Pain Interference Influence on Postoperative Clinical Trajectory in Patients Undergoing Lumbar Decompression

James W. Nie, Timothy J. Hartman, Omolabake O. Oyetayo, Keith R. MacGregor, Eileen Zheng, Kern Singh

OBJECTIVE: **Newer Patient-Reported Outcomes (PROs) may offer benefits over legacy PROs in ease of administration and interpretation. We aim to study the influence of preoperative pain interference (PI) using the Patient-Reported Outcomes Measurement Information System (PROMIS) Pain Interference (PROMIS-PI) on postoperative clinical outcomes in patients undergoing lumbar decompression.**

METHODS: **Patients undergoing lumbar decompression without fusion were separated into 2 cohorts: PROMIS-PI < 64 (lesser PI) and PROMIS-PI ≥ 64 (greater PI). PROs included PROMIS physical function, PROMIS anxiety (PROMIS-A), PROMIS sleep disturbance (PROMIS-SD), PROMIS-PI, Patient Health Questionnaire-9, Visual Analog Scale (VAS) back, VAS leg, and Oswestry Disability Index (ODI) and were collected at preoperative and postoperative time points. Demographics, perioperative characteristics, PROs, and Minimum Clinically Important Difference (MCID) were compared among groups through non-parametric inferential statistics.**

RESULTS: **One-hundred and seven patients were identified. Independent of preoperative PI, patients reported significant postoperative improvement in PROMIS physical function, PROMIS-A, PROMIS-PI, VAS back, VAS leg, and ODI. The greater PI cohort reported significant postoperative improvement in Patient Health Questionnaire-9 and PROMIS-SD. The lesser PI cohort reported superior preoperative PROs in all domains. Postoperatively, the lesser PI cohort reported superior 6-week PROMIS-A and PROMIS-SD. MCID achievement rates were higher in the greater PI cohort for PROMIS-PI, VAS back, VAS leg, and ODI.**

CONCLUSIONS: **Patients with lower preoperative PI reported superior postoperative anxiety and sleep disturbance. Patients with greater preoperative PI had higher MCID achievement rates in PI, pain, and disability. Patients with greater preoperative PI undergoing lumbar decompression may demonstrate higher rates of clinically tangible improvement.**

INTRODUCTION

The Patient-Reported Outcomes Measurement Information System (PROMIS) program represents a newer set of patient-reported outcomes (PROs) utilized to evaluate different aspects of patients' quality of life, such as physical function, anxiety, pain interference (PI), and sleep disturbance.[1,2] PROMIS pain interference (PROMIS-PI) is a measure utilized to evaluate the extent that pain affects patients' physical, mental, and social activities.[1,3] These PROMIS measures had similar responsiveness and moderate to strong correlations to legacy

Key words
- Lumbar decompression
- MCID
- Pain
- PROs

Abbreviations and Acronyms
MCID: Minimum clinically important difference
ODI: Oswestry Disability Index
PI: Pain interference
POD0: Postoperative day 0
PROs: Patient-Reported Outcomes
PROMIS: Patient-Reported Outcomes Measurement Information System
PROMIS-A: Patient-Reported Outcomes Measurement Information System-Anxiety
PROMIS-PF: Patient-Reported Outcomes Measurement Information System-Physical Function
PROMIS-PI: Patient-Reported Outcomes Measurement Information System-Pain Interference
PROMIS-SD: Patient-Reported Outcomes Measurement Information System-Sleep Disturbance
VAS: Visual analog scale

Department of Orthopaedic Surgery, Rush University Medical Center, Chicago, Illinois, USA

To whom correspondence should be addressed: Kern Singh, M.D. [E-mail: kern.singh@rushortho.com]

Citation: World Neurosurg. (2023) 169:e270-e278. https://doi.org/10.1016/j.wneu.2022.10.122

*Journal homepage: **www.journals.elsevier.com/world-neurosurgery***

*Available online: **www.sciencedirect.com***

measures widely utilized in spine surgery, such as the Oswestry Disability Index (ODI) and 12-Item Short Form, with significantly less time required to complete.[4]

Despite the shorter time for completion of these surveys and similar responsiveness, the prognostic utility of preoperative PROMIS scores to postoperative outcomes has not been widely studied in spine surgery. To the authors' knowledge, only 1 spine article in patients undergoing lumbar discectomy has studied the prognostic value of pain interference on postoperative clinical outcomes.[5] As pain interference encompasses many aspects of patients' quality of life, investigation into the impact of pain interference on postoperative outcomes may provide prognostic value and management of patient expectations. In this study, we aim to evaluate the prognostic value of preoperative pain interference in patients undergoing lumbar decompression without fusion. To do so, we utilized a single-surgeon registry stratifying patients by preoperative PROMIS-PI.

