Field testing and clinical validation of the mSQUASH to measure physical activity in patients with Sjögren's disease

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Abstract

Objective

Regular physical activity is recommended in patients with rheumatic diseases. In order to uniformly measure physical activity, our aim was to perform field testing of the modified Short QUestionnaire to ASsess Health enhancing physical activity (mSQUASH) in Sjögren's disease (SjD), together with other rheumatic diseases, and to investigate construct validity and test-retest reliability of the mSQUASH in patients with SjD.

Methods

The mSQUASH was tested by conducting semi-structured interviews in patients with SjD (n=10), systemic lupus erythematosus (n=10), giant cell arteritis/polymyalgia rheumatica (n=10) and axial spondyloarthritis (n=13) to check for understandability, interpretation and relevance. For construct validity (n=263 SjD), the association of mSQUASH to other patient-reported outcome measures was analysed using Spearman correlations. It was hypothesised that correlations are highest for physical-related outcomes, with fair to moderate correlations due to partly overlapping constructs. For test-retest reliability (n=75 SjD), intra-class correlation coefficients (ICCs) were calculated and Bland-Altman analysis was performed.

Results

All patient groups perceived the mSQUASH as relevant and easy to complete. Some minor adaptations and clarifications were implemented. As expected, mSQUASH total score showed fair associations with ESSPRI total score (ϱ=-0.30) and EQ-5D total score (ϱ=-0.34). Within the subdomains, correlations were higher for ESSPRI fatigue and pain compared to dryness and highest for EQ-5D activity and mobility. Test-retest reliability was good, with an ICC of 0.84. Bland-Altman analysis showed no systemic bias, but limits of agreement were wide.

Conclusion

The mSQUASH is a feasible, valid and reliable questionnaire to assess daily physical activity in SjD patients.

Key words

Sjögren's disease, physical activity, patient-reported outcome measures, field testing, measurement properties

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Introduction

Sjögren's disease (SjD) is a chronic, systemic autoimmune disease characterised by sicca symptoms of the eyes and mouth. Other frequently experienced symptoms are chronic fatigue, muscle pain and joint pain, which have major impact on health-related quality of life (HR-QOL) (1). Fatigue was found to be the dominant predictor of physical function (2, 3). In patients with SjD, levels of physical activity and physical capacity appeared to be reduced compared to healthy individuals (4-6).

In general, regular physical activity shows beneficial effects in the prevention of several chronic diseases such as cardiovascular disease, diabetes, cancer, hypertension, obesity, depression and osteoporosis (7). Physical activity is recommended in different rheumatic diseases such as rheumatoid arthritis (RA), axial spondyloarthritis (axSpA), systemic lupus erythematosus (SLE) and SjD. Regular physical activity can have a beneficial effect on pain, fatigue, functional status and general health in patients with rheumatic diseases (8).

Of the various symptoms, patients with SjD considered fatigue and pain as the most important symptoms in need of improvement by treatment, reported at the baseline visit in an open-label trial with rituximab (9). The first therapeutic step recommended for the management of pain in SjD patients is comparable to those advised for general chronic pain patients (10), including physical activity and aerobic exercise (11). Exercise is also recommended for the management of fatigue in patients with SjD (11-13). The recommendation for fatigue is based on a small controlled intervention trial involving 10 patients with SjD. This research showed that patients in the exercise treatment group improved significantly in fatigue, as well in aerobic capacity, anxiety, depression and HR-QoL (14). More recent research, investigating the effect of supervised walking (15) and resistance training (16) on fatigue, support these guidelines. In daily clinical practice and research, there is a need for a measurement instrument to assess the amount and type of daily physical activity in patients with SjD.

