

Clinical and Demographic Factors Associated With Baseline PROMIS Categorization in Shoulder and Elbow Patients

Matthew W. Brewer,^{*}  Madison R. Smith,^{*} Jordan S. Roylance,^{*} Sage A. Copling,^{*} Zachary A. Gehring,[†] Thomas Guffey,[‡] PhD, Sean M. Kennedy,[§] PhD, DPT, John E. Conway,[†] MD, James M. Gregory,[†] MD , and Natalie L. Myers,^{||¶} PhD, ATC, PES
Investigation performed at McGovern Medical School, The University of Texas Health Science Center at Houston, Houston, Texas, USA

Background: Patient-Reported Outcomes Measurement Information System (PROMIS) computer adaptive tests (CATs) are commonly used in orthopaedics. While prior work has validated PROMIS domains in upper extremity populations, there is limited literature describing associations of clinical and demographic factors with baseline PROMIS score categorization in shoulder and elbow patients.

Hypothesis: It was hypothesized that sex, operative status, body mass index (BMI), age, and injured body region would be associated with baseline PROMIS-Pain Interference (PI) and PROMIS-Physical Function (PF) categorization.

Study Design: Cross-sectional study; Level of evidence, 3.

Methods: A retrospective analysis was performed between March 2022 and March 2025. Patients ≥ 18 years of age with a primary complaint of shoulder or elbow pain were included. PROMIS-PI and PROMIS-PF CATs were completed at the initial visit. Multinomial logistic regression was used to examine associations of impairment severity (mild, moderate, or severe), with the within normal limits group as the reference category. Independent variables included injured body part, sex, operative status, BMI, and age. A secondary analysis limited to shoulder patients incorporated primary encounter diagnosis as an additional factor.

Results: The primary analysis included a cohort of 1324 patients (977 shoulder, 347 elbow; mean age, 53 ± 16 years; 43.7% female). Injured body part was not associated with impairment severity. Among this cohort, women were more likely to demonstrate all levels of PI (OR, 1.38-2.50) and moderate to severe PF impairment (OR, 1.90-3.24). Operative status was associated with greater odds of moderate to severe PI (OR, 2.00-3.78) and PF impairment (OR, 2.40-2.85). BMI ≥ 30 was associated with greater odds of moderate to severe PI (OR, 1.52-2.45) and all levels of PF impairment (OR, 1.50-2.76). Older age was modestly associated with severe PI and mild to severe PF impairment. In the shoulder-only cohort, rotator cuff pathology and arthritis were associated with lower likelihoods of severe impairment, while adhesive capsulitis was associated with mild to moderate PI but lower odds of severe PF impairment.

Conclusion: Female sex, operative status, higher BMI, and advanced age were associated with worse baseline PROMIS-PI and PF categorization, while shoulder-specific diagnoses demonstrated variable associations.

Keywords: PROMIS; shoulder; elbow; pain interference; physical function

Patient-reported outcome measures (PROMs) are survey instruments designed to measure a patient's perspective

of their own health status.⁵⁰ The constructs embedded within PROMs can be diverse. In orthopaedic literature, these instruments often quantify functional status, health-related quality of life, symptoms and symptom burden, personal experience of care, and health-related behaviors such as anxiety and depression.^{6,50} The inclusion of PROMs in clinical practice is essential for patient-centered

The Orthopaedic Journal of Sports Medicine, 14(5), 23259671261440868
DOI: 10.1177/23259671261440868
© The Author(s) 2026

This open-access article is published and distributed under the Creative Commons Attribution - NonCommercial - No Derivatives License (<https://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits the noncommercial use, distribution, and reproduction of the article in any medium, provided the original author and source are credited. You may not alter, transform, or build upon this article without the permission of the Author(s). For article reuse guidelines, please visit SAGE's website at <http://www.sagepub.com/journals-permissions>.

care and the incorporation of the biopsychosocial model into standard of practice within orthopaedics.⁴ Implementation of these outcome measures allows health care providers to monitor progress after an intervention, screen for pain and/or functional barriers, and improve patient-physician communication.³⁹

PROMs can be designed in several different ways to gather a wide range of information. In orthopaedics, legacy PROMs are typically discussed using 2 categories: specific and generic. Specific PROMs focus on a particular health condition or anatomic region, while generic PROMs aim to quantify a patient's general health or health-related quality of life.⁵¹ Legacy PROMs have strengths and weaknesses. These PROMs tend to be detailed and quite comprehensive and are not adaptive, often becoming burdensome to the patient due to their length. Recently, researchers have expressed concern that the limitations of these outcomes may outweigh their strengths, limiting the practicality of these instruments for routine clinical application.¹⁰

To mitigate concerns regarding legacy PROMs,^{5,20} the National Institutes of Health (NIH) designed the Patient-Reported Outcomes Measurement Information System (PROMIS) as a means to assess multiple health conditions.¹⁰ The NIH initiative sought to address “the need for more valid, reliable, and generalizable measures of clinical outcomes that are important to patients.”¹ The PROMIS is a computer adaptive test (CAT) intended to assess different pillars of health and well-being. Item banks assessing different constructs of health and well-being are publicly available for use and include, but are not limited to, physical function, pain interference, fatigue, sleep disturbance, and emotional health-related items.¹⁰ In contrast to legacy PROMs, the PROMIS-CAT is algorithmic in nature, such that future questions adapt based on previously answered questions within a specific domain.¹⁰ As a result, patients often respond to fewer and more focused questions, both reducing survey burden and providing surveyors with more specific, patient-tailored data. Furthermore, the collection of information happens more efficiently and precisely.^{21,22}

