatively short (median 8.8 years) and this is concerning given the young age of many patients at the time of injury
- Almost one-fifth of sport-related injury presentations with subsequent knee replacement involved people who were aged 20-39 years at the time of initial injury
- The direct healthcare costs of knee replacement were estimated to exceed $1.65 million for the knee injury group (representing 21% of knee replacement costs for the overall sports-injured cohort)

Strengths, limitations and future directions

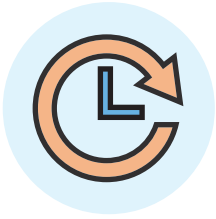
Study strengths

This study included data from both the public and private hospital systems, to ensure that the research findings were relevant to the broader population. This is important given that 57% of Australian adults had private health insurance in 2011-2012, rising from 53% in 2007-2008,[24] and that 70% of knee replacements are performed in the private hospital sector.25 In addition, both emergency department presentation and hospitalisation databases were utilised, in order to capture sports injuries spanning a range of severities. Further, our analyses incorporated total knee replacement and unicompartmental knee replacement procedures (the latter are more commonly performed in younger patients, although their use in Australia is declining over time [6,7]) to ensure that all primary knee replacement procedures were included. Finally, we used a multivariable analysis that clustered for individuals, to ensure that patients who had multiple hospital admissions for the same knee injury did not distort our findings.

Limitations

We also acknowledge the limitations of this research. Our study focused on patients who sustained a sports-related injury and we reported a PAR that is specific to sports-injured patients. While we cannot determine how generalisable this cohort is to the overall population, sports participation rates across Victoria are high and increasing.[26] Therefore, this group represents an important segment of the population. We also recognise that the VEMD dataset is restricted to emergency department presentations in 38 Victorian public hospitals. However, as only 6 Victorian private hospitals have emergency departments we do not see this as problematic. The VEMD and VAED datasets do not contain information on laterality (side of injury and side of surgery); however, given the strong established link between joint injury and knee OA,[8] it is reasonable to assume that knee replacement surgery was performed on the same side that sustained the injury. Sports injuries treated outside the hospital setting (for example, injuries that were treated by a general practitioner or physiotherapist) could not be included in our analyses, as reliable and systematic injury data are not available for primary healthcare settings. As such, the total number of sports injuries is likely to be much higher than reported in our study. Also, a number of injuries (2,806 in total) were classified as 'unspecified' or 'multiple injuries' and it is possible that some knee injuries may have been included in this total but were not captured within our knee injury subgroup. We also recognise that patients who underwent knee replacement surgery outside of Victoria were not captured and given the 15-year follow-up period, it is possible that some patients may have moved interstate in that time. A longer follow-up time may also be needed to capture the complete burden of knee replacement among sports-injured individuals, who may receive surgery beyond the 15-year window. Given these limitations, we consider that our analyses represent a conservative estimate of the burden of knee replacement after sports-related injury.

Future directions



The methods used for this study can be easily re-applied at future time points, in order to monitor changes in knee OA disease burden at the population level and to evaluate the impact of sports injury prevention efforts over time. Future studies could utilise a longer follow-up period to identify additional knee replacements attributable to sports injury and improve our understanding of the longer-term outcomes of knee injury. The longer-term risk and costs of knee replacement surgery following sports injury could be explored at a national level, using the National Non-Admitted

Patient Emergency Department Care Database and the National Hospital Morbidity Database, or through potential linkage with the Australian Orthopaedic Association National Joint Replacement Registry. Evaluating the risk of hip replacement surgery after sports-related hip and thigh injury (and associated costs) is also important, and this work is currently underway.

