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Familial osteorarthritis : risk factors and determinants of outcome

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Activity limitations in the lower extremities in patients with osteoarthritis: the modifying effects of illness perceptions and mental health

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Abstract

Objectives

Using the International Classification of Functioning, Disability and Health as framework, we evaluated modifying effects of illness perceptions and mental health on the association between impairments in body structures and functions due to osteoarthritis (OA) and limitation in activities in the lower extremities.

Methods

Self-reported limitation in activities was assessed by the WOMAC function subscale in 316 patients with knee or hip pain or evidence of OA on knee or hip radiographs. Body structures and functions were evaluated during clinical and radiological assessments. Illness perceptions and mental health were assessed with the revised Illness Perception Questionnaire (IPQ-R) and RAND-36 mental component summary score, respectively. For each patient an expected WOMAC function score was calculated, using an equation based on a multivariate model of the association of body structures and functions with limitation in activities.

Results

The median (interquartile) self-reported WOMAC function score was 22.2 (9.6-43.5). 91 patients reported more and 120 patients reported less limitation in activities than expected. Patients with lumbar spine degeneration, physical or exercise therapy and high IPQ-R identity, consequences and chronic timeline scores had an increased risk to report more limitation in activities than the expected range. Low IPQ-R identity, consequences and emotional representation scores and better mental health were associated with reporting less limitation in activities than the expected range.

Conclusion

Illness perceptions and mental health modify the association between self-reported limitation in activities and calculated limitation in activities based on impairments in body structures and functions due to OA.

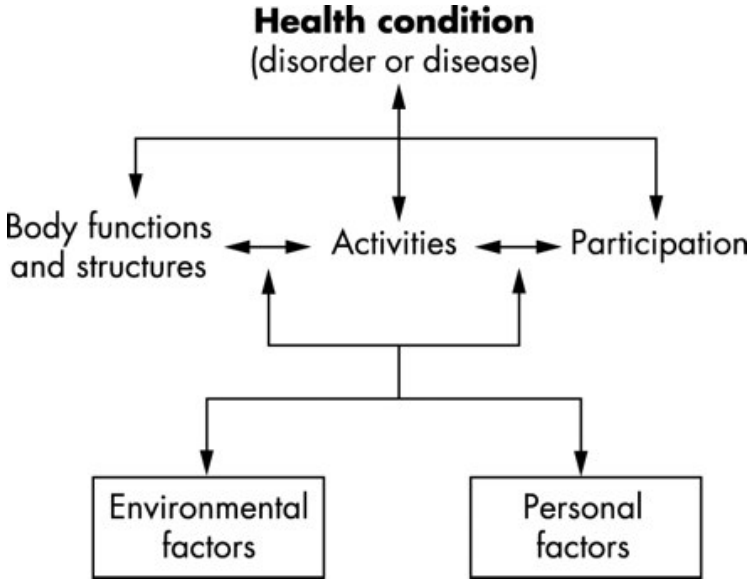
Keywords

Osteoarthritis, Disability, ICF, Illness perceptions, Mental Health

Introduction

Osteoarthritis (OA) is the most prevalent musculoskeletal disorder and is often associated with some degree of functional impairment and disability. Since it is a common reason for utilizing health care resources, understanding of the factors involved in disability is important for patients with OA as well as for society.

Figure 1. The current framework of disability-World Health Organization International Classification of Functioning, Disability and Health (ICF) [1].



New models of disability suggest that disability is not primarily the consequence of disease processes. Rather, they acknowledge the potential exacerbating or buffering roles of other factors. The World Health Organization (WHO) developed a multidimensional framework, the International Classification of Functioning, Disability and Health (ICF) (figure 1) [1], that can be used when investigating disability by providing a multi-perspective approach for the classification of disability. The ICF classifies functioning in the activity and participation component. The health-related component is classified into two dimensions: body structures, including categories such as cartilage, bone and soft tissues and body functions, including categories such as pain and mobility in the joints. Additionally, the ICF describes personal and environmental factors that can modify the association between body structures and functions and activity and participation. In OA, it is well recognized that disability is not always associated with the OA disease process itself and that in some patients there is a discrepancy between objective measures of changes in joints due to OA and disability outcomes. Psychological factors, such as learned helplessness, mood, pain coping, and self-efficacy have been shown to be potential modifying personal factors in OA [2-7].

