The PROMIS Physical Function Correlates With the QuickDASH in Patients With Upper Extremity Illness

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Abstract

Background To assess disability more efficiently with less burden on the patient, the National Institutes of Health has developed the Patient Reported Outcomes Measurement Information System (PROMIS) Physical Function—an instrument based on item response theory and using computer adaptive testing (CAT). Initially, upper and lower extremity disabilities were not separated and we were curious if the PROMIS Physical Function CAT could measure upper extremity disability and the Quick Disability of Arm, Shoulder and Hand (QuickDASH).

Questions/purposes We aimed to find correlation between the PROMIS Physical Function and the QuickDASH questionnaires in patients with upper extremity illness. Secondarily, we addressed whether the PROMIS

Physical Function and QuickDASH correlate with the PROMIS Depression CAT and PROMIS Pain Interference CAT instruments. Finally, we assessed factors associated with QuickDASH and PROMIS Physical Function in multivariable analysis.

Methods A cohort of 93 outpatients with upper extremity illnesses completed the QuickDASH and three PROMIS CAT questionnaires: Physical Function, Pain Interference, and Depression. Pain intensity was measured with an 11-point ordinal measure (0–10 numeric rating scale). Correlation between PROMIS Physical Function and the QuickDASH was assessed. Factors that correlated with the PROMIS Physical Function and QuickDASH were assessed in multivariable regression analysis after initial bivariate analysis.

Results There was a moderate correlation between the PROMIS Physical Function and the QuickDASH questionnaire ($r = -0.55$, $p < 0.001$). Greater disability as measured with the PROMIS and QuickDASH correlated most strongly with PROMIS Depression ($r = -0.35$, $p < 0.001$ and $r = 0.34$, $p < 0.001$ respectively) and Pain Interference ($r = -0.51$, $p < 0.001$ and $r = 0.74$, $p < 0.001$ respectively). The factors accounting for the variability in PROMIS scores are comparable to those for the QuickDASH except that the PROMIS Physical Function is influenced by other pain conditions while the QuickDASH is not.

Conclusions The PROMIS Physical Function instrument may be used as an upper extremity disability measure, as it correlates with the QuickDASH questionnaire, and both instruments are influenced most strongly by the degree to which pain interferes with achieving goals.

Level of Evidence Level III, diagnostic study. See the Instructions for Authors for a complete description of levels of evidence.

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Introduction

With standard outcome questionnaires such as the DASH, the patient addresses 30 questions (11 for the QuickDASH) [18, 20]. Combined with other similar questionnaires and forms for baseline demographics, patients in research studies may spend 15 to 30 minutes completing questionnaires. If patients lose focus or energy completing lengthy questionnaires, they may alter their responses, skip questions, or stop completing questionnaires altogether [24, 36]. An approach that may limit patient burden, avoid missed questions, and may be less prone to floor and ceiling effects is computer adaptive testing (CAT) [19, 25, 26]. CAT uses item response theory to optimize questionnaire administration by administering only relevant items based on the estimated level of function [9, 11]. For instance, if a patient says they can walk a mile, it will not ask if they can walk a block. CAT and full-length questionnaires are highly correlated and measure patient disability with comparable precision [9]. CAT can be completed more quickly and has lower floor and ceiling effects [13, 19, 22]. The National Institutes of Health has developed several questionnaires based on this approach: the Patient Reported Outcomes Measurement Information System (PROMIS) [10, 14].

Initially, upper and lower extremity function was assessed together under PROMIS Physical Function because there was little distinction between upper and lower extremity conditions in initial field testing and validation [7, 15, 16]; an upper extremity-specific disability measure recently was released for PROMIS. We were surprised that the developers of the PROMIS Physical Function CAT found little difference when they separated upper and lower extremity questions. The finding that it does not matter much if you ask patients questions regarding legs or arms—if confirmed—would suggest that measures of musculoskeletal disability may be measuring something other than pathophysiology or impairment. In other words, if patients with upper extremity illness report equal trouble with upper and lower extremity activities, then the instrument may not be measuring the upper extremity. Given the evidence that measure of symptoms and disability correlate most strongly with psychosocial factors, perhaps these instruments are measures of mindset and circumstances more than physical disease and impairment [37, 39].

The aims of our study were to confirm that a general disability measure (PROMIS Physical Function) correlates with a measure of upper extremity disability (QuickDASH), and to determine the factors influencing the variation in both scores to see if they are similar [2, 8, 12, 18, 20, 28–30, 32, 41, 42].

