Original article

Performance of PROMIS Physical Function, Pain Interference, and Depression Computer Adaptive Tests Instruments in Patients Undergoing Meniscal Surgery

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Purpose: To compare the performance of the Patient-Reported Outcomes Measurement Information System (PROMIS) physical function (PF), pain interference (PIF), and depression computer adaptive tests (CAT) relative to legacy instruments in patients undergoing meniscal surgery. **Methods:** Patients scheduled to undergo meniscal surgery completed legacy knee function PROMs (International Knee Documentation Committee [IKDC], Knee Injury and Osteoarthritis Outcome Score [KOOS] subscores), Marx Activity Rating Scale (MARS), Veterans-Rand 12 (VR12), Short Form 12 (SF12), and the Brief Resilience Scale (BRS) alongside PROMIS PF, PIF, and Depression preoperatively. Spearman rank correlations were calculated, and score distributions were examined for floor and ceiling effects. **Results:** 152 patients (46.6 ± 14.9 years, 67.1% male) completed PROMs for appropriate inclusion. PROMIS PF yielded high-moderate to high correlations with the IKDC and KOOS subscales ($r = 0.61$ to 0.73), demonstrating similar performance to the IKDC. PROMIS PIF demonstrated moderately high-moderate to high correlations with the IKDC, KOOS subscales, VR-12 Physical Component Score (PCS), and SF12 PCS ($r = 0.62$ to 0.71), performing comparably to KOOS Pain ($r = 0.55$ to 0.92). PROMIS Depression demonstrated moderate to high-moderate correlations with the mental health legacies ($r = 0.46$ to 0.66). Significant ceiling effects were observed for MARS (n = 29, 18.8%), and significant floor effects were exhibited by PROMIS Depression (n = 38, 25%) and MARS (n = 27, 17.6%). **Conclusion:** The PROMIS PF, PIF CAT, and Depression instruments exhibit comparable performance profiles relative to legacy knee PROMs. PROMIS PF and PIF demonstrated no floor and ceiling effects, whereas PROMIS Depression exhibited a significant relative floor effect. PROMIS PF and PIF may be appropriately used to establish functional baselines preoperatively. **Level of Evidence:** IV, diagnostic case series.

As health care experts and policy makers continue to examine value within the American health care system, patient-reported outcome (PRO) data are increasingly used in the orthopedic literature to assess clinical outcomes and gauge the effectiveness of surgical interventions.[1-3] Numerous patient-reported outcome

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The authors report the following potential conflicts of interest or sources of funding: N.V. reports grants from Smith & Nephew; personal fees and nonfinancial support from Arthrex; nonfinancial support and other from Arthroscopy, *Vindico Medical-Orthopedics Hyperguide; personal fees from DJ Orthopaedics, Orthospace; board or committee member, American Orthopaedic Society for Sports Medicine, American Shoulder and Elbow Surgeons, Arthroscopy Association of North America; stock or stock options, Cymedica, Omeros; editorial or governing board,* Journal of Knee Surgery, *SLACK Incorporated; paid consultant and stock or stock options, Minivasive. B.F. reports personal fees from Elsevier, Arthrex, Jace Medical, Stryker; grants from Smith & Nephew, Ossur. B.C. reports other from Aesculap/B. Braun,* American Journal of Orthopedics, American Journal of Sports Medicine, *Aqua Boom, Arthrex,* Arthroscopy, *Arthroscopy Association of North America, Athletico, Biomerix,* Cartilage, *DJ Orthopaedics, Elsevier Publishing, Flexion, Geistlich, Giteliscope, International Cartilage Repair Society,* Journal of Bone and Joint Surgery, American Edition, Journal of Shoulder and Elbow Surgery, *JRF Ortho, National Institutes of Health,* Operative Techniques in Sports Medicine, *Ossio, Regentis, Sanofi-Aventis, Smith & Nephew, Tornier, Zimmer. Full ICMJE author disclosure forms are available for this article online, as supplementary material.*

Received May 21, 2019; accepted April 23, 2020.

