Published in final edited form as:

J Am Acad Orthop Surg. 2018 December 15; 26(24): e511–e518. doi:10.5435/JAAOS-D-17-00039.

Using PROMIS Measures to Understand the Relationship Between Improvement in Physical Function and Depressive Symptoms

Casey M Beleckas, BS, Jason Guattery, MS, Aaron M Chamberlain, MD, MSc, Taleef Khan, BA, Michael P Kelly, MD, MSc, and Ryan P Calfee, MD, MSc

Investigation performed at Washington University, St. Louis, Missouri

Abstract

Introduction: This investigation determined if improved physical function and decreased pain would reduce depressive symptoms using the Patient-Reported Outcomes Measurement Information System (PROMIS).

Methods: This cohort study analyzed PROMIS Depression, Physical Function, and Pain Interference CAT scores from 3339 patients presenting to a tertiary orthopaedic center. Patients demonstrating at least a 5 point (effect size 0.5) improvement in PROMIS Physical Function between consecutive visits were eligible for inclusion.

Results: Patients presented, on average, with Physical Function and Pain Interference scores nearly 1 standard deviation worse than population averages and Depression scores that approximated the normal population. Improved Physical Function and Pain Interference scores demonstrated no correlation with change in Depression scores ($r = -0.13$, $r = 0.25$).

Discussion: Substantial early improvement in PROMIS Physical Function scores is not associated with change in PROMIS Depression scores. PROMIS Depression scores likely reflect underlying mental health rather than situational depressive symptoms.

Level of Evidence: Prognostic, Level III

Keywords

PROMIS; Depression; Physical Function; Pain Interference; orthopedic; mental health

INTRODUCTION:

Depression affects up to 20% of the general population^{1–3}. In patients seeking orthopaedic care, the prevalence of depression reaches 33–45%^{4,5}. Orthopedic patients with co-morbid depression require longer hospital admissions, experience higher rates of long term pain, and report lower quality-of-life (QOL) scores after treatment than patients without depression^{6–9}. Despite poorer perceived outcomes, however, patients with depression may experience similar improvements in physical function when compared to those without depression,

highlighting the complex relationship between mental health and physical outcomes¹⁰. Relevant studies in the orthopedic literature have consistently focused on the impact of mental health and depressive symptoms on musculoskeletal outcomes^{11–14}. Therefore, it remains unclear how changes in musculoskeletal health resulting from orthopedic care impact depressive symptoms.

This study was designed to determine if improvement in self-reported physical function corresponds with an improvement in depressive symptoms using the Patient-Reported Outcomes Measurement Information System (PROMIS) domains of Physical Function, Pain Interference, and Depression. PROMIS was developed by the National Institute of Health as part of its Health Roadmap Initiative. PROMIS provides a robust tool with increased sensitivity through a wider range of health function due the PROMIS tools' utilization of a large pool of validated questions administered through computerized adaptive testing (CAT)^{15–18}. In this model, the initial response leads to the selection of the next question, which over the course of 4–12 questions results in a sensitive measure of function through a wide range of perceived mental and physical health. The PROMIS tools are not disease-specific and examine the domains of physical, social, and mental health. Each PROMIS module is scored to produce a population normal mean score of 50 with a standard deviation of 10 points (theoretical range 0–100) as based on scores from a general adult US census matched population. Higher scores on each module represent more of the domain being measured such that higher scores are associated with greater physical function, more depression, and increased pain respectively. Although there is inherent subjectivity in any patient-reported outcome measure, PROMIS assessments present questions asking the frequency and amount of difficulty associated with certain tasks that have been demonstrated to be reliable over time^{16,19,20}. PROMIS has been validated as an effective screening tool for both depressive symptoms and physical function^{21–24}. Based on the literature documenting the negative association between self-reported physical function and depression, this study tested the null hypothesis that patients with improved physical function and pain following their orthopedic treatment, as measured by an increase in PROMIS Physical Function and a decrease in PROMIS Pain Interference scores respectively, would demonstrate a moderate correlation with improvement, or decrease, in PROMIS Depression scores.