The interactive PROMIS-CAT platform has recently gained traction across various clinical subspecialties due to its limited survey burden on patients.³⁰ In fact, within the orthopaedic realm, the PROMIS-CAT provides valuable insight into preoperative and postoperative functional assessment and direction of care.^{10,33} For example, individual PROMIS outputs are often used to help quantify

patient progress in a variety of different musculoskeletal disorders.⁹

Over the past 10 years, the PROMIS has been investigated as a useful tool for orthopaedic care of the shoulder and elbow.^{3,19,23,31} Specifically, previous researchers have suggested that preoperative PROMIS scores predict postoperative achievements in patients undergoing total shoulder arthroplasty.¹⁴ Additionally, work has been done to validate a variety of PROMIS-CAT domains against legacy shoulder and elbow outcome measures in order to demonstrate the utility of these assessments in shoulder and elbow populations.^{18,34,47,49} While the validation of these CATs is critical to support these instruments for clinical use, there is limited literature discussing baseline PROMIS scores in a shoulder and elbow cohort. Baseline scores can provide a comprehensive view of a patient's health status, helping health care providers make informed decisions about surgical plans and potential recovery strategies and trajectories. Although limited, some researchers have investigated baseline PROMIS scores in the shoulder population and found differences between the baseline scores for patients undergoing various procedures, including labral repair, shoulder arthroplasty, and rotator cuff reconstruction.²³ Additionally, sex-related differences are present in baseline PROMIS scores before undergoing a reverse total shoulder arthroplasty, with women demonstrating lower preoperative scores when compared to their male counterparts, despite similar demographics and comorbidities.³⁶ PROMIS-Physical Function (PF) scores have also been shown to vary among different age groups in individuals with neck pain.³²

Baseline elbow PROMIS scores similarly lack robust discussion in the current literature. We were only able to find 1 study specific to elbow pathology (elbow dislocations) in which PROMIS scores were documented over the course of nonoperative care, finding little change from the initial time of injury to 6 months.¹¹ Prior work by Meldau et al⁴⁰ demonstrated significant correlations among PROMIS domains in shoulder and elbow patients, supporting the internal consistency of PROMIS domains in this cohort and providing an opportunity to translate this consistency into more clinically applicable severity thresholds. Given the wide-ranging potential for the application of PROMIS-CAT scores in clinical decision-making, a better understanding of baseline PROMIS-CAT scores and the factors that impact baseline scores is necessary, particularly in discipline-specific populations such as patients

*Address correspondence to Natalie L. Myers, PhD, ATC, PES, ATI Physical Therapy Institute for Musculoskeletal Advancement, 2001 Butterfield Rd, Downers Grove, IL 60515, USA (email: nmyers02@gmail.com).

[†]McGovern Medical School, The University of Texas Health Science Center at Houston, Houston, Texas, USA.

[‡]Department of Orthopaedic Surgery, McGovern Medical School, The University of Texas Health Science Center at Houston, Houston, Texas, USA.

[§]Center of Research Design and Analysis, Texas Woman's University, Denton, Texas, USA.

[¶]AdventHealth Research Institute, Sports Med and Rehab, Orlando, Florida, USA.

^{||}ATI Physical Therapy Institute for Musculoskeletal Advancement, Downers Grove, Illinois, USA.

Final revision submitted February 10, 2026; accepted March 6, 2026.

One or more of the authors has declared the following potential conflict of interest or source of funding: J.E.C. has received royalties or license from Arthrex; nonconsulting fees from Arthrex; and education payments from MedInc of Texas, Pylant Medical, and Arthrex. J.M.G. has received research support and consulting payments from Arthrex and Stryker and stock/stock options from Sparta Biomedical.

Ethical approval for this study was obtained from the University of Texas Health Science Center at Houston (IRB approval No. HSC-MH-21-1041).

with upper extremity injuries. Therefore, the purpose of this study was to examine clinical and demographic factors associated with classification into 1 of 4 PROMIS T-score categories (as determined by HealthMeasures).²⁸ We hypothesized that age, sex, injured body region, operative status, and body mass index (BMI) would be associated with PROMIS-CAT severity categorization.

METHODS

Data for this study were obtained from a multisurgeon patient cohort within a prospectively maintained clinical registry. The registry prospectively collects clinical and demographic data at the point of care, with enrollment beginning on March 10, 2022, and continuing to the present. For the purposes of this study, we performed a retrospective analysis of data that had been prospectively collected in the registry. Data for this project were queried between March 10, 2022, and March 16, 2025. Study data were collected at the patient's initial visit with the orthopaedic surgeon and managed using REDCap (Research Electronic Data Capture) tools hosted by UTHealth's School of Biomedical Informatics.^{24,25} REDCap is a secure, web-based software platform designed to support data capture for research studies, providing (1) an intuitive interface for validated data capture, (2) audit trails for tracking data manipulation and export procedures, (3) automated export procedures for seamless data downloads to common statistical packages, and (4) procedures for data integration and interoperability with external sources. All patients read and signed an electronic informed consent/assent form approved by the University of Texas Health Science Center at Houston before enrollment in the patient registry.³⁷

Patient recruitment was conducted in the clinics of 2 board-certified, fellowship-trained orthopaedic surgeons (J.E.C., J.M.G.) specializing in shoulder and elbow care. To meet inclusion criteria for this study, patients had to be ≥ 18 years of age and present with a primary complaint of either shoulder or elbow pain. Patients were excluded from the study if they were evaluated with any of the following during the study's time frame: (1) a shoulder diagnosis and elbow diagnosis on the same arm, (2) bilateral shoulder pain, and (3) bilateral elbow pain. Individuals with bilateral pain were excluded to preserve a more homogeneous cohort as PROMIS scores reflect overall pain and function for the whole patient, not a single body part. When pain is bilateral or involves multiple joints, it is challenging to accurately interpret the extent to which a single joint contributes to the overall score; thus, these exclusions promoted consistency of comparison. Additionally, patients were excluded if they underwent revision surgeries, sought physical therapy for a body region other than the shoulder/elbow, or did not speak and read English as their primary language.

