

# Osteoarthritis and Cartilage



## Current and future impact of osteoarthritis on health care: a population-based study with projections to year 2032



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### SUMMARY

**Objective:** To estimate the current and future (to year 2032) impact of osteoarthritis (OA) health care seeking.

**Method:** Population-based study with prospectively ascertained data from the Skåne Healthcare Register (SHR), Sweden, encompassing more than 15 million person-years of primary and specialist outpatient care and hospitalizations. We studied all Skåne region residents aged  $\geq 45$  by the end of 2012 ( $n = 531,254$ ) and determined the prevalence of doctor-diagnosed OA defined as the proportion of the prevalent population that had received a diagnosis of OA of the knee, hip, hand, or other locations except the spine between 1999 and 2012. We projected consultation prevalence of OA until year 2032 using Statistics Sweden's (SCB) projected age and sex structure and prevalence of overweight and obesity.

**Results:** In 2012 the proportion of population aged  $\geq 45$  with any doctor-diagnosed OA was 26.6% (95% confidence interval (CI): 26.5–26.8) (men 22.4%, women 30.5%). The most common locations were knee (13.8%), hip (5.8%) and hand (3.1%). Of the prevalent cases 26.8% had OA in multiple joints. By the year 2032, the proportion of the population aged  $\geq 45$  with doctor-diagnosed OA is estimated to increase from 26.6% to 29.5% (any location), from 13.8% to 15.7% for the knee and 5.8–6.9% for the hip.

**Conclusion:** In 2032, at least an additional 26,000 individuals per 1 million population aged  $\geq 45$  years are estimated to have consulted a physician for OA in a peripheral joint compared to 2012. These findings underscore the need to address modifiable risk factors and develop new effective OA treatments.

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### Introduction

Osteoarthritis (OA) is a leading cause of pain and functional impairment in working age adults and the elderly<sup>1–3</sup>. Number of years lived with disability due to knee and hip OA alone increased by 64% between 1990 and 2010 and OA is currently ranked eleventh

in the world on the list of leading causes of years lived with disability<sup>4</sup>. Between 1999 and 2007/2008 the number of total knee replacements due to OA in the United States (US) and Scandinavia more than doubled.<sup>5–7</sup>

However, patients who receive total joint replacement constitute only a minority of all OA patients. While the twentieth century prevalence and incidence of symptomatic or radiographic OA has been extensively studied, the impact of OA on health care use has been much less studied<sup>1,6,8–10</sup>. Further, disease occurrence in OA is not in a steady state due to aging of the population and the major risk factor for OA which is increased body mass index (BMI). For instance, there is evidence that obesity increases the risk for knee OA, but an increase in risk of hip and hand OA has been reported as

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well<sup>11–14</sup>. Thus, as the prevalence of obesity in most societies is projected to increase, it is expected that OA prevalence will increase as well<sup>15,16</sup>. The prevalence of self-reported doctor diagnosed arthritis in US adults has been projected to increase from 22% in 2003 to 25% by 2030<sup>17</sup>. Presently there is a substantial lack of valid information on the future prevalence of OA leading to health care seeking. Expected changes in disease occurrence require changes in planning and resource prioritization. Hence, we posed two important questions: What proportions of the population consult due to OA at various joint sites? What proportions can be expected to consult a physician in the future?

## Methods

### Data sources

The Skåne region with 1.26 million inhabitants (by December 31, 2012) is located in southern Sweden, and contains both rural and urban areas. Primary and specialist level healthcare is provided by public and private payers through the same tax-based financing system. The patient's co-pay is similar irrespective of whether the care is provided by a public or private healthcare provider and it is common that patients seek care from, or are referred to, both types of providers.