MATERIALS AND METHODS:

This retrospective cohort study analyzed PROMIS scores drawn from a series of 37,697 consecutive initial outpatient clinic visits of adult patients presenting to a single tertiary orthopaedic clinic from 6/22/2015–8/1/2016. An Institutional Review Board exemption was confirmed, as all data were de-identified. All patients completed electronic PROMIS Depression, Physical Function, and Pain Interference Computer Adaptive Testing (CAT) upon arrival. At check-in, patients received a tablet computer (iPad mini, Apple, Cupertino, CA) that loaded the appropriate PROMIS health domain CATs for the patient to complete. This study gathered data from patients with a minimum of two office visits to our orthopaedic department during the inclusive study dates.

As our primary aim was to determine if improved perceived physical function or reduced pain interference were associated with lessened depressive symptoms, our inclusion criteria

required patients to have demonstrated at least a moderate improvement in PROMIS Physical Function (5 points, effect size 0.5) between consecutive visits. This 5 point cutoff was selected to approximate an estimated minimal clinically important difference in multiple PROMIS CATs, including Physical Function^{25–26}. Patients with an initial PROMIS Depression score of 35 (actual floor score indicating minimal depression 1.5 SD less than normal population) were excluded from analysis as improved Depression score is not possible given current scoring algorithms. Thus, 3339 patients, with 6678 visits, were eligible for inclusion (Figure 1). Patients were not selected based on specific conditions or treatment delivered. Time between visits was not constant as consecutive visits with improvement in physical function were sufficient for inclusion.

Pairwise non-parametric correlations with Spearman's rank correlation coefficients evaluated the relation of change in PROMIS scores from the first to second visit between all three modules. Non-parametric testing was chosen as the study's inclusion/exclusion criteria resulted in non-normal score distributions. Potential correlations with patient age as well as the relationship between absolute PROMIS scores and the magnitude of change were tested similarly. Correlation coefficients (r) were interpreted as recommended by Calkins: 0.00–0.29 no correlation, 0.30–0.49 weak correlation, 0.50–0.69 moderate correlation, 0.70–0.89 strong correlation, and 0.90–1.00 very strong²⁷. One-way ANOVA and Student's t-testing analyzed the impact of race and sex respectively on the magnitude of change in Physical Function, Pain Interference, and Depression scores.

Multivariable linear regression analyses with forwards selection assessed the impact of initial PROMIS Depression scores, change in PROMIS Pain Interference score, change in PROMIS Physical Function score, race, sex, and age on the magnitude of the change in PROMIS Depression scores between visits.

Subgroup analysis examined patients with initial Depression scores greater than the average for a general normative population mean (>50) and greater than one standard deviation above the normative population mean (>60).

RESULTS:

The patients meeting inclusion criteria (PROMIS Physical Function improvement of at least 5 points between visits, Depression score > 35) were comparable to the entire population of patients with repeat orthopaedic office visits (Table 1). Patients presented with, on average, Physical Function and Pain Interference scores over 1 standard deviation worse than normal population averages (i.e. worse physical function and increased pain) with Depression scores that approximated the normal population (Table 2). The average improvement in Physical Function score between first and second visits was 10.3 (SD 5). Over the same interval, Pain Interference scores improved 6.6 points (SD 8), while Depression scores improved 4.5 points (SD 8).

There was no correlation between patient age and the magnitude of change in any of the PROMIS scores ($r < 0.06$). The magnitude of change in Depression, Pain Interference, and

Physical Functions scores did not significantly differ according to race ($p=0.21$) or sex ($p=0.23$).

