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REVIEW

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The effect of lower limb osteoarthritis on work-related outcomes: a systematic review and meta-analysis

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ABSTRACT

Purpose: Lower limb osteoarthritis (OA) is a prevalent condition that has a profound impact on an individual's life in several domains, including occupational activities. The objective of this study was to systematically describe and compare work-related outcomes (e.g., employment status, absenteeism, and productivity loss) in individuals with and without lower limb OA.

Materials and methods: Five databases were searched until 17 June 2023. Studies were eligible for inclusion if they compared work-related outcomes between individuals with lower limb OA and healthy controls (e.g., people without OA or the general population).

Results: Seven studies met the inclusion criteria of which two were included in a meta-analysis. Meta-analysis revealed that individuals with OA were less frequently in paid employment than control individuals (odds ratio: 0.25; 95% confidence intervals: 0.12, 0.53). Evidence from single studies indicated greater absenteeism and presenteeism and poorer functional capacity in people with lower limb OA compared to controls.

Conclusions: This systematic review suggests that individuals with lower limb OA have poorer work-related outcomes than those without OA. Low study numbers and lack of consistency in the way work outcomes are defined and measured make accurate quantification of the impact of OA on work challenging.

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IMPLICATIONS FOR REHABILITATION

- Individuals with lower limb osteoarthritis (OA) are less frequently in paid employment and experience greater absenteeism and presenteeism and poorer functional capacity than people without OA.
- For holistic management of lower limb OA, healthcare providers should have conversations about any difficulties experienced at work and include outcome measures related to work.
- Clinicians should work with individuals with lower limb OA and employers to develop interventions to maximize work participation.

Introduction

Osteoarthritis (OA) is one of the leading causes of pain and disability among adults [1]. Worldwide, it is estimated that over 300 million people are affected by OA [2]. Although OA is often considered to be a disease affecting the elderly, it can affect people of all ages [3]. Post-traumatic OA of the knee [4] and ankle [5] develops after joint injury, which commonly occurs at a young age and thus affects people for a considerable portion of their lives. While OA can occur in any joint, it most commonly affects the hip and knee [6]. In fact, hip/knee OA is ranked as the 11th highest contributor to global disability [7].

People with hip [8], knee [8], ankle [9,10], and foot [11] OA typically experience chronic pain, reduced joint mobility, muscle weakness, and difficulties with ambulatory activities, which can limit participation and performance in recreational and occupational activities [12]. A decreased ability to participate in work is concerning. Work is central to an individual's personal identity and social status, providing financial and emotional security and independence [13,14]. The inability to work is associated with negative health outcomes such as poorer general health, mental health and psychological well-being, high rates of medical consultation, medication consumption and hospital admission, and increased rates of overall mortality [6,15].

A previous systematic review identified that while research on the impact of OA on work participation is scarce and of low methodological quality, hip, and knee OA has an effect on work participation, including work productivity, sick leave, and work disability, but individuals generally cope with the difficulties experienced [16]. Notably, this study did not compare work-related outcomes between

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individuals with and without OA. More recently, a 2021 systematic review investigated work-related outcomes in adults aged 16–50 years with all forms of arthritis (e.g., rheumatoid arthritis, systemic lupus erythematosus, and juvenile idiopathic arthritis) [17]. The authors concluded that individuals with arthritis have moderate to high work limitations and a higher work disability, but no differences in absenteeism, compared to healthy populations. While data from the review by Berkovic et al. [17] suggests the presence of serious work limitations in people with arthritis, the effect of lower limb OA on work is difficult to interpret due to the inclusion of individuals with a wide range of arthritic conditions. Further, this review only included participants aged up to 50 years old, which may have underestimated the impact of OA on work-related outcomes due to the progressive nature of the disease. With an increase in the retirement age and people staying in the workforce longer, there is an increasing number of people with OA working [18–20]. Thus, a greater understanding of the impact of lower limb OA on work-related outcomes is needed [21]. This systematic review aimed to compare work-related outcomes among individuals with lower limb OA compared to those without lower limb OA or the general population.

Methods

Protocol and registration

The protocol of this systematic review was registered with the international Prospective Register of Systematic Reviews (#CRD42020178820) [22]. The review was performed according to the Preferred Reporting for Systematic Reviews and Meta-Analyses (PRISMA) criteria [23].

Selection criteria

Studies were eligible for inclusion if they: included a population of working-age individuals (18–75 years) with OA affecting the hip, knee, ankle, and/or foot; included a comparator group of individuals without lower limb OA (e.g., people without OA or the general population); and reported work-related outcomes (e.g., employment status, absenteeism, presenteeism, productivity, and functional capacity) separately from other outcomes. Lower limb OA could be self-reported, clinically determined, or radiographically determined. For studies with mixed populations (e.g., upper and lower limb OA), studies were included if greater than 50% of the sample were people with lower limb OA, or data for lower limb OA participants were reported separately. Treatment studies were eligible for inclusion if baseline data on work-related outcomes was reported and compared to a control group. Non-English language studies, single case reports, qualitative studies, animal studies, abstracts from meetings and conferences, and review articles were excluded.

