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OSTEOARTHRITIS and CARTILAGE

Comparison of the WOMAC (Western Ontario and McMaster Universities) osteoarthritis index and a self-report format of the self-administered Lequesne–Algofunctional index in patients with knee and hip osteoarthritis

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Summary

Objective: To compare the metric properties and validity of German versions of the WOMAC (Western Ontario and McMaster Universities) and a self-administered questionnaire-format of the Lequesne–Algofunctional–Index in patients with osteoarthritis (OA) of the lower extremities.

Design: Cross-sectional analysis of the instruments' internal consistency (Cronbach's coefficient alpha) and construct validity (correlation with radiological OA-severity and limitation in range-of-motion) in ambulatory patients and patients before hip arthroplasty. Test–retest reliability was assessed on a subsample after 10 days.

Results: Data from 51 patients out of 91 contacted could be analyzed. Twenty-nine patients had knee and 22 patients had hip OA. Both the WOMAC and Lequesne OA-indices and their scales or sections had a satisfactory test–retest reliability (Intraclass correlation coefficient 0.43–0.96). All scales of the WOMAC were internally consistent (Cronbach's coefficient alpha 0.81–0.96) and associated with radiological OA-severity and joint range of motion. However, only the function but not the symptom sections (Cronbach's coefficient alpha knee: 0.55; hip: 0.63) of the self-administered Lequesne OA index were internally consistent for both, patients with knee and hip OA. Also, the symptom components were not or only weakly associated with radiological OA-severity and joint range of motion.

Conclusions: Although our results are based on a German version using a self-report format we may caution using the self-administered Lequesne OA index without prior testing of its metric properties and validity.

Key words: Osteoarthritis, Health status, Clinimetrics, WOMAC, Lequesne.

Introduction

Comprehensive assessment of patients with osteoarthritis (OA) of the lower extremities includes both measurement of impairment and disease consequences to the patient [1–4]. There are a variety of instruments that measure the different dimensions of health status in patients with OA [5]. It has been suggested that the assessment should include both disease specific and generic instruments which cover distinct but important aspects of patients' health [6]. Probably the two most widely used instruments for the assessment of OA-specific health status are the Lequesne–Algofunctional Indices for the hip [7–9] and the knee [8–10] and the WOMAC (Western Ontario and McMaster Universities) OA index [2, 4, 11–16]. Both instruments cover OA-specific symptoms and physical functional disability. However, whereas the WOMAC addresses symptoms and functional disability in separate scales which may be aggregated into a composite index the Lequesne OA indices directly aggregate symptoms and function which are not graded separately. Also, the WOMAC is a patient questionnaire whereas the Lequesne OA-index has been developed as an interview format [2, 8–10].

The objective of our study was to compare the metric properties and validity of German versions of the WOMAC and a self-administered questionnaire format of the Lequesne OA index in patients with OA of the lower extremities. We chose to test a self-report format because in clinical trials it

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allows for mailing to patients and thus repeat administration.

Methods

PATIENTS AND DATA COLLECTION

Patients were recruited from the Departments of Rheumatology and Orthopedic Medicine at the University Hospital Basle. Patients who attended the Rheumatology Department in 1994 and were coded as having OA on a clinical registry were mailed a postcard asking for participation in the study. Patients who attended the orthopedics department in May 1995 to undergo joint replacement surgery where asked by the study physician to participate in the study. Patients from the rheumatology department were examined by a medical student after training in standardized clinical assessment whereas patients at the orthopedics department were examined by the study physician trained in standardized clinical data assessment. Examination included assessment of the combined clinical and radiological classification criteria for OA [17, 18] using a short-arm goniometer (degrees) [23]. After examination, patients were given the questionnaires. Test–retest reliability was assessed on a random subsample of patients recruited at the department of rheumatology. Patients were provided with a second questionnaire with the date of the second administration marked (10 days after the visit and completion of the baseline questionnaire). Patients were instructed to complete the questionnaire at the prespecified date and return the second questionnaire in a preadressed envelope.