A personal identification number is assigned to all Swedish residents and provides information on age and sex. Swedish law requires that all healthcare contacts are registered by the personal identification number, serving as the basis for reimbursement to the healthcare provider. The Skåne Healthcare Register (SHR) contains information about every healthcare contact made in the region and includes data on healthcare provider, the profession (physician, physical therapist *etc.*), type of contact (e.g., primary/specialist care, in- or out-patient visit, clinic *etc.*) and contact date. Furthermore, the register contains the publicly practicing physicians' diagnostic codes according to the International Classification of Diseases (ICD) 10 system. These codes are assigned by the doctors themselves and are retrieved from the electronic medical records to the register. The diagnostic codes assigned by privately practicing physicians are not forwarded to the register (while other details of the visit are).

The Swedish population register contains information about vital events such as births, deaths, and changes in residential address for all inhabitants in Sweden through the personal identification number. The register is continuously updated by the Swedish Tax Agency.

Statistics Sweden (SCB) provided us with individual information on income, which we linked by the personal identification number. SCB also provided age and sex specific longitudinal data on the prevalence of overweight and obesity and the population projection for Sweden until year 2032.

The study was approved by the Lund University Ethics Committee.

### Multiple imputation of missing diagnoses

Of all persons who had at least one health care visit to a physician during the study period, 96% had at least one ICD-10 code registered. Of all physician health care visits 29.5% were made in the private care and had no diagnostic code registered, as the codes from private care are not yet forwarded to the SHR (while other details of the visits are). We considered these codes to be missing at random and adjusted for this<sup>18</sup>. Further, 15% of all physician health care visits had no diagnostic code registered in the public health care system. A majority of those visits were made in primary care before the year 2004, as the registration of diagnostic codes was

less reinforced before 2004. We used multiple imputation to adjust for missing diagnostic codes in both private and public healthcare as detailed in [web appendix A](#).<sup>19</sup>

### Current point prevalence of doctor-diagnosed OA

First, as a measure of the current impact on health care, we estimated the 2012 point prevalence of doctor-diagnosed OA, defined as the proportion of the population that, using data from 1999 onward, had been diagnosed with OA at least once and were still alive, aged 45+ years and residing in the region as of December 31, 2012.

Hence, we retrieved data from all clinic visits with a physician at a primary care unit or with a specialist (or a physician under specialty training) at an internal medicine, rheumatology, orthopedics, rehabilitation, surgery (including hand surgery and oral and maxillofacial surgery) or emergency medicine clinic made between 1999 and 2012 for all Skåne region residents aged 45 years or older in 2012. Subjects who received a diagnosis of OA in any joint (excluding the spine) at least once during this time period were defined as having 'any OA'. Subjects were classified as having OA of the knee, hip, hand or other joints, respectively, according to the ICD-10 diagnosis received ([Table 1](#)). In the prevalence calculation each person was counted only once. A person with OA in more than one location (knee, hip, hand or other) contributed to the prevalence of OA in every location where diagnosed. We then calculated the prevalence of doctor-diagnosed OA by December 31, 2012 by individual linkage with the population register to exclude all subjects who had died or relocated from the region.

### Validation of knee OA diagnosis in the register (positive predictive value)

To validate if the SHR diagnosis of knee OA was correct we used the population based Malmö Osteoarthritis (MOA) study carried out between 2007 and 2008<sup>20–23</sup>. We obtained the positive predictive values of the knee OA diagnosis in the register as specified in the [web appendix B](#).

### Projected prevalence of OA to 2032

We used the age and sex specific 2012 prevalence estimates of doctor-diagnosed knee OA, hip OA, hand OA or 'any OA' to predict the prevalence until 2032. First we used the sex and age specific (in age categories: 45–49, 50–59, 60–69, 70–79, 80+ years)

**Table 1**  
ICD 10 system of OA

Location	ICD 10 code	Diagnosis
Knee	M17	Gonarthrosis [arthrosis of knee]
Hip	M16	Coxarthrosis [arthrosis of hip]
Hand/wrist	M18	Arthrosis of first carpometacarpal joint
	M15.1	Heberden's nodes (with arthropathy)
	M15.2	Bouchard's nodes (with arthropathy)
	M19.0D	Primary arthrosis of other joints, site: wrist/hand
	M19.1D	Post-traumatic arthrosis of other joints, site: wrist/hand
	M19.2D	Other secondary arthrosis, site: forearm
Other	M15 (other than M15.1, M15.2)	Polyarthrosis (excluding Heberden's/Bouchard's nodes)
	M19 (other than M19.0D, M19.1D, M19.2D)	Other arthrosis (excluding arthrosis in hand/wrist)
Any	M25.5*	Pain in joint