Literature search

A systematic literature search was conducted across five databases (PubMed, EMBASE, CINAHL, Web of Science, and Cochrane) from the date of database inception until 17 June 2023. Search terms were developed in consultation with a medical librarian. Three concepts were combined to identify relevant studies. The first concept of terms referred to the disease of interest (e.g., osteoarthritis) and its synonyms. The second concept of terms related to the hip, knee, ankle, and foot and included other anatomical terms used to refer to these joints, and the third concept of terms related to work (e.g., absenteeism) and synonyms for work (e.g., occupation). Supplementary Appendix 1 provides a detailed search strategy.

Screening

Two authors (YSA and RM) independently performed the search. All identified citations were uploaded into EndNote V.X9 and duplicates were removed. Search results were imported into Covidence (Veritas Health Innovation Ltd, Melbourne, Australia) for screening. Pairs of two authors (YSA, RM, MLP, HZ) independently reviewed the title and abstract screening. Full-text screening was performed by pairs of two authors (YSA, MLP, HZ), and any disagreements were resolved by a third senior author (MDS or VJ). Reference lists of all eligible studies were searched for additional titles.

Data extraction

The following data was extracted from all included studies: authors, year, country of publication, selection criteria, sample size, participant characteristics (e.g., age, sex, OA joint), and work-related outcomes. Data were extracted by one reviewer (YSA) and independently audited by a second reviewer (VJ).

Methodological quality assessment

A quality assessment of all eligible studies was completed using the epidemiological appraisal instrument (EAI), which has been shown to be a valid and reliable tool for the assessment of observational studies [24]. This instrument comprises 43 items grouped into five sections: reporting, subject selection, measurement quality, data analysis, and generalization of results. Each item was scored as either "Yes" (score = 2), "Partial" (score = 1), "No" (score = 0), "Unable to determine" (score = 0), or "not applicable" (item removed from scoring). An overall score was derived as an average score across all applicable items (range = 0–2). Two authors (YSA and MLP), independently evaluated the methodological quality of the included studies. Scores were compared for agreement, and disagreements were resolved through discussion with a third investigator (MDS).

Data and statistical analysis

The Kappa (κ) statistic (95% confidence intervals (CI)) was calculated to determine the agreement between the two assessors for screening and methodological quality rating. The κ statistic was interpreted as: 0.00–0.20 = slight agreement, 0.21–0.40 = fair agreement, 0.41–0.60 = moderate agreement, 0.61–0.80 = substantial agreement, and 0.81–1.00 = almost perfect agreement [25]. Statistical analysis was undertaken in SPSS (Version 26, IBM Corporation, Armonk, NY, USA).

Homogeneous studies were considered for meta-analyses in RevMan 5.4 (Cochrane Collaboration, Nordic Cochrane Center, Copenhagen, Denmark). We considered the graphic display of results, direction of effects, population characteristics and the I^2 statistics (as an estimate of heterogeneity) when determining suitability for meta-analysis [26,27]. Effect sizes (odds ratios or standardized mean difference) and 95% confidence intervals (CI) were calculated for dichotomous or continuous outcomes respectively, and data presented in a forest plot. A narrative synthesis of results of studies that could not be included in meta-analyses was undertaken.

Results

Selection of studies

A total of 45 352 studies were identified from five databases, of which 10 477 duplicates were removed. Title and abstracts of the

34 905 remaining studies were screened, followed by a screening of 1246 full-text articles. Seven studies were eligible for inclusion in the review, and of those, two studies were ultimately included in the meta-analysis (Figure 1). A manual reference list search of included studies did not reveal any additional eligible studies. Agreement between assessors for title/abstract screening and full-text screening was almost perfect (κ statistic (95% CI): 0.90 (0.81, 1.00) and 0.96 (0.81, 1.00), respectively).

Study characteristics

Study characteristics are detailed in Table 1. The seven included studies had a total of 4151 hip and knee OA participants (1574 participants with knee OA, 1494 with hip OA, 407 with both hip and knee, and 676 participants whose affected joint was not stated) and 14 767 control participants. All studies included participants with hip and/or knee OA, with no studies of individuals with foot or ankle OA. One study included a mixed population of OA locations, with 89% of participants having hip or knee OA [33]. One treatment study was included in the review with baseline data (pre-total joint replacement surgery) for people with hip and knee OA compared to a reference population [34]. Diagnostic criteria for OA varied between studies (Table 1). Job characteristics were reported in one study as either white-collar (e.g., professional, administrative, or support-type occupations) or blue-collar (e.g., trade or labor occupations) [33], while another study stated that the majority of participants were farmers or had been engaged in farming [31]. The other five studies did not indicate participant occupation [28–30, 32, 34]. Work-related outcomes investigated were employment status [28,29,31–33], absenteeism

