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Concurrent Validation of the DASH and the QuickDASH in Comparison to Neck-Specific Scales in Patients With Neck Pain

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VALIDATION OF THE DASH AND THE QUICKDASH IN PATIENTS WITH NECK PAIN

INTRODUCTION

The prevalence of neck pain and related disability is increasing and accounts for a significant amount of pain, disability, lost work hours, and health care costs (1-5). Pain and neurological involvement in the upper limbs are common in patients with neck pain (6) and disability related to neck pain is greater in patients who also experience radiating symptoms and arm pain compared to those who only experience neck pain (7,8). Since there is no specific diagnostic test or pathology that is common to patients with neck pain, evaluation of the outcomes of intervention relies on assessments of pain and disability.

Previous structured reviews have indicated that the Neck Disability Index (NDI) is the most commonly used self-report measure for neck pain (9, 10). A recent systematic review provided additional support for using the NDI but also identified a number of gaps in the psychometric evidence (11). Although the NDI has strong measurement properties, it was not developed using a clinimetric process where item generation is performed by asking patients about important symptoms, but rather used a pre-existing back questionnaire with clinician input. Hence, it is possible that important aspects of neck pain were not sampled while developing the NDI. Another pain and disability scale designed specifically for the neck is the Cervical spine outcome questionnaire (CSOQ), which was designed to be more inclusive for symptoms and health impacts of neck pain. The CSOQ has multiple items in different subscales providing a more comprehensive, but complex assessment of health status in patients with neck pain (12). To date, few publications or clinical practices have incorporated this measure.

Neck and arm symptoms often coexist (6, 13). Neurological involvement, such as nerve root compression, can produce dermatomal weakness and sensory disturbances. Furthermore, a lack of proximal stability and impaired muscle co-contraction around neck muscles in the presence of neck pain can alter motor control of the upper extremity and affect hand functions (14, 15). Hence, it might be anticipated that upper extremity symptoms or functional disability might be important features in patients with neck pain.

The Disabilities of Arm, Shoulder, and Hand (DASH) and more recently the QuickDASH were developed using a clinimetric process but were designed as measures of the upper extremity disability (16, 17). The 30 item DASH is reliable and valid for a variety of upper extremity conditions (18-20). A recent study examined the validity of the DASH in patients with neck pain (21). The study findings indicated that the DASH demonstrated discriminative validity in detecting differences between six subgroups who were formulated according to the locations of their pain complaints. The responsiveness ratio, measured by The Guyatt Responsiveness Index, ranged from 1.4 in patients with only symptoms in the neck region to 2.0 in patients with additional symptoms affecting the shoulder, arm and hand. However, the authors acknowledged that the DASH was not compared with neck-specific scales such as the NDI and more research was needed to determine the use of the DASH in patients with neck pain; particularly research that would compare the DASH with neck specific scales (21).

Since brevity is critical in clinical practice there has been a move to shorten the DASH. The QuickDASH is an 11 item scale and was developed using three item-reduction approaches to retain the clinically relevant contents from the DASH (17). A recent study measured predictive and discriminative validity of the QuickDASH in patients with neck and upper extremity musculoskeletal disorders (22). However, the study did not specifically evaluate the

construct validity of the QuickDASH nor was the predictive validity of the Quick DASH compared to a neck-specific outcome measure (such as the NDI). In another surveillance study, the use of the QuickDASH was demonstrated in screening workers at-risk of developing upper extremity musculoskeletal disability (UEMSD) (23).

Evidence is emerging that the DASH might be useful for patients with neck pain, but no studies have specifically compared it with neck specific scales. If clinicians were to decide to use the DASH, it might be as an adjunct to a neck specific scale. Therefore, it is important to understand whether the shorter QuickDASH demonstrates similar usefulness to that for the full version. Therefore, the purpose of this study was to determine whether the DASH and the QuickDASH provided valid indications of upper quadrant disability in patients with neck and more specifically to determine:

1. the distribution of scores
2. the item difficulty for both the DASH and QuickDASH in comparison to the items from NDI to determine the extent to which each reflects the problematic areas ,
3. assess the agreement between both versions of the DASH; whether the QuickDASH provides similar scores to full version and,
4. the construct validity of the DASH and QuickDASH scales as indicated by the relationship with two neck specific scales and visual analog scale (VAS) for pain.

MATERIALS AND METHODS

Study Design

The study design was cross-sectional validity assessment. The participants were recruited from physical therapy clinics for research studies by **The Hand Neck Shoulder Arm** (HaNSa) research group (24). The study was approved by the McMaster University ethics board.