Physical activity can be measured with questionnaires, which are low in cost, take little time and offer the possibility to include information about the specific physical activity (domains, duration, frequency and intensity) (17). Examples of validated questionnaires for physical activity are the International Physical Activity Questionnaire (IPAQ) and the modified Short Questionnaire to ASsess Health enhancing physical activity (mSQUASH). The main difference between the questionnaires is that the IPAQ measures walking, moderate and vigorous activities, whereas the mSQUASH measures all activities (light, moderate, and vigorous) and the domains of the mSQUASH are more detailed. In the IPAQ, the activity score is based only on the metabolic equivalent of task (MET) value. In the mSQUASH, the MET value is combined with the perceived physical demand reported by the patient to calculate the activity score. Previous research in patients with axSpA showed that the mSQUASH correlated better with accelerometer data compared to the IPAQ (mSQUASH p=0.57; IPAQ p=0.24). Moreover, the mSQUASH showed slightly stronger correlations with disease activity, physical function and HR-QoL, had better sensitivity to change, fewer missing values, and was preferred by patients with axSpA over the IPAQ (18). The original SQUASH was developed for adults in a general population and the adaptations of the mSQUASH for axSpA were ultimately generic. Therefore, we expect that the mSQUASH is more widely applicable and can also be used in patients with SjD. The aim of this study was to perform field testing of the mSQUASH in SjD, together with other rheumatic diseases, and to investigate construct validity and test-retest reliability of the mSQUASH in patients with SjD.

Methods

Patients

The study was conducted within the REgistry of Sjögren Syndrome LongiTudinal (RESULT) cohort. This is an ongoing prospective longitudi-

nal observational cohort study with standardised follow-up including patient-reported outcome measures (PROMs). This cohort was approved by the Medical Ethics Committee of the University Medical Center Groningen (UMCG) (METc 2014/491 + nonWMO mSQUASH project: METc 2022/581) and was conducted according to the declaration of Helsinki. All patients provided written informed consent (19). Inclusion criteria for this study were patients aged ≥18 years and fulfilling the American College of Rheumatology/European League Against Rheumatism (ACR-EULAR) classification criteria for SjD. For the interviews, patients from the RESULT cohort were selected at the outpatient clinic of the Sjögren's expertise centre in the UMCG with specific attention to a variety in age, sex, occupation and disease activity, in order to create a heterogeneity representing the broad disease spectrum of SjD. Patients with concomitant conditions restricting physical activity were excluded. For the clinical validation, consecutive patients from the RESULT cohort were used.

mSQUASH

The mSQUASH measures the amount of physical activity of a normal week in the past month. The questions can be divided in four different domains:

1. commute to/from work or school and commute to/from other destinations,
2. work or school/study activities,
3. household activities,
4. leisure activities and sports and exercise.

For each question, participants are asked whether the question applies, how many days per week the activities were performed, how much time on average was spent on the activity per day (hours and minutes) and how strenuous the performed activities were. The perceived physical demand can be divided in slow/light, moderate and fast/high. The scores that can be calculated are the total activity score and the scores per domain. This is done by multiplying the minutes per week with an intensity score of the activities executed. The intensity score ranges from 1 to 9 and is based on the perceived physical demand reported by the patient and the MET values of the Ainsworth compendium (20, 21). One MET is the energy equivalent to the energy spend while seated at rest (22).

When more than two subdomain scores were missing, the total activity score was not calculated. The 'minutes per week' variable was set on a maximum of 6720 to exclude extreme values that are not realistic outcomes. This maximum of on average 16 hours of activity per day assumes that respondents sleep or are inactive for at least 8 hours per day. When the duration and frequency of the sport was filled out, but the type of sport was missing, an average MET value of 5.5 was used. A detailed guideline for data preparation, score calculation, results and interpretation of the mSQUASH can be found in the manual (23).

Cognitive debriefing interviews

Field testing of the mSQUASH was performed in 10 patients with SjD by semi-structured, one-to-one interviews (nine face-to-face and one online). Each patient completed the questionnaire and was interviewed in order to check the understandability, interpretation, comprehensiveness and relevance. The interviews were digitally recorded using a voice recorder. The recorded data was transcribed verbatim, coded and analysed using a thematic analysis approach. The same process was conducted within prospective observational cohort studies for patients with SLE (n=10) (24) and giant cell arteritis/polymyalgia rheumatica (GCA/PMR; n=10) (25) in the UMCG, the Netherlands, and axSpA (n= 13) in the University of California, San Francisco (UCSF), USA (23).