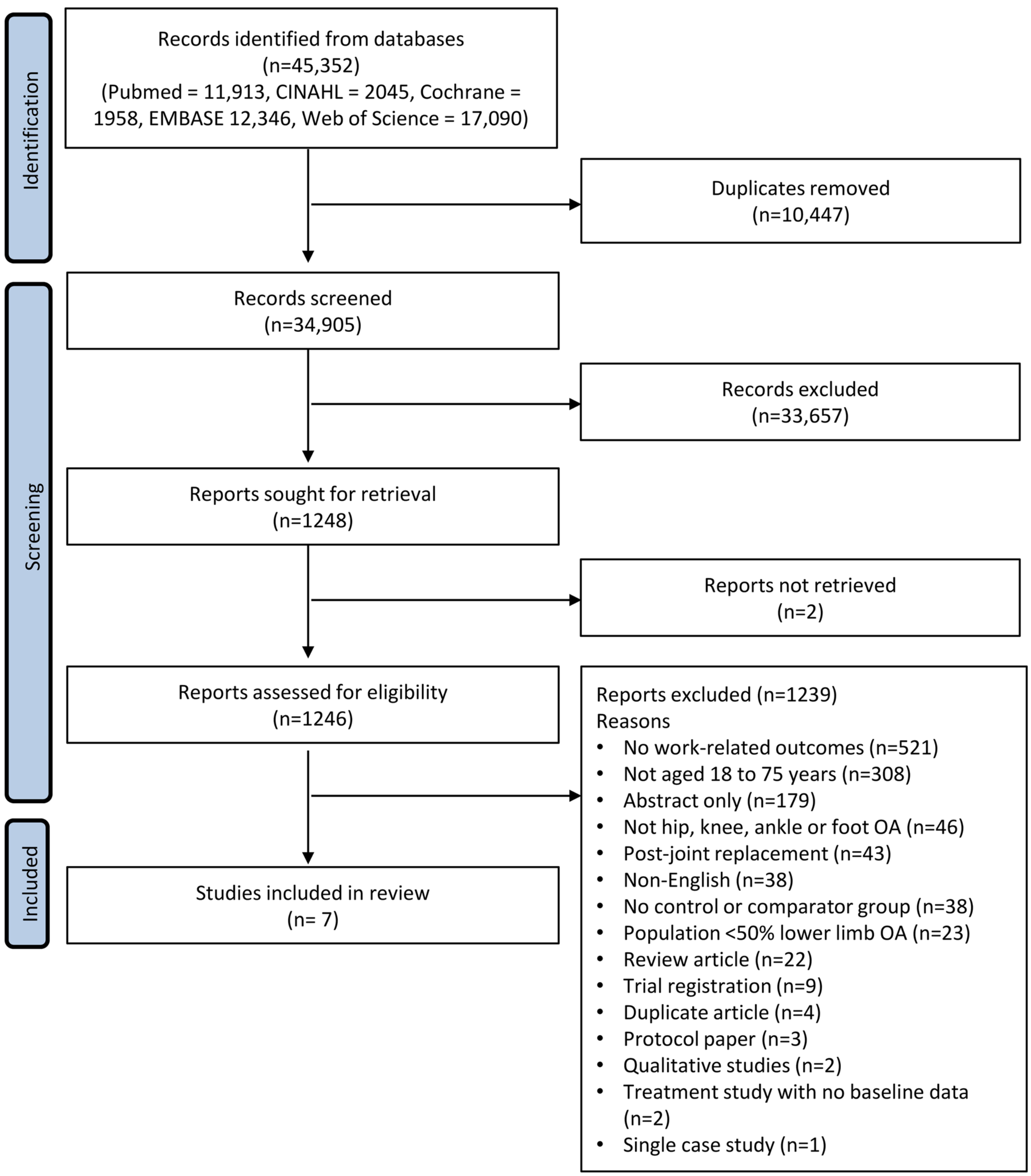

Figure 1. PRISMA flow diagram showing the flow of studies through the review.

Table 1. Characteristics of included studies.