Participants

The common inclusion criteria were participants suffering from neck pain with/without arm pain and headache, those with whiplash associated disorder (WAD) level 2 or 3, and between the ages of 18-65 years of age. The exclusion criteria were pre-existing shoulder/arm pathology, any other condition that could affect their ability to use arm, and cognitive impairment. For this study, we included participants who had complete data sets (no missing items) (n=66). All patients completed the DASH, the QuickDASH, the NDI, and the Visual VAS- pain, whereas the CSOQ was completed by 42 patients since the CSOQ was not routinely used.

Self-reported Outcome Measures

The DASH and the QuickDASH

The DASH is a 30 items scale that focuses on upper extremity functions and provides information regarding disability related to those functions. Each item has five possible responses to determine the extent of difficulty in that particular function (16). Since its development (16), it has been cross-culturally adapted and validated in over 20 languages. The QuickDASH consists of 11 items derived from the DASH. Psychometric properties of the QuickDASH have been tested based on the responses within the DASH and results indicated that the QuickDASH is equally reliable and valid compared to the full DASH in patients with upper extremity injury (25). In this study, QuickDASH scores were calculated from the relevant items

in the DASH for all the participants. For both the scales, the scores are converted to the ranges of 0 (no disability) to 100 (most severe disability) (16, 17).

The NDI and the CSOQ

The NDI and CSOQ were used as the neck-specific outcome measures in the study. The NDI was conceived by Vernon et al. (1991) and psychometric properties of its English (26) as well as other language versions have been examined (26-32). The NDI consists of ten questions, where one question focuses on pain intensity and other nine focus on the impact of neck pain on daily activities and functions (26). The scores total provides a score out of 50. Some authors have calculated percentage scores as a means of dealing with missing items, although this is not recommended by the developer. The Cervical Spine Outcomes Questionnaire (CSOQ) was primarily developed to include a broad range of deficits that occur in patients with neck pain (12, 33). Other than neck pain and disability, CSOQ also includes subscales of pain in the arm and shoulder, functional disability, psychological distress, physical symptoms, health care utilization, and patient satisfaction (12). Each domain is scored separately and converted to the ranges of 0 to 100, where a higher score indicates greater dysfunction.

Pain measures

Participants were asked to report their pain intensity using VAS. The anchors of the VAS were ‘no pain’ and ‘worst possible pain’. The VAS is considered to be a valid and reliable tool for measuring pain intensity (34-36).

Data Analysis

Data quality checks and descriptive analysis of variables were performed. The potential for floor and ceiling effects or other range/distribution problems were evaluated using histograms

plotted for the NDI, DASH, and QuickDASH. The NDI scores were converted from 0 to 100 for plotting the histogram.

The item difficulty for both the DASH and QuickDASH in comparison to the items from the NDI was determined by forming a ranked-item difficulty analysis for the items in these scales. Since the scoring is performed on the scale of 1 to 5 for the DASH and the QuickDASH and 0 to 5 for the NDI, the scores were normalized for each item within the DASH and the QuickDASH over the scale of 0 to 5. This allowed us to identify the most difficult items across these three measures. The mean scores and SD were calculated for each item. We were also able to determine whether the QuickDASH has retained a subset of DASH items that are relevant to patients with neck pain.

We also used the Bland and Altman technique to examine the agreement between the DASH and the QuickDASH (38, 39) to determine whether consistency between the two tools was maintained across the spectrum of scores. This graphical technique requires that you plot the difference between both the scores versus the mean score and establish limits of agreement (two standard deviations) for the overall mean difference between measures (38).

Concurrent validity was evaluated by examining whether the DASH and QuickDASH exhibited expected relationships (using Pearson correlations) with neck specific and visual analog pain scales.

Although previous studies have supported the reliability and validity of the QuickDASH as compared to the DASH (17, 25, 37), our purpose was to extend this comparison to include measures of neck disability in patients with neck pain.

The constructed hypotheses were,

1. The DASH and the QuickDASH should have high concordance ($r > 0.75$) with each other and more moderate correlation ($r > 0.5 – 0.75$) with either the neck pain and disability scores or the VAS pain score.

2. Correlations with the pain or neck specific scales would be similar regardless of whether the QuickDASH or DASH was used.

