

Evaluation of the Patient-Reported Outcomes Measurement Information System Upper Extremity Computer Adaptive Test

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Purpose The Patient-Reported Outcomes Measurement Information System Upper Extremity Computer Adaptive Test (UE CAT) has recently been made available by the National Institutes of Health to measure physical function outcomes in the upper extremity. We hypothesized that the UE CAT would psychometrically outperform the Disabilities of the Arm, Shoulder, and Hand (DASH) and the Patient-Reported Outcomes Measurement Information System Physical Function Computer Adaptive Test (PF CAT) in a hand patient population.

Methods The UE CAT, PF CAT, and DASH were each electronically administered to all adult patients who presented to a tertiary hand and upper extremity (nonshoulder) orthopedic clinic. Patient responses were retrospectively studied to determine the validity, reliability, and floor/ceiling effects of all 3 instruments using the Rasch Partial Credit Model. Responder burden and Pearson correlations were calculated for each instrument.

Results A total of 379 patients completed the UE CAT, PF CAT, and the DASH. On average, 6 UE CAT, 9 PF CAT, and 30 DASH questions were administered to each patient. All 3 instruments were each highly correlated with each other. Floor effects were low and similar between all instruments; however, ceiling effects were higher in the UE CAT (10.82%) than in the PF CAT (1.32%) or DASH (5.28%). High person reliability (PR) and item reliability (IR) were found for all 3 metrics: UE CAT ($\alpha = 0.99$; PR = 0.91; IR = 0.94); PF CAT ($\alpha = 0.95$; PR = 0.89; IR = 0.96); and DASH ($\alpha = 0.97$; PR = 0.95; IR = 0.99). The UE CAT questions had the best item-fit: only 1 of 15 UE CAT items had poor fit in contrast to 4 of 30 DASH items and 7 of 33 PF CAT items.

Conclusions The psychometric properties of the UE CAT compare favorably with the PF CAT and the DASH in nonshoulder upper extremity patients. The relatively large ceiling effect found in the UE CAT could be improved with item bank expansion to include items at the upper end of function.

Clinical relevance The UE CAT is a useful patient-reported outcome measure that merits further investigation. (*J Hand Surg Am.* 2016;41(7):739–744. Copyright © 2016 by the American Society for Surgery of the Hand. All rights reserved.)

Key words PROMIS, computerized adaptive testing, upper extremity, physical function, psychometric.



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MEASURING PATIENT OUTCOMES IS critical to improving care and controlling health care costs.^{1,2} In addition, health care payers are expected to increasingly emphasize outcome data as payment models change when determining the value of treatment and setting reimbursement.

In the hand and upper extremity, a variety of metrics have been designed to measure functional outcomes, including the widely used Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire. It is worth noting here that disability, although linked to the concept of function, is not an equivalent term. Questionnaires measuring functional outcomes contain items that ask about a patient's ability to perform certain specific tasks. In contrast, metrics assessing disability may attempt to quantify symptoms such as pain, weakness, and/or numbness or to measure the impact of those symptoms on certain activities. The DASH has been shown to be a valid, responsive, and reliable measure of upper extremity disability³⁻⁵; however, it may be prone to ceiling and floor effects in some populations.⁶ The ideal outcome measurement instrument should achieve maximal accuracy (validity) and reproducibility (precision) using the minimum number of questions to not overburden patients.

The Patient-Reported Outcomes Measurement Information System (PROMIS) was recently developed by the National Institutes of Health to address deficiencies in classic fixed-length scales such as the DASH. (<http://www.nihpromis.org>).⁷ The PROMIS uses probability-based computer algorithms to select only the minimum number of informative questions while still achieving high measurement precision.⁸ Early evaluation of several of the PROMIS computer adaptive tests (CATs) in a variety of orthopedic patients has shown that it is highly correlated with classic patient-reported outcomes (PROs), but it has reduced floor and ceiling effects, increased reliability, and greatly reduced test length.^{7,9,10} These improved performance characteristics are likely in part due to the CAT's ability to efficiently draw from a potentially larger item bank that can include questions addressing a wider range of abilities—at both the high and the low ends of function.

Regarding the use of PROMIS in the hand and upper extremity, 2 CATs were developed that assess patient-reported physical function: the Physical Function CAT (PF CAT) is a general measure of physical function that includes both upper and lower extremity question items, and the Upper Extremity CAT (UE CAT) includes only upper extremity question items. The PF CAT has been shown to

correlate well with the DASH and showed excellent reliability in nonshoulder upper extremity patients,^{11,12} but a high ceiling effect has been noted in orthopedic patients with primarily upper extremity complaints.^{9,13} A ceiling effect can occur when patients score at the top end of the functional scale yet still perceive functional limitations and can severely limit the ability of a scale to detect differences in outcomes in higher-functioning patients.

The UE CAT was developed to address concerns about using a generalized measure of physical function to determine outcomes in hand and upper extremity surgery.⁴ The UE CAT has recently become available for clinical use, and although its psychometric properties are well understood in the general population, the UE CAT has not been extensively studied in the patient population presenting to hand surgeons. In 1 small study of 84 patients, the UE CAT demonstrated good correlation with the Quick Disabilities of the Arm, Shoulder, and Hand (Quick-DASH) and no ceiling or floor effects and took less time for patients to complete.¹⁴ Reliability, item-fit, and dimensionality have, to date, not been compared between the DASH, PF CAT, and UE CAT.

The aim of this study was to evaluate and compare the psychometric properties of the PROMIS UE CAT, the PROMIS PF CAT, and the DASH in a cohort of patients presenting to a tertiary-care orthopedic outpatient upper extremity (nonshoulder) surgery practice.

METHODS

This study was reviewed and approved by our institutional review board. Between July and December of 2013, the UE CAT, the PF CAT, and the DASH were each administered via tablet computer to all new, return, and postoperative adult patients who presented to hand (nonshoulder) surgeons in a university orthopedic outpatient clinic. The only exclusion criterion was patient age younger than 18 years. Patients who completed all 3 metrics during a clinic visit were included in this retrospective study. For those patients who completed multiple surveys at different clinic visits, we selected only their first encounter.

Each patient was given a tablet computer and asked to complete the questionnaire, which included the DASH, PROMIS PF CAT, and PROMIS UE CAT (Appendix A; available on the *Journal's* Web site at www.jhandsurg.org). Surveys were not checked for completeness at the time of administration, but only scoreable surveys were included in the analysis. The DASH requires at least 27 of 30 items completed to be scoreable, and the PROMIS surveys

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