The Influence of Psychological Factors on the Michigan Hand Questionnaire

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Abstract

Background: Psychosocial factors help account for the gap between impairment and disability. This study examines the relationship between the Michigan Hand Questionnaire (MHQ) and commonly used psychological measures in patients with upper extremity illness. **Methods:** A cohort of 135 new or follow-up patients presenting to an urban academic hospital-based hand surgeon were invited to complete a web-based version of the MHQ, Abbreviated Pain Catastrophizing Scale (PCS), and two Patient-Reported Outcomes Measurement Information System (PROMIS)-based questionnaires: Pain Interference and Depression. Bivariate and multivariable analyses measured the correlation of these psychological measures with MHQ. **Results:** Accounting for potential confounding factors in multivariable regression, upper extremity disability as rated by the MHQ was independently associated with PROMIS Depression, PROMIS Pain Interference, visit type, and working status. The model accounted for 37% of the variability in MHQ scores, with PROMIS Pain Interference having the most influence. **Conclusion:** Among the non-pathophysiological factors that contribute to patient-to-patient variation in MHQ scores, the measure of less effective coping strategies and symptoms of depression were most influential. Our data add to the evidence of the pivotal role of emotional health in upper extremity symptoms and limitations and the importance of psychosocial considerations in the care of hand illness.

Keywords: MHQ, PROMIS, functionality, questionnaire, psychology

Introduction

Upper extremity-specific symptoms and limitations are measured with a variety of instruments, such as the Patient-Reported Outcomes Measurement Information System (PROMIS) Upper Extremity questionnaire, the Disability of the Arm, Shoulder, and Hand (DASH) questionnaire, and the Michigan Hand Questionnaire (MHQ).^{2,10,11,14} Mounting evidence suggests that patient-to-patient variation in the PROMIS Upper Extremity and DASH scores is more strongly related to mood, coping strategies, and circumstances than to pathophysiology and objective impairment.^{1,3,5,10-12,18,22,23} The role of psychological factors in variation in MHQ scores is less well studied.^{6,10,13,21,24} London et al noted that the mean MHQ scores were lower in patients categorized as having a high score on the Pain Catastrophizing Scale (PCS), but did not evaluate the correlation of ineffective coping strategies with hand-specific symptoms and limitations on the continuum on which they occur.¹⁶

We undertook this study to examine the relationship between commonly used psychological measures and the MHQ in patients with upper extremity illness. We tested the

primary null hypothesis that there is no correlation between the PROMIS Pain Interference and the MHQ. Secondly, we characterized the association of the MHQ with the PROMIS Depression and Abbreviated PCS.

Methods

Study Design

With the approval of our institutional review board, 135 new or follow-up patients presenting to an urban academic hospital-based hand surgeon were invited to enroll in this cross-sectional study. Patients were considered eligible if they were at least 18 years old and spoke English fluently. Enrollment took place between May 2014 and March 2015. Ten patients (7%) declined participation, leaving 125 in the

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study. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Informed consent was obtained from all patients included in the study.

A research assistant asked all consenting patients to complete a demographic survey, the MHQ,⁶ the Abbreviated PCS,⁴ and two PROMIS-based questionnaires: Pain Interference and Depression.¹⁷ All questionnaires were filled out using an electronic tablet. Data were administered with use of Assessment Center, a secure web-based resource promoted and built by the PROMIS initiative (<http://www.assessmentcenter.net>).

Patient Characteristics

Our study sample consisted of 59 women and 67 men with a mean age of 51 years (SD = 16) (Table 1). Most patients (81%) were white and working full time (60%). Fifty-two percent of office visits were related to acute traumatic conditions (fractures, sprains, dislocations, lacerations, and contusions).

Outcome Measures

The MHQ is a hand-specific outcomes instrument consisting of 37 items under 6 domains: (1) overall hand function, (2) activities of daily living, (3) work performance, (4) pain, (5) aesthetics, and (6) patient satisfaction with hand function. Each item on the MHQ is answered on a 5-point Likert scale. Responses are then summed to yield a domain score for each of the 6 domains. Each domain score is transformed to range from 0 to 100. With the exception of the pain scale, higher scores indicate better performance for all scales. The MHQ also yields a summary score, which can be calculated by averaging the scores for each domain, after reversing the pain score.^{7,25}

The PROMIS questionnaires use computerized adaptive testing to tailor the most appropriate series of questions for each patient based on their previous responses. The number of questions administered ranges from 4 to 12. The PROMIS Pain Interference quantifies the extent to which pain limits or interferes with patients' physical, mental, and social activities. The PROMIS Depression measures self-reported negative mood (sadness, guilt), views of self (self-criticism, worthlessness), social cognition (loneliness, interpersonal alienation), as well as decreased positive affect and engagement (loss of interest, meaning, and purpose).

