Responsiveness of the Michigan Hand Outcomes Questionnaire and the Disabilities of the Arm, Shoulder, and Hand Questionnaire in Patients With Hand Injury

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Purpose To compare responsiveness of the Michigan Hand Outcomes Questionnaire (MHQ) with that of the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire in patients with hand injuries. We postulated that the MHQ may be more sensitive to functional changes in the hands, whereas the DASH questionnaire would have a closer association with days of disability.

Methods Patients with hand injuries were consecutively recruited from 2 community hospitals. Each patient was asked to complete out the MHQ, the DASH questionnaire, the satisfaction with their health-related quality of life (Sat-HRQOL) measure, and Chinese Health Questionnaire (CHQ), which is a measure of psychological stressors. Disability days were defined as the duration of restricted activities of daily living during the previous 4 weeks. Patients repeated the same questionnaires between 2 and 9 months after enrollment (average: 4 mo).

Results A total of 105 patients with hand injuries were recruited, and 50 of the 105 patients returned for the second evaluation. There were no statistical differences between responders and nonresponders for age, gender, disability days, the MHQ, the DASH questionnaire, the CHQ, or the Sat-HRQOL. Responsiveness was evaluated by effect sizes and standardized response means: Those for the MHQ were 0.84 and 1.05, and those for the DASH were 0.67 and 0.86, respectively. A mixed model analysis for repeated measurements of the 50 participants showed a significant influence of psychological factors (CHQ) for both the Sat-HRQOL and disability days. After adjustment for the effects of age, gender, and the CHQ, there was an increment of one Sat-HRQOL unit for an MHQ score increment of 3.2, whereas the score decrement for the DASH questionnaire was 3.3 units.

Conclusions The MHQ might be slightly more sensitive to functional changes, but the DASH questionnaire seemed more correlated with disability days. Psychological factors are the strongest determinants of the HRQOL and disability. *(J Hand Surg 2010;35A:430–436. Copyright © 2010 by the American Society for Surgery of the Hand. All rights reserved.)*

Key words Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire, hand injury, Michigan Hand Outcomes Questionnaire (MHQ), responsiveness.

EARLY LITERATURE FOCUSED on developing standardized methods for measuring impairment in dexterity, strength, and range of motion.[1] Recent literature has placed a greater emphasis on the impacts of patient-reported outcomes and the ability to function in daily life, although this kind of assessment can be challenging.[2–4] Among the many instruments that have been developed for the assessment of the disability status of the hands and upper extremities, two of the most well-known and frequently used tools are the Michigan Hand Outcomes Questionnaire (MHQ) and the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire. The MHQ is a questionnaire comprising a total of 37 hand-specific questions,[5,6] whereas the DASH questionnaire features a 30-item scale relating to the upper extremities.[7,8] Both have been validated in the evaluation of impairments, activity limitations, and participation restrictions to normal daily living activity.

It is both theoretically and clinically important to gain a complete understanding of the responsiveness and minimal important difference (MID) of these 2 measurement tools. *Responsiveness* refers to the ability of an instrument to detect clinically important changes over time and may thus be considered as an aspect of validity.[9] *Minimal important difference* refers to the smallest difference in a score that would be perceived by patients as being important, irrespective of whether it is beneficial or harmful, and which would, as a result, lead the treating clinician to consider a change in the patient's current course of treatment.[10,11]

Although an in-depth investigation has already been performed regarding the comparative responsiveness of the MHQ and the DASH questionnaire after surgery on patients with carpal tunnel syndrome,[12] we could find no similar studies that have been conducted on patients with hand injuries. Because it has often been shown that the responsiveness of various outcome measures is population-specific, we postulated that the MHQ may be more sensitive to functional changes in the hands, whereas the DASH questionnaire would have a closer association with disability days.

MATERIALS AND METHODS

Data collection

The sample cohort for this study consisted of patients with hand injuries consecutively recruited from 2 community hospitals. The patients were recruited 1 month or more after the occurrence of injury, when they were referred to receive rehabilitation therapy. The majority of the injuries were ruptures of flexor/extensor tendons and fractures of hands, and about half of the injuries were work-related.

