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USING THE COMMON SENSE MODEL OF ILLNESS PERCEPTIONS TO EXAMINE OSTEOARTHRITIS CHANGE: A 6-YEAR LONGITUDINAL STUDY

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ABSTRACT

Objective. To examine the association between changes in common sense models and changes in functional status over a 6-year follow-up period in patients with osteoarthritis (OA).

Design. At baseline and follow-up, OA outpatients (N=241) recruited from a university medical center completed the Illness Perception Questionnaire-Revised (IPQ-R), the Australian/Canadian Osteoarthritis Hand Index and the Western Ontario and McMasters Universities Osteoarthritis Index. Also, their physician-assessed pain intensity, biomedical and clinical measures of medical severity of OA were recorded.

Main outcome measures. Functional disability, pain intensity.

Results. Over 6 years, functional disability and pain intensity increased. The IPQ-R dimensions of timeline, personal control and illness coherence became more negative, and emotional representations became less negative (i.e., more accepting). Patients identified as sharing a similar profile of negative changes on the IPQ-R had significantly worse functioning on 2 of 3 outcomes, independent of objectively measured OA severity.

Conclusions. Changes in illness perceptions were associated with changes in outcomes. Interventions to prevent increasingly negative patterns of illness perceptions over time, with an emphasis on strengthening control cognitions, may benefit functional status outcomes in patients with OA.

INTRODUCTION

The outcome of medical care for patients with chronic physical illness is determined to a considerable extent by nonmedical factors.[1] According to the Common Sense Model (CSM), illness perceptions (both cognitive and emotional) and coping responses are determinants of medical outcomes.[2] There is considerable evidence in support of various aspects of the CSM, although studies of processes by which illness perceptions change and the health consequences of these changes remain relatively rare.[3] The present study examined the association between changes in illness perceptions and changes in functional status over a 6-year follow-up period for patients with osteoarthritis (OA).

Longitudinal studies of illness perceptions for a chronic illness create the opportunity to examine whether illness perceptions change over time. We are aware of only three previous longitudinal studies in which changes in illness perceptions were examined together with change in health status. Foster et al.[4] found that the changes seen in several dimensions of the Illness Perception Questionnaire-Revised (IPQ-R)[5] were different in patients with low back pain who had a good clinical outcome compared with those who had a poor outcome at 6-month follow-up. Furze et al. found that change in beliefs about angina was the most significant predictor for physical status at 1-year follow-up.[6] In a large sample of recently diagnosed patients with type 2 diabetes, self-management and a patient education program led to changes in illness perceptions with consequent changes in quality of life and metabolic control at 3-months follow-up.[7]

Our study also enabled the exploration of a new theoretical issue regarding illness perceptions, namely the examination of clusters of persons characterised by similar change profiles across dimensions of illness perception and the relation of these clusters to changes on various outcomes. The developers of the CSM have emphasised the potential value of examining interrelations between combinations of illness perceptions as predictors of outcomes in patients with chronic physical illness.[2] Clatworthy et al. took up this challenge and maintained that "people do not hold illness representations in isolation, they are part of a schema …when it comes to the analysis, it may be more appropriate to use a method that takes into account all aspects of a patient's illness schema…cluster analysis enables the identification of groups of people who share similar illness perceptions, and the utility of the CSM in predicting coping and outcome from these beliefs can still be tested".[8] An objective of our study, therefore, was to determine whether there would be differences on outcomes between groups of patients identified as sharing similar patterns of change in illness perceptions.

OA is one of the most common chronic conditions in elderly persons in developed societies, with a significant impact on their quality of life.[9] Current treatment for OA includes pharmacological therapy to alleviate the impact of inflammation and pain, physiotherapy to facilitate activities of daily living and psychosocial interventions to reduce the negative psychosocial effects and to encourage social participation in society.[10-12] We are aware of 13 previous empirical studies in which illness perceptions of OA patients were addressed.[13-25] These studies corroborate the CSM by demonstrating that OA patients' illness perceptions are associated with limitations

in daily activities, well-being, health status and quality of life. A pattern emerged across these various studies to indicate that more negative perceptions of OA were associated with more functional disability. However, these studies shared the limitation of being cross-sectional, precluding inferences about causes and effects.