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2666-061X/19657
https://doi.org/10.1016/j.asmr.2020.04.012

measures (PROMs) have been developed to evaluate various health domains, including function, mental health, pain, and health-related quality of life (HRQoL).[4-8] Although the increase in PROMs has helped ensure thoroughness of assessment, important secondary limitations such as a lack of standardization have led to large variability in the PROMs selected to assess health states.[9-12] Furthermore, each new instrument developed must be evaluated in each population of interest such that acceptable correlational strengths are confirmed.[13-16]

The National Institutes of Health developed the Patient Reported Outcomes Management Information System (PROMIS) in an effort to unify instrument selection across research disciplines with a single, multidomain PROM.[17-19] Integrating computer adaptive testing (CAT) and item response theory (IRT), PROMIS offers distinct advantages compared with traditional legacy instruments, including decreased question burden and time-to-completion,[20] high instrument responsiveness,[21,22] and the potential for early responsivity compared with traditional outcome instruments.[21,23-26] As PROMIS measures continue to be introduced in new orthopedic disciplines, continued evaluation in specific patient populations before widespread adoption is essential.[27-30] Although the performance of the PROMIS PF CAT has previously been examined in meniscal surgery,[31] the comparative performance of the PF CAT relative to gold standard function PROMs has yet to be established.[31] Furthermore, the performance of PROMIS PIF and Depression has yet to be established in meniscal surgery.[31]

In addition to correlations with legacy instruments, the presence of ceiling and floor effects can reduce instrument sensitivity, as variations in score above a ceiling or below a floor in any specific population of patients will remain undetected. This can have important implications in the utility of PROM instruments.

The purpose of this study is to compare the performance of PROMIS PF, PIF, and Depression relative to legacy instruments in patients undergoing meniscal surgery. We hypothesized that (1) PROMIS CAT scores based on physical function (PF) and pain interference (PI) would show strong correlations with the legacy functional and HRQoL PROMs comparable to the accepted standard, the International Knee Documentation Committee (IKDC) form and the Knee Injury and Osteoarthritis Outcome Score (KOOS) pain, respectively; (2) PROMIS Depression would correlate strongly with traditional mental health legacies such as the Brief Resilience Scale (BRS) and the Veterans-Rand 12 (VR12)/Short Form 12 (SF12) Mental Health Component Score (MCS); and (3) all PROMIS measures would exhibit fewer floor and ceiling effects than legacy scores.

Methods

Study Design and Patient Selection

Power analysis performed assuming a 2-sided test, with a type 1 error rate of 5%, estimated that a sample size of 36 would provide 80% power to distinguish a correlation of 0.6 (good) from 0.2 (poor) when measuring the correlation between the PROMIS CAT and legacy instruments.[12,31] PRO data were collected between January 2018 and January 2019 across 4 sports surgeons using a prospectively maintained institutional registry (Outcome Based Electronic Research Database; Universal Research Solutions, Columbia, MO). Inclusion criteria included full completion of preoperative PROMs and receipt of either an arthroscopic partial meniscectomy or arthroscopic meniscal repair. Patients without full PROM completion; those receiving significant concomitant procedures, including osteotomy, anterior cruciate ligament reconstruction, osteochondral allograft transplantation, or biological augmentation; patients with ≥grade 2 MCL tears; and patients with grade 4 osteoarthritis on the Outerbridge Classification found on arthroscopy were excluded. Demographics and preoperative variables were collected inclusive of age and sex. Intraoperative variables collected by trained research assistants at the time of operation included the type and location of meniscal pathology as well as the presence of arthritis as seen on arthroscopy reported by the operating surgeon.