METHODS

Patient Population

Prior to the onset of the current study, IRB approval (ORA #14051301) and patient consent were obtained. A prospectively maintained single-surgeon registry was retrospectively queried from November 2019 to September 2022. Inclusion criteria were patients undergoing primary, elective lumbar decompression without fusion with preoperative PROMIS-PI scores. Lumbar decompression procedures included some combination of laminectomy, discectomy, laminotomy, foraminotomy, partial facetectomy, and annulotomy. Exclusion criteria were patients undergoing revision surgery, lumbar fusion, or patients diagnosed with neoplasm, acute fracture, or infection.

Data Collection

Data collected were separated into demographic characteristics, perioperative characteristics, and PROs. Demographic characteristics included age, gender (female or male), body mass index, ethnicity (African-American, Asia, Hispanic, White, or other), and insurance type (Medicare/Medicaid, workers' compensation, or private). Individual comorbidities of smoking status, hypertension, and diabetes were recorded. Composite comorbidities of American Society of Anesthesiologists classification and Charlson Comorbidity Index scores were recorded. Perioperative characteristics of spinal pathology, number of decompressed levels, procedure, operative time, estimated blood loss, postoperative length of stay, postoperative day 0 (POD0) pain, and POD0 narcotic consumption. Spinal pathologies included recurrent herniated nucleus pulposus, central stenosis, and foraminal stenosis. Procedures included laminectomy, discectomy, laminotomy, foraminotomy, partial facetectomy, and annulotomy. PROs for physical function, anxiety, pain interference, sleep disturbance, depression, back pain, leg pain, and disability outcomes were recorded at preoperative and postoperative 6-week, 12-week, 6-month, 1-year, and 2-year time points. The PROMIS was utilized to evaluate physical function (PROMIS-PF), anxiety (PROMIS-A), PROMIS-PI, and sleep disturbance (PROMIS-SD). Back and leg pain were evaluated using the visual analog scale (VAS). Disability was evaluated through the ODI.

Statistical Analysis

Data were analyzed using Stata 17.0 (StataCorp LP, College Station, Texas, USA). A significance value of 0.05 was utilized. Patients were separated into 2 cohorts at PROMIS-PI of 64 based on the mean PROMIS-PI defined in a validation study of PROMIS-PI in patients with chronic back pain.[6] Patients with PROMIS-PI < 64 were classified as the lesser PI cohort, while patients with PROMIS-PI ≥ 64 were classified as the greater PI cohort. Comparisons between cohorts for continuous and categorical variables were calculated using Wilcoxon ranked sum tests and Fisher exact tests, respectively. Postoperative improvement in PROs was calculated using Wilcoxon ranked sign tests. Minimum Clinically Important Difference (MCID) achievement rates were calculated to comparison of previously established values in literature. These values were 4.5 for PROMIS-PF, 6.3 for PROMIS-A, 5.0 for PROMIS-PI, 3.5 for PROMIS-SD, 3.0 for V, 2.1 for VAS back, 2.8 for VAS leg, and 14.9 for ODI.[7-9] Overall MCID achievement was defined as the number of unique patients achieving MCID throughout the postoperative time period. Comparison between cohorts with continuous and categorical variables utilized Wilcoxon ranked sum test and Fisher exact test, respectively. Postoperative improvement of PROs was calculated using Wilcoxon signed rank test.

RESULTS

A total of 107 patients underwent lumbar decompression. Thirty-five patients were in the lesser PI cohort, while 72 patients were classified in the greater PI cohort. Patients were typically White (75.0%) males (63.6%) with private insurance (80.4%). Patients were generally younger with a mean age of 46.7 years. Patients typically reported a low comorbidity burden, with few patients classified as smokers (9.5%), hypertensive (18.9%), or diabetic (5.6%). Most patients were classified with American Society of Anesthesiologists ≤ 2 (87.9%) and had a mean Charlson Comorbidity Index score of 1.2. There were no significant differences between cohorts for demographic characteristics. These findings are in **Table 1**.