More recently the variation in the ways in which patients adapt to illness has been examined according to the self-regulation model [8;9]. Self-regulation theory proposes that patients create their own cognitive representation of and an emotional reaction to their illness, which play an important role in influencing a person's adjustment to illness. Research on the structure of cognitive representations suggests that patients develop a working model of what the illness is, its effects, why it has happened, how long it will last and whether it can be cured or controlled [10]. Studies on illness perceptions across a range of illness conditions provide empirical support that illness perceptions predict health outcomes [11]. Also, interventions targeting unhelpful illness perceptions have proved useful in enhancing treatment outcomes for people with myocardial infarctions [12], and in reducing disability in low back pain [13].

To date, only a relatively small number of studies have adopted the self-regulation approach to investigate activity limitation in rheumatoid arthritis [14-18], and osteoarthritis [19;20]. From these studies it seems that patients' beliefs about the number of symptoms associated with arthritis, the perceived physical, emotional and economic consequences of the illness, and perceived control over the illness are consistently related to limitation in activity.

In these studies, the effect of the psychological factors on disability was investigated for the study population as a whole. Using the ICF as framework, we analyzed disability in the present study based on the premise that in some patients there is a discrepancy between impairments in body structures and functions due to OA and limitation in activities in the lower extremities. We separately examined the modifying effects of personal factors in patients reporting less and patients reporting more limitation in activities than what would be expected based on impairments in body structures and body functions. We thought that there would be a difference in the modifying effect of these factors between the two groups of patients, since different mechanisms could underlie the discrepancies in the two groups.

Methods

Design

The present study is part of the GARP (Genetics, ARthrosis and Progression) study, which is primarily aimed at identification of genetic determinants of OA in a population comprising Caucasian sib-pairs of Dutch ancestry. The GARP study was approved by the Medical Ethics Committee of the Leiden University Medical Center. These well-documented patients also allowed us to investigate the modifying effects of psychological factors on the association between body structures and functions and limitation in activities due to OA.

Patients

Details of recruitment and selection of patients have been described elsewhere [21]. In brief, patients (probands) between 40 and 70 years of age with OA, diagnosed by rheumatologists, orthopedic surgeons and general practitioners were informed of the ongoing study by mail. A questionnaire

about demographic data, medical history, symptoms and signs and family history of OA was mailed to interested probands. Subsequently, eligible probands were requested to introduce a sibling "with joint complaints". Between August 2000 and March 2003, 191 probands and 202 siblings, both with OA, were included in the GARP study after giving informed consent.
Patients with secondary OA, familial syndromes with a Mendelian inheritance pattern or a shortened life expectancy were excluded. Post-traumatic OA (unless there was an intra-articular fracture), crystal deposition arthropathies (unless in the case of severe polyarticular gout), and diabetes mellitus or thyroid conditions were not considered as exclusion criteria.

OA diagnosis

Probands and siblings were required to have symptomatic OA (as defined below) preferably in at least two joint sites in the hands or at two or more of the following joints sites: hands, spine (cervical or lumbar), knees or hips. Patients with symptomatic OA in just one joint site were required to have structural abnormalities in at least one other joint site defined by the presence of radiographic OA in either of the four joint groups or the presence of two or more Heberden nodes, Bouchard nodes or squaring of at least one CMC1 joint on physical examination of the hands.
Symptomatic knee OA was defined as pain or stiffness on most days of the prior month and osteophytes at joint margins of the tibiofemoral joint [22]. Symptomatic hip OA was defined as pain or stiffness in the groin and hip region on most days of the prior month in addition to femoral or acetabular osteophytes or joint space narrowing on radiograph [23]. Joint prostheses in hips or knees for end stage OA were included as OA in that particular joint. Symptomatic degeneration of the spine (cervical and lumbar) was defined as pain or stiffness on most days of the prior month in the spine in addition to a Kellgren-Lawrence score of two in at least one disc or one apophyseal joint. Symptomatic OA in hand joints was defined as pain or stiffness on most days of the prior month in addition to 3 of the following 4 criteria: bony swelling of 2 or more of the 10 selected joints (bilateral DIP joints 2 + 3, bilateral PIP joints 2 + 3 and CMC 1 joints), bony swelling of 2 or more DIP joints, less than 3 swollen MCP joints and deformity of at least 1 of the 10 selected joints [24].
In the present study, we excluded patients with hip or knee prostheses (n=50); and patients who had no pain in knees or hips for most days of the prior month or no evidence of OA on knee or hip radiographs (n=26).

