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ORIGINAL REPORT

DISABILITY OF THE ARM, SHOULDER AND HAND QUESTIONNAIRE IN SWEDISH PATIENTS WITH RHEUMATOID ARTHRITIS: A VALIDITY STUDY

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Objective: **The aim of this study was to assess the reliability and validity of the Disability of the Arm, Shoulder and Hand (DASH) questionnaire in a Swedish rheumatoid arthritis population.**

Methods: **To investigate the concurrent and convergent validity, 67 patients with rheumatoid arthritis completed the DASH, the Health Assessment Questionnaire Disability Index (HAQ) and activity-induced pain. Active shoulder-arm motion, handgrip force and disease activity (Disease Activity Score in 28 joints; DAS28) were assessed. The test-retest reliability was investigated in 26 patients. Face validity was also investigated.**

Results: **Spearman's correlation coefficient revealed a significant association ($p < 0.001$) between the DASH score and HAQ index (r_s 0.80), confirming satisfactory concurrent validity. A significant association ($p \leq 0.02$) was found between the DASH score and active shoulder-arm motion (r_s –0.38 to –0.50), handgrip force (r_s –0.46 to –0.59), activity-induced pain (r_s 0.66) and DAS28 (r_s 0.63), confirming satisfactory convergent validity for the DASH questionnaire. Satisfactory test-retest reliability (intraclass correlation coefficient 0.99, 95% confidence interval 0.98–0.99) and face validity of the questionnaire were confirmed.**

Conclusion: **The DASH questionnaire showed satisfactory test-retest reliability, concurrent-, convergent-, and face validity for patients with rheumatoid arthritis and can be recommended for use in rheumatoid arthritis populations.**

Key words: disability evaluation; rheumatoid arthritis; upper extremity; reliability; validity; questionnaire.

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INTRODUCTION

Shoulder problems are common among patients with rheumatoid arthritis (RA), but are often neglected. Sixty-five to 90% of patients with RA report shoulder symptoms, mainly pain (1, 2). In addition to the causes of shoulder problems that are common to all adults, patients with RA have the additional risk of impaired shoulder function as a consequence of the inflammatory process affecting the peri-articular and intra-articular tissues (3, 4), which eventually leads to joint destruction and deteriorated shoulder function. In a longitudinal study, 50% of patients with RA showed moderate to severe radiographic erosions in the glenohumeral joints, according to the Larsen score, after having the disease for 15 years (5).

Reduced active and passive range of motion and movement-induced pain (6) are common clinical symptoms of deteriorated shoulder function among patients with RA. In spite of the often low inflammatory activity caused by more aggressive disease-modifying anti-rheumatic drug (DMARD) treatment (7), patients with RA appear to have difficulties in heavier physical activities, such as carrying a load and working with the arms above shoulder height.

The shoulder function has traditionally been measured by assessing active range of motion (8–10), muscle endurance (11), pain (12) and general activity (13). There is a need of a feasible, reliable and valid instrument that specifically focuses on activity limitations in the upper extremities in patients with RA to complement the measures of joint and muscle function.

The Disabilities of the Arm, Shoulder and Hand questionnaire (DASH) (14) is a self-administered outcome instrument identified for upper extremity function in patients with muscular-skeletal disorders. The overall purpose of the instrument is to detect upper extremity disorders of different severity and to assess changes over time. The DASH is suggested to be among the best-rated self-administered questionnaires for its clinometric properties in populations with upper extremity musculoskeletal disorder (15). The Swedish version of the DASH questionnaire is reliable and valid (16) for use in patients with upper extremity musculoskeletal disorders, although it has not been evaluated for use in a Swedish RA population. A previous study in the Netherlands included patients with RA who had consultations for their upper extremity dysfunction and activity limitations. The finding was that DASH possesses good validity and reliability in patients with RA (17). Since cultural differences have been reported among patients with RA with regard to symptoms such as pain and function (18), we found it relevant to validate the DASH for Swedish patients. The aim of the present study was to assess concurrent validity, convergent validity, face validity and reliability of the DASH questionnaire in a Swedish RA population.

