

# Osteoarthritis in England: Incidence Trends From National Health Service Hospital Episode Statistics

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**Objective.** It is typical in epidemiological research of osteoarthritis (OA) to collect data for the hand, hip, and knee. However, little population-based data exist for this disease in the foot. Thus, we addressed patterns of OA for the foot compared with the hand, hip, and knee spanning 2000/2001 to 2017/2018 in England.

**Methods.** Secondary-care data from 3 143 928 patients with OA of the foot, hand, hip, and knee were derived from the National Health Service (NHS) Hospital Episode Statistics (HES) database. Distribution, population prevalence, and incidence of joint-specific OA were stratified by age and sex.

**Results.** OA incidence increased significantly at the foot [3.8% (95% confidence interval [CI] 3.0, 4.6)], hand [10.9% (10.1, 11.7)], hip [3.8% (2.9, 4.7)], and knee [2.9% (2.2, 3.6)] per year from 2000/2001 to 2017/2018. A higher proportion of women were diagnosed with OA, whereas greater incidence in men was estimated for the hand and hip. Foot OA presented comparable diagnosis numbers to the hand. More recently during 2012/2013 to 2017/2018, a significant rise in hip OA was estimated among younger adults, whereas knee OA decreased across all age groups. Incidence of OA in the foot and hand were particularly significant among the 75 or older age group, though bimodal age distributions were observed for both sites.

**Conclusion.** The significant increase in secondary care records for OA in England underscores the importance of exploring possible causative factors and identifying groups most at risk. Further detailed data may be particularly important for the hip, which represents significant incidence among younger adults. Greater incidence of OA in the foot compared with the knee emphasizes the need for well-conducted epidemiological research in this area. Monitoring the performance of surgical outcomes at the population-level for this frequently affected yet understudied site could have substantial potential to reduce the socioeconomic burden it represents to the NHS.

## INTRODUCTION

Osteoarthritis (OA) represents a growing burden to the National Health Service (NHS) in England. The UK Chief Medical Officer has recommended investigating this disease, for which there is currently no cure (1). Previous estimates of hand, hip, and knee OA from a local database in North Staffordshire, England, have indicated an increase in diagnoses among 35- to 44-year-olds between 2003 and 2010 (2). However, there is limited up-to-date population-based data of temporal trends in patient demographics with respect to OA in England.

Kurtz et al projected an increase in demand for the treatment of younger patients affected by knee and hip OA in the United States (3). In Sweden, incidence of OA affecting the hip and knee

increased significantly between 1998 and 2015 (4). This was supported by W-Dahl et al, who found that knee surgery in Swedish patients younger than 55 years of age doubled between 2000 and 2010 (5). Sweden is particularly focused on registry-based research, integrating public health needs into clinical strategy. Epidemiological OA research has concentrated on the hand, hip, and knee (4). Less attention has been given to the foot despite its inclusion in early descriptions of generalized OA (2,4,6,7).

Although few studies use the same definition to provide population prevalence estimates, first metatarsophalangeal (first MTP) joint OA appears to be the most common degenerative disease in the foot and ankle (7–11). Clinically referred to as hallux rigidus, this condition can be characterized by changes in subchondral bone, joint space narrowing, and focal areas of eroded cartilage,

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resulting in severely restricted joint motion and pain (12,13). The frequency of hallux rigidus among middle-aged to older adults can vary greatly from 6% to 39%, largely because of differences in age, population, and case definition (8,9).

Up-to-date population-based sources are needed to better approximate the sex ratios and age distributions of patients with hallux rigidus in England and the potential burden it poses to the NHS. To address these gaps in knowledge, we reviewed the NHS Hospital Episode Statistics (HES) database, which records secondary care data for England, to ascertain population prevalence and incidence trends in hallux rigidus compared to first carpometacarpal (first CMC), hip, and knee joint OA by sex and age between 2000/2001 and 2017/2018.

## MATERIALS AND METHODS

Aggregate data for English NHS patients were derived from HES between 2000/2001 and 2017/2018 and are made publicly available through the National Archives (<http://www.webarchives.nationalarchives.gov.uk>). The HES database (governed by the Department of Health and Social Care) stores records for all NHS England-related admissions within a given fiscal year. It covers care delivered in treatment centers (including the independent sectors) funded by NHS England, episodes of care in England for non-British residents, and privately funded patients treated within NHS England hospitals. Each record in the database is associated with a "finished consultant episode." This refers to the duration a patient has spent under the care of a hospital consultant (board certified specialist). The HES database was accredited as a national statistic in 2008 and has been validated for research purposes (14).

