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The influence of dominant limb involvement on DASH and QuickDASH

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Abstract
Purpose The purpose of this study is to determine whether involvement of the dominant limb affects Disabilities of the Arm Shoulder and Hand (DASH) scores.
Methods A convenience sample of 948 patients from 12 prospective studies that recorded hand dominance, affected side, diagnosis, and a DASH or QuickDASH score was used to assess the influence of involvement of the dominant limb on DASH scores. Diagnosis was categorized as traumatic and nontraumatic. Region was categorized as hand and wrist, elbow, and arm and shoulder.
Results In bivariate analysis, involvement of the dominant limb, diagnosis, region, and sex had significant influence on DASH/QuickDASH score. In multivariable analysis, dominant hand condition, traumatic diagnosis, arm and shoulder involvement, and female sex were associated with significantly higher DASH scores (more disability), but accounted for only 10 % of the variability in scores.
Conclusion Upper extremity disability as measured by the DASH is slightly, but significantly greater when the dominant limb is involved.
Level of evidence: Prognostic level II

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Introduction

The Disabilities of the Arm Shoulder and Hand (DASH) instrument (and its shortened form the QuickDASH) is one of the most commonly used measures of upper extremity-specific disability [2, 10]. When completing the DASH, patients rate their ability to complete specific tasks (e.g., writing) regardless of which hand they use for the task [14, 18]. In contrast, the Michigan Hand Outcome Questionnaire (MHOQ) takes the affected side into account [5].

One would expect that pathophysiology of the dominant limb would have a substantial and measurable affect on symptoms of disability. Hand dominance has an impact on the ability to perform certain activities such as writing [11]. Bot et al. in a study on individual DASH tasks after distal radius fracture showed that "write" score differs significantly when the dominant side is affected [3]. Conversely, a study of patients after proximal humerus fracture and a study of patients after surgery for axillary lymph node dissection found no difference in the DASH score when the dominant limb was involved [6, 12].

All of these studies were small, confined to a specific region and diagnosis, and addressed the correlation between the DASH and involvement of the dominant limb as a secondary hypothesis. We felt that a large cohort of patients with a variety of diagnoses might provide useful information about the influence of involvement of the dominant limb on disability. This is part of a line of research that is attempting to distinguish the influence of objective pathophysiology compared to psychosocial factors on symptoms and disability. It is our observation that patients and surgeons tend to assume that impairment of the dominant limb will lead to notably greater

Table 1 Detailed diagnosis for traumatic and nontraumatic conditions

Traumatic	No. (%)	DASH/QuickDASH score, mean±SD (range)	Nontraumatic	No. (%)	DASH/QuickDASH score, mean±SD (range)
Finger/thumb fracture	109 (27)	31±20 (0–93)	Carpal tunnel syndrome	34 (6.9)	34±16 (7.5–73)
Finger/thumb amputation	12 (3.0)	41±25 (9.5–77)	Medial epicondylitis	6 (1.2)	29±14 (6.7–44)
Finger/thumb laceration	57 (14)	39±23 (2.3–80)	Lateral epicondylitis	43 (8.7)	34±21 (9.1–75)
Finger/thumb sprain	24 (5.9)	16±11 (5–39)	Trigger finger/thumb	86 (17)	27±17 (0–70)
Wrist fracture	94 (23)	37±19 (2.5–92)	Tendinitis	7 (1.4)	42±26 (6.7–74)
Wrist sprain	15 (3.7)	25±12 (10–42)	TMC arthrosis	102 (21)	30±18 (0–82)
Elbow fracture	30 (7.3)	43±23 (12–77)	Arm pain	21 (4.2)	40±21 (4.2–88)
Elbow dislocation	3 (1.0)	55±43 (7.8–91)	Elbow pain	4 (1.0)	40±20 (11–58)
Humerus fracture	8 (2.0)	42±22 (10–70)	Wrist pain	7 (1.3)	25±24 (4.6–73)
Biceps tendon tear	4 (1.0)	26±18 (6.8–46)	Hand pain	7 (1.3)	23±26 (2.7–69)
Rotator cuff tear	11 (2.6)	52±22 (26–70)	Finger tumor	5 (1.2)	9.4±6.5 (1.7–16)
Arm trauma	5 (1.2)	42±12 (24–64)	De Quervain	76 (15)	33±17 (5.8–68)
Other	37 (7.3)	50±18 (2.3–96)	Dupuytren	35 (7.0)	6.2±5.8 (0–16)
Total	*409* (*100*)		Cubital tunnel syndrome	24 (4.8)	43±23 (2.5–73)
			Ganglion cyst	15 (3.0)	12±19 (0–48)
			Other	24 (5.0)	24±21 (0–91)
			Total	*496* (*100*)	

TMC trapeziometacarpal joint, *SD* standard deviation

Italicized values are the sum of the above values showing the total number

disability than involvement of the nondominant limb, because it is more difficult to adapt to involvement of the dominant limb.

In contrast to the Michigan Hand Questionnaire, the DASH does not account for handedness. Therefore, this study tested the primary null hypothesis that there is no difference in the DASH/QuickDASH score between patients with upper extremity conditions involving the dominant or nondominant limb.

Materials and Methods

In this institutional review board-approved study, we used data from 12 prospective studies conducted between 2010 and 2014. We selected studies that recorded the following: hand dominance, affected side, diagnosis, and a DASH or QuickDASH score. These 12 studies included 1198 subjects with any type of hand- and upper extremity-related conditions visited at Orthopedic Hand and Upper Extremity Service. Eleven studies used the DASH, while only one study used the QuickDASH. We used the first DASH score from each patient in each study. Multivariable analysis addressed potential confounding factors including sex, age, diagnosis, and region of involvement that were available to study and also might have had an influence on the DASH score. The attending orthopedic surgeon determined the diagnosis and the region of involvement.

The DASH and QuickDASH scores were calculated using the equation: [(sum of n responses/n)−1]×25], giving a total score scaled from 0 to 100 representing best to worst possible score. A score was not calculated if more than three items on DASH or one item on QuickDASH were missing.

The exclusion criteria were missing data on limb dominance or involved side, involvement of both sides, and ambidextrous patients. After excluding 127 patients where dominance or involved hand was not adequately documented or the DASH/QuickDASH score could not be calculated, 12 ambidextrous patients, and 111 patients with involvement of both hands, 948 subjects were analyzed. Diagnosis was categorized as traumatic or nontraumatic. Region was categorized as hand and wrist, elbow, and arm and shoulder (Table 1).

Statistical Analysis

The scaled DASH/QuickDASH score was the response variable. Explanatory variables included involvement of the dominant limb, age, sex, region, and traumatic vs. nontraumatic diagnosis.

Continuous data were reported as means with standard deviation and categorical data presented as absolute values with percentages. Pearson's chi-square and Fisher's exact tests were done for categorical variables. The DASH/QuickDASH score

was compared between subgroups with the use of the independent sample *t*-test and one-way ANOVA for categorical variables and Pearson correlation for continuous variables. To determine the independent influence on DASH/QuickDASH score, variables were entered into a backward multivariable linear regression model.

Results

In bivariate analysis, the higher DASH/QuickDASH scores were significantly associated with involvement of the dominant limb ($P<0.001$), traumatic diagnosis ($P<0.001$), arm and shoulder region ($P=0.001$), and women ($P=0.006$) (Table 2). Post hoc analysis in terms of region showed that there was a significant difference in the mean DASH score between hand/wrist and arm/shoulder problems ($P=0.022$), but there was no significant difference between elbow problems with either hand/wrist ($P=0.39$) or arm/shoulder ($P=0.57$) problem. In multivariable analysis, the effects of all four variables were still significant. However, the best model including all four variables only accounted for 10 % of the variability in the DASH/QuickDASH score. If there was any confounding between the variables, one may have dropped out of the multivariable model, indicating that each factor has an influence somewhat independent of the others (Table 3).

Table 2 Characteristics of patients with hand and upper extremity problem from 12 former studies ($n=948$)

Characteristics	Total	DASH/QuickDASH, mean±SD (range)	*P* value[a]
Age, mean±SD (range)	52±16 (15–90)	33±21 (0–96)	0.97[b]
Sex, no. (%)			
Women	584 (61)	35±20 (0–96)	0.0060[c]
Men	361 (38)	31±22 (0–93)	
Diagnosis, no. (%)			
Nontraumatic	496 (52)	30±19 (0–88)	<0.001[c]
Traumatic	409 (43)	39±21 (0–96)	
Region, no. (%)			
Hand and wrist	810 (90)	33±20 (0–96)	0.010[d]
Elbow	62 (6)	38±23 (0–91)	
Arm and shoulder	33 (4)	44±21 (2.5–88)	
Involvement of the dominant limb, no. (%)			
Yes	476 (50)	36±22 (0–96)	<0.001[c]
No	472 (50)	31±20 (0–92)	
Involvement of the dominant limb, no. (%)			
Right dominant	427 (45)	36±22 (0–96)	0.93[c]
Left dominant	49 (5)	36±18 (6.8–77)	
Involvement of the nondominant limb, no. (%)			
Right dominant	428 (45)	31±20 (0–92)	0.86[c]
Left dominant	44 (5)	31±19 (0–86)	

[a] Bivariate analysis of patients after DASH/QuickDASH scoring

[b] Correlation

[c] Independent *t*-test

[d] One-way ANOVA

Discussion

This study addressed the primary null hypothesis that there is no difference in the DASH/QuickDASH score between patients with involvement of the dominant and nondominant limb. We rejected the null hypothesis: there is a small but significant difference on average. Involvement of the dominant limb leads to greater symptom intensity and magnitude of disability (greater DASH scores).

There are several limitations to consider as well. Mixing diagnoses may have diluted the effect of involvement of the dominant limb. A prospective study of specific condition—particularly one with greater pathophysiology and objective physical impairment (stiffness, weakness, numbness, etc.) might find a greater effect of involvement of the dominant limb on the DASH scores. Another limitation is that we retrospectively analyzed and reused data collected from prospective studies. Furthermore, even though the data were collected prospectively, limb involvement and dominance was not consistently recorded, and the exclusion of the patients that did not have complete data might have affected the results.

In addition to the involvement of the dominant limb, sex, region, and trauma affected the DASH scores, which is consistent with prior studies [3, 4, 16]. The observation of higher scores with traumatic events might relate to greater adaptation to nontraumatic diseases over time. In addition, traumatic events maybe cause greater nociception and impairment on average—at least early on—leading to greater symptoms and disability. It is possible that studies of specific traumatic injuries would find a greater influence of limb dominance on DASH scores.

Prior studies of the influence of limb dominance on DASH scores were inconsistent and region dependent with studies in

Table 3 Multivariable linear regression analysis: predictors of DASH and QuickDASH ($n=948$)

Parameter	*P* value	Partial R^2	Adjusted R^2
Best model			0.096
Involvement of the dominant limb	<0.001	0.017	
Sex	0.0030	0.010	
Diagnosis	<0.001	0.075	
Region	0.0010	0.013	

shoulder region finding no influence of limb dominance [6, 12, 16], while studies of hand and wrist problems did find a difference [3, 4, 9]. Lee et al. showed that DASH score is greater with lower grip strength of the dominant hand in men [13].

We found that more proximal anatomical sites are associated with greater symptoms and disability. Perhaps more proximal problems are more difficult to adapt to, or perhaps the hand or wrist needs to be involved for limb dominance to affect symptoms and disability.

Involvement of the dominant limb seems to have a small, somewhat inconsistent effect on the upper extremity-specific disability, perhaps varying by anatomic site and type of injury or impairment. Given that the average difference between involvement of the dominant and nondominant limb was less than the minimally important difference noted in prior studies [7, 17], the differences in symptoms and disability when an illness involves the dominant vs. the nondominant limb may be negligible. This is somewhat counterintuitive given how much we rely on our dominant hand for daily activities.

One would expect that pain or impairment of the dominant limb would have a more substantial effect on symptoms and disability, particularly when measured using an instrument such as the DASH that does not account for involvement of the dominant limb. On the other hand, this finding is consistent with studies that show unexpectedly limited differences in responsiveness between more general (e.g., SF-36) and more specific (e.g., DASH) measure of symptoms and disability [1, 8]. Given the growing evidence that psychological factors are the key determinants of symptom intensity and magnitude of disability [15, 19], it may be that involvement of the dominant limb is less important than one's ability to adapt to symptoms and impairment. In other words, evidence is accumulating that on average, symptoms and disability are influenced more by mindset and circumstances, than by specific types of pathophysiology or impairment, including involvement of the dominant limb.

Conflict of Interest Amir Reza Kachooei declares that he has no conflict of interest.

Ali Moradi declares that he has no conflict of interest.

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David Ring declares that he has no conflict of interest.

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References

1. Angst F, Goldhahn J, Drerup S, et al. Responsiveness of five outcome measurement instruments in total elbow arthroplasty. Arthritis Care Res (Hoboken). 2012;64(11):1749–55.
2. Beaton DE, Wright JG, Katz JN, et al. Development of the QuickDASH: comparison of three item-reduction approaches. J Bone Joint Surg Am. 2005;87(5):1038–46.
3. Bot AG, Souer JS, van Dijk CN, et al. Association between individual DASH tasks and restricted wrist flexion and extension after volar plate fixation of a fracture of the distal radius. Hand (N Y). 2012;7(4):407–12.
4. Chan JC, Ong JC, Avalos G, et al. Illness representations in patients with hand injury. J Plast Reconstr Aesthet Surg. 2009;62(7):927–32.
5. Chung KC, Pillsbury MS, Walters MR, et al. Reliability and validity testing of the Michigan Hand Outcomes Questionnaire. J Hand Surg [Am]. 1998;23(4):575–87.
6. Edelmann K, Obruba P, Kopp L, et al. Comparison of functional outcomes in angle-stable osteosynthesis of comminuted fractures of the proximal humerus with those in percutaneous Kirschner-wire fixation. A prospective study of mid-term results. Acta Chir Orthop Traumatol Cech. 2011;78(4):314–20.
7. Franchignoni F, Vercelli S, Giordano A, et al. Minimal clinically important difference of the disabilities of the arm, shoulder and hand outcome measure (DASH) and its shortened version (QuickDASH). J Orthop Sports Phys Ther. 2014;44(1):30–9.
8. Gay RE, Amadio PC, Johnson JC. Comparative responsiveness of the disabilities of the arm, shoulder, and hand, the carpal tunnel questionnaire, and the SF-36 to clinical change after carpal tunnel release. J Hand Surg [Am]. 2003;28(2):250–4.
9. Hirche C, Heffinger C, Xiong L, et al. The 1,2-intercompartmental supraretinacular artery vascularized bone graft for scaphoid nonunion: management and clinical outcome. J Hand Surg [Am]. 2014;39(3):423–9.
10. Hudak PL, Amadio PC, Bombardier C. Development of an upper extremity outcome measure: the DASH (disabilities of the arm, shoulder and hand) [corrected]. The Upper Extremity Collaborative Group (UECG). Am J Ind Med. 1996;29(6):602–8.
11. Jung HS. Hand dominance and hand use behaviour reported in a survey of 2437 Koreans. Ergonomics. 2009;52(11):1362–71.
12. Lee KC, Alexander S, Varma S. Patient-reported outcomes post axillary block dissections for skin cancer. J Plast Reconstr Aesthet Surg. 2013;66(6):787–91.
13. Lee JE, Kim KW, Paik NJ, et al. Evaluation of factors influencing grip strength in elderly koreans. J Bone Metab. 2012;19(2):103–10.
14. London DA, Stepan JG, Boyer MI, et al. Performance characteristics of the verbal QuickDASH. J Hand Surg [Am]. 2014;39(1):100–7.
15. Niekel MC, Lindenhovius AL, Watson JB, et al. Correlation of DASH and QuickDASH with measures of psychological distress. J Hand Surg [Am]. 2009;34(8):1499–505.
16. Ozaras N, Cidem M, Demir S, et al. Shoulder pain and functional consequences: does it differ when it is at dominant side or not? J Back Musculoskelet Rehabil. 2009;22(4):223–5.
17. Sorensen AA, Howard D, Tan WH, et al. Minimal clinically important differences of 3 patient-rated outcomes instruments. J Hand Surg [Am]. 2013;38(4):641–9.
18. van Kampen DA, Willems WJ, van Beers LW, et al. Determination and comparison of the smallest detectable change (SDC) and the minimal important change (MIC) of four-shoulder patient-reported outcome measures (PROMs). J Orthop Surg Res. 2013;8:40.
19. Vranceanu AM, Barsky A, Ring D. Psychosocial aspects of disabling musculoskeletal pain. J Bone Joint Surg Am. 2009;91(8):2014–8.