



Original Article

## Validation of the shoulder36 for the activities of daily living with shoulder disorders

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**Abstract.** [Purpose] The Shoulder36 (V 1. 3) is a regional questionnaire in Japan that has not been validated as a functional evaluation of the shoulder via a thorough comparison with other questionnaires (e.g., QuickDASH). The purpose of this study was to test the reliability, validity, and responsiveness of the Shoulder36 (V 1. 3). [Subjects and Methods] A series of 46 patients with upper extremity disorders completed the Shoulder36 (V 1. 3) and the QuickDASH Japanese version (QuickDASH-JSSH). The reliability of the Shoulder36 was assessed for consistency and validity. The correlation coefficients between the Shoulder36 (V 1. 3) and the QuickDASH-JSSH were obtained. [Results] The total of the Cronbach's alpha coefficients for the Shoulder36 (V 1. 3) was 0.98. The intraclass correlation coefficients for the six domains of the Shoulder36 (V 1. 3) were similarly high, ranging from 0.81 to 0.94. The correlations between the six domains of the Shoulder36 (V 1. 3) and the three domains of the QuickDASH subscales ranged from  $-0.43$  to  $-0.78$ . [Conclusion] The Shoulder36 (V 1. 3) was able to evaluate the relationship between activities of daily living and shoulder joint function with the same degree of accuracy but in more detail than QuickDASH-JSSH. Therefore, it should prove to be a valuable asset in physiotherapy plans and have multiple research applications.

**Key words:** Shoulder function assessment, Self-report questionnaire, Shoulder36

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### INTRODUCTION

Recently, several measures for the evaluation of upper extremity function have been developed, including the Disability of the Arm, Shoulder, and Hand scale (DASH), the Shoulder Pain and Disability Index (SPADI), and the American Shoulder and Elbow Surgeons (ASES). There are a large number of upper limb assessments available, and selecting the most appropriate outcome measure to predict the effectiveness of clinical interventions can be challenging<sup>1-4)</sup>. The choice of the most appropriate questionnaire to use may be based on the specific study group, the purpose of the questionnaire, its clinimetric quality as shown by validity, reproducibility, responsiveness, or practical considerations. The Disabilities of the Shoulder36 (V 1. 3) questionnaire was devised as a region-specific, subjective (self-report) measure by the Japanese Orthopaedic Association and the Japan Shoulder Society in 2010. The rationale for the creation of this measure is that the upper extremity is a functional unit or kinetic chain. Therefore, the Shoulder36 (V 1. 3) is suitable for measuring health status outcomes because it is primarily a measure of disability. Recently, the Shoulder36 questionnaire has been used extensively throughout, however, it has not been validated against other questionnaires for its functional evaluation of the shoulder, such as the QuickDASH, which was developed for patients with any disorders in any joints of the upper limbs. Moreover, the Shoulder36 (V 1. 3)

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has been introduced as a new evaluation system, and the similarities and differences between the Shoulder36 and other questionnaires have not been assessed by a novel evaluation system in the literature. Thus, the purpose of this study was to demonstrate the reliability, validity, and responsiveness of the Shoulder36 (V 1. 3).

## SUBJECTS AND METHODS

The Shoulder36 (V 1. 3) has six domains; 1) the severity of activity-related pain (Sh36-P); 2) the restrictions to range of motion (Sh36-ROM); 3) the effects of the muscle strength on activities (Sh36-MS); 4) the effects of the injury related problems on the patient's sense of well-being (Sh36-GH); 5) the effect of the injury on activities of daily living (Sh36-ADL); and 6) the degree of detriment on athletic ability (Sh36-S). Each scale concerns the function of the patient's upper extremity, and each item has five possible responses, ranging from "cannot do it" to "no difficulty" scored on a scale of 0–4. The items ask about pain (Sh36-P, 6 items: numbers 3, 16, 22, 24, 28 and 32); range of motion (Sh36-ROM, 9 items: numbers 2, 4, 5, 7, 8, 9, 11, 12 and 18); muscle strength (Sh36-MS, 6 items: numbers 13, 20, 23, 27, 29 and 34); general health (Sh36-GH, 6 items: numbers 1, 17, 25, 26, 31 and 33); activities of daily living (Sh36-ADL, 7 item: number 6, 10, 14, 15, 19, 21 and 30); and the ability to play sports (Sh36-S, 2 items: numbers 35 and 36). These provide the Shoulder36 (V 1. 3) with six domains ranging from 0 (the severest disability) to 4 (no disability), after totaling the average value of the scores for each domain.