		OA group			Control group				
Study and country	Study design	*n*	Age (years)	Sex (% female)	*n*	Age (years)	Sex (% female)	Inclusion criteria for study groups	Work-related outcomes (measurement method)
Ackerman et al. [28]; Australia	Cross-sectional survey	237	66 (56–74)[a]	62%	917	55 (47–66)[a]	55%	OA group: aged ≥39 years with a self-report of a diagnosis of hip or knee OA by a doctor or other health professional; control group: aged ≥39 years with no diagnosis of hip or knee OA	Paid and unpaid employment status; premature exit from the workforce because of hip/knee OA (questionnaire)
Bieleman et al. [29]; Netherlands	Cross-sectional study	970	56 (6)[b]	79%	1749	Not reported	37%	OA group: aged 45–65 years with pain and/or stiffness of the hip or knee, consulted a GP for these symptoms for the first time ≤6 months ago; Control group: general Dutch population	Paid employment status (questionnaire)
Bieleman et al. [30]; Netherlands	Cross-sectional study	93	Male: 58 (5.3)[b] Female: 56 (4.8)[b]	84%	275	Male: 52 (4.1)[b] Female age: 52 (4.0)[b]	33%	OA group: aged 45–65 years with hip and/or knee complaints not attributed to direct trauma or other disorders, consulted a GP for these symptoms ≤6 months ago; Control group: aged 20–61 years who were working in a range of professions and reported no absenteeism due to musculoskeletal complaints in the last year	Functional capacity tests of lifting, carrying, overhead working, bending and reaching (laboratory)
Ling et al. [31]; China	Observational cross-sectional study	109	62.7 (8.9)[b]	68%	514	57.3 (7.8)[b]	45%	Symptomatic knee OA group: aged ≥50 years with knee pain in the past 12 months and KL OA grade ≥2; Knee pain group: aged ≥50 years with knee pain in the past 12 months and KL OA grade <2; Control group: aged ≥50 years with no knee pain in the past 12 months	Employment status (interview)
Pelle et al. [32]; Netherlands	Observational cross-sectional study	110	69 (9.1)[b]	58%	3374	63 (9.1)[b]	49.5%	OA group: aged ≥18 years with a clinical diagnosis of hip or knee OA by GP or medical specialist; Control group: aged ≥50 years and living in a private household	Paid employment status (questionnaire)
Ricci et al. [33]; United States	Case-control study	329	40–65[c]	71%	91	40–65[c]	64%	OA group: aged 40–65 years, working for pay or profit, and clinically meaningful arthritis defined as arthritis or joint pain on most days for at least 1 month during the previous year as per the first NHANES-I criteria; Control group: workers aged 40–65 years who did not meet criteria for arthritis or back pain	Employment status; absenteeism and presenteeism over the last 2 weeks (interview)
Stigmar et al. [34]; Sweden	Observational study	Hip: 1307 Knee: 996	Hip: 53 (5.1)[b] Knee: 55 (3.9)[b]	Hip: 46% Knee: 56%	Hip: 4604[d] Knee: 3425[d]	Hip: 53 (5.1)[b,d] Knee: 55 (3.9)[b,d]	Hip; 44%[d] Knee: 55%[d]	OA group: aged 40–59 years with hip/knee OA who had a total joint replacement and resided in the Skane region 1 year before surgery; Control group: Individuals who had any kind of healthcare contact matched for sex, birth year and area of residence	Absenteeism per month over 12, 6 and 3 months before surgery (registry data)

OA = osteoarthritis, *n* = number of participants, GP = general practitioner, KL = Kellgren–Lawrence grading system, NHANES-I = National Health and Nutrition Examination Survey.
Age is reported as [a]median (inter-quartile range); [b]mean (standard deviation); [c]range. [d]Control participants were reported as hip reference cohort and knee reference cohort.

Table 2. Results from the quality assessment of included studies ($n = 7$) using the Epidemiological Appraisal Instrument.

Item	Bieleman et al. [29]	Bieleman et al. [30]	Ling et al. [31]	Ackerman et al. [28]	Ricci et al. [33]	Stigmar et al. [34]	Pelle et al. [32]
1. Hypothesis/aim/objective clearly described	2	2	2	2	2	2	2
2. Exposure variables clearly described	2	2	2	1	2	2	2
3. Main outcomes clearly described	2	2	1	2	2	2	1
4. Study design clearly described	2	2	2	2	2	2	2
5. Source of subject population clearly described	1	1	2	1	2	2	2
6. Eligibility criteria for subject clearly described	2	2	2	1	2	1	2
7. Participation rate reported, ascertainment of record availability described	1	0	2	NA	2	NA	1
8. Characteristics of study participants described	1	1	2	1	2	1	2
9. Characteristics of subjects lost after entry/subjects not participating described	0	0	1	2	0	NA	NA
11. Important covariates described in items of individual variables	1	1	2	1	2	1	1
12. Important covariates described in items of environment variables	0	0	0	0	2	0	0
13. Statistical methods clearly described	2	2	2	2	2	2	2
14. Main findings of the study clearly described	2	2	2	2	2	2	2
15. Study provides estimates of random variability in data for main outcomes	1	2	2	0	2	2	2
16. Study provides estimates of the statistical parameters	1	0	2	1	0	0	2
17. Sample size calculations performed and reported	0	0	0	0	0	0	0
18. Comparison group comparable to the exposed group	0	0	2	NA	2	2	NA
19. Participation rate and ascertainment of record availability adequate	2	0	2	NA	0	0	0
20. Study subjects from different groups recruited over same period of time	0	0	0	2	2	2	0
21. Subject losses taken into account	0	0	0	0	0	NA	NA
25. Exposure variables reliable	0	0	0	0	0	0	2
26. Exposure variables valid	0	1	2	0	1	0	2
27. Methods of assessing the exposure variables similar for each group	0	0	2	2	2	0	0
29. Blinding of assessors	0	0	0	NA	0	0	NA
30. Blinding of subjects	0	0	0	NA	0	0	NA
31. Main outcome measures reliable	0	0	0	0	0	0	0
32. Main outcome measures valid	0	0	0	0	0	0	0
33. Methods of assessing the outcome variables standard across all groups	0	2	2	2	2	2	0
34. Observation taken over the same time for all groups	0	0	0	0	2	2	0
35. Prior history of disease/symptoms collected and included in analysis	0	0	0	0	0	0	0
36. Adequate adjustment for covariates in terms of individual variables in the analyses	2	1	1	0	1	0	1
37. Adequate adjustment for covariates in terms of environment variables in the analyses	0	2	0	0	0	0	0
40. Outcome data reported by levels of exposure	0	0	0	2	0	0	2
41. Outcome/exposure data reported by subgroups of subjects	2	2	0	0	0	0	2
42. Study results can be applied to the eligible population	0	0	2	NA	0	0	2
43. Study results can be applied to other relevant populations	1	0	1	NA	0	0	0
Overall quality score (range 0–2)	0.75	0.75	1.11	0.89	1.15	0.93	0.79

Key: 2 = "Yes," 1 = "Partial," 0 = "No," or "unable to determine", NA = "not applicable, EAI = epidemiological appraisal instrument.