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METHODS

Recruitment process: validity study

The patients were recruited from the Rheumatology Unit at Sahlgrenska University Hospital in Gothenburg through the Swedish RA register of Gothenburg. The beginning and end points of recruitment from the Swedish RA register were April 2005 and August 2007, respectively. The Swedish RA register was established for epidemiological purposes and includes participation of all rheumatology units in the country. All individuals diagnosed with RA who have agreed to participate in the register, are systematically reported regarding disease activity and treatment to a central database. The inclusion criteria in the present study were patients with RA, fulfilling the 1987 American College of Rheumatology (ACR) criteria (19), with duration of RA ranging from 6 months to 3 years, aged 20–60 years, who were able to read and speak Swedish. Patients with other severe somatic or psychiatric diseases were excluded. A total of 90 individuals were found to be potentially eligible and were invited for examination. Invitations were followed up by a telephone call. Nine individuals could not be contacted by telephone and 14 declined to participate in the study because of time restrictions ($n = 9$) or lack of interest ($n = 5$), leaving a total of 67 patients.

Recruitment process: reliability study

A total of 30 patients with RA who fulfilled the ACR criteria and were 20–60 years of age were consecutively recruited at a visit to the Rheumatology Unit at Sahlgrenska University Hospital in Gothenburg. The inclusion criteria were the same as those used for the validity study except for disease duration comprising 6 months to 10 years and absence of corticosteroid injections for the most recent week to avoid changes in health status that could interfere with the test-retest reliability results. Four patients did not return the DASH questionnaire on the second occasion. Thus, 26 protocols were included in the analyses of the test-retest reliability of the DASH questionnaire.

Measures and analysis

Information on demographic data and disease variables was obtained in interviews and from the patient records. The patients were provided with self-reported questionnaires: the Swedish version of the DASH questionnaire and the Health Assessment Questionnaire Disability Index (HAQ). Active shoulder-arm motions, activity-induced pain, handgrip force, and the number of swollen and tender joints were assessed by two physiotherapists specialized in rheumatology. A blood sample was collected to estimate the erythrocyte sedimentation rate (ESR). All the examinations and questionnaire completions took place at the clinic. All patients received verbal and written information about the study and signed the informed consent forms. The study was approved by the ethics committee at the Sahlgrenska Academy, Gothenburg University.

Concurrent validity means agreement with the true value (20). As no "gold-standard" is available for activity limitations related to the upper extremities for patients with RA, we compared the DASH questionnaire with the well-established instrument HAQ, which measures general activity limitations in RA. We expected to observe a high correlation between the questionnaires.

Convergent validity studies relationships between the instrument (phenomenon) in focus and other instruments expected to be related to it (20). Thus we analysed the association between the DASH score and the rating of activity-induced pain (Borg symptom scale), handgrip force (Grippit) and active shoulder-arm motion (the shoulder-arm movement impairment instrument) and shoulder-specific HAQ items. A correlation between the DASH score and Disease Activity Score in 28 joints (DAS28) was also investigated, since activity limitations are assumed to be associated with inflammation. We expected to find at least a moderate association between the DASH score and the other variables supposed to be related to the activity limitations in the shoulder-arm-hand.

To evaluate face validity, patients were asked to give their opinion of the relevance of the questionnaire in two open questions and by answering two statements graded from "agree totally" to "do not agree at all" (0–4 scale).

Test-retest reliability assesses the degree of stability in an individual's scores from one administration to another and was studied for the total score of the DASH. The patients were asked to complete the questionnaire on two occasions, separated by 2–5 day intervals.

The DASH questionnaire (14, 16) was used to assess activity limitations related to the shoulder-arm-hand. The DASH consists of: a 30-item disability/symptom scale concerning the patient's health status during the preceding week; and two optional scales, one concerning the ability to perform sport or to play an instrument and the other the ability to work. Only the 30-item disability scale was applied in this study. Twenty-one items reflect the degree of difficulty in performing various physical activities due to arm, shoulder or hand problems, 5 items represent the severity of each symptom of pain, activity-related pain, tingling, weakness and stiffness and 4 items reflect the effect on social activities, work and sleep. Each item has 5 response choices, ranging from "no" difficulty or no symptom to "unable" to perform activity or very "severe symptom", and is scored on a scale from 1 to 5. The DASH score ranges from 0 to 100, where 100 represent the most severe disability. The mean value for the reference group aged 19–75+ years is suggested to be 10 (standard deviation (SD) 15) (21).

