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Determinants of WOMAC function, pain and stiffness scores: evidence for the role of low back pain, symptom counts, fatigue and depression in osteoarthritis, rheumatoid arthritis and fibromyalgia

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Abstract

Objectives. The Western Ontario MacMaster (WOMAC) is a validated instrument designed specifically for the assessment of lower extremity pain and function in osteoarthritis (OA) of the knee or hip. In the clinic, however, we have noted that OA patients frequently have other musculoskeletal and non-musculoskeletal problems that might contribute to the total level of pain and functional abnormality that is measured by the WOMAC. In this report, we investigated back pain and non-articular factors that might explain WOMAC scores in patients with OA, rheumatoid arthritis (RA) and fibromyalgia (FM) in order to understand the specificity of this instrument.

Methods. RA, OA and FM patients participating in long-term outcomes studies completed the WOMAC and were assessed for low back pain, fatigue, depression and rheumatic disease symptoms by mailed questionnaires.

Results. Regardless of diagnosis, WOMAC functional and pain scores were very much higher (abnormal) among those complaining of back pain. On average, WOMAC scores for back pain (+) patients exceeded those of back pain (−) patients by ∼65%, and 52% of OA patients reported back pain. In regression analyses, study symptom variables explained 42, 44 and 38% of the variance in WOMAC function, pain and stiffness scores, respectively. In the subset of OA patients, radiographic scores added little to the explained variance. The strongest predictor of WOMAC abnormality in bivariate and multivariate analyses was the fatigue score, with correlations of 0.58, 0.60 and 0.53 with WOMAC function, pain and stiffness, respectively. The WOMAC performed well in RA and FM, and correlated strongly with the Health Assessment Questionnaire (HAQ) disability scale and a visual analogue scale (VAS) pain scale.

Conclusion. The WOMAC captures more than just knee or hip pain and dysfunction, and is clearly influenced by the presence of fatigue, symptom counts, depression and low back pain. WOMAC scores also appear to reflect psychological and constitutional status. These observations suggest the need for care in interpreting WOMAC scores as just a measure of function, pain or stiffness, and indicate the considerable importance of psychological factors in rheumatic disease and rheumatic disease assessments.

KEY WORDS: WOMAC, Low back pain, Osteoarthritis, Rheumatoid arthritis, Fibromyalgia, Symptoms.

The Western Ontario MacMaster (WOMAC) scale was designed to measure dysfunction and pain associated with osteoarthritis (OA) of the lower extremities by assessing 17 functional activities, five pain related-activities and two stiffness categories [1]. This instrument has been well studied, and many of its psychometric properties are known [2–6]. It is among the most sensitive of all instruments used in the assessment of OA of the knee or hip, and has been widely used in clinical trials [7, 8].

In reviewing the WOMAC, however, we noted that most of the individual WOMAC items could be affected by non-OA problems, the most common of which might

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be low back pain. For example, doing heavy chores, getting in and out of a car—to name just two—are activities that could be affected by low back pain. We therefore undertook a study of the effect of low back pain on WOMAC scores in OA. In addition, we considered whether other symptoms including fatigue, depression, and a general count of symptoms—as a measure of somatization—might also affect WOMAC scores.

We also have been struck by the fact that although the WOMAC is used primarily in OA, there is nothing about the instrument that makes it unsuitable for use in other illnesses that affect the lower extremities, such as rheumatoid arthritis (RA) or fibromyalgia (FM). In fact, the WOMAC might be particularly useful in RA or FM where no other functional instruments exist to assess this region adequately. Therefore, we extended the study to include patients with RA and FM as well.

The specific questions of this study were as follows. To what extent are WOMAC scores affected by low back pain and psychological factors in RA, OA and FM? To what extent are WOMAC scores affected by radiographic abnormality compared to back pain and psychological or non-disease factors in OA of the hip or knee? Is the behaviour of the WOMAC consistent and similar across the three disorders?

