Impact of osteoarthritis on activities of daily living: does joint site matter?

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Abstract

Background  We consider the relationships between a clinical and radiological diagnosis of knee or hip OA and activities of daily-living (ADL) in older adults.

Methods  Data were available for 222 men and 221 women from the Hertfordshire Cohort Study (HCS) who also participated in the UK component of the European Project on Osteoarthritis (EPOSA). Participants completed the EuroQoL survey where they reported if they had difficulties with mobility, self-care, usual activities and movement around their house. Hip and knee radiographs were graded for overall Kellgren and Lawrence score (positive definition defined as a 2 or above). Clinical OA was defined using American College of Rheumatology criteria.

Results  In men, a clinical diagnosis of hip or knee OA were both associated with reported difficulties in mobility, ability to self-care and performing usual-activities (hip OA: OR 17.6, 95% CI 2.07, 149, \( p = 0.009 \); OR 12.5, 95% CI 2.51, 62.3, \( p = 0.002 \); OR 4.92, 95% CI 1.06, 22.8, \( p = 0.042 \) respectively. Knee OA: OR 8.18, 95% CI 3.32, 20.2, \( p < 0.001 \); OR 4.29, 95% CI 1.34, 13.7, \( p = 0.014 \); OR 5.32, 95% CI 2.26, 12.5, \( p < 0.001 \) respectively). Similar relationships were seen in women, where in addition, a radiological diagnosis of knee OA was associated with difficulties performing usual activities (OR 3.25, 95% CI 1.61, 6.54, \( p = 0.001 \)). In general, men with OA reported stronger associations between moving around the house, specifically around the kitchen (clinical hip OA: OR 13.7, 95% CI 2.20, 85.6, \( p = 0.005 \); clinical knee OA OR 8.45, 95% CI 1.97, 36.2, \( p = 0.004 \)) than women.

Discussion and conclusion  Clinical OA is strongly related to the ability to undertake ADL in older adults and should be considered in clinic consultations when seeing patients with OA.

Keywords  Osteoarthritis · Activities of daily living · Knee · Hip

Introduction

The increase in life expectancy and the subsequent ageing population has led to a higher prevalence of chronic, non-communicable diseases and in particular musculoskeletal (MSK) disorders. After cardiovascular diseases, malignant neoplasms and chronic respiratory diseases, MSK disorders are the fourth leading cause of morbidity in older people [1]. Osteoarthritis (OA) is the most common of the MSK disorders affecting older people [2]. It has been estimated that OA affects over 26 million people in the USA, and around 1.6–3.4 million in England and Wales [3, 4]. There is a significant economic burden associated with OA, largely secondary to the effects of disability associated with OA, comorbid diseases and cost of treatment [4].

In OA there is degeneration of the joints involving the articular cartilage and many of the surrounding tissues [5]. There is a breakdown of the equilibrium between breakdown and repair of joint tissue, leading to the loss of articular cartilage, remodelling of subchondral bone, osteophyte formation, ligament laxity, periarticular muscle weakening, and occasionally synovitis [6]. This can occur in any joint, but the joints more commonly afflicted by OA are the hands, feet, facet joints and large weight-bearing joints, such as the...
knees and hips [5]. Joint degeneration in OA results in pain, which in turn leads to stiffness and restricted movement.

Epidemiological studies of OA have principally defined OA using two methods: radiographic and clinical [7, 8]. A radiographic definition of OA captures the structural changes in the joints of interest. The majority of studies employ the radiographic technique first proposed by Kellgren and Lawrence [9], which characterises knee OA into five grades (0, normal to 4, severe) with a score of 2 or above representing OA. A radiological diagnosis of OA alone, however, may not accurately reflect the clinical burden of the disease as studies have shown that pain in OA is heightened by co-morbid illness, muscle-strength, mood, cognition and disability [10]. An alternative method of defining OA is to utilise clinical criteria. In the early 1990s, the American Rheumatism Association (ACR) developed a definition of OA that takes into account medical history, laboratory test results and physical examinations.

OA can contribute to inactivity with ageing, secondary to pain and reduced function, thus ultimately impairing quality of life. It is well established that OA pain, swelling or stiffness can make it difficult for individuals to perform simple activities of daily living (ADL) such as opening boxes of food, tucking in bed sheets, writing, using a computer mouse, driving a car, walking, climbing stairs and lifting objects [11] but to our knowledge the impact the condition has on everyday function has been little studied in individuals who are not awaiting joint replacement surgery.