(time absent away from work) [33,34], presenteeism (reduced performance while at work) [33], and physical capacity to work [30].

Methodological quality assessment

Overall agreement between the two authors on the methodological quality of included studies was almost perfect (κ statistic (95% CI): 0.84 (0.81, 1.00)). Agreement was reached on 268 out of 301 EAI items (absolute agreement: 89%), with consensus reached on the remaining items. The total EAI scores for the included studies ranged from 0.75 to 1.15 out of a possible score of 2 (Table 2). The methodological quality assessment revealed that descriptions of the research objectives, study design, statistical methods, and key findings were addressed in all included studies [28–34]. Four studies [31–34], adequately reported the source of the participant population, and three studies [31, 33,34], included a control group that was comparable to the OA group in terms of the source of population and recruitment method. No studies accounted for the history of symptoms in analyses or reported sample size calculation, participant loss after entry, or the validity and reliability of the work-related outcome measures.

Meta-analysis

Due to variability in outcomes and the way work status was defined in the studies in this review, only two studies could be included in a meta-analysis. Two studies compared the percentage of individuals with lower limb OA ($n = 347$) and controls ($n = 2576$) who were in paid employment [28, 32]. The odds of being in paid employment were lower in individuals with lower limb OA compared to controls without OA (pooled odds ratio (95% confidence intervals): 0.25 (0.12, 0.53); I^2:87%; $p < 0.001$) (Figure 2).

Narrative synthesis of individual studies

Employment status

Employment status was the most frequently explored work outcome, investigated in four studies ($n = 4$; 57%) [28,29, 31, 33]. It was measured as the proportion of participants who were: working (paid or unpaid employment status not stated) [31], working in part time employment [33], retired [28], and employed in paid work (defined as ≥8 h work/week for the OA group and ≥12 h work/week for the control group) [29].

Studies reported that individuals with OA were less likely to be working [31], less likely to be working full-time (and more

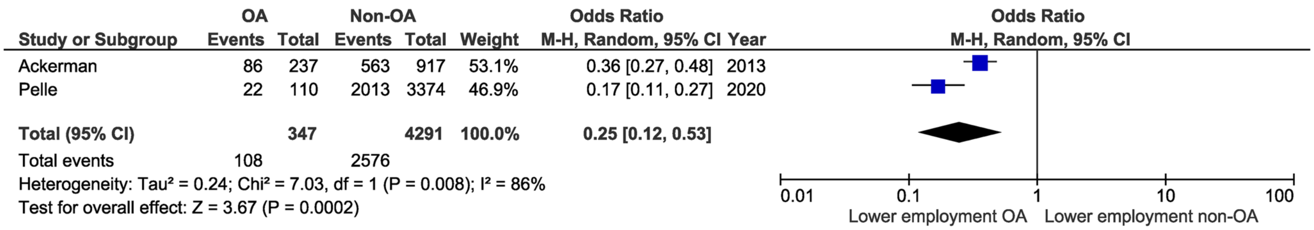

Figure 2. Forest plots of paid employment (event) between individuals with lower limb OA and controls.

Table 3. Summary of results of individual studies.