Radiographs

Standardized radiographs of the knees (Posterior-Anterior [PA] weight-bearing, fixed-flexed views and lateral supine views), hips (PA weight-bearing) and lumbar spine (PA lateral, supine) were obtained and scored by a single experienced musculoskeletal radiologist (HK) according to the Kellgren-Lawrence method [25]. For the radiographic severity of OA in the lower extremities, a Kellgren-Lawrence total score was calculated by adding the grades of left and right tibiofemoral joints and left and right hips (range 0-16). Patellofemoral joints were scored for the presence of patellofemoral osteophytes according to the consensus of two readers (SB, HK) and defined by a score of ≥ 1 in at least one knee [26].

Clinical Assessments

Standardized questionnaires were used to record age, sex, body mass index (BMI) (weight/height^2), current use of pain medication (paracetamol or nonsteroidal anti-inflammatory drugs), current physical or exercise therapy and the presence of comorbidities, including diabetes mellitus, hypertension, cardiovascular disease, cerebrovascular disease and peripheral vascular disease.

During physical examination, the presence of knee joint effusion and malalignment was assessed. Range of joint motion was measured (in degrees) in the knees (flexion and extension) and hips (flexion and endorotation) using a goniometer. Z scores were calculated for the separate measurements to avoid weighting problems due to different ranges in scores. A standardized total range of motion score was composed by adding all the Z scores and then dividing it through the standard deviation of the sum score. Joint pain on movement was assessed separately in each knee and hip and graded on a 0-3 scale (3 maximal tenderness) and summed to obtain a joint pain total score, ranging from 0-12.

Psychological measures

The revised version of the Illness Perceptions Questionnaire (IPQ-R) [27] was completed by 266 of the patients. The IPQ-R consists of two sections, with 8 subscales that provide information about the components that underlie both cognitive and emotional representation of illness. The first section, the identity component, is concerned with symptoms the patient associates with OA. Patients were asked whether or not they have experienced fourteen commonly occurring symptoms since their illness and also if they believed these symptoms were related to their OA. The sum of the yes-rated items on the second question formed the identity subscale.

The second section of the IPQ-R consists of statements rated on a five-point Likert scale and provides separate scores for the following 7 subscales: consequences (an individual's beliefs about illness severity and impact on physical, social and psychological functioning), acute or chronic timeline (perceptions of likely chronic duration of their health problems), cyclical timeline (perceptions of likely variability of their health problems), illness coherence (how much patients comprehend or understand their illness), personal control (belief in personal control over illness), treatment control (belief in cure through treatment) and emotional dimensions (negative emotions generated by the illness). Items are coded so that high scores represent strong beliefs on the particular dimension. Although the revised version of the IPQ is a relatively new tool, data indicate reasonable psychometric properties [27].

Mental health was assessed with the mental component summary score (MCS) of the Dutch validated RAND 36-item Health Survey, including social functioning, role limitations, mental health and vitality [28;29]. A higher score indicates better mental health.

Assessment of limitation in activities

The function subscale of the Western Ontario and McMaster Universities (WOMAC) OA Index [30] was used to assess self-reported limitation in activities in the lower extremities. Patients were asked to report on the questions regarding their knees and hips and considering the last 48 hours. The 17

function items of the WOMAC function subscale have been linked to ICF categories, concerning mobility, self-care and domestic life, that belong to the component 'activities and participation' [31]. One patient with missing WOMAC functions items was excluded from the present analyses.

Statistical analyses

Data concerning body structures and functions in association with WOMAC function scores were analyzed using SPSS, version 11.0 (SPSS Inc, Chicago, Ill). Linear mixed models, with a random intercept to adjust for the familial effect within the sib-ships, were used for modeling. Univariate analyses were performed initially to examine associations between the disease variables and WOMAC function scores as dependent variables. Multivariate analyses were performed to show the independent effects of the body structure and function variables on WOMAC function scores. Estimates of fixed effects were reported with 95% confidence intervals.