We hypothesized that there would be no correlation between the PROMIS Physical Function CAT and the QuickDASH. Secondary study questions addressed

Table 1. Demographics of the 93 patients

Demographic	Mean	SD	Range
Age (years)	50	18	21–94
Education (years)	15	2.3	12–20
Sex	Number	Percent	
Women	52	56	
Men	41	44	
Work status			
Working full-time	41	44	
Working part-time	11	12	
Homemaker	1	1.1	
Retired	21	23	
Unemployed, able to work	6	6.5	
Unemployed, unable to work	11	12	
Workers compensation	1	1.1	
Currently on sick leave	1	1.1	
Marital status			
Single	35	38	
Living with partner	2	2.2	
Married	41	44	
Separated/divorced	12	13	
Widowed	3	3.2	
Prior surgery			
Yes	10	11	
No	83	89	
Sought treatment before			
Yes	37	40	
No	56	60	
Other pain conditions			
Yes	27	29	
No	66	71	
Health-related outcomes	Mean	SD	Range
QuickDASH	34	23	0–95
PROMIS Physical Function	46	9.5	20–66
PROMIS Pain Interference	57	7.5	39–75
PROMIS Depression	47	9.1	34–65
Numeric rating scale	3.9	2.8	0–10

QuickDASH = Quick Disability of Arm, Shoulder and Hand; PROMIS = Patient Reported Outcomes.

Measurement Information System.

whether the PROMIS Physical Function and QuickDASH correlate with the PROMIS Depression CAT and PROMIS Pain Interference CAT instruments. Finally, we assessed the differences among the demographic, diagnostic, and psychologic factors associated with QuickDASH and PROMIS Physical Function in multi-variable analysis.

Patients and Methods

Study Design

Between May 2013 and July 2013 we invited new and followup outpatients presenting to the hand surgery outpatient clinic of three orthopaedic hand surgeons to participate in this institutional review board-approved observational cross-sectional study. We excluded pregnant women, patients younger than 18 years, subjects with a mental health condition, and patients unable to communicate in English. Informed consent was obtained. Except for patients missed while the researcher was occupied, these were consecutive patients and represented the average patient seen in the office.

From the 105 patients who fulfilled our eligibility criteria, 11 declined participation, and one was unable to complete the study questionnaires because of lack of time. This resulted in a final sample of 93 patients from which data were used for analysis. There were 41 men and 52 women with an average age of 50 ± 18 years (range, 21–94 years) (Table 1).

Outcome Measures

Patients completed the PROMIS Physical Function CAT and the QuickDASH to assess physical function and upper extremity disability, respectively. In addition, the PROMIS Pain Interference CAT and PROMIS Depression CAT were completed. Pain intensity at the time of enrollment was measured with an 11-point ordinal measure (0–10 numeric rating scale).

The overall score of each PROMIS instrument can range from 0 to 100 with a score of 50 points being the mean score for the general population in the United States. Higher scores of instruments assessing negatively worded items (eg, depression, pain interference) reflect higher levels of depression or pain interference. For positively worded questionnaires such as the PROMIS Physical Function, total scores are positively correlated with the level of physical function. All PROMIS items use a 5-point Likert scale: 1 = not at all; 2 = a little bit; 3 = somewhat; 4 = quite a bit; or 5 = very much [33].

The PROMIS Physical Function (Version 1.0) questionnaire assesses one's ability to accomplish physical activities ranging from low-impact tasks (eg, bathing and dressing) to vigorous physical activities (eg, running, strenuous sports). The questions do not refer to a particular recall period, but involve the participant's status at the time of completion [7, 21, 35].

In the PROMIS Depression (Version 1.0) questionnaire, patients are asked to state the severity of their symptoms

during the past 7 days. The PROMIS Depression CAT uses a 28-item question bank [17, 30].

The PROMIS Pain Interference (Version 1.0) assesses the consequences of pain on common aspects of daily life. This incorporates social, cognitive, emotional, physical, and recreational aspects. The PROMIS Pain Interference CAT uses the full 41-item question bank [1].

The QuickDASH is an 11-item questionnaire that measures upper extremity-specific disability [18]. Items are answered on 5-point Likert scales. The overall score is scaled to range from 0 (no disability) to 100 (most severe disability) with a score of 11 points reflecting the mean score for the general US population [3, 18, 29].

The numeric rating scale for pain is an 11-point ordinal pain intensity scale anchored at each end by opposite statements, which are “no pain” (0) versus “worst possible pain” (10) [23, 40].

Statistical Analysis

An a priori power analysis was conducted with respect to the primary null hypothesis. This indicated that a minimum sample size of 84 patients was needed to detect a 0.3 (moderate) correlation between the QuickDASH and the PROMIS Physical Function with 80% power (alpha 0.05). Taking a potential 10% incomplete data into account, a total of 93 patients was required.

