Correlation of PROMIS Physical Function, Pain Interference, and Depression in Pediatric and Adolescent Patients in the Ambulatory Sports Medicine Clinic

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Background: Recently, interest has increased in incorporating the National Institutes of Health Patient-Reported Outcomes Measurement Information System (PROMIS) outcomes into clinical and research applications in sports medicine. The PROMIS forms have not been studied in pediatric and adolescent sports medicine patients.

Purpose/Hypothesis: The goal of this study was to determine the correlation between PROMIS Computer Adaptive Test (CAT) forms measuring physical function, pain interference, and depression in pediatric and adolescent patients seen in the ambulatory sports medicine clinic. We hypothesized that there would be a negative correlation between physical function and pain interference as well as depression, as has been demonstrated in adult patient populations.

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

Methods: All patients aged 8 to 17 years seen by 3 shoulder and sports medicine providers were included in this study. Patients completed a series of PROMIS CAT forms at clinic visits, including the PROMIS-PF and PROMIS-UE (Physical Function and Upper Extremity; depending on the nature of the complaint), PROMIS-PI (Pain Interference), and PROMIS-Depression subscales. Pearson correlation coefficients were calculated between the PROMIS forms as well as with other patient demographic data.

Results: A total of 236 patient visits (152 patients) were included in the study, comprising 712 total PROMIS CAT forms. A negative correlation was found between PROMIS-PF and both PROMIS-Depression ($R = -0.34$) and PROMIS-PI ($R = -0.76$). These correlations with PROMIS-Depression and PROMIS-PI were $-0.21$ and $-0.75$, respectively, when considering the PROMIS-UE CAT. Patient demographic information had minimal impact on PROMIS scores as well as on correlations between scores.

Conclusion: Correlations between physical function, pain interference, and depression were found to be similar in pediatric patients as they are in adult patients, as measured by PROMIS CAT forms.

Keywords: PROMIS; computer adaptive test; pediatrics
Computer Adaptive Testing (CAT) forms tailor the questions posed to the patient by using previous responses and a bank of questions. This allows for accurate responses in fewer questions answered. Numerous studies have demonstrated improved efficiency when using these scores compared with traditional, lengthier PRO scores, without loss of psychometric properties. The use of these scores in the pediatric and adolescent sports medicine population has not been extensively studied, however. In a recent validation study of PROMIS Physical Function (PROMIS-PF) and Upper Extremity (PROMIS-UE) forms in patients with glenohumeral instability, the researchers included pediatric and adolescent patients (age range of 12-54 years in the total patient cohort) and found that younger patients demonstrated a higher likelihood of ceiling effect with the PROMIS-UE form. Therefore, the need for dedicated study of these increasingly popular PROMIS forms in pediatric and adolescent patients is justified.

The goal of this study was to examine the correlation of PROMIS-PF, PROMIS Pain Interference (PROMIS-PI), and PROMIS-Depression CAT forms in pediatric and adolescent patients in the ambulatory sports medicine clinic. We hypothesized that there will be an inverse correlation between physical function and both pain interference and depression scores, as has been found in numerous studies in adult patients.

METHODS

All patients 17 years of age or younger presenting to an orthopaedic sports medicine ambulatory clinic of 3 providers were recruited for the study. Recruitment was done at a single, multisite institution between July 2017 and November 2017. Surveys were administered upon check-in for the office visit prior to the evaluation. Survey forms were completed on a tablet computer (iPad tablet; Apple). Those patients or guardians who could not communicate (read and write) in English or who refused participation were excluded from the study.

All study data were collected and managed through use of Research Electronic Data Capture (REDCap), a secure, web-based application designed to support data capture for research studies hosted at our institution. These surveys included an intake form asking for the name of the patient’s provider and location of pain followed by a CAT set consisting of PROMIS-PF for patients with lower extremity concerns or PROMIS-UE for patients with upper extremity concerns, PROMIS-PI, and PROMIS-Depression (Table 1).

