

# The Effect of Osteoarthritis of the Hip or Knee on Work Participation

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**ABSTRACT.** In our systematic literature search, we included studies involving patients with hip or knee osteoarthritis (OA) and outcome measures of work participation. Methodological quality was assessed using 11 criteria; a qualitative data analysis was performed. Fifty-three full-text articles were selected out of 1861 abstracts; finally, data were extracted from 14 articles. Design, populations, definitions, and measurements in the studies showed large variations; work outcomes were often only secondary objectives. The outcomes were summarized as showing a mild negative effect of OA on work participation. Many patients had paid work and managed to stay at work despite limitations. However, research on the effect of OA on work participation is scarce and the methodological quality is often insufficient. The longitudinal course of work participation in individuals with OA has not been described completely. (First Release June 15 2011; J Rheumatol 2011;38:1835–43; doi:10.3899/jrheum.101210)

*Key Indexing Terms:*  
OSTEOARTHRITIS

WORK PARTICIPATION

Osteoarthritis (OA) is a disorder with a high prevalence and a substantial burden of disease<sup>1,2,3</sup>. Patients experience pain and stiffness in the affected joints and functional limitations in daily life<sup>4</sup>. Although the prevalence of OA is highest among the elderly, the early stage of OA starts at an age when people are still working<sup>5,6,7,8</sup>. There is a bidirectional relation between OA and work. On the one hand, several aspects of physical workload have been identified as risk factors for developing knee and hip OA, for example, kneeling work positions, jumping, and heavy lifting<sup>9,10,11,12,13,14,15</sup>. On the other hand, people who have OA may perceive difficulties in performing work. This latter effect can subsequently lead to decreased productivity, sick leave, (longterm) work disability,

and early retirement<sup>16,17</sup>. Measures to reduce these effects may address the work situation<sup>18</sup>, such as adapting hours, tasks, workplace/workload, and the use of aids, as well as by offering physical training and coping programs<sup>19,20</sup>. However, studies on work disability prevention in rheumatic diseases and on the effect of OA on work as well as intervention studies are still scarce<sup>21,22</sup>.

From a societal point of view, the costs of these phenomena are of major importance. For individuals with OA, aspects such as sick leave, adaptations in the work situation, or even inability to continue work because of OA are equally important for personal well-being. Considering the anticipated increase in OA prevalence (due to aging populations and more obese people) and the political aim to increase work participation among the elderly<sup>23,24,25</sup>, this issue needs more attention. In addition, it is important for occupational health professionals as well as for treating physicians and therapists to gain insight into the need for adaptations in the work situation due to OA. For these reasons our aim was to review the literature on the effect of OA on work participation as a major aspect of social participation of patients. The study questions of this review were: (1) What is the effect of OA of hips and knees on work participation in terms of having paid work, work productivity, sick leave, work disability, and early retirement? (2) What is the frequency and nature of work adaptations that people have made because of OA? and (3) Does the effect of OA of hips and knees on work change with disease progress?

## MATERIALS AND METHODS

*Literature search.* In June 2009, we searched Medline, Embase, CINAHL, and PsycInfo with the following terms and combination of terms: ((knee OR

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hip) AND (artrosis OR arthrosis OR osteoarthritis)) OR coxarthrosis OR gonarthrosis AND ('work participation' OR 'paid work' OR occupation\* OR employment OR 'sick leave' OR burden OR impact OR 'work transitions' OR 'work adaptations' OR 'work changes').

First, titles and abstracts obtained by the search were screened for relevance to our study questions by 2 of the authors independently. Second, after this preselection, full-text articles of relevant titles and abstracts were also screened by 2 authors independently for final inclusion. Reference lists of these articles were analyzed for additional titles. In case of disagreement on the selection, a consensus meeting was held between the 2 authors. If disagreement was still present, a third author acted as referee.

**Selection criteria.** Studies were included if they met the following criteria: (1) a study population of working age (18-65 years) people with OA was used, or a part of the study population was working-age people with OA and there were separate reports on these people, or having OA was analyzed as a determinant; (2) data were included on work participation and a quantification of the effect of OA on work participation (decrease in productive hours, sick leave, work disability, work adaptations, early retirement); and (3) the study was published in English, German, French, or Dutch and was available as a fulltext article. Articles were excluded if they presented only estimates in terms of money lost, without data on the factors upon which those costs were based.