Methods

The Arthritis Center, an out-patient rheumatology clinic and research centre, has been collecting longitudinal data on OA, RA and FM patients since 1974. As part of this data collection, we send mailed questionnaires at 6 month intervals to patients who choose to participate in mailed longitudinal arthritis assessments. The characteristics of this data bank and the methods of data collection have been described previously [9, 10]. In the mailings sent between July 1996 and January 1998, the WOMAC questionnaire was added to the assessment package. This report describes 1013 patients with RA, 625 with OA and 531 with FM; a total of 2115 patients. Among the RA patients, 447 of the 1013 were members of a US inception cohort of RA who were recruited during the study period from the practices of rheumatologists, and who had a disease duration of <1 yr when first seen by their rheumatologists. Of the 625 OA patients, 348 were recruited during the study period by media and mailed advertising for participation in an OA outcome project. Seventy-five of the 531 FM patients were from centres other than Wichita who had participated in previous FM outcome studies [11]. Patients with RA and FM satisfied published criteria [12, 13]. Patients with OA had definite radiographic abnormality and knee pain, and clinically had OA. Although most satisfied published criteria for OA [14, 15], it was the purpose of this project to identify mild cases so that minimal entry criteria for this study included a clinical diagnosis of OA, definite osteophytes and characteristic knee pain.

Assessments

All patients completed the WOMAC, a 57 item check of somatic symptoms, a fatigue scale, a depression scale, and indicated the presence or absence of low back pain (yes/no). The symptom check list functions in part as a measure of the number of symptoms ('severity') and as an index of somatization [16]. The WOMAC OA index assesses pain (five items), stiffness (two items) and physical function activities (17 items) related to OA of the hip or knee [1, 2, 6, 7, 17–21]. In this study, the WOMAC was used in its visual analogue scale (VAS) format. The range of the WOMAC scores is: function (0–170), pain (0–50) and stiffness (0–20).

The list of symptoms included 57 symptoms relevant to rheumatic disease, and included all major organ systems, e.g. rash, headache, epigastric distress, dysuria, difficulty thinking, fatigue, dyspnoea, anaemia, fatigue, low back pain, etc. Stiffness was not included in the check list. From the list, a symptom count was compiled that ranged from 0 to 57. Because back pain and fatigue are included in the symptom count, we performed analyses which used the symptom count with and without the inclusion of back pain and fatigue. Only extremely trivial differences in results were noted. Therefore, we report the analyses using the full 57 item symptom count.

In addition, patients were assessed for fatigue with a 15 cm VAS [22], anchored at the ends with the descriptors 'Fatigue is no problem'/'Fatigue is a major problem'. A similar scale was used to assess pain. Depression was assessed by the Arthritis Impact Measurement Scales (AIMS) (I) depression questionnaire [23]. This instrument has been widely used and has been shown to be valid and reliable in different rheumatic disorders [23–29]. The Stanford Health Assessment Questionnaire disability index (HAQ) was administered as well [30, 31].

All OA patients had radiographs of their affected knees or hips. Radiographs of the knees and hips were weight-bearing AP films, but beginning in July 1996, the knee films were made using the weight-bearing, semi-flexed views described by Buckland-Wright [32]. Knee radiographs were scored for joint space narrowing (0–3) and osteophytes (0–3) as described in the *Atlas of individual radiographic features in osteoarthritis* [33]. For hip films, Kellgren and Lawrence scores (KL) [34] were better correlated with WOMAC scores, and OA hip data are expressed in terms of this index. Preliminary analyses of knee data in the regression models of Table 3 indicated that for both osteophytes and joint space narrowing there were no significant differences between scores of 2 and 3. Therefore, the scores were compressed to a 0–2 scale where a '2' means 'moderate or greater'. Similarly, for Kellgren and Lawrence hip scores, the two highest categories were compressed such that the highest grade is a KL score of '3' where '3' means KL of '3 or greater'. Radiographs used in this study were generally obtained within 1 yr of the date of the questionnaire assessments.

Statistics

Data were analysed using Stata Version 5.0 [35]. First we described differences in WOMAC function, pain and stiffness, low back pain and symptom count (Table 1). Groups were compared by ANOVA and post hoc comparisons between groups were analysed using Scheffe's test. In the analysis of symptom count, a square root transformation was used to stabilize variance. For the analyses of Table 2, comparing back pain (+) and back pain (−) patients, *t*-tests were used and equal variances were not assumed. The regression analyses in Tables 4 and 5 were performed using linear regression with WOMAC function, pain or stiffness as the dependent variables, and low back pain, symptom count, VAS fatigue scale and depression as the independent variables. In Table 5, all clinical and radiographic variables were added to the model, but non-significant variables were removed in stepwise fashion. At each stage, age and sex were added as potential covariates, but they were never significant in the model. Dependent variables with $P \leq 0.1$ were retained in the table. Dependent variables used in the modelling of Table 5 included low back pain, symptoms count, VAS fatigue scale, depression, joint space narrowing and osteophytes (knees) and K-L score (hips). All P values for the correlation analyses are significant at $P < 0.001$; therefore, significance is not reported in the text. Statistical significance was set at the 0.05 level.