The HES records included were those with the International Classification of Disease (ICD-10) codes M16 (coxarthrosis [arthrosis of the hip]), M17 (gonarthrosis [arthrosis of the knee]), M18 (arthrosis of the first CMC joint), and M20.2 (hallux rigidus). The information associated with these ICD-10 codes includes the total number of diagnoses, sex, and age. Age was calculated for all cases in the HES dataset, which did not discriminate between men and women. English population data for 2000 to 2017 were obtained from the Office for National Statistics UK ([www.ons.gov.uk](http://www.ons.gov.uk)).

**Statistics.** Descriptive statistics were used to report the distribution data for hallux rigidus, first CMC, hip, and knee joint OA, including totals and percentages (%). Population prevalence and incidence trends were computed in Joinpoint v.4.7.0.0 ([www-surveillance.cancer.gov/joinpoint](http://www-surveillance.cancer.gov/joinpoint)). Joinpoint is a publicly available statistical software that uses regression functions to test whether a change in trend over time is statistically significant. The software provides a summary measure of trend over time by calculating the Average Annual Percent Change (AAPC) using the weighted average of the slope coefficients of the regression line with the weights equal to the length of each segment over

a predetermined time period. A 95% confidence interval (CI) is then computed based on the normal distribution of AAPC.

Population prevalence and incidence trends in OA were estimated in Joinpoint per 100000 population in England, stratified by sex and age. The numerator for estimates by sex included each finished consultant episode divided into groups for pooled, men, and women, whereas the denominator consisted of the total English population in each calendar year. The numerator for estimates by age included each finished consultant episode within the defined age groups, whereas the denominator consisted of the population of each age group for the same calendar year. A *P* value of <0.05 was used to indicate statistical significance.

Sex-stratified incidence of OA was compiled for the entire 17-year period reviewed in this study; however, calculations stratified by age were made using data from the most recent 6 years because of limitations of the HES age classification system prior to 2012/2013. Before this period, patient age was reported within a large range; for example, patients aged 15 to 59 years old were calculated as a single group. Such a grouping would have biased the age-stratified incidence calculations of OA, thus data recorded before 2012/2013 were excluded from the regression analyses. The concurrent age boundaries used were those provided in the HES database.

## RESULTS

### Distribution of osteoarthritis (2000/2001 to 2017/2018).

During 2000/2001 to 2017/2018, there were a total of 3143928 patients presenting with OA. Based on this data, knee OA represented the greatest proportion of patients. Distribution of OA was higher among women for all joints examined (Table 1).

The distribution of knee and hip OA across age exhibited a single peak at the 70- to 74-year-old group. This distribution was bimodal for the first MTP and first CMC joints. Peaks at the 50- to 54- and 65- to 69-year-old groups were observed for the first MTP joint and at the 55- to 59- and 65- to 69-year-old groups for the first CMC joint (Figure 1).

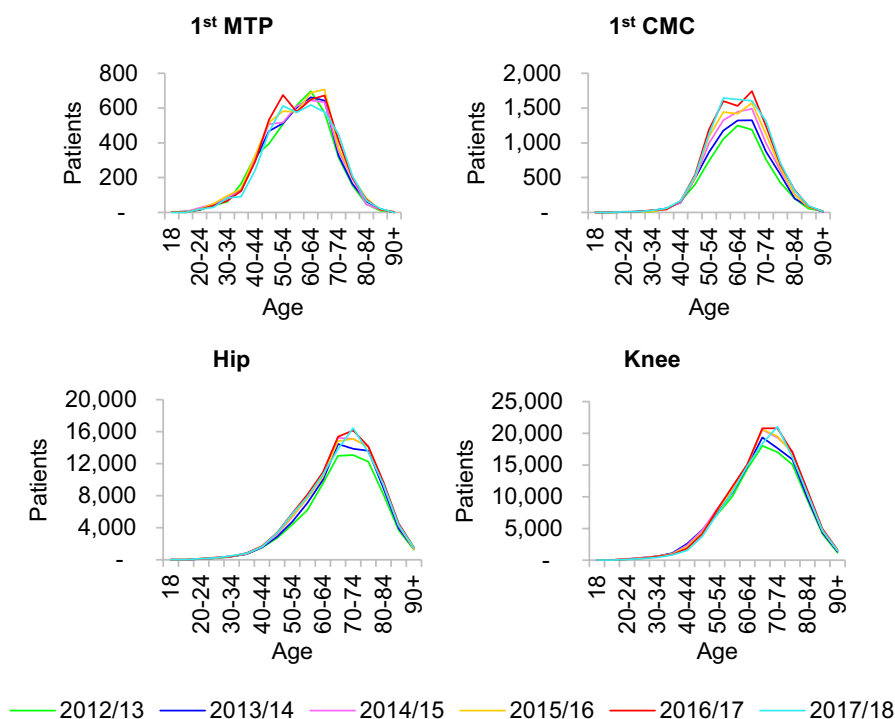
### Sex-stratified incidence of osteoarthritis (2000/2001 to 2017/2018).