MEASURES

The WOMAC is a three-dimensional measure of pain, stiffness and physical functional disability [2, 11–16]. The pain scale includes five questions (S1–S5) asking about pain when 'Walking on a flat surface' (S1), 'Going up or down stairs' (S2), 'At night while in bed' (S3), 'Sitting or lying' (S4), 'Standing upright' (S5). The stiffness scale includes two questions (St1, St2) asking about stiffness 'after first awakening in the morning' (St1) and 'after sitting, lying or resting later in the day' (St2). The function scale (F1–F17) asks about the degree of difficulty when 'Descending stairs', 'Ascending stairs', 'Rising from sitting', 'Standing', 'Bending to floor', 'Walking on flat', 'Getting in/out of car', 'Going shopping', 'Putting on socks/stockings', 'Rising from bed', 'Taking off socks/stockings', 'Lying in bed', 'Getting in/out of bath', 'Sitting', 'Getting on/off toilet', 'Heavy domestic duties', 'Light domestic duties'. Each of the totally 24 questions is graded either on a Likert scale or a visual analogue scale [2] ranging from 'no' to 'extreme'. In this study we used a numerical rating scale ranging from 0 to 10 which is the preferred format in our population [19]. Similar to the visual analogue scale it provides interval-type data. To score each scale we calculated the mean of the item scores. The results thus equal standardized WOMAC scores (standardization of WOMAC scores is by division of the scale sum score by the number of items [2]). A composite score was calculated as the unweighted mean of the three scale scores. The scale scores as well as the composite score thus range from 0 to 10.

The Lequesne OA index directly aggregates symptoms and function which are not graded separately. The index includes three sections with a total of 10 questions and takes few minutes to complete. For the purpose of this study we studied the three sections separately. The first section (1A–1E) asks about pain or discomfort 'at night' (1A), 'after getting up in the morning' (1B), 'when standing' (1C) and 'when walking' (1D). The fifth pain question (1E) addresses pain 'when rising from sitting' (knee index) and pain when 'sitting 2 h' (hip index). Questions 1C and 1E are graded dichotomously: 0 = no, 1 = yes. Questions 1A, 1B and 1D have three categories with 0 = no; categories 1 and 2 are different for each question (1A: 1 = only with movement or in certain positions, 2 = with no movement; 1B: 1 = more than one but less than 15 min, 2 = 15 min or more; 1D: 1 = only after walking some distance, 2 = initially and increasingly with continued walking). The second section asks about the maximum walk distance [graded from 0 = unlimited to 6 = less than 100 m (328 ft)]. If patients use one or two walking aids the score is upgraded by one and two points, respectively. The third section addresses physical function disability with four categories graded from 0 = without difficulty to 2 = unable to do. The knee index asks about 'climbing one flight of stairs upward', 'downward', 'squatting' and 'walking on uneven ground'. The hip index asks about 'putting on socks', 'pick up an object on the floor', 'going up or down one flight of stairs', 'getting out of a car or a chair'. The Lequesne OA index is scored as the sum of all questions. The score range of each section is from 0 to 8 resulting in a total score ranging from 0 to 24. The Lequesne OA index has been developed using an interview format. Because we were interested in comparing the performance of the two most widely used OA-specific health

status instruments using patient self-report useful for clinical trials and epidemiologic research, we adapted the Lequesne OA index for questionnaire use (self-administered Lequesne OA Index). Specifically, we added a question about the use of walking aids.

ANALYSES

To assess whether the WOMAC and the self-administered Lequesne OA index measure similar constructs, we examined the correlations between the instruments and their respective symptom and function dimensions using Spearman's rank correlation coefficient.

The internal consistency of the symptom and function dimensions of both instruments was examined using Cronbachs' coefficient alpha [20, 21] and inter-item correlations. To account for the ordinal grading of the self-administered Lequesne questions we used Spearman's rank correlation coefficient for the inter-item correlation matrix.

Test–retest reliability of the indices and dimensions was examined using the intraclass correlation coefficient. To compare the construct validity we examined the association of the scales and sections with radiological OA-severity using the method described by Kellgren and Lawrence (grading from 0–4) [22] and range of motion using a short-arm goniometer (degrees) [23]. For the knee flexion and extension the deficit was recorded; for the hip we used flexion and internal rotation which have been found to be most important when classifying patients based on clinical criteria [17].

