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Course of Functional Status and Pain in Osteoarthritis of the Hip or Knee: A Systematic Review of the Literature

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Objective. To systematically review studies describing the course of functioning in patients with osteoarthritis (OA) of the hip or knee and identifying potential prognostic factors.

Methods. A systematic search was performed. Studies involving patients with hip or knee OA, >6 months of follow-up, and outcome measures on functional status or pain were included. Methodologic quality was assessed using a standardized set of 11 criteria; a qualitative data analysis was performed.

Results. Approximately 6,500 titles and abstracts were screened and 48 publications were considered for inclusion. Eighteen studies, 4 of which met the high methodologic quality criteria, were included. For hip OA, there was limited evidence that functional status and pain do not change during the first 3 years of follow-up. After 3 years, however, a worsening of functional status and pain was seen. For knee OA, there was conflicting evidence for the first 3 years and limited evidence for worsening of pain and functional status after 3 years. Furthermore, limited evidence was established for negative associations between future functional status and laxity, proprioceptive inaccuracy, age, body mass index, and knee pain intensity. In contrast, greater muscle strength, better mental health, better self-efficacy, social support, and more aerobic exercise were protective factors in the first 3 years.

Conclusion. Pain and functional status in hip or knee OA seem to deteriorate slowly, with limited evidence for worsening after 3 years of follow-up. In specific subgroups, prognosis in the first 3 years of follow-up was either worse or better, as both risk factors and protective factors were identified. Prognostic factors included biomechanical factors, psychological factors, clinical factors, and treatment modalities. To strengthen the evidence, further high-quality longitudinal research on hip or knee OA functioning is needed.

INTRODUCTION

Patients with osteoarthritis (OA) of the hip or knee often experience pain and problems with daily activities. The disease frequently leads to disability, especially in elderly patients (1,2). Little is known, however, about the course of disability over time in patients with OA. Rather than focusing on functional consequences, OA studies and reviews mostly assess radiologic progression and prognosis of radiologic changes over time (3–5). Evidence from these reviews suggests that deterioration of radiographic OA is common. Because results on the association between radiologic OA and functioning (6–8) are contradictory, information about functional course cannot be derived from studies on radiologic progression. Research on functional progression is limited and therefore has not yet been systematically reviewed and summarized.

The association between prognostic factors and disability in OA has been studied frequently in cross-sectional studies. Results have demonstrated that psychological factors (9–13), demographic and clinical factors (9,11,14), biomechanical factors (10,15,16), and treatment modalities (10,17) are associated with disability. It is not known, however, whether these factors also predict future disability. Therefore, the objective of this study was to systematically review studies that 1) describe the course of functioning in patients with OA of the hip or knee and 2) identify factors that predict functional outcome in patients with OA of the hip or knee.

MATERIALS AND METHODS

Literature selection.

A systematic search was carried out in the following databases: PubMed (1966 to March 2005), PsychINFO (1887 to March 2005), Cinahl (1982 to March 2005), and Embase (1974 to March 2005). The following search strategy was used: <osteoarthritis [mh] OR osteoarthritis [tw] AND (knee [tw] OR hip [tw] OR weight bearing [tw])> AND <cohort studies [mh] OR longitudinal studies [mh] OR follow-up studies [mh] OR prospective studies [mh] OR prognos* [tw] OR predict* [tw] OR course [tw] OR risk [tw] OR determinant* [tw]>. The search strategy was based on a strategy suggested for prognosis studies (18). The search was then extended by examining the private database of the Netherlands Institute for Health Services Research (NIVEL) library and scanning references of relevant publications. A study was included in the review if 1) the study population consisted of patients with OA of the hip and/or knee; 2) the study addressed changes in functional level over a period >6 months; 3) the study used ≥ 1 outcome measures that evaluated functioning (activities and participation, described in this study as functional status or pain) according to the International Classification of Functioning, Disability and Health (19); 4) the study was published in Dutch, English, German, or French; and 5) the study was a full-text article. Reviews and clinical trials were excluded. The focus on functioning in this article is in line with recommendations and guidelines on outcome measurement in OA by the Outcome Measures in Rheumatology Clinical Trials group (20) and the European League Against Rheumatism (21).