Estimated OA incidence increased significantly from 2000/2001 to 2017/2018 for every joint. Similar trends for hallux rigidus, hip, and knee OA were observed. The first CMC joint demonstrated compara-

**Table 1.** Total joint-specific osteoarthritis diagnoses, 2000/2001 to 2017/2018

	Joint			
	First MTP	First CMC	Hip	Knee
All (N)	60 986	88 178	1 222 446	1 772 318
Men	32%	24%	39%	43%
Women	68%	76%	61%	57%

Correction added after online publication 18 September 2019: the dates in the Table 1 heading have been changed to 2017/2018.



**Figure 1.** Distribution of joint-specific OA by age group, 2012/13-2017/18.

tively higher increases (Table 2). Over more recent years, hallux rigidus and knee OA experienced a stabilization in diagnoses. The incidence of hallux rigidus was significant from 2000/2001 to 2010/2011 [6.6% (5.5, 7.7)]. After this time, no significant change occurred [−0.1% (−1.5, 1.4)]. Knee OA demonstrated significant increases until 2007/2008 [6.7% (5.1, 8.4)], after which time no significant change was estimated [0.3% (−0.3, 1.1)]. Incidence of hip OA continued to rise significantly until 2014/2015 [4.5% (4.0, 5.1)]; this increase was not significant from 2015/2016 [0.3% (−4.2, 5.1)] onward. Estimated incidence of first CMC joint OA was significant throughout the 17 years reviewed (Figure 2).

**Age-stratified incidence of osteoarthritis (2012/2013 to 2017/2018).** Between 2012/2013 and 2017/2018, a statistically significant decline in hallux rigidus was estimated in the 55- to 64-year-old group. There was a significant rise in the incidence of patients who were 75

years or older. The 45- to 54-year-old group also exhibited an increasing trend of OA, though this trend was not significant. The incidence of first CMC joint OA was significant in the 45- to 54-year-old group and older. There were also significant increases in the incidence of younger patients presenting with hip OA. Conversely, there were significant declines in the number of younger patients presenting with knee OA (Table 3).

**DISCUSSION**

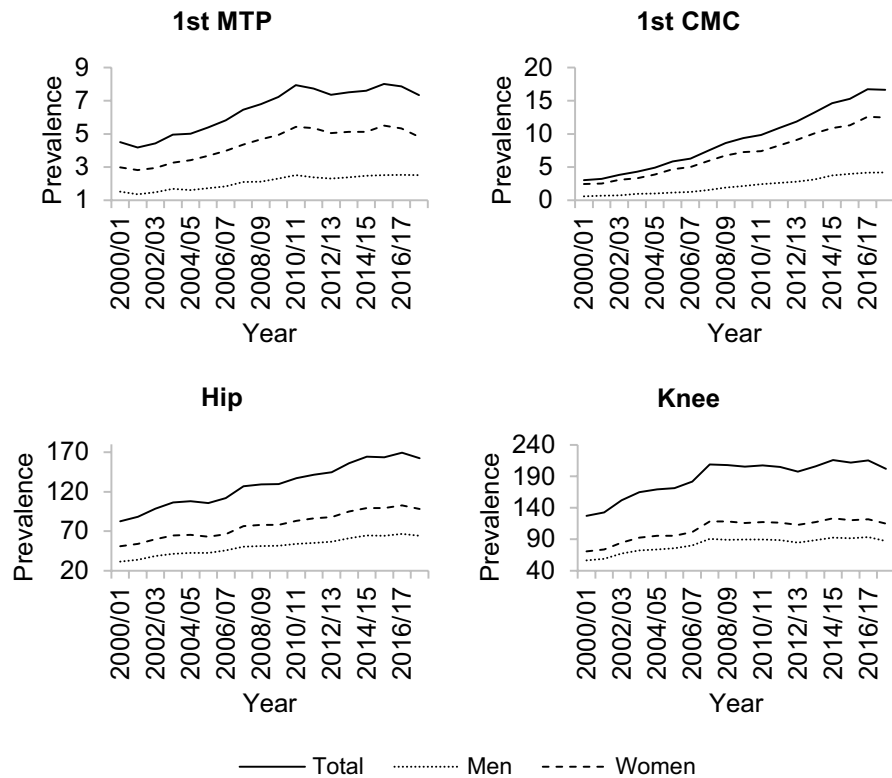
The present study estimated significant increases in the incidence of hallux rigidus, first CMC, hip, and knee joint OA over a 17-year period in England. Although women comprised the largest proportion of diagnoses, greater incidence in first CMC and hip joint OA were estimated among men. Hip OA represented the highest growth among younger patients, whereas the first CMC joint had the highest overall incidence. Older patients (75 years or older group) with hallux rigidus and