Results

The relationship between WOMAC scores and low back pain and symptom count for RA, OA and FM patients

The mean age of the RA, OA and FM patients was 58.8 (S.D. 14.8), 67.8 (S.D. 11.5) and 55.4 (S.D. 11.8), respectively; and the percentage of males was 23.8, 23.5 and 6.1.

As shown in Table 1, all variables are least abnormal in RA and most abnormal in FM, including WOMAC scores, number of somatic symptoms and the percentage with low back pain. Of particular importance, 51.5% of OA patients reported low back pain. Groups differed by ANOVA for each variable in Table 1 at the 0.001 level, and individual diagnostic groups differed from each other in post hoc analyses at $P < 0.05$ for the Table 1 variables, except for WOMAC stiffness which did not differ significantly between RA and OA in the post hoc analyses.

Table 2 presents WOMAC scores for low back pain (+) and low back pain (−) patients. Among all categories of patients, scores are much higher (abnormal) in those with low back pain. Among OA patients,

TABLE 1. WOMAC, back pain and symptom count scores in RA, OA and fibromyalgia

Disorder	*n*	WOMAC function	WOMAC pain	WOMAC stiffness	Low back pain (%)	Symptom count
RA	1013	53.0 (39.1)	14.9 (11.4)	8.2 (5.3)	34.4%	6.6 (5.2)
OA	655	65.1 (40.9)	18.6 (11.8)	8.9 (5.3)	51.5%	8.0 (6.1)
Fibromyalgia	537	73.8 (41.6)	22.8 (12.1)	10.7 (5.3)	69.6%	14.2 (7.7)

Values are the mean and S.D.

TABLE 2. WOMAC function and pain scores for patients with and without low back pain

	WOMAC function		WOMAC pain		WOMAC stiffness	
	Back pain (+)	Back pain (−)	Back pain (+)	Back pain (−)	Back pain (+)	Back pain (−)
RA	70.2 (38.8)	44.0 (36.2)	20.1 (11.4)	12.2 (10.5)	9.9 (5.2)	7.3 (5.1)
OA	80.3 (37.8)	48.9 (37.7)	23.1 (11.1)	13.8 (10.4)	10.7 (4.9)	7.0 (5.1)
Fibromyalgia	81.8 (39.4)	54.5 (40.8)	25.5 (11.5)	16.9 (11.5)	11.8 (5.0)	8.3 (5.4)

Values are the mean and S.D.

TABLE 3. Spearman correlation coefficients for study variables for all patients ($n = 2205$)

	Symptom count	Low back pain	WOMAC function	WOMAC pain	WOMAC stiffness	Fatigue	Depression
Symptom count			0.549	0.567	0.512	0.636	0.551
Low back pain	0.542		0.372	0.399	0.322	0.358	0.281
WOMAC function	0.549	0.372				0.577	0.325
WOMAC pain	0.567	0.399	0.856			0.600	0.366
WOMAC stiffness	0.512	0.322	0.757	0.729		0.524	0.329
Fatigue	0.636	0.358	0.577	0.600	0.524		0.497
Depression	0.551	0.281	0.325	0.366	0.329	0.497	

All coefficients are significant at $P < 0.0001$.

TABLE 4. Linear regression analyses of the effect of symptom variables on WOMAC function, pain and stiffness scores in 2205 rheumatic disease patients

	WOMAC function		WOMAC pain		WOMAC stiffness	
Independent variable	Coefficient (S.E.)	t	Coefficient (S.E.)	t	Coefficient (S.E.)	t
Low back pain (yes/no)	7.98 (1.63)	4.91	2.96 (0.47)	6.33	0.72 (0.23)	3.19
Symptom count (0–57)	1.34 (0.15)	9.21	0.40 (0.04)	9.60	0.16 (0.02)	8.20
Fatigue VAS (0–3)	15.07 (1.03)	14.57	4.73 (0.30)	15.94	2.11 (0.14)	14.72
Depression (0–10)	3.30 (0.43)	7.62	0.81 (0.12)	6.52	0.29 (0.06)	4.90
Constant	13.61 (1.45)	9.38	3.37 (0.42)	8.10	3.17 (0.20)	15.78
Adjusted R^2 (full model)	0.42		0.44		0.38	
Adjusted R^2 (without symptom count)	0.39		0.42		0.34	
Adjusted R^2 (without symptom count and back pain)	0.37		0.39		0.32	

All P values are significant at <0.001.