The Stanford HAQ Index (13, 22) was used to assess general activity limitations. The HAQ is a RA disease-specific instrument that measures 8 aspects of activity during the previous week rated from 0 (no limitations) to 3 (severe difficulties). Three HAQ-items, representing activity limitations in the shoulder were selected for specific analysis of concurrent validity: hair-washing, washing-and-drying-oneself, and reach.

Active shoulder-arm motion was assessed by the Shoulder-arm movement impairment instrument (6, 10). The instrument measures 5 common shoulder movements; hand-raising, hand-to-opposite-shoulder, hand-behind-back, hand-to-neck and hand-to-seat. The score ranges from 1 to 6, where score 6 represents full ability. The total score is 5–30, for each shoulder.

Activity-induced pain during an unloaded active shoulder-arm motion of the shoulder arm was assessed by the Borg's Category Scale for Ratings of perceived pain (23). The score ranges from 0 to 10, where 0 represents no pain. The total score is 0–50 for each shoulder.

Handgrip force was assessed by the Grippit (AB Detektor, Gothenburg, Sweden) (24). The instrument measures the actual force produced by the hand when squeezing with maximum intensity for a period of 10 s. The handgrip force was measured in Newtons (N).

The DAS28 (25) was used to assess disease activity and is based on a calculation of the ESR, number of swollen and tender joints (28-joint index), and self-reported general health perception scored on a visual analogue scale (0–100, where 0 = no symptoms). The DAS28 (0–10) scores < 3.2 indicates low and > 5, 1 high disease activity.

Statistics

Descriptive data are presented as percentage, means and SD. Validity was assessed by Spearman's correlation coefficient. The following classification was used to interpret the correlation values: 0–0.25 indicates little or no relationship, 0.25–0.50 indicates a fair degree of relationship, 0.50–0.75 a moderate to good relationship, while a correlation above 0.75 indicates a very good to excellent relationship. The test-retest reliability was expressed as the differences between the readings (test 2 – test 1) and the SD of the differences the intraclass correlation coefficient (ICC2.1), 95% confidence intervals (95% CI) for ICC and the intra-individual SD. ICC of 0.90 is recommended for assessment of individual protocols, while 0.70 is acceptable for group comparison, Wilcoxon's signed rank test was chosen to analyse systematic differences in the variables between the 2 occasions. All tests were two-tailed and conducted at the 5% significance level. Analyses were made using SPSS18.0.

RESULTS

Concurrent, convergent and face validity

All patients ($n = 67$) completed the DASH, while 2 HAQ-protocols could not be calculated due to missing values. DAS28 was obtained from 62 patients of the total population ($n = 67$) as the ESR data was missing in 5 patients.

The study population included 52 women and 15 men with a mean age of 47 years (SD 9.9), ranging from 23 to 60 years. The mean duration of disease was 21 months (SD 7.6), ranging from 6 to 36 months. The mean DAS28 score was 3.0 (SD 1.10), ranging from 0.98 to 6.25, and 69% of the study population was rheumatoid factor seropositive. A majority of the patients (94%) was treated with DMARDs and 9% with oral glucocorticosteriods. The mean HAQ-index was 0.5 (SD 0.51), ranging from 0 to 2.1, while the mean DASH score was 22 (SD 18.0), ranging from 0 to 77. Activity limitations and body functions of the study population are summarized in Table I.

Concurrent validity

The associations between the DASH score and the HAQ-index was found to be very good to excellent (r_s 0.80, $p < 0.001$) (Table II).