The first selection, based on titles and abstracts, was performed independently by 2 reviewers (GMD and CHME) using the criteria described above. This selection resulted in probable inclusion or exclusion. Disagreements were discussed. If disagreement persisted, the final inclusion decision was based on the full article. The second selection was performed using full articles. If there was disagreement, a third reviewer (CV) made the decision.

Assessment of methodologic quality.

The methodologic quality of each included study was independently assessed by 2 reviewers (GMD and CV) using a standardized set of 11 predefined criteria (Table 1). These criteria were based on lists of methodologic criteria used in previous reviews of prognosis and observational studies in the field of musculoskeletal disorders (5,22,23) and included items for both internal and external validity. Conflicting scores for the various items were discussed until consensus was reached. If disagreement persisted, a third reviewer (CHME) was consulted. Consistent with other studies, a study was rated as being high quality if at least 60% of the criteria were met. All items were assumed to be of equal importance and were not weighted.

[TABLE 1]

Data extraction and analysis.

Two reviewers (GMD and CV) systematically extracted the following information from the included studies: authors, year of publication, setting and study population, study design, outcome measures, prognostic factors, and results. If a study presented conflicting results on different outcome measures for functional status, results measured by a performance test were preferred over other outcome measures. If no performance test was applied, results measured by well-known and validated questionnaires, such as the Western Ontario and McMaster Universities Osteoarthritis Index, the Short Form 36, or self-perceived effect, were preferred (24). If more than 1 pain measure was applied, visual analog scale score results were reported.

Because the majority of the studies on the course of functional status or pain did not report statistical analyses, the following criteria for worsening and improvement were applied: worsening or improvement was present if 1) >60% of patients reported such outcome on a dichotomous scale; 2) the difference between improved patients and patients whose functioning deteriorated, measured on an ordinal scale, was $\geq 10\%$; or 3) the difference between baseline and follow-up functional status or pain on a continuous scale was $\geq 10\%$. Choosing 10% as a reference value was based on the fact that, if tested, all changes of 10% were found to be significant. Because statistical measures were given in the majority of the studies on prognostic factors, results (statistically tested) were presented.

Because OA is a slowly progressing disease, it is important to take length of follow-up into account when describing the results. A distinction was made between studies with a follow-up of 6–36 months and studies with a follow-up >3 years, because this criterion was used as a cut-off point for higher methodologic quality in our list of criteria for methodologic quality and in previous reviews (5,22,23).

Because the included studies were considered heterogeneous with regard to study population, study design, prognostic factors, and outcome measures, a qualitative data analysis (best-evidence synthesis) was performed (25). Levels of evidence were based on an earlier review of progress of hip OA (5). Levels of evidence are summarized in Table 2.

[TABLE 2]

A sensitivity analysis was performed, distinguishing between a follow-up period of ≤ 5 and > 5 years. Furthermore, the qualitative data analysis was repeated with 75% as a cut-off point for high methodologic quality instead of 60%.

RESULTS

After screening ~6,500 titles and abstracts, 48 publications were considered for inclusion. The inclusion process is shown in Figure 1. If studies were based on the same cohort and contained the same information, the most recent publication was included in the review (26,27). If studies of the same cohort presented different information, reported on different prognostic factors (28,29), or presented results after different follow-up periods (30,31), both studies were included. In total, 18 studies were included in this review (27–44). A list of excluded studies is presented in Appendix 1 on the NIVEL Web site (available at: http://www.nivel.nl/systeem/scripts/downloadtracker.asp?download=http://www.nivel.nl/pdf/CARPA_review_AC&R_appendix.doc).

[FIGURE 1]

Study characteristics.