**Table 2.** Incidence of joint-specific osteoarthritis stratified by sex, 2000/20001 to 2017/2018<sup>a</sup>

	Joint			
	First MTP	First CMC	Hip	Knee
All	3.8% (3.0, 4.6) <sup>b</sup>	10.9% (10.1, 11.7) <sup>b</sup>	3.8% (2.9, 4.7) <sup>b</sup>	2.9% (2.2, 3.6) <sup>b</sup>
Men	3.6% (2.8, 4.5) <sup>b</sup>	11.9% (10.7, 13.2) <sup>b</sup>	4.3% (3.2, 5.5) <sup>b</sup>	2.7% (2.0, 3.4) <sup>b</sup>
Women	3.9% (3.0, 4.7) <sup>b</sup>	10.7% (9.8, 11.7) <sup>b</sup>	3.8% (2.9, 4.7) <sup>b</sup>	3.1% (2.3, 3.8) <sup>b</sup>

<sup>a</sup>In the Joinpoint regression analysis, AAPC (%) and 95% confidence interval in crude rates per 100 000 population were used.

<sup>b</sup>All values in table are statistically significant results (P value < 0.05).



**Figure 2.** Population prevalence of joint-specific OA per 100,000 English population, 2000/01-2017/18. [Color figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

first CMC joint OA represented the fastest growing population. A significant rise in the total number of patients with knee OA was estimated from 2000/2001 to 2017/2018; however, there was a higher incidence of hallux rigidus over the same time period.

The current findings were within the range of UK-based estimates of OA (2,15). A large study by Yu et al found that a higher proportion of women were diagnosed with OA. The trend toward declined hip and knee OA later in life was also comparable to our results, as was a plateau in diagnoses for the knee since 2008/2009 (15). However, previous estimates of increased knee OA among 35- to 44-year-olds were not in agreement with our data (2). This difference can be attributed to the prior analysis of local-level data from 1992 to 2013

compared with our regression analyses of national-level data beginning 2012/2013.

Incidence of OA in England was consistent with global trends (3,4,6). Analysis of a secondary care database from Sweden found that population growth and ageing accounted for just one-third of patients presenting with OA, which suggests that these factors do not fully explain increased incidence of the disease (4). Kiadaliri et al postulated that although hip OA constituted the highest proportion of patients in Sweden, knee OA could surpass the hip in coming years. In contrast, the present data suggest that incidence of knee OA has stabilized in England and may be overtaken by the hip if current trends are maintained.