RESULTS

Table 1 highlights participant characteristics and the demographics. The histograms for the NDI, the DASH, and the QuickDASH with normal distribution curves are illustrated in Figure 1. The distributions are similar across all three measures. Descriptive information for the scores is contained in Table 2. The maximum score and the mean score for the NDI and the QuickDASH were similar. Whereas the mean score for the QuickDASH was approximately 2.77 points higher as compared to the DASH.

The result for the ranked-item difficulty analysis within the NDI, the DASH and the QuickDASH is shown in Table 3. In both the DASH scales, participants rated the activities that demand free and overhead movements of upper extremity as the most difficult items, whereas those that require lesser shoulder movement and greater movement of distal joints were rated as less difficult items. While the QuickDASH items are scattered in terms of their range of difficulty, most of the items (10 out of 11) appear within the 20 most difficult items of the DASH. Within the NDI, items that examine pain intensity in neck and headaches associated with neck pain were rated to be of more concern to the patients.

Figure 2 illustrates the Bland and Altman plot for the agreement between the DASH and the QuickDASH scores. Average scores for these two scales for each participant are shown along

X-axis, whereas differences between them are reported along Y-axis. Mean overall difference between these two measures and 2 SD limits (2.77 ± 10) were calculated and are shown in the graph.

Table 4 demonstrates correlations between the self-report measures including different subscales of the CSOQ. The highest correlation was observed between the DASH and the QuickDASH (r = 0.97). Both the upper extremity disability measures, the DASH and the QuickDASH, showed high correlation (r > 0.75) with the NDI. The DASH and the QuickDASH showed moderate correlation (r = 0.58 – 0.59) with the functional disability subscale of the CSOQ. Consistent with our hypothesis, the subscales of pain within the CSOQ and the VAS showed moderate correlation with the DASH and the QuickDASH (r = 0.5 – 0.75). The NDI had high correlation (r = 0.78) with the functional disability subscale of the CSOQ.

DISCUSSION

This study provides preliminary support for the use of the QuickDASH or DASH in patients presenting with neck pain, because they seem to capture items of difficulty that are not represented on the NDI and exhibit appropriate response patterns and concurrent validity. Since the QuickDASH is shorter and captures a majority of the difficult items for patients with neck pain, it may be more appropriate given that most clinicians and researchers would be using it to augment their neck specific scale with an instrument for upper extremity disability.

Both the QuickDASH and the DASH demonstrated concurrent validity in patients with neck pain. While both versions of the DASH demonstrated high correlation with the NDI in patients with neck pain, we did not separate patients with associated arm pain. This was because

only 14 patients had associated arm pain (21.2 %) versus 52 (78.8 %) with only neck pain. This would have resulted in insufficient power for this subgroup analysis. Furthermore, we expect that proximal stability and neck symptoms may have consequences for arm function in the absence of arms symptoms and thus groups may not be differentiated based on arm symptoms. Five of the most difficult items reported on the DASH had higher mean scores than the mean score for the most difficult item on the NDI suggesting that the DASH is capturing important aspects of disablement through items not reflected on the NDI. It might be expected that the item ranked as most difficult on the DASH, 'activities requiring translation of force or impact through the upper extremity', would transfer these forces to the neck causing pain. Other difficult items were either heavier in nature or involved large movements of the upper extremity. Given that neck and shoulder pain often exist concurrently, this is anticipated. Opening a jar might appear to be a more hand focused item, but requires proximal stability to perform the task.

In comparing these items ranked as difficult on the DASH to items of the NDI, it could considered that these specific actions fall under broader items already present on the NDI since recreation, lifting, and work are NDI items. Because most of our patients had chronic neck pain (almost 88%), it is possible that they had already modified their activities to avoid certain difficult tasks and thus generic questions would not elicit responses about the difficulty level in these specific arm tasks. Another possibility is that specifically mentioning difficult tasks cues respondents to focus on these difficult tasks, whereas generic questions cause people to respond on their average difficulty within a realm of tasks in that domain, many which could be less problematic than the named item. It has been our observation that a substantial number of patients with wrist disorders rank "pain while lifting a heavy object" higher than "worst pain" (40) suggesting that this phenomena may be a common feature in self-report.

The findings of our study are in agreement with Huisstede et al (2009), who studied a large group of patients with neck pain using only the DASH (21). Our study provides additional information on the relationship between the DASH and neck-specific scales. Our findings of upper extremity involvement in patients with neck pain are consistent with other studies that reported high level of upper extremity dysfunction in patients with neck pain. However, they used global assessment (7) and SF-36 (8) to estimate upper extremity dysfunction. The higher number (almost 80%) of female participants in our study could be because neck pain is more common in females (1, 2, 41). In addition, the participants were recruited from physiotherapy clinics and women tend to have higher rates of utilization of physiotherapy services (42, 43). Our patients had chronic neck pain but many did not report high levels of pain and disability on the NDI. Some of the previous studies that measured disability in patients with chronic neck pain also reported lower NDI scores in this patient group (44-46).