The EuroQol survey is a standardized instrument for measuring generic health status developed in 1990 by the EuroQol group which is a multidisciplinary team of researchers from five European countries; The Netherlands, UK, Sweden, Finland, and Norway [12]. Their aim was to develop an instrument which is not specific to disease but standardized and can be used as a complement for existing health-related quality of life (HRQoL) measures. In the current study, we use components of the Euroqol survey to consider the relationships between a clinical or radiological diagnoses of lower limb OA and ADL in older men and women.

### Methods

The study participants were 222 men and 221 women from the Hertfordshire Cohort Study (HCS) who also participated in the UK component of the European Project on Osteoarthritis (EPOSA). The Hertfordshire Cohort Study (HCS) is a population-based UK cohort of older adults. Study design and recruitment have been described in detail previously [13]. In brief, we traced men and women born between 1931 and 1939 in Hertfordshire and who still lived there in 1998–2003. A nurse-administered questionnaire, which included details of socioeconomic status and dietary calcium intake, was conducted at this time. In a follow-up study in 2011–2012, 443 participants consented to a home visit by a trained research nurse. At this visit a nurse-administered questionnaire was again administered which included details of smoking status, alcohol consumption and physical activity (average minutes per day spent walking, cycling, gardening, playing sport and doing housework in the last 2 weeks). Height was measured to the nearest 0.1 cm and weight to the nearest 0.1 kg on a SECA floor scale (Chasmos Ltd, London, UK). Body mass index (BMI) was calculated as weight divided by height$^2$ (kg/m$^2$). Participants also answered questions taken from the EuroQol study where they were asked: “Do you have problems with mobility?”; “Do you have problems with self-care?”; “Do you have problems undertaking your usual activities?” [12]. Participants were then asked more detailed questions on mobility where they were asked: “Do you have problems moving around inside and outside your house?”; “Do you have problems moving around your bathroom?”; “Do you have problems moving around your kitchen?”; “Do you have problems moving around your toilet?”; “Do you have problems accessing public facilities such as grocery shops, bus stops or banks?”.

Radiographs were taken of the hip and knees under standardised conditions at a local hospital after the home visit. Clinical OA was defined based on algorithms developed by the American College of Rheumatology [14].

A clinical diagnosis of hip OA was made if pain, as assessed by WOMAC, was present in addition to all of the following: (1) pain associated with hip internal rotation in at least one side; (2) morning stiffness lasting < 60 min evaluated by the WOMAC stiffness subscale (score from ‘mild’ to ‘extreme’); and (3) age of over 50 years [15]. Pain was assessed using the Western Ontario and McMaster Universities OA Index (WOMAC) pain subscale score. The WOMAC is a 24-item questionnaire with three subscales measuring pain (five items), stiffness (two items), and physical function (17 items) [16].

To diagnose clinical knee OA the patient had to experience knee pain and any three of the following: (1) bony tenderness in at least one side on examination; (2) crepitus on active motion in at least one side on examination; (3) less than 30 min of morning stiffness, evaluated by the WOMAC stiffness subscale; (4) no palpable warmth of synovium in both knees on examination; (5) age over 50 years; or (6) bony enlargement in at least one side on examination.

Radiographs were graded according to Kellgren and Lawrence (KL). KL classifies OA into five grades (0, normal to 4, severe). The KL grading system is briefly described as follows: grade 0—no radiographic features of OA are present; grade 1—unlikely narrowing of the joint space and possible osteophytes on the radiograph; grade 2—small osteophytes and possible narrowing of the joint space; grade
3—multiple, moderately sized osteophytes, definite joint space narrowing, some sclerotic areas and possible deformation of bone ends; and grade 4—multiple large osteophytes, severe joint space narrowing, marked sclerosis and definite bony end deformity [9]. In our study, a positive definition of OA reflected a KL score of 2 or above. The radiographs were all graded by two experienced rheumatologists with good inter-observer agreement.