Depression scores at initial visits demonstrated a weak positive correlation with initial Pain Interference scores ($r=0.368$) and a weak negative correlation with initial Physical Function scores ($r=-0.339$) (Figure 2). Initial Depression scores demonstrated no correlation with subsequent change in Depression scores ($r=-0.229$), change in Physical Function scores ($r=-0.039$) or change in Pain Interference scores ($r=-0.020$).

The change in Physical Function scores demonstrated no correlation with change in Depression scores ($r=-0.13$) (Figure 3). No correlation was also demonstrated between change in Pain Interference scores with change in Depression score ($r=0.26$) (Figure 4). In multivariable modeling for predictors of change in depression, our model was significant but only predicted 15% of the variation in depression change ($r^2=0.15$, $p<0.01$) when including initial Depression scores, change in Pain Interference, and change in Physical Function with age, sex, and race being excluded from the final model.

Subgroup analysis on the 1757 patients with Depression scores >50 at initial presentation found no correlation between improved Physical Function and Depression scores ($r=-0.17$) and no correlation between improved Pain Interference and Depression scores ($r=0.29$). Subgroup analysis on the 571 patients with Depression scores >60 at baseline again demonstrated no correlation between improved Physical Function and Depression ($r=-0.18$), but a weak positive correlation was found between improvement in Pain Interference and Depression scores ($r=0.33$).

DISCUSSION:

Baseline PROMIS Physical Function scores document worse perceived function as patients report more depressive symptoms (PROMIS Depression scores). This inverse relationship between perceived physical function and depression is consistent with investigations using other patient-reported outcome measures^{10,14,28}. London et al. evaluated 256 patients with orthopaedic hand conditions and found that patients with higher levels of depression reported worse levels of function¹⁰. Likewise, depression more strongly predicted poor functional status than radiographic or physical examination findings in a study that evaluated 72 patients with trapeziometacarpal arthritis²⁸. In patients with full-thickness rotator cuff tears, Wylie et al. reported that mental health, as measured by SF-36 MCS, was a stronger predictor of pain and shoulder outcome scores than rotator cuff tear size¹⁴. While both PROMIS Physical Function and Depression CATS are individually validated²⁹, our results support that these domains capture an interaction between physical function and depression at presentation for care that has been demonstrated using other patient-reported health measures.

Although it is clear that mental and physical health are inter-related, the manner in which change in one domain may impact the other is less well understood^{10,12,30,31}. Callahan et al. and others have determined that treating depression could lead to an improvement in physical function^{30,31}. Meanwhile, our data suggest that improving physical function is not

associated with substantial change in depressive symptoms measured by PROMIS, as improvement in Physical Function scores accounted for only 0.5% of the variance in change in Depression scores. There are several possible explanations for our findings. Although musculoskeletal dysfunction and pain are acknowledged to produce depressive symptoms, PROMIS Depression scores may more accurately reflect underlying depressive outlook as opposed to brief situational depression. To this end, it is notable that PROMIS Depression questions specifically assess symptoms within the past seven days which would presumably have changed comparably to the change in physical function if indeed the musculoskeletal condition were the predominate source of the depressive symptoms. Second, this could be an indication that the relationship between physical function and mental health is less bidirectional than previously thought. Rather, poor mental health may affect one's perception of their physical health, but once poor physical health has triggered a change in mental health for the worse³², a subsequent improvement in physical health will not simply restore one's mental health. Finally, mental health changes that result from changes in physical function could lag behind and only become apparent with prolonged follow up. Regardless of the cause, when utilizing PROMIS scores in a clinical setting, it is important to recognize that early changes in physical function are not expected to substantially improve Depression scores.

We considered the potential bias towards finding that Depression scores changed little relative to Physical Function scores based on the inclusion of patients who reported less depressive symptoms than the normative population. To determine whether this bias was present, we chose to analyze two subgroups of patients: those with Depression scores greater than the population mean (>50) and those with scores one standard deviation greater than the mean (>60). This highest cutoff point was chosen for consistency with Pilkonis et al. who determined that the average PROMIS Depression score in a group of clinically depressed patients was 62³³. However, even when these subsets of patients were analyzed, there was no stronger association between improvement in physical function and improvement in depression.