### TABLE 1

| PROMIS Domain Definitions<sup>a</sup> |
|---------------------------------------|
| Physical Function                     |
| The ability to perform physical activities including those of the upper extremities, lower extremities, neck, back, and activities of daily living |
| Upper Extremity                       |
| The ability to perform physical activities that require use of the upper extremities |
| Pain                                  |
| The impact of pain on one’s life including mental, social, and physical well-being |
| Interference                          |
| Depression                             |
| An evaluation of negative mood, views of self, and social cognition, in addition to one’s affect and engagement |

<sup>a</sup>PROMIS, Patient-Reported Outcomes Measurement Information System. Data are from Northwestern University.

Patient sex, age, race, ethnicity, body mass index (BMI), tobacco use, employment status, and the diagnosis of the presenting concern were retrospectively collected from the electronic medical record (EMR). Tobacco use, including any form, was recorded as never, current, or former use. Employment status was recorded as employed or unknown. Patients with documented employment were designated as employed, while those listed as unemployed or without EMR employment documentation were collectively categorized as unknown. Median household income (MHI) was recorded as the MHI of the patient’s ZIP code. This information was publicly available online (https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml?src=bkmk). Primary diagnosis and chronicity were determined from a chart review of the clinic visit during which the survey was collected. The chronicity of the diagnosis was recorded as acute (if present for ≤6 weeks) or chronic (if present for >6 weeks).

Statistical Analysis

All statistical analysis was conducted by one of the authors who was trained in statistics (J.S.). Continuous data, consisting of PROMIS outcomes, were compared between groups by use of 1-way analyses of variance and independent t tests, with P ≤ .05 denoted as a statistically significant difference. All analyses were performed using Stata, version 14. Pearson correlations were performed to investigate the relationships between PROMIS scores. Correlation coefficients were interpreted based on previously published medical statistics literature, with absolute values of 0.00 to 0.30 representing a negligible correlation.

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0.31 to 0.50 a weak correlation, 0.51 to 0.70 a moderate correlation, 0.71 to 0.90 a strong correlation, and 0.91 to 1.00 a very strong correlation.14

RESULTS

A total of 236 CAT questionnaire sets (PROMIS-PF and/or PROMIS-UE, PROMIS-PI, and PROMIS-Depression) were collected and analyzed from 152 unique patients (Table 2), totaling 712 PROMIS forms. In 4 instances, a patient identified an upper and a lower extremity concern, resulting in the completion of both PROMIS-PF and PROMIS-UE. The mean ± SD age of the patients surveyed was 15.5 ± 1.5 years (range, 8-17 years), with 58% male and 42% female participants. The MHI was $67,326 ± $24,504 ($20,891-$130,699). The average BMI of our population was 24.6 ± 4.6 kg/m² (range, 15.5-39.4 kg/m²), and 58% of the patients identified as white, with the predominant ethnicity being non-Hispanic (68%). A total of 11 (5%) of the questionnaire sets were completed by patients with documented employment. The majority of patient surveys (96%) stated they had never used tobacco. The most frequent presenting concerns were those of the knee, followed by the shoulder, hip, and elbow (Table 3).

Patients were asked to answer the most questions while taking the PROMIS-Depression (7.6 ± 3.8). This was followed by PROMIS-UE, PROMIS-PI, and PROMIS-PF. The average number of questions completed per PROMIS domain is shown in Table 4.

Table 5 summarizes PROMIS correlations as each domain relates to the other domains, age, BMI, and MHI. PROMIS-PF was found to have a strong negative correlation with PROMIS-PI (R = −0.76, P < .001) and a weak correlation with PROMIS-Depression (R = −0.34, P < 0.001). The stronger correlation between PROMIS-PF and PROMIS-PI suggests that these domains are more closely represented by a linear relationship compared with that of PROMIS-PF and PROMIS-Depression. PROMIS-UE also had a strong negative correlation with PROMIS-PI (R = −0.75, P < .001). PROMIS-PI was weakly correlated with PROMIS-Depression (R = 0.45, P < .001).