**Assessment of risk of bias.** Two authors independently assessed the methodological quality of the articles in the final selection. A specific set of assessment criteria were formulated, based on existing criteria lists (Appendix). The internal validity was the main aspect judged, to assess the risk of bias and to inform the reader about the quality of the studies regarding our research questions. The validity of studies assessing the effect of OA on work may be threatened in different ways: by selection bias, in the case of disproportionate inclusion of either relatively healthy patients or patients with severe complaints; by confounding, if other patient characteristics (age, education level) are related both to the OA and to effects on work participation; or by information bias, in the case of unreliable or invalid measurements. The criteria were therefore grouped into 4 categories: the study population (selection bias), the validity of assessing determinants (OA and possibly confounding determinants of work outcomes), the validity of reported work measures (information bias), and the quality of data analysis (to correct for all factors). The possible judgments were "yes" (coded +), "no", and "unclear", (both coded -; Table 1). Cohen's  $\kappa$  were calculated to assess agreement between the reviewers (before consensus was reached).

## RESULTS

**Study selection.** The searches in Medline, EMBASE, CINAHL, and PsycInfo resulted in 1476, 261, 108, and 16 titles, respectively. Screening of these 1861 titles and abstracts resulted in a selection of 53 fulltext articles that were studied thoroughly. From the reference lists, 1 additional title was added. Finally, 14 articles were included in the review, from which the data were extracted and analyzed.

**Quality assessment: risk of bias.** Results of the quality assessment are presented in Table 1. Two reviewers independently scored 154 items and agreed on 120 (78%; Cohen's  $\kappa = 0.53$ ). Disagreement was mostly caused by differences in interpretation of the criteria list or unclear reporting in the article and considered mainly the items of standardized and valid measurements of outcome measures, presentation of outcome measures, and multivariable estimates. Agreement was reached by consensus after a discussion in which the referee participated.

**Study characteristics.** Of the selected articles, 4 studies concerned large population surveys or database surveys<sup>26,27,28,29</sup>; 2 prospective cohort studies and 1 cross-sectional study concerned workers, all with OA or including patients with OA<sup>30,31,32</sup>; and 7 cross-sectional studies concerned patients with OA<sup>33,34,35,36,37,38,39</sup>. The characteristics of the included studies are presented in Table 2.

Two studies were prospective: 1 was an OA cohort with 4.5 years followup<sup>30</sup> and 1 was a cohort of workers, among them a group with self-reported OA, with a 6-month followup<sup>31</sup>. One study had included a population of 10,412 patients diagnosed by a physician, of which 1750 had paid work<sup>33</sup>. Several studies reported on older populations in which only a small minority of subjects were still working<sup>34,35,36,38</sup>. Seven studies were performed in Europe<sup>26,27,31,33,35,28,39</sup>, 6 in North

Table 1. Methodological quality of included studies (after consensus was reached).

Authors	Study Pop-ulation	Source Pop-ulation	In-/exclusion Criteria	Valid OA Diagnosis	Relevant Prognostic Factors	Standardized /Valid Progn. Measurements	Presentation Prognostic Factors	Relevant Outcome Measures	Standardized/ Valid Outcome Measurements	Presentation Outcome Measures	#Multivariable Estimates	Cohen's $\kappa$ per Study
Gignac, 2008 <sup>30</sup>	+	+	+	-	+	+	+	+	+	+	+	NA (9/11)
Grotle, 2008 <sup>26</sup>	+	+	+	-	+	+	+	+	+	+	+	0.16
Merx, 2007 <sup>27</sup>	+	+	-	+	-	-	-	+	+	+	-	0.29
Rabenda, 2006 <sup>31</sup>	-	+	+	-	+	+	+	+	+	-	-	1.0
Fautrel, 2005 <sup>33</sup>	+	+	+	+	+	+	+	+	+	+	-	0.74
Gupta, 2005 <sup>34</sup>	+	+	-	+	+	+	+	+	-	+	-	0.31
Leardini, 2004 <sup>35</sup>	-	+	+	+	+	+	+	+	_*	_*	-	0.35
Maetzel, 2004 <sup>36</sup>	-	+	+	+	+	+	+	+	+	+	-	0.62
Woo, 2003 <sup>37</sup>	-	+	-	+	+	-	+	+	+	+	-	1.0
Lerner, 2002 <sup>32</sup>	-	+	+	+	+	+	+	+	+	+	+	0.30
Gabriel, 1997 <sup>38</sup>	-	+	-	+	-	-	-	+	+	+	-	0.79
Mäkelä, 1993 <sup>28</sup>	+	+	+	+	+	+	+	+	+	+	+	NA (8/11)
Pincus, 1989 <sup>29</sup>	+	+	+	-	+	+	+	+	+	+	-	NA (8/11)
Julkunen, 1981 <sup>39</sup>	-	+	+	+	+	+	+	+	+	+	-	0.56