\* The code for pain in joint was used only in the sensitivity analysis.

population projection provided by SCB and sex and age specific prevalence estimates to project the future prevalence of OA due to changes in the age and sex structure of the population. Further, we used the observed sex and age specific prevalence of overweight and obesity in Sweden measured by SCB in 1988, 2008 and 2010 (three measurements) to assess the impact of obesity on the future prevalence of OA. We assumed that the linear increase observed between 1988 and 2010 would continue until 2032. We used previously published results from meta-analyses and assumed that an increase in BMI of five units (which represents moving one “full step” from the normal weight category to overweight, or from overweight to obese) increases the risk for incident OA by 1.35 for the knee (1.22 for men and 1.38 for women) and 1.11 for hip and hand (for both men and women)<sup>24,25</sup>. As 50% of all 2012 prevalent OA cases had knee OA, we assumed the risk for ‘any OA’ equal to the mean of those for knee and hip. The calculations were made using the following formula linking the prevalence proportions and incidence rates: (number of prevalent OA)\*(1/disease duration) = incidence\*(number of people in population-number of prevalent OA), where we assumed that the disease duration is equal to the life expectancy at the mean age of subjects with OA in our cohort<sup>14</sup> (Table II). The years of life expectancy for those aged 65 in the year 2012 were retrieved from SCB publications. The estimates of the prevalence of overweight, obesity and the years of life expectancy as well as the exact formulas used to derive projections are available in [web appendix C](#).

To assess sensitivity of the projections with respect to assumptions on BMI increase and its impact on risk of OA we modified the risk rates for incident OA to be equal with their lower or upper confidence limits, i.e., 1.23 (lower limit) or 1.54 (upper limit) for knee OA in women, 1.19 or 1.25 for knee OA in men and 1.07 or 1.16 for hip and hand OA<sup>24,25</sup>. Second, we modified the projected prevalence of overweight and obesity and assumed that the increase would be 10% lower or 10% higher than the one observed between 1988 and 2010.

### Statistical analysis

We used a logit regression model to obtain the prevalence estimates with confidence intervals (CI). In a sensitivity analysis, we repeated the analyses using an expanded definition for OA, which incorporated a diagnosis of pain in joint (ICD-10 code: M25.5, no location specified) at age 55 years or older<sup>10</sup>. All presented prevalence numbers were based on the imputed data. Analyses were performed using R (R Core Team) and STATA 13.

## Results

### Current point prevalence of doctor-diagnosed OA

The current proportion of the population aged  $\geq 45$  ( $n = 531,254$ , 52% women) that had any doctor-diagnosed OA between 1999 and 2012 was 26.6% (95% CI: 26.5, 26.8). The prevalence in men was 22.4% (95% CI: 22.2, 22.6) and in women 30.5% (95% CI: 30.3, 30.7). The most common location was the knee joint with the prevalence of 13.8% (95% CI: 14.7, 13.9) followed by other joints, 12.4% (95% CI: 12.3, 12.5), hip, 5.8% (95% CI: 5.7, 5.9) and hand, 3.11% (95% CI: 3.06,

3.16). The prevalence typically increased with increasing age and was higher in women (Table III).

Of all OA cases, 26.8% had been diagnosed with OA in more than one location. Knee OA and OA of other joints was the most common combination (10.9%). (Figure 1) Of all hand OA cases 53.6% had been diagnosed with OA in at least one other location.

When we expanded our OA definition to include a diagnostic code for ‘joint pain’ (location not specified) in those aged 55 years or older, the 2012 prevalence of OA in the population  $\geq 45$  was estimated to be 42.3% (36.4% in men and 47.7% in women).