Subsequently, the results from the interviews with SjD, SLE and GCA/PMR and axSpA patients were discussed in a group of experts comprising a multidisciplinary team of physicians, a methodologist and the interviewers. During the expert meeting, an adaptation was implemented when it was 1) in line with the purpose of the mSQUASH (measuring physical activity), 2) understandable and content/linguistically correct (construct/face validity) and 3) not in contrast with another suggested adaptation or current content of the questionnaire. If multiple suggested adaptations covered similar topics, the most accessible adaptation was chosen. Following the expert meeting, the adapted final mSQUASH was used to investigate the construct validity and test-retest reliability in SjD.

Construct validity

Construct validity of the mSQUASH was investigated by comparing the relation to other PROMs: questionnaires regarding disease activity, fatigue, mental status and health status/HR-QoL. Disease activity was assessed with the EULAR Sjögren's Syndrome Patient Reported Index (ESSPRI), in which patients are asked to rate their symptoms of dryness, fatigue and pain. Fatigue was assessed with the physical and mental fatigue domains of the Multidimensional Fatigue Index (MFI). Mental status was assessed with the Hospital Anxiety and Depression Scale (HADS). Health status was assessed with the Euroqol-5 dimensions (EQ-5D-5L) and HR-QoL with the 36-item Short Form health survey (SF-36). Primary outcomes were the ESSPRI and EQ-5D. Secondary outcomes were the MFI, HADS and SF-36. At baseline, 2-year, 5-year, 7-year, 10-year visits from the RESULT cohort, all questionnaires were completed (mSQUASH, ESSPRI, EQ-5D, MFI, HADS and SF-36). At the other yearly or half-yearly visits from the RESULT cohort, only the mSQUASH, ESSPRI and EQ-5D were completed. It was hypothesised that the correlations between mSQUASH and other PROMs would be highest for physical-related outcomes, with fair to moderate correlations due to partly overlapping constructs.

Test-retest reliability

Test-retest reliability was investigated by evaluating if patients with stable disease had the same test results when the assessment was repeated two weeks later (with a maximum of three weeks). The two weeks were chosen to be short enough so that disease status would not change, but long enough to reduce the chance of recall bias. Pa-

Table I. Patient characteristics of the cognitive debriefing interviews.

Participant	Sex	Age	Living place	Occupation (previous)	Duration symptoms (years)	Time since diagnosis (years)	ESSDAI	ESSPRI	HCQ	CO	DMARD	SSA	Biopsy
1	f	35	Village	Nurse	12	8	2	7.33	no	no	no	+	+
2	f	59	Village	Teacher	4	3	2	8.67	yes	no	no	-	+
3	f	66	Village	Residential nurse	46	6	0	8.67	yes	no	yes	+	+
4	f	76	Village	Farmer	6	6	1	6.00	yes	no	no	+	+
5	f	48	Village	Store owner	20	12	1	6	no	no	no	+	+
6	m	24	City	Electrical engineering student	5	4	4	0	yes	no	no	+	+
7	m	68	Village	Agricultural machinery repair	5	4	4	2.67	no	no	no	-	+
8	f	59	City	Administration	2	2	30	6.67	no	yes	yes	+	+
9	f	39	City	Cleaner	5	4	0	*	yes	no	no	+	+
10	f	71	City	Professor	14	14	3	*	no	no	no	+	+

* missing data; +: positive; f: female; m: male; ESSDAI: EULAR Sjögren's Syndrome Disease Activity Index; ESSPRI: European League Against Rheumatism (EULAR) Sjögren's Syndrome Patient Reported Index; HCQ: hydroxychloroquine; CO: corticosteroids; DMARD: disease-modifying anti-rheumatic drugs; SSA: anti-Sjögren's-syndrome-related antigen A autoantibodies; Biopsy: a positive salivary gland biopsy according to the ACR-EULAR classification criteria.

tients with known changes in physical activity (*e.g.* due to holiday) or treatment regimen were excluded. It was hypothesised that test-retest reliability would be good, comparable to the Dutch mSQUASH in axSpA patients (18).