Improvement in Pain Interference scores demonstrated some positive correlation with improvement in Depression scores in the subpopulation of patients reporting Depression scores over 1 standard deviation greater than the normal population mean. Pain has long been known to be intimately associated with the development of depression³⁴⁻³⁶. Current research suggests that the descending pathways of pain modulation are affected by levels of norepinephrine and serotonin, the same neurotransmitters targeted by antidepressants³⁷⁻³⁸. Clinically, patients with higher levels of depression are more likely to report higher scores on the Chronic Pain Grade³⁴. Depressed patients are also more likely to report both more frequently recurrent and higher levels of post-operative pain after a variety of surgical procedures^{35,36}. Conversely, Sullivan et al. found that reduction of pain was correlated with decreased depressive symptoms³⁹. Von Korff et al. demonstrated that patients who experienced resolution of their pain subsequently reported improved depressive symptoms as measured by the SCL-90 Depression Scale⁴⁰. The positive, albeit weak, correlation between improvement in depression and pain interference scores in this cohort demonstrates that PROMIS captures this relationship. Notably, PROMIS Pain Interference measures the degree to which pain interferes with function as opposed to pain magnitude. At this time, we

cannot determine if depressive symptoms would more strongly or weakly correlate with changes in absolute pain magnitude.

This study was conducted to broadly include all adult patients presenting for orthopedic care. The large number of patients contributing data and the inclusion of patients from all orthopedic specialties should strengthen the ability to generalize our results. However, there are several limitations inherent to our study. CPT codes were not available within this dataset and manual chart review was not feasible to determine specific treatment modalities, radiographic findings, or other clinical correlates. Therefore, we examined temporal changes between visits, rather than change after specific treatment. Furthermore, the times between consecutive office visits were not standardized although we were able to select a population reporting improved physical function with an effect size of at least 0.5. Data regarding antidepressant and pain medication use, as well as a clinical diagnosis of depression, were also unavailable, which could potentially confound the impact of improving physical function on depressive symptoms. It is also worth noting that, although PROMIS Depression scores can be translated into scores on other depression screening surveys, these scores are not intended to make the diagnosis of clinical depression. It is possible that patients with a clinical diagnosis of depression may report less transience of their depressive symptoms, and thus less improvement with improving pain or function. We anticipate continued research into the inter-relationships of mental and physical health as well as investigation into the application of PROMIS in the clinical setting. Finally, while computer adaptive testing improves the sensitivity and efficiency of PROMIS, this feature prohibits us from performing question level analysis as each patient may receive different questions within each health assessment.

PROMIS represents a substantial governmental effort to produce a unified collection of health domain assessments that may be used across specialties. Although PROMIS is well tested in the normal population, we are still working to better understand its performance in the clinical setting. Our data supports the concept of inter-related perceptions of physical function, pain, and depressive symptoms at presentation, but suggests that improved physical function is not consistently associated with less depressive symptoms. Thus, when used to assess populations of patients, PROMIS depression scores appear to capture an element of mental health and outlook which is not modified by early improvement in physical function or pain following orthopaedic treatment.

Acknowledgments

Grant Support: This publication was made possible by Grant Number UL1 TR000448 and TL1 TR000449 from the National Center for Advanced Translational Sciences (NCATS), National Institutes of Health. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

Dr. Chamberlain or an immediate family member serves as a paid consultant to Arthrex, DePuy, and Zimmer; and has received research or institutional support from Zimmer. Dr. Kelly or an immediate family member has received research or institutional support from DePuy. Dr. Calfee or an immediate family member has received research or institutional support from Medartis; and serves as a board member, owner, officer, or committee member of the American Society for Surgery of the Hand. None of the following authors or any immediate family member has received anything of value from or has stock or stock options held in a commercial company or institution related directly or indirectly to the subject of this article: Ms. Beleckas, Mr. Guattery, and Mr. Khan.