\* Outcome measures presented, but unclear and difficult to control. Values in parentheses. NA: not applicable —  $\kappa$  could not be calculated because one of the authors rated only positive scores; OA: osteoarthritis.

Table 2. Articles presenting original data on work participation, work disability, sick leave, and work adaptations: study characteristics.

Author, Country	Study Design and Aim	Subjects' Details	Diagnosis of OA	Methods of Work Data Collection
Gignac, 2008 <sup>30</sup> Canada	Prospective 4.5 year cohort study; 4 time points, each 18 months apart. Aim: to prospectively examine arthritis-related work transitions and factors associated with it	At baseline; n = 490 (278 OA, 49 OA + RA, 163 RA), 78% F, all workers. Mean age 50.9, mean disease duration 9.2 yrs (SD 8.7)	Criteria: a reported physician diagnosis of inflammatory arthritis or OA, duration > 1 yr	2-h interview based on structured questionnaire; Workplace Activity Limitations Scale. Work transitions: productivity loss, work changes, leaving employment + demographic, illness, work context, and psychological variables
Grotle, 2008 <sup>26</sup> Norway	Cross-sectional population survey, postal questionnaire. Aim: to investigate prevalence of OA in knee, hip, and hand	A community population, n = 3266 (55% F, median age 45 yrs), overall OA prevalence = 12.8% (n = 418)	Self-reported physician-diagnosed OA	Postal questionnaire: sociodemographic and lifestyle variables (incl. work status); musculoskeletal symptoms: Standardized Nordic Pain Questionnaire; emotional distress: General Health Questionnaire; quality of life: COOP-WONCA functional assessment charts, medical consumption. Logistic regression
Merx, 2007 <sup>27</sup> Germany	Cross-sectional analysis of several databases (healthcare institutions, government authorities, public health insurance). Aim: to summarize the effect of medical care and related costs due to treatment of OA	Data of 600,000 patients in Germany were analyzed	(Partly) based on ICD classification (ICD-9:715 and ICD10-M15-19)	Amount and costs of acute and rehab treatments, sick leave, and early retirement related to OA were estimated
Rabenda, 2006 <sup>31</sup> Belgium	Prospective cohort (6 mo). Aim: to estimate direct and indirect costs of OA	N = 1811, employees of city council, 57% F, mean age 45.9 (SD 9.8). OA prevalence = 34%	Self-reported diagnosis	Subjects completed a health record: demographics, socioeconomic, healthcare utilization, sick leave, reduction of activities, health-related quality of life
Fautrel, 2005 <sup>33</sup> France	Cross-sectional national survey, recruiting patients with OA through 5000 French physicians. Aim: to assess the clinical burden of OA	N = 10412 patients with OA, mean age 66.2 (SD 10.2), 66% F; mean disease duration 9.3 yrs (6.8)	Doctor diagnosis (and radiographic for 84.5% of patients)	Questionnaire: part 1 — physician: medical information; part 2 — patient: effect on activities of daily life, including occupation (“are you limited in your ability to ...?”)
Gupta 2005 <sup>34</sup> Canada	Cross-sectional population OA cohort. Aim: to estimate direct and indirect attributable costs	N = 1258, 74% F, mean age 73.1 yrs (59–100); 96.3% were retired; 37 still worked	96% had clinical signs of hip and/or knee OA	Telephone interview, using standardized questionnaire
Leardini, 2004 <sup>35</sup> Italy	Retrospective 12-month cohort. Aim: to estimate the burden of knee OA	N = 254, GP-diagnosed, mean age 65.8, 76% F; 21% work (54), 42% housewife, 35% pension; OA duration 8.6 yrs	Diagnosis: ACR-criteria + K-L score	Identifying, measuring, and appraising resources absorbed by the patients. Indirect: production loss, working days lost, reduction/loss of work activity and informal care
Maetzel, 2004 <sup>36</sup> Canada	3 cohorts, recruited by rheumatologists and family physicians (OA, RA, HBP), analyzed at baseline and 3 months. Aim: to compare economic burden	253 RA (57 ± 13 yrs, 80% F); 140 OA (70 ± 8 yrs, 70% F); 191 OA + HBP (72 ± 8 yrs, 75% F); 142 HBP (68 ± 9 yrs, 61% F)	Physician-diagnosed OA of knee (185), hip (99), hand (99), spine (176)	Telephone interview/questionnaire (at 0 + 3 mo) on demographics, health status, comorbidity, use of healthcare, time lost from work
Woo 2003 <sup>37</sup> Hong Kong	Retrospective cross-sectional study, cohort with 3 OA subgroups (mild, severe, prosthesis). Aim: to determine direct and indirect costs of OA	N = 574, 76% F, 47% > 70 yrs	Physician-diagnosed OA; subgroups based on ACR classification for functional status	Indirect cost estimates included days of sick leave, days off work by relatives/friends in helping the patient, loss of job because of OA. Human capital approach to assess productivity loss
Lerner, 2002 <sup>32</sup> USA	Cross-sectional survey. Aim: to assess aspects of reliability and validity of the Work Limitations Questionnaire	230 employed patients with OA (mean 53.7, 65% F) + 37 healthy employed controls (mean 45 yrs, 54% F)	Physician diagnosis + radiological	Work Limitations Questionnaire (25 items), Short Form Health Survey (SF-12), Western Ontario McMaster Osteoarthritis Index, chronic condition checklist, occupation battery, Patient Global Assessment, demographics
Gabriel, 1997 <sup>38</sup> USA	Cross-sectional comparison of cohorts (OA, RA, controls). Aim: to describe economic effects of these disorders	123 RA (61; 29–92 yrs; 68% F); 116 OA (68; 32–102 yrs; 69% F); 94 cont (42; 20–100 yrs; 51% F)	Physician-diagnoses OA. Location of OA unclear (“peripheral joints”)	Pretested postal survey. Health Assessment Questionnaire. Number of work days missed, miles travelled for care