In the present Genetics ARthrosis and Progression (GARP) study illness perceptions were assessed at entry and 6 years later. The aim of the GARP cohort study is to identify determinants of OA susceptibility and progression.[26] Given the longitudinal design of the GARP study and the detailed and objective assessments of biomedical and clinical characteristics, this study allowed examination of the association between changes in illness perceptions and changes in functional status over an extended follow-up period, controlling for various indicators of health status. Although OA is a chronic condition, treatment and self-management activities can prevent further decline in or even improve functional status. Over a 6-year follow-up, there is ample opportunity for illness perceptions to change in response to changes in health status and for health status to change in response to coping activities prompted by illness perceptions. In furtherance to Leventhal et al.[2] and Clatworthy et al.[8], we hypothesised that a group of patients sharing similar positive changes in illness perceptions would have reductions in functional impairments, whereas the patients with negative changes in illness perceptions would have a greater degree of functional impairment.

METHODS

Participants and recruitment

The GARP study population comprises Caucasian sibling pairs of Dutch ancestry with familial OA at multiple sites. Details on the recruitment, selection and inclusion have been published elsewhere.[26] Patients were included in the study through rheumatology and orthopaedic outpatient clinics or through practices of general practitioners (family physicians). Patients with secondary OA, familial syndromes with a clear Mendelian inheritance pattern or a shortened life expectancy were excluded. The GARP study was approved by the medical ethics committee of the Leiden University Medical Center.

OA diagnosis

All patients had familial OA. The OA had to have a polyarticular or generalised nature, defined as OA at multiple sites. Patients were eligible for inclusion if they had symptomatic OA at multiple joint sites in the hand or with OA in two or more of the following joint sites: hand, spine, knee or hip. Patients with just one symptomatic joint site with OA were required to have structural abnormalities (radiographic OA or bony swelling) in at least one other joint site. This phenotype is in accordance with the definition by Kellgren and Lawrence of generalised OA.[27,28,29] The generalised nature of the disease was not the same in all patients; for example, a combination of hand and spine or of knee and hand. The frequency of all combinations was described by Riyazi et al.[26] More patients had involvement of hands (about 70%) than knee (approximately 30%) and hip (approximately 25%), but all patients had generalised OA.

Symptomatic OA in the knee and hip was defined with the American College of Rheumatology (ACR) criteria for knee and hip OA.[30] Knee OA was defined as pain or stiffness on most days of the prior month and osteophytes at joint margins of the tibiofemoral joints. 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 of joint space narrowing on radiograph. Symptomatic hand OA was defined according to the ACR criteria[31] as pain or stiffness on most days of the prior month in addition to three of the following criteria: bony swelling of ≥2 of the 10 selected joints (bilateral distal interphalangeal (DIP) joints II and III, bilateral proximal interphalangeal (PIP) joints II and III, and bilateral carpometacarpal (CMC-1) joints), bony swelling of ≥2 distal joints, <3 swollen metacarpophalangeal (MCP) joints and deformity of ≥1 of the 10 selected joints. Symptomatic OA of the spine was defined as pain or stiffness on most days of the prior month in the spine in addition to a Kellgren-Lawrence score ≥2 in ≥1 disc or one apophyseal joint.

Of the 384 patients evaluated at baseline (August 2000 – March 2003), 317 (82.6%) gave informed consent to participate. Of the eligible patients, 241 completed the IPQ-R at baseline and follow-up (April 2007 – May 2008). The mean follow-up time was 6.0 years (SD 0.4 years).