References

1. Robins LN, Helzer JE, Weissman MM, et al. Lifetime prevalence of specific psychiatric disorders in three sites. *Arch Gen Psychiatry*. 1984;41(10):949–958. [PubMed: 6332590]
2. Kessler RC, Berglund P, Demler O, et al. The epidemiology of major depressive disorder: results from the National Comorbidity Survey Replication (NCS-R). *JAMA*. 2003;289(23):3095–3105. [PubMed: 12813115]
3. Blazer DG, Kessler RC, McGonagle KA, Swartz MS. The prevalence and distribution of major depression in a national community sample: the National Comorbidity Survey. *Am J Psychiatry*. 1994;151(7):979–986. [PubMed: 8010383]
4. Crichlow RJ, Andres PL, Morrison SM, Haley SM, Vrahas MS. Depression in orthopaedic trauma patients. Prevalence and severity. *J Bone Joint Surg Am*. 2006;88(9):1927–1933. [PubMed: 16951107]
5. de Moraes VY, Jorge MR, Faloppa F, Belloti JC. Anxiety and depression in Brazilian orthopaedics inpatients: a cross sectional study with a clinical sample comparison. *J Clin Psychol Med Settings*. 2010;17(1):31–37. [PubMed: 20111986]
6. Brander V, Gondek S, Martin E, Stulberg SD. Pain and depression influence outcome 5 years after knee replacement surgery. *Clin Orthop Relat Res*. 2007;464:21–26. [PubMed: 17603386]
7. Singh JA, Lewallen D. Age, gender, obesity, and depression are associated with patient-related pain and function outcome after revision total hip arthroplasty. *Clin Rheumatol*. 2009;28(12):1419–1430. [PubMed: 19727914]
8. Duivenvoorden T, Vissers MM, Verhaar JA, et al. Anxiety and depressive symptoms before and after total hip and knee arthroplasty: a prospective multicentre study. *Osteoarthritis Cartilage*. 2013;21(12):1834–1840. [PubMed: 24012622]
9. Caracciolo B, Giaquinto S. Self-perceived distress and self-perceived functional recovery after recent total hip and knee arthroplasty. *Arch Gerontol Geriatr*. 2005;41(2):177–181. [PubMed: 16085069]
10. London DA, Stepan JG, Boyer MI, Calfee RP. The impact of depression and pain catastrophization on initial presentation and treatment outcomes for atraumatic hand conditions. *J Bone Joint Surg Am*. 2014;96(10):806–814. [PubMed: 24875021]
11. Garcia GH, Wu HH, Park MJ, et al. Depression Symptomatology and Anterior Cruciate Ligament Injury: Incidence and Effect on Functional Outcome--A Prospective Cohort Study. *Am J Sports Med*. 2016;44(3):572–579. [PubMed: 26628516]
12. Ring D, Kadzielski J, Fabian L, Zurakowski D, Malhotra LR, Jupiter JB. Self-reported upper extremity health status correlates with depression. *J Bone Joint Surg Am*. 2006;88(9):1983–1988. [PubMed: 16951115]
13. Yeoh JC, Pike JM, Slobogean GP, O'Brien PJ, Broekhuysen HM, Lefaivre KA. Role of Depression in Outcomes of Low-Energy Distal Radius Fractures in Patients Older Than 55 Years. *J Orthop Trauma*. 2016;30(5):228–233. [PubMed: 27101161]
14. Wylie JD, Suter T, Potter MQ, Granger EK, Tashjian RZ. Mental Health Has a Stronger Association with Patient-Reported Shoulder Pain and Function Than Tear Size in Patients with Full-Thickness Rotator Cuff Tears. *J Bone Joint Surg Am*. 2016;98(4):251–256. [PubMed: 26888672]
15. 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. [PubMed: 24241485]
16. Hung M, Franklin JD, Hon SD, Cheng C, Conrad J, Saltzman CL. Time for a paradigm shift with computerized adaptive testing of general physical function outcomes measurements. *Foot Ankle Int*. 2014;35(1):1–7. [PubMed: 24101733]
17. Pilkonis PA, Choi SW, Reise SP, et al. Item banks for measuring emotional distress from the Patient-Reported Outcomes Measurement Information System (PROMIS®): depression, anxiety, and anger. *Assessment*. 2011;18(3):263–283. [PubMed: 21697139]