The Abbreviated PCS is a validated short form of the PCS that utilizes 4 questions (items 3, 6, 8, 11) to assess coping strategies in response to nociception.⁴ The maximum score is 16, with a higher score indicating a higher level of catastrophic thinking.

Table 1. Patient Demographic Characteristics (n = 126).

Parameter	Value
Age, mean (SD) years	51 (16)
Sex, n (%)	
Female	59 (47)
Male	67 (53)
Ethnicity, n (%)	
White	102 (81)
Black	5 (4)
Asian/Pacific Islander	7 (6)
Other	12 (10)
Working status, n (%)	
Full time	75 (60)
Part time	8 (6)
Retired	23 (18)
Unemployed	20 (16)
Other pain conditions, n (%)	
Yes	75 (60)
No	51 (40)
Smoking status, n (%)	
Yes	19 (15)
No	107 (85)
Marital status, n (%)	
Single	39 (31)
Living with partner	3 (2)
Married	65 (52)
Separated or divorced	12 (10)
Widowed	7 (6)
Diagnosis, n (%)	
Sprain, dislocation, or mallet finger	14 (11)
Hand fracture	16 (13)
Wrist fracture	15 (12)
Amputation, crush, or cubital tunnel syndrome	17 (13)
Osteoarthritis	10 (8)
Trigger finger	13 (10)
Nonspecific arm pain	5 (4)
Elbow fracture	6 (5)
Other diagnoses	30 (24)
Visit type, n (%)	
Initial	58 (46)
Follow-up	68 (54)
Outcome measures, mean $\pm$ SD (range)	
MHQ	62 $\pm$ 17 (24-90)
PROMIS Depression	46 $\pm$ 9.4 (34-71)
PROMIS Pain Interference	56 $\pm$ 8.0 (39-73)
PCS	4.2 $\pm$ 4.3 (0-16)

Note. MHQ = Michigan Hand Questionnaire; PROMIS = Patient-Reported Outcome Measurement Information System; PCS = Abbreviated Pain Catastrophizing Scale.

Statistical Analysis

An a priori power analysis indicated that a minimum sample size of 123 patients would provide 80% statistical power

($\alpha = 0.05$) to detect a 0.25 correlation strength between the MHQ and PROMIS Pain Interference.

Continuous data were presented in terms of the mean, the standard deviation, and the range. Categorical variables were presented with frequencies and percentages.

To evaluate the association between each explanatory variable to MHQ, associations with continuous variables were assessed using Pearson correlations. Associations with dichotomous and categorical variables were measured using independent samples *t* test and 1-way analysis of variance (ANOVA), respectively.

Variables with $P < .10$ in bivariate analysis were inserted into multivariable linear regression analysis, in order to assess their independent ability to explain the variation in MHQ scores. Because PCS and PROMIS Pain Interference measure the same construct, and to avoid co-linearity, we only entered the questionnaire with the strongest correlation in bivariate analysis into the multivariable model. The model produced the R^2 value, a statistical measure of the percentage of the overall variability in MHQ scores that could be accounted for by the variables included in the model. Statistical significance was set at $P < .05$.

Results

In bivariate analysis, the MHQ correlated with PROMIS Pain Interference ($r = -.62, P < .0001$), PROMIS Depression ($r = -.46, P < .0001$), PCS ($r = -.51, P < .0001$), follow-up visit (rather than new patient) ($t = 40.2, P \leq .001$), other pain conditions aside from the purpose of the visit such as fibromyalgia or polymyalgia rheumatica ($t = 40.1, P = .0001$), sex ($t = 39.5, P \leq .0001$), smoking status ($t = 40.4, P \leq .0001$), and working status ($F = 1509, P \leq .0005$), marital status ($F = 1504, P \leq .0001$), and ethnicity ($F = 1545, P \leq .0001$) (Table 2). The etiology of the illness, acute trauma versus atraumatic diagnosis, also correlated with MHQ score ($F = 1620, P \leq .0001$) (Table 2). Accounting for potential confounding effects using multivariable modeling, upper extremity disability as rated by the MHQ was independently associated with PROMIS Depression, PROMIS Pain Interference, visit type, working status, and the other variables that demonstrated significant correlations with the MHQ. The model accounted for 53% of the variability in the MHQ scores, with PROMIS Pain Interference having the most influence (partial $R^2 = .27$) (Table 3).

Discussion

The aim of this study was to evaluate the association of psychological factors with the MHQ. We found that MHQ scores were independently associated with measures of depression and coping strategies in response to nociception, with the latter accounting for most of the variability in MHQ scores.^{6,10,24}

Table 2. Bivariate Analysis (n = 126).