Statistical analysis

Statistical analysis was performed using SPSS version 28. Categorical variables were presented as absolute numbers and percentages. Normally distributed continuous variables were described with means and standard deviations. Non-normally distributed continuous variables were described with medians and interquartile range (p25-p75).

Construct validity

Spearman's correlation coefficients were calculated between mSQUASH total activity score and other PROMs. Correlations of 0.0-0.2 were interpreted as poor, >0.2-0.4 as fair, >0.4-0.6 as moderate, >0.6-0.8 as good and >0.8-1.0 as excellent (26).

Test-retest reliability

Intraclass correlation coefficients (ICCs; two-way mixed effect model, single measures, absolute agreement) between the first and second assessment were calculated. Reliability was assessed for both total scores and activity scores per domain. ICC values of at least 0.70 indicated good reliability (27). Additionally, Bland-Altman analysis was performed on the total scores to assess systematic difference and to calculate 95% limits of agreements (LOA). p-values <0.05 were considered statistically significant.

Results

Cognitive debriefing interviews

A representative sample of 10 patients with SjD was interviewed. The characteristics of these patients are shown in Table I. Their age ranged from 24 to 71 years and two patients were male. Based on the interpretation of their occupation, patients varied from low educated (*e.g.* cleaner) to highly educated (*e.g.* professor). Slightly more than half of the patients used any kind of immunosuppressive (HCQ, corticosteroids, DMARD). The ESSDAI varied from 0 to 30. In most patients, this was based on activity in the biological or haematological domain. One patient had low articular involvement. The patient with an ESSDAI of 30 showed activity in the renal, constitutional, lymphadenopathy, haematological and biological domain.

Only the feedback that was given by the majority of the SjD patients and the adaptations which were implemented after the expert meeting are reported. The feedback from the SjD patients was similar to that from patients with SLE, GCA/PMR and axSpA (23).

Overall, the SjD patients were satisfied with the questionnaire and perceived it as relevant and easy to complete. There were only minor suggestions for adjustments, related to the layout and the terminology of the mSQUASH. The modifications were made for clarification purposes, but the general structure and content of the mSQUASH remained unchanged.

Adaptations were made to the layout of the questionnaire. During the interviews, it was noticed that not every patient read the instructions. Therefore, the layout of the instructions was somewhat changed, *i.e.* 'Classification of the level of intensity' was not in italic lettering anymore, and the key points of the instructions were repeated on the second page. Some patients forgot to use the 'Not applicable' box, therefore the response choice 'Not applicable' was moved from the left towards the centre.

There were also adaptations to the specific domains. It was mentioned that the category 'Other transport' could possibly be difficult to understand and can be confused with means of transport such as the bus or train. Therefore, the title was changed to 'Commute to/from other destinations'. In addition, feedback from patients indicated the need for more examples to clarify the meaning of 'Other transport'. Consequently, the example 'visiting someone' was added.

It was mentioned that the domain title 'Physical Activity at Work or School' could be confusing, because it could be interpreted to mean that the type of work or school must include a physical activity to answer the question. Physical activity was also not mentioned in the other titles of the categories. Therefore, it was decided to remove 'Physi-

Table II. Characteristics of patients with SjD included in the assessment of construct validity and test-retest reliability.