18. Riley WT, Pilkonis P, Cella D. Application of the National Institutes of Health Patient-reported Outcome Measurement Information System (PROMIS) to mental health research. *J Ment Health Policy Econ*. 2011;14(4):201–208. [PubMed: 22345362]
19. Bartlett SJ, Orbai AM, Duncan T, et al. Reliability and Validity of Selected PROMIS Measures in People with Rheumatoid Arthritis. *PLoS One*. 2015;10(9):e0138543. [PubMed: 26379233]
20. Broderick JE, Schneider S, Junghaenel DU, Schwartz JE, Stone AA. Validity and reliability of patient-reported outcomes measurement information system instruments in osteoarthritis. *Arthritis Care Res (Hoboken)*. 2013;65(10):1625–1633. [PubMed: 23592494]
21. Cella D, Riley W, Stone A, et al. The Patient-Reported Outcomes Measurement Information System (PROMIS) developed and tested its first wave of adult self-reported health outcome item banks: 2005–2008. *J Clin Epidemiol*. 2010;63(11):1179–1194. [PubMed: 20685078]
22. Hays RD, Bjorner JB, Revicki DA, Spritzer KL, Cella D. Development of physical and mental health summary scores from the patient-reported outcomes measurement information system (PROMIS) global items. *Qual Life Res*. 2009;18(7):873–880. [PubMed: 19543809]
23. Ho B, Houck JR, Flemister AS, et al. Preoperative PROMIS Scores Predict Postoperative Success in Foot and Ankle Patients. *Foot Ankle Int*. 2016;37(9):911–918. [PubMed: 27530986]
24. Choi SW, Schalet B, Cook KF, Cella D. Establishing a common metric for depressive symptoms: linking the BDI-II, CES-D, and PHQ-9 to PROMIS depression. *Psychol Assess*. 2014;26(2):513–527. [PubMed: 24548149]
25. Yost KJ, Eton DT, Garcia SF, Cella D. Minimally important differences were estimated for six Patient-Reported Outcomes Measurement Information System-Cancer scales in advanced-stage cancer patients. *J Clin Epidemiol*. 2011;64(5):507–516. [PubMed: 21447427]
26. Amtmann D, Kim J, Chung H, Askew RL, Park R, Cook KF. Minimally important differences for Patient Reported Outcomes Measurement Information System pain interference for individuals with back pain. *J Pain Res*. 2016;9:251–255. [PubMed: 27175093]
27. Calkins KG, Andrews University. Applied Statistics-Lesson 5: Correlation Coefficients. <http://www.andrews.edu/~calkins/math/edrm611/edrm05.htm>. Accessed Oct 14, 2016.
28. Lozano-Calderon SA, Souer JS, Jupiter JB, Ring D. Psychological differences between patients that elect operative or nonoperative treatment for trapeziometacarpal joint arthrosis. *Hand (N Y)*. 2008;3(3):271–275. [PubMed: 18780109]
29. Peters RM, Menendez ME, Mellema JJ, Ring D, Vranceanu AM. Sleep Disturbance and Upper-Extremity Disability. *Arch Bone Jt Surg*. 2016;4(1):35–40. [PubMed: 26894216]
30. Callahan CM, Kroenke K, Counsell SR, et al. Treatment of depression improves physical functioning in older adults. *J Am Geriatr Soc*. 2005;53(3):367–373. [PubMed: 15743276]
31. Greco T, Eckert G, Kroenke K. The outcome of physical symptoms with treatment of depression. *J Gen Intern Med*. 2004;19(8):813–818. [PubMed: 15242465]
32. Dersh J, Mayer T, Theodore BR, Polatin P, Gatchel RJ. Do psychiatric disorders first appear preinjury or postinjury in chronic disabling occupational spinal disorders? *Spine (Phila Pa 1976)*. 2007;32(9):1045–1051. [PubMed: 17450081]
33. Pilkonis PA, Yu L, Dodds NE, Johnston KL, Maihoefer CC, Lawrence SM. Validation of the depression item bank from the Patient-Reported Outcomes Measurement Information System (PROMIS) in a three-month observational study. *J Psychiatr Res*. 2014;56:112–119. [PubMed: 24931848]
34. de Heer EW, Gerrits MM, Beekman AT, et al. The association of depression and anxiety with pain: a study from NESDA. *PLoS One*. 2014;9(10):e106907. [PubMed: 25330004]
35. Lindberg MF, Miaskowski C, Rustøen T, Rosseland LA, Cooper BA, Lerdal A. Factors that can predict pain with walking, 12 months after total knee arthroplasty. *Acta Orthop*. 2016:1–7.
36. Trief PM, Ploutz-Snyder R, Fredrickson BE. Emotional health predicts pain and function after fusion: a prospective multicenter study. *Spine (Phila Pa 1976)*. 2006;31(7):823–830. [PubMed: 16582857]
37. Fields H Pain modulation, expectations, opioid analgesia, and virtual pain. *Prog Brain Res*. 2000;122:245–253. [PubMed: 10737063]
38. Hirakawa N, Tershner SA, Fields HL. Highly delta selective antagonists in the RVM attenuate the antinociceptive effect of PAG DAMGO. *Neuroreport*. 1999;10:3125–29. [PubMed: 10574547]