We next calculated an expected WOMAC function score for each patient by using an equation based on the multivariate linear model of the association between the independent variables, body structures and functions and limitation in activities, assessed by WOMAC function scores, as described in the former paragraph: calculated WOMAC function score = intercept + $a_1X_1 + a_2X_2 + a_3X_3$ etc, where a is the coefficient of each factor X and describes the slope of the regression line. The amount of discrepancy between disease and disability was defined as the difference between the self-reported and calculated expected WOMAC function scores.

Finally, the modifying effects of illness perceptions and other factors were analysed in the same study population. Potential modifying factors were investigated separately in patients who had a higher (by 10 or more points) self-reported than expected WOMAC function score and in patients who had a lower (by 10 or more points) self-reported than expected WOMAC function score. Both groups were compared with patients who had a self-reported WOMAC function score that was around (within a range of 10 points) the expected WOMAC function score. Changes of 10 points on the WOMAC scale were regarded as minimal perceptible clinical changes in patients with hip and knee OA [32].

Categorical modifying factors were analyzed according to their presence or absence. Continuous variables concerning illness perceptions and mental health were transformed into binary variables using the median value as the cut-off point in order to make the resuls easier to interpret. Crude and adjusted (age, sex and BMI) odds ratios (ORs) were calculated using logistic regression and are presented with 95% confidence intervals (CI95) and P values. To take into account the intra-family effect, robust standard errors were computed using the statistical program STATA 7.0 (StataCorp, Texas).

Table I. General characteristics of 316 patients with osteoarthritis at multiple sites.

Age, median (IQR)	59.1 (54.1-65.1)
Women, no. (%)	264 (83.5)
Body mass index (kg/m^2), median (IQR)	26.3 (23.9-29.6)
Symptomatic knee and / or hip OA, no. (%)[1]	173 (54.7)
Pain in knee and / or hip joints, no. (%)[2]	301 (95.3)
Radiological knee and / or hip OA, no. (%)[3]	207 (65.5)
WOMAC function score, median (IQR)	22.2 (9.6-43.5)

[1] Defined as knee pain or stiffness for most days of the prior month in addition to tibiofemoral or patellofemoral osteophytes on radiograph and / or pain or stiffness in the groin and hip region on most days of the prior month in addition to femoral or acetabular osteophytes or joint space narrowing on radiograph.
[2] Defined as pain in the knees, groin or hip region for most days of the prior month.
[3] Defined as tibiofemoral, patellofemoral, femoral or acetabular osteophytes or hip joint space narrowing on radiographs.

Table II. Impairments in body structures and body functions due to osteoarthritis (N=316).

Variable	Prevalence[1]	Univariate association with WOMAC function[3]	Multivariate association with WOMAC function[3]
Kellgren-Lawrence total score (0-16)	2 (1-4)	1.4 (0.4, 2.3)	-0.1 (-0.0, 0.9)
Patellofemoral osteophytes, no. (%)	125 (39.6)	4.0 (-1.2, 9.3)	-
Knee effusion, no. (%)	36 (10.5)	7.6 (-0.4, 15.6)	-
Knee malalignment, no. (%)	31 (9.8)	1.2 (-7.3, 9.7)	-
Total range of motion[2]	0.1 (-0.5-0.6)	-9.0 (-11.4, -6.6)	-6.6 (-9.3, -4.0)
Joint pain total score (0-12)	1 (0-2)	5.8 (4.3, 7.3)	4.4 (2.9, 6.0)

[1]Values are medians (interquartile ranges) or numbers of patients (percentages).
[2]Standardized score of total range of motion in knees and hips.
[3]Estimates of fixed effects on WOMAC function scores, presented per increase in or presence of each factor (95% confidence interval)

Results

Population description.

The general characteristics of the 316 patients (150 probands and 166 siblings) are shown in Table I; the median age was 59.1 years and 83.5% were women. Respectively 35.1%, 32.6% and 17.4% of the patients had symptomatic tibiofemoral, patellofemoral and hip OA. Symptomatic lumbar spine degeneration was present in 70.6% of the patients. The median (interquartile [IQR]) WOMAC function score was 22.2 (9.6-43.5).

Table III. The prevalence and distribution of personal and psychological factors[1].