All of the subjects were invited to participate in the study on an entirely voluntary basis with prior informed consent having been obtained from each of the patients. Approval to carry out this study was provided by the institutional review board.

Each patient was asked to complete a set of questionnaires, including the MHQ, the DASH questionnaire, and the Chinese Health Questionnaire (CHQ), with the demographic data of the patients (including age, gender, and working status) also being recorded along with their medical histories. Disability days were defined as the duration of restricted activities of daily living during the previous 4 weeks due to hand injury.[13,14] The patients were asked to rate their satisfaction with their health-related quality of life (Sat-HRQOL) using a visual analog scale.[14,15] All participants received occupational therapy, and the length of rehabilitation varied according to the severity of the injury. The patients were followed up with the same questionnaire to evaluate changes in their disability status and HRQOL. The average follow-up time was 5 months ± 3 (range, 2 to 9 mo).

Michigan Hand Outcomes Questionnaire

The MHQ is a questionnaire composed of a total of 37 questions specifically related to the hand that are categorized under the following six domains: (1) overall hand functioning; (2) activity of daily living; (3) pain; (4) work performance; (5) aesthetics; and (6) patient satisfaction with hand functioning.[5,6]

Each of the categories of the MHQ is subdivided into right- and left-hand–specific questions, with the exceptions of the pain and the work performance categories. Activities of daily living are also divided into right- and left-hand–specific questions, in addition to a set of questions on bilateral task performance.

Disabilities of the Arm, Shoulder, and Hand questionnaire

The DASH questionnaire is a 30-item scale that relates to the upper extremities and is scored as a percentage (where 0 indicates no problems). The majority of the questions are concerned with functional activities requiring use of the upper extremities, and the remaining questions include the following: 2 items specifically relating to pain, 3 questions relating to other symptoms, 1 question that addresses social life, 1 directly related to work, 1 related to sleeping, and 1 that aims to determine the patients' perceptions of their own capabilities.[7,8]

Satisfaction with health-related quality of life

The patients were asked to rate their Sat-HRQOL, a single measure of overall satisfaction in this domain, using a visual analog scale as the external criterion with scores ranging from 0 to 100; a score of 0 indicates the lowest level of satisfaction with health-related quality of life, and a score of 100 indicates the highest possible level of satisfaction.[14,15]

Chinese Health Questionnaire

The CHQ is a validated questionnaire for psychological illness that was derived from a Chinese translation of the General Health Questionnaire, with the addition of specially designed, culturally relevant items.[16] The 4 categories of questions in the CHQ cover the assessment of (1) anxiety and depression; (2) the respondent's concern over sleep disturbances; (3) somatic symptoms/concerns; and (4) interpersonal difficulties.

The scoring method applied in this study involves a 0/1 alternative, with the total score for all items ranging between 0 and 12. This reflects a simple, nonweighted sum of the items, as endorsed by the respondent, with a higher (lower) score representing a greater (lesser) degree of emotional distress.[16]

Responsiveness

The responsiveness of each questionnaire is evaluated in this study using 2 different approaches, the first of which is a distribution-based methodology: This is performed by calculating the effect size (the mean change divided by the standard deviation [SD] of the baseline value), as well as the standardized response mean (SRM; the mean change divided by the SD of the change).[9]

The second approach, an anchor-based methodology, evaluates responsiveness by selecting the Sat-HRQOL and the number of disability days as the external criteria.

Data and statistical analysis

Analysis of the data was performed for the following aspects: (1) responsiveness, including effect size and standardized response mean; (2) Pearson correlations between the scores of the MHQ, the DASH questionnaire, the CHQ, the Sat-HRQOL, and the number of disability days; (3) the 95% confidence interval (CI) of the effect size and standardized response means, estimated by bootstrap methods; and (4) anchor-based methodology with the Sat-HRQOL and the number of disability days as the external criteria. Mixed effects models were constructed for repeated measurements of the Sat-HRQOL instrument and disability days at initial and follow-up clinic visits; we also included age, gender, the CHQ, the DASH questionnaire, or the MHQ as fixed effects and appropriately adjusted the models.

RESULTS

Initial-stage data

A total of 105 hand injury patients (74 men and 31 women) were recruited and completed the questionnaire from the Departments of Physical Medicine and Rehabilitation in 2 community hospitals between 2004 and 2007. Fifty of the original 105 participants (36 men and 14 women) responded to the follow-up questionnaire. Detailed demographic information on the subjects is provided in Table 1.

