The ‘M² DASH’—Manchester-Modified Disabilities of Arm Shoulder and Hand Score

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Abstract The Disability of the Arm, Shoulder, and Hand (DASH) questionnaire was originally designed as a measure of disability in patients with disorders of the upper limb, but the DASH score is also affected by disability because of lower limb disorders. The aim of this study was

to investigate the construct validity of the DASH questionnaire and to create a revised DASH questionnaire, the Manchester-modified or M² DASH, with fewer questions that is more specific to the upper limb. Patients were asked to fill in the DASH questionnaire in a fracture clinic after ethical approval. This included 79 patients with upper limb injuries, 61 patients with lower limb injuries, and 52 control subjects. The mean DASH scores for the three groups varied significantly, and the lower limb group had a mean score of 16. The M² DASH questionnaire was developed using questions more specific to the upper limb and included questions 1–4, 6, 13–17, 21–23, and 26–30 from the original questionnaire. The mean M² DASH score for the lower limb group was 9 and, unlike the original DASH score, was not statistically different from the control group. The M² DASH scores were then calculated for the upper limb group and a correlation study showed highly significant correlation between the original DASH scores and the M² DASH scores. Our study shows that the original DASH questionnaire is not specific for the upper limb. The M² DASH questionnaire has the advantage of being more specific for the upper limb than the DASH questionnaire, and it correlates well with the original DASH questionnaire when looking at isolated upper limb injuries.

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Introduction

Injuries and diseases commonly affect the upper limb, and these can significantly affect the ability of an individual to perform activities of daily living. The use of regional outcome measures or scoring systems is important as it allows comparison between these injuries and diseases and

allows clinicians to assess progression and the effects of different treatment modalities [3].

Table 1 shows the Disability of the Arm, Shoulder, and Hand (DASH) questionnaire [4, 13] and the shorter version QuickDASH [5] that were originally designed and have been validated as a measure of disability in patients with disorders of the upper limb. The DASH questionnaire is frequently used to assess self-reported patient outcome in orthopedics, rheumatology, and neurology [9, 12]. The content of the DASH questionnaire links well with the International Classification of Functioning, Disability, and Health [8], and radiological and objective physical results have also been associated with the DASH score [14]. The score out of 100 is calculated from a patient-based questionnaire after the patient answers 30 questions choosing 1 of 5 responses. Six domains are assessed in the DASH questionnaire: daily activities, symptoms, social function, work function, sleep, and confidence. It was originally developed as a regional outcome measure specific for the upper limb, but a recent study showed that the DASH scores in patients with lower limb disability are also higher than normal control subjects [7]. This suggests that the questionnaire does not exclusively measure disability associated with disorders of the upper limb.

Although a number of studies using the DASH score have specified that the injuries were isolated [10, 11], this has not always been the case [2, 6]. In previous studies looking at DASH scores where there were injuries to both upper and lower limbs and in studies of polyarthropathies [1], the DASH scores need to be interpreted with caution. Care must be taken when attributing disability measured by the DASH score to disability of the upper limb when problems are also present in the lower limb.

It is important that a scoring system is developed that allows satisfactory regional outcome measurements specific for the upper limb. This is particularly important in injuries that involve both upper and lower limbs and in polyarthropathies. The aim of this study was twofold; firstly, to investigate the construct validity of the DASH score in patients after injuries to the upper and lower limbs and to confirm that DASH score does not measure disability solely attributed to the upper limb. Secondly, to create a modified DASH score with fewer questions that can discriminate clearly between disabilities because of problems at the upper limb and is more specific to the upper limb. This would allow the score to be satisfactorily used in patients with both upper and lower limb disability and only measure the disability in the upper limb.

Materials and Methods

One hundred and ninety three patients were asked to fill in the DASH questionnaire in the waiting room of fracture clinics at Stepping Hill Hospital, Stockport, UK between January and

June 2007 after ethical approval. This included 79 patients with upper limb injuries, 61 patients with lower limb injuries, and 52 control subjects. The inclusion criteria were an isolated upper or lower limb injury, aged 18 or over, and previous independence in performing the activities of daily living. Where a patient was not able to complete the questionnaire because of upper limb injury, an accompanying person acted as a scribe. The control subjects were relatives attending the fracture clinic with the patients and who had not sustained an injury requiring hospital attendance within the last 6 months. Eligible patients were invited to participate while waiting for their appointment.