	Construct validity	Test-retest reliability
Total patients (n)	263	75
Gender (female)	229 (87)	65 (87)
Age (years)	57 (46-68)	62 (49-69)
Disease duration (years)	10 (7-16)	9 (6-15)
Symptom duration (years)	17 (11-24)**	16 (9-24)*
Current immunosuppressive use (any)	100 (38)	27 (36)
Hydroxychloroquine	73 (28)	21 (28)
Corticosteroid	17 (7)	5 (7)
Rituximab	11 (4)	3 (4)
Other	34 (13)	7 (9)
Presence of anti-SSA	228 (87)	67 (89)
IgG (g/L)	13.7 (10.5-18.2)	13.2 (10.1-18.0)
RF (IU/ml)	7.3 (2.0- 28.5)	7.70 (1.7-24.9)
Positive biopsy	215 (82)	62 (84)
ESSDAI	4 (2-6)	4 (2-7)*
ESSDAI domain activity†		
Cutaneous	14 (6)	2 (3)
Respiratory	3 (1)	1 (1)
Renal	1 (0.4)	0 (0)
Articular	33 (13)	7 (10)
Muscular	0 (0)	0 (0)
Peripheral nervous system	10 (4)	4 (6)
Central nervous system	0 (0)	0 (0)
Haematological	104 (41)	37 (52)
Glandular	59 (23)	16 (22)
Constitutional	52 (21)	18 (25)
Lymphadenopathy	12 (5)	3 (4)
Biological	191 (76)	51 (72)
Primary outcomes (n)	263	75
mSQUASH questionnaire		
Total activity score	6570 (3317-9630)	6300 (3540-9045)‡
Work	0 (0-5040)	0 (0-4860)
Commute	400 (30-960)	360 (120-940)
Household	1608 (874-2730)	1680 (1155-2843)
Leisure-time and sport	1100 (505-2105)	1190 (540-2205)
ESSPRI questionnaire		
ESSPRI total score	6 (5-7)	6 (5-7)
ESSPRI dryness	7 (5-8)	7 (5-8)
ESSPRI fatigue	7 (5-8)	6 (4-8)
ESSPRI pain	6 (3-7)	6 (3-7)
EQ-5D questionnaire		
EQ-Index	0.78 (0.65-0.85)	0.79 (0.65-0.86)
Mobility	0.00 (0.00-0.04)	0.00 (0.00-0.04)
Selfcare	0.00 (0.00-0.00)	0.00 (0.00-0.00)
Activity	0.04 (0.00-0.09)	0.04 (0.00-0.09)
Pain	0.09 (0.07-0.09)	0.07 (0.07-0.09)
Anxiety	0.00 (0.00-0.07)	0.00 (0.00-0.07)
Secondary outcomes (n)	155	
MFI questionnaire		
MFI physical fatigue	13 (10-16)	
MFI mental fatigue	11 (7-13)	
HADS questionnaire		
HADS anxiety	5 (3-5)	
HADS depression	4 (2-7)	
SF-36 questionnaire		
SF-36 physical functioning	75 (55-90)	
SF-36 social functioning	63 (63-88)	
SF-36 role limitations (physical problem)	50 (31-69)	
SF-36 role limitations (emotional problem)	75 (50-100)	
SF-36 mental health	75 (64-85)	
SF-36 vitality	50 (36-63)	
SF-36 pain	67 (45-80)	
SF-36 general health perception	40 (30-55)	

Data presented as mean ± SD, median (IQR) or n (%). Missing data: *5-10%, **10-15%. †number (%) of patients having any degree of activity per ESSDAI domain (score of at least 1). ‡mSQUASH scores from the first assessment.

ESSDAI: EULAR Sjögren's Syndrome Disease Activity Index; mSQUASH: modified Short QUestionnaire to Assess Health enhancing physical activity; ESSPRI: European League Against Rheumatism (EULAR) Sjögren's Syndrome Patient Reported Index; EQ-5D: EuroQoL 5 dimensions; MFI: Multidimensional Fatigue Index; HADS: Hospital Anxiety and Depression Scale; SF-36: Short Form 36.

cal Activity' from the title. During the interviews, several patients had forgotten to complete voluntary work in this category. As a result, a form of physical activity was missed in the questionnaire. To solve this issue, the title was changed to 'Work (paid/unpaid) or school/study'. In addition to school, study was added, since the word study is more appropriate for university students than the word school. For consistency in the questionnaire, 'unpaid/paid work or school/study' was also added underneath the category title 'Commute to/from work or school'.

In the category 'Sports and exercise', dancing was added as an example based on the comments of the patients. In addition, 'handball' was replaced with 'football' because football is a more common sport in The Netherlands and also internationally applicable. The sport 'ice skating' was replaced with 'running' to make it more internationally applicable.