Patient-Reported Outcome Measures

The legacy PROMs of interest in this study include the BRS, Marx Activity Ratings Scale (MARS), VR12), SF12, Knee Injury and Osteoarthritis Outcome Score (KOOS) subscales include Joint Replacement (JR), Physical Function (PS), Symptoms (Sx), Pain, Activities of Daily Living (ADL), Sport, and Quality of Life (QoL) and the IKDC score. The PROMIS instruments of interest include the PROMIS Physical Function (PF CAT), Pain Interference (PIF CAT), and Depression CAT. KOOS PS, as well as the PIF and Depression CATs, are scored in an inverted scale with higher scores correlating to worse clinical status.[32] Questionnaires were administered in the following order: KOOS components, MARS, VR/SF-12, PF CAT, PIF CAT, Depression CAT, and IKDC.

Statistical Analysis

PROM scores were evaluated with a Shapiro-Wilk test for normality. Spearman rank correlations were calculated between the PROMIS CATs and the legacy PROMs, with r values of 0 to 0.3 indicating weak correlation; 0.31 to 0.39, moderate-weak correlation; 0.4 to 0.6, moderate correlation; 0.61 to 0.69, high-moderate correlation; and ≥0.70, high correlation.[31] Floor and ceiling effects were

Table 1. Patient Demographics and Tear Characteristics, Meniscal Surgery Group (n = 152)

Variable	Value
Demographic variables	
Age (y)	46.6 ± 14.9
Male sex	102 (67.1)
Right side	78 (51.3)
Intraoperative and tear characteristics	
Type of surgery	
Meniscectomy	134 (89.2)
Meniscal repair	18 (11.8)
Tear location	
Both	21 (13.8)
Medial	98 (64.5)
Lateral	33 (21.7)
Tear type	
Horizontal cleavage	13 (8.55)
Oblique	4 (2.63)
Peripheral	7 (4.61)
Degenerative	34 (22.4)
Flap Tear	9 (5.92)
Radial	25 (16.45)
Complex	29 (19.1)
Root Tear	15 (9.87)
Bucket Handle	4 (2.63)
Vertical	12 (7.89)

Data are mean ± standard deviation or n (%).

evaluated. Absolute floor and ceiling effects were considered significant if ≥15% of patients scored the absolute minimum or maximum possible scores on each measure, respectively. Relative effects were considered significant if ≥15% of patients scored the highest and lowest available score within the score distribution.[33] Subgroup analyses were performed to identify demographic variables contributing to significant ceiling and floor effects. Continuous variables were compared with Welch's *t* test, and categorical variables were compared using Mann-Whitney *U* test. All statistical analysis was performed using RStudio software version 1.0.143 (R Foundation for Statistical Computing, Vienna, Austria).

Results

There were 237 patients available for eligibility screening. Of these, patients without full PROM completion (n = 68, 29%), those receiving significant concomitant procedures (eg, osteotomy, biological augmentation, anterior cruciate ligament reconstruction) (n = 12, 5%), and those with grade 4 arthritis on arthroscopy (5, 2%) were excluded. A total of 152 patients (102, 67.1% male) with a mean (± standard deviation) age of 46.6 ± 14.9 years met inclusion criteria. The mean follow-up was 12 weeks (range 2 to 30). A total of 134 patients underwent partial meniscectomy (89.2%), and 18 underwent meniscal repair (11.8%). Of the partial meniscectomy patients, 98 (64.5%) patients underwent partial medial meniscectomy, 33 patients underwent partial lateral meniscectomy (21.7%), and 21 patients underwent bilateral partial meniscectomy (13.8%) (Table 1).

Respondents answered an average of 4.19, 4.23, and 4.23 questions on completing the PF, PIF, and Depression CATs, respectively. By comparison, 12 questions were required to complete the VR/SF-12, 42 items to complete the KOOS, and 19 items for the IKDC questionnaire. Average time to completion was ≤1.5 minutes for the PF, PIF, and Depression CAT, whereas average completion time for the IKDC, KOOS, and MARS were all ≥3.5 minutes. The BRS required 1.5 minutes to complete, comparable to the PROMIS CAT. Mean preoperative scores were 41.3 ± 6.78 for the PF CAT, 59.8 ± 6.74 for the PIF CAT, and 45.3 ± 8.45 for the Depression CAT (Table 2). Preoperative scores on legacy instruments are also provided in Table 2.

