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Substantial rise in the lifetime risk of primary total knee replacement surgery for osteoarthritis from 2003 to 2013: an international, population-level analysis

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SUMMARY

Objective: To estimate and compare the lifetime risk of total knee replacement surgery (TKR) for osteoarthritis (OA) between countries, and over time.
Method: Data on primary TKR procedures performed for OA in 2003 and 2013 were extracted from national arthroplasty registries in Australia, Denmark, Finland, Norway and Sweden. Life tables and population data were also obtained for each country. Lifetime risk of TKR was calculated for 2003 and 2013 using registry, life table and population data.
Results: Marked international variation in lifetime risk of TKR was evident, with females consistently demonstrating the greatest risk. In 2013, Finland had the highest lifetime risk for females (22.8%, 95%CI 22.5–23.1%) and Australia had the highest risk for males (15.4%, 95%CI 15.1–15.6%). Norway had the lowest lifetime risk for females (9.7%, 95%CI 9.5–9.9%) and males (5.8%, 95%CI 5.6–5.9%) in 2013. All countries showed a significant rise in lifetime risk of TKR for both sexes over the 10-year study period, with the largest increases observed in Australia (females: from 13.6% to 21.1%; males: from 9.8% to 15.4%).
Conclusions: Using population-based data, this study identified significant increases in the lifetime risk of TKR in all five countries from 2003 to 2013. Lifetime risk of TKR was as high as 1 in 5 women in

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Finland, and 1 in 7 males in Australia. These risk estimates quantify the healthcare resource burden of knee OA at the population level, providing an important resource for public health policy development and healthcare planning.

Introduction

Knee osteoarthritis (OA) represents a significant public health challenge internationally. The increasing burden of knee OA worldwide is evident from the results of the Global Burden of Disease Study[1]. This landmark study highlighted a major shift in the global burden of disease over the past 20 years from infectious diseases to non-communicable diseases including musculoskeletal conditions that are associated with significant disability[2]. This is supported by data from a range of developed countries that show steady growth in the rate of knee replacement surgeries performed predominantly for severe knee OA over the past two decades[3–5]. Total knee replacements (TKRs) represent the majority of procedures performed, with only a small proportion of patients receiving unicompartmental knee replacement (UKR)[5,6]. While joint replacement surgery is cost-effective[7], planning for future healthcare demand is critical and requires robust population-level data on disease burden and healthcare utilisation.

Estimating the lifetime risk of joint replacement surgery is an evolving area within musculoskeletal epidemiology. This statistical approach is commonly used in the cardiovascular and cancer fields[8,9]. The lifetime risk of TKR refers to the probability of having this surgical procedure over an individual's lifetime. Lifetime risk estimates provide a complementary approach to quantifying population-level disease burden and related use of healthcare services, and can be easily interpreted by health policymakers, clinicians and patients (as they are expressed as percentages). A key advantage of the lifetime risk statistic is that it provides a cumulative measure of risk that incorporates population life expectancy and all-cause mortality.

Data on the lifetime risk of TKR surgery are limited. Research from the United Kingdom found that the lifetime risk of TKR had increased markedly over a 15-year period from 1991 to 2006, particularly for women[10]. In the United States, Weinstein *et al.*[11] used national health survey data to estimate the cumulative lifetime risk of TKR, although changes in risk over time were not evaluated. Most recently, Bohensky and colleagues used hospital administrative data to estimate the lifetime risk of TKR in the state of Victoria, Australia[12]. A clear increase in the lifetime risk of TKR was evident over a nine-year period (1999–2008), most notably for females. Previous studies investigating the lifetime risk of TKR have all obtained data on joint replacement utilisation from observational studies or health system administrative datasets, which have known limitations around generalisability, completeness and accuracy. The use of population-based procedure data from national arthroplasty registries with almost complete coverage would enable more precise estimates of the lifetime risk of TKR.

While a number of earlier studies have compared TKR incidence rates or utilisation rates between countries[4,6,13–15], an international comparison of the lifetime risk of TKR has not been undertaken. The present study aimed to:

- estimate and compare the lifetime risk of primary TKR for OA in five countries;
- describe change in lifetime risk over a ten-year period (2003–2013); and
- examine changes in utilisation rates of primary TKR and UKR performed for OA over time.

Methods

Study design

A multi-national, population-level retrospective analysis was undertaken.

Data sources

We obtained data on all primary TKR and UKR procedures performed for OA from 1 January 2003 to 31 December 2003 and 1 January 2013 to 31 December 2013 in Australia, Denmark, Finland, Norway and Sweden. These countries were selected for their longstanding and comprehensive national arthroplasty registries. The years 2003 and 2013 were chosen to align with the most recent life table data available across all five countries. De-identified, aggregate data on the number of surgical procedures and the number of patients receiving TKR and UKR in each year were obtained from the Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR), the Danish Knee Arthroplasty Register, the Finnish Arthroplasty Register (Finnish UKR data were obtained from the Finnish Hospital Discharge Register), the Norwegian Arthroplasty Register, and the Swedish Knee Arthroplasty Register. These registries collect data from public and private hospitals and all report over 95% registration completeness for primary joint replacement procedures. Approval for accessing AOANJRR data was obtained from The University of Melbourne Human Research Ethics Committee and the AOANJRR Data Review Committee. The study was also approved by the Nordic Arthroplasty Register Association. Ethics approval was not required for Denmark, Finland, Norway or Sweden, in line with local legislation.

Extracted registry data for each country included:

- sex;
- age; and
- operation type: TKR and UKR.

Life table data for 2003 and 2013 (stratified by gender) were obtained online from the Australian Bureau of Statistics, Statistics Denmark, Statistics Norway, and Statistics Sweden. Life table data for Finland were obtained online from Eurostat, the statistical office of the European Union. Life tables use all-cause mortality rates to estimate the number of people alive at each year of age (age range 0–100 years) for a hypothetical cohort of 100,000 people. Data on the population of each country (by age and sex) and life expectancy for 2003 and 2013 were obtained from the above sources and OECD.Stat[16], respectively.

Data analysis

Data were categorised into pre-specified age groups for analysis: <40 years, 40–49 years, 50–59 years, 60–69 years, 70–79 years and ≥80 years. A 'standardised lifetime risk' calculation incorporating age-specific rates[17] was used to calculate the lifetime risk of primary TKR, accounting for potential differences in population size and life expectancy between countries (Supplementary material). Simultaneous bilateral TKR was counted as one TKR procedure to avoid potential over-estimation of lifetime risk. Where staged (non-