Of the spinal pathologies, most patients were diagnosed with central stenosis (97.2%), herniated disc (86.9%), and foraminal stenosis (80.4%). The majority of patients underwent single-level decompression (83.2%). For procedures, a greater proportion of lesser patients with PI underwent foraminotomy ($P = 0.023$). However, all other procedures had no significant differences between cohorts. The mean operative time, estimated blood loss, and length of stay were 36.3 minutes, 24.3 mL, and 3.3 hours, respectively. Postoperatively, the mean reported pain and narcotic consumption in were 3.6 and 12.9, respectively. For these measures, the greater PI cohort reported significantly higher postoperative pain and narcotic consumption ($P \leq 0.013$, both). Findings of perioperative characteristics are in **Table 2**.

For PROs, the lesser PI cohort reported significant improvement in 6-week PROMIS-PF, 6-week PROMIS-A, 6-week and 6-month PROMIS-PI, 6-week VAS back, 6-week and 6-month VAS leg, and 6- and 12-week ODI ($P \leq 0.047$, all). The greater PI cohort demonstrated significant improvement in 6-week–1-year PROMIS-PF, 6-week to 6-month PROMIS-A, 6-week to 1-year PROMIS-PI, 6-week to 6-month PROMIS-SD, 6-week Patient

Table 1. Patient Demographics

Characteristic	Total (n = 107)	PROMIS-PI < 64 (n = 35)	PROMIS-PI ≥ 64 (n = 72)	*P* Value*
Age (mean ± SD, years)	46.7 ± 14.0	46.6 ± 14.9	46.8 ± 13.7	0.887
Gender				0.524
Female	36.5% (39)	31.4% (11)	38.9% (28)	
Male	63.6% (68)	68.6% (24)	61.1% (44)	
BMI (mean ± SD, kg/m^2)	29.8 ± 6.4	28.3 ± 5.9	30.4 ± 6.7	0.141
Ethnicity				0.405
African American	8.0% (8)	3.0% (1)	10.5% (7)	
Asian	3.0% (3)	0.0% (0)	4.5% (3)	
Hispanic	12.0% (12)	9.1% (3)	13.4% (9)	
White	75.0% (75)	84.9% (28)	70.2% (47)	
Other	2.0% (2)	3.0% (1)	1.5% (1)	
Comorbidities				
Smoker	9.5% (10)	11.8% (4)	8.5% (6)	0.724
Hypertension	18.9% (20)	20.0% (7)	18.3% (13)	1.000
Diabetes	5.6% (6)	11.4% (4)	2.8% (2)	0.088
ASA score				0.214
≤2	87.9% (94)	94.3% (33)	84.7% (61)	
>2	12.2% (13)	5.7% (2)	15.3% (11)	
CCI Score (mean ± SD)	1.2 ± 1.5	1.3 ± 1.6	1.1 ± 1.4	0.656
Insurance type				0.544
Medicare/medicaid	8.4% (9)	11.4% (4)	6.9% (5)	
Workers' comp	11.2% (12)	14.3% (5)	9.7% (7)	
Private	80.4% (86)	74.3% (26)	83.3% (60)	

PROMIS-PI, Patient-Reported Outcomes Measurement Information System Pain Interference; SD, standard deviation; BMI, body mass index; ASA, American Society of Anesthesiologists; CCI, Charlson Comorbidity Index; Workers' Comp, workers' compensation.
**P* value calculated using Fisher exact tests for categorical variables or Mann-Whitney U test for continuous variables.

Health Questionnaire-9, 6-week to 6-month VAS back, 6-week to 6-month VAS leg, and 6-week to 6-month ODI ($P \leq 0.023$, all). Preoperatively, the lesser PI cohort reported superior PROM scores in all domains ($P \leq 0.001$, all). Postoperatively, the lesser PI cohort demonstrated significantly superior 6-week PROMIS-SD ($P = 0.011$). Direct assessment of PROM scores is in Table 3.

At individual time points, the greater PI cohort had higher rates of MCID achievement at 6-week PROMIS-PI, 6-week–6-month VAS back, 6- and 12-week VAS leg, and 6-week ODI ($P \leq 0.020$, all). The greater PI cohort achieved higher rates of overall MCID in PROMIS-PI, VAS back, VAS leg, and ODI ($P \leq 0.022$, all). MCID achievement rates are in Table 4.