The 2 PROMIS-CAT adult self-reported physical health assessments utilized in this study were the PROMIS-Pain Interference (PI) and PROMIS-PF item banks. Per

HealthMeasures, the governing and distributing body of PROMIS item banks, PROMIS-PI assesses "self-reported consequences of pain on relevant aspects of one's life," while PROMIS-PF assesses "self-reported capability rather than actual performance of physical activities."²⁶

Procedures

Before meeting with the surgeon for the initial office visit, each patient completed (1) a demographic survey, (2) the PROMIS-PI, and (3) the PROMIS-PF. The shared library feature within REDCap was used to input both PROMIS-CAT questionnaires into the REDCap project.⁴² All data were entered by the patient on a tablet (iPad; Apple), allowing for automated input capabilities directly into REDCap. Each patient received the PROMIS-PI followed by the PROMIS-PF and was prompted to answer one question at a time. Based on the answers provided, the survey would either continue to the next question within that same PROMIS-CAT or automatically continue to the following survey. Because of the dynamic nature of PROMIS, the total number of questions asked differs from patient to patient. To prevent data editing or incorrectly changing a status from "incomplete" to "complete," REDCap permanently locks all answers given through the PROMIS-CATs. To ensure only patients with fully completed scores were included in this study, any survey marked as "incomplete" by REDCap was excluded. The PROMIS-CAT scores are interpreted against a healthy reference population and use "a T-score metric in which 50 is the mean of a relevant reference population and 10 is the standard deviation (SD) of that population."²⁷ More specifically, the T-scores provide a reference for the current sample to the general population. For both PROMIS-PF and PROMIS-PI, a higher score correlates to a higher level of self-reported physical function and pain interference, respectively. Consequently, higher PROMIS-PF scores indicate higher (better) physical function, while higher PROMIS-PI scores indicate greater (worse) pain interference.

Statistical Analysis

Multinomial logistic regression was utilized to determine which independent variables decrease or increase the likelihood of falling into 1 of the 3 T-score cut points of mild, moderate, and severe for the PROMIS-PI and PROMIS-PF, with the fourth T-score cut point (within normal limits [WNL]) used as the reference group. The categorization of the dependent variables for both PROMIS-PI and PROMIS-PF is documented in Table 1.

Independent variables included injured body part (shoulder = 0; elbow = 1), sex (male = 0; female = 1), operative status (nonoperative = 0; operative = 1), BMI (<30 kg/m² = 0; ≥ 30 kg/m² = 1), and age (continuous). Previous surgical history was considered in preliminary analyses but was removed from final models due to a small ratio of patients who had a previous surgical history compared to those who had not. The shoulder sample was large enough to permit a secondary analysis that included

TABLE 1
Interpretation of the 4 T-Score Categories for Both the PROMIS-PI and PROMIS-PF^a

PROMIS Domain	PROMIS-PI	PROMIS-PI Code	PROMIS-PF	PROMIS-PF Code
Within normal limits	<55	0	>45	0
Mild	≥55 and <60	1	>40 and ≤45	1
Moderate	≥60 and <70	2	>30 and ≤40	2
Severe	≥70	3	≤30	3

^aZero represents the reference category. PF, Physical Function; PI, Pain Interference; PROMIS, Patient-Reported Outcomes Measurement Information System.

shoulder primary encounter diagnosis as a variable in the multinomial logistic regression models. Each patient had 1 of 6 shoulder primary encounter diagnoses (rotator cuff pathology = 0; shoulder arthritis = 1; adhesive capsulitis = 2; shoulder impingement = 3; shoulder fracture = 4; other encounter diagnosis = 5). After model evaluation, the 3 most common diagnoses—rotator cuff pathology, shoulder arthritis, and adhesive capsulitis—were kept as individual categories coded 0, 1, and 2, respectively, and all other shoulder diagnoses were considered the reference group. Shoulder arthritis included diagnoses of arthritis, osteoarthritis, and rheumatoid arthritis. Diagnoses categorized as “other” included acromioclavicular and sternoclavicular joint pathology, labral pathology, shoulder instability, impingement, muscle and bone pathology, and nerve-related pathology. Given the low frequency of individual diagnoses outside of rotator cuff pathology, arthritis, and adhesive capsulitis, all other shoulder diagnoses were consolidated into an other shoulder diagnosis category. This grouping minimized cell sizes too small for valid statistical analysis while allowing inclusion of the full clinical population. Running a model that exclusively included elbow primary encounter diagnosis was not feasible due to sample size limitations within the elbow cohort, as this would result in unreliable estimates. In total, 4 final models were estimated. The first 2 models estimated the odds of pain interference (PROMIS-PI) and physical function (PROMIS-PF) with elbow or shoulder injury included as independent variables. The second 2 models restricted estimates to a portion of the sample with a shoulder diagnosis and included the top 3 shoulder primary encounter diagnoses compared to all other shoulder diagnoses. All assumptions were met to run the multinomial logistic regression models: independence of observations, multicategorical dependent variables, no significant outliers, linearity of the logit, and normality. Statistical significance was set to a *P* value <.05. All analyses were performed using statistical package SPSS Version 29 (IBM).

RESULTS

Primary Analysis: Shoulder or Elbow Cohort

Multinomial logistic regression results for patients presenting with a shoulder (*n* = 977) or elbow injury (*n* =

347) are shown in Table 2A for both PROMIS-PI and PROMIS-PF. The total sample had a mean age of 53 ± 16 years, mean height of 170 ± 11 cm, and mean weight of 84 ± 20 kg. There were 746 men, 578 women, 218 Hispanic or Latino patients, and 1106 not Hispanic or Latino patients.