Stata version 14 was used for all analyses. Study participants’ characteristics were summarised using means and standard deviations (SD) or medians and interquartile ranges (IQR) for continuous variables, and numbers and percentages for binary and categorical variables. Logistic regression was used to model the association between self-reported OA, clinical OA and radiographic OA with the components of the EuroQol survey and questions on mobility. These analyses were completed with and without adjustment for age, BMI, social class, activity, alcohol intake, baseline dietary calcium and smoking status and years since menopause and HRT use in women. These confounders were selected as they have been shown to be associated with the ability to undertake ADL and OA in previous studies. A study by Pollard and colleagues on a cohort of 763 people who had been diagnosed with OA in Somerset and Avon, UK showed that impact of OA on ADL appears to vary with respect to social deprivation [17]. A recent study by Magnusson and colleagues showed alcohol was associated with inflammatory hand OA whereas smoking appeared to be protective [18]. Farr et al. have demonstrated using accelerometry that the majority of patients with knee OA do not meet the recommended levels of physical activity [19] which results in weight gain and obesity, progression of OA and impairment of function [20]. Finally, significantly higher concentrations of calcium have been found in the meniscus of individuals with knee OA undergoing total knee replacement surgery [21].

Results

The mean [standard deviation (SD)] age of study participants was 75.5 (2.5) and 75.8 (2.6) years in men and women, respectively. The mean body mass index (BMI) was 27.9 kg/m² (SD 3.9) in men and 28.4 kg/m² (SD 5.1) in women. Men had a lower median activity time than women in the last 2 weeks [176 min/day (IQR 105–270) and 200 min/day (IQR 135–283) respectively], although this did not reach statistical significance (p = 0.089). A higher proportion of men were current smokers [5% (n = 11) vs 2.7% (n = 6) of women] (Table 1).

Seven (3.2%) men and 13 (6.0%) women had a clinical diagnosis of hip OA. Radiographic hip OA was more common, affecting 46.3% (n = 93) of men and 40.6% (n = 78) of women. Knee OA was overall more common than hip OA in both sexes with the radiographic diagnosis again being more prevalent [50.2% (n = 101) of men and 58.7% (n = 118) of women], compared with the clinical diagnosis [12% (n = 26) of men and 19% (n = 41) of women] (Table 1).

In men, a clinical diagnosis of hip or of knee OA were both associated with reported difficulties in mobility, ability to self-care and performing usual activities (hip OA: OR 17.6, 95% CI 2.07, 149, p = 0.009; OR 12.5, 95% CI 1.62, 97.2, p = 0.012; knee OA: OR 13.2, 95% CI 1.71, 100.9, p = 0.021).

Table 1 Participant demographics

|                  | Men    | Mean (SD) | Women   | Mean (SD) |
|------------------|--------|-----------|---------|-----------|
| **Age (years)**  | n      |           | n       |           |
|                  | 222    | 75.5 (2.5)| 221     | 75.8 (2.6)|
| **Height (cm)**  | n      | 172.7 (6.5)| 217     | 158.8 (6.1)|
| **BMI (kg/m²)**  | n      | 27.9 (3.9)| 217     | 28.4 (5.1)|
| **Activity time in last 2 weeks (min/day)** | n | 176 (105–270) | 200 | 200 (135–283) |
| **Daily dietary calcium intake (mg)** | n | 1221 (1021–1432) | 221 | 1105 (939–1281) |
| **Alcohol consumption (units/week)** | n | 6.5 (1.0–14.0) | 221 | 0.5 (0.0–3.5) |
| **Total n**      | n (%)  |           | n (%)   |           |
| **Clinical OA**  |         |           |         |           |
| Hip              | 219    | 7 (3.2)   | 216     | 13 (6.0)  |
| Knee             | 216    | 26 (12.0) | 216     | 41 (19.0) |
| **Radiographic OA** |      |           |         |           |
| Hip              | 201    | 93 (46.3) | 192     | 78 (40.6) |
| Knee             | 201    | 101 (50.2)| 201     | 118 (58.8)|
CI 2.51, 62.3, \( p = 0.002 \); OR 4.92, 95% CI 1.06, 22.8, \( p = 0.042 \), respectively. Knee OA: OR 8.18, 95% CI 3.32, 20.2, \( p < 0.001 \); OR 4.29, 95% CI 1.34, 13.7, \( p = 0.014 \); OR 5.32, 95% CI 2.26, 12.5, \( p < 0.001 \), respectively. With the exception of the association between clinical knee OA and self-care these findings remained robust following adjustment for confounders (Table 2). Very similar relationships were seen in women, where clinical OA at hip and knee were both associated with reported difficulties in mobility, ability to self-care and performing usual activities (Hip OA: OR 5.49, 95% CI 1.63, 18.5, \( p = 0.006 \); OR 8.81, 95% CI 2.67, 29.0, \( p < 0.001 \) and OR 15.9, 95% CI 3.40, 74.0, \( p < 0.001 \) respectively; Knee OA: OR 7.51, 95% CI 3.56, 15.9, \( p < 0.001 \); OR 9.52, 95% CI 3.87, 23.4, \( p < 0.001 \) and OR 9.20, 95% CI 4.31, 19.7, \( p < 0.001 \), respectively). The association between clinical knee OA and difficulties moving around the bathroom or toilet in men but significant associations were seen with both clinical hip OA and radiographic hip OA (bathroom: clinical hip OA—OR 290, 95% CI 11.1, 7559, \( p = 0.001 \) and radiographic hip OA—OR 7.71, 95% CI 1.28, 46.4, \( p = 0.026 \); toilet: clinical hip OA—OR 93.1, 95% CI 5.44, 1593, \( p = 0.002 \) and radiographic hip OA—OR 5.84, 95% CI 1.00, 34.1, \( p = 0.050 \) (Table 4).