DISCUSSION

In this study, we aimed to evaluate the influence of preoperative PI on postoperative clinical outcomes in patients undergoing lumbar decompression. Here, we found that patients with greater preoperative PI had greater PODo pain and narcotic consumption. Further, patients with greater preoperative PI had inferior preoperative PROs in all domains and postoperative anxiety and sleep disturbance. Regardless of preoperative PI, patients undergoing lumbar decompression reported significant postoperative improvement in physical function, anxiety, PI, pain, and disability. Patients with greater preoperative pain interference demonstrated additional improvement in sleep disturbance and depression. The greater PI cohort had higher MCID achievement rates in pain interference, pain, and disability outcomes. These findings indicate that patients with greater preoperative PI undergoing lumbar decompression may experience higher rates of clinically meaningful improvement.

Current spine literature on the influence of preoperative PI on postoperative outcomes is limited. One article of 78 patients undergoing lumbar discectomy reported that preoperative

Table 2. Perioperative Characteristics

Characteristic	Total (n = 107)	PROMIS-PI < 64 (n = 35)	PROMIS-PI ≥ 64 (n = 72)	*P* Value*
Spinal pathology				
Recurrent HNP	86.9% (93)	85.7% (30)	87.5% (63)	0.769
Central stenosis	97.2% (104)	97.1% (34)	97.2% (70)	1.000
Foraminal stenosis	80.4% (86)	80.0% (28)	80.6% (58)	1.000
Number of decompressed levels				0.452
1	83.2% (89)	77.1% (27)	86.1% (62)	
2	13.1% (14)	17.1% (6)	11.1% (8)	
3	3.7% (4)	5.7% (2)	2.8% (2)	
Procedure				
Laminectomy	98.1% (105)	97.1% (34)	98.6% (71)	0.549
Discectomy	88.8% (95)	85.7% (30)	90.3% (65)	0.522
Laminotomy	0.9% (1)	0.0% (0)	1.4% (1)	1.000
Foraminotomy	28.0% (30)	42.9% (15)	20.8% (15)	**0.023**
Facetectomy	36.5% (39)	48.6% (17)	30.6% (22)	0.088
Annulotomy	5.6% (6)	8.6% (3)	4.2% (3)	0.390
Operative time (minutes)				
Mean ± SD	36.3 ± 16.6	39.5 ± 18.8	34.7 ± 15.3	0.278
Estimated blood loss (mL)				
Mean ± SD	24.3 ± 2.9	23.9 ± 4.4	24.6 ± 1.9	0.610
Length of stay (hours)				
Mean ± SD	3.3 ± 3.5	3.5 ± 3.2	3.2 ± 3.6	0.707
Acute postoperative VAS pain				
POD 0	3.6 ± 2.2	2.7 ± 2.1	4.0 ± 2.2	**0.013**
Postoperative narcotic consumption (OME)				
POD 0	12.9 ± 9.4	11.4 ± 12.3	13.6 ± 7.7	**0.009**

Boldface indicates significance.
PROMIS-PI, Patient-Reported Outcomes Measurement Information System-Pain Interference; HNP, herniated nucleus pulposus; SD, standard deviation; VAS, visual analog scale; POD, postoperative day 0; OME, oral morphine equivalents.
**P*-value calculated using Fisher exact tests for categorical variables or Mann-Whitney U test for continuous variables.

PROMIS-PI, PROMIS-PF, and PROMIS depression scores were predictive of postoperative outcomes.[5] Further, patients with significantly worse preoperative PROMIS values were more likely to achieve MCID.[5] Despite the limited findings in the prognostic use of PROMIS-PI on clinical outcomes, many spine studies examine the relationship between PROMIS-PI to other PROMIS domains and legacy PROs in various populations and surgical techniques. One article of 2770 undergoing either cervical or lumbar spine surgery determined a strong correlation between PROMIS-PI and PROMIS-PF throughout the preoperative and postoperative period, with the absolute value of the correlations greater than 0.6.[10] A separate article examining spine trauma patients found a strong positive correlation of 0.79 between PROMIS-PI and ODI.[11] A study of 9020 patients presenting to an orthopedic spine clinic determined a correlation between ODI and PROMIS-PI as 0.81.[12] One study in cervical spine patients determined a moderately positive correlation between VAS neck and arm scores to PROMIS-PI.[13] A systematic review of 16 studies examining the relationship between various PROMIS domains and legacy PROs of ODI and 12-Item Short Form scores in spine surgery found moderate to strong correlations with decreased time to completion and comparable responsiveness.[4] Despite the limited literature on the prognostic value, these findings suggest moderate to strong correlations of preoperative and postoperative PI with legacy PROs relating to disability, pain, physical function, and mental function.