The PF CAT exhibited high correlations with the KOOS Sport and Recreational, KOOS PS, and IKDC ($r = 0.70$ to 0.73). Significant high-moderate correlations were demonstrated relative to KOOS Pain, KOOS JR, VR-12 PCS, SF12 PCS, and KOOS QoL (0.61 to 0.68). Overall, the PF CAT demonstrated 5 high-moderate to high correlations, comparable to the IKDC measure (Tables 3 and 4).

The PIF CAT demonstrated significant high correlations with IKDC and KOOS ADL ($r = -0.71$) and significant high-moderate correlations with KOOS PS, KOOS Pain, KOOS JR, VR-12 PCS, and SF12 PCS ($r = 0.62$ to 0.69). Overall, the PIF CAT demonstrated 7 high-moderate to high correlations with legacies,

Table 2. Preoperative Scores and Time to Complete Each PROM Instrument

Instrument	Baseline Score	Time to Complete (min)
BRS	3.98 ± 0.63	1.5 ± 2.8
MARS	8.32 ± 6.02	4.9 ± 1.4
VR-12 MCS	57.2 ± 8.37	3.5 ± 7.1
VR-12 PCS	39.8 ± 9.52	
SF12 MCS	54.4 ± 9.07	
SF12 PCS	37.8 ± 9.36	
IKDC	42.8 ± 16.2	4.5 ± 3.2
KOOS Symptoms	57.9 ± 20.1	6.7 ± 5.7
KOOS Pain	55.3 ± 20.4	
KOOS ADL	63.1 ± 21.5	
KOOS Sports	33.2 ± 24.1	
KOOS QoL	29.7 ± 20.6	
KOOS JR	55.9 ± 17.1	
KOOS PS	41.8 ± 16.1	
PF CAT	41.3 ± 6.78	1.5 ± 0.78
PIF CAT	59.8 ± 6.74	1.5 ± 0.95
Depression CAT	45.3 ± 8.45	1.2 ± 1.34

Data are mean ± standard deviation. Abbreviations: ADL, activities of daily living; BRS, Brief Resilience Score; CAT, computer adaptive testing; IKDC, International Knee Documentation Committee; JR, joint reconstruction; KOOS, Knee Injury and Osteoarthritis Outcome Score; MARS, Marx Activity Ratings Scale; MCS, Mental Component Score; PCS, Physical Component Score; PF, physical function; PIF, pain interference; PS, physical symptoms; QoL, quality of life; SF12, Short-Form 12; VR12, Veteran's Rand.

Table 3. Spearman Correlation Coefficients Between the PF CAT, the PIF CAT, the Depression CAT, and Physical Function, HRQoL, and Mental Health Legacies

	PF CAT		PIF CAT		Depression CAT	
Instrument	Correlation	Strength	Correlation	Strength	Correlation	Strength
Function legacies						
MARS	0.21*	Weak	−0.09	Weak	0.006	Weak
KOOS Sport	0.70*	High	−0.57*	Moderate	−0.19	Weak
KOOS PS	−0.70*	High	0.64*	High-moderate	−0.21	Weak
KOOS Symptoms	0.51*	Moderate	−0.52*	Moderate	−0.27*	Weak
KOOS Pain	0.64*	High-moderate	−0.69*	High-moderate	−0.21	Weak
KOOS JR	0.67*	High-moderate	−0.68*	High-moderate	−0.20	Weak
IKDC	0.73*	High	−0.71*	High	−0.14	Weak
HRQoL legacies						
VR-12 PCS	0.68*	High-moderate	−0.66*	High-moderate	−0.13	Weak
SF12 PCS	0.65*	High-moderate	−0.62*	High-moderate	−0.06	Weak
KOOS ADL	0.73*	High	−0.71*	High	−0.19	Weak
KOOS QoL	0.61*	High-moderate	−0.54*	High-moderate	−0.27*	Weak
Mental health legacies						
BRS	0.03	Weak	−0.11	Weak	−0.46*	Moderate-weak
VR-12 MCS	0.34*	Moderate-weak	−0.36*	Moderate-weak	−0.66*	High-moderate
SF12 MCS	0.18*	Weak	−0.21*	Weak	−0.59*	Moderate
PROMIS CAT						
PF CAT			−0.69*	High-moderate	−0.17*	Weak
PIF CAT	−0.69*	High-moderate			0.18*	Weak
Depression CAT	−0.17*	Weak	0.18*	Weak		

