Mapping the EQ-5D-5L Utility Scores: A Pilot Study in Orthopaedic Patients

Man Hung*, Christine Cheng, Shirley D. Hon, Jerry Bounsanga

Orthopaedic Surgery and Operation, School of Medicine, University of Utah, Salt Lake City, UT, USA
Email: *Man.Hung@hsc.utah.edu

Abstract

Objective: The purpose of this study is to investigate whether the LE CAT, PROMIS PF CAT, Depression CAT, or Pain CAT can be used as a proxy for the EQ-5D-5L. Background: Patient-reported outcome measures have become vital tools for physicians to understand the effectiveness and value of treatment and care. Methods: This study was conducted in 2012 with 116 patients that took the EQ-5D-5L and a number of patient-reported outcome instruments in a university orthopaedic clinic. Regression analyses were conducted to predict EQ-5D-5L index scores from the LE CAT, PROMIS PF CAT, Depression CAT, and Pain CAT. Results: All predictors, separately or combined, significantly predicted the EQ-5D-5L index scores (p < 0.0001). The LE CAT was the best predictor; it alone accounted for 37% of the variability in the EQ-5D-5L. When combining patient-reported outcome measures, the best predicting model was the one consisting of the LE CAT, Depression CAT and Pain CAT; they explained for 43.9% of the variance in EQ-5D-5L. Conclusions: The findings provide encouraging news that the LE CAT, PF CAT, Depression CAT and Pain CAT can be used alone or in combination as a proxy for the EQ-5D-5L. Researchers have the options of using these patient-reported outcome measures for economic evaluations and medical intervention studies.

Keywords

1. Introduction

Assessment of health outcomes has progressed greatly in the past decade with the introduction of new tools that rely on advanced statistical methodologies. Patient-reported outcome measures have become vital tools for physicians to understand the effectiveness and value of treatment and care. Physicians traditionally relied mainly on

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*Corresponding author.

clinical measures to assess and compare the effectiveness of treatment. Even though clinical measures provide a great deal of information to the physician and patient, they do not necessarily reflect how a patient feels in their everyday life [1]. There is some evidence that there is not a very strong correlation between clinical and patient-reported outcome measures and therefore, measures should be used in conjunction with each other when assessing the condition of patients [2]-[4]. As a result, physicians are increasingly relying on the integration of clinical measures and patient-reported outcome measures to assess treatment outcomes and interventions.

There is not a universal patient-reported outcome measure that is widely used by all physicians. Instrument selection varies depending on the physician's background and familiarity with the tools and their areas of specialization. The Medical Outcomes General Health Survey and the European Quality of Life-5 Dimensions (EQ-5D) are very popular among physicians to measure health outcomes and are utilized for quality-adjusted life-years in cost-utility analyses. Other instruments such as the National Institute of Health sponsored Patient-Reported Outcomes Measurement Information System (PROMIS) Physical Function (PF), Computerized Adaptive Test (CAT), and the Lower Extremity (LE) CAT have demonstrated desirable psychometric properties and are increasing applications in clinical studies. Utilizing item response theory, the PROMIS PF item bank is developed, which includes 124 items measuring upper extremity, lower extremity, central, axial, and instrumental activities of daily living [5]. The PF CAT draws items from the PF item bank for test administration. It has been demonstrated to exhibit validity and reliability in the orthopaedic population and for patients undergoing foot and ankle surgery [6]. A recent study suggested that less instrument bias could be accomplished by developing a lower extremity instrument from the PF item bank. As a result, the 79-item LE CAT item bank was developed in an effort to specifically target patients with lower extremity conditions [5] [7]. The PROMIS also includes item banks that address depression and pain. When considering cost-utility analyses, the EQ-5D is often adopted and its preference-based index scores are used for estimation of quality-adjusted life years for economic evaluation. Its index scores are derived from measures across five health dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. The EQ-5D can be a very useful tool for clinicians and researchers. The EQ-5D-3L (three response levels) has been shown to be a valid and reliable instrument in many contexts, but it has also received scrutiny for lacking sensitivity and failing to capture disease specific conditions [8]-[12]. In response, the European Quality of Life Group developed a five response level version of the EQ-5D, the European Quality of Life-5 Dimensions 5 Response Levels (EQ-5D-5L). Compared to the previous version with three response levels, the EQ-5D-5L has demonstrated a lower ceiling effect [11], good convergent validity [12], and content and face validity [8].

Researchers in the past have conducted studies to map preference-based index scores from general health outcome profile measures [13]-[17]. Several studies have been published detailing the mapping of the EQ-5D-3L index scores from the Medical Outcomes General Health Survey using large national samples [18]-[21]. Recently, scores from the PROMIS global item bank and selected domain item banks have also been mapped to the EQ-5D-3L on the general population and a few clinical samples [22]. Given the increasing utilization of patient-reported outcome measures and the application of PROMIS instruments in clinical settings and in research studies, mapping of the health preference scores from the patient-reported outcome measures can be very useful and these scores can be used in cost-effectiveness studies when health preference measures are unavailable. To our knowledge, there is no existing published study to date reporting the mapping of EQ-5D-5L from any patient-reported outcome measures or health profiles.

The purpose of this study is to investigate whether the LE CAT, PF CAT, PROMIS Depression, and/or PROMIS Pain measures can be mapped from the EQ-5D-5L. In doing so, we are ultimately interested if the scores from any of these patient-reported outcome instruments can be used as a proxy of health preference scores when health preference assessments such as EQ-5D are absent.

2. Methods

2.1. Data Collection

In 2012, data were collected from a large university orthopaedic center with patients that were 18 years old or older who came to visit for lower extremity orthopaedic problems. This university orthopaedic center had over 90,000 total patient visits and over 3,000 total surgeries per year. At the end of their clinic visit, patients were asked to voluntarily complete the EQ-5D-5L, the LE CAT, the PF CAT, the PROMIS Depression CAT, and the PROMIS Pain CAT instruments (See **Appendices 1-5**) along with a few demographic questions. These ques-

tionnaires were administered electronically using tablet computers. The order of questionnaire administration was completely random in efforts to minimize potential bias from test administration. Institutional Review Board approval was obtained prior to the study. Medical and research staff obtained informed consent from the patients and the rights of the subjects were protected. The final sample consisted of 116 patients.

2.2. Analytic Approach

Descriptive statistics were conducted to summarize patient demographic and instrument characteristics. All CAT scores used in the analyses were T scores, which had a mean of 50 and standard deviation of 10. The EQ-5D-5L utility index scores were derived and converted from the responses to the five dimensions of the EQ-5D questionnaire. To examine the association between the patient-reported outcome measures (LE CAT, PF CAT, Depression CAT, and Pain CAT) and the EQ-5D-5L index value, we examined the Pearson product-moment correlations among these instruments. To investigate whether the patient-reported outcome measures can be mapped from the EQ-5D-5L, we applied ordinary least square linear regression analyses to predict EQ-5D-5L from the patient-reported outcome measures. Six regression models were conducted to assess the individual contribution of each of the patient-reported outcome measures and the combined contribution of the patient-reported outcome measures. Model 1 included only the LE CAT as the predictor of EQ-5D-5L; model 2 included only the PF CAT as the predictor; model 3 included only the Depression CAT as the predictor; model 4 included only the Pain CAT as the predictor; model 5 included the LE CAT, Depression CAT and Pain CAT as the predictors; and model 6 included the PF CAT, Depression CAT and Pain CAT as predictors. Intraclass correlation coefficients were computed to compare the actual EQ