### Validation of knee OA diagnosis in the register (positive predictive values)

The probability of an ICD-10 code M17 diagnosis (knee OA) in the SHR to be in a MOA study subject fulfilling either the American College of Rheumatology (ACR) clinical & radiographic criteria (with respect to the side) or having radiographic knee OA equivalent to Kellgren/Lawrence grade  $\geq 2$  was 88%.

### Projected prevalence of OA to 2032

Taking into account only the projected changes in the sex-age structure of the population the prevalence of ‘any OA’, knee OA and hip OA, respectively, is expected to increase from 26.6% to 29.0%, from 13.8% to 15.2% and from 5.8% to 6.8%, respectively over the next two decades. When accounting additionally for the increase in the estimated prevalence of overweight and obesity the prevalence of ‘any’ OA, knee and hip OA may increase from 26.6% to 29.5%, from 13.8% to 15.7% for the knee and 5.8–6.9% for the hip, respectively. The pattern was similar for men and women (Fig. 2). This corresponds to the relative increase of 10%, 12% and 18%, respectively. Thus, by 2032 there may be over 26,000 more doctor diagnosed OA prevalent cases per 1,000,000 population aged 45 or older as compared to 2012. The gray areas in Fig. 2 show the impact of different assumptions on the increase in prevalence of overweight and obesity and its impact on the risk of OA as specified in the sensitivity analyses.

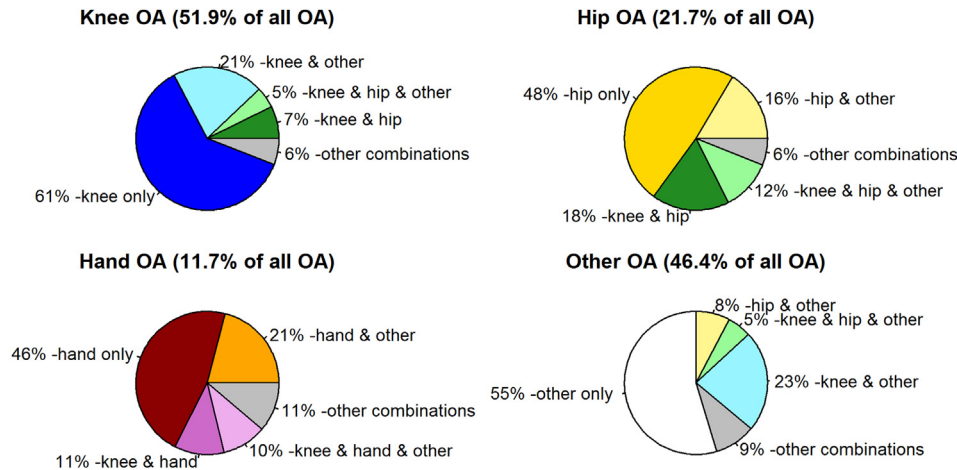
## Discussion

We examined the current impact of OA on the health care system by determining the proportion of the population with doctor diagnosed OA using 14 years of comprehensive Swedish health register data. Currently, one in four adults aged  $\geq 45$  has doctor-diagnosed OA in at least one joint, excluding the spine, and more than one in eight had doctor-diagnosed OA of the knee. We also made projections over the next two decades. These projections indicate that almost 30% of adults aged  $\geq 45$  in 2032 are expected to have consulted for OA by 2032 and half of those for knee OA.