Convergent validity

The associations between the DASH score and the HAQ–hair-washing (r_s 0.55, $p < 0.001$), the HAQ–washing-and-drying-oneself (r_s 0.61, $p < 0.001$) and the HAQ–reach (r_s 0.72, $p < 0.001$) were all moderate to good (Table II).

The association between the DASH score and active shoulder-arm motion was moderate to good (r_s –0.50, $p < 0.001$) for the right arm, and fair (r_s –0.38, $p = 0.002$) for the left arm (Table II).

Table I. *Characteristics of the study population (*n = *67)*

Variable	Mean (SD)
Age, years	47 (9.9)
Disease duration, months	21 (7.6)
ESR, mm/h	15 (14.2)
Tender joints (0–28)	4 (4.5)
Swollen joints (0–28)	2 (1.61)
General health (0–100)	26 (20.5)
DAS28 (0–10)[a]	3.0 (1.10)
DASH (0–100)	22 (18.0)
HAQ total score (0–3)[b]	0.5 (0.51)
HAQ – hair-washing[b]	0.2 (0.51)
HAQ – washing-and-drying-oneself[b]	0.4 (0.66)
HAQ – reach[b]	0.5 (0.62)
Activity induced pain, right (0–50)	7.1 (7.34)
Activity induced pain, left (0–50)	6.4 (6.30)
Shoulder function index, right (0–30)	27 (4.1)
Shoulder function index, left (0–30)	27 (3.7)
Grippit, right, *n*, 10 s	208 (130.6)
Grippit, left, *n*, 10 s	195 (126.6)

[a] $n = 62$; [b] $n = 64$.

ESR: erythrocyte sedimentation rate; DAS28: Disease Activity Score in 28 joints; DASH: Disabilities of the Arm, Shoulder and Hand questionnaire; HAQ: Health Assessment Questionnaire; SD: standard deviation; N: Newtons. Shoulder function index: active range of motion in shoulder, and arm; Grippit: handgrip force.

Table II. *Relationship between the Disabilities of the Arm, Shoulder and Hand questionnaire (DASH) and measures of disease activity, activity limitation and body function,* n = *67. Values are given as Spearman's correlation coefficients* (r_s) *and* p*-values*

Variables	*n*	DASH r_s	*p*-value
DAS28	62	0.63	<0.001
ESR	62	0.15	0.256
Swollen joints	67	0.27	0.029
Tender joints	67	0.59	<0.001
General health	67	0.71	<0.001
HAQ total score	64	0.80	<0.001
HAQ – hair-washing	64	0.55	<0.001
HAQ – washing-and-drying-oneself	64	0.61	<0.001
HAQ – reach	64	0.72	<0.001
Shoulder function index, right	67	–0.50	<0.001
Shoulder function index, left	67	–0.38	0.002
Activity-induced pain, right	67	0.66	<0.001
Activity-induced pain, left	67	0.66	<0.001
Grippit, right	67	–0.59	<0.001
Grippit, left	67	–0.46	<0.001

DAS28: Disease Activity Score in 28 joints; ESR: erythrocyte sedimentation rate; HAQ: Health Assessment Questionnaire. Grippit: handgrip force.

The association between the DASH score and the handgrip force was moderate to good (r_s –0.59, $p < 0.001$) for the right hand and fair (r_s –0.46, $p < 0.001$) for the left hand (Table II).

The association between the DASH score and activity-induced pain was moderate to good (r_s 0.66, $p < 0.001$) for both the right and left shoulder-arms (Table II).

The association between the DASH score and DAS28 was moderate to good (r_s 0.63, $p < 0.001$) (Table II).

Face validity

Out of 26 patients, 77% reported current symptoms in the shoulder-arm-hand. Ninety-six percent of the patients found the DASH to reflect fully or in general their shoulder-arm-hand problems. Ninety-six percent found the DASH easy to understand and 79% found the items relevant. However, question number 21, comprising sexual activities, was found to be too personal by 2 patients, and 1 patient raised a question about car driving and ability to change gear. The results confirmed that the DASH questionnaire possesses satisfactory face validity.