We did not set out to validate the CSOQ. Since, it has other domains beyond neck related disability, an alternative approach to using both the NDI and the QuickDASH would be to use a single CSOQ. Our data does not provide a rationale for one approach versus the other. The CSOQ does have a specific scale focused on the upper extremity and thus could meet this need. However, even the CSOQ may not be comprehensive since it was developed using the inputs from different clinicians involved in the care of patients with neck pain and may have overlooked some of the concerns reported by patients (47). The functional disability subscale of the DASH and CSOQ were only moderately correlated suggesting they do not provide a highly concordant view of disability. This may have possibly occurred because there are fewer items allocated to disability on the CSOQ making it less stable. A practical concern that may affect selection of the NDI/QuickDASH combination versus a CSOQ is the complexity of the latter. It

has over 50 items which are distributed across a number of subscales and the response burden is considerably higher than the combination of the NDI and the QuickDASH. Furthermore, it is more complex to score and thus involves greater clinician burden. In particular, Physiotherapists who are involved in assessing and treating musculoskeletal disability in patients with neck pain may find the CSOQ less useful as it has fewer questions related to pain and functional impairments compared to the NDI and both versions of the DASH.

In our study, participants scored on average 2.77 points higher on the QuickDASH compared to the DASH. Our item ranking suggests that this may occur because more of the difficult items from the DASH have ended up on the QuickDASH. Since item difficulty may vary according to the clinical problem, this may not hold true across other conditions. However our findings are consistent with previous studies, where higher scores were reported on the QuickDASH in patients with different upper extremity disorders (25) and shoulder pathologies (37). Since non-random errors reflect a "bias", users of the QuickDASH should be aware that the scores in their patients would on average be higher than scores reported in the literature or by other therapists obtained by using the full DASH.

Despite this systematic difference, the correlation between the DASH and the QuickDASH was extremely high ($r = 0.97$) and similar to what has been reported in the previous studies (17, 37). Agreement between these two measures was also confirmed by the Bland and Altman plot, where most (95%) of the differences between the DASH and the QuickDASH fell within the limits of agreement (12.77 to -7.23 points).

This study alone is not sufficient evidence to suggest a particular course of action for clinical assessment of patients with neck pain. We do not suggest the QuickDASH is a

replacement for the NDI, which at present remains the most studied and used instrument in this patient population. Rather we suggest that it provides a useful add-on to assess upper extremity impacts of neck pain. A recent study determined that the DASH is more responsive in subgroups of neck pain patients that have shoulder or arm/hand involvement as compared to patients with isolated neck pain (21). Future studies should focus on whether the QuickDASH differentiates patients with isolated neck pain from those with upper extremity symptoms and the comparative responsiveness of the QuickDASH and NDI in these different clinical subgroups.

There are a few limitations to this study. Firstly, the sample size is relatively small. Secondly, due to cross-sectional design we could only examine concurrent relationships. Finally, no definitive diagnosis for the primary cause of the neck pain was identified and the pathophysiological subgroups were not defined.

In conclusion, this study provides evidence to support the use of the QuickDASH to measure upper extremity symptoms and disability in patients presenting with neck pain. The DASH and the QuickDASH are both valid tools for assessing disability related to upper extremity tasks in patients with neck pain. However, since the QuickDASH retains a strong proportion of items that present difficulty for patients with neck pain and has a lower administrative burden, it may be preferable for clinical practice.

FIGURE LEGENDS

Figure 1. Histograms for the Outcome Measures

The distribution of the scores across the NDI, the DASH, and the QuickDASH with the normal curve is shown.

Figure 2. Bland and Altman Plot

The agreement between the DASH and the QuickDASH is shown in this plot. The lines for the limits of agreement and the mean difference are illustrated.