All included studies were cohort studies. Twelve collected data prospectively (28,30–33, 35,37,38,40–43) and 3 used retrospective data collection methods (27,34,39). The other 3 articles used both prospective and retrospective data collection methods (29,36,44). The study population in 14 of the included studies consisted of patients with knee OA. Patients with hip OA were included in 3

studies (27,35,42). One study included patients with knee OA as well as patients with hip OA (32). The mean follow-up period ranged from 6.7 months to 16 years. In most studies, patients were recruited from hospitals. Six studies, however, recruited patients from the community (28–31,35,37). One study provided no information on patient recruitment (36). A detailed description of the included studies is presented in Appendix 2 on the NIVEL Web site (available at: http://www.nivel.nl/systeem/scripts/downloadtracker.asp?download=http://www.nivel.nl/pdf/CARPA_review_AC&R_appendix.doc).

Methodologic quality.

Overall agreement on methodologic quality scores between reviewers was 87%. Four articles were high quality (31–33,41) and 14 were low quality. The mean methodologic quality score was 49% (range 27–73%). In general, studies scored better on items of internal validity than on items of external validity. None of the studies fulfilled all criteria. Authors of the included studies and the methodologic quality scores are presented in Table 3.

[TABLE 3]

Hip osteoarthritis.

Results on course of functional status and pain in hip OA. Of the 4 studies on the course of functional status in hip OA (27,32,35,42), 1 was high quality and reported on the course of functional status and pain in the first 3 years of follow-up (32). No change in functional status and pain was found in this study, providing limited evidence that functional status and pain in hip OA did not change during the first 3 years of follow-up. The same study, however, found a deterioration of functional status and pain after a period of >3 years (32), providing limited evidence for worsening of functional status and pain in hip OA after >3 years of follow-up (see Table 4).

[TABLE 4]

Results on prognostic factors in hip OA. Because there were only low-quality studies on prognostic factors for functional outcome in hip OA (27,35,42), no evidence was found on prognosis in hip OA.

Knee osteoarthritis.

Results on course of functional status and pain in knee OA. Of the studies that presented data on the course of functional status (31,32,34,36–38, 40,41,43), 3 studies were of high quality and reported on the first 3 years of follow-up. One study found an improvement in functional status (41), whereas the other studies both reported worsening of functional status (31,32). These results provide conflicting evidence on the course of functional status in the first 3 years of follow-up. Functional status was measured in one high-quality study with a follow-up period of >3 years (32). Worsening of function was reported in this study, providing limited evidence for worsening of functional status after >3 years of follow-up (see Table 4).

Of the 7 studies on the course of pain (32,36,39–41, 43,44), 1 high-quality study with a follow-up period of ≤3 years found no change in pain (32), whereas another study reported improved pain scores (41). These findings provide conflicting evidence for the course of pain in the first 3 years of follow-up. In contrast, worsening of pain was found after a follow-up of >3 years (32), providing limited evidence for worsening of pain after a period >3 years (see Table 4).

Results on prognostic factors in knee OA. Eight studies assessed prognosis of future functional status (28–31, 33,34,41,43). Most prognostic factors of future functional status, however, were studied in 1 high-quality article with a follow-up period of ≤3 years (31). Results provide limited evidence that increased laxity, proprioceptive inaccuracy, age, body mass index (BMI), knee pain intensity, and increased knee pain elevate the likelihood of deterioration of functional status in knee OA in the first 3 years of follow-up. The results furthermore provide limited evidence that greater muscle strength, better mental health, better self-efficacy, social support, and more aerobic exercise decrease the likelihood of functional deterioration. There is also limited evidence for a lack of association between future functional status in the first 3 years of follow-up and the following prognostic factors:

alignment, sex, physical activity, role functioning, comorbidity, marital status, severity of OA, and presence of bilateral OA. Radiologic changes were studied as a prognostic factor of future functional status in 2 high-quality studies. Of these 2, one study observed that more severe joint space narrowing increased the risk of functional deterioration (41). The other study found no association between radiologic changes and future functional status (33). Therefore, conflicting evidence is provided for an association between radiologic changes and future functional status in the first 3 years of follow-up. These findings are summarized in Table 5. No high-quality studies were found on the association of prognostic factors and future functional status that followed patients for >3 years. Thus, no evidence was provided.