The DASH score was calculated as specified in the questionnaire. The original DASH questionnaire allows for the omission of up to three questions, and the score is adjusted to accommodate for this. Comparison of the DASH scores between the three groups was made using the Kruskal–Wallis test. Pairwise comparisons between the groups were made using the Mann–Whitney test. A *p* value of <0.05 was taken as statistically significant.

Using the frequency tables and bar charts for the scores for each group for each question, we identified and eliminated questions that the lower limb injury group scored highly on. This allowed us to come up with a revised questionnaire, referred to as the Manchester-modified or M² DASH. We retained at least half the number of questions from each of the six domains described in the original DASH questionnaire. We allowed the omission of up to two questions for the M² DASH. The score was calculated just like the original questionnaire by adding up the total scores from all answered questions, dividing it by the number of answered questions, subtracting 1, and multiplying by 25. Comparison of the M² DASH scores between the three groups was also made using the Kruskal–Wallis test, followed by pairwise comparisons between the groups using the Mann–Whitney test. This was followed by the chi-square tests to identify the questions that are not specific for the upper limb, i.e., questions where there was no significant difference in response between the upper and lower limb groups.

To assess the validity of the modified questionnaire, the M² DASH score was calculated for the upper limb injury group using the previously completed questionnaires and a comparison was made with the original DASH score. The correlation between the two questionnaires was assessed by calculating Spearman's correlation coefficients and this served to analyze the validity of the modified questionnaire. All analyses were performed on SPSS version 12.0 (SPSS, Chicago, IL, USA).

Results

The mean ages and standard deviations (SDs) for the three groups were 46 years (22 years) for the upper limb group,

Table 1 The original DASH, QuickDASH, and M² DASH questionnaires.

Please Rate your Ability to do the Following Activities in the Last Week	No Difficulty	Mild Difficulty	Moderate Difficulty	Severe Difficulty	Unable
1. <i>Open a tight or new jar</i>	1	2	3	4	5
2. Write	1	2	3	4	5
3. Turn a key	1	2	3	4	5
4. Prepare a meal	1	2	3	4	5
5. Push open a heavy door	1	2	3	4	5
6. Place an object on a shelf above your head	1	2	3	4	5
7. <i>Do heavy household chores (e.g., wash walls, wash floors)</i>	1	2	3	4	5
8. Garden or do yard work	1	2	3	4	5
9. Make a bed	1	2	3	4	5
10. <i>Carry a shopping bag or briefcase</i>	1	2	3	4	5
11. Carry a heavy object (over 10 lbs)	1	2	3	4	5
12. Change a light bulb overhead	1	2	3	4	5
13. Wash or blow dry your hair	1	2	3	4	5
14. <i>Wash your back</i>	1	2	3	4	5
15. Put on a pullover sweater	1	2	3	4	5
16. <i>Use a knife to cut food</i>	1	2	3	4	5
17. Recreational activities which require little effort (e.g., card playing, knitting, etc.)	1	2	3	4	5
18. <i>Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g., golf, hammering, tennis, etc.)</i>	1	2	3	4	5
19. <i>Recreational activities in which you move your arm freely (e.g., playing frisbee, badminton, etc.)</i>	1	2	3	4	5
20. Manage transportation needs (getting from one place to another)	1	2	3	4	5
21. Sexual activities	1	2	3	4	5
22. <i>During the past week, to what extent has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbors or groups?</i>	Not at all	Slightly	Moderately	Quite a bit	Extremely
	1	2	3	4	5
23. <i>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?</i>	Not limited at all	Slightly limited	Moderately limited	Very limited	Unable
	1	2	3	4	5
24. <i>Arm, shoulder or hand pain</i>	None	Mild	Moderate	Severe	Extreme
25. <i>Arm, shoulder or hand pain when you performed any specific activity</i>	1	2	3	4	5
26. Tingling (pins and needles) in your arm, shoulder or hand	1	2	3	4	5
27. Weakness in your arm, shoulder or hand	1	2	3	4	5
28. Stiffness in your arm, shoulder or hand	1	2	3	4	5
29. <i>During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand?</i>	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	So much difficulty I can't sleep
	1	2	3	4	5
30. I feel less capable, less confident or less useful because of my arm, shoulder or hand problem	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
	1	2	3	4	5