Injured Body Part. Patients with an elbow injury did not differ from those with a shoulder diagnosis in the odds of any PROMIS-PI or PROMIS-PF category relative to WNL.

Sex. Significant differences were observed between women and men across all levels of PI (mild, moderate, and severe) and in moderate and severe PF. Women had greater odds of all levels of PI, nearly twice the odds of moderate PF, and >3-fold greater odds of severe PF compared to men. There was no significant difference between sexes in the odds of mild PF relative to WNL.

Operative Status. Operative status was associated with at least 2-fold greater odds for both moderate and severe PI and moderate and severe PF compared to WNL, but lacked association with either mild PI or mild PF.

Body Mass Index. BMI ≥30 was associated with greater odds of moderate and severe PI and all 3 categories of PF relative to WNL compared with individuals with a BMI <30.

Age. Aside from injured body part, age demonstrated the weakest associations with PROMIS categorization. While not significantly associated with mild or moderate PI relative to WNL, increasing age was associated with greater odds of severe PI and of mild, moderate, and severe PF relative to PI and PF WNL, respectively.

Secondary Analysis: Shoulder-Only Cohort

Multinomial logistic regression results for patients with a shoulder injury alone (*n* = 977) are shown in Table 2B for both PROMIS-PI and PROMIS-PF. The sample had a mean age of 56 ± 16 years, mean height of 172 ± 11 cm, and mean weight of 83 ± 20 kg. There were 532 men, 445 women, 151 Hispanic or Latino patients, and 826 not Hispanic or Latino patients.

Shoulder Diagnosis. Among the 3 most common shoulder diagnoses, rotator cuff pathology was associated with lower odds of severe PI and severe PF relative to WNL but was not significantly associated with other PI or PF categories. Adhesive capsulitis was associated with greater

TABLE 2A
Multinomial Logistic Regression Models Examining Associations With PROMIS-PI
and PROMIS-PF Among Shoulder and Elbow Patients (N = 1324)^a

	PROMIS-PI ^b				PROMIS-PF ^c			
	OR	95% CI		<i>P</i> Value	OR	95% CI		<i>P</i> Value
		Lower	Upper			Lower	Upper	
		Mild (≥55 and <60)				Mild (>40 and ≤45)		
Elbow	0.84	0.59	1.21	.349	0.82	0.58	1.17	.267
Female sex	1.38	1.01	1.90	.048	1.31	0.97	1.78	.082
Operative status	1.16	0.78	1.71	.467	1.42	0.99	2.01	.052
BMI ≥30	1.30	0.91	1.86	.152	1.50	1.08	2.08	.016
Age	1.00	0.99	1.01	.825	1.02	1.01	1.03	<.001
		Moderate (≥60 and <70)				Moderate (>30 and ≤40)		
Elbow	0.79	0.58	1.06	.118	0.72	0.50	1.03	.073
Female sex	1.51	1.16	1.98	.003	1.90	1.41	2.55	<.001
Operative status	2.00	1.46	2.73	<.001	2.40	1.74	3.32	<.001
BMI ≥30	1.52	1.13	2.06	.006	1.55	1.12	2.14	.008
Age	1.00	0.99	1.01	.647	1.03	1.02	1.04	<.001
		Severe (≥70)				Severe (≤30)		
Elbow	0.58	0.33	1.02	.061	0.63	0.35	1.15	.130
Female sex	2.50	1.60	3.91	<.001	3.24	2.06	5.12	<.001
Operative status	3.78	2.38	6.01	<.001	2.85	1.79	4.52	<.001
BMI ≥30	2.45	1.55	3.88	<.001	2.76	1.77	4.32	<.001
Age	1.02	1.00	1.03	.018	1.05	1.03	1.06	<.001

^aBMI, body mass index; PF, Physical Function; PI, Pain Interference; PROMIS, Patient-Reported Outcomes Measurement Information System.

^bThe reference category is within normal limits < 55 .

^cThe reference category is within normal limits > 45 .

odds of mild and moderate PI and lower odds of severe PF relative to WNL compared to other diagnoses. Shoulder arthritis was associated with lower odds of severe PI and severe PF relative to WNL and lacked association with other PI and PF categories.

Sex. Among shoulder patients, women had more than twice the odds of severe PI, greater odds of moderate PF, and > 3 times the odds of severe PF relative to WNL compared with men. Sex had no significant association with mild or moderate PI or mild PF.

Operative Status. Operative status was associated with greater odds of all levels of both PI and PF. The strongest association was observed for severe PI, where operative patients had > 5 -fold greater odds compared with nonoperative patients.

Body Mass Index. Among shoulder patients, a BMI ≥ 30 was associated with greater odds of moderate and severe PI and all PF categories relative to WNL. Odds of severe PI and severe PF were nearly 3-fold higher in patients with BMI ≥ 30 .

Age. Age demonstrated the weakest association of the statistically significant odds ratios among categories of PF and PI. Increasing age was associated with greater odds of severe PI relative to WNL, as well as mild, moderate, and severe PF relative to WNL. Age was not associated with mild or moderate PI.

DISCUSSION

The results of the present study regarding patients with shoulder or elbow injuries indicate several important findings: (1) presenting with shoulder or elbow pain was not associated with the likelihood of falling into 1 of the 3 PROMIS T-score cut points, (2) women had greater PI than men and presented with more moderate and severe PF impairment than men, (3) patients undergoing surgery (shoulder or elbow) had greater odds of moderate to severe PI and PF compared to the nonoperative cohort, (4) a BMI ≥ 30 was associated with greater odds of moderate and severe PI and mild, moderate, and severe PF, and (5) increasing age was associated with greater odds of having severe PI and mild, moderate, and severe PF impairment. These findings partially support our hypothesis that age, sex, injured body region, operative status, and BMI would be associated with PROMIS-CAT T-score categorization.