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Table 2. Continued.

Author	Study Design and Aim	Subjects' Details	Diagnosis of OA	Methods of Work Data Collection
Mäkelä, 1993 <sup>28</sup> Finland	Cross-sectional study in the Mini-Finland Health Survey	N = 5673 aged 30-64 yrs. Prevalence of knee OA 4% (229) and hip OA 1.8% (101)	Physician diagnosis	Interview + questionnaire + screening examination. Multivariate analyses on determinants of disability, incl. reduced work capacity
Pincus, 1989 <sup>29</sup> USA	US Social Security Survey of Disability and Work; interviews. Aim: to analyze earnings losses in (surrogate) RA and OA (cross-sectional)	N = 9859, 18-64 yrs, answering "Yes" to "doctor told...arthritis or rheumatism"	Self-reported OA of knee, hip, or hand	Disability, work status, earnings losses
Julkunen, 1981 <sup>39</sup> Finland	Aim: to clarify etiological, social, and therapeutic aspects of OA and STR; cross-sectional case-control study.	690 patients with OA (58 yrs, 67% F) from Health Centers + 690 random controls. Also 475 soft tissue rheumatism and controls	Physician-diagnosed OA mostly of ankle (10%), knee (50%), and hip (19%)	Standardized printed questionnaires concerning demographics, occupation, living and working conditions, health situation

OA: osteoarthritis; F: female; RA: rheumatoid arthritis; ICD: International Classification of Diseases; GP: general practitioner; ACR: American College of Rheumatology; K-L: Kellgren-Lawrence; HBP: high blood pressure; STR: soft-tissue rheumatism.