Age, ≥ 60 years, no (%)	**138 (43.6)**
Women, no. (%)	264 (83.5)
Obesity (BMI ≥ 30 kg/m^2), no. (%)	70 (22.2)
Presence of comorbidity, no. (%)	99 (31.3)
Lumbar spine degeneration, no, (%)	223 (70.6)
Pain medication, no. (%)	182 (57.6)
Physical or exercise therapy, no (%)	92 (29.1)
IPQ-R subscales	
Identity (0-14)	5 (3-7)
Consequences (0-30)	17 (14-20)
Chronic timeline (0-30)	25 (24-29)
Cyclical timeline (0-20)	15 (12-16)
Personal control (0-30)	19 (17-22)
Treatment control (0-25)	14 (12-16)
Illness coherence (0-25)	18 (15-20)
Emotional representations (0-30)	14 (12-17)
RAND-36 MCS (0-100) [2]	82.2 (57.3-92.0)

[1] Values are medians (interquartile ranges) unless stated otherwise.

[2] RAND-36 mental component summary score

Table IV. The odds ratios for reporting more limitation than calculated.

Modifying factor	Crude OR (95CI) [1]	Adjusted OR (95CI) [2]	P value
Age, ≥ 60 years	1.2 (0.7-2.1)	1.2 (0.7-2.2)	0.484
Female sex	2.3 (0.9-5.6)	2.1 (0.9-5.1)	0.102
Obesity (BMI ≥ 30 kg/m^2)	2.1 (1.1-4.0)	2.1 (0.9-5.1)	0.104
Presence of comorbidity	1.4 (0.8-2.4)	1.1 (0.6-2.1)	0.690
Lumbar spine degeneration	3.7 (1.6-8.4)	3.9 (1.6-9.2)	0.002
Pain medication	1.9 (1.0-3.5)	1.6 (0.8-3.1)	0.153
Physical or exercise therapy	4.9 (2.2-10.8)	4.8 (2.0-11.3)	0.000
IPQ-R subscales			
Identity	2.6 (1.4-4.8)	2.4 (1.2-4.6)	0.011
Consequences	2.8 (1.4-5.3)	2.8 (1.4-5.5)	0.003
Chronic timeline	2.1 (1.2-3.7)	2.2 (1.2-4.0)	0.014
Cyclical timeline	1.5 (0.8-2.9)	1.4 (0.7-2.9)	0.310
Personal control	1.1 (0.5-2.0)	1.2 (0.6-2.3)	0.647
Treatment control	0.8 (0.4-1.5)	0.8 (0.4-1.5)	0.508
Illness coherence	0.7 (0.4-1.4)	0.8 (0.4-1.5)	0.456
Emotional representations	1.4 (0.7-2.6)	1.2 (0.7-2.3)	0.503
RAND-36 MCS (0-100)	0.7 (0.4-1.3)	0.7 (0.4-1.3)	0.292

[1] The crude odds ratios (95% confidence intervals) for having a self-reported WOMAC function score that was higher than the calculated WOMAC function score, given specific factors. (N=196)

[2] Adjustments were made for age, sex and body mass index.

Association between impairments in body structures and functions and self-reported WOMAC function scores.

In Table II the distribution of impairments in body structures and functions and their associations with self-reported WOMAC function scores are shown. In univariate analyses, Kellgren-Lawrence total scores, total range of motion and joint pain total scores were associated with WOMAC function scores. Subsequently, these variables were included into a multivariate linear model that showed that total range of motion and joint pain total scores were independently associated with WOMAC functions scores. An expected WOMAC function score was calculated for each patient using the equation: $Y = 22.8 + (-0.1 \times$ Kellgren-Lawrence total score$) + (-6.6 \times$ standardized total range of motion score$) + (4.4 \times$ joint pain total score).

Discrepancies between self-reported and expected WOMAC function scores.

The median (IQR) expected WOMAC function score was 25.8 (21.4-33.3). When self-reported and expected WOMAC function scores were compared, 105 (33.2%) patients had self-reported and expected WOMAC scores that were similar (less than 10 points difference). 91 (28.8%) patients reported more and 120 (38.0%) patients reported less limitation in activities than expected.

Table V. The odds ratios for reporting less limitation than calculated.