Measures

Sociodemographic characteristics (e.g., age, sex, marital status, body mass index (BMI), education) were collected at baseline. Three biomedical measures were used to assess severity of OA: the Australian/Canadian Osteoarthritis Hand Index (AUSCAN) assesses hand pain, stiffness and function by self-report[32]; the Kellgren-Lawrence scale is a measure of radiographically assessed degree of OA[28]; and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)) assesses lower extremity pain, stiffness and function in OA of the knee or hip by self-report.[33] Pain intensity was assessed during a physical examination in response to lateral pressure or passive movement of the joint, (0=no pain, 1=complaining of pain, 2=complaining of pain and wincing, 3=complaining of pain and withdrawal of the joint) in the hands, knees, hips and spine, and on a dichotomous scale (0=no pain, 1=pain) in the acromioclavicular joints, sternoclavicular joints, elbows, ankles and metatarsalphalangeal joints. This pain intensity score (range 0 to 145) is a modification of the articular index for the assessment of OA described by Doyle et al.[34]

We assessed CSMs of OA using the Illness Perception Questionnaire-Revised (IPQ-R).[5] In the instructions, patients were asked to answer the questions with regard to their OA, as suggested by the designers of the IPQ-R. The IPQ-R measures illness perceptions, emotional representations, and perceived causes, and assesses patients' beliefs about 1) the identity of the disease (labels and symptoms describing the illness (14 items); in the instruction, "illness" was substituted with "osteoarthritis"), 2) whether the timeline is acute or chronic (6 items), 3) the consequences of the disease (the severity of the illness and the impact of the disease on life in general, self-image, finance and family members (6 items)), 4) the degree of personal control over OA (6 items), 5) the extent to which treatment controls

or cures the disease (5 items), 6) illness coherence (the degree to which patients believe they understand their illness (5 items)), 7) the cyclical nature of the disease (the likely variability of the disease and/or symptoms (4 items)), and 8) the emotional representation of the disease (negative emotions experienced due to OA (6 items)). The causes subscale assesses the degree to which the patient attributes the cause of the disease to psychological factors, risk, immune function and accident or chance. As in the Identity scale, in the fragment "Causes of my illness", "osteoarthritis" replaced "illness". All items were rated on five-point Likert scales ranging from strongly disagree to strongly agree. Items were coded so that high scores represent strong beliefs on these particular dimensions. Higher scores indicate a stronger belief that the experienced symptoms are part of the patient's illness, in the chronicity of OA, in serious negative consequences of OA, in the patient's own ability to control symptoms, in the effectiveness of treatment for controlling OA, in the coherence of OA, in the cyclical nature of OA and a stronger negative emotional response to OA.

Statistical analysis

Two repeated measures multivariate analysis of variance (MANOVA) were conducted to compare IPQ-R scores and disease progression at baseline with scores at follow-up. Cluster analysis was used to classify patients into subgroups according to their change in illness perceptions from baseline to 6-year follow-up. Simple change scores (follow-up score minus baseline score) of the illness perceptions dimensions identity, timeline chronic, timeline cyclical, consequences, personal control, treatment control and emotional representations were used to perform the two-stage clustering method as researched and advised for research in illness perceptions by Clatworthy et al.[8] All change scores were standardised to z-scores prior to clustering. Ward's clustering method was conducted to determine the centroids and number of groups, followed by K-means analysis. Squared Euclidian distance was selected as the similarity measure and the cluster centroids and numbers of clusters determined by Ward's method were used for the K-means analysis. The dendrogram and agglomeration schedule of the initial Ward's clustering method suggested that it would be appropriate to set the K-means clustering solution to produce two clusters.

Independent t-tests were used to investigate differences in IPQ-R change scores between both cluster groups.