Recommendations

The findings of this study can be used to develop evidence-informed policy recommendations that support health promotion activities. Targeted sports injury prevention programs may reduce the individual and societal burden of knee OA and subsequent knee replacement surgery. Minimising the need for knee replacement surgery among younger adults is particularly important as the risk of joint replacement prosthesis failure and likelihood of revision surgery is much greater among younger individuals. [27,28] As the lifespan for joint replacement prostheses is approximately 20 years, it is also possible that younger patients (for example, those aged in their 30s or 40s) who undergo knee replacement surgery may require multiple revision surgeries over their lifetime.

Consistent with the shift towards preventative healthcare, the ultimate goal is to reduce the frequency of sports injuries that could result in knee OA. However, making changes to sports culture and training practices is difficult. The increased risk of knee replacement identified in this study lends further weight to support the active reduction of knee injuries sustained in sport. This could be achieved through:

1. the implementation of injury prevention programs in sporting clubs and schools;

2. the effective rehabilitation of knee injuries and careful consideration of return to sport timing to minimise the likelihood of re-injury; and

3. initiatives to improve awareness and reduce sporting injuries at the population level.

Injury prevention

While an exhaustive review of the sports injury prevention literature is beyond the scope of this report, several systematic reviews provide evidence for the effectiveness of injury prevention programs in reducing ACL injuries,[29] knee injuries,[30] and lower limb injuries.[31] Practical guidance for implementing injury prevention programs in community settings is also available.[32] Knee injury prevention programs should ideally comprise hip and knee strengthening, balance and proprioception activities, targeted exercises to improve neuromuscular control, as well as plyometric (such as jumping and landing drills) and direction changing activities (especially cutting).[32] Examples of available knee injury prevention programs in Australia include the FootyFirst program and Netball Australia's KNEE program. The FootyFirst program was developed using research evidence, expert consensus, and football community feedback.[33] The program is designed to replace usual warm-up activities and does not require specialised equipment, but is recommended to be performed at least twice per week (preferably at every training session).[34] The KNEE program is designed to prevent knee injuries which are commonly sustained during netball. It includes warm-up, strength, balance and landing, and agility components, and it is recommended that this program be completed at least twice per week. Identifying and addressing unsafe movement patterns relating to landing, deceleration and change of direction are a key focus of the KNEE program, which targets three specific groups of players (junior, recreational, and elite players).[35]

Rehabilitation of knee injuries and return to sport

Effective rehabilitation of knee injuries is also important, and this should be undertaken in accordance with clinical advice from sports physicians, orthopaedic surgeons, and/or physiotherapists, as appropriate. However, the prevalence of knee OA following ACL and meniscus injury is high,[36] even when ACL reconstruction surgery is performed[37,38] and individuals who sustain such injuries should be made aware of this potential outcome. Another important factor to consider is the likelihood of re-injury and when to return to sport. Returning to sport too early greatly increases the risk of re-injury after ACL reconstruction. Research from Norway has shown that ACL re-injury rates were reduced by 51% for every month that return to sport was delayed, until 9 months after reconstruction.[39] Decisions regarding the appropriate time to return to sport should take individual fitness, muscle strength and neuromuscular control into account, as well as the specific demands of the desired sport and the level of competition. Appropriate decision-making regarding rehabilitation and return to sport can change the likelihood of re-injury, and potentially reduce the risk of future knee OA development.

Initiatives to improve awareness

Finally, initiatives to raise community awareness of the potential longer-term consequences of knee injuries and the need for effective sports injury prevention should be considered. These could involve mass media or social media campaigns led by prominent sports players or coaches. Opportunities for funding, co-branding, and promoting knee injury prevention programs could also be explored, through liaison with peak sporting bodies (for example, the Australian Football League and Netball Australia), professional organisations (for example, the Australian Physiotherapy Association, Sports Medicine Australia, and Australian College of Sport and Exercise Physicians), sporting merchandise manufacturers, and arthritis consumer organisations. We are not aware of any existing clinical practice guidelines or consensus-based position statements with regard to sports-related knee injury prevention (although a consumer fact sheet is available on the Sports Medicine Australia website) and this may also be an appropriate gap to address.

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