A series of 46 patients with upper extremity disorders were seen on an inpatient or outpatient basis at orthopedic surgery department in Fuefuki central hospital. Exclusion criteria included, age younger than 19 years and an existing comorbidity. The study was conducted on 46 patients (25 males, 21 females) who were suffering from rotator cuff disease (33 patients), osteoarthritis of the shoulder (6 patients), or other problems (7 patients). The mean age was 66.2 years (SD: 14.5 years; range: 28–85 years). The data collected from the 46 patients were compared with similar questionnaires. All patients underwent therapy during the consecutive inpatient or outpatient visits, and filled out both the Shoulder36 (V 1. 3) and the QuickDASH-JSSH questionnaires on the same day. The subjects provided written informed consent to participate in the study prior to its commencement, and the study conformed to the principles of the Declaration of Helsinki. This study was conducted with the approval of the Research Ethics Committee of Health Science University (approval number: 31).

A principal component analysis was conducted to examine the construct validity and the unidimensionality of the six domains of the Shoulder36 (V 1. 3). Completeness of the item responses in both the Shoulder36 (V 1. 3) and QuickDASH-JSSH was examined. Correlation coefficients between the Shoulder36 (V 1. 3) and the QuickDASH-JSSH were obtained, and the following hypotheses were examined to investigate concurrent validity: 1) the Sh36-ROM, Sh36-ADL, and QuickDASH-JSSH disability/symptom (QuickDASH-JSSH-DS) would exhibit the strongest associations to each other; 2) the Sh36-P, the Sh36-MS, and DASH-JSSH work (QuickDASH-JSSH-W) would exhibit the next strongest association to each other; 3) the Sh36-GH and the sport/music (DASH-JSSH-SM) would exhibit the weakest association. Correlation coefficients between the Shoulder36 (V 1. 3) domains (Sh36-P, Sh36-ROM, Sh36-MS, Sh36-GH, Sh36-ADL, and Sh36-S) were also obtained.

Cronbach's alpha was used to assess the internal consistency. The interval measurements of the Sh36-P, Sh36-ROM, Sh36-MS, Sh36-GH, Sh36-ADL, DASH-JSSH-W, and DASH-JSSH-SM were normally distributed; therefore, the correlation was assessed using a parametric test (Pearson's correlation). The other interval measurements (Sh36-S, DASH-JSSH-DS) were not normally distributed, and thus, the correlation was assessed using a nonparametric test (Spearman's correlation). Statistical analyses were conducted using the Statistical Package for Social Science (SPSS) software and Statcel3 (OMS, Saitama, Japan). The critical values for significance were set at  $p < 0.05$ .

## RESULTS

None of the patients experienced difficulty completing the Shoulder36 (V 1. 3) questionnaire. The total answer rate for the Shoulder36 (V 1. 3) was 99%. Moreover, the Sh36-P, Sh36-ROM, and Sh36-ADL answer rates were 100%, as shown in Table 1. However, the answer rate for the QuickDASH-DS, QuickDASH-W, and QuickDASH-SM were 99%, 100% and 100%, respectively. Four patients did not respond to items 31 or 33 regarding "general health," and 2 patients did not respond to items 35 or 36 regarding "sports abilities." The majority of the patients considered all of the items of the Shoulder36 (V 1. 3) to be clear. The mean age ( $69 \pm 12$  years) of the nonrespondent group ( $n=5$ ) was higher than the mean age ( $66 \pm 15$  years) of the respondent group ( $n=41$ ) who completed all of the items ( $p=0.694$ ) (data not shown).

Internal consistency was assessed using the Cronbach's alpha coefficient. The total Cronbach's alpha coefficient for the 36 items of the Shoulder36 (V 1. 3) was 0.98, as shown in Table 1. The alpha coefficients for the six individual domains were also high (0.81–0.94), especially Sh36-ROM and Sh36-MS which were both 0.94. The alpha coefficients for the QuickDASH-DS, QuickDASH-W, and QuickDASH-SM were 0.84, 0.96, and 0.95, respectively.