Our secondary analysis focusing on only shoulder patients included the encounter diagnosis in the final models and indicated that (1) patients with rotator cuff pathology or shoulder arthritis had lower odds of severe PI and PF relative to WNL compared with other diagnoses, (2) patients diagnosed with adhesive capsulitis had greater odds of mild to moderate PI but lower odds of severe PF relative to other diagnoses, (3) women with shoulder injuries

TABLE 2B
Multinomial Logistic Regression Models Examining Associations With PROMIS-PI
and PROMIS-PF Among Shoulder Patients (n = 977)^a

	PROMIS-PI ^b				PROMIS-PF ^c				
	OR	95% CI		<i>P</i> Value	OR	95% CI		<i>P</i> Value	
		Lower	Upper			Lower	Upper		
Mild (≥55 and <60)					Mild (>40 and ≤45)				
Diagnosis ^d									
Rotator cuff pathology	1.54	0.98	2.44	.063	0.84	0.54	1.29	.420	
Arthritis	1.19	0.59	2.40	.636	1.19	0.63	2.23	.589	
Adhesive capsulitis	2.17	1.11	4.23	.023	0.93	0.49	1.79	.837	
Female sex	1.17	0.80	1.70	.418	1.37	0.96	1.95	.085	
Operative status	1.76	1.09	2.86	.022	1.62	1.07	2.47	.024	
BMI ≥30	1.25	0.81	1.92	.316	1.56	1.06	2.29	.025	
Age	0.99	0.98	1.01	.282	1.02	1.01	1.03	.012	
Moderate (≥60 and <70)					Moderate (>30 and ≤40)				
Diagnosis ^d									
Rotator cuff pathology	1.26	0.86	1.85	.241	0.89	0.59	1.38	.626	
Arthritis	1.27	0.72	2.24	.407	1.17	0.64	2.13	.614	
Adhesive capsulitis	1.83	1.02	3.29	.044	1.56	0.86	2.83	.146	
Female sex	1.32	0.96	1.82	.088	1.48	1.05	2.09	.025	
Operative status	2.72	1.82	4.07	<.001	3.05	2.09	4.47	<.001	
BMI ≥30	1.56	1.09	2.24	.015	1.68	1.15	2.43	.007	
Age	1.00	0.99	1.01	.425	1.03	1.02	1.05	<.001	
Severe (≥70)					Severe (≤30)				
Diagnosis ^d									
Rotator cuff pathology	0.36	0.20	0.67	.001	0.13	0.07	0.25	<.001	
Arthritis	0.42	0.18	0.98	.044	0.27	0.12	0.61	.002	
Adhesive capsulitis	0.49	0.16	1.55	.225	0.20	0.06	0.70	.011	
Female sex	2.36	1.42	3.95	.001	3.03	1.80	5.09	<.001	
Operative status	5.42	3.12	9.39	<.001	3.48	2.04	5.96	<.001	
BMI ≥30	2.75	1.62	4.66	<.001	2.92	1.72	4.96	<.001	
Age	1.02	1.01	1.02	.019	1.06	1.04	1.08	<.001	

^aBMI, body mass index; PF, Physical Function; PI, Pain Interference; PROMIS, Patient-Reported Outcomes Measurement Information System.

^bThe reference category is within normal limits < 55 .

^cThe reference category is within normal limits > 45 .

^dThe reference category is all other diagnoses.

had greater odds of severe PI and moderate and severe PF than men, (4) patients undergoing shoulder surgery had greater odds of all levels of PI and PF impairment, (5) shoulder patients with a BMI ≥ 30 had greater PF impairment than those with a BMI < 30 , (6) shoulder patients with a BMI of ≥ 30 had greater odds of moderate and severe PI than those with a BMI < 30 , and (7) increasing age among patients with shoulder injuries was associated with greater PF impairment and greater odds of severe PI.

PROMIS measures have become widely adopted in orthopaedic practice to capture patient-reported outcomes related to pain interference and physical function.¹³ Yet, their ability to discriminate between joint-specific conditions and across patient characteristics remains an active area for investigation. Whereas Meldau et al⁴⁰ previously described interdomain PROMIS correlations in similar cohorts, the present study extends this work through focus on severity-based categorization and identifying associated

factors of clinically meaningful impairment at presentation. In the context of shoulder and elbow care, patient-reported pain and function appear to be driven less by the specific joint affected and more by the overarching burden of symptoms that prompt individuals to seek treatment. These findings contrast with reports in lower extremity populations, where joint-specific variation has been demonstrated among patients with total hip and total knee arthroplasty,^{43,48} underscoring the possibility that PROMIS measures function differently across upper versus lower extremity cohorts. Further research is needed to clarify the utility of generic versus joint-specific PROMIS measures in capturing nuanced differences in orthopaedic patient populations.

Patient-level characteristics exerted a stronger and more consistent influence on PROMIS scores than the affected joint itself. Consistent with prior literature, sex differences^{43,44} and the disproportionate burden carried

by patients with higher BMI^{7,8,17} highlight how biological and systemic influences extend beyond localized pathology. Obesity remains a critical modifiable factor, reinforcing the need for integrated strategies that address both musculoskeletal health and broader contributors to pain and function. Age-related trends, while less pronounced, suggest that functional limitations in older adults may reflect a complex interplay of reduced activity, adaptation, and chronic symptom persistence rather than joint-specific impairment alone.^{12,38,41}

Clinical trajectory further shaped PROMIS reporting, as patients who ultimately underwent surgery had greater baseline impairments in both pain and function. Similar findings have been described in hip and shoulder osteoarthritis cohorts, where PROMIS scores were predictive of operative status.^{29,45} Taken together, these results suggest that PROMIS measures may offer value not only in capturing symptom burden, but also in informing surgical decision-making for shoulder and elbow patients.