Variable	Outcome	OA group	Control group	Summary of findings
Employment status	% retired	55% ($n=130$)	32% ($n=296$)	People with hip and knee OA were more likely to be retired than controls ($p<0.01$) [28]
	% in paid employment	51% ($n=493$)	N/A	Similar reported employment rate in people with pain and/or stiffness of the hip and/or knee compared to the Dutch population [29]
	% employed[a]	67 ($n=73$)	86% ($n=442$)	People with symptomatic knee OA were less likely to be employed than controls ($p<0.001$) [31]
	% in part-time employment	PT: 25.5% ($n=84$) FT: 74.5%; ($n=247$)	PT: 15.4%, ($n=14$) FT: 84.6% ($n=77$)	People with OA are more likely to be working part-time (and less likley to be working full-time) than those without OA ($p<0.04$) [33]
	% in high/low demand/control jobs	13.7% ($n=329$	3.3% ($n=91$)	People with OA are more likely to work in low demand/high control jobs than controls ($p=0.02$) [33]
Absenteeism	% >0 absenteeism in last 2 weeks	14.7%	3.9%	Workers with OA missed more work than pain-free controls ($p<0.001$) [33]
	Hours lost/worker/week in the last 2 weeks[a]	1.74 (1.28–2.19)	0.57 (0–1.23)	Workers with OA lost more work hours per week compared to pain-free controls ($p=0.01$) [33]
	# days sick leave/month 12 months before THA[a]	Male: 1.5 (1.2–1.9) Female: 2.9 (2.3–3.4)	Male: 0.8 (0.7–1.0) Female: 1.2 (1.0–1.4)	No statistical comparisons conducted [34]
	# days sick leave/month 6 months before THA[a]	Male: 3.1 (2.6–3.6) Female: 4.2 (3.6–4.9)	Male: 1.0 (0.8–1.2) Female: 1.3 (1.1–1.5)	No statistical comparisons conducted [34]
	# days sick leave/month 3 months before THA[a]	Male: 4.9 (4.3–5.5) Female: 5.9 (5.1–6.6)	Male: 1.0 (0.9–1.2) Female: 1.3 (1.1–1.5)	No statistical comparisons conducted [34]
	# days sick leave/month 12 months before TKA[a]	Male: 3.5 (2.8–4.3) Female: 4.4 (3.8–5.1)	Male: 0.9 (0.7–1.1) Female: 1.2 (1.0–1.4)	No statistical comparisons conducted [34]
	# days sick leave/month 6 months before TKA[a]	Male: 5.3 (4.5–6.1) Female: 6.2 (5.5–7.0)	Male: 0.9 (0.7–1.1) Female: 1.3 (1.1–1.5)	No statistical comparisons conducted [34]
	# days sick leave/month 3 months before TKA[a]	Male: 6.8 (5.9–7.7) Female: 7.6 (6.8–8.4)	Male: 1.2 (0.9–1.4) Female: 1.4 (1.1–1.6)	No statistical comparisons conducted [34]
Presenteeism	% >0 presenteeism in last 2 weeks	50.7%	18.9%	More workers with OA reported reduced performance than pain-free controls ($p<0.001$) [33]
	Hours lost/worker/week in the last 2 weeks	3.62 (2.84, 4.40)	2.21 (0.23, 4.20)	Workers with OA lost more work hours than pain-free controls ($p=0.21$) [33]
Functional capacity	Lifting low (kg)[b]	Male: 33.5 (6.3) Female: 17.0 (7.0)	Male: 44.3 (13.0) Female: 24.8 (8.5)	Males and females with OA had less capacity for "lifting low" than healthy workers (male: 10.9 (7.0, 14.8); female: 7.8 (5.3,10.2)) [30][c]
	Lifting overhead (kg)[b]	Male: 17.9 (3.7) Female: 8.0 (3.6)	Male: 19.7 (4.8) Female: 11.2 (3.3)	There was no difference in capacity for "lifting overhead" between males with OA and healthy workers (1.8 (−0.7, 4.3)), but capacity was less for females with OA than healthy workers (3.2 (2.1, 4.2)) [30][c]
	Two hand carry (kg)[b]	Male: 38.5 (12.5) Female: 19.3 (6.5)	Male: 45.4 (11.7) Female: 27.7 (7.7)	Males and females with OA had less capacity for "2-hand carry" than healthy workers (male: 7.0 (0.7, 13.1); female: 8.3 (6.1,10.5)) [30][c]
	Overhead work (s)[b]	Male: 214 (72) Female: 160 (74)	Male: 270 (119) Female: (233 (103)	There was no difference in capacity for "overhead work" between males with OA and healthy workers (55 (−7, 117)), but capacity was less for females with OA than healthy workers (73 (45, 101)) [30][c]
	Dynamic bend (s)[b]	Male: 60 (15) Female: 60 (16)	Male: 48 (7) Female: 45 (6)	Males and females with OA had less capacity for "dynamic bend" than healthy workers (Male: −12 (3, 21); Female: 15 (−19, −11)) [30][c]
	Repetitive side reach (s)[b]	Male: 91 (21) Female: 87 (21)	Male: 80 (13) Female: 75 (9)	There was no difference in capacity for "repetitive side reach" between males with OA (91 (21)) and healthy workers (−11 (−23, 2), but capacity was less for females with OA than healthy workers (−12 (−17, −7)) [30][c]

THA = total hip arthroplasty; TKA = total knee arthroplasty, CI = confidence intervals, PT = part-time, FT = full-time, N/A = data not provided.
[a]Data presented as mean (95% confidence intervals).
[b]Data presented as mean (standard deviation).
[c]Data presented as mean difference (95% confidence intervals).

likely to be working part-time) [33], and more likely to be retired [28] than controls without OA/pain (Table 3). In contrast, Bieleman et al. [29] reported similar rates of paid employment in individuals with hip and knee pain and/or stiffness and the general Dutch population when data was stratified by age, sex, and education level (Table 3). One study reported that workers with lower limb

OA were more likely to hold jobs characterized by low demand and high control (as assessed with the Karasek job demand control measure [35]) than healthy controls (Table 3) [33].