The number of ceiling and floor scores for the Shoulder36 (V 1. 3) questionnaire and QuickDASH-JSSH are shown in Table 2. No patients reported the maximum disability score of 0 (floor) on the Sh36-P, Sh36-GH, or Sh36-ADL. Fifteen patients reported the minimum score and six patients had the maximum score for the Sh36-S and the Sh36-ROM respectively, as shown in Table 2.

A principal component analysis was conducted to confirm the unidimensionality of the Shoulder36 (V 1. 3). The first factor had an eigenvalue (amount of variation in the total sample accounted for by that factor) of 41.23, which explained the

**Table 1.** Scores for the Shoulder36 and QuickDASH

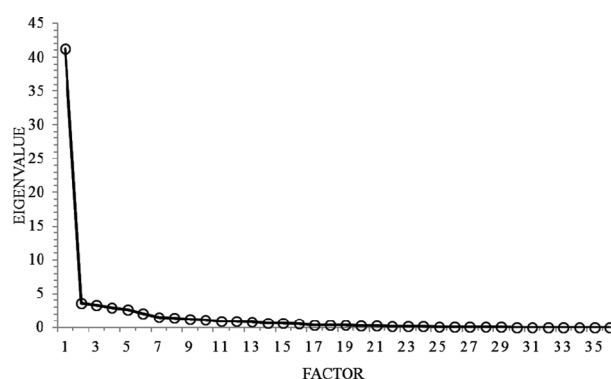
Instrument	n	Question answer rate	Score			
			Mean (SD)	Median	Range	Cronbach's $\alpha$ range
Sh36-total	46	99	2.4 (1.5)	3	0.0–4.0	0.98
Sh36-P	46	100	2.7 (0.9)	2.9	0.2–4.0	0.86
Sh36-ROM	46	100	2.6 (1.0)	2.8	0.0–4.0	0.94
Sh36-MS	46	99	1.9 (1.2)	1.7	0.0–4.0	0.94
Sh36-GH	46	98	2.7 (0.8)	2.8	0.8–4.0	0.82
Sh36-ADL	46	100	2.5 (1.0)	2.9	0.3–4.0	0.92
Sh36-S	46	95	1.5 (1.3)	1.5	0.0–4.0	0.81
QuickDASH-DS	46	99	31.8 (17.8)	32	0–72	0.84
QuickDASH-W	30	100	41.8 (28.1)	28	0–100	0.96
QuickDASH-SM	11	100	58.5 (30.5)	63	0–100	0.95

Sh36-total: functioning subscale of the 6-domains of the Shoulder36 (V 1. 3); Sh36-P: the severity of activity-related pain; Sh36-ROM: the restrictions to range of motion; Sh36-MS: the effects of muscle strength on activities; Sh36-GH: the effects of the problems on the patient's sense of well-being; Sh36-ADL: the effect on activities of daily living; Sh36-S: the degree of determent on athletic ability; QuickDASH-DS: disability/symptom scale of the QuickDASH-JSSH; QuickDASH-W: work module of the QuickDASH-JSSH; QuickDASH-SM: sport/music module of the QuickDASH-JSSH

**Table 2.** Ceiling and floor scores for the Shoulder36 (V 1.3) and DASH-JSSH

Instrument scale	No.	No.	Ceiling scores <sup>a</sup>	No.	Floor scores <sup>b</sup>
Sh36-P	46	5	(11%)	0	
Sh36-ROM	46	6	(13%)	1	(2%)
Sh36-MS	46	3	(7%)	7	(15%)
Sh36-GH	46	4	(9%)	0	
Sh36-ADL	46	5	(11%)	0	
Sh36-S	46	2	(4%)	15	(33%)
DASH-JSSH-DS	46	1	(2%)	0	
DASH-JSSH-W	30	4	(13%)	2	(7%)
DASH-JSSH-SM	11	2	(18%)	2	(18%)

<sup>a</sup>Maximum health status scores, <sup>b</sup>Minimum health status scores



**Fig. 1.** Scree plot of the principal components in the Shoulder36 (V 1.3)

61% of the total variance of the patients' Shoulder36 (V 1. 3) scores, as shown in Fig. 1. The unidimensionality was found to be strong due to a substantial difference between the first and the second factors (eigenvalue 3.57). When looking at the first-factor loading for each item, all items had a loading of 0.4 or higher, as shown in Table 3.