We performed three repeated measures analyses of covariance (ANCOVAs) to test the effects of cluster group on changes in pain intensity, AUSCAN and WOMAC. The factors in these analyses were cluster group (cluster 1: patients identified as having more negative illness perceptions over time; cluster 2: patients identified as having more positive illness perceptions over time), time (baseline and 6-year follow-up) and potentially confounding variables entered as covariates: age, sex, BMI, Kellgren-Lawrence score at baseline, and additionally, pain intensity (at baseline and at 6 years) for the dependent variables AUSCAN and WOMAC. The reported values for the strength of the associations between independent and dependent variables in the MANOVAs and ANCOVAs are partial etas squared (η^2)

RESULTS

Sample

At the time of the present study, 241 patients completed the IPQ-R, AUSCAN and WOMAC at baseline and follow-up. Patient baseline characteristics are shown in table 1. The majority of participants were older women, with a BMI at the lower end of overweight, representing a range of educational achievement.

Mean scores on the IPQ-R dimensions, AUSCAN, WOMAC and physician-reported pain intensity at baseline and at follow-up are presented in table 2.

Change on IPQ-R dimensions and disease progression

We conducted a repeated measures MANOVA to investigate differences over time in scores on the IPQ-R dimensions. All dimensions and the perceived causes were entered as dependent variables. There was a statistically significant difference over time on the combined dependent variables with $F(12.224)=3.66$, $p<0.01$, Wilks' Lambda=0.84, multivariate $\eta^2=0.16$. When the results for the dependent variables were considered separately, five IPQ-R dimensions differed significantly between baseline and follow-up. For the entire sample, beliefs changed to a significantly more chronic timeline ($F(1.235)=8.28$, $p=0.004$, $\eta^2=0.03$), less personal control over the illness ($F(1.235)=8.69$, $p=0.004$, $\eta^2=0.04$), increased sense of coherence ($F(1.235)=10.72$, $p=0.001$, $\eta^2=0.04$), a reduction in the belief in OA as cyclical ($F(1.235)=4.91$, $p=0.028$, $\eta^2=0.02$) and a less strong negative emotional response to OA (i.e., more positive) ($F(1.235)=11.58$, $p=0.001$, $\eta^2=0.05$). No significant differences between baseline and follow-up were found on the other IPQ-R dimensions or on the IPQ-R questions that explore perceived causes of OA.

A repeated measures MANOVA was also conducted to investigate differences over time in disease progression. AUSCAN, WOMAC and pain intensity scores were entered as dependent variables. There was a statically significant difference over time on the combined dependent variables with $F(3.206)=11.41$, $p<0.001$, Wilks' Lambda=0.86, multivariate $\eta^2=0.14$. When the results for the dependent variables were considered

Table 1. Baseline characteristics in 241 patients with osteoarthritis.

Age, mean (SD), years	59.0 (7.5)
Women, %	82.2
Marital status, no.	
Married/living together	186
Single	55
Body mass index, mean (SD), kg/m^2	26.8 (4.7)
Education, %	
Elementary school	27
Junior high school	76
High school	85
College/University	53
Kellgren-Lawrence score, mean (SD)*	43.9 (20.0)
Range	0-180

*Kellgren-Lawrence is a measure of radiographic defined osteoarthritis severity

Table 2. Descriptive statistics for baseline and 6-year follow-up illness perceptions and disease progression.

	Range	Baseline, mean (SD)	Follow-up, mean (SD)	F*	p
Illness Perception Dimension					
Identity	0-14	5.3 (2.5)	5.2 (2.2)	0.60	.438
Timeline acute/chronic	6-30	25.4 (3.7)	26.2 (3.4)	8.28	.004
Consequences	6-30	16.8 (4.6)	16.5 (4.6)	0.87	.351
Personal control	6-30	18.8 (3.5)	18.0 (3.8)	8.69	.004
Treatment control	5-25	13.9 (2.8)	13.6 (3.0)	2.50	.115
Illness coherence	5-25	17.9 (4.1)	18.6 (4.0)	10.72	.001
Timeline cyclical	4-20	14.3 (3.1)	13.8 (3.2)	4.91	.028
Emotional representations	6-30	14.3 (5.2)	13.3 (5.4)	11.58	.001
Psychological attribution	6-30	12.7 (4.3)	12.4 (4.4)	0.69	.407
Risk attribution	7-35	17.7 (3.3)	18.0 (3.6)	1.40	.237
Immune function attribution	3-15	6.7 (2.0)	6.4 (2.2)	2.69	.102
Accident/chance attribution	2-10	4.9 (1.6)	4.9 (1.6)	0.05	.823
AUSCAN total score	0-60	19.5 (14.2)	22.2 (14.1)	10.31	.002
WOMAC total score	0-100	27.2 (22.9)	28.9 (23.1)	0.28	.598
Pain intensity	0-145	7.9 (8.3)	10.8 (9.5)	31.85	.000