Table 3. Mean Patient Reported Outcomes

PROM	PROMIS-PI < 64 (Mean ± SD)	*P* Value*	PROMIS-PI ≥ 64 (Mean ± SD)	*P* Value*	*P* Value†
PROMIS-PF					
Preoperative	41.5 ± 5.7	-	34.1 ± 5.7	-	**<0.001**
6-week	46.3 ± 9.7	**<0.001**	40.7 ± 7.8	**<0.001**	0.065
12-week	45.1 ± 8.4	0.193	44.1 ± 8.6	**<0.001**	0.857
6-month	48.2 ± 8.0	0.281	47.7 ± 8.9	**<0.001**	0.663
1-year	44.4 ± 6.3	1.000	49.7 ± 12.3	**0.004**	0.377
PROMIS-A					
Preoperative	48.5 ± 9.2	-	59.6 ± 9.0	-	**<0.001**
6-week	46.6 ± 8.7	**0.003**	53.5 ± 11.4	**<0.001**	**0.016**
12-week	48.0 ± 9.7	0.021	51.3 ± 11.1	**<0.001**	0.311
6-month	45.1 ± 6.1	0.426	48.8 ± 11.0	**0.001**	0.249
1-year	44.3 ± 8.6	0.578	50.9 ± 10.9	0.297	0.244
PROMIS-PI					
Preoperative	58.4 ± 5.3	-	68.8 ± 3.9	-	**<0.001**
6-week	52.9 ± 9.2	**0.002**	56.6 ± 9.0	**<0.001**	0.289
12-week	53.9 ± 11.0	0.432	55.5 ± 11.7	**<0.001**	0.721
6-month	52.2 ± 6.8	**0.002**	54.8 ± 9.2	**<0.001**	0.331
1-year	57.7 ± 2.5	0.438	53.6 ± 11.8	**0.031**	0.505
PROMIS-SD					
Preoperative	48.0 ± 8.4	-	60.7 ± 8.8	-	**<0.001**
6-week	44.8 ± 8.6	0.342	51.9 ± 10.3	**<0.001**	**0.011**
12-week	44.9 ± 8.4	0.765	50.1 ± 10.6	**<0.001**	0.264
6-month	47.9 ± 4.5	1.000	46.9 ± 10.3	**<0.001**	0.436
1-year	48.5 ± 4.7	0.250	52.7 ± 13.3	0.578	0.932
PHQ-9					
Preoperative	3.3 ± 3.5	-	7.3 ± 6.1	-	**0.001**
6-week	2.2 ± 2.6	0.055	4.4 ± 4.8	**0.023**	0.069
12-week	3.8 ± 4.9	0.688	4.1 ± 5.1	0.070	0.773
6-month	3.0 ± 4.3	0.375	4.8 ± 5.7	0.219	0.563
1-year	2.8 ± 2.6	1.000	6.3 ± 6.1	1.000	0.407
VAS back					
Preoperative	4.0 ± 2.2	-	6.9 ± 2.2	-	**<0.001**
6-week	2.2 ± 2.1	**0.006**	2.7 ± 2.6	**<0.001**	0.447
12-week	2.4 ± 2.7	0.309	2.3 ± 2.5	**<0.001**	0.836
6-month	2.7 ± 3.1	0.984	2.5 ± 2.5	**<0.001**	0.958
1-year	2.0 ± 1.6	0.375	3.0 ± 3.1	0.063	0.810
VAS leg					
Preoperative	4.7 ± 2.4	-	6.7 ± 2.4	-	**<0.001**
6-week	3.2 ± 2.9	**0.039**	2.3 ± 3.0	**<0.001**	0.237
12-week	3.8 ± 3.2	0.672	2.8 ± 2.9	**<0.001**	0.319

Continues

Table 3. Continued

PROM	PROMIS-PI < 64 (Mean ± SD)	*P* Value*	PROMIS-PI ≥ 64 (Mean ± SD)	*P* Value*	*P* Value†
6-month	2.5 ± 3.1	**0.047**	2.0 ± 2.6	**<0.001**	0.686
1-year	1.6 ± 0.5	0.063	2.4 ± 3.3	0.125	0.810
ODI					
Preoperative	25.9 ± 11.8	-	50.9 ± 16.7	-	**<0.001**
6-week	19.8 ± 13.2	**0.008**	25.5 ± 20.0	**<0.001**	0.386
12-week	15.7 ± 14.0	**0.013**	22.8 ± 19.9	**<0.001**	0.320
6-month	14.5 ± 15.9	0.113	16.8 ± 17.4	**<0.001**	0.669
1-year	17.0 ± 9.2	0.625	19.7 ± 25.1	0.156	0.699

Boldface indicates significance.