The mean age of the 50 participants in this study was 42 years ± 14, with 37 of 50 being married and 30 of 50 having sustained injuries to the dominant hand. Twenty-two of these patients' injuries were directly attributable to their work. The mean number of disability days during the previous 4 weeks was 14 days ± 13, and the mean CHQ was 7.4 ± 3.4.

Follow-up data

At the follow-up stage, the mean number of disability days during the previous 4 weeks was 6 days ± 12, and the mean CHQ was 6.7 ± 3.7. Using t-test and chi-square analyses, we found no statistical differences between responders and nonresponders for age, gender, education level, dominant hand injury, disability days, the MHQ, the DASH questionnaire, the CHQ, or the Sat-HRQOL (as summarized in Table 1).

There were significant correlations among the MHQ, the DASH questionnaire, the CHQ, and the Sat-HRQOL, as summarized in Table 2. Among those, strong associations were discernible between the MHQ and the DASH questionnaire (r = −0.89, p < .01).

A comparison of the health status of the respondents at the initial and follow-up stages showed statistically significant improvements in the MHQ, DASH, and Sat-HRQOL scores (p < .05). As shown in Table 3, the effect size for the MHQ was 0.84 (confidence interval [CI] 0.61, 1.18), and that for the DASH questionnaire was 0.67 (CI 0.41, 1.08); furthermore, the standardized response mean for the MHQ was 1.05 (CI 0.78, 1.42), and that for the DASH questionnaire was 0.86 (CI 0.60, 1.20).

The mixed model analyses, adjusted for the effects of age, gender, and the CHQ on the changes in the Sat-HRQOL, revealed coefficients of 0.31 for the MHQ and −0.30 for the DASH questionnaire (models I and II

TABLE 1. Frequency Distribution (Percentages) of Demographic and Clinical Data for Hand Injury Patients

Characteristics	Total (N = 105)	Respondents (n = 50)	Nonrespondents (n = 55)
Personal characteristics			
Men	71	72	69
Married	64	74	56
Employed	79	72	85
Smoking habit	42	41	43
Right-handed	86	84	87
Injury to dominant hand	60	63	56
Educational level			
College/university	21	26	17
Senior high	42	42	43
Junior high or below	37	32	41
Personal monthly income (US$)			
<700	67	61	66
700–2000	18	20	21
>2000	16	18	17
Family monthly income (US$)			
<1300	20	13	26
1300–4000	53	58	49
>4000	27	29	25
Cause of injury			
Injury at work	50	44	55
Injury during daily activity	14	12	16
Injury from traffic accident	16	18	15
Injury from falling	9	12	6
Injury from other persons	7	4	9
Other	5	10	—
Diagnosis of injury			
Tendon rupture	30	28	31
Fracture	29	26	31
Nerve injury	2	—	4
Amputation	4	2	6
Combined injury	24	32	16
Other	12	12	13

in Table 4). Namely, an increase of 1 unit of the MHQ resulted in an elevation of 0.31 unit of the Sat-HRQOL, whereas that of the DASH corresponded with a decrease of 0.30 unit. In other words, an MHQ score increment of 3.2 reduced the satisfaction of the HRQOL by 1, whereas the same effect was obtained for the DASH questionnaire with a score decrement of 3.3, indicating a similar magnitude of change in satisfaction with the quality of life for 1 unit change of these 2 instruments. In these 2 models, the CHQ was also a significant predictor for the HRQOL ($p < .01$).

We also used a mixed model analysis to determine whether the scores of both instruments correlated with the number of disability days. However, the results revealed that only the CHQ ($p < .05$) and the DASH ($p < .01$) questionnaire were significant predictors for the number of disability days, whereas the MHQ was not (models III and IV in Table 4).

TABLE 2. Correlation Matrix Between the MHQ, the DASH Questionnaire, the Sat-HRQOL, the CHQ, and the Number of Disability Days Among Hand Injury Patients*

	MHQ	DASH	Sat-HRQOL	Number of Disability Days†	CHQ
MHQ	1.00				
DASH	−0.89†	1.00			
Sat-HRQOL	0.54†	−0.45†	1.00		
Number of disability days	−0.22	0.22	−0.39‡	1.00	
CHQ	−0.44†	0.42†	−0.47†	0.37‡	1.00

*Total sample number = 50.
†Significance at the .01 level.
‡Significance at the .05 level (2-tailed).

TABLE 3. Responsiveness of the MHQ and the DASH Questionnaire Among Hand Injury Patients Returning for Re-evaluation*

Variables	Initial Score		Follow-Up Score		Observed Change		Effect Size	Standardized Response Mean
	Mean (1)	SD	Mean (2)	SD	Mean (2) – (1)	SD		
DASH†	31.0	19.1	18.3	18.8	−12.7	14.7	0.67	0.86
MHQ†	47.4	18.7	63.2	21.1	15.8	15.0	0.84	1.05
Function†	44.6	24.8	58.8	25.0	14.4	21.2	0.59	0.68
Activities of daily living (ADL)†	52.1	29.0	72.2	24.2	20.1	24.5	0.69	0.82
Work†	34.3	27.3	57.6	28.7	23.3	23.8	0.85	0.98
Pain	38.1	22.6	29.0	22.7	−9.1	24.2	0.40	0.38
Aesthetics†	53.4	20.2	63.3	22.9	9.9	23.9	0.49	0.41
Satisfaction†	38.4	24.5	54.4	26.6	16.1	20.5	0.66	0.78

*Total sample number = 50.
†Statistical significance between the groups (p < .05, paired t-test).

DISCUSSION

The results of this study reveal that the standardized response mean, at 1.05, and the effect size, at 0.84, of the MHQ are both larger than those for the DASH questionnaire (standardized response mean, 0.86; effect size, 0.67). This means that the MHQ may be better able to reflect the changes in scores. Similar findings were reported in a study that examined these 2 instruments in the setting of carpal tunnel syndrome.[12] We hypothesize that the increased responsiveness of the MHQ arises because (1) the MHQ is specific to the hand, whereas the DASH questionnaire is a general arm instrument; and (2) the MHQ assesses at least 4 separate domains for each hand, whereas the DASH questionnaire does not.

However, the previous study found that the pain domain seemed to be the most responsive for the

MHQ,[12] but as shown in Table 3, our study found that work performance appeared to be the most responsive. Such a divergence may be attributable to the rapid improvement in pain and numbness after surgery for carpal tunnel syndrome, whereas comprehensive improvements in hand functioning, as opposed to changes in sensation, would be experienced by patients with hand injuries after rehabilitation.

In this study, 30 of the 50 participants had high psychological stress (CHQ score >5). This implies that patients with hand injuries suffer more frequently from emotional distress than do Chinese high school students (67 of 471 subjects; CHQ score >5).[17] We also found that both the MHQ and the DASH questionnaire had moderate correlations with the CHQ (Table 2), and the mixed model analysis revealed that the CHQ was a significant predictor for both the Sat-HRQOL and the

TABLE 4. Multiple Regression Coefficients ($\hat{\beta} \pm$ Standard Error of $\hat{\beta}$) Based on Construction of a Mixed Model for the Sat-HRQOL and Disability Days for 50 Follow-Up Patients

	Sat-HRQOL		Disability Days	
	Model I	Model II	Model III	Model IV
Predictors	$\hat{\beta} \pm$ SE $\hat{\beta}$	$\hat{\beta} \pm$ SE $\hat{\beta}$	$\hat{\beta} \pm$ SE $\hat{\beta}$	$\hat{\beta} \pm$ SE $\hat{\beta}$
MHQ	0.31 ± 0.06*		−0.05 ± 0.07	
DASH		−0.30 ± 0.07*		0.18 ± 0.07†
CHQ	−0.77 ± 0.35†	−0.82 ± 0.36†	1.09 ± 0.39*	0.92 ± 0.36†
Akaike's information criterion (AIC)	731.6	755.1	664.5	674.4

SE, standard error.
  Note: Results were adjusted for age and gender. †p < .05, *p < .01.

number of disability days (Table 4). These results imply that psychological factors not only play an important role when patients rate their subjective HRQOL but that they also influence the subject's self-evaluation of the extent of his or her disability. Thus, the future care of patients with upper extremity injuries must also take into account their psychological health in addition to function improvement.

There is still a general lack of consensus on any gold standard for the effective estimation of responsiveness and MID for patient-reported outcomes.[11] The standardized response mean may be a more statistically efficient index of responsiveness than effect size, as it takes into account the variability in change over time by applying the pooled variances of mean differences.[18] Nevertheless, a statistically significant divergence in the scores has no direct link with clinical importance, as there is no intuitive meaning of the standard deviation units.[19] Anchor-based methods may have better correlations with clinical changes. Because the Sat-HRQOL and the number of disability days are generally considered as clinically important by patients and health care professionals, we adopted the Sat-HRQOL and the number of disability days as the anchor.

The results of the mixed model analyses revealed that the magnitude of change in the Sat-HRQOL for a single unit change in the MHQ is 0.31 unit, whereas that for a single unit change in the DASH questionnaire is −0.30 unit. As all 3 instruments have a scale of 0 to 100, the minimal differences in the DASH questionnaire and the MHQ may indicate a similar magnitude of change for a unit of subjective score change, with about 3 score units linked to 1 unit of satisfaction in the quality of life. The MHQ and the DASH questionnaire may have similar linkages to the HRQOL as a result of the following: (1) the strong correlation between the MHQ and the DASH questionnaire; and (2) moderate correlation among the MHQ, the DASH questionnaire, the CHQ, and the Sat-HRQOL. Some patients with hand injuries might have activity restrictions not only to their hand and wrist but also to their elbow and shoulder because of long-term immobilization. The strong correlation suggests that the DASH, a more function-oriented instrument, may be a good alternative for evaluating patients with hand injury.

However, the number of disability days might not directly reflect the severity of hand disability. As found in a prior study conducted with patients with chronic musculoskeletal pain, depression and anxiety could have adverse effects on pain severity, functional limitations, disability days, and HRQOL.[20] The disability days are largely explained by psychosocial factors and environmental support, especially for those disabled from work.

Thus, compared with the MHQ, the DASH questionnaire appears to have better correlation with the changes in disability days; it is also shorter in length and therefore probably easier to handle in terms of the total amount of time required to complete and score the questionnaire. However, it would appear that the MHQ is slightly more sensitive to clinical changes, particularly if the focus is solely on hand functioning. Because it contains 6 domains, it can be scored individually, thereby helping clinicians to more easily detect a patient's major problems.

Because both instruments are shown to be relatively responsive to patients with carpal tunnel syndrome,[12] this study consecutively recruited patients with many different types of hand injuries, as summarized in Table 1. Although the follow-up time has a wide range, the responsiveness of the MHQ and the DASH questionnaire were evaluated simultaneously for each patient, and we only inquired about the number of disability days for the past 4 weeks. We directly analyzed the

correlation coefficient between the number of disability days and the duration of follow-up, which showed -0.22 (p = .22). The negative sign of the correlation coefficient implies that the patients with a longer period of follow-up did not seem to show a larger number of disability days, or no association between these 2 variables on this sample. The diversified diagnoses provided us with a broader range of evaluation for patients with many types of injuries, but our results may differ from those of studies focusing on 1 specific type of injury, due to the heterogeneity of patients, or may be less likely to demonstrate responsiveness to disability days.

The patients in this study were recruited from the Departments of Physical Medicine and Rehabilitation in 2 community hospitals, and given that only 50 of the 105 participants responded to the follow-up questionnaire, we should remain cautious in any attempts to generalize our findings to other establishments as they may not be appropriate for clinics under widely different settings. However, as there were no significant differences between the respondent and nonrespondent groups in the results for the MHQ, the DASH questionnaire, or the disability days, it appears that our conclusions may also be applicable to those patients who did not return for follow-up.

The results revealed that the MHQ might be slightly more sensitive to functional changes, but the DASH questionnaire seemed more correlated with disability days. Psychological factors are the strongest determinants of HRQOL and disability days. Using anchor-based methodology, we have demonstrated that an MHQ score increment of 3.2 units would increase satisfaction with the HRQOL by 1 unit, whereas that for the DASH questionnaire would correspond with a decrement of 3.3 units.

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