TABLE 5. Linear regression analyses of the effect of symptom variable and radiographic scores on WOMAC function, pain and stiffness scores in knee ($n = 564$) and hip ($n = 81$) osteoarthritis

Condition	Dependent variable	Variable	Coefficient	S.E.	T	P	Standard beta	Model R^2
Knee OA	WOMAC function	Fatigue	17.58	2.02	8.69	0.000	0.37	0.45
		Symptom count	1.27	0.30	4.21	0.000	0.19	
		Depression	3.30	0.74	4.47	0.000	0.17	
		Knee narrowing	8.00	1.72	4.66	0.000	0.15	(0.42)
		Back pain	6.70	3.03	2.21	0.027	0.08	
		Constant	7.80	3.38	2.31	0.021		
Knee OA	WOMAC pain	Fatigue	4.85	0.59	8.15	0.000	0.35	0.43
		Symptom count	0.34	0.09	3.89	0.000	0.18	
		Depression	0.95	0.22	4.37	0.000	0.16	
		Knee narrowing	1.66	0.50	3.28	0.001	0.11	(0.41)
		Back pain	2.70	0.89	3.03	0.003	0.12	
		Constant	3.03	0.99	3.05	0.002		
Knee OA	WOMAC stiffness	Fatigue	2.19	0.28	7.76	0.000	0.36	
		Symptom count	0.16	0.04	3.80	0.000	0.18	0.36
		Depression	0.27	0.10	2.61	0.009	0.10	
		Knee narrowing	0.50	0.24	2.07	0.039	0.07	(0.35)
		Back pain	0.90	0.42	2.13	0.033	0.09	
		Constant	2.76	0.47	5.87	0.000		
Hip OA	WOMAC function	Fatigue	24.11	4.08	5.91	0.000	0.52	0.57
		Back pain	24.69	7.09	3.48	0.001	0.31	
		KL score	11.91	4.01	2.97	0.004	0.23	(0.52)
		Constant	−18.46	14.65	−1.26	0.212		
Hip OA	WOMAC pain	Fatigue	6.20	1.24	5.00	0.000	0.47	0.51
		Back pain	7.73	2.15	3.59	0.001	0.34	
		KL score	2.58	1.22	2.12	0.038	0.17	(0.50)
		Constant	−2.75	4.45	−0.62	0.539		
Hip OA	WOMAC stiffness	Fatigue	3.80	0.61	6.19	0.000	0.58	0.51
		Back pain	1.89	1.07	1.77	0.081	0.17	
		KL score	1.73	0.60	2.86	0.005	0.23	(0.45)
		Constant	−2.63	2.21	−1.19	0.236		

KL score, Kellgren and Lawrence score.

WOMAC function scores are 31.4 units or 64% greater than in back pain (−) patients; WOMAC pain scores are 67% greater and WOMAC stiffness scores are 53% greater than in the back pain (−) patients. For the three WOMAC variables, differences between back pain (+) and back pain (−) groups are significant at $P < 0.001$ for all groups combined, as well as for the RA, OA and FM patients separately. These data indicate that patients with back pain have substantially more abnormal WOMAC scores than do patient without back pain, regardless of diagnosis.

The relationship between WOMAC measures and other measures of function and pain

To estimate the ability of the WOMAC to assess function in RA and FM, we obtained correlations between the HAQ disability index and the WOMAC function score. These Pearson correlations for RA, OA and FM were 0.774, 0.779 and 0.807. The correlations between a VAS pain scale and WOMAC pain scale were, for RA, OA and FM, 0.706, 0.727 and 0.659. These data describe a strong correlation between WOMAC function and HAQ, and between WOMAC pain and VAS pain across all disorders.

The relationship between WOMAC scores and back pain, symptom count, fatigue and depression

We next investigated the relationship of WOMAC scores to factors associated with psychological distress and back pain by correlation analysis. Because results indicated that there were only minor differences in correlations by diagnostic group (data not shown), we combined the groups and performed correlation analyses on all patients as shown in Table 3. The strongest correlations were between the WOMAC variables and symptom count and fatigue: 0.512–0.600. The correlations with back pain were between 0.322 and 0.399. These data indicate that in bivariate analyses, WOMAC scores are significantly and importantly associated with physical and distress variables.