Overall, the associations between OA and difficulties with reported mobility were weaker in women. In contrast to men there was no association between either hip or knee OA and difficulties accessing public facilities and moving around the bathroom following adjustment for confounders. Knee, but not hip, OA in women was associated with general

### Table 2 Hip and knee OA as explanatory variables for EuroQoL scores in men

| EuroQoL mobility          | Unadjusted | Adjusted* |
|---------------------------|------------|-----------|
|                           | \( n \) | OR (95% CI) | \( n \) | OR (95% CI) | \( p \) value |
| **Clinical hip OA**       | 219 | 17.6 (2.07, 149) | 0.009 | 192 | 250 (6.45, 9663) | 0.003 |
| Radiographic hip OA       | 201 | 0.94 (0.50, 1.78) | 0.846 | 176 | 1.90 (0.83, 4.31) | 0.127 |
| Clinical knee OA          | 216 | 8.18 (3.32, 20.2) | <0.001 | 188 | 7.81 (2.47, 24.8) | <0.001 |
| Radiographic knee OA      | 201 | 1.15 (0.61, 2.16) | 0.661 | 175 | 0.60 (0.27, 1.32) | 0.204 |

| EuroQoL self-care         | Unadjusted | Adjusted* |
|---------------------------|------------|-----------|
|                           | \( n \) | OR (95% CI) | \( n \) | OR (95% CI) | \( p \) value |
| **Clinical hip OA**       | 219 | 12.5 (2.51, 62.3) | 0.002 | 192 | 43.9 (3.86, 499) | 0.002 |
| Radiographic hip OA       | 201 | 1.68 (0.51, 5.47) | 0.392 | 176 | 2.96 (0.72, 12.1) | 0.131 |
| Clinical knee OA          | 216 | 4.29 (1.34, 13.7) | 0.014 | 188 | 2.33 (0.56, 9.81) | 0.247 |
| Radiographic knee OA      | 201 | 3.16 (0.83, 12.1) | 0.091 | 175 | 3.14 (0.60, 16.5) | 0.176 |

| EuroQoL usual activities  | Unadjusted | Adjusted* |
|---------------------------|------------|-----------|
|                           | \( n \) | OR (95% CI) | \( n \) | OR (95% CI) | \( p \) value |
| **Clinical hip OA**       | 218 | 4.92 (1.06, 22.8) | 0.042 | 191 | 10.7 (1.60, 71.3) | 0.015 |
| Radiographic hip OA       | 200 | 0.82 (0.41, 1.64) | 0.571 | 175 | 1.16 (0.50, 2.66) | 0.730 |
| Clinical knee OA          | 215 | 5.32 (2.26, 12.5) | <0.001 | 187 | 3.02 (1.07, 8.49) | 0.036 |
| Radiographic knee OA      | 200 | 1.33 (0.67, 2.65) | 0.422 | 174 | 0.80 (0.35, 1.84) | 0.605 |

*Adjusted for age, BMI, social class, smoker status, alcohol consumption, activity and baseline dietary calcium
problems moving inside and outside the house following adjustment for confounders (clinical knee OA: OR 13.5, 95% CI 4.09, 44.7, \( p < 0.001 \); radiographic knee OA: OR 12.4, 95% CI 2.41, 64.0, \( p = 0.003 \)) and problems moving around the kitchen after adjustment for confounders (clinical knee OA: OR 5.38, 95% CI 1.17, 24.7, \( p < 0.030 \)). Similarly to men, clinical hip OA was associated with problems moving around the toilet (OR 12.1, 95% CI 3.34, 43.6, \( p < 0.001 \)) and this association also remained significant post adjustment for confounders (Table 5).