The correlation coefficients between the six domains of the Shoulder36 (V 1. 3) ranged from  $-0.71$  to  $-0.89$  ( $p < 0.01$ ), as shown in Table 4. These results indicate strong correlations between the Sh36-P and Sh36-ROM, as well as between the Sh36-ROM and the Sh36-ADL. The correlations between the Shoulder36 (V 1. 3) and the subscales of the QuickDASH-JSSH ranged from  $-0.43$  to  $-0.80$  as presented in Table 4. The strongest correlation was observed for the Sh36-P followed by the QuickDASH-JSSH-W. The correlations between the Sh36-ROM, Sh36-MS, Sh36-GH, Sh36-ADL, and "QuickDASH-JSSH-D" were high. Therefore, these strong correlations support the hypotheses stated earlier with the exception that, despite the high correlation coefficient between the Sh36-S and "QuickDASH-JSSH-SM," it was not significant.

## DISCUSSION

Clinicians and researchers are confounded by the various outcome measures used for the assessment of injury of the upper limbs<sup>5-7</sup>. In addition to rating the clinimetric properties of a questionnaire, the selection of a particular questionnaire is dependents on its purpose and applicability. An easy scoring method and information regarding acceptable levels of missing data sever to enhance applicability. In this study, we examined the psychometric qualities of the Shoulder36 (V 1. 3) by assessing its psychometric standards regarding of reliability and validity. Our data indicates that the questionnaire was easy to understand as none of the patients left more than four items unanswered, which were thought to pertain to specific

**Table 3.** Factor loading (unrotated) of the principal components of the Shoulder36 (V 1. 3)

Question no.	Item	Load- ing
1	Daily activities at home	0.76
2	Reading a newspaper at a shoulder high	0.84
3	Reaching a back pocket of your trousers using your affected side	0.69
4	Putting your arm through a jacket	0.65
5	Wearing a sweater jacket over your head	0.80
6	Taking off clothes	0.57
7	Placing a jacket on a hanger	0.83
8	Knotting your hands together behind your head	0.82
9	Washing your face with hands	0.62
10	Combing your hair	0.77
11	Washing your armpit opposite to your affected shoulder, using your affected shoulder	0.79
12	Rinsing your whole body by holding a shower head with your affected side	0.84
13	Washing your back with a towel by holding both ends of the towel with an affected side holding the top of the towel	0.82
14	Squeezing out the water from a towel using both hands	0.73
15	Carrying a bowl of soup on the tray	0.76
16	Reaching into a condiment on a table (soy sauce, salt, pepper, etc.) using your affected shoulder	0.84
17	Eating	0.65
18	Tying an apron behind your back	0.81
19	Washing plates with a sponge	0.80
20	Placing plates on a shelf above your head height using the affected shoulder	0.85
21	Holding a filled up kettle with your affected side	0.85
22	Clapping your hands 10 times	0.45
23	Stretching your body with your hands held up	0.83
24	Sleeping side ways with your affected shoulder lying on the floor	0.72
25	Getting a good sleep	0.52
26	Feeling less fatigue than usual getting through the week	0.48
27	Keeping both your arms horizontal for a minute	0.82
28	Walking with your arms swinging back and forth	0.76
29	Managing daily tasks using your affected shoulder, without help of another shoulder	0.92
30	Wiping windows with your affected shoulder at a head high	0.88
31	Going shopping close to your house	0.80
32	Opening an umbrella (with exception to Push-Button umbrella) with your affected shoulder	0.76
33	Getting on a bus or train	0.74
34	Holding on a strap in a bus or train with your affected shoulder	0.84
35	Moving your shoulders at a recreational level of activities	0.83
36	Moving your shoulders at a competitive level of activities	0.73