Abbreviations: ADL, activities of daily living; BRS, Brief Resilience Score; CAT, computer adaptive testing; HRQoL, health-related quality of life; IKDC, International Knee Documentation Committee; JR, joint reconstruction; KOOS, Knee Injury and Osteoarthritis Outcome Score; MARS, Marx Activity Ratings Scale; MCS, Mental Component Score; PCS, Physical Component Score; PF, physical function; PIF, pain interference; PS, physical symptoms; SF12, Short-Form 12; VR12, Veteran's Rand.

*Significant correlation, $p < .05$.

comparable to the KOOS Pain, which demonstrated 8 (Table 5). The Depression CAT demonstrated significant high-moderate correlation only with the VR-12 MCS ($r = 0.66$) (Table 6).

Analysis of floor and ceiling effects yielded significant absolute ceiling (n = 29, 18.8%) and floor (n = 27, 17.6%) effects on the MARS, and a significant relative floor effect (n = 38, 25%) on the Depression CAT at a score of 34.2 (Table 7). Subgroup analysis found that patients who reported the absolute minimum score on the MARS were found to be older than those who did not report minimal scores (55.8 ± 10.3 versus 44.9 ± 15.3, $p = .001$). Similarly, patients who reported the absolute maximum score on the MARS were younger than those who did not (39.3 ± 17 versus 49.0 ± 14.1, $p = .045$). Subgroup analysis found no significant differences between patients exhibiting a relative minimum score on the Depression CAT and those who reported nonminimal scores with respect to age, sex, or length of follow-up.

Discussion

The principle findings of this study were as follows. First, patients undergoing meniscal surgery reported PROMIS PF CAT and PIF CAT scores that demonstrated high-moderate to high correlations with functional and HRQoL legacies, respectively. The depression CAT also demonstrated high-moderate to high correlations with mental health legacies. Second, significant ceiling and floor effects were observed on the MARS, and a significant floor effect was observed on the depression CAT. Finally, subgroup analysis found age to be significantly associated with those who achieved the ceiling/floor effect on the MARS. Preoperatively, high-moderate to high correlation was observed between the PF CAT and HRQoL and dedicated lower extremity physical function instruments, in agreement with extensive evidence from previous studies correlating the PF CAT with legacy instruments in other lower extremity pathology or sports injuries.[12,34-37] Among legacy instruments, the KOOS sports and recreational activities component has consistently demonstrated remarkable agreement with the PF CAT, and we found it to have the strongest correlation in our group.[31,35,38] Studies in shoulder instability and meniscal surgery made similar observations.[12,31] However, these studies have not directly examined the correlation strengths of the PF CAT with the legacy gold standard. Side-by-side comparisons in this study demonstrated equal numbers of high to high moderate correlations with legacies between the PROMIS CATs and the IKDC, the VAS pain, and the VR/SF12 MCS in patients undergoing meniscal surgery, which further supports its implementation as a more efficient and equivalently sensitive

Table 4. Comparison of Spearman Correlation Coefficients With Function Legacies Between the PROMIS PF CAT and the AAOS Recommended IKDC Score

	PF CAT		IKDC	
Instrument	*r*	Strength	*r*	Strength
MARS	0.21*	Weak	0.26	Weak
KOOS Sport	0.70*	High	0.74	High
KOOS PS	−0.70*	High	−0.80*	High
KOOS Symptoms	0.51*	Moderate	0.69	High-moderate
KOOS Pain	0.64*	High-moderate	0.82*	High
KOOS JR	0.67*	High-moderate	0.82*	High
IKDC	0.73*	High		

Abbreviations: IKDC, International Knee Documentation Committee; JR, joint reconstruction; KOOS, Knee Injury and Osteoarthritis Outcome Score; MARS, Marx Activity Ratings Scale; PS, physical symptoms; *r*, Spearman correlation coefficient.