In our report the prevalence of OA in any location excluding spine in adults aged  $\geq 45$  that had led to healthcare consultation was 26.6%, higher than the prevalence in 2001 reported from Canada<sup>26</sup>. The prevalence of self-reported doctor-diagnosed OA in a Norwegian survey of 44–76 year-olds was 10.7% for knee and 8.7% for hip<sup>27</sup>. Our estimates (10.9% and 3.6%) in the corresponding age group are lower for the hip but may be explained by 43% nonresponse in the Norwegian survey that was not adjusted for, or recall bias. Prevalence of symptomatic OA (combining radiographic evidence and pain in the symptomatic joint in epidemiologic studies) in those aged  $\geq 45$  varies between studies from 6.7% to 15.9% in the knee and 1.6% to 9.2% in the hip<sup>1,8,9,28</sup>. Our estimates of clinically relevant OA of 13.8% in the knee and 5.8% in the hip are in the middle of this range. The prevalence of symptomatic hip OA in

**Table II**  
The mean age of OA subjects in the SHR, by sex and OA location

	Knee OA	Hip OA	Hand OA	Any OA
Women	68.1	72.0	65.6	70.0
Men	66.5	70.9	67.2	67.6



**Fig. 1.** The 2012 site distribution of OA that burdens health care and its overlap in adults aged  $\geq 45$ . Numbers are percentages of all cases with OA. Other – includes OA of joints other than knee, hip and hand such as shoulder, elbow, ankle and foot, jaw and polyarthrosis (excluding Bouchard's and Heberden's nodes as those are included in the hand). Other combinations – includes all combinations of knee, hand, hip and other, not already listed in a pie. Spine is not included.

Johnston County OA Project was 9.2% and our estimate of 5.8% can be expected as not all symptomatic patients seek care.<sup>9</sup>

As many as one in four of the prevalent OA cases were diagnosed with the disease at multiple joint sites. In a study of symptomatic limb joint OA patients attending a rheumatologist in Bristol, United Kingdom, where both clinical symptoms and radiographic changes in the symptomatic joint were required for the diagnosis, 50% of the study sample was diagnosed with the disease in multiple joints<sup>29</sup>. However, substantially more severe OA cases are to be expected at a rheumatology clinic than in health care in general. The associations found in the literature between knee OA or hip OA and hand OA are classically based on radiographic definition of the disease, but has been shown even for clinically diagnosed OA<sup>30,31</sup>. In our study, 26% of patients with doctor-diagnosed hand OA were diagnosed with OA of knee and 11% with OA of the hip. The OA cases with multiple sites involved might require more healthcare resources than others which warrant more research to understand the implications of their disease.

We projected a relative increase on 10% over two decades (by year 2032) in the occurrence of 'any OA' that leads to health care consultation taking into account the future age and sex structure of the population as well as the prevalence of overweight and obesity.