Results

PATIENTS

Data from 51 patients could be analyzed. Thirty-seven out of 70 patients who were mailed postcards participated in the study. One patient died, one patient returned the postcard and denied to participate and 29 patients did not return the postcard. Two of the 37 patients did not fill in the questionnaire leaving 35 questionnaires to be analyzed. Nineteen out of 21 patients awaiting surgery agreed to participate. However, the data of three patients was incomplete and they were excluded from the study leaving 16 questionnaires for the analysis. All 12 out of 13 patients who agreed to fill in a second questionnaire after 10 days returned the questionnaire between 11 and 14 days.

The mean age of the patients was 70 (standard deviation 13.4). Sixty-seven percent of the patients were female. Twenty-nine patients had knee OA and 22 patients had hip OA. All patients fulfilled the ACR criteria for hip or knee OA [17, 18]. Radiological OA-severity and limitations in range of motion are shown in Table IV.

ANALYSES

Correlation between scales (Table I)

There was a moderate to high correlation between the WOMAC and self-administered Lequesne OA-indices for both the knee and hip. As expected, there was a higher correlation between the respective symptom and function dimensions than across dimensions.

Table I
Spearman's rank correlation between the self-administered Lequesne and WOMAC scales

	WOMAC Knee				WOMAC Hip			
	Composite	Pain	Stiffness	Function	Composite	Pain	Stiffness	Function
Lequesne knee								
Composite	0.65	0.52†	0.61†	0.72				
Pain	0.68†	0.66†	0.59†	0.66†				
Walk	0.26	0.17	0.25	0.32				
Function	0.63†	0.52†	0.51†	0.72†				
Lequesne hip								
Composite					0.82†	0.66†	0.79†	0.87†
Pain					0.69†	0.68†	0.70†	0.61†
Walk					0.68†	0.51*	0.61†	0.79†
Function					0.73†	0.49*	0.69†	0.77†

*$P < 0.05$.
†$P < 0.01$.

Table II
Metric properties of the WOMAC and self-administered Lequesne indices

	Score	Internal consistency scale*	Item-scale correlation†	Intraobserver reliability scale‡	Items‡
Lequesne knee					
Composite	11.0 (4.5)	0.82	0.19–0.81	0.86	—
Pain	4.5 (1.7)	0.55	0.18–0.43	0.87	0.14–1.00
Function	4.0 (2.0)	0.86	0.62–0.76	0.92	0.40–1.00
Lequesne hip					
Composite	11.4 (5.4)	0.83	0.24–0.91	0.94	—
Pain	4.5 (2.1)	0.63	0.25–0.57	0.96	0.58–1.00
Function	3.9 (1.8)	0.84	0.53–0.81	0.85	0.76–0.87
WOMAC knee					
Composite	4.0 (2.5)	—	—	0.83	—
Pain	3.9 (2.8)	0.89	0.53–0.81	0.90	0.52–0.94
Stiffness	4.0 (3.2)	0.93	0.87	0.72	0.65–0.69
Function	4.1 (2.5)	0.96	0.54–0.86	0.71	0.22–0.96
WOMAC hip					
Composite	4.6 (2.7)	—	—	0.77	—
Pain	4.4 (2.6)	0.82	0.47–0.64	0.79	0.48–0.86
Stiffness	4.6 (3.2)	0.81	0.68	0.43	0.41–0.48
Function	4.7 (2.7)	0.96	0.51–0.86	0.93	0.45–0.97

*Cronbach's coefficient alpha.
‡Intraclass correlation coefficient.
†Correlations are computed with the item of interest deleted.

Internal consistency (Table II, III)

All WOMAC scales had a high Cronbach's coefficient alpha ranging from 0.81–0.96 for both the hip and the knee. The inter-item correlations and item-correlation with the scale score were significant, moderate to strong, indicating that the WOMAC scales are measures of the underlying constructs pain, stiffness and physical function. An equally high internal consistency with Cronbach alpha's of 0.84 and 0.86 and significant, moderate to strong, inter-item correlations were found for the function sections of both the self-administered knee and the hip Lequesne OA indices. There were, however, low Cronbach's coefficients alpha of 0.55 and 0.63 for the symptom sections of both the knee and the hip. In some instances inter-item correlations were negative. There was a correlation of $r = -0.10$ between 'pain at night' and 'pain after getting up in the morning' in patients with hip OA whereas the correlation of 'pain at night' and 'pain while standing' in patients with knee OA was $r = -0.07$. Overall there was no consistent association among the symptom items and between the symptom and function items. This indicates that neither the symptom section nor the composite index which integrates the symptom and function items are unidimensional measures [21, 24].