America<sup>29,30,32,34,36,38</sup>, and 1 in Asia<sup>37</sup>. Eight studies were published in the last 5 years, two 5-10 years ago, and the other 4 more than 10 years ago.

*Outcome measures.* The results of the included studies are presented in Table 3.

The only prospective study with a substantial followup period (4.5 years) demonstrated that 37% of 490 working patients with arthritis [57% OA, 10% both OA and rheumatoid arthritis (RA), 33% RA] left the labor force in this period<sup>30</sup>. Leaving the labor force was related to higher age, lower education, having less control over one's work schedule, working as a health or education professional, and reporting previous job disruptions and reductions to work hours. A weakness of this study was that it used patient reports of a physician's diagnosis and that the body sites of the arthritis were not specified.

OA was independently related to being out of work, having work limitations, and being on sick leave in 2 large population surveys<sup>26,28</sup>. Work participation rates, matched for age and sex, were equal for patients with OA and healthy controls in 2 cross-sectional studies<sup>33,39</sup>. Another study<sup>29</sup> showed that the work participation in subjects with OA (age 18-64) was lower than in controls without arthritis, in both men and women, but additional analysis demonstrated that age, education level, and comorbidity explained a large part of this difference. The effect on work participation of OA was smaller than that of RA in 3 comparative studies<sup>29,36,38</sup>. The other 6 cross-sectional studies did not report work participation rates, or no comparisons with controls were made.

The overall conclusion regarding the effect of OA on work participation is that it varied. Some studies found similar rates as in controls, 1 found that more than one-third of the patients dropped out of work in 4.5 years. Many of the results were confounded by age, comorbidity, and education level. On average there seems to have been a mild decrease of work participation at a population level.

*Productivity, work disability, sick leave, and early retirement.* The occurrence of occupational limitations leading to reduced productivity during work was reported in 3 studies<sup>28,32,33</sup> and found to be 3-5 times higher than in controls. Reports on lost working days because of sick leave showed varied results, but seemed to be not very high<sup>30</sup>, similar to controls<sup>39</sup>, or slightly higher<sup>31,37</sup>. Sick-leave data do not show a normal distribution; many subjects had no (or only a few) days of absence, and the small proportion of subjects with a long absence has a strong influence on the mean duration. One study<sup>27</sup> showed that OA caused a substantial part of all temporary work disability periods and early retirement in Germany. Regarding early retirement, 2 studies<sup>34,35</sup> reported exactly the same proportion (2.5%) of patients who indicated they were not working because of OA, and 1 study<sup>38</sup> reported a higher proportion (13.7%).

The pattern arising from these studies is that many workers with OA do not reach their optimal productivity during work. On the other hand, OA is responsible for long periods of sick leave or for early retirement only in a small proportion of workers.

*Work adaptations.* Three-quarters of the working subjects with OA in a followup study of 4.5 years reported any kind of change to their work situation<sup>30</sup>. This was the only study specifically designed to monitor changes in work; work transitions were related to subsequently leaving employment. In most cross-sectional studies, work changes were either not reported at all, or small proportions of patients (1-10%) reported changes in their work<sup>35,37,38</sup>.

*Work participation and disease progress.* Both the mean age, the mean disease duration, and the disease progress of subjects in the studies varied, from a disease duration of < 1 year<sup>39</sup> to about 9 years<sup>30,33,35</sup>. From the cross-sectional studies, no information on the effect of disease progression can be drawn, but the studies do demonstrate that many subjects with longer duration of OA are (still) working. The only longitudinal study showed that in 4.5 years, 63% of the subjects (mean

Table 3. Articles presenting original data on work participation, work disability, sick leave, and work adaptations: outcomes.