**Table 4.** The correlations for the Shoulder36 (V 1. 3) and QuickDASH-JSSH

	Sh36-P	Sh36-ROM	Sh36-MS	Sh36-GH	Sh36-ADL	Sh36-S
Sh36-P‡	-	-	-	-	-	-
Sh36-ROM‡	-0.89**	-	-	-	-	-
Sh36-MS‡	-0.83**	-0.84**	-	-	-	-
Sh36-GH‡	-0.84**	-0.78**	-0.83**	-	-	-
Sh36-ADL‡	-0.83**	-0.87**	-0.85**	-0.81**	-	-
Sh36-S#	-0.73**	-0.71**	-0.78**	-0.73**	-0.73**	-
QuickDASH-DS#	-0.75**	-0.71**	-0.78**	-0.77**	-0.77**	-0.56**
QuickDASH-W‡	-0.80**	-0.62**	-0.68**	-0.65**	-0.74**	-0.55**
QuickDASH-SM‡	-0.60*	-0.43	-0.76**	-0.64	-0.52	-0.77

\*p&lt;0.05, \*\*p&lt;0.01; ‡Pearson's correlation; #Spearman's correlation

recreational or competitive level activities not performed by these individuals. For the respondent burden, a positive rating was assigned when the questionnaire could be completed within 10 minutes (data not shown). The lack of floor and ceiling effects assured the authors that this version of the Shoulder36 (V 1. 3) was valid. The alpha coefficient for the 36 items in the Shoulder36 (V 1. 3) total was 0.98, as shown in Table 1. However, large, high-quality studies are still required to confirm these findings. Moreover, other studies have confirmed that the relative reliability of questionnaires is excellent when the intraclass correlation coefficients are 0.85 or higher<sup>8, 9</sup>. Thus, the Shoulder36 (V 1. 3) should, be used with caution for the daily assessment of the status of individual patients.

The validation process of the Shoulder36 (V 1. 3) questionnaire revealed that the strong correlations between Sh36-P, Sh36-ROM, Sh36-MS, Sh36-GH, Sh36-ADL, and the QuickDASH-JSSH support its validity, and demonstrates results similar to those of validation papers for the other questionnaire<sup>10</sup>. Similarly, the strong correlations between Sh36-P, Sh36-ADL, and the QuickDASH-JSSH-W support this validity and demonstrate results similar to those of a published validation paper<sup>11</sup>. Additionally, the correlations between Sh36-P, Sh36-ROM, Sh36-GH, Sh36-ADL, Sh36-S, and the QuickDASH-JSSH-SM were weak due to the small sample size. These results indicate that the Shoulder36 (i.e., Sh36-S and QuickDASH-JSSH-SM) measures the important elements that describes health factors related to quality of life. One merit of this study was the finding that the Shoulder36 demonstrated good consistency and validity. On the other hand, a limitation of this present study is that we were unable to successfully validate the relationship between the Sh36-S and the QuickDASH-JSSH-SM since the sample size was relatively small and the patient's response rate was low. In addition, the subjects in this study are not representative of the general population. Self-report measures are regarded to be simple, inexpensive ways of obtaining good clinical data, and in many instances they are easy to score and interpret for the clinician, thus adding valuable information to the clinical picture<sup>12, 13</sup>. The DASH, SPADI, and ASES have been evaluated most often and the DASH has received the best overall ratings for its clinimetric properties. In addition, the DASH has been previously recommended for evaluative purposes in outpatient clinics<sup>14</sup>. Similar to the QuickDASH, we have demonstrated that the Shoulder36 questionnaire has good reproducibility, consistency, and validity.

Interest in using patient-based instruments during clinical practice for the assessment and monitoring of individual patients receiving treatment continues to grow. Therefore, these tools assist clinicians in the detection and treatment of functional and psychological problems that may have previously been missed. Furthermore, they promote shared decision-making and facilitate doctor-patient communication. Furthermore, questionnaires with fewer items and shorter administration times may be more practical for routine use in clinical practice.

Some limitations include that the Shoulder36 has not been used by anyone except its developers and it measures only the physical components of health. In addition, the study population consisted of a non-random sample; the sample size was low with no mention of patient characteristics and no cross-cultural validation was performed. Furthermore, there are no standardized criteria for evaluating the quality of the Shoulder36, and the specific criteria we used to evaluate the Shoulder36 may be disputed. In the future, more consolidated guidelines are required to set standards and define the instruments by which patients with shoulder disorders should be assessed. In addition, the continued accumulation of research data regarding the clinimetric properties of the evaluation questionnaire is important for demonstrating how the scale might be used in both clinical practice and research applications.

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