Intraobserver reliability (Table II)

Using the intraclass correlation coefficient, there was a good test–retest reliability for both indices. The test–retest reliability of the dimensions was generally higher for the self-administered Lequesne OA index than for the WOMAC. For the hip, the reliability of the WOMAC stiffness scale was only 0.43 which is weak. One may note, that the WOMAC stiffness scale consists of only two questions which may result in a less stable estimate.

Construct validity (Table IV)

As hypothesized we found moderate, significant correlations of the WOMAC and self-administered Lequesne OA index with radiological OA severity and range of motion for both, patients with hip and knee OA. For both indices there were generally higher correlations for the function dimensions (including walking distance for the self-administered Lequesne OA index) than for the symptom scales. A lack of significant association with the biological parameters was, however, found for the

Table III
Spearman's rank correlation between the items of the self-administered Lequesne index (row 1: knee; row 2: hip)

		Pain				Walk distance	Function			
	Items	1B	1C	1D	1E	2	3A	3B	3C	3D
Pain	1A	–0.08 –0.10	–0.07 0.11	0.20 0.20	0.41* 0.47*	0.08 0.05	0.23 0.14	0.04 0.35	0.39* –0.02	0.23 0.35
	1B		0.41* 0.15	0.20 0.51*	0.33 0.24	–0.04 0.62†	0.19 0.20	0.31 0.39	0.36 0.64†	0.58† 0.67†
	1C			0.15 0.21	–0.01 0.26	0.08 –0.15	0.13 0.21	0.08 0.25	0.29 0.01	0.51† 0.20
	1D				0.22 0.40	0.32 0.34	0.46* 0.09	0.44* 0.38	0.17 0.22	0.52† 0.42
	1E					0.24 0.14	0.59† 0.18	0.49† 0.41	0.24 –0.04	0.39* 0.36
Walk distance	2						0.72† 0.41	0.60† 0.53*	0.46* 0.70†	0.50† 0.77†
Function	3A							0.76† 0.69†	0.50† 0.45*	0.66† 0.58†
	3B								0.49† 0.42	0.58† 0.73†
	3C									0.69† 0.71†

*$P < 0.05$.
†$P < 0.01$.

symptom section of the self-administered Lequesne OA index.

Discussion

The WOMAC and the self-administered Lequesne OA index are two highly related disease-specific measures of symptom severity and physical functional disability in patients with OA of the lower extremities. With the exception of the WOMAC stiffness scale in patients with hip OA which had a weak intraobserver reliability both instruments and subscales had a satisfactory intraobserver reliability.

All three WOMAC scales had a good internal consistency. The internal consistency of the WOMAC scales was comparable (Cronbach alpha's of >0.8) to the results from previous work by Bellamy summarized in the user's guide to the WOMAC [4]. Instead, only the physical function sections of the self-administered Lequesne but not the symptom sections and thus the composite indices which integrate symptom and physical function items were internally consistent. As to the best of our knowledge there are no previous data on the internal consistency of the Lequesne OA index, so we can not put our data in perspective. The internal consistency did not reach the minimal requirements for group comparisons by Nunally [21]. This was found for both, knee and hip OA. In other words, the symptom section and thus the composite self-administered Lequesne OA index are not unidimensional measures of an underlying construct [21, 24]. Assuming identical physical function we may not conclude that patients with a higher score on the symptom section have more severe symptoms then patients with a lower score.

Interestingly, the symptom section of the self-administered Lequesne OA index for both hip and knee OA was not or only weakly correlated with radiological OA severity and limitations of range of motion whereas the WOMAC pain scale was a moderate significant correlate of these parameters. This is further evidence that the symptom section of the self-administered Lequesne OA index was not a reliable measure of pain in patients with OA of the lower extremities. It is interesting that the assocation between the WOMAC and the impairment parameters was low for the knee while it was moderate for the hip. This

Table IV
Correlation of the WOMAC and self-administered Lequesne scales with radiology [22] and range of motion