### Discussion

In the current study, we have shown that a diagnosis of lower limb OA is strongly related to the ability to undertake ADL in older adults. We have demonstrated that in both men and women a clinical diagnosis of hip or of knee OA and a radiological diagnosis of knee OA in women is associated with difficulties in mobility, ability to self-care and performing usual activities. Our data, therefore, suggests that using a clinical criteria to diagnose OA, especially in men, is more sensitive at identifying individuals who are at risk of functional impairment then employing a radiographic diagnosis alone. This is consistent with previous studies that have shown that OA leads to impairments in quality of life and ADL and as a consequence, results in dependency, institutionalisation and increased health-care costs [24, 25].

Our data are consistent with previous studies that have shown that OA leads to impairments in quality of life and ADL and as a consequence, results in dependency, institutionalisation and increased health-care costs [24, 25]. The majority of these studies have been qualitative in nature but a recent study by Stamm and colleagues explored the limitations in the ADLs in older adults in a population-based survey of 3097 subjects aged ≥ 65 years in Austria. They demonstrated that OA was associated with a with a 68% higher chance of impairment of intense ADLs such as lifting and carrying a shopping bag of over 5 kg of weight, bending and kneeling down, walking 500 m without the use of aids, climbing stairs without the use of aids and heavy housework [25].

We have observed in the current study that problems with mobilising around specific rooms in the house and accessing public facilities varied according to site and sex. The ability of men to mobilise around the kitchen and to access public facilities was impeded by both hip and knee OA with stronger associations seen when a clinical definition of OA is utilised. In contrast to men, there was no
significant association between lower limb OA and difficulties accessing public facilities or mobilising around the bathroom in women following adjustment for confounders. In both sexes, however, hip OA was associated with difficulties mobilising around the toilet. These results suggest that the specific movements required for mobilising around a toilet, which is usually in a confined space, and the action of getting on and off a toilet are more impeded by hip OA than knee OA. Conversely, mobilising around traditionally larger rooms, such as the kitchen, appears to be more impeded by knee OA. These results are particularly pertinent when considering the benefit of potentially tailoring occupational therapy (OT) services to different groups of patients and that we should ask about ADL in the clinic setting. Indeed, there is strong evidence to suggest that to successfully design healthcare programs for the treatment of OA it is essential to consider what patients need and prefer, and how they value various aspects of a health intervention [26].

Our study is limited in that the results may not be entirely representative of the wider UK population since all recruited participants were born in the county of Hertfordshire and at age 75 were still living there (as had been the case in previous studies). We have demonstrated that this cohort are a good representation of the general population with regard to body build and lifestyle factors, such as smoking and alcohol intake, therefore suggesting that selection bias was minimal [27]. Furthermore, all comparisons undertaken were internal. There is a possibility that there may have been some inconsistencies in the interpretation of radiographs. To minimise this risk, however, two experienced rheumatologists were used to grade the radiographs, with high inter-observer concordance. We have also previously shown that for both clinical and radiographic assessment of OA used within this current study good levels of agreement exists between-and within-observer variation. Briefly, repeatability for all observations was graded either good or excellent by multiple observers [28]. Additionally, only a small number of
participants (7 men and 13 women) fit the diagnostic criteria for clinical hip OA which may limit our power to detect statistically significant relationships. Finally, the study population did not specifically exclude individuals who were awaiting a joint replacement operation and therefore some of these individuals may have been included in the analysis. There is evidence to suggest, however, that although functional improvements following knee arthroplasty are excellent regardless of age, knee arthroplasty contributes little to the quality of life in older patients (octogenarians) [29].

**Conclusions**

Our study shows that a diagnosis of OA is strongly related to the ability to undertake ADL in older adults. Limitations in ADLs and mobility vary according to site and sex and these differences should be considered in the clinical setting. These data support the requirement for functional assessment and corresponding interventions to prevent worsening functional decline in individuals with OA and the consequent health and social problems which would arise at great expense to the individual and society.

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**Compliance with ethical standards**

**Conflict of interest** Author Michael Clynes has received support for attending conferences from UCB, Pfizer and Eli Lilly. Author Elaine Dennison has received fees from Pfizer and UCB. Author Professor Cyrus Cooper has received lecture fees and honoraria from Amgen, Danone, Eli Lilly, GSK, Medtronic, Merck, Nestlé, Novartis, Pfizer, Roche, Servier, Shire, Takeda and UCB outside of the submitted work.