Data were analyzed for each patient’s first survey administration. Table 6 summarizes PROMIS correlations as each

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**TABLE 2**

| Variable               | Value               |
|------------------------|---------------------|
| Age, y                 | 15.5 ± 1.5 (8-17)   |
| Body mass index        | 24.6 ± 4.6 (15.5-39.4) |
| Median household income| $67,326 ± $24,504 ($20,891-$130,699) |
| Sex                    |                     |
| Male                   | 136 (58)            |
| Female                 | 100 (42)            |
| Race                   |                     |
| White                  | 136 (58)            |
| Black                  | 43 (18)             |
| Other                  | 24 (10)             |
| Unknown                | 33 (14)             |
| Ethnicity              |                     |
| Hispanic or Latino     | 14 (6)              |
| Non-Hispanic or Latino | 160 (68)            |
| Unknown                | 62 (26)             |
| Employment status      |                     |
| Employed               | 11 (5)              |
| Unknown                | 225 (95)            |
| Tobacco use            |                     |
| Current                | 0 (0)               |
| Former                 | 0 (0)               |
| Never                  | 227 (96)            |
| Unknown                | 9 (4)               |

Values are expressed as mean ± SD (range) or n (%). Data are derived from 236 questionnaire sets from 152 patients.

**TABLE 3**

| Location of Presenting Concern | n (%) |
|--------------------------------|-------|
| Knee                           | 153 (65)       |
| Shoulder                       | 40 (17)        |
| Hip                            | 27 (11)        |
| Elbow                          | 16 (7)         |
| Chronic                        | 68 (29)        |
| Postoperative/unknown          | 63 (27)        |

**TABLE 4**

| PROMIS Domain               | Mean ± SD |
|-----------------------------|-----------|
| Physical Function           | 4.7 ± 2.0 |
| Upper Extremity             | 6.7 ± 3.5 |
| Pain Interference           | 5.1 ± 2.7 |
| Depression                  | 7.6 ± 3.8 |

**TABLE 5**

| PROMIS-PF | PROMIS-UE | PROMIS-PI | PROMIS-Depression |
|-----------|-----------|-----------|-------------------|
| PROMIS-UE |           |           |                   |
| PROMIS-PI | −0.76c    | −0.75c    |                   |
| PROMIS-Depression | −0.34c    | −0.21     | 0.45c             |
| Age       | −0.10     | 0.15      | 0.05              |
| BMI       | −0.19c    | 0.18      | 0.13              |
| MHI       | 0.10      | −0.23     | −0.01             |

BMI, body mass index; MHI, median household income; PF, Physical Function; PI, Pain Interference; PROMIS, Patient-Reported Outcomes Measurement Information System; UE, Upper Extremity.

aBNo correlation because of only 4 pairings.

bDenotes a statistically significant finding (P ≤ .05).

Table 5 summarizes PROMIS correlations as each domain relates to the other domains, age, BMI, and MHI. PROMIS-PF was found to have a strong negative correlation with PROMIS-PI (R = −0.76, P < .001) and a weak correlation with PROMIS-Depression (R = −0.34, P < 0.001). The stronger correlation between PROMIS-PF and PROMIS-PI suggests that these domains are more closely represented by a linear relationship compared with that of PROMIS-PF and PROMIS-Depression. PROMIS-UE also had a strong negative correlation with PROMIS-PI (R = −0.75, P < .001). PROMIS-PI was weakly correlated with PROMIS-Depression (R = 0.45, P < .001).
TABLE 6
Correlations Between PROMIS Domains
on First Questionnaire Set