Construct validity

The mSQUASH was completed together with the ESSPRI and EQ-5D by 263 patients with SjD and together with the MFI, HADS and SF-36 by 155 patients with SjD. Patient characteristics of the total group are shown in Table II.

As expected, mSQUASH total activity score showed fair association with ESSPRI total score (p= -0.30) and EQ-5D total score (p= -0.34). The domains fatigue and pain in the ESSPRI had a stronger negative association with the mSQUASH total activity score than the dryness domain (p= -0.30 and -0.23 *vs*. -0.20). Except for anxiety, all the EQ-5D domains showed a fair correlation ranging from -0.23 to -0.34, with the highest correlation for activity and mobility. Within the subdomains of the other PROMs, correlations were higher for MFI physical fatigue than mental fatigue, higher for HADS depression than anxiety, and highest for the SF-36 physical domains (Table III).

Test-retest reliability

A total of 75 patients with SjD were included to investigate the test-retest reliability. Patient characteristics are shown in Table II.

Table III. Construct validity: correlation between mSQUASH and other PROMs in patients with SjD.

	mSQUASH total score	*p*-value
ESSPRI questionnaire		
ESSPRI total score	-0.30	<0.001
ESSPRI dryness	-0.20	0.001
ESSPRI fatigue	-0.30	< 0.001
ESSPRI pain	-0.23	<0.001
EQ-5D questionnaire		
Total score	-0.34	<0.001
Mobility	-0.33	<0.001
Selfcare	-0.28	<0.001
Activity	-0.34	<0.001
Pain	-0.23	<0.001
Anxiety	-0.16	0.009
MFI questionnaire		
MFI physical fatigue	-0.37	<0.001
MFI mental fatigue	-0.12	0.144
HADS questionnaire		
HADS anxiety	-0.18	0.026
HADS depression	-0.31	<0.001
SF-36 questionnaire		
SF-36 physical functioning	0.37	<0.001
SF-36 social functioning	0.25	0.002
SF-36 role limitations (physical problem)	0.44	<0.001
SF-36 role limitations (emotional problem)	0.26	0.001
SF-36 mental health	0.21	0.010
SF-36 vitality	0.27	<0.001
SF-36 pain	0.28	<0.001
SF-36 general health perception	0.13	0.099

ESSPRI and EQ-5D questionnaires were completed by 263 patients. MFI, HADS and SF-36 questionnaires were completed by 155 patients.
ESSPRI: European League Against Rheumatism (EULAR) Sjögren's Syndrome Patient Reported Index; EQ-5D: EuroQoL 5 dimensions; MFI: Multidimensional Fatigue Index , HADS: Hospital Anxiety and Depression Scale; SF-36: Short Form 36.

The ICC for the mSQUASH total activity score was 0.84 (95%CI 0.76-0.90), indicating a good reliability. The different domains had an ICC for the mSQUASH ranging from 0.74 (household activities) to 0.91 (work and school/study) (Table IV). The Bland-Altman analysis showed that there was no systematic bias present, because the mean difference between the first and second assessments was small and not significantly different from zero. However, the 95% limits of agreements were wide, indicating that only large changes in the mSQUASH score can be considered true changes (Fig. 1).

Discussion

This study provided field testing and clinical validation of the mSQUASH to measure physical activity in patients with SjD. In the cognitive debriefing interviews, SjD patients evaluated the mSQUASH as relevant and easy to complete. Minor modifications were made to the layout and terminology for clarification. The construct validity showed fair to moderate associations between the mSQUASH and other PROMs based on partly overlapping constructs, *i.e.* higher reported physical activity was associated with less symptoms of pain, fatigue, depression and better health status and HR-QoL in patients with SjD. As hypothesised, the mSQUASH demonstrated strongest associations with physical-related outcomes. The correlation coefficients were comparable to the associations between the mSQUASH and PROMs in patients with axSpA (ranging from *p*=-0.26 to -0.40) (18, 23). The mSQUASH total score showed good test-retest reliability with an ICC of 0.84. There was no systematic bias present. However, the 95% limits of agreements of the Bland-Altman plot were wide, indicating that only large changes in the mSQUASH score can be considered true changes at individual patient level. These results are in line with the previous studies in axSpA patients, which also reported a good reliability (ICC 0.80 and 0.87) and wide limits of agreement for the mSQUASH (18, 23). This seems a general problem of physical activity questionnaires, since the IPAQ also showed wide limits of agreement in axSpA patients (18).