[TABLE 5]

Table 5 also presents results on the relationship between prognostic factors and future pain. Of the 4 studies that presented data on prognosis of pain (33,34,40,43), 1 highquality study (33) provided limited evidence for a lack of association between radiologic changes and pain in the first 3 years of follow-up. Because no high-quality studies were found with a follow-up period exceeding 3 years, no evidence was provided.

Sensitivity analyses.

Studies with methodologic quality scores exceeding 75% were not available. Changing the cut-off score to 75% therefore established no evidence in either hip or knee OA. If a distinction was made between studies with a follow-up period ≤ 5 years and > 5 years, results of the qualitative data analysis were unchanged.

DISCUSSION

This review summarizes results on the course and prognosis of functional status and pain in hip or knee OA. In all, there was limited evidence that functional status and pain deteriorate after >3 years of follow-up in both hip and knee OA. There also was limited evidence that deterioration of functioning can be seen in the first 3 years of follow-up in specific patient groups with knee OA, because certain prognostic factors of future functional status and pain were identified. Increased laxity, proprioceptive inaccuracy, older age, greater BMI, greater knee pain intensity, and increased knee pain elevate the risk of deterioration of functional status during the first 3 years of follow-up. Furthermore, greater muscle strength, better mental health, better self-efficacy, social support, and more aerobic exercise can be seen as protective factors, decreasing the risk of deterioration of functional status in the first 3 years of follow-up. Conclusions, however, lack solidity because the results were derived from only 1 study on prognostic factors for functional status with a follow-up period of ≤ 3 years (31).

Previous results from cross-sectional studies suggested there was no or only a weak association between radiologic changes and functioning. In the present review, this ambiguous relationship was confirmed by the results of longitudinal studies, emphasizing the need to focus on functional rather than radiologic consequences. Such functional focus is furthermore important because knowledge of functional consequences is essential for the development of optimal rehabilitation programs in patients with OA.

Disease duration or symptom duration is a significant aspect in the course of both functional status and pain. Instead of grouping the studies according to follow-up period, it might be more accurate to classify according to duration of disease or symptoms. Unfortunately, such classification was unfeasible in this review, because only a few included studies provided information on duration. Symptom or disease duration should play a prominent role in future research on the course of functioning.

In this review, some methodologic choices were made with regard to search strategy, study population, follow-up period, outcome measures, methodologic quality, and interpretation of the results. Although well-thought decisions were made, some issues must be considered. First, when comparing the number of studies found with the number of studies included in this review (~6,450 studies were excluded on the basis of titles and abstracts), one sees that the search strategy was not very specific. Narrowing the search by adding terms on functional outcome measures limited the

number of studies found. This, however, resulted in missing significant articles on functional course in OA. Therefore, it was decided to use the broader search strategy in this review.

Second, opinions with regard to inclusion and exclusion criteria for OA differed in the articles. Radiologic criteria (27–30,34,38,39,43,44) or a combination of radiologic criteria and clinical symptoms (31–33,35–37,40,42) were used in most of the studies. One study included patients diagnosed on the basis of American College of Rheumatology criteria (41,45,46). There were also studies in which patients with hip or knee pain were included as an OA population. In this review, however, only studies with separate analyses of patients with hip and knee OA (based on radiologic and/or clinical criteria) were included. Studies of general populations, such as individuals with knee pain or the elderly in general without stratified analyses of OA subgroups, were not included. As a consequence, a recent high-quality study by Peters et al (47) was excluded. Although most patients in this study were considered to have OA, no separate analyses were presented. In this study, disability (including pain) worsened over 7 years and comorbidity was associated with greater deterioration in both hip and knee disease. Other factors associated with deterioration included lower social class, retirement, and higher BMI.