*A repeated measures MANOVA was conducted to investigate differences over time
Abbreviations: AUSCAN: Australian/Canadian Osteoarthritis Hand Index; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index.

separately, sores on AUSCAN (F(1.208)=10.31, p=0.002, η^2=0.05) and pain intensity (F(1.208)=31.85, p< 0.001, η^2=0.13) indicated an increased (negative) impact on daily functioning and pain. No significant differences were observed for the sample as a whole on WOMAC scores.

Table 3 shows the mean IPQ-R change scores for the two subgroups of patients classified according to their profile of change in illness perceptions. Increases in identity, chronic timeline and consequences and decreases in personal control, treatment control and emotional representations (cluster group 1) describe an illness model that becomes more negative over time.[2,3,8] Decreases in identity, chronic timeline, consequences and emotional representations and increases in personal control and treatment control (cluster group 2), represent an illness model that can be defined as positive. Both clusters had negative change scores on emotional representations, indicating a tendency for both to get less negative over time. However, the positive cluster became significantly less negative than the negative cluster, which is consistent with the theoretical model.[2,3,8]

Differences between cluster groups on functional status

Pain intensity. A 2 (time) x 2 (cluster group) mixed-model ANCOVA revealed that the main effects for cluster group (F(1.203)=1.39, p>0.05, η^2=0.01) and time (F(1.203)=2.80, p>0.05, η^2=0.01) were not significant (figure 1). Thus, there were no overall differences in the mean pain intensity scores of the negative cluster

Table 3. Mean differences (SD) in IPQ-R change scores[*] between cluster groups.

	Cluster 1: Illness model more negative over time (n=114)	Cluster 2: illness model more positive over time (n=126)	F	p-value
Identity	0.45 (2.35)	-0.71 (2.39)	3.793	.000
Timeline acute/chronic	3.01 (3.42)	-1.24 (3.24)	9.882	.000
Consequences	1.81 (4.28)	-2.31 (4.06)	7.648	.000
Personal control	-2.76 (3.30)	0.99 (3.46)	-8.582	.000
Treatment control	-2.19 (2.70)	1.38 (2.59)	-10.436	.000
Illness coherence	0.48 (3.17)	0.95 (3.60)	-1.077	.283
Timeline cyclical	-0.52 (3.69)	-0.42 (3.12)	-0.214	.831
Emotional representations	-0.06 (4.14)	-1.91 (4.96)	3.113	.002

[*]Change scores: follow-up score minus baseline score.

group (8.54) compared to the positive cluster group (10.01). Mean pain intensity scores at follow-up (10.76) were not significantly higher than at baseline (7.80). Of the potentially confounding variables (age, sex, BMI, K-L score), only the time x sex interaction was significant (F(1.203 =3.90, p<0.05, η^2=0.02) suggesting a sharper rise in pain intensity for females across both groups.