|          | PROMIS-PF | PROMIS-UE | PROMIS-PI |
|----------|-----------|-----------|-----------|
| PROMIS-UE | \( b \)   | \(-0.69^c\) | \(-0.79^c\) |
| PROMIS-PF | \(-0.29^c\) | \(-0.32^c\) | 0.45\( ^c \) |
| PROMIS-Depression | \(-0.72^c\) | \(-0.80^c\) | \( R = -0.69, P < .001 \) |
| PROMIS-UE | \(-0.79^c\) | \( R = -0.79, P < .001 \) |
| PROMIS-PI | \(-0.32^c\) | \(-0.72^c\) | \( R = -0.76, P < .001 \) |
| PROMIS-PF | \(-0.58, P < .05 \) | \( R = -0.58, P < .05 \) |
| PROMIS-Depression | \( R = 0.45, P < .001 \) | \( R = 0.45, P < .001 \) | \( R = 0.45, P < .001 \) |
| PROMIS-UE | \( R = -0.60 \) | \( R = -0.65 \) | \( R = -0.60 \) |
| PROMIS-PI | \( R = -0.75 \) | \( R = -0.75 \) | \( R = -0.75 \) |
| PROMIS-PF | \( R = -0.72 \) | \( R = -0.72 \) | \( R = -0.72 \) |
| PROMIS-Depression | \( R = 0.45, P < .001 \) | \( R = 0.45, P < .001 \) | \( R = 0.45, P < .001 \) |

\( ^a \)PF, Physical Function; PI, Pain Interference; PROMIS, Patient-Reported Outcomes Measurement Information System; UE, Upper Extremity.
\( ^b \)No correlation because of only 4 pairings.
\( ^c \)Denotes a statistically significant finding (\( P < .05 \)).

The relevance of PROMIS forms in the pediatric population has been studied in non–sports medicine applications. These investigations have demonstrated usefulness of pediatric PROMIS forms in this patient population. In 1 study of 33 patients aged 6 to 17 years with congenital hand conditions, good correlation was noted between the pediatric PROMIS-UE CAT and objective measures of grip strength and pinch strength (0.60 and 0.52, respectively). The correlation between the PROMIS-UE CAT and the Michigan Hand Questionnaire (MHQ) (overall function) was noted to be 0.46, and a strong negative correlation was found between the PROMIS-UE CAT and the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire (–0.87). Although the pediatric PROMIS form was used in that study, the correlations were noted with the standard MHQ and DASH forms. Other studies in hand surgery have similarly used the pediatric PROMIS scores.

Our study examined standard PROMIS forms in the pediatric and adolescent population. In addition to the correlations observed and reported above, we examined the
Impact of Patient-Centric Factors on PROMIS

| Sex            | PROMIS-PF | PROMIS-UE | PROMIS-PI | PROMIS-Depression |
|----------------|-----------|-----------|-----------|-------------------|
| Male           | 42.5 ± 11.7 | 41.4 ± 11.9 | 56.2 ± 8.8 | 44.1 ± 8.2 |
| Female         | 45.2 ± 11.4 | 38.5 ± 7.6  | 55.3 ± 8.7 | 44.9 ± 9.6  |
| Race           |           |           |           |                  |
| White          | 41.5 ± 11.4 | 38.5 ± 10.6 | 57.1 ± 8.4 | 44.7 ± 8.4  |
| Black          | 45.0 ± 11.2 | 49.6 ± 10.7 | 59.3 ± 9.3 | 44.3 ± 10.0 |
| Other          | 45.4 ± 9.2  | 37.1 ± 7.3  | 55.3 ± 9.1 | 46.2 ± 12.3 |
| Chronicity     |           |           |           |                  |
| Acute          | 42.6 ± 9.3  | 38.8 ± 9.9  | 57.6 ± 6.9 | 45.4 ± 8.2  |
| Chronic        | 40.7 ± 10.8 | 37.9 ± 9.9  | 58.1 ± 8.5 | 45.6 ± 8.6  |
| Age quartile   |           |           |           |                  |
| First (8-15 y) | 41.5 ± 11.4 | 38.3 ± 9.7  | 54.4 ± 9.2 | 42.6 ± 7.6  |
| Second (15-16 y) | 45.0 ± 11.2 | 31.0 ± 9.1  | 57.4 ± 9.2 | 44.3 ± 10.0 |
| Third (16-17 y)| 45.4 ± 9.16 | 42.3 ± 11.7 | 55.6 ± 7.8 | 46.2 ± 12.3 |
| Fourth (17 y)  | 45.0 ± 11.2 | 34.9 ± 10.9 | 55.6 ± 8.9 | 44.3 ± 10.0 |
| BMI quartile   |           |           |           |                  |
| First ($20,891-$49,739) | 43.2 ± 10.2 | 44.2 ± 14.0 | 55.7 ± 9.2 | 44.1 ± 8.8  |
| Second ($49,811-$65,295) | 40.3 ± 10.1 | 43.0 ± 10.5 | 57.0 ± 8.0 | 45.8 ± 9.2  |
| Third ($65,295-$81,705)  | 45.8 ± 13.2 | 38.1 ± 10.4 | 54.7 ± 9.6 | 43.6 ± 9.0  |
| Fourth ($81,729-$130,699) | 45.3 ± 12.2 | 37.8 ± 9.0  | 56.0 ± 8.0 | 44.2 ± 8.4  |

**TABLE 7**

Correlations Between PROMIS Domains Stratified by Patient-Centric Factors

| PROMIS-PF | PROMIS-UE | PROMIS-PI |
|-----------|-----------|-----------|
| Sex       | PROMIS-UE |
| Male, female | –0.72, –0.80<sup>c</sup> | –0.76, –0.58<sup>c</sup> |
| Race      | PROMIS-UE |
| White, black, other/unknown | –0.77, –0.68, –0.76<sup>c</sup> | –0.80, –0.61, 0.08 |
| Chronicity| PROMIS-UE |
| Acute, chronic | –0.71, –0.73<sup>c</sup> | –0.70, –0.70<sup>c</sup> |

**TABLE 8**

Role of patient-centric factors on PROMIS score outcomes. We found that chronicity of symptoms had minimal impact on score outcomes (in patients with acute vs chronic symptom duration). We also noted minimal impact on PROMIS scores with the other metrics recorded, such as age, BMI, MHI, and race (with the exception of higher PROMIS-UE scores in black patients compared with white patients).

One additional important finding from this study was the positive correlation between PROMIS-PI and PROMIS-Depression in this patient population. Across the entire cohort, the correlation was found to be 0.45, which is considered a weak correlation. However, if stratified by sex, the correlation was significantly higher in female patients compared with male patients (0.52 compared with 0.39).
respectively). In contrast, patient race and symptom chronicity had little impact on this correlation. To date, this relationship has not been studied extensively in the pediatric population. Trentacosta et al\(^1\) previously described detrimental impacts of knee ligament surgery performed on school-aged patients, but their study did not focus on depression and pain interference in this patient population. Therefore, the findings from our study highlight the relationship between pain interference and depression, along with the potential adverse impact on physical function, in pediatric and adolescent sports medicine patients.

There are important limitations to this study. First, the data were collected according to standard clinical PRO collection procedures. Therefore, we did not document whether the patient had assistance (eg, from a family member) when completing the survey forms. Because the forms were administered in the pediatric and adolescent population, prospectively collected data about assistance would have been helpful in order to determine whether parental or guardian assistance in PRO completion had any impact on PROMIS outcomes. Second, we used the adult version of the PROMIS score. In our clinic, we use a standardized set of PROMIS forms and do not distinguish according to age. Future comparative studies between the adult and pediatric versions of the PROMIS CAT forms may be useful. Third, we did not validate the PROMIS CAT forms against legacy PRO scores or against objective outcomes. Because the purpose of this study was to investigate the correlations between pain interference, depression, and physical function in this patient population, such validation measures, while helpful, were not in the scope of the study.

CONCLUSION

Both pain and depression demonstrated a negative correlation with physical function as measured by PROMIS CAT forms in the pediatric and adolescent sports medicine patient population. Patient demographics and socioeconomic factors had minimal impacts on this correlation. This study justifies continued study of PROMIS CAT forms in the pediatric and adolescent sports medicine patient populations.