	MHQ	
Pearson correlation	<i>r</i>	<i>P</i> value
Age	0.018	0.843
PROMIS Depression	−0.457	<.0001
PROMIS Pain Interference	−0.624	<.0001
PCS	−0.51	<.0001
<i>t</i> test	<i>t</i>	<i>P</i> value
Follow-up patient	40.2	<.0001
Sex	39.5	<.0001
Other pain conditions	40.15	<.0001
Smoking status	40.45	<.0001
One-way ANOVA	<i>F</i>	<i>P</i> value
Diagnosis	1619.75	<.0001
Working status	1509.5	<.0001
Marital status	1504.16	<.0001
Ethnicity	1544.92	<.0001

Note. MHQ = Michigan Hand Questionnaire; PROMIS = Patient-Reported Outcome Measurement Information System; PCS = Abbreviated Pain Catastrophizing Scale; ANOVA = analysis of variance. Bold italic denotes statistical significance ($P < .05$).

A number of shortcomings of the study should be kept in mind to better interpret our data. The findings might apply best to our region and our practice setting. All patients were enrolled from the practice of a single urban academic hospital-based hand surgeon. Some patients had a noticeable loss of concentration filling out so many questionnaires. Some patients had more than 1 medical issue affecting hand function, but we focused on the presenting problem. It is possible that there are pathophysiological factors other than diagnosis that might account for some of the variation in symptoms and limitations. However, our findings are consistent with extensive research consistently finding that patient-to-patient variation in symptom intensity and magnitude of limitations is more strongly related to stress, distress, and ineffective coping strategies than to diagnosis or degree of pathophysiology.

The finding that approximately half of the variation in MHQ scores is accounted for by ineffective coping strategies, symptoms of depression, and work status is consistent with prior studies of the DASH, PROMIS Physical Function, and PROMIS Upper Extremity Function instruments.^{8,15} The correlation of objective measures of pathophysiology (eg, stiffness, arthritis, injury severity)⁹ with patient-reported outcome measures is consistently much less than the correlation with psychosocial factors.^{1,3,4,10-12,18,22,23}

These findings are important given the increasing emphasis on value and patient-reported outcome measures. All hand- and upper extremity-related patient-reported outcome measures studied to date are strongly influenced by psychological and sociological factors. Our data add to the evidence of the pivotal role of emotional health in upper extremity

Table 3. Multivariable Analysis (n = 126).

	Coefficient	SE	Partial R ²	95% CI	P value
PROMIS Depression	-0.41	0.13	.083	-0.66 to -0.16	.002
PROMIS Pain Interference	-0.98	0.15	.274	-1.28 to -0.68	<.001
Follow-up patient	0.10	2.24	.000	-4.33 to 4.54	.963
Other pain conditions	-2.54	2.45	.009	-7.39 to 2.31	.302
Working status	-2.45	0.66	.109	-3.76 to -1.14	<.001
Marital status	0.36	0.97	.001	-1.56 to 2.29	.711
Smoking	-5.10	2.96	.026	-10.96 to 0.76	.088
Ethnicities	-1.13	0.67	.025	-2.46 to 0.19	.094
Sex	1.33	2.30	.003	-3.22 to 5.88	.563
Trauma vs nontrauma	0.83	0.34	.048	0.142 to 1.51	.018

Note. Adjusted R² = .53. PROMIS = Patient-Reported Outcome Measurement Information System; CI = confidence interval.

disability^{15,19,20} and the importance of psychosocial considerations in clinical approaches to hand-related injuries. There may be significant opportunities to reduce symptoms and limitations by addressing stress, distress, and less effective coping strategies in patients with hand illness.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Statement of Informed Consent

Informed consent was obtained from all individual participants included in the study.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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References