Test-retest reliability

Test-retest reliability was analysed for 26 patients (20 women and 6 men) with a mean age of 44 years (SD 10.92), ranging from 23 to 60 years. Their mean disease duration was 51 months (SD 33.5) and their mean ESR was 16 (SD 10.6), ranging from 1 to 52. The total score of the DASH for the first and second times was 32 (SD 30.06) and 32 (SD 30.76), respectively. Each patient completed the questionnaire twice within a mean interval of 2.2 days, ranging from 2 to 5 days. The ICC (2.1) was 0.99 (95% CI, 0.98–0.99) for the DASH score, indicating excellent agreement. The mean difference for the DASH score was –0.15 (SD 4.05), ranging from –9 to 12. The intra-individual SD was

2.78. No systemic differences were found for the protocols completed on the two occasions ($p = 0.652$).

DISCUSSION

Concurrent and convergent validity of the DASH questionnaire were satisfactory, showing that the DASH covers activity limitations related to the shoulder-arm-hand in a Swedish RA population.

Concurrent validity was assessed by correlating the DASH score with the measure of general activity limitations in RA, the HAQ. There was very good to excellent correlation, which is in agreement with a previous study (17).

Several other analyses were made to assess convergent validity with health aspects that are thought to be related to activity limitations in the upper extremities. As the HAQ assesses general activity limitations, a further analysis was conducted to study the correlation between the DASH and 3 shoulder-arm-hand specific items of the HAQ. The analysis showed a moderate to good correlation, which is in line with a previous study of patients with painful shoulders (26). The association between the DASH score and the active shoulder-arm motion for the right arm was better than the association with the left arm. The result of a moderate to good association between the DASH score and the right arm was in line with a previous study of patients with painful shoulders (26). An explanation for a lower correlation between the DASH score and the left arm might be that most patients had a rather good active shoulder-arm motion in the left arm. The association between the DASH score and the handgrip force showed similar findings; a slightly higher association in the right than in the left arm, respectively.

The disease activity in the study population was generally low, as assessed by the DAS28. This might be the cause that it reflects the current health status of patients with RA, but at the same time it can be considered as a limitation of the study, with fewer patients with severe disease activity and more severe activity limitations.

The moderate to good association between the DASH score and DAS28 indicated that activity limitations in the upper extremities are probably more common among patients with a higher general disease activity. As pain may contribute to the severity of activity limitations in RA (27), we excluded the two items in the DASH that assess pain; the association between disease activity and the DASH was still high (r_s 0.73), $p < 0.001$).

Sixty-five percent of the DASH protocols showed scores above 10, which indicates some activity limitations related to the shoulder-arm-hand in comparison with norm values (21). This implies that RA patients with a low disease activity can have some activity limitations that are related to the upper extremity, warranting longitudinal studies to identify possible progress. DASH might be an instrument that can feasible be used to identifying limitations of activity. The face validity of the DASH was established by asking the patients about the relevance of the DASH, and they reported the questionnaire to reflect problems they had in their shoulders, arms and hands.

Satisfactory test-retest reliability, studied by ICC, was found for the DASH score for groups of patients and individual protocols, and this is supported by previous studies (17, 28). The interval between the two tests was 2–5 days to avoid bias caused by a change in the health status. It is difficult to decide what the interval should be between the two tests to assess test-retest. Some authors recommend a 1–2 week period between the tests to minimize recall bias, while others use a shorter period of time of 2–3 days between the tests in order to avoid possible changes in the health status. Since the health status of RA patients can change rapidly, we found a shorter period of time between the tests to be more appropriate for this study in its investigation of test-retest for the DASH questionnaire. However, the patients' possible recall of previous answers can be considered a methodological limitation of the study.

To conclude, the DASH questionnaire, which assesses activity limitations in the shoulder-arm-hand, was shown to possess satisfactory concurrent and convergent validity in patients with RA when compared with traditional measures. The DASH was also shown to have satisfactory test-retest reliability, indicating that the instrument can be used to monitor the progress of upper extremity function. The DASH appears to cover activity limitations related to the shoulder-arm-hand in patients with RA and can be recommended for use in RA populations.

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