Absenteeism

Absenteeism in individuals with hip and knee OA compared to controls was reported in two studies (28%) [33,34], with data collected via telephone interview (the Caremark Work and Health Interview) [33] and retrospective analysis of data from the Swedish Social Insurance Agency [34]. Ricci et al. [33] collected absenteeism due to "any health reason" in the last two weeks, quantified in hours lost per worker per week [36], and estimated absenteeism due to "arthritis or joint pain" for the hip and knee OA group as the difference from that reported by the control group. Stigmar et al. [34] reported absenteeism as the number of days absent from work per month due to "any health-related reason" at intervals of 12, 6, and 3 months before joint replacement surgery.

Workers with hip and/or knee OA were more likely to miss work than controls and had more absenteeism (hours lost per worker per week) than controls for "any health-related reason" (Table 3) [33]. Absenteeism due to "arthritis or joint pain" in those with hip and/or knee OA was calculated at 0.57 h per worker per week [33]. Male and female workers with hip and knee OA undergoing joint replacement surgery took a greater number of sick leave days per month than controls at all timepoints (3, 6, and 12 months) in the year prior to surgery, with absenteeism increasing as time to surgery decreased (Table 3) [34].

Presenteeism

Presenteeism, defined as reduced performance while at work, was reported in one study [33]. The telephone-based Caremark Work and Health Interview questionnaire was used to quantify presenteeism in hours lost per week in the last two weeks due to "any health-related reason" and due to "arthritis". Workers with hip and/or knee OA were more likely to report reduced work performance due to "any health-related reason" than controls, but groups did not differ in the hours lost at work per worker per week (Table 3) [33].

Functional capacity at work

One study compared the functional capacity to perform physical job demands between male and female workers with hip and knee pain and/or stiffness and healthy workers [30]. Functional capacity was measured using six tests of the work-well systems functional capacity evaluation [37]: lifting low (e.g., from table to floor), lifting overhead, two-handed carrying, overhead working (e.g., postural tolerance of overhead working), dynamic bending (e.g., repetitive bending), and repetitive side reaching (e.g., fast repetitive side movement). Male OA participants performed poorer than healthy male workers on lifting low, two-handed carry, and dynamic bending, and female OA participants performed poorer than their healthy working counterparts on all six tests (Table 3).

Discussion

This systematic review aimed to compare work-related outcomes between individuals with lower limb OA and controls. The literature in this area is limited, with only seven studies identified, and the heterogeneity of outcome measures meant that only two studies could be included in a meta-analysis. Data from a meta-analysis indicate that individuals with lower limb OA are less likely to be in paid employment than healthy controls without OA. Evidence from single studies showed that individuals with lower limb OA were more likely to be in part-time employment or retired, have more work hours lost due to absenteeism, report reduced work performance, and have lower functional capacity compared to controls. There were mixed findings from individual studies on the proportion of people with and without lower limb OA who were working.

Employment status was the most commonly investigated work outcome in the studies included in this review. Our meta-analysis revealed that fewer individuals with hip and knee OA were in paid employment than individuals without OA. A systematic review by Bieleman et al. [16] found that hip and knee OA had a mildly negative effect on work participation; however, as this review did not compare employment status between people with and without OA, results cannot be directly compared with our data. Further, a recent systematic review on work-related outcomes in young to middle-aged adults with arthritis reported lower employment rates in those with arthritis compared to healthy populations [17]. The population in this study differs from our review in that it consists of individuals with a range of types of arthritis, including rheumatoid arthritis, systemic lupus erythematosus, and juvenile idiopathic arthritis.

There is mixed evidence from single studies on employment status in people with and without lower limb OA. Lin et al. [31] reported that individuals with OA were less likely to be working (paid or unpaid employment not stated), whereas Bieleman et al. [29] reported similar paid employment rates between groups. Differences in findings may be due to different methodologies. Bieleman et al. [29] controlled for potential confounding factors, such as age, sex, and education level, and used a more conservative definition of paid work in the OA group (≥8 h of work per week) compared to the control group (≥12 h of work per week). Employment data from individual studies also identified that people with hip and knee OA were more likely than controls to be employed part-time [33], work in jobs with low demand and high control [33], or be retired [28]. However, the higher reported retirement rate among individuals with hip and knee OA should be interpreted with caution, as control participants were younger (median age: 55 years) than OA participants (median age: 66 years) [28]. The lack of a consistent definition of employment status and differences between OA and comparator groups make it difficult to accurately quantify the impact of OA on work.

Based on data from two single studies, individuals with hip and knee OA have greater absenteeism from work than controls [33,34]. Workers with OA took over twice as much sick leave than controls for "any health-related reason" [33,34], with absenteeism due to "arthritis" estimated to be 0.57 hours per worker per week [33]. Data from the study by Stigmar et al. [34], identified an increase in sick leave with closer proximity to joint replacement surgery, suggesting that the severity or progression of hip and knee OA is associated with greater hours of sick leave. Greater absenteeism in individuals with hip and knee OA is supported by a systematic review that found an association between chronic knee pain and absenteeism [38]. It should be noted that, as it is common for workers not to disclose a health issue due to concerns about job security [39], it may be difficult to obtain a precise estimate of absenteeism attributable to OA. Furthermore, comorbid health conditions are more common among individuals with OA than those without OA [40], and as such, absenteeism among workers with OA may be high due to both OA and other comorbidities. Thus, future studies should include measures of comorbid conditions to disentangle the impact of OA on work from that of other health conditions.