The table shows the 30 questions that form the original DASH questionnaire. The QuickDASH questions are in italics, and the M² DASH questions are in bold. The score is calculated by adding up the total scores for each answered question, dividing it by the number of answered questions, subtracting 1, and multiplying by 25. This applies to all three questionnaires and gives a score out of 100.

38 years (17 years) for the lower limb group, and 44 years (19 years) for the control group. The patients' ages did not vary significantly between the three groups (Kruskal–Wallis: $p>0.05$). The mean DASH scores and SDs for the three groups were 54 (22) for the upper limb group, 16 (10) for the lower limb group, and 2 (3) for the control group (Fig. 1a). The DASH scores varied significantly between the three groups (Kruskal–Wallis: $p<0.001$); the mean score for the upper limb group were higher than the other two groups, and the mean score for the lower limb group was higher than the control group. Pairwise comparisons between upper and lower limb groups (Mann–Whitney: $p<0.001$), and between lower limb and control groups (Mann–Whitney: $p<0.001$) showed statistically significant differences.

The M² DASH questionnaire was developed using questions specific to the upper limb and included questions

1–4, 6, 13–17, 21–23, and 26–30 from the original questionnaire (Table 1). The mean M² DASH scores and SDs for the three groups were 51 (23) for the upper limb group, 9 (9) for the lower limb group, and 2 (2) for the control group (Fig. 1b). The M² DASH scores also varied significantly between the three groups (Kruskal–Wallis: $p<0.001$). Pairwise comparisons between the upper and lower limb groups (Mann–Whitney: $p<0.001$) and between the upper limb and control groups (Mann–Whitney: $p<0.001$) showed statistically significant differences. It is important to note that no significant difference was seen between the lower limb group and the control group (Mann–Whitney: $p>0.05$) when using the M² DASH scores.

Using chi-square tests, only question 10 ($p>0.05$) and question 20 ($p>0.05$) showed no evidence of a difference between the upper limb and lower limb groups, suggesting that they were not specific for the upper limb group. These two questions were not in the M² DASH questionnaire.

The M² DASH questionnaire score was then calculated for the group of patients with upper limb injury and a correlation study performed with the original DASH questionnaire score showed a high correlation (Spearman's correlation coefficient: $r=0.98$, $p<0.001$), confirming that the ranking of the upper limb patients is similar in the two questionnaires.

Discussion

Our study shows that the DASH score was significantly higher in the upper limb group than the lower limb group and the control group, and lower limb group had a score higher than the control group. The DASH score was developed as a region-specific questionnaire but, in our study, the lower limb group scored significantly higher than the control group, suggesting that the questions are not specific for the upper limb. This is because the DASH questionnaire includes questions that do not solely rely on the function of the upper limb, e.g., 'ability to make a bed' or 'ability to manage transportation needs', which are obviously affected by both lower and upper limb disabilities. Other questions do not involve the use of the lower limb function, e.g., 'ability to turn a key' or 'ability to open a jar'.