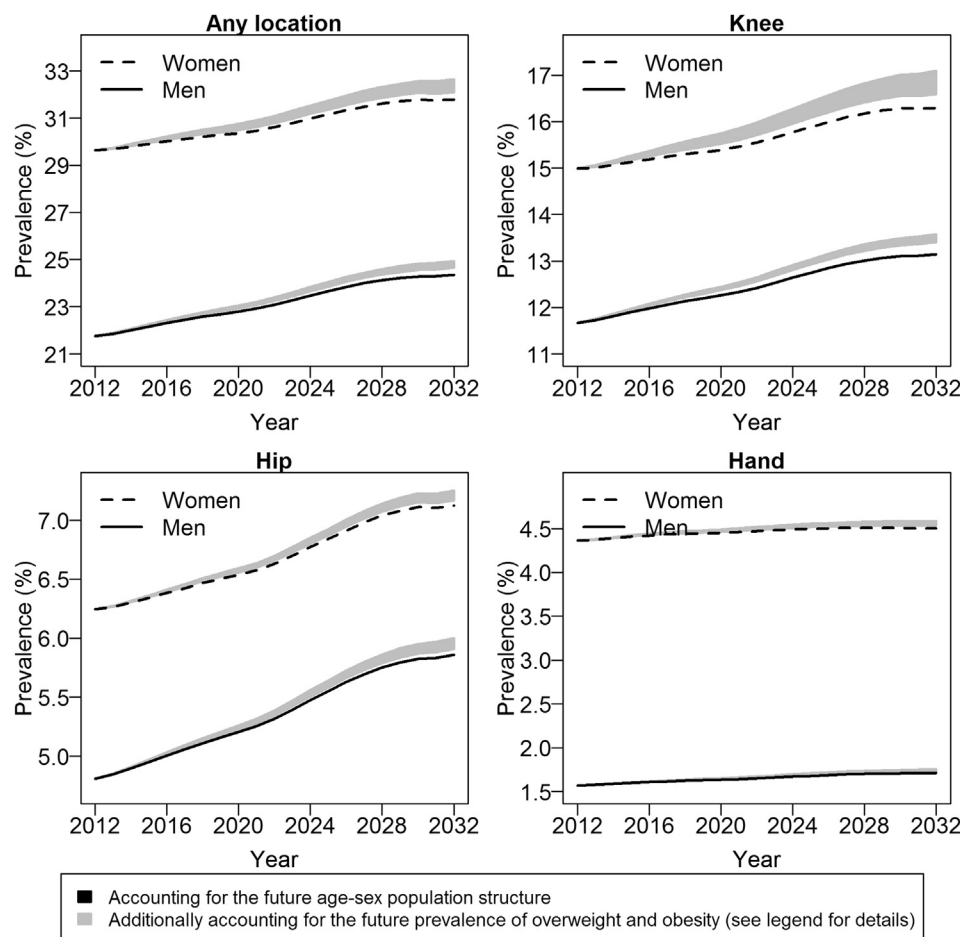
This increase is higher than the projected increase of self-reported doctor diagnosed arthritis from 29.6% in 2010 to 31.7% of the US population aged  $\geq 20$  when only change in age structure was accounted for<sup>32</sup>. Our estimates are lower than those of other researchers in US and Canada who reported projections of the prevalence of self-reported arthritis with relative increase that ranged from 16% to 50% within two decades in population aged 15 or older<sup>17,33</sup>. In a 2011 national report from Canada the projected increase in the prevalence of OA in any location by the year 2030 compared to 2010 was 75% for the whole population<sup>34</sup>. Those results reflect to a high extent the expected shift in the population structure of USA and Canada with a higher share of older adults. This shift didn't affect our results to the same extent as we used the age group 45 or older, a group typically affected by OA. Comparisons with other countries are challenging also due to different current and projected age and sex structures. Furthermore, our projection didn't take into account the potential for increased awareness of OA in the society which would increase the propensity to consult health care. The current high prevalence of obesity and its expected increase in the populations over the world is another important factor that will affect the future prevalence of OA, especially of the knee<sup>35</sup>. Our results indicate though that the

**Table III**

The 2012 population prevalence (%) and 95% CIs (in parentheses) of OA that burdens health care, by age, sex and joint site. Other OA- includes OA of joints other than knee, hip and hand such as shoulder, elbow, ankle and foot, jaw and polyarthrosis (excluding Bouchard's and Heberden's nodes as those are included in the hand). Spine is not included.