Table 1. Participant Characteristics and Demographics (N = 66)

Variable	N/(Percentage)	Mean	Standard Deviation
Age (years)		40.6	14.2
Male	13 (19.7)	40.7	15.5
Female	53 (80.3)	40.5	14
Associated Arm pain			
Present	14 (21.2)		
Absent	52 (78.8)		
Duration of Pain (months)			
< 3 months	8 (12.1)	1.9	0.6
3 months - 2 years	19 (28.8)	8	5.3
Over 2 years	39 (59.1)	122.1	112.2
VAS (Pain)		5 cm	1.8 cm

Table 2. Scores on the Self report Measures

Variable	N	Minimum	Maximum	Mean	SD
NDI (/50)	66	3	44	19	9.2
DASH (/100)	66	0	78.3	33.3	19.2
QuickDASH (/100)	66	0	88.4	36.1	20.5

Table 3. Ranked-item Difficulty Analysis for the DASH, QuickDASH, and the NDI

NDI	Mean ± SD	DASH	Mean ± SD
Pain Intensity	2.33 ± 1.39	***Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g., golf, hammering, tennis, etc.)**	**2.96 ± 1.42**
Headaches	2.19 ± 1.44	*Recreational activities in which you move your arm freely	2.69 ± 1.47
Sleeping	2.09 ± 1.45	Garden or do yard work	2.63 ± 1.47
Reading	2.02 ± 1.18	**Do heavy household chores (e.g., wash walls, wash floors)**	**2.59 ± 1.56**
Recreation	2 ± 1.36	I feel less capable, less confident or less useful because of my arm, shoulder or hand problem	2.46 ± 1.63
Lifting	1.86 ± 1.51	Arm, shoulder or hand pain when you performed any specific activity	2.25 ± 1.10
Driving	1.68 ± 0.96	Carry a heavy object (over 10 lbs)	2.21 ± 1.56
Work	1.40 ± 1.17	Change a lightbulb overhead	2.06 ± 1.63
Concentration	1.05 ± 1.06	***Arm, shoulder or hand pain**	**2 ± 1.18**
Personal care (Washing, Dressing, etc.)	0.71 ± 0.99	Weakness in your arm, shoulder or hand	2 ± 1.22
		Opening a Tight or New Jar	**1.93 ± 1.54**
		Stiffness in your arm, shoulder or hand	1.82 ± 1.34
		***During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem?**	**1.78 ± 1.28**

***During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand?**	**1.76 ± 1.49**
Push open a heavy door	1.63 ± 1.29
Carry a shopping bag or briefcase	**1.6 ± 1.31**
Place an object on a shelf above your head	1.58 ± 1.38
***Wash your back**	**1.57 ± 1.47**
Tingling (pins and needles) in your arm, shoulder or hand	**1.53 ± 1.5**
During the past week, to what extent has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups?	**1.46 ± 1.4**
*Wash or blow dry your hair	1.2 ± 1.2
Make a bed	1.81 ± 0.99
Put on a pullover sweater	1.06 ± 1.2
Sexual activities	1.05 ± 1.35
Prepare a meal	0.91 ± 1.25
*Recreational activities which require little effort (e.g., cardplaying, knitting, etc.)	0.83 ± 1.06
Manage transportation needs (getting from one place to another)	0.83 ± 1.08
Write	0.72 ± 0.91
Use a knife to cut food	**0.62 ± 0.94**
Turn a key	0.44 ± 0.89

* The items that are reporting similar functions covered in the NDI are marked with an asterix. The items within the DASH with bold text indicate the 11 QuickDASH items.

Table 4. Correlation between Self-report Measures

	Quick DASH	DASH	CSOQ Neck Pain (N = 42)	CSOQ Shoulder and Arm Pain (N = 42)	CSOQ Physical Symptom (N = 42)	CSOQ Functional Disability (N = 42)	CSOQ Psycho. Distress (N = 42)	VAS
NDI	**0.82****	**0.83****	0.73**	0.43**	0.74	**0.78****	0.61**	0.68**
QuickDASH		**0.97****	0.65**	0.57**	0.68**	0.59**	0.58**	0.64**
DASH			0.61**	0.55**	0.67**	0.58**	0.56**	0.66**
CSOQ Neck Pain				0.52**	0.53**	0.68**	0.56**	0.7**
CSOQ Shoulder and Arm Pain					*0.25*	0.48**	0.36*	0.6**
CSOQ Physical Symptoms						0.54**	0.56**	0.44**
CSOQ Functional Disability							0.67**	0.66**
CSOQ Psycho. Distress								0.44**

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed). The r values shown in bold letters indicate high correlations. The r value in italics shows the correlation believed to be non-significant. N = 66 for the NDI, both versions of the DASH, and the VAS.

Figure 1. Histograms for the Outcome Measures