Besides questionnaires, there are other methods to measure physical activity, such as the objective doubly labelled water (DLW) method, accelerometers and activity tracking apps. Nonetheless, the DLW method is expensive and time-consuming and the different methods lack specification of all the types of physical activity in the different domains. Especially household activities and leisure activities such as gardening, home maintenance and shopping

Table IV. Test-retest reliability: ICC of mSQUASH in patients with SjD.

	First assessment mSQUASH	Second assessment mSQUASH	ICC	95% CI	*p*-value
Total activity score (n=75)	6300 (3540-9045)	6090 (3120-9120)	0.84	0.76-0.90	<0.001
Work and school score (n=75)	0 (0-4860)	0 (0-4500)	0.91	0.86-0.94	<0.001
Commute score (n=75)	360 (120-940)	320 (120-840)	0.74	0.61-0.82	<0.001
Household activity score (n=73)	1680 (1155-2843)	1470 (893-2835)	0.74	0.61-0.83	<0.001
Leisure activities, sports and exercise score (n=75)	1190 (540-2205)	1255 (640-1950)	0.88	0.82-0.92	<0.001

Data are presented as median (interquartile range).
ICC: intraclass correlation; CCI: confidence interval.

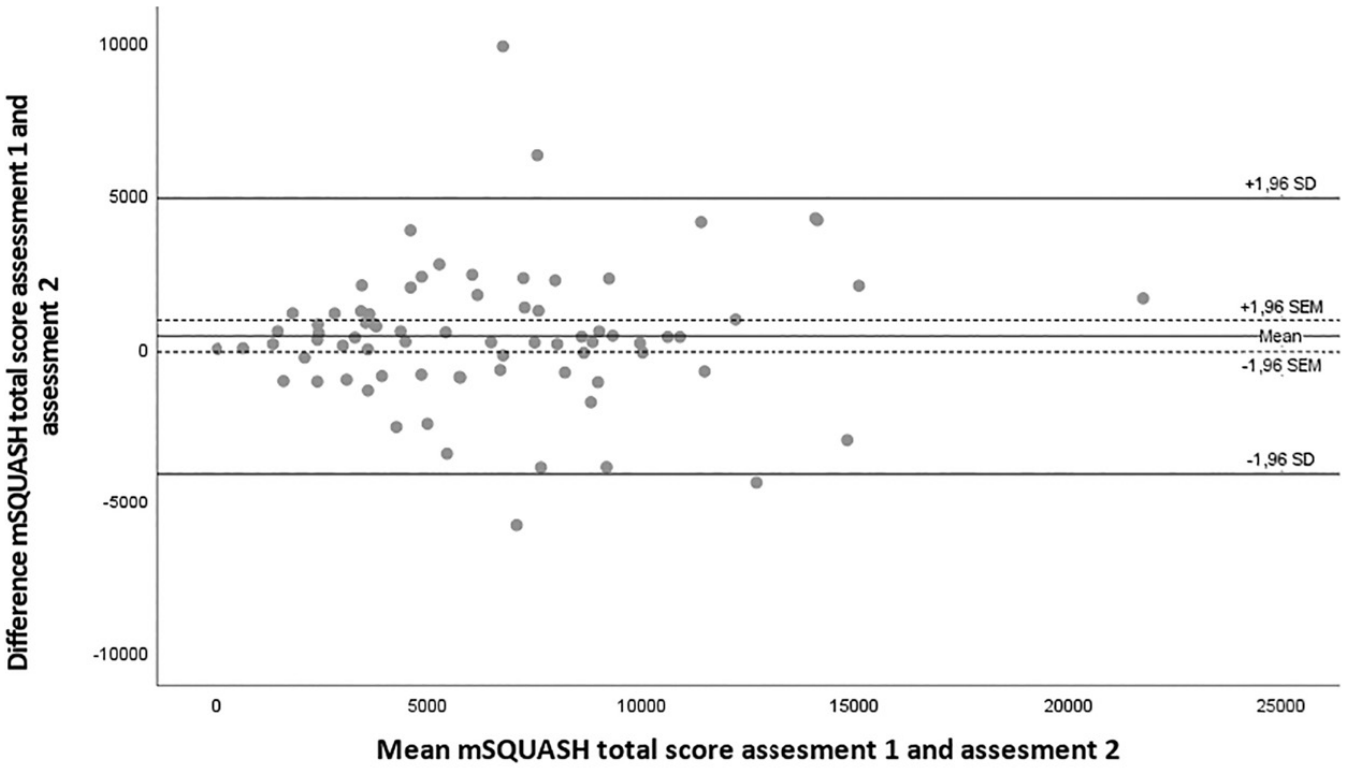

Fig. 1. Test-retest reliability: Bland-Altman plot of mSQUASH total score in patients with SjD.

will be missed. The mSQUASH gives a quick and complete overview of all specific physical activities performed by a patient. This extensive information about daily physical activity can help to identify areas for improvement. Goal setting interventions at individual patient level are generally effective in promoting physical activity behaviour (28), making the mSQUASH potentially a useful tool to promote patient self-management and create individualised exercise programmes. Improving regular physical activity habits of SjD patients may be beneficial to reduce pain and fatigue symptoms (11, 12, 14-16) and improve HR-QoL (1). For SjD patients, there is not (yet) a registered pharmacological treatment, which makes optimising lifestyle behaviours such as exercise, nutrition and sleep even more important. Based on the good measurement properties and the fair association with symptoms of disease activity, it could also be interesting to use the mSQUASH as secondary outcome measure in future clinical trials. In addition to good validity and test-retest reliability, previous research in axSpA patients has demonstrated good responsiveness of the mSQUASH. Standardised response mean values were large and corresponded to the direction of self-reported changes in physical activity after 3 months (18). Further research with an effective intervention is needed to investigate the responsiveness in SjD.