PROMIS-PI, Patient-Reported Outcomes Measurement Information System-Pain Interference; PROMIS-PF, Patient-Reported Outcomes Measurement Information System-Physical Function; PROMIS-A, Patient-Reported Outcomes Measurement Information System-Anxiety; PROMIS-SD, Patient-Reported Outcomes Measurement Information System-Sleep Disturbance; PHQ-9, Patient Health Questionnaire-9; VAS, visual analog scale; ODI, Oswestry Disability Index.

**P* values calculated using Wilcoxon Signed Rank Sum test to determine improvement in PROs.

†*P* values calculated using Mann-Whitney U test for independent samples to compare PROs between groups.

For perioperative characteristics, patients with greater preoperative PI had higher immediate postoperative pain and narcotic consumption. As PI evaluates the impact of pain on activities of daily living, the higher postoperative pain values and narcotic consumption in the greater preoperative PI cohort are unsurprising.[1,3] Further, previous studies have established a moderate correlation between PI and pain scores.[13] Nevertheless, the overall narcotic consumption remained low in both cohorts.[14] Despite the higher pain scores and narcotic consumption in the greater PI cohort, the overall low narcotic consumption may indicate these differences may not indicate clinically significant findings.

In this present study, patients undergoing lumbar decompression reported significant postoperative improvement in physical function, anxiety, PI, pain, and disability outcomes independent of preoperative PI. Patients with greater preoperative PI demonstrated additional postoperative improvement in sleep disturbance and depression outcomes. As described in the previously cited sources, PROMIS-PI has moderate to strong correlations to physical function, disability, pain, and mental function.[4,10-13] As such, the findings of significantly inferior preoperative PROs in all domains for the greater PI cohort are unsurprising. Postoperatively, the persistence of significantly inferior anxiety and sleep disturbance in the greater PI cohort demonstrates the wide impact PI has on physical, mental, and social activities.[1,3] Despite the inferior postoperative outcomes in anxiety and sleep disturbance, both cohorts demonstrated PROMIS-A and PROMIS-SD less than 55, which represents a classification of slight to no anxiety or sleep disturbance, respectively.[15] Further, these differences did not persist past the 6-week time point and were not present postoperatively in all other domains evaluated. As such, preoperative PI may not limit postoperative improvement in physical function, anxiety, PI, sleep disturbance, mental health, pain, and disability after 6 weeks in patients undergoing lumbar decompression.

Patients with greater preoperative PI had higher MCID achievement rates in PI, pain, and disability outcomes. These findings of inferior preoperative outcomes with higher rates of MCID achievement were paralleled in the previous spine study cited.[5] One explanation of these findings may be that the patients with greater preoperative PI have a higher potential for postoperative improvement. As such, these patients are more likely to report greater improvements in their pain, disability, and pain interference postoperatively. Overall, these findings suggest that patients with greater preoperative PI had higher rates of clinically meaningful improvement.

The retrospective nature and primary outcomes of this study introduce several limitations. Utility of a single-surgeon registry limits the external validity and generalizability of these findings. This limitation is noted in the demographics, as patients were typically younger and generally had a low comorbidity burden. Usage of PROs as the primary outcome introduces susceptibility to response bias. Further, the loss to follow-up and retrospective review of the single-surgeon registry introduces selection bias, particularly at the later time points. This limitation is noted in the loss of statistical significance and worsening of postoperative PROs at 1-year follow-up for pain and disability outcomes in the greater PI cohort. One article examined this phenomenon, where

Table 4. MCID Achievement

PROM	PROMIS-PI < 64 %, (n)	PROMIS-PI ≥ 64 %, (n)	*P* Value*
PROMIS-PF			
6-weeks	50.0% (7)	56.8% (25)	0.761
12-weeks	50.0% (5)	66.7% (22)	0.460
6-months	50.0% (4)	83.3% (20)	0.152
1-year	33.3% (2)	66.7% (6)	0.315
Overall	61.9% (13)	77.4% (41)	0.246
PROMIS-A			
6-weeks	27.8% (5)	47.7% (21)	0.170
12-weeks	31.3% (5)	50.0% (17)	0.240
6-months	66.7% (6)	70.8% (17)	1.000
1-year	28.6% (2)	28.6% (2)	1.000
Overall	50.0% (14)	63.5% (33)	0.341
PROMIS-PI			
6-weeks	38.9% (7)	79.6% (35)	**0.003**
12-weeks	40.0% (4)	76.3% (29)	0.051
6-months	66.7% (8)	76.7% (23)	0.699
1-year	20.0% (1)	71.4% (5)	0.242
Overall	56.0% (14)	81.8% (45)	**0.027**
PROMIS-SD			
6-weeks	50.0% (8)	67.5% (27)	0.240
12-weeks	54.6% (6)	83.9% (26)	0.094
6-months	33.3% (2)	76.2% (16)	0.136
1-year	33.3% (1)	42.9% (3)	1.000
Overall	63.2% (12)	84.8% (39)	0.094
PHQ-9			
6-weeks	15.8% (3)	26.5% (9)	0.502
12-weeks	18.2% (2)	15.8% (3)	1.000
6-months	25.0% (2)	23.8% (5)	1.000
1-year	0.0% (0)	40.0% (2)	0.444
Overall	19.2% (5)	31.0% (13)	0.399
VAS back			
6-weeks	35.3% (6)	24.4% (10)	**0.005**
12-weeks	23.1% (3)	75.0% (21)	**0.003**
6-months	12.5% (1)	83.3% (15)	**0.001**
1-year	20.0% (1)	60.0% (3)	0.262
Overall	36.0% (9)	80.4% (37)	**<0.001**
VAS leg			
6-weeks	35.3% (6)	70.0% (28)	**0.020**
12-weeks	15.4% (2)	60.7% (17)	**0.009**

Continues

Table 4. Continued

	PROMIS-PI < 64	PROMIS-PI ≥ 64	
PROM	**%, (n)**	**%, (n)**	***P* Value***
6-months	50.0% (4)	77.8% (14)	0.197
1-year	20.0% (1)	76.0% (3)	0.206
Overall	36.0% (9)	75.6% (34)	**0.002**
ODI			
6-weeks	25.0% (4)	66.7% (28)	**0.007**
12-weeks	50.0% (6)	68.6% (24)	0.306
6-months	40.0% (4)	76.0% (19)	0.059
1-year	20.0% (1)	66.7% (4)	0.242
Overall	46.2% (12)	74.5% (38)	**0.022**

Boldface indicates significance.
PROMIS-PI, Patient-Reported Outcomes Measurement Information System-Pain Interference; PROMIS-PF, Patient-Reported Outcomes Measurement Information System-Physical Function; PROMIS-A, Patient-Reported Outcomes Measurement Information System-Anxiety; PROMIS-SD, Patient-Reported Outcomes Measurement Information System-Sleep Disturbance; PHQ-9, Patient Health Questionnaire-9; VAS, visual analog scale; ODI, Oswestry Disability Index.
**P* values calculated using Fisher exact test.

patients undergoing lumbar fusion who were contacted after being lost to follow-up reported substantially greater improvement compared to patients who continued to follow-up.[16]

CONCLUSION

Independent of preoperative PI, patients undergoing lumbar decompression demonstrated significant improvement in physical function, anxiety, PI, pain, and disability outcomes. Patients with lesser preoperative PI reported superior anxiety and sleep disturbance scores at the first postoperative follow-up, but this difference between groups did not persist in later follow-up periods. Patients with greater PI interference had higher MCID achievement in PI, pain, and disability outcomes. Patients undergoing lumbar decompression with greater preoperative PI may experience similar postoperative improvements and higher rates of clinically meaningful improvement. PROMIS-PI's combined predictive utility and decreased time required to complete this survey may offer surgeons and patients a more optimal assessment tool for managing expectations prior to surgery.

CRediT AUTHORSHIP CONTRIBUTION STATEMENT

James W. Nie: Conceptualization, Methodology, Visualization, Formal analysis, Software, Investigation, Writing — original draft, Writing — review & editing. **Timothy J. Hartman:** Conceptualization, Methodology, Visualization, Formal analysis, Software, Investigation, Writing — original draft, Writing — review & editing. **Omolabake O. Oyetayo:** Project administration, Data curation, Investigation, Writing — review & editing. **Keith R. MacGregor:** Project administration, Data curation, Investigation, Writing — review & editing. **Eileen Zheng:** Project administration, Data curation, Investigation, Writing — review & editing. **Kern Singh:** Conceptualization, Methodology, Supervision, Resources, Investigation, Writing — review & editing.