*Significant correlation, $p < .05$.

alternative. Nonetheless the effect of specific numerical differences in the strengths of correlations on clinical application is a worthy topic of future investigation.

High-moderate to high correlations were similarly observed between the PIF CAT and functional as well as HRQoL legacies. The PIF CAT has been implemented to measure and capture the impact of pain in a number of orthopedic surgery populations including knee arthroscopy, knee arthroplasty, foot and ankle surgery, and orthopedic oncology.[39-41] Additionally, multiple studies in the literature have emerged to support the use of the PIF CAT as an important augmentation to capturing physical function in patients with pain.[27,34,42] Kendall et al.[43] correlated the PIF CAT with the PF CAT in a population of patients presenting with spinal pain and concluded that the PIF CAT is a useful augmentation to physical function measures. A recent study by Kenney et al.[41] evaluated the PF CAT and the PIF CAT in a group of patients undergoing knee arthroscopy and observed high-moderate to high correlations (0.61 to 0.79) between both the PF CAT and the PIF CAT and the IKDC. However, the study population was limited to 76 patients undergoing heterogeneous knee procedures,[41] and the present study is the first examination of the PIF CAT specifically in a group of meniscal surgery patients.

Compared with the KOOS pain component score, the PIF CAT exhibited a comparable number of high-moderate to high correlations (8 for the KOOS pain versus 7 for the PIF CAT). These findings present the PIF CAT as a viable multidomain alternative to legacy pain measurements in capturing the physical, psychosocial, and mental effects of pain on patient well-being. Of the PROMIS domains evaluated in this study, the depression CAT remains relatively unexplored in sports medicine orthopedics. Driban et al.[34] evaluated the construct validity and floor/ceiling effects of the Depression CAT, among other PROMIS domains, in a group of patients undergoing conservative interventions for knee osteoarthritis. Kollmorgen et al.[44] evaluated the Depression CAT with legacy instruments in patients undergoing hip arthroscopy but were able to correlate it only with functional legacies; the authors also noted a relative floor effect (25%). In the study population, the Depression CAT demonstrated moderate to high-moderate correlations with the legacy mental health measures (VR-12 and SF12 MCS), and notably, an identical floor effect (25%). Guattery et al.[45] evaluated this floor effect in a sample of 77,211 orthopedic surgery patient visits and found that patients exhibiting the floor effect demonstrated significantly reduced seconds to completion compared with those who did not (4 ± 3 versus 7 ± 7), concluding that hasty completion by respondents may be responsible for this effect.

Consistent with the literature, the MARS demonstrated both significant ceiling (18.8%) and floor (17.6%) effects at baseline.[31] Evidence of a significant ceiling effect limiting the use of MARS in the young and active population has also been shown.[46] The present study found a significant difference in age of patients who achieved either the ceiling or the floor scores on the MARS, with older patients achieving the floor score and younger patients achieving the ceiling score. This observation suggests that the MARS may be of limited utility in differentiating baseline activity level for older patients as well.

Table 5. Performance Comparison Between PROMIS PIF CAT and the KOOS Pain Component

	PIF CAT		KOOS Pain	
Instrument	*r*	Strength	*r*	Strength
Function legacies				
MARS	−0.09	Weak	0.17	Weak
KOOS Sport	−0.57*	Moderate	0.71*	High
KOOS PS	0.64*	High-moderate	−0.83*	High
KOOS Symptoms	−0.52*	Moderate	0.79*	High
KOOS Pain	−0.69*	High-moderate		
KOOS JR	−0.68*	High-moderate	0.95*	High
IKDC	−0.71*	High	0.82*	High
HRQoL legacies				
VR-12 PCS	−0.66*	High-moderate	0.61*	High-moderate
SF12 PCS	−0.62*	High-moderate	0.55*	Moderate
KOOS ADL	−0.71*	High	0.86*	High
KOOS QoL	−0.54*	Moderate	0.61*	High-moderate
Mental health legacies				
BRS	−0.11	Weak	0.10	Weak
VR-12 MCS	−0.36*	Moderate-weak	0.41*	Moderate
SF12 MCS	−0.21*	Weak	0.29*	Weak

Abbreviations: ADL, activities of daily living; BRS, Brief Resilience Score; CAT, computer adaptive testing; HRQoL, health-related quality of life; IKDC, International Knee Documentation Committee; JR, joint reconstruction; KOOS, Knee Injury and Osteoarthritis Outcome Score; MARS, Marx Activity Ratings Scale; MCS, Mental Component Score; PCS, Physical Component Score; PF, physical function; PIF, pain interference; PS, physical symptoms; *r*, Spearman correlation coefficient; SF12, Short-Form 12; VR12, Veteran's Rand.

*Significant correlation, $p < .05$.

Table 6. Performance Comparison Between PROMIS Depression CAT and Competing Mental Health Legacies

	Depression CAT		VR-12 MCS		SF12 MCS	
Instrument	*r*	Strength	*r*	Strength	*r*	Strength
HRQoL						
VR-12 PCS	−0.13	Weak	0.39*	Moderate-weak	0.14	Weak
SF12 PCS	−0.06	Weak	0.30*	Moderate-weak	0.02	Weak
KOOS ADL	−0.19	Weak	0.37*	Moderate-weak	0.25*	Weak
KOOS QoL	−0.27*	Weak	0.46*	Moderate	0.28*	Weak
Mental health legacies						
BRS	−0.46*	Weak	0.40*	Moderate	0.37*	Moderate-weak
VR-12 MCS	−0.66*	High-moderate			0.93*	Strong
SF12 MCS	−0.59*	Moderate	0.93*	Strong		
PROMIS CAT						
PIF CAT	0.18*	Weak	−0.36*	Moderate-weak	−0.21*	Weak

Abbreviations: BRS, Brief Resilience Score; CAT, computer adaptive testing; HRQoL, health-related quality of life; KOOS, Knee Injury and Osteoarthritis Outcome Score; MCS, Mental Component Score; PCS, Physical Component Score; PIF, pain interference; QoL, quality of life; *r*, Spearman correlation coefficient; SF12, Short-Form 12; VR12, Veteran's Rand.

*Significant correlation, $p < .05$.

The IRT nature of the PROMIS PF CAT suggests superiority over traditional instruments with respect to question burden, and an accumulating body of evidence provides support for this assertion by highlighting the reduced question load and increased responsiveness of the PF CAT in a variety of orthopedic patient populations.[25,38] Hung et al.[47] compared the PROMIS PF CAT with the short Musculoskeletal Function Assessment (sMFA) in the orthopedic trauma population and found that the PF CAT required a mean number of 4 responses and a mean time of 44 seconds to complete. A response requirement of ~4 questions with a mean time to completion ranging from 45 seconds to several minutes was similarly observed in multiple patient groups undergoing different orthopedic procedures.[24,38,48] We observed an average of 4 responses over the course of 88 seconds to complete the PF CAT, consistent with the current literature. Compared with those observed for legacy measures from the present study as well as data from the literature for the KOOS (7 to 12 minutes), the IKDC (3 to 5 minutes), the SF12 (4 minutes), and the MARS (2 to 3 minutes), the PF CAT demonstrated clear superiority in both duration to completion and question burden.[49-53] The BRS, while easily administered, does not correlate well with most PROMs because of its narrow domain focus.