When evaluating outcomes by specific shoulder diagnoses, distinct patterns emerged that illustrate the complexity of patient-reported outcomes. Adhesive capsulitis was associated with substantial pain interference but less frequent severe physical function impairment, a paradox that echoes prior studies demonstrating that patient-reported disability in this condition often reflects pain intensity more than objective motion loss.^{2,16,35} By contrast, rotator cuff pathology and shoulder arthritis were generally associated with lower odds of severe impairment, consistent with reports that these conditions may cause persistent symptoms but often produce less global disability compared to adhesive capsulitis.^{15,46} These nuances emphasize that PROMIS measures capture the lived patient experience, which may not always align directly with structural severity or physical examination findings.

Procedural limitations of this study include variation among participant questionnaire interpretation and lack of visual aids for patients to associate a specific body region with the location of their symptoms. Regarding statistical limitations, the data set contained PROMIS domain T-scores with summary variance but did not include item-level response, precluding calculation of the exact range of questions completed per patient and assessment of the potential effects of variable test length. Data limitations also arose from the analytical model used for our primary analysis, as 6 primary shoulder pathologies were grouped and compared to a reference group consisting of all other shoulder diagnoses. This resulted in a reference group with significant variability, encompassing acute and chronic conditions across broader anatomic range that may only have partial involvement in the shoulder joint such as “nerve-related pathology.” Additionally, given the smaller elbow cohort, there was inadequate diagnostic variability to perform a regression for patients with solely an elbow diagnosis in the same manner that was done for the shoulder cohort in our secondary analysis. This leaves clear direction for future studies to analyze factors associated with PROMIS-PI and PROMIS-PF in patients reporting an elbow injury alone. Further studies may also investigate specific clinical applications of factors assessed

in this study, as well as validating the use of PROMIS-PI and PROMIS-PF for upper extremity cohorts outside the population we included (eg, patients who report both shoulder and elbow pain, had prior revision surgeries, sought physical therapy for another body region other than the shoulder or elbow, or do not consider English as their primary language).

CONCLUSION

This retrospective cross-sectional study found that sex, operative status, BMI, and age were significantly associated with baseline PROMIS-CAT T-score categorization for pain interference and physical function in shoulder and elbow patients, whereas injured body region was not associated with PROMIS categorization, and shoulder-specific diagnoses demonstrated variable associations. A thorough understanding of these factors may allow upper extremity providers a more robust consideration of their patient's health status at presentation. These findings support the utility of PROMIS as a valuable tool in the care of patients with upper extremity injuries while highlighting opportunities for refinement, including the potential role of joint-specific instruments and the integration of patient characteristics into outcome interpretation.

ORCID iDs

Matthew W. Brewer  <https://orcid.org/0009-0005-8459-4276>

James M. Gregory  <https://orcid.org/0000-0002-3595-7158>

REFERENCES

1. Ader DN. Developing the Patient-Reported Outcomes Measurement Information System (PROMIS). *Med Care*. 2007;45(5):S1-S2.
2. Alben MG, Gambhir N, Shankar D, Gordon D, Zuckerman JD, Virk MS. Minimal clinically important difference (MCID), substantial clinical benefit (SCB), and Patient Acceptable Symptomatic State (PASS) of upper extremity PROMIS scores in idiopathic adhesive capsulitis. *Clin Rheumatol*. 2023;42(2):579-589. doi:10.1007/s10067-022-06479-3
3. Anthony CA, Glass NA, Hancock K, Bollier M, Wolf BR, Hettrich CM. Performance of PROMIS instruments in patients with shoulder instability. *Am J Sports Med*. 2017;45(2):449-453. doi:10.1177/0363546516668304
4. Ayers DC, Franklin PD, Ring DC. The role of emotional health in functional outcomes after orthopaedic surgery: extending the biopsychosocial model to orthopaedics: AOA critical issues. *J Bone Joint Surg Am*. 2013;95(21):e165. doi:10.2106/JBJS.L.00799
5. Baron JE, Parker EA, Wolf BR, Duchman KR, Westermann RW. PROMIS versus legacy patient-reported outcome measures for sports medicine patients undergoing arthroscopic knee, shoulder, and hip interventions: a systematic review. *Iowa Orthop J*. 2021;41(2):58.
6. Black N. Patient reported outcome measures could help transform healthcare. *BMJ*. 2013;346:f167. doi:10.1136/bmj.f167
7. Blanchett JW, Kuhlmann NA, Fidai MS, Borowsky PA, Muh SJ, Makhni EC. Using Patient-Reported Outcome Measurement Information System computer adaptive testing domains to investigate the impact of obesity on physical function, pain interference, and mental