Bivariate and multivariable analyses were conducted to test our hypotheses. A Pearson correlation was conducted to assess normally distributed variables. Spearman's rank correlation method was conducted for nonparametric data. The association between dichotomous variables and continuous variables was analyzed using the Student's t-test in case of normally distributed data and the Wilcoxon rank-sum test in case of nonnormally distributed data. The association between categorical variables (eg, marital status, work status) and continuous variables were analyzed by use of the one-way ANOVA test in case of normally distributed data and the Kruskal-Wallis test for nonnormally distributed data.

To determine the factors that are independently and most strongly associated with PROMIS Physical Function and QuickDASH score, a backward, stepwise, multivariable linear regression analysis was performed. Explanatory variables that met p less than 0.10 significance criteria in bivariate factor analysis were entered in the multivariable linear regression. An adjusted R-squared was calculated to assess the collective influence of the factors in the final multivariable regression model on the variability in PROMIS Physical Function and QuickDASH scores.

Table 2. Bivariate analyses

Health-related outcomes	PROMIS Physical Function		QuickDASH	
	Coefficient	p value	Coefficient	p value
QuickDASH	−0.55	< 0.001	N/A	N/A
PROMIS Physical Function	N/A	N/A	−0.55	< 0.001
PROMIS Pain Interference	−0.51	< 0.001	0.74	< 0.001
PROMIS Depression	−0.35	< 0.001	0.34	< 0.001
Age	−0.27	0.0084	0.23	0.026
Years of education	0.17	0.10	−0.19	0.074
Pain	−0.20	0.055	0.38	< 0.001

PROMIS = Patient Reported Outcomes Measurement Information System; QuickDASH = Quick Disability of Arm, Shoulder and Hand; N/A = not applicable.

Mean imputation was used for one missing pain intensity score and the marital status of one patient was retrieved from the medical records.

Results

There was moderate correlation between the PROMIS Physical Function and the QuickDASH questionnaire ($r = -0.55$; $p < 0.001$) (Table 2).

Higher PROMIS Physical Function correlated with lower PROMIS Depression ($r = -0.35$; $p < 0.001$) and PROMIS Pain Interference ($r = -0.51$; $p < 0.001$). Similarly, higher disability on the QuickDASH correlated with PROMIS Depression ($r = 0.34$; $p < 0.001$) and PROMIS Pain Interference ($r = 0.74$; $p < 0.001$) (Table 2).

Other correlates of greater disability in bivariate analysis included older age and work status (Table 3).

After controlling for likely confounding variables in multivariable analysis, pain interference had the strongest influence on physical function ($\beta = -0.57$, partial R-squared = 0.25; $p < 0.001$). Together with male sex; presence of other pain conditions; prior surgery; retired patients; unemployed patients who are able to work; and patients on workers compensation, the full model accounted for 49% of the variance in PROMIS Physical Function scores (Table 4).

Again, after controlling for likely confounding variables, PROMIS Pain Interference had the strongest influence on QuickDASH scores ($\beta = 1.9$, partial R-squared = 0.48; $p < 0.001$). Together with older age; homemakers; unemployed patients who are able to work; unemployed patients who are unable to work; and patients on workers compensation, the full model accounted for 61% of the variance in QuickDASH scores (Table 4).

Table 3. Bivariate analyses

Patient demographics (n = 93)	PROMIS Physical Function		QuickDASH	
	Mean (SD)	p value	Mean (SD)	p value
Sex				
Men	48 (9.4)	0.034	31 (21)	0.21
Women	44 (9.2)		37 (24)	
Marital status				
Single	46 (9.3)	0.26	33 (23)	0.44
Living with partner	40 (7.1)		28 (11)	
Married	47 (9.3)		33 (22)	
Separated/divorced	42 (11)		38 (27)	
Widowed	37 (9.1)		58 (19)	
Work status				
Working full-time	49 (8.1)	0.0014	28 (18)	0.0018
Working part-time	50 (5.2)		18 (12)	
Homemaker	50 (0)		75 (0)	
Retired	42 (8.7)		39 (22)	
Unemployed, able to work	43 (13)		41 (21)	
Unemployed, unable to work	37 (10)		58 (26)	
Workers compensation	37 (0)		39 (0)	
Currently on sick leave	45 (0)		36 (0)	
Other pain condition				
Yes	41 (8.3)	< 0.001	38 (22)	0.20
No	47 (9.3)		33 (23)	
Sought treatment before				
Yes	44 (9.2)	0.12	36 (24)	0.67
No	47 (9.6)		33 (22)	
Prior surgery				
Yes	39 (10)	0.014	47 (24)	0.080
No	46 (9.2)		33 (22)	

PROMIS = Patient Reported Outcomes Measurement Information System; QuickDASH = Quick Disability of Arm, Shoulder and Hand.

Discussion

To assess disability more efficiently with less burden on the patient, the NIH developed the PROMIS Physical Function instrument based on item response theory and using CAT. We were curious if the PROMIS Physical Function CAT could measure upper extremity disability as well as the QuickDASH—a standard upper extremity-specific disability measure. We found that the PROMIS Physical Function instrument may be used to measure disability in patients with upper extremity illness as it correlates with the QuickDASH questionnaire. We also found that both instruments are influenced most strongly by the degree to which pain interferes with achieving goals (pain interference).

Table 4. Multivariable analysis of predictive factors for disability

PROMIS Physical Function	Coefficient	Partial R ²	SE	p value	Adjusted R ²	95% CI	
PROMIS Pain Interference	−0.57	0.25	0.11	< 0.001	0.49	−0.7	−0.36
Sex	3.2	0.054	1.5	0.030		0.31	6.1
Other pain conditions	−3.8	0.059	1.6	0.023		−7.0	−0.53
Prior surgery	−4.3	0.039	2.3	0.066		−8.9	0.29
Work status retired	−4.7	0.080	1.7	0.0080		−8.2	−1.3
Work status unemployed, unable to work	−6.5	0.076	2.4	0.010		−11	−1.6
Work status on workers compensation	−19	0.083	6.9	0.0070		−33	−5.5
QuickDASH	Coefficient	Partial R ²	SE	p value	Adjusted R ²	95% CI	
PROMIS Pain Interference	1.9	0.48	0.22	< 0.001	0.61	1.5	2.4
Age	0.24	0.081	0.086	0.0070		0.065	0.41
Work status homemaker	43	0.094	14	0.0040		14	71
Work status unemployed, able to work	14	0.056	6.0	0.027		1.6	26
Work status unemployed, unable to work	13	0.072	5.0	0.011		3.0	23
Work status on workers compensation	31	0.050	14	0.036		2.0	59

PROMIS = Patient Reported Outcomes Measurement Information System; QuickDASH = Quick Disability of Arm, Shoulder and Hand; SE = standard error.

This study should be considered in light of its shortcomings. Participants filled out four questionnaires, which might have affected the quality of the data. Lengthy questionnaires cause respondents to become tired, distracted, and even bored [24, 36]. However, most of our questionnaires use CAT and therefore are relatively short. Furthermore, our study addressed the general mix of patients in a hand and upper extremity office and the findings might be different among patients with specific injuries or illnesses, patients from certain backgrounds or locales, studies of problems at a particular anatomic site, studies at a specific point of recovery from injury or surgery, among patients with different levels of psychologic distress, and among patients with different types of coping strategies in response to pain.

Our findings suggest that the PROMIS Physical Function instrument can be used to study patients with upper extremity illness because it correlates with the QuickDASH questionnaire. Prior studies have shown good correlation of general and more specific measures of disability; however, general measures are somewhat less responsive to specific conditions and more prone to floor and ceiling effects owing to measurement of domains that are not relevant to the condition being studied [4–6, 27, 38]. There are several possible explanations for why a general physical function measure correlates well with an upper extremity specific instrument. First, it is possible that the strong correlation of disability (general and anatomic-specific) with psychosocial factors indicates that disability measures are assessing these aspects of illness more than pathophysiology or impairment (ie, that disability is not

specific to a given anatomy or pathophysiology). Second, it is possible that general disability correlates with anatomy-specific disability because both are influenced by general health and activity level. Finally, there may be enough upper extremity-specific questions in general disability measures that a high correlation can be expected.

Regarding our secondary study questions, both disability measures correlated with symptoms of depression and ineffective coping strategies (pain interference), which is consistent with prior research [34, 35]. Ineffective coping strategies had the stronger influence in this study although coping skills and depression tend to correlate. Also consistent with prior work, secondary gain (eg, workers compensation)—a strong sociological influence on illness—correlated with both instruments [37]. The finding that PROMIS Physical Function was influenced more by other pain conditions than the QuickDASH is not surprising given that it is a general measure. Because the relative influence of other pain conditions was quite low emphasizes the much stronger influence of psychosocial factors on symptoms and disability.

The observation that a general measure of disability (the PROMIS Physical Function instrument) correlates with an upper-extremity-specific measure (the QuickDASH) in patients with upper extremity illness is interesting and may be because both measures are most strongly affected by psychosocial factors. Future studies will address the recently released PROMIS Upper Extremity questionnaire to determine the advantage it provides over the general physical function measure. Studies of the responsiveness of each measure and the reasons for such high correlations

might contribute to better assessment and amelioration of disability.

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