		Correlation of radiology and range of motion with				
	Mean (Std)	Pain	Stiffness	Walk distance	Function	Composite
Lequesne knee ($N = 29$)						
Kellgren (0–4)	2.5 (0.9)	0.10	—	0.42†	0.59‡	0.47‡
Flexion (°)	123 (21)	–0.16	—	–0.48†	–0.62‡	–0.51‡
Extension deficit (°)	7 (6)	0.37†	—	0.17	0.38†	0.39†
Lequesne hip ($N = 22$)						
Kellgren (0–4)	3.2 (0.9)	0.18	—	0.42†	0.46†	0.37
Flexion (°)	96 (26)	–0.09	—	–0.34	–0.29	–0.25
Internal rotation (°)	9 (17)	–0.13	—	–0.43	–0.31	–0.34
WOMAC knee ($N = 29$)						
Kellgren (0–4)	2.5 (0.9)	0.28	0.24	—	0.44†	0.34
Flexion (°)	123 (21)	–0.27	–0.36†	—	–0.54‡	–0.44†
Extension deficit (°)	7 (6)	0.42†	0.33	—	0.45†	0.38†
WOMAC hip ($N = 22$)						
Kellgren (0–4)	3.2 (0.9)	0.73‡	0.46†	—	0.61‡	0.67‡
Flexion (°)	96 (26)	–0.47†	–0.27	—	–0.43	–0.44†
Internal rotation (°)	9 (17)	–0.51†	–0.33	—	–0.47†	–0.49†

*Spearman's rank correlations coefficient.
†$P < 0.05$.
‡$P < 0.01$.

is consistent with a weaker association between radiology and range of motion in knee as compared to hip OA [24]. Hip and knee OA are two clinically distinct entities which need to be assessed in a specific manner with respect to both, clinical and health outcomes.

There are different possible explanations for the lack of internal consistency and validity of the symptom section of the self-administered Lequesne OA index tested in our study. First, we used a German adaptation of the French original using a self-report format instead of an interview. Because we performed a cultural adaptation following the recently published guidelines [25, 26] including translation and backtranslation procedures and committee review which revealed no particular problems [27, 28] translation is an unlikely cause. The fact that most patients consistently filled in the questionnaire and the good intraobserver reliability of the symptom items also makes the different format an unlikely explanation. Second, the grading of the self-administered Lequesne symptom questions which follows different concepts such as 'presence of pain', 'pain with movement', 'duration of pain' and 'appearance of pain after a certain period of time' may explain the lack of correlation among the symptom items. Consistent with clinical experience our results suggest that one may not assume that patients with 'pain at night without movement' (as compared with 'pain only on movement or in certain positions') are more likely to experience 'pain for more than 15 min after getting up in the morning' (as compared with 'pain for 1–15 min') and to have 'immediate pain with walking' (as compared with 'pain only after a certain distance'). The suggestion that the grading of the self-administered Lequesne symptom items is responsible for the lack of internal consistency is supported by the high internal consistency of comparable WOMAC items consistently graded from 'no pain' to 'extreme pain'. To the best of our knowledge, there is no report on the internal consistency of the Lequesne symptom questions. It is thus not possible to decide whether the lack of internal consistency was a problem specific to our population and the self-report format or of the self-administered Lequesne OA indices in general.

To compare the two indices we made two assumptions. First, based on the data from the development of the WOMAC [4], current concepts of condition specific measurement in general [29] and clinical face validity we assumed that there are two distinct, although related, dimensions of condition specific health: pain and function. Since we did not question this assumption we did not perform a factor analysis but analyzed the two dimensions separately. We therefore analyzed the symptom and function section of the Lequesne OA index separately although the index uses an overall score. Because there is no published data on the internal consistency of the composite index we can not put our results in perspective. However, because the analysis of internal consistency of both the symptoms and function items does not increase the lack of association among the

symptom items, it is unlikely that our separate analysis of the symptom and function sections does question our conclusion.

A limitation of our study is the relatively small sample size and the selection of patients from a rheumatology registry and an orthopedics department. Although all patients fulfilled the ACR OA criteria, the study sample is unlikely to be representative for the whole spectrum of OA patients. In another sample the result may thus be different.

Summarizing the results of our comparison of the WOMAC and the self-administered Lequesne OA indices, we found the WOMAC to have good metric properties and validity whereas the symptom section of the self-administered Lequesne OA index and thus the composite index were neither internally consistent nor valid. The most likely reason for the lack of consistency among the symptom items is the inconsistent grading along different dimensions. Although our results are based on a German version using a self-report format we may caution using the self-administered Lequesne OA index without prior testing of its metric properties and validity.

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