Workers with hip and knee OA were more likely to report reduced work performance (presenteeism) than workers without hip and/or knee OA or back pain, but hours of lost productive work time did not differ between groups [33]. It was estimated that health-related lost productive time in workers with hip and/or knee OA costs United States employers $22.8 billion per year, which is $15.96 billion per year more than that in workers without hip and/or knee OA or back pain [33]. This suggests that productivity in people with lower limb OA is a serious concern for both individuals and society. A recent qualitative study found that individuals with OA commonly lost time at work due to leaving early, arriving late, taking extra breaks, and being unable to take on extra responsibilities [41]. As presenteeism is multi-dimensional and is influenced by a number of job-related factors, such as physical and psychosocial characteristics of work [42], future research is needed to better understand the relative contribution of these factors.

In the study by Bieleman et al. [30], the capacity to perform physically demanding tasks was poorer in workers with hip and knee OA compared to healthy workers. In addition, those with OA were found to have difficulty performing physical work, especially work that involved lifting objects to the floor, carrying objects, and repetitive bending. These findings are supported by a recent survey of employed senior workers with lower limb pain showing that the combination of physical work demands and lower limb pain is associated with limited ability to perform work [43]. Performance of physical work was especially reduced in female workers with hip and knee OA [30]. Considering all functional capacity tests performed, 20–40% of the younger women with OA (45–54 years) and 25–65% of the older women with OA (55–65 years) demonstrated functional capacities that could be considered insufficient to meet the lowest category of physical job demands (e.g., sedentary work) as described by the dictionary of occupational titles [44]. A consequence may be the need for females with hip and knee OA to change jobs or leave the workforce due to an inability to meet the job demands, as was suggested by a recent study in eldercare workers with moderate to high musculoskeletal pain [45]. Further research is needed to understand the effects of lower limb OA on current and future employment in this population.

This systematic review synthesized data from seven studies to compare work-related outcomes in individuals with lower limb OA compared to controls. This provides novel and important information on the impact of lower limb OA on work and differs from previous systematic reviews that have considered all locations and forms of arthritis together (e.g., rheumatoid arthritis, systemic lupus erythematosus, and juvenile idiopathic arthritis) [17], and have not compared work-related outcomes between OA and controls [16]. However, there are limitations that must be considered. At the review level, data pooling and comparison between studies were limited due to variable methodology, outcome measures, and timeframes for data collection. While the two studies included in the meta-analysis had similar findings, the same direction of effect, and relatively small confidence intervals that did not overlap, heterogeneity (based on the I^2 statistic) was high [26]. This may be because of the small numbers of individuals with OA and differences in sample sizes between studies ($n=22$ [34] vs. $n=86$ [28]). Selection criteria for participants with OA varied between studies in the review and included radiographic [31] or clinical [32] diagnoses of OA, self-reported diagnoses [28–30, 33], and participants who were scheduled for joint replacement surgery. [34]. The diversity of study selection criteria and stages of OA is likely to influence the level of disability and workability, which makes comparing findings between studies difficult.

At the study level, our quality assessment revealed several limitations in the available literature. No studies accounted for the history of symptoms or severity of OA in analyses, reported sample size calculations, or reported the validity and reliability of the work-related outcome measures. Only three of the seven studies included a control group that was comparable to the OA group (source population and recruitment) [31, 33,34], and only one study controlled for potential confounding factors (e.g., age, sex, and education level) in the analysis [29]. No studies investigated work-related outcomes in individuals with foot or ankle OA. Future research on foot and ankle OA and studies on lower limb OA that adjust for confounding factors, including the stage of OA, are needed to better quantify the impact of lower limb OA on work-related outcomes.

The findings of this systematic review indicate that OA can negatively affect work outcomes, but the impact is difficult to accurately quantify. Health care professionals, as one of the key providers of care to people with OA, are ideally placed to support clients' desire to remain working by enquiring about possible difficulties performing work. A holistic, work-focused approach to care considers outcomes of interest to the individual. This recommendation is consistent with Fan et al. [46] who suggested that core outcomes in OA should include time absent from work, employment status, work productivity, and work interference. While research shows that healthcare professionals have the potential to improve work-related outcomes in individuals with musculoskeletal conditions, there is variability as to whether work is included in patient management [47]. There is also evidence that insufficient communication and collaboration between healthcare professionals and employers is a barrier to work participation [48]. Healthcare professionals and employers should work together with employees with OA to implement suitable and sustainable management plans and refer to vocational specialists as needed.

Conclusion

Our systematic review suggests that individuals with lower limb OA, specifically hip and knee OA, have poorer work-related outcomes (employment status, absenteeism, presenteeism, and physical capacity) than those without lower limb OA. As lower limb OA is common in working-age adults and employment contributes to social, emotional, and financial well-being, there is a need to implement strategies to retain people with lower limb OA in productive employment without negatively impacting their health and determine consistent work outcomes to evaluate this.

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