AUSCAN. A significant time x cluster group effect was obtained with F(1.201)=9.96, p<0.01, η^2=0.05. Examination of the cell means indicated that, although there was an increase in mean AUSCAN scores for the negative cluster group from baseline (17.65) to follow-up (22.86), the positive cluster group did not change in mean AUSCAN scores from baseline (21.26) to follow-up (21.60). At baseline, the negative cluster group had significantly better AUSCAN scores than did the positive cluster group (t(238)=-1.99, p<0.05). Other significant effects emerged for Kellgren-Lawrence scores (F(1.201)=8.74, p<0.01, η^2=0.04), baseline pain scores (F(1.201)=19.17, p<0.001, η^2=0.09) and for follow-up pain scores (F(1.201)=41.16, p<0.001, η^2=0.17) showing more negative AUSCAN scores across both time points for patients with higher Kellgren-Lawrence scores and higher pain intensity scores.

WOMAC. A significant time x cluster group effect was obtained with F(1.200)=9.43, p<0.01, η^2=0.05. Examination of the cell means indicated that, although there was an increase in mean WOMAC scores for the negative cluster group from baseline (25.51) to follow-up (31.42), the positive cluster group did slightly improve in mean WOMAC scores from baseline (28.97) to follow-up (26.85). At baseline the negative cluster group had slightly (non-significant) better WOMAC scores than did the positive cluster group.

Other significant effects emerged for BMI (F(1.200)=32.89, p<0.001, η^2=0.14), baseline pain scores (F(1.200)=8.22, p<0.01, η^2=0.04) and follow-up pain scores (F(1.200) = 37.44, p<0.001, η^2=0.16), showing more negative WOMAC scores across both time points for patients with higher BMI scores and higher pain intensity scores.

Although the two patient clusters were not significantly associated with changes over time in physician-reported pain intensity, they were associated with modest but
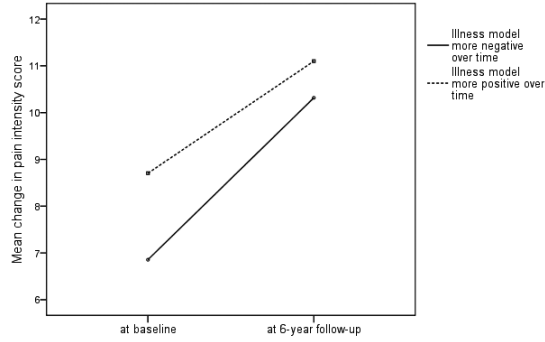
Figure 1. Change in pain intensity from baseline to 6 years follow-up for the two cluster groups.
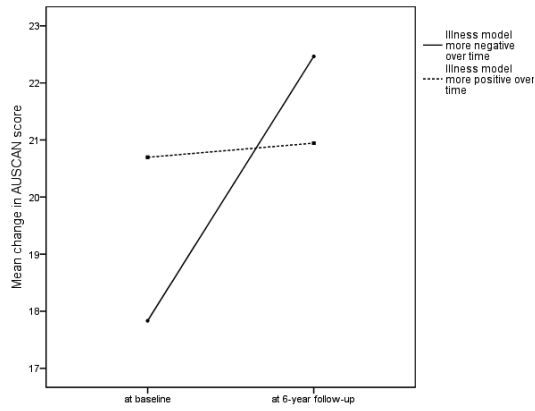

Figure 2. Change in AUSCAN score from baseline to 6 years follow-up for the two cluster groups.
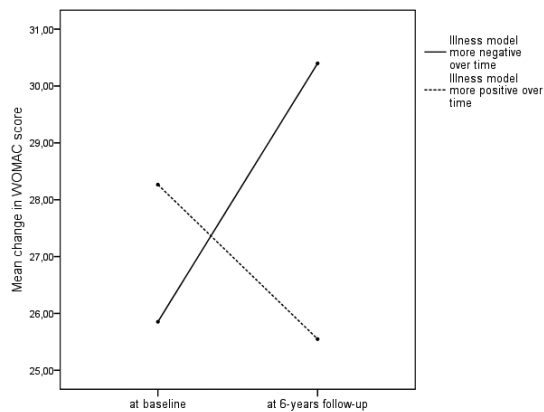

Figure 3. Change in WOMAC score from baseline to 6 years follow-up for the two cluster groups.

meaningful changes at follow-up in AUSCAN and WOMAC scores. As hypothesised, the cluster with a more positive illness model was associated with better outcomes, and the cluster with a more negative illness was associated with poorer outcomes on the two functional impairment scales, AUSCAN and WOMAC. These results corroborate the validity of the two-cluster solution for the IPQ-R dimensions presented here and suggest that these clusters may be associated with clinically meaningful changes in functional impairment.