REFERENCES

1. 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.
2. Bae DS, Canizares MF, Miller PE, Waters PM, Goldfarb CA. Functional impact of congenital hand differences: early results from the Congenital Upper Limb Differences (CoULD) Registry. J Hand Surg Am. 2018;43(4):321-330.
3. Brenner JS; Council on Sports Medicine and Fitness. Sports specializations and intensive training in young athletes. Pediatrics. 2016; 138(3):e20162148.
4. Brusalis CM, Lakomkin N, Suryavanshi JR, et al. Clinical outcome reporting in youth ACL literature is widely variable. Orthop J Sports Med. 2017;5(8):232596717724431.
5. Cho CH, Seo HJ, Bae KC, Lee KJ, Hwang I, Warner JJ. The impact of depression and anxiety on self-assessed pain, disability, and quality of life in patients scheduled for rotator cuff repair. J Shoulder Elbow Surg. 2013;22(9):1160-1166.
6. Dodwell ER, Lamont LE, Green DW, Pan TJ, Marx RG, Lyman S. 20 years of pediatric anterior cruciate ligament reconstruction in New York State. Am J Sports Med. 2014;42(3):675-680.
7. 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.
8. Frank JS, Gambacorta PL. Anterior cruciate ligament injuries in the skeletally immature athlete: diagnosis and management. J Am Acad Orthop Surg. 2013;21(2):78-87.
9. Kazemirs NH, Hung M, Rane A, Bounsanga J, Weng C, Tyser AR. Association of physical function, anxiety, and pain interference in nonshoulder upper extremity patients using the PROMIS platform. J Hand Surg Am. 2017;42(10):781-787.
10. Kendall R, Wagner B, Brodker D, et al. The relationship of PROMIS pain interference and physical function scales. Pain Med. 2018;19(9):1720-1724.
11. List of adult measures. Northwestern University. http://www.healthmeasures.net/index.php?option=com_content&view=category&layout=blog&id=113&Itemid=908. Accessed May 28, 2018.
12. Makhni EC. Editorial commentary: are we comparing apples to oranges? The need for standardized outcomes reporting in orthopaedic surgery. Arthroscopy. 2017;33(2):484-485.
13. Makhni EC, Saltzman BM, Meyer MA, et al. Outcomes after shoulder and elbow injury in baseball players: are we reporting what matters? Am J Sports Med. 2017;45(2):495-500.
14. Mukaka MM. Statistics corner: a guide to appropriate use of correlation coefficient in medical research. Malawi Med J. 2012;24(3):69-71.
15. Nixon DC, McCormick JJ, Johnson JE, Klein SE. PROMIS Pain Interference and Physical Function scores correlate with the Foot and Ankle Ability Measure (FAAM) in patients with hallux valgus. Clin Orthop Relat Res. 2017;475(11):2775-2780.
16. Phillips L, Carsen S, Vasireddi A, Mulpuri K. Use of patient-reported outcome measures in pediatric orthopaedic literature. J Pediatr Orthop. 2018;38(8):393-397.
17. Trentacosta NE, Vitale MA, Ahmad CS. The effects of timing of pediatric knee ligament surgery on short-term academic performance in school-aged athletes. Am J Sports Med. 2009;37(9):1684-1691.
18. Waljee JF, Carlozzi N, Franzblau LE, Zhong L, Chung KC. Applying the patient-reported outcomes measurement information system to assess upper extremity function among children with congenital hand differences. Plast Reconstr Surg. 2015;136(2):200e-207e.
19. Wall LB, Patel A, Roberts S, Goldfarb CA. Long-term outcomes of Huber opposition transfer for augmenting hypoplastic thumb function. J Hand Surg Am. 2017;42(8):657.
20. Wolfensberger A, Vuistiner P, Konzelmann M, Piemb-Holmes C, Leger B, Luthi F. Clinician and patient-reported outcomes are associated with psychological factors in patients with chronic shoulder pain. Clin Orthop Relat Res. 2016;474(9):2030-2039.