**Ethical approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The

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**Table 5** Hip and knee OA as explanatory variables for problems moving around in women

|                        | Unadjusted | Adjusted | p value | Unadjusted | Adjusted | p value |
|------------------------|------------|----------|---------|------------|----------|---------|
|                        | n          | OR 95% CI| p value | n          | OR 95% CI| p value |
| **Problems moving around inside and outside house** |            |          |         |            |          |         |
| Clinical hip OA        | 216        | 6.73 (2.11, 21.4) | 0.001  | 192        | 5.32 (0.58, 48.8) | 0.139  |
| Radiographic hip OA    | 192        | 1.84 (0.87, 3.88)  | 0.110  | 170        | 2.43 (0.82, 7.18) | 0.108  |
| Clinical knee OA       | 216        | 14.7 (6.45, 33.5)  | <0.001 | 192        | 13.5 (4.09, 44.7) | <0.001 |
| Radiographic knee OA   | 201        | 5.32 (1.97, 14.4)  | 0.001  | 179        | 12.4 (2.41, 64.0) | 0.003  |
| **Problems moving around bathroom** |            |          |         |            |          |         |
| Clinical hip OA        | 216        | 6.84 (2.01, 23.2)  | 0.002  | 192        | 7.85 (0.75, 82.2) | 0.085  |
| Radiographic hip OA    | 192        | 1.70 (0.71, 4.08)  | 0.233  | 170        | 2.20 (0.49, 9.83) | 0.303  |
| Clinical knee OA       | 216        | 7.63 (2.95, 19.7)  | <0.001 | 192        | 3.49 (0.82, 14.8) | 0.090  |
| Radiographic knee OA   | 201        | 5.44 (1.56, 19.0)  | 0.008  | 179        | 4.00 (0.66, 24.2) | 0.130  |
| **Problems moving around kitchen** |            |          |         |            |          |         |
| Clinical hip OA        | 216        | 7.30 (2.14, 25.0)  | 0.002  | 192        | 7.21 (0.59, 87.8) | 0.121  |
| Radiographic hip OA    | 192        | 1.71 (0.69, 4.24)  | 0.249  | 170        | 3.19 (0.53, 19.1) | 0.204  |
| Clinical knee OA       | 216        | 11.1 (4.09, 30.4)  | <0.001 | 192        | 5.38 (1.17, 24.7) | 0.030  |
| Radiographic knee OA   | 201        | 4.80 (1.37, 16.9)  | 0.014  | 179        | 3.37 (0.47, 24.2) | 0.227  |
| **Problems moving around toilet** |            |          |         |            |          |         |
| Clinical hip OA        | 216        | 12.1 (3.34, 43.6)  | <0.001 | 192        | 15.7 (1.36, 180) | 0.027  |
| Radiographic hip OA    | 192        | 1.75 (0.61, 5.03)  | 0.301  | 170        | 2.09 (0.44, 9.80) | 0.351  |
| Clinical knee OA       | 216        | 13.8 (4.07, 46.8)  | <0.001 | 192        | 5.00 (0.96, 26.1) | 0.056  |
| Radiographic knee OA   | 201        | 5.01 (1.10, 22.9)  | 0.037  | 179        | 5.24 (0.49, 56.0) | 0.171  |
| **Problems accessing public facilities** |            |          |         |            |          |         |
| Clinical hip OA        | 216        | 6.39 (1.98, 20.6)  | 0.002  | 192        | 1.51 (0.11, 20.2) | 0.756  |
| Radiographic hip OA    | 192        | 2.02 (0.89, 4.60)  | 0.093  | 170        | 2.23 (0.58, 8.54) | 0.242  |
| Clinical knee OA       | 216        | 7.98 (3.43, 18.6)  | <0.001 | 192        | 3.24 (0.76, 13.9) | 0.113  |
| Radiographic knee OA   | 201        | 2.22 (0.89, 5.51)  | 0.087  | 179        | 1.22 (0.32, 4.65) | 0.770  |

*aAdjusted for age, BMI, social class, smoker status, alcohol consumption, activity, baseline dietary calcium, years since menopause and HRT use

*bProblems with accessing public facilities such as grocery shops, bus stops or banks
UK component of EPOSA had ethical approval from the Hertfordshire Research Ethics Committee, reference number 10/h0311/59.

Informed consent Informed consent was obtained from all individual participants included in the study.

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