Modifying factor	Crude OR (95CI) [1]	Adjusted OR (95CI) [2]	P value
Age, ≥ 60 years	1.2 (0.7-2.0)	1.2 (0.7-2.1)	0.647
Female sex	0.8 (0.4-1.6)	0.8 (0.4-1.6)	0.610
Obesity (BMI ≥ 30 kg/m^2)	1.3 (0.6-2.5)	1.3 (0.6-2.5)	0.486
Presence of comorbidity	0.9 (0.5-1.5)	0.8 (0.4-1.4)	0.383
Lumbar spine degeneration	0.6 (0.4-1.1)	0.6 (0.4-1.1)	0.126
Pain medication	0.7 (0.4-1.2)	0.7 (0.4-1.2)	0.149
Physical or exercise therapy	0.7 (0.3-1.4)	0.7 (0.3-1.5)	0.340
IPQ-R subscales			
Identity	0.8 (0.4-1.3)	0.8 (0.4-1.3)	0.373
Consequences	0.5 (0.2-0.9)	0.5 (0.2-0.9)	0.009
Chronic timeline	0.9 (0.5-1.6)	0.9 (0.5-1.6)	0.809
Cyclical timeline	1.4 (0.8-2.6)	1.4 (0.8-2.6)	0.217
Personal control	1.7 (0.9-3.0)	1.7 (0.9-3.0)	0.075
Treatment control	1.6 (0.9-2.7)	1.6 (0.9-2.7)	0.135
Illness coherence	1.4 (0.8-2.4)	1.4 (0.8-2.4)	0.250
Emotional representations	0.4 (0.3-0.9)	0.4 (0.3-0.9)	0.021
RAND-36 MCS (0-100)	2.9 (1.7-5.0)	2.9 (1.7-5.0)	0.000

[1] The crude odds ratios (95% confidence intervals) for having a self-reported WOMAC function score that was lower than the calculated WOMAC function score, given specific factors. (N=225)

[2] Adjustments were made for age, sex and body mass index.

Reporting more limitation than expected.
The prevalence of personal and psychological factors and the ORs for reporting more limitation in activities than expected are shown in Table III and IV. Patients with lumbar spine degeneration and physical or exercise therapy had an increased risk to report more limitation in activities than the expected range. High IPQ-R identity, IPQ-R consequences and IPQ-R chronic timeline scores were associated with an increased risk to report more limitation in activities than the expected range.

Reporting less limitation than expected. The ORs for reporting less limitation in activities than expected is shown in Table V. High IPQ-R consequences and IPQ-R emotional representation scores were associated with a decreased risk to report less limitation in activities than the expected range. Patients with better mental health had an increased risk to report less limitation in activities than the expected range.

Discussion

In approximately two thirds of OA patients with involvement of the lower extremities, there was a discrepancy between limitation in activities, assessed by self-reported WOMAC function scores, and the expected WOMAC function scores based on impairments in body structures (Kellgren-Lawrence total score) and body functions (total range of motion and joint pain total score): 28.8% reported more and 38.0% reported less limitation in activities than expected. Reporting more limitation than expected was associated with illness perceptions, lumbar spine degeneration and physical or exercise therapy. Reporting less limitation in activities than expected was associated with illness perceptions and mental health.
When evaluating the role of illness perceptions in adjustment to OA in our study, several components were found to be important. Patients who strongly believed that more than 5 out of 14 common symptoms, such as breathlessness or nausea, were associated with their OA had an increased risk to report more limitation in activities than expected. Patients who strongly believed that OA had a large impact on their functioning and who strongly believed in the likely chronic duration of their OA also had an increased risk to report more limitation than expected. Patients who believed that OA had a small impact on their functioning and who experienced less negative feelings associated with their OA more often reported less limitation in activities than the expected range. These results are in line with earlier studies in OA patients. Patients with OA following joint replacement surgery, functional activity 9 months after surgery was higher amongst those patients that did not attribute their condition to growing older and that perceived more control over their symptoms [20]. Hampson et al. [19] found an association between perceiving OA as more intense (reporting more symptoms and perceiving OA as more serious) and greater use of health services, lower levels of physical functioning, and poorer quality of life. In patients with OA undergoing joint replacement surgery, those who perceived that their illness had more severe consequences were less functionally active pre-operatively. Functional adjustment 9 months after surgery was higher amongst those

patients who did not attribute their condition to growing older and who perceived more control over their symptoms [20]. These results and our findings suggest that restructuring the patient's cognitive representation is necessary if self-regulation of pain and disability is to be improved.