DISCUSSION

The results of this prospective study with a 6-year follow-up add to the limited number of empirical studies in which longitudinal changes in IPQ-R dimensions were examined. They advanced our knowledge of changes in CSMs of OA over time, suggesting which IPQ-R dimensions remain stable and which ones change. For OA, it appears that attributions of causality remain relatively unaffected by the passage of time. However, over time, OA is increasingly perceived as a relatively chronic condition, as less cyclical and as less amenable to personal control, independent of objectively assessed illness severity. Moreover, the identification of two patient clusters, each with similar change profiles across the dimensions of illness perceptions as recommended by Clatworthy et al.[8], yielded additional meaningful associations between change in illness perceptions and change in functional status. Consistent with the conclusions from Hagger and Orbell's meta-analysis of illness perceptions, a deterioration in functional abilities over time was associated with a pattern of change on illness perceptions associated with poor outcomes: more passive and chronic views, perceiving less control and experiencing a higher emotional load regarding the illness.[3]

Demonstrating that change to a more negative illness representation is associated with deterioration of functional status across long-term follow-up is indicative of a reciprocal process between illness representations and illness outcomes as proposed by the CSM.[2] The present findings for OA are comparable to previous studies of low back pain[4], angina[6], venous thrombosis[35] and diabetes[7]. Together, these results have important clinical implications. They suggest that identifying illness dimensions on which patients hold beliefs indicative of poor outcomes and intervening to change these beliefs may have beneficial effects on the course of a chronic disease.[3,8,12] As noted by Clatworthy et al.[8] "as the focus of illness perception research moves towards intervention development, there is a further practical advantage to grouping people in this way. Groups of people with schemata associated with poor coping or outcome would be ideal targets for interventions. The cluster analysis would not only identify these groups but would also provide information on the types of beliefs held by the groups that may need to be addressed in an intervention".

Strengths of the present study include the comparatively large sample size compared to previous research on OA illness perceptions, the unusually long follow-up period and the relatively low level of subject attrition. The present sample was comparable to the samples of OA patients in the studies mentioned in the introduction with regard to sociodemographic and other medical characteristics. The measure of

the illness perceptions used here reflected the same theoretical base (the CSM of Leventhal et al.[2]) as many of these studies. Such comparability increases the external validity and hence the generalisibility of our findings.

Limitations include the absence of a measure of functional status that was not based on self-report. However, the AUSCAN and WOMAC are widely used to assess the impact of OA in daily life and are considered the gold standard in research on OA patients. Moreover, unlike many previous studies, pain intensity was measured objectively and controlled for in all analyses. Assessment of change on both illness perceptions and functional status at one or more times during the follow-up period could have yielded even more interesting results, enabling the examination of correlated change across time and investigated cross-lagged correlations. Multiple assessments are recommended for future studies.

The potential of interventions to change illness perceptions and examine effects thereof on disease outcomes is only just beginning to be recognised.[36] Only a few intervention studies have been published up to now.[4,6,37-42] Theoretical and conceptual issues in designing interventions in the context of the CSM are discussed by Deary and Wearden et al.[43,44] The present study suggests that interventions that increase patients' pattern of positive beliefs, especially the control components in illness perceptions – that is increase perceived ability to control their OA and the effectiveness of their medical treatment; reduce perceived symptoms and the perceived physical, social and emotional consequences of the disease – could result in less self-reported functional disability. Future research on patients with OA should focus on identifying more precisely which patterns of illness perceptions are associated with more specific outcome measures and developing interventions designed to change these patterns of beliefs.

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