- Alonso J, Bartlett SJ, Rose M, et al. The case for an international Patient-Reported Outcomes Measurement Information System (PROMIS®) initiative. *Health Qual Life Outcomes*. 2013;11:210.
- Amtmann D, Cook KF, Jensen MP, et al. Development of a PROMIS item bank to measure pain interference. *Pain*. 2010;150(1):173-182.
- Berkanovic E, Hurwicz ML, Lachenbruch PA. Concordant and discrepant views of patients' physical functioning. *Arthritis Care Res (Hoboken)*. 1995;8(2):94-101.
- Bot AG, Becker SJ, van Dijk CN, Ring D, Vranceanu AM. Abbreviated psychologic questionnaires are valid in patients with hand conditions. *Clin Orthop Relat Res*. 2013;471(12):4037-4044.
- Bot AG, Mulders MA, Fostvedt S, Ring D. Determinants of grip strength in healthy subjects compared to that in patients recovering from a distal radius fracture. *J Hand Surg*. 2012;37(9):1874-1880.
- Chung BT, Morris SF. Reliability and internal validity of the Michigan Hand Questionnaire. *Ann Plast Surg*. 2014;73(4):385-389.
- Chung KC, Pillsbury MS, Walters MR, Hayward RA. Reliability and validity testing of the Michigan Hand Outcomes Questionnaire. *J Hand Surg Am*. 1998;23(4):575-587.
- Doomberg JN, Ring D, Fabian LM, Malhotra L, Zurakowski D, Jupiter JB. Pain dominates measurements of elbow function and health status. *J Bone Joint Surg Am*. 2005;87(8):1725-1731.
- Farzad M, Asgari A, Dashab F, et al. Does disability correlate with impairment after hand injury? *Clin Orthop Relat Res*. 2015;473:3470-3476.
- Giladi AM, Chung KC. Measuring outcomes in hand surgery. *Clin Plast Surg*. 2013;40(2):313-322.
- Gregorich SE. Do self-report instruments allow meaningful comparisons across diverse population groups? testing measurement invariance using the confirmatory factor analysis framework. *Med Care*. 2006;44(11 suppl 3):S78-S94.
- Haas F, Hubmer M, Rapp T, Koch H, Parvizi I, Parvizi D. Long-term subjective and functional evaluation after thumb replantation with special attention to the Quick DASH questionnaire and a specially designed trauma score called modified Mayo score. *J Trauma*. 2011;71(2):460-466.
- Hong YS, Lin MC, Feng CT, Huang CH, Wu HC, Wang JD. Responsiveness of the Michigan Hand Outcomes Questionnaire and the Disabilities of the Arm, Shoulder, and Hand Questionnaire in patients with hand injury. *J Hand Surg Am*. 2010;35(3):430-436.
- Khanna D, Krishnan E, Dewitt EM, Khanna PP, Spiegel B, Hays RD. The future of measuring patient-reported outcomes in rheumatology: Patient-Reported Outcomes

- Measurement Information System (PROMIS). *Arthritis Care Res (Hoboken)*. 2011;63(S11):S486-S490.
15. Lindenhovius AL, Buijze GA, Kloen P, Ring DC. Correspondence between perceived disability and objective physical impairment after elbow trauma. *J Bone Joint Surg Am*. 2008;90(10):2090-2097.
 16. London DA, Stepan JG, Boyer MI, Calfee RP. The impact of depression and pain catastrophization on initial presentation and treatment outcomes for atraumatic hand conditions. *J Bone Joint Surg Am*. 2014;96(10):806-814.
 17. Pilkonis PA, Yu L, Dodds NE, Johnston KL, Maihoefer CC, Lawrence SM. Validation of the depression item bank from the Patient-Reported Outcomes Measurement Information System (PROMIS) in a three-month observational study. *J Psychiatr Res*. 2014;56:112-119.
 18. Ring D. Invited commentary: disability versus impairment. *J Orthop Trauma*. 2015;29(4):200-201.
 19. Ring D, Kadzielski J, Fabian L, Zurakowski D, Malhotra LR, Jupiter JB. Self-reported upper extremity health status correlates with depression. *J Bone Joint Surg Am*. 2006;88(9):1983-1988.
 20. Ring D, Kadzielski J, Malhotra L, Lee SG, Jupiter JB. Psychological factors associated with idiopathic arm pain. *J Bone Joint Surg Am*. 2005;87(2):374-380.
 21. Shauver MJ, Chung KC. The Michigan Hand Outcomes Questionnaire after 15 years of field trial. *Plast Reconstr Surg*. 2013;131(5):779e-787e.
 22. Vranceanu AM, Bachoura A, Weening A, Vrahas M, Smith RM, Ring D. Psychological factors predict disability and pain intensity after skeletal trauma. *J Bone Joint Surg Am*. 2014;96(3):e20.
 23. Vranceanu AM, Jupiter JB, Mudgal CS, Ring D. Predictors of pain intensity and disability after minor hand surgery. *J Hand Surg Am*. 2010;35(6):956-960.
 24. Waljee JF, Chung KC, Kim HM, et al. Validity and responsiveness of the Michigan Hand Questionnaire in patients with rheumatoid arthritis: a multicenter, international study. *Arthritis Care Res (Hoboken)*. 2010;62(11):1569-1577.
 25. Waljee JF, Kim HM, Burns PB, Chung KC. Development of a brief, 12-item version of the Michigan Hand Questionnaire. *Plast Reconstr Surg*. 2011;128(1):208-220.