To explore multivariate relationships, we performed a series of linear regressions with WOMAC function, pain and stiffness as the dependent variables, and low back pain, symptom count, fatigue and depression as the independent variables. As shown in Table 4, the strongest predictor of WOMAC scores was fatigue, followed by the symptom count. The independent variables had similar t scores across the three regressions, indicating a similar strength of effect regardless of dependent variable.

The R^2 for the full models with WOMAC function, pain and stiffness as dependent variables were 0.42, 0.44 and 0.38, respectively. We next explored the explanatory power of reduced models. Removing the symptom count first, and then the symptom count and low back pain, led to little reduction in explanatory power (Table 4, bottom). Fatigue as the only dependent variable had R^2 of 0.33, 0.35 and 0.30 for WOMAC function, pain and stiffness, respectively, and depression had R^2 of 0.21, 0.20 and 0.16. When these analyses were performed separately for the three diagnostic groups, similar results were obtained (data not shown). These data indicate that back pain and psychological symptoms explain a substantial portion of the variance in WOMAC scores.

The relationship between WOMAC scores and symptom and radiographic variables in OA of the knee and hip

To determine whether radiographic OA of the knee or hip was an important determinant of WOMAC scores, we studied symptom variables as well as Kellgren and Lawrence scores for hip OA and joint space narrowing, and osteophyte scores for OA of the knee. Regardless of the analysis, age and sex were not significant in any model, nor was the knee osteophyte score. These variables were not included in any of the final models. As with the analyses shown in Table 4, fatigue was the strongest determinant of WOMAC scores in OA regardless of joint (Table 5). The contribution of radiographic abnormality to WOMAC scores in knee and hip OA was small: elimination of the radiographic score reduced the model R^2 negligibly (Table 5).

Discussion

This study suggests that WOMAC results are influenced by factors other than lower extremity disease, at least when the WOMAC is used 'globally' rather than referring to a specific joint or specific joint groups. On reflection, it is easy to see how low back pain might influence functional and pain-related scores for items such as rising from a chair, getting out of bed, walking up and down stairs, etc. Indeed, our data, which show that 53% of OA patients have low back pain, offer a ready explanation for the substantial average decrease in WOMAC scores seen among OA patients when those with back pain are excluded.

However, WOMAC scores appear to be indicative of more than just regional pain, as shown in Tables 3, 4 and 5. WOMAC scores have important correlations with fatigue and depression, and the symptom count which is strongly correlated with WOMAC scores is also strongly correlated with fatigue and depression. These data suggest that the results of the WOMAC reflect psychological and constitutional status as well as regional back pain and regional knee or hip abnormalities.

The data raise a number of questions. In randomized controlled trials (RCT) what are we actually measuring? Is it back pain that improves or fatigue or is it only joint function and pain? Back pain is rarely, if ever, measured in RCT, but it would appear to be a key variable [36], as would be fatigue and depression. Since a minority of OA patients regularly use non-steroidal anti-inflammatory drugs and we select these patients for our RCT, is there something different about them—differences that might be explained by factors such as fatigue and depression as well as pain and dysfunction?

It is of interest that although RA is studied extensively by psychologists, little interest has been shown toward the psychosocial distress that is clearly present in OA.

OA is more than a joint disease [22], and our approach to it and our measurement of it should include these other important, non-articular factors. In this study, as in others, little association was noted between radiographic scores and clinical variables [37–39]. That the WOMAC is sensitive to psychological and non-disease factors is not to criticize the instrument. All self-report instruments are sensitive to these factors and, indeed, such factors contribute to the actual pain and dysfunction that patients report.

We also noted that WOMAC function and pain scores correlated strongly with HAQ function and the VAS pain scale in RA and FM. Conceptually, WOMAC function taps into the major complaints of FM patients. It is possible that the WOMAC might be a useful additional assessment tool both in RA and FM when lower body function needs to be addressed specifically.

Our study has a number of limitations. First, it is not a random sample of persons with arthritis, but a study of persons who choose to participate in outcome studies. Nor did we include in our models other factors that might contribute to WOMAC severity, including body mass index, education level and marital status. We did not include items such as these because we wanted to address a more narrow question, but future studies of predictors of WOMAC severity might wish to include additional variables. It is also possible that if we had used better radiographic or scintigraphic methods to assess OA [32, 40–42], or included biochemical markers [43–47], we might have detected a stronger disease effect.

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