A significant trend in younger patients diagnosed with hip OA may align with recent recognition of femoroacetabular impinge-

**Table 3.** Incidence of joint-specific osteoarthritis stratified by age, 2012/2013 to 2017/2018<sup>a</sup>

Age group	Joint			
	First MTP	First CMC	Hip	Knee
25-34	-0.6% (-11.4, 11.6)	6.7% (-9.1, 25.3)	2.3% (1.5, 3.2) <sup>b</sup>	-6.1% (-11.0, -0.9) <sup>b</sup>
35-44	-4.6% (-10.1, 1.2)	1.7% (-0.9, 4.5)	2.9% (1.1, 4.8) <sup>b</sup>	-7.4% (-12.1, -2.4) <sup>b</sup>
45-54	3.8% (-0.3, 8.0)	6.6% (2.2, 11.2) <sup>b</sup>	4.2% (1.8, 6.7) <sup>b</sup>	-2.1% (-5.0, 1.0)
55-64	-2.8% (-4.0, -1.7) <sup>b</sup>	5.8% (3.8, 7.8) <sup>b</sup>	1.9% (-0.1, 4.9)	-0.3% (-2.6, 2.2)
65-74	-0.2% (-2.8, 2.5)	5.2% (2.3, 8.0) <sup>b</sup>	-0.5% (-2.5, 1.6)	-0.8% (-2.8, 1.3)
75+	4.9% (1.0, 8.9) <sup>b</sup>	7.8% (43.4, 11.3) <sup>b</sup>	0.9% (-1.7, 3.6)	-0.7% (-1.7, 3.2)

<sup>a</sup>In the Joinpoint regression analysis, AAPC (%) and 95% confidence interval in crude rates per 100 000.

<sup>b</sup>Indicates statistically significant results ( $P$  value < 0.05).

ment (FAI) as a precursor to hip degeneration in young adults. Highly active patients with features of FAI may place greater than normal stress on their hips, leading to mechanical damage at an early age (16). The potential for early onset OA in young adulthood can have serious implications on quality of life and the efficacy of conventional treatment strategies; thus, this finding warrants further investigation.

The observed bimodal age distributions of hallux rigidus and first CMC joint OA are likely the results from differences in primary and secondary pathways of disease. The specific reasons are unclear but may reflect multiple factors, such as better diagnostics for these conditions, improvements in referral to secondary care, a change in health care-seeking behavior among certain age groups, differences in joint injury/trauma, including heightened risk of falls among the elderly (17), occupation, and longevity of modern careers (18). Additional studies of patient demographics and populations are required to explore these potential risk factors in more depth.

Although population-level data for risk factors associated with hand, hip, and knee OA are well documented, there is sparse evidence with respect to the first MTP joint, which has largely been excluded from OA-based epidemiology research. The frequency of hallux rigidus, which has equal numbers to the first CMC joint OA and higher incidence than the knee, emphasizes the need for well-conducted epidemiological studies of the first MTP joint to guide the design of future research.

Though long-term results of joint replacement for the hip and knee have been made available through the National Joint Registry, the inability to evaluate brand-specific first MTP and first CMC joint implant outcomes and survival at the population level is an obvious shortcoming in this data. Such information would be especially useful for the evaluation and design of the next generation of joint replacements. Current versions of this technology for these joints yield unpredictable results and unreliable longevity (19,20).

Some limitations must be considered when interpreting the results of this study. We were unable to account for body mass index, height, or other patient characteristics from the available data. Furthermore, utilization of secondary care data should be cautiously interpreted. Although it reflects a large data set across extended time periods, it may also reflect biases that are due to under- or overrecording practices for conditions incentivized by the General Medical Services as well as variable coding quality between different NHS trusts. However, the application of this large and population representative sample, which has been validated for use and maintained across recent timeframes, enabled comprehensive evaluation of temporal trends in OA.

In conclusion, the current study provides up-to-date population data for OA in England across a span of 17 years. The significant increase in secondary care records for first MTP, first CMC, hip, and knee joint OA underscores the importance of exploring possible causative factors and identifying groups most at risk. Further detailed information may be particularly impor-

tant for the hip, which represents a significant rise in diagnoses among younger adults. In highlighting the burden that hallux rigidus represents to the NHS with comparative data from the hand, hip, and knee, the results emphasize the urgent need for future research into the surgical outcomes and standards of care for underappreciated and underrecognized foot burdens at the population level.

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## AUTHOR CONTRIBUTIONS

All authors were fully involved in the study and preparation of this manuscript and approved the final version for publication. Oliver Morgan accessed and organized the study data and takes responsibility for its integrity and the accuracy of analyses. No potential conflicts of interest relevant to this article were reported.

**Study conception and design.** Morgan, Hillstrom, Hillstrom.

**Acquisition of data.** Morgan.

**Analysis and interpretation of data.** Morgan, Hillstrom, Ellis, Golightly, Russell, Hannan, Deland III, Hillstrom.

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