Third, a variety of outcome measures and instruments were used. Because psychometric properties of outcome measures differ, researchers should make a considered choice in which instrument to use. In all, the use of valid and reliable instruments clearly improves the quality of both future clinical trials and descriptive studies. Uniformity in instruments will facilitate the summarizing of findings on the functional course in patients with OA.

Fourth, contrary to a previous review on progression of radiographic OA (5) using only internal validity items, we applied both internal and external validity criteria to score methodologic quality. In our opinion, both validity aspects are important in studies of clinical course and prognostic factors (22,48). Because studies scored better on items of internal validity, we may conclude that using both internal and external validity criteria is stricter than using just internal validity criteria.

Lastly, choices were made with regard to the definition of improvement or worsening of functional status and pain. We believe that our definition of improvement and worsening proved to be a useful tool in making the results presented in the studies explicit. We expect our definition may be of use in future reviews on prognosis in knee and hip OA.

In conclusion, pain and functional status in hip or knee OA seem to deteriorate slowly, with limited evidence for worsening after 3 years of follow-up. In specific subgroups, the prognosis in the first 3 years of follow-up is either worse or better, as both risk factors and protective factors were identified. Prognostic factors included biomechanical factors, psychological factors, clinical factors, and treatment modalities. Evidence, however, was provided by one highquality cohort study. To strengthen the evidence, there is a need for further high-quality longitudinal research on functioning in hip or knee OA.

TABLES AND FIGURE

Table 4. Results of the qualitative data analysis on studies describing functional status and pain in hip and knee osteoarthritis*		
	Hip osteoarthritis	Knee osteoarthritis
Length of followup ≤3 years		
Functional status	No change†	Conflicting evidence
Pain	No change†	Conflicting evidence
Length of followup >3 years		
Functional status	Worsening†	Worsening†
Pain	Worsening†	Worsening†
* A distinction is made between studies with a followup period ≤3 years and studies with a followup period >3 years.		
† Limited evidence was provided in the qualitative data analysis.		

Table 1. Criteria used for methodologic quality	
Study population	Selection of the study population (positive if the study population consists of a series of consecutive patients)
	Description of inclusion criteria and exclusion criteria (positive if duration of illness is clearly described and osteoarthritis is defined using American College of Rheumatology criteria or Kellgren and Lawrence grades)
	Description of potential prognostic factors (positive if at least 6 of the following 11 items are reported at baseline: age, sex, clinical and disease characteristics, physical impairments, cognitive impairments, comorbidity, coping, emotional status, social support/social context, treatment and use of rehabilitation services/health care, use of aids and devices)
Study design	Prospective study design (positive if a prospective study design was used)
	Study size (positive if number of patients included in the study exceeds 100)
Followup	Followup period (positive if followup period is ≥ 36 months)
	Number of dropouts and loss to followup (positive if total number of dropouts/loss to followup is $\leq 15\%$ when followup period is < 36 months or $\leq 20\%$ when followup period is > 36 months; if a retrospective study design was used, a negative score was assigned)
	Description of dropouts and loss to followup (positive if dropouts and loss to followup are specified, i.e., if demographic/clinical information is presented for completers and withdrawals)
Outcome measures	Outcome measures (positive if at least 2 of the 4 following outcome measures are used: perceived disability in physical activities, performance, quality of life, and pain)
Analysis and data presentation	Frequencies of the primary outcome measures (positive if frequency or percentage [or mean and standard deviation/confidence interval] of at least 1 of the 4 following outcome measures is presented for each followup measurement: perceived disability in physical activities, performance, quality of life, and pain)
	Appropriate analysis techniques (positive if appropriate techniques were used in the data analysis and sample size is adequate in relation to number of prognostic variables [10:1])