- health in sports medicine patients. *J Obes Metab Syndr*. 2019;28(4):246. doi:10.7570/jomes.2019.28.4.246
8. Blümel JE, Arteaga E, Mezones-Holguín E, et al. Obesity is associated with a higher prevalence of musculoskeletal pain in middle-aged women. *Gynecol Endocrinol*. 2017;33(5):378-382. doi:10.1080/09513590.2016.1269741
 9. Brodke DJ, Saltzman CL, Brodke DS. PROMIS for orthopaedic outcomes measurement. *J Am Acad Orthop Surg*. 2016;24(11):744-749. doi:10.5435/JAAOS-D-15-00404
 10. Bykerk VP. Patient-Reported Outcomes Measurement Information System versus legacy instruments: are they ready for prime time? *Rheum Dis Clin North Am*. 2019;45(2):211-229. doi:10.1016/j.rdc.2019.01.006
 11. Carroll TJ, Dondapati A, Minto J, Hoffman S, Hammert WC, Mahmood B. An analysis of Patient-Reported Outcomes Measurement Information System (PROMIS) in non-operative posterolateral elbow dislocations. *Cureus*. 2023;15(8):e43297. doi:10.7759/cureus.43297
 12. Cassou B, Derriennic F, Monfort C, Norton J, Touranchet A. Chronic neck and shoulder pain, age, and working conditions: longitudinal results from a large random sample in France. *Occup Environ Med*. 2002;59(8):537-544. doi:10.1136/oem.59.8.537
 13. Cella MS, Baumhauer JF, Rothrock NE, Swantek K, Franklin PD. Use of Patient-Reported Outcomes Measurement Information System measures in orthopaedic specialties: Results of a scoping review for 2018 to 2022. *J Am Acad Orthop Surg*. 2025;33(11):561-568. doi:10.5435/JAAOS-D-24-00432
 14. Chen RE, Papuga MO, Nicandri GT, Miller RJ, Voloshin I. Preoperative Patient-Reported Outcomes Measurement Information System (PROMIS) scores predict postoperative outcome in total shoulder arthroplasty patients. *J Shoulder Elbow Surg*. 2019;28(3):547-554. doi:10.1016/j.jse.2018.08.040
 15. Clausen MB, Witten A, Christensen KB, et al. Assessing shoulder disability in orthopaedic specialist care: introducing the Copenhagen Shoulder Abduction Rating (C-SAR). *Musculoskelet Sci Pract*. 2022;61:102593. doi:10.1016/j.msksp.2022.102593
 16. De Baets L, Matheve T, Dierickx C, Bijnsens E, Jans D, Timmermans A. Are clinical outcomes of frozen shoulder linked to pain, structural factors or pain-related cognitions? An explorative cohort study. *Musculoskelet Sci Pract*. 2020;50:102270. doi:10.1016/j.msksp.2020.102270
 17. Díaz-González CDLM, Ramal-López JM, de la Rosa-Hormiga M. The impact of obesity on pain perception during and after subcutaneous injections: a cross-sectional analysis. *Obesities*. 2024;4(4):438-452. doi:10.3390/obesities4040035
 18. Döring AC, Nota SP, Hageman MG, Ring DC. Measurement of upper extremity disability using the Patient-Reported Outcomes Measurement Information System. *J Hand Surg Am*. 2014;39(6):1160-1165. doi:10.1016/j.jhsa.2014.03.013
 19. Dowdle SB, Glass N, Anthony CA, Hettrich CM. Use of PROMIS for patients undergoing primary total shoulder arthroplasty. *Orthop J Sports Med*. 2017;5(9):2325967117726044. doi:10.1177/2325967117726044
 20. Fidai MS, Saltzman BM, Meta F, et al. Patient-Reported Outcomes Measurement Information System and legacy patient-reported outcome measures in the field of orthopaedics: a systematic review. *Arthroscopy*. 2018;34(2):605-614. doi:10.1016/j.arthro.2017.07.030
 21. Fries JF, Bruce B, Cella D. The promise of PROMIS: using item response theory to improve assessment of patient-reported outcomes. *Clin Exp Rheumatol*. 2005;23(5):S53.
 22. Fries JF, Witter J, Rose M, Cella D, Khanna D, Morgan-DeWitt E. Item response theory, computerized adaptive testing, and PROMIS: assessment of physical function. *J Rheumatol*. 2014;41(1):153-158. doi:10.3899/jrheum.130813
 23. Guo EW, Elhage K, Cross AG, et al. Establishing and comparing reference preoperative Patient-Reported Outcomes Measurement Information System (PROMIS) scores in patients undergoing shoulder surgery. *J Shoulder Elbow Surg*. 2021;30(6):1223-1229. doi:10.1016/j.jse.2020.09.003
 24. Harris PA, Taylor R, Minor BL, et al. The REDCap consortium: building an international community of software platform partners. *J Biomed Inform*. 2019;95:103208. doi:10.1016/j.jbi.2019.103208
 25. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. A metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*. 2009;42(2):377-81. doi:10.1016/j.jbi.2008.08.010
 26. HealthMeasures. Differences between PROMIS Measures. Accessed August 13, 2025. <https://www.healthmeasures.net/explore-measurement-systems/promis/intro-to-promis/differences-between-promis-measures/292-differences-between-promis-measures>
 27. HealthMeasures. Interpret scores. Accessed September 4, 2024. <https://www.healthmeasures.net/score-and-interpret/interpret-scores>
 28. HealthMeasures. PROMIS Score Cut Points. Accessed January 9, 2025. <https://www.healthmeasures.net/score-and-interpret/interpret-scores/promis/promis-score-cut-points>
 29. Horn ME, George SZ, Goode AP, Reinke EK, Scott LG, Bolognesi MP. Can Patient-Reported Outcome Measurement Information System measures differentiate patients who will undergo hip and knee total joint arthroplasty: a retrospective case-control study. *J Arthroplasty*. 2022;37(6):S56-S62. doi:10.1016/j.arth.2022.02.053
 30. Horn ME, Reinke EK, Yan X, et al. Use of Patient-Reported Outcomes Measurement Information System (PROMIS) measures to characterise health status for patients seeking care from an orthopaedic provider: a retrospective cohort study. *BMJ Open*. 2021;11(9):e047156. doi:10.1136/bmjopen-2020-047156
 31. Hung M, Voss MW, Bounsanga J, Gu Y, Granger EK, Tashjian RZ. Psychometrics of the Patient-Reported Outcomes Measurement Information System physical function instrument administered by computerized adaptive testing and the Disabilities of Arm, Shoulder and Hand in the orthopedic elbow patient population. *J Shoulder Elbow Surg*. 2018;27(3):515-522. doi:10.1016/j.jse.2017.10.015
 32. Jevtovsky DS, Tishelman JC, Stekas N, et al. Age and gender confound PROMIS scores in spine patients with back and neck pain. *Global Spine J*. 2021;11(3):299-304. doi:10.1177/2192568220903030
 33. Jones RS, Stukenborg GJ. Patient-Reported Outcomes Measurement Information System (PROMIS) use in surgical care: a scoping study. *J Am Coll Surg*. 2017;224(3):245-254.e1. doi:10.1016/j.jamcollsurg.2016.11.015
 34. Kahan JB, Kassam HF, Nicholson AD, Saad MA, Kovacevic D. Performance of PROMIS Global-10 to legacy instruments in patients with lateral epicondylitis. *Arthroscopy*. 2019;35(3):770-774. doi:10.1016/j.arthro.2018.09.019
 35. Kolade O, Ghosh N, Luthringer TA, et al. Correlation of Patient Reported Outcome Measurement Information System (PROMIS) with American Shoulder and Elbow Surgeon (ASES), and Constant (CS) scores in idiopathic adhesive capsulitis. *J Shoulder Elbow Surg*. 2021;30(3):554-560. doi:10.1016/j.jse.2020.05.040
 36. Lai CH, Chandak S, Karlapudi P, Tokish J. Sex-related differences in PROMIS prior to the outcome: comparison of preoperative PROMIS physical function scores in female vs. male patients undergoing shoulder arthroplasty. *JSES Int*. 2023;7(6):2473-2475. doi:10.1016/j.jseint.2023.07.012
 37. Lawrence CE, Dunkle L, McEver M, et al. A REDCap-based model for electronic consent (eConsent): moving toward a more personalized consent. *J Clin Transl Sci*. 2020;3(4):345-353. doi:10.1017/cts.2020.30
 38. Lee SW, Patel R, Werner B, Yoo JW, Tiu T. The role of physical activity in older adults and practical intervention. *HCA Healthc J Med*. 2021;2(6):387. doi:10.36518/2689-0216.1352
 39. Lohr KN, Zebrack BJ. Using patient-reported outcomes in clinical practice: challenges and opportunities. *Qual Life Res*. 2009;18:99-107. doi:10.1007/s11136-008-9413-7
 40. Meldau JE, Borowsky P, Blanchett J, et al. Impact of patient demographic factors on preoperative Patient-Reported Outcomes Measurement Information System (PROMIS) physical function, pain interference, and depression computer adaptive testing scores in patients undergoing shoulder and elbow surgery. *Orthop J Sports*

- Med. 2019;7(11):2325967119884543. doi:10.1177/2325967119884543
41. Naugle KM, Blythe C, Naugle KE, Keith N, Riley ZA. Kinesiophobia predicts physical function and physical activity levels in chronic pain-free older adults. *Front Pain Res.* 2022;3:874205. doi:10.3389/fpain.2022.874205
 42. Obeid JS, McGraw CA, Minor BL, et al. Procurement of shared data instruments for Research Electronic Data Capture (REDCap). *J Biomed Inform.* 2013;46(2):259-265. doi:10.1016/j.jbi.2012.10.006
 43. Penrose CT, George SZ, Bolognesi MP, Bhavsar NA, Horn ME. Do you PROMIS (Patient Reported Outcomes Measurement Information System)? Physical function and pain interference scores after total knee and hip arthroplasty. *Arthroplast Today.* 2023;23:101208. doi:10.1016/j.artd.2023.101208
 44. Plessen CY, Liegl G, Hartmann C, et al. How are age, gender, and country differences associated with PROMIS physical function, upper extremity, and pain interference scores? *Clin Orthop Relat Res.* 2024;482(2):244-256. doi:10.1097/CORR.0000000000002798
 45. Rechenmacher AJ, Ballengee LA, George SZ, Bolognesi MP, Horn ME. Utility of Patient Reported Outcome Measurement Information System measures in predicting shoulder arthroplasty in patients with shoulder osteoarthritis. *J Shoulder Elbow Surg.* 2024;33(10):e529-e536. doi:10.1016/j.jse.2024.01.052
 46. Roberts AM, Voloshin I. Mapping physical functions of the shoulder to American Shoulder and Elbow Surgeons and Patient-Reported Outcomes Measurement Information System scores. *J Shoulder Elbow Surg.* 2020;29(4):707-718. doi:10.1016/j.jse.2019.08.017
 47. Rojas EO, Glass N, Owens J, et al. Performance of the PROMIS in patients undergoing 3 common elbow procedures. *Orthop J Sports Med.* 2019;7(6):2325967119852595. doi:10.1177/2325967119852595
 48. Shaw JH, Swantek A, Lindsay-Rivera K, Rahman TM, Davis JJ, Makhni EC. Changes in patient reported outcome measure scores from initial presentation to day-of-surgery in patients undergoing hip and knee arthroplasty. *J Arthroplasty.* 2022;37(12):2340-2346. doi:10.1016/j.arth.2022.05.046
 49. Tyser AR, Beckmann J, Franklin JD, et al. Evaluation of the PROMIS physical function computer adaptive test in the upper extremity. *J Hand Surg Am.* 2014;39(10):2047-2051.e4. doi:10.1016/j.jhssa.2014.06.130
 50. Weldring T, Smith SM. Article commentary: patient-reported outcomes (PROs) and patient-reported outcome measures (PROMs). *Health Serv Insights.* 2013;6:61-68. doi:10.4137/HSI.S11093
 51. Wilson I, Bohm E, Lübbecke A, et al. Orthopaedic registries with patient-reported outcome measures. *EFORT Open Rev.* 2019;4(6):357-367. doi:10.1302/2058-5241.4.180080