The aim of developing the revised M² DASH questionnaire was to form a questionnaire that is more specific for upper limb injuries. The revised questionnaire was devised by excluding questions that the lower limb injury group scored highly on or, in other words, questions that were not specific for the upper limb. Using the original DASH questionnaire, the lower limb injury group scored significantly greater than the control group with no injuries, but this was not the case with the M² DASH questionnaire. Figure 1 clearly shows that the revised questionnaire results in lower

Figure 1 The dataset showing the distribution of DASH scores obtained using **a** the original DASH questionnaire and **b** the M² DASH questionnaire for the upper limb injury group, lower limb injury group, and control group. The results show that the lower limb group scores are lower with the M² DASH questionnaire.

scores for the lower limb injury group, and the scores for the upper limb injury group and the control group remain largely unaffected. In the modified questionnaire, at least half the questions from the original questionnaire's six domains remain. Question 10, 'ability to carry a shopping bag or briefcase' and question 20, 'ability to manage transportation needs' were among the 12 questions removed in the revised questionnaire. In addition, we have also shown a significant correlation between the scores obtained using the original DASH questionnaire and the M² DASH questionnaire in the group with upper limb injury, also suggesting that the M² DASH questionnaire is valid.

Our study shows that the original DASH questionnaire is not specific for the upper limb. This has important implications in measuring response in injuries and diseases that involve both upper and lower limbs. We have devised a revised questionnaire that we suggest is referred to as M² DASH questionnaire to allow identification as different from the original DASH questionnaire. The M² DASH questionnaire has the advantage of being more specific for the upper limb than the DASH questionnaire, and it correlates well with the original DASH questionnaire when looking at isolated upper limb injuries.

References

- Adams J, BurrIDGE J, Mullee M, Hammond A, Cooper C. Correlation between upper limb functional ability and structural hand impairment in an early rheumatoid population. *Clin Rehabil* 2004;18:405–3.
- Angst F, John M, Goldhahn J, et al. Comprehensive assessment of clinical outcome and quality of life after resection interposition arthroplasty of the thumb saddle joint. *Arthritis Rheum* 2005;53:205–13.
- Baldry Currans JA. Evaluation of disability and handicap following injury. *Injury* 2000;31:99–106.
- Beaton DE, Katz JN, Fossel AH, et al. Measuring the whole or the parts? Validity, reliability and responsiveness of the disabilities of the arm, shoulder, and hand outcome measure in different regions of the upper extremity. *J Hand Ther* 2001;14:128–46.
- Beaton DE, Wright JG, Katz JN. Upper extremity collaborative group. Development of the QuickDASH: comparison of three item-reduction approaches. *J Bone Joint Surg Am* 2005;87:1038–46.
- Chiari-Grisar C, Koller U, Stamm TA, Wanivenhaus A, Trieb K. Performance of the disabilities of the arm, shoulder and hand outcome questionnaire and the Moberg picking up test in patients with finger joint arthroplasty. *Arch Phys Med Rehabil* 2006;87:203–6.
- Dowrick AS, Gabbe BJ, Williamson OD, Cameron PA. Does the disabilities of the arm, shoulder and hand (DASH) scoring system only measure disability due to injuries to the upper limb? *J Bone Joint Surg* 2006;88B:524–7.
- Drummond AS, Sampaio RF, Mancini MC, Kirkwood RN, Stamm TA. Linking the disabilities of arm, shoulder, and hand to the international classification of functioning, disability, and health. *J Hand Ther* 2007;20:336–44.
- Jupiter JB, Ring D. Treatment of unreduced elbow dislocations with hinged external fixation. *J Bone Joint Surg* 2002;84A:1630–5.
- Khan WS, Agarwal M, Muir L. Management of intra-articular fractures of the proximal interphalangeal joint with internal fixation and bone grafting. *Arch Orthop Trauma Surg* 2004;124:654–8.
- Khan WS, Fahmy NRM. The S-Quattro in the management of sports injuries of the hand. *Injury* 2006;37:860–8.
- McKee MD, Wild LM, Schemitsch EH. Midshaft malunion of the clavicle. *J Bone Joint Surg* 2003;85A:790–7.
- Solway S, Beaton DE, McConnell S, Bombardier C. The DASH outcome measure user's manual. 2nd ed. Toronto: Institute for Work and Health; 2002.
- Wilcke MK, Abbaszadegan H, Adolphson PY. Patient-perceived outcome after displaced distal radius fractures a comparison between radiological parameters, objective physical variables, and the DASH score. *J Hand Ther* 2007;20:290–9.