Further (preferably longitudinal) research is required to confirm the influences of illness perceptions on limitation in activities in patients with OA. In intervention studies it has been shown that self-management programs and cognitive behavioral therapies can produce significant reductions in OA patients' ratings of disability [33-35]. Our findings contribute to the knowledge needed to decide which cognitions should be targeted in such interventions. In the clinical setting it might be important to assess illness perceptions to identify patients who could benefit from these interventions and/or to discuss maladaptive illness perceptions to enhance consultation outcome.

An independent association between depressive symptoms and limitation in activities in patients with OA has been described [2;36]. Our study confirmed that the effect of good mental health is of importance in patients reporting less limitation in activities than expected based on their impairments in body structures and functions. This was however not the case in patients reporting more limitation in activities than expected.

In the present study we investigated the effects of modifying factors in patients who reported more limitation than expected separately from patients who reported less limitation than expected. The results showed that the influences of modifying factors, i.e. illness perceptions and mental health, are not similar in the two groups of patients. These results suggest that reporting more or less limitation in activities than expected based on impairments in body structures and functions are separate entities with different causations.

In earlier studies, obesity [3;36-38] and female sex [37;38] were associated with limitation in activities. In the present study, obesity modified the association between body structures and functions and activities in the univariate analysis for reporting more limitation than calculated, but this association was not significant after adjustment for age and sex. Female sex tended to do the same, even with the small number of men in the study. This is in accordance with surveys showing higher rates of joint symptoms or arthritis-related consequences for women than men [38]. Remarkable is that these tendencies were only present in patients reporting more self-reported limitation in activities than expected. In other words, female or obese patients, with a given burden of OA, tended to report more limitation in activities, but the reverse, that male or non-obese patients report less limitation, was not the case.

Patients with lumbar spine degeneration reported more limitation in activities than expected more often than patients without lumbar spine degeneration. The ICF classifies additional comorbid conditions as personal factors with potential independent modifying effects on limitation in activities. We considered lumbar spine degeneration as an additional condition, because the lumbar spine is not part of the lower extremities. Our results support the observation by Wolfe et al. [2], showing that low back pain influences disability in the lower extremities of patients with OA. Lumbar spine degeneration is rarely recorded in clinical trials in OA, while these findings have important implications for the interpretation of WOMAC function scores. The present findings suggest that evaluation of limitation in activities in the lower extremities of OA patients should include the lumbar spine.

Physical or exercise therapy have been reported to improve physical functioning, assessed by the WOMAC, in patients with OA of the knee [36;39]. Therefore, we expected that patients using physical or exercise therapy would report less limitation in activities than expected compared to patients not using physical or exercise therapy. The contrary however was the case. As expected, the patients that currently received therapy had slightly more impairments in body structures and functions than the patients without current or past therapy. The median joint pain total score and the median Kellgren Lawrence total score was higher in the patients with and than without current therapy. The median total range of motion in knees and hips was also lower in the patients with than without therapy. As a result of these differences, patients with current therapy had higher expected (calculated) WOMAC scores compared with patients without therapy, since the calculated score was based on the impairments in body structures and functions. However, despite this compensation, these patients reported even more limitation in activities than one would expect based on their impairments in body structures and functions. This could indicate that doctors prescribe non-pharmacologic therapy more often in this group of patients, but that the effect of therapy is not that large that patients report less limitation in activities.

This study has possible limitations. We did not obtain information on muscle strength and malalignment, which have been shown to influence disability in knee OA. The calculation of the expected WOMAC function scores for each patient as well as the analyses concerning potential modifying factors were performed in the same patient population. However, this was an exploratory analysis to get more insight in the discrepancy between disease and disability in OA and the modifying factors in this relationship. Due to the cross-sectional design of the study, causality cannot be established and future analyses of prospectively collected data on this cohort should be performed to allow confirmation of these results.

To conclude, our study shows the importance of modifying psychological factors, with respect to limitation in activities in patients with OA and the complexity of interactions between different aspects within the ICF framework.

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