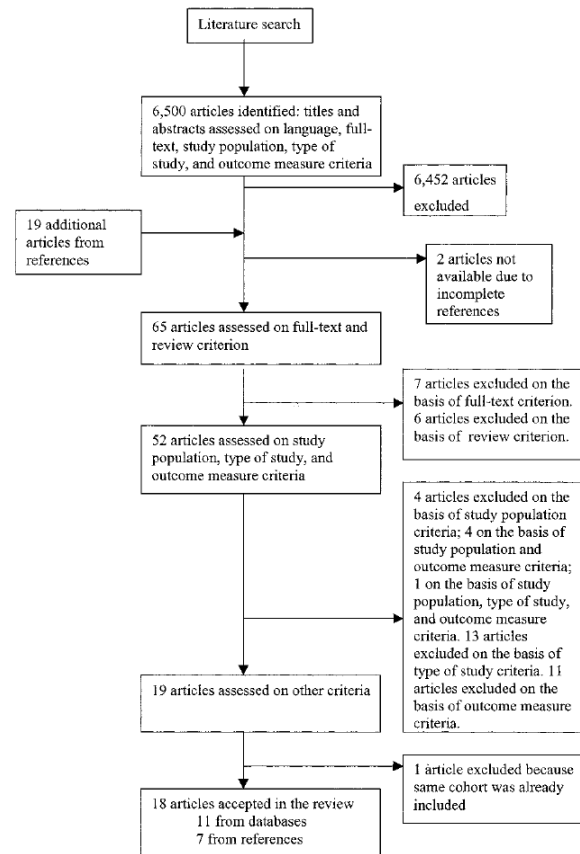


Figure 1. Literature search to find articles on the course of functional status and pain in hip or knee osteoarthritis.

Table 2. Levels of evidence that were applied in the qualitative data analysis (best-evidence synthesis)	
Strong evidence	Generally consistent findings in multiple high-quality cohort studies
Moderate evidence	Generally consistent findings in 1 high-quality cohort study and ≥ 2 high-quality case-control studies, or in ≥ 3 high-quality case-control studies
Limited evidence	(Generally consistent) findings in a single high-quality cohort study, or in ≤ 2 high-quality case-control studies
Conflicting evidence	Conflicting findings in high-quality studies (i.e., $< 75\%$ of the studies reported consistent findings)
No evidence	No high-quality studies could be found

Authors, year of publication	MQ
Dieppe et al, 2000 (32)	73%
Sharma et al, 2003 (31)	64%
Dougados et al, 1992 (41)	64%
Dieppe et al, 1997 (33)	64%
Ledingham et al, 1995 (43)	55%
Massardo et al, 1989 (36)	55%
Miller et al, 2001 (37)	55%
Ledingham et al, 1993 (42)	46%
Sharma et al, 2001 (30)	46%
Davis et al, 1991 (28)	46%
Dieppe et al, 1993 (40)	46%
Spector et al, 1992 (44)	46%
Ettinger et al, 1994 (29)	46%
Odenbring et al, 1991 (38)	36%
Hernborg and Nilsson, 1977 (34)	36%
Auquier et al, 1979 (27)	36%
Lane et al, 2004 (35)	31%
Berkhout et al, 1985 (39)	27%

* A complete overview of the study characteristics can be found in Appendix 2 on the NIVEL Web site (available at: http://www.nivel.nl/systeem/scripts/downloadtracker.asp?download=http://www.nivel.nl/pdf/CARPA_review_AC&R_appendix.doc). MQ = methodologic quality score (a study was rated high quality if at least 60% of the criteria were met).

	Risk factor†	Protective factor†	No association found†
Future functional status	Increased laxity; proprioceptive inaccuracy; older age; greater BMI; greater knee pain intensity; increased knee pain (from baseline to followup)	Greater muscle strength; better mental health; better self-efficacy; social support; more aerobic exercise	Alignment; sex; physical activity; role functioning; comorbidity; marital status; severity of OA; presence of bilateral OA
Pain			Radiologic changes

* OA = osteoarthritis; BMI = body mass index.
 † Limited evidence was provided in the qualitative data analysis.

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