Authors	Work Status	Disability, Sick Leave/ Reduced Production	Work Adaptations	Early Retirement
Gignac, 2008 <sup>30</sup>	63% remained employed; 70% made at least 1 work change; diagnosis is not predictive for work transitions score	40% have been absent in 6 mo (mean duration 4.5 days)	75% reported work transitions; work transitions were related to subsequently leaving employment	37% stopped working during the 4.5 year followup period
Grotle, 2008 <sup>26</sup>	70.6% of respondents were employed	Having OA was related to being on sick leave > 8 wks in the previous year (hip OR = 4.19, knee OR = 1.95)	—	OA was related to being out of work (hip OR = 3.34, knee OR = 2.47)
Merx, 2007 <sup>27</sup>	No information on course of OA or on proportion who are not work-disabled	Estimated 240,000 yearly cases of OA-related work disability (1.6–2.3% of sick-leave days); mean duration 37 (knee OA) and 56 (hip OA) days [German population in 2002: 82.5 million]	—	OA caused 4.9% of cases of early retirement (all data are from 2002)
Rabenda, 2006 <sup>31</sup>	616 workers with OA	On average 0.8 days per mo sick leave per patient	—	—
Fautrel, 2005 <sup>33</sup>	17.5% had paid work, equal to age- and sex-matched controls	60.5% (hip) and 65.7% (knee) of these reported occupational limitations (compared to 14% of the controls); 21.6% had missed workdays because of OA	—	—
Gupta, 2005 <sup>34</sup>	96.3% were retired; 48 workers	—	—	2.5% indicated not able to work because of OA
Leardini, 2004 <sup>35</sup>	54 (21.3%) were working	22% of subjects lost working days (mean: 25 days in the past year)	2% changed job during observation	2.4% reported having ceased work due to OA
Maetzel, 2004 <sup>36</sup>	Proportions of subjects employed full time: RA: 31% (78); OA: 9% (12); OA + HBP: 8% (15); HBP: 13% (18)	Subjects reporting time lost from work (in 6 months): RA: 17% - mean 137 h; OA: 4% (5) - mean 77 h; OA + HBP: 0.5% (1) - 160 h; HBP: 4.2% - 272 h	—	—
Woo, 2003 <sup>37</sup>	Of the 574 subjects 108 have paid work. Subjects with no formal education and in the not working category had more severe disease	57 (9.9%) patients needed to take leave from their work to see the doctor; 57 reported sick leave (12.3 ± 19 days) in the previous 12 mo	Overall, 8 (1.4%) patients had changed jobs because of OA	27 (4.7%) patients quit their jobs due to OA
Lerner, 2002 <sup>32</sup>	230 OA patients, all working > 20 h per week	Job effectiveness: 87% (vs 92% in controls); 0.33 days per 2 weeks missed (vs 0.03 in controls)	—	—
Gabriel, 1997 <sup>38</sup>	—	—	Changed occupation because OA: 1.7%; Reduced work hours/ stopped OA: 10.5%; Lost job due to OA: 0.9%; Unable to get job due to OA: 9.4%	Retired early because OA: 13.7%
Mäkelä, 1993 <sup>28</sup>	—	Knee OA 229 (4%) - of which 71% had reduced work capacity; hip OA 101 (1.8%) - of which 83% reduced work capacity	OA, especially of the hip, was a strong determinant (OR = 5.1–8.0) of occasional need for assistance	—
Pincus, 1989 <sup>29</sup>	Arthritis prev. = 11.3%. 35.5% of F with OA worked (total pop: 58%), 66.7% of M with OA (total pop: 87%). Mean age of OA subjects was 52 vs 37 yrs in subjects with no arthritis	Self-reported work disability in subjects with OA 67% in women and 71% in men	—	—
Julkunen, 1981 <sup>39</sup>	51% of OA patients were employed (similar to controls)	67% of working OA patients were given sick leave (mean 17.8 days; controls: 15.4 days)	31% of working OA patients were recommended to resume work, 4% to change occupation	21% of working OA patients were recommended to retire on pension

OA: osteoarthritis; RA: rheumatoid arthritis; OR: odds ratio; HBP: high blood pressure.

age 50.9 years, mean disease duration at baseline 9.2 years) remained employed. The longitudinal course of work participation in OA has not yet been completely described.