These findings mark a substantial addition to the existing literature regarding the application of novel adaptive PROM instruments in the evaluation of preoperative patient health states. It demonstrates the PROMIS CATs to be of equal effectiveness to legacies, albeit with a more efficient usability profile, in those undergoing meniscal surgery. Future comparative evaluation of the multidomain PROMIS CATs against current legacies in other procedures can help identify viable alternatives that reduce question burden, optimize workflow, and improve patient satisfaction and value-based care.

Limitations

Several limitations of our study should be considered in making an informed interpretation of our results. Our patient outcome collection system does not randomize

Table 7. Absolute Ceiling and Floor Effects

	Ceiling		Floor	
Instrument	n	%	n	%
Function				
PF CAT	1†	1.2	1†	1.2
MARS	29	18.8*	27	17.6*
KOOS Sports	1	1.2	9	5.9
KOOS JR Score	2	2.4	1†	1.2
KOOS PS Score	1	1.2	3	3.6
KOOS Symptoms Score	1	1.2	1†	1.2
KOOS Pain Score	2	2.4	1	1.2
IKDC	1†	1.2	1†	1.2
HRQoL				
VR-12 PCS	1†	1.2	1†	1.2
SF12 PCS	1†	1.2	1†	1.2
KOOS QOL	2	2.4	9	5.0
KOOS ADL	6	3.15	1	0.4
PIF CAT	1†	1.2	3†	3.6
Mental health				
VR-12 MCS	1†	1.2	1†	1.2
SF12 MCS	1†	1.2	1†	1.2
BRS	17	11.2	1†	1.2
Depression CAT	1†	1.2	38†	25*

Minimum and maximum values: PROMIS PF CAT, 20 to 80; KOOS components, VR/SF-12 PCS/MCS, defined as + 3 SD; MARS, 0 to 16; IKDC, 0 to 100. Abbreviations: ADL, activities of daily living; BRS, Brief Resilience Score; CAT, computer adaptive testing; HRQoL, health-related quality of life; IKDC, International Knee Documentation Committee; JR, joint reconstruction; KOOS, Knee Injury and Osteoarthritis Outcome Score; MARS, Marx Activity Ratings Scale; MCS, Mental Component Score; PCS, Physical Component Score; PF, physical function; PIF, pain interference; PS, physical symptoms; SF12, Short-Form 12; VR12, Veteran's Rand.

*Significant effects.

†Relative floor effects, in cases where absolute minimum/maximum scores were not achieved.

questionnaire order, which may introduce question fatigue, as each patient completed the instruments in the same order. To be as inclusive as possible in selection of patients with meniscal tears, we included patients from multiple surgeons, as well as a small percentage of patients who underwent meniscal repair, which may introduce heterogeneity into postoperative outcomes. However, only preoperative PROMs were evaluated, and regardless of treatment, patients in previous investigations into meniscal surgeries have included both meniscectomy and repair.[23,31] These findings come from a high-volume academic orthopedic institution and thus interpretation and application to smaller, community-based hospitals must be done with consideration of the population differences that exist. Additionally, while the IRT nature of the PROMIS CAT suggests adaptability across health and functional domains, the reality is that the PROMIS CATs remain limited by domain differences, and cross-coverage of pathologies is not advised. Furthermore, the domain-specific PROMIS CATs evaluated in this study may not adequately describe the patient's health state as other more time-consuming legacies, such as the full roster of KOOS component scores, and physicians may risk sacrificing granularity for expedience.

Conclusions

The PROMIS PF, PIF CAT, and Depression instruments exhibit comparable performance profiles relative to legacy knee PROMs. PROMIS PF and PIF demonstrated no floor and ceiling effects, whereas PROMIS Depression exhibited a significant relative floor effect. PROMIS PF and PIF may be appropriately used to establish functional baselines preoperatively.

Acknowledgments

The authors acknowledge Elizabeth Chang, BS, for her help with data collection in the generation of this manuscript.

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