		Age (years)					
		45–54	55–64	65–74	75–84	85+	45+
Knee OA	All	4.1 (3.9–4.2)	10.3 (10.1–10.5)	17.5 (17.3–17.8)	25.9 (25.4–26.3)	30.8 (30.2–31.4)	13.8 (13.7–13.9)
	Men	4.0 (3.8–4.1)	9.2 (9.0–9.5)	16.1 (15.7–16.4)	23.4 (22.8–24.0)	27.4 (26.4–28.6)	12.0 (11.9–12.2)
	Women	4.1 (4.0–4.3)	11.3 (11.0–11.6)	19.0 (18.6–19.3)	27.8 (27.2–28.4)	32.4 (31.7–33.1)	15.5 (15.3–15.6)
Hip OA	All	0.8 (0.8–0.9)	2.3 (2.3–2.4)	7.0 (6.9–7.2)	14.8 (14.5–15.1)	17.9 (17.5–18.4)	5.8 (5.7–5.9)
	Men	0.8 (0.7–0.9)	2.3 (2.2–2.4)	6.5 (6.3–6.7)	13.5 (13.1–14.0)	17.5 (16.7–18.3)	5.0 (4.9–5.1)
	Women	0.8 (0.7–0.9)	2.4 (2.3–2.5)	7.5 (7.3–7.8)	15.7 (15.3–16.1)	18.2 (17.6–12.5)	6.5 (6.3–6.7)
Hand OA	All	0.9 (0.9–1.0)	3.1 (3.0–3.1)	4.7 (4.6–4.8)	4.6 (4.4–4.7)	3.5 (3.3–3.7)	3.1 (3.1–3.2)
	Men	0.4 (0.4–0.5)	1.4 (1.3–1.5)	2.5 (2.3–2.6)	2.8 (2.6–3.0)	2.4 (2.1–2.7)	1.6 (1.6–1.7)
	Women	1.4 (1.3–1.5)	4.7 (4.5–4.8)	6.9 (6.7–7.1)	5.9 (5.7–6.2)	4.0 (3.7–4.3)	4.5 (4.4–4.6)
Other OA	All	3.4 (3.3–3.5)	9.9 (9.8–10.1)	16.4 (16.2–16.6)	22.0 (21.6–22.4)	25.0 (24.3–25.7)	12.4 (12.3–12.5)
	Men	2.9 (2.8–3.1)	7.7 (7.5–7.9)	13.1 (12.8–13.4)	18.0 (17.4–18.5)	21.0 (19.8–22.2)	9.6 (9.4–9.7)
	Women	3.9 (3.7–4.0)	12.2 (11.9–12.4)	19.6 (19.2–20.0)	25.1 (24.5–25.6)	26.9 (26.2–27.7)	14.9 (14.8–15.1)
Any OA	All	8.2 (8.0–8.4)	21.1 (20.9–21.4)	34.8 (34.5–35.1)	47.5 (47.0–47.9)	53.1 (52.4–53.7)	26.6 (26.5–26.8)
	Men	7.4 (7.2–7.6)	17.6 (17.4–18.0)	30.3 (29.8–30.8)	42.7 (42.0–43.3)	48.8 (47.6–50.1)	22.4 (22.2–22.6)
	Women	9.0 (8.8–9.2)	24.6 (24.3–25.0)	39.1 (38.6–39.6)	51.2 (50.6–51.8)	55.2 (54.5–55.9)	30.5 (30.3–30.7)





**Fig. 2.** The 2012 prevalence and the projection for years 2013–2032 of OA that burdens health care. The projection is based on the predicted changes in age-structure of the Swedish population, predicted increase in the age and sex specific prevalence of overweight and obesity in Sweden and differential effects of increased BMI on different joint sites. The lower boundary of the gray area shows the projected prevalence when assuming the impact of BMI on the incidence of OA equal to the lower confidence level and the increase in the prevalence of overweight and obesity 10% lower than that observed in Sweden between 1988 and 2010. Accordingly, the upper bound of the gray area show the projected prevalence assuming the impact of BMI equal to its upper confidence level and the increase in the prevalence of overweight and obesity 10% higher than that observed in Sweden between 1988 and 2010.

highest relative increase is to be expected in the hip OA. This is due to the greatest population growth in those aged 70 or older, where the hip OA is highly prevalent.

As a measure of impact on health care, we estimated the location-specific as well as the overall occurrence of doctor-diagnosed OA based on 14 years of data in a register with validated ICD-10 codes covering a well-defined population. This approach enables direct interpretation in terms of healthcare utilization. Naturally, myriad factors impact consultation patterns beyond the actual occurrence of disease. The capacity of health care systems may change, the policies and national campaigns focusing on different aspects of health may influence patients' willingness to consult or receive a treatment. Easier access to healthcare for persons with OA, through e.g., care programs such as 'Better management of OA' in Sweden or Affordable Care Act in US, may result in an increase of number of persons consulting for OA but also contribute to alleviating the consequences of the increasing prevalence of OA. As the number of effective drugs for the treatment of OA is limited, and no widely accepted disease modifying intervention exists, there appear to be no reasons for the burden of OA on health care to plateau (or decline) within the next two decades. The expected increase in OA occurrence poses a growing threat to public health as also proven by historical data<sup>4</sup>. OA accounts for a

substantial number of healthcare visits in populations with access to medical care and caused 6.8% of all disability adjusted life years in 2010, an increase from 2% reported in 2004<sup>10,36</sup>. Between 1991 and 2010 the number of knee replacement surgeries increased by 162% for those aged 65 or older in the US, a 673% increase in rates is projected by 2030.<sup>15,37</sup>