## DISCUSSION

*Main findings.* Many individuals with OA had paid work, and OA could not be proven to be a strong reason for leaving the work force through sick leave or early retirement. Occupational limitations and reduced work capacity or job effectiveness were reported more frequently by patients with OA than by controls. Sick leave mostly did not differ from healthy populations. Work adaptations were measured only occasionally; however, they were revealed as important factors that may precede changes such as leaving the work force<sup>30</sup>. Because of its high prevalence, OA was a significant factor in longterm disability statistics<sup>27</sup>. As a result of the differences among the studies, the magnitude could not be expressed quantitatively. Overall, it appeared that many patients with OA were faced with problems in their work, but only a relatively small proportion left the workforce because of these problems. However, the course of OA in relation to work participation has not yet been described completely; neither regarding changes in time, nor influencing factors.

*Search strategy.* Despite a broad search strategy that resulted in 1861 titles, only 14 studies were included. Many of the included studies reported on the effect on work only as a secondary or even lower outcome measure. The majority were designed for an overall assessment of the burden and the costs of OA for patients in a wide, but mainly higher, age range. Consequently, current effects on work were only relevant for subjects in their working years, which were often a small minority; errors of recall when answering retrospective questions on work in the past may have introduced bias into the estimation of relevant outcome measures. This resulted in a limited amount of relevant information or data that could not distinguish between workers and nonworkers. We confirmed the conclusion that studies on the effect of OA on work are still scarce<sup>22</sup>.

*Quality assessment.* At first a systematic difference was noticed between the 2 reviewers concerning applying the criteria specifically to the questions of our review. These were different from the primary questions that were frequently formulated in included studies. This dilemma was reflected in the  $\kappa$  scores for agreement between the reviewers. An example is that OA was associated with older age and comorbidity and that patients frequently had limited education<sup>26,29</sup>. These factors are well-known determinants of a lower work participation rate. Therefore the results of studies that included mainly older individuals were probably confounded and the effects on work were not independently determined by OA. Discussions in which the referee participated clarified this matter and thereafter consensus was easily reached.

The diagnostic methods to determine OA varied from self-report or patient report of a physician's diagnosis, to

physician diagnosis and/or radiological assessment. Besides that, all studies included patients with complaints of knee and/or hip, but sometimes also of other body regions. OA in the hands and the back may obviously have an added or different effect on work participation than knee or hip OA only. Four studies<sup>26,29,30,31</sup> used self-reported diagnosis only, which harmed the validity. The differences in diagnostic methods have probably led to the inclusion of different patient categories, which also hampered valid comparisons. On the other hand the association between OA-related impairments (radiological status, pain, stiffness) and limitations in activities is moderate<sup>40</sup>, while participation in work is a result of even more factors and interactions among these factors. From this perspective, in future studies on this issue the aspects of body structures and functions, activities, and participation should be validly measured<sup>41</sup> to enable appropriate analyses of the relations between them.

Several outcome measures were reported, for example, work status, sick leave, work disability, reduced productivity, lost work days, and work transitions; the amount of information was often very limited. Definitions or standardization of these variables were not always presented and different methods were used for measurement. This has limited interpretation and made comparison of the results of these studies more difficult. Differences in conceptualization and outcome measurements have been addressed<sup>42</sup>. Standardized instruments for work-related outcomes need to be studied better and applied in research more often<sup>43,44,45</sup>.

*Implications.* Occupational and ergonomic interventions may be applied more often to help people to stay in their jobs and to prevent progression of work-related complaints and limitations<sup>46</sup>. Patients who cannot meet job demands should be supported in attempts to switch to another job that matches their physical capacity<sup>7,30,47,48</sup>. Our review demonstrated that limited research has been performed on the time course of work participation in OA. The critical periods that precede an employee's decision to leave the workforce because of OA have hardly been analyzed. Extrapolations and projections based on the current literature may have overestimated the effect of OA on work, because studies appear to have included mainly patients with relatively severe complaints or long disease duration, while patients who are functioning well in their work were outside the scope of research.

*Limitations of the review.* The question of the effect on work of disease progress and duration could not be answered adequately, since the continuum from early complaints through more progressed stages until joint replacement was not covered in the review literature. A number of studies have been published<sup>49,50,51,52,53</sup> of work participation by subjects awaiting or having had surgical interventions such as total hip arthroplasty (THA) or total knee arthroplasty (TKA). These operations are carried out almost exclusively for OA, but the manuscripts did not meet the inclusion criteria of our review. Considering the increase in THA and TKA, their application

at younger ages and the progress in surgical techniques, evaluating their effect on work participation and return to work is relevant.