Overall, the mSQUASH was perceived as easy to complete by the patients, but some challenges were faced while analysing the results from the questionnaire completed by a large group of patients. One of the challenges was that some patients reported unrealistic levels of physical activity. These values did not exceed the maximum minutes per week of the questionnaire, and thus were not excluded from the database after running the syntax. For example, a patient filled out one day, 20 hours and no minutes of cycling. This value is unrealistic and therefore it was corrected to 20 minutes. A detailed manual with syntax has been written to describe various pitfalls and how to deal with unrealistic values (23). Another challenge that occurs when using physical activity questionnaires in general is the potential for overestimating physical activity. Previous research showed that both the mSQUASH and IPAQ overestimate the intensity of the performed physical activity compared to the accelerometer. Both questionnaires measured most minutes of activity in moderate intensity, whereas accelerometer measured most minutes of activity in light intensity (18, 29). A possible explanation is that the patients might give socially desirable answers or automatically answer that they perform activities with moderate intensity (as average), whereas part of the intensities would better fit the definitions of light intensity (30).

One of the strengths of this study was the heterogeneity of patients included in the field testing and clinical validation. A variety of age, sex, occupation and disease activity was represented amongst the interviewees, representing the broad disease spectrum of SjD patients. A limitation of this study was that it did not examine criterion validity, such as comparison with accelerometer data. However, the small textual and layout adjustments are not expected to have a major impact on the measurement of physical activity. Furthermore, our results regarding construct validity and test-retest reliability were very similar to previous findings in axSpA (17). Therefore, the correla-

tion between the mSQUASH and the accelerometer is expected also to be comparable to the original mSQUASH in patients with axSpA (18).

Overall, improving lifestyle behaviour is an important step in the management of patients with rheumatic diseases, with the goal to improve symptoms and HR-QoL (8). Regular physical activity is recommended for patients with SjD. Our study showed that the mSQUASH is a feasible, valid and reliable questionnaire to uniformly measure physical activity in patients with SjD.

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