Importantly, our aim was *not* to estimate the occurrence of OA disease in general but only the occurrence of OA that directly impacts the health care system in terms of visits to a physician. That is undoubtedly an underestimation of the "true" prevalence of the disease as about 40% of symptomatic knee OA patients identified in the Malmö OA study hadn't consulted a physician due to knee OA or knee pain or didn't receive those diagnoses during the 3 years preceding the study examination (unpublished data). Primary care physicians may have difficulties with clinical examination of musculoskeletal disorders that could bias our estimates<sup>38</sup>. However, specialist care is relatively easily accessed in Sweden (even without referral from a primary care physician) and we used data over a 14-year period. In the Skåne region the formal guidelines for the diagnosis of OA were implemented first in 2012. The diagnoses registered between 1999 and 2011 were based on the physicians' clinical judgment. However, the validity of rheumatic diagnoses in the SHR has been shown to be high<sup>39,40</sup>.

In the present study, we performed an extensive validation for knee OA against a number of OA criteria. The positive predictive value of knee OA diagnosis in SHR was 88% and is higher than for example in the Massachusetts health maintenance organization for OA in any location.<sup>41</sup>

Our projections took into account the future age and sex structure of the population and the future prevalence of overweight and obesity. There are other factors, such as the incidence of knee injuries or willingness to consult that will impact the future prevalence of doctor-diagnosed OA. The uncertainty of the population projections, the assumed increase in the prevalence of overweight and obesity and risk for developing OA at different joints sites all contribute to the uncertainty of the projection. We assumed that the linear increase in the prevalence of overweight and obesity observed between 1988 and 2010 would continue in the next 20 years, which might not hold true, e.g., if effective prevention programs will be implemented. We assumed the same mortality in persons with and without OA which could bias our estimates upwards if patients with OA will experience significantly higher mortality than the general population. The 2012 net immigration in the Skåne region was 0.07% of the population aged 45 or older and thus we expect that migration would have a negligible effect of the projected estimates when accounting for an increase in BMI. As we have studied the population aged 45 or older, we were not able to assess the potential increase in prevalence in younger patients.

Our results show that in 2012 almost one in seven adults aged  $\geq 45$  in Southern Sweden had doctor-diagnosed OA of the knee. As the 2012 prevalence of persons with knee prosthesis aged  $\geq 45$  in Sweden was 2.3%, it implies that 17% of prevalent doctor-diagnosed knee OA cases have undergone knee replacement surgery (unpublished data). By 2032, over 26,000 new OA cases per 1,000,000 population aged 45 or older will have consulted healthcare. To a large extent it will be the primary care physicians who will face the increased workload but a crisis in supply of total joint replacement surgery is also anticipated<sup>42,43</sup>. This will put a considerable stress on the health care system. In most western European countries the age of retirement is increasing and therefore, the future work force will include an increasing number of individuals suffering from OA. Prioritization of research on population health strategies to reduce OA, including weight loss and knee injury prevention, and, for those affected by OA, the development of effective therapies is needed. Further research on the burden of OA on health care is needed to evaluate the accuracy of these projections, especially since many previous predictions of both the incidence of surgery in OA and the prevalence of arthritis have been far outgrown by reality.<sup>33</sup>

#### Author contributions

Conception and design: ME, AT.

Analysis and interpretation of the data: all authors.

Drafting the article: ME, AT.

Critical revision of the article for important intellectual content and approval of the final version: all authors.

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#### Competing interests

Authors declare no competing interests.

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#### Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.joca.2014.07.015>.

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