We realize that most of the included studies were not primarily designed to answer our research questions regarding work outcomes. As a consequence, bias and confounding with regards to this outcome measure may have been introduced in some studies and precautions should have been taken in extrapolations to conclusions on the effect of OA on work. Valid information on the influence of job type and workload was not reported either. We believe this is the first systematic review that revealed these methodological shortcomings, and its value is that we gathered basic insight into the issue of OA and work.

**Recommendations.** Studies on the effect of OA on work participation should preferably include both working and non-working individuals with OA and compare these to both working and nonworking controls, over a longer period of time. Cohort studies with a followup of at least 5 years could yield valuable information. Different stages of disease progress should be studied and body sites of OA specified, as well as specific aspects of work participation. Multivariable regression analysis should be applied to control for confounding factors such as age, comorbidity, and education level.

Work is an important aspect of people's social participation, irrespective of their health condition. Staying at work depends on several critical factors, and specific interventions may be needed to reinforce the work ability of patients with OA. To support their work participation, this issue should be addressed regularly in contacts with healthcare professionals.

In this review, a mild negative effect of OA on work participation was found. Many patients with OA may experience difficulties in their work, but they seem to cope with it. However, the longitudinal course of work participation in OA has not been described completely. Considering the need for increasing numbers of people to continue working at an older age, this issue needs attention in well-designed studies and in clinical practice.

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## APPENDIX. Criteria list details.

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### Criteria

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#### Study population

- a) Study population: positive if there is no disproportionate inclusion of either relatively healthy patients or patients with severe complaints.
- b) Source population: positive if this was described in terms of place of recruitment (e.g., Amsterdam, the Netherlands), time-period of recruitment, and sampling frame of source population. Negative if  $\leq 2$  features of the source population are given.
- c) Relevant inclusion and exclusion criteria: positive if these have been described.

#### Determinant: OA

- d) Standardized or valid OA diagnosis: positive if OA is diagnosed by physician and/or by radiology.
- e) Potential prognostic factors included: positive if the report describes, besides the socio-demographic factors (age and sex), at least 1 other factor of the following at baseline:
  - 1) Highest education level
  - 2) Physical/disease factors (e.g., severity of pain, stiffness and disability)
  - 3) Job type (white/blue collar, business sector)
  - 4) Comorbidity
  - 5) Insurance system-related factors (e.g., financial compensation, litigation)
- f) Standardized or valid measurements of the potential prognostic factors: positive if at least 1 of the factors of e), excluding age and sex, are reported in a standardized or valid way (for example, by means of a questionnaire, a diary, or an objective measurement such as the Western Ontario and McMaster Universities Osteoarthritis Index or the Insurance Data Base)
- g) Data presentation of most important prognostic factors: positive if frequencies, or percentages, or mean (and SD/CI), or median (and interquartile range) are reported for the 3 most important prognostic factors of e): age, sex, and  $\geq 1$  other factor, for the most important followup measurements.

#### Outcome: e.g., work participation, sick leave

- h) Relevant outcome measures: positive if besides "complaints" in terms of symptoms (e.g., pain)  $\geq 1$  other outcome criterion for "participation, sick leave, etc." is reported, such as:
  - 1) Having a paid job (or not)
  - 2) Lost days of work or return to work
  - 3) Work adaptations (changing job/work hours/work place/etc.)
  - 4) Early retirement
  - 5) Difficulties getting/keeping a job
- i) Standardized or valid measurements of outcome measures: positive if  $\geq 1$  of the main outcome measures of h) (having a job/lost days of work) are reported in a standardized or valid way (for example, by means of a questionnaire, a diary, or an objective outcome measure such as registration of lost working days or receiving work disability compensation according to a register/database).
- j) Data presentation of most important outcome measures: positive if frequencies, percentages, or mean (and SD/CI), or median (and inter quartile range) are reported for  $\geq 1$  of the main outcome measures for the most important followup measurements.

#### Analysis

- k) Appropriate multivariable analysis: positive if appropriate multivariable techniques are used, such as logistic regression analysis or survival analysis for dichotomous outcomes, or linear regression analysis for continuous outcomes. Negative if no multivariable techniques are performed at all.
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