REFERENCES

1. Amtmann D, Cook KF, Jensen MP, et al. Development of a PROMIS item bank to measure pain interference. *Pain*. 2010;150:173-182.
2. Witter JP. The promise of patient-Reported Outcomes Measurement Information System-turning theory into reality: a uniform approach to patient-reported outcomes across rheumatic diseases. *Rheum Dis Clin North Am*. 2016;42:377-394.
3. Chen CX, Kroenke K, Stump TE, et al. Estimating minimally important differences for the PROMIS pain interference scales: results from 3 randomized clinical trials. *Pain*. 2018;159:775-782.
4. Young K, Steinhaus M, Gang C, et al. The use of patient-reported outcomes measurement information system in spine: a systematic review. *Int J Spine Surg*. 2021;15:186-194.
5. Rubery PT, Houck J, Mesfin A, Molinari R, Papuga MO. Preoperative patient reported outcomes measurement information system scores assist in predicting early postoperative success in lumbar discectomy. *Spine (Phila Pa 1976)*. 2019;44:325-333.

6. Askew RL, Cook KF, Revicki DA, Cella D, Amtmann D. Evidence from diverse clinical populations supported clinical validity of PROMIS pain interference and pain behavior. *J Clin Epidemiol*. 2016;73:103-111.

7. Parker SL, Adogwa O, Paul AR, et al. Utility of minimum clinically important difference in assessing pain, disability, and health state after transforaminal lumbar interbody fusion for degenerative lumbar spondylolisthesis. *J Neurosurg Spine*. 2011;14:598-604.

8. Hung M, Bounsanga J, Voss MW, Saltzman CL. Establishing minimum clinically important difference values for the Patient-Reported Outcomes Measurement Information System Physical Function, hip disability and osteoarthritis outcome score for joint reconstruction, and knee injury and osteoarthritis outcome score for joint reconstruction in orthopaedics. *World J Orthop*. 2018;9:41-49.

9. Ibaseta A, Rahman R, Andrade NS, et al. Determining validity, discriminant ability, responsiveness, and minimal clinically important differences for PROMIS in adult spinal deformity. *J Neurosurg Spine*. 2021;34:725-733.

10. Khalifeh JM, Dibble CF, Hawasli AH, Ray WZ. Patient-Reported Outcomes Measurement Information System physical function and pain interference in spine surgery. *J Neurosurg Spine*. 2019;31:1-10.

11. Bernstein DN, Greenstein AS, D'Amore T, Mesfin A. Do PROMIS physical function, pain interference, and Depression correlate to the Oswestry Disability Index and Neck Disability Index in spine trauma patients? *Spine (Phila Pa 1976)*. 2020;45:764-769.

12. Tang X, Schalet BD, Hung M, Brodke DS, Saltzman CL, Cella D. Linking Oswestry Disability Index to the PROMIS pain interference CAT with equipercentile methods. *Spine J*. 2021;21:1185-1192.

13. Owen RJ, Khan AZ, McAnany SJ, Peters C, Zebala LP. PROMIS correlation with NDI and VAS measurements of physical function and pain in surgical patients with cervical disc herniations and radiculopathy. *J Neurosurg Spine*. 2019;31:519-524.

14. Dowell D, Haegerich TM, Chou R. CDC guideline for prescribing opioids for chronic pain - United States, 2016. *MMWR Recomm Rep*. 2016;65:1-49.

15. Kim M, Opsasnick L, Batio S, et al. Prevalence and risk factors of sleep disturbance in adults with underlying health conditions during the ongoing COVID-19 pandemic. *Medicine (Baltimore)*. 2022;101:e30637.

16. Chen DA, Vaishnav AS, Louie PK, et al. Patient reported outcomes in patients who stop following up: are they doing better or worse than the patients that come back? *Spine (Phila Pa 1976)*. 2020;45:1435-1442.

Conflict of interest statement: The authors declare that the article content was composed in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received 26 September 2022; accepted 31 October 2022

Citation: World Neurosurg. (2023) 169:e270-e278.
https://doi.org/10.1016/j.wneu.2022.10.122

Journal homepage: ***www.journals.elsevier.com/world-neurosurgery***

Available online: ***www.sciencedirect.com***