39. Sullivan MJ, Adams H, Tripp D, Stanish WD. Stage of chronicity and treatment response in patients with musculoskeletal injuries and concurrent symptoms of depression. *Pain*. 2008;135(1–2):151–159. [PubMed: 17646052]
40. Von Korff M, Deyo RA, Cherkin D, Barlow W. Back pain in primary care. Outcomes at 1 year. *Spine (Phila Pa 1976)*. 1993;18(7):855–862. [PubMed: 8316884]

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Figure 1:
Flowchart of patients who met the inclusion and exclusion criteria for the study population.

Figure 2:

Relationship between initial PROMIS Depression scores with a) initial Physical Function scores and b) Pain interference scores. Bars represent 95% confidence intervals.

Figure 3:
Correlation between change in Physical Function scores and change in Depression scores.

Figure 4:
Correlation between change in Physical Function scores and change in Depression scores.

Table 1.

Demographic data for study patients and all patients presenting within the study period.

	All patients (n=37,697)	Study patients (n=3,339)
Female Sex	21540 (57.1%)	1926 (57.7%)
Average Age (SD)	53 y (17)	53 y (17)
Race		
Caucasian	31689 (84.1%)	2788 (83.5%)
African American	4912 (13.0%)	444 (13.3%)
Other	1096 (2.9%)	107 (3.2%)
Orthopedic Division		
Upper Extremity	9215 (24.5%)	868 (26.0%)
Lower Extremity	8132 (21.6%)	732 (21.9%)
Sports	5541 (14.7%)	521 (15.6%)
Trauma	2185 (5.8%)	370 (11.1%)
Spine	2734 (7.3%)	198 (5.9%)
Other	9877 (26.2%)	650 (19.5%)

Table 2.

Average baseline and changes in PROMIS scores.

	Baseline Score (SD)	Range	Change Between Visits (Visit 2 – Visit 1) (SD)
Depression	52 (8)	38–84	–5 (8)
Pain Interference	64 (7)	39–84	–6 (8)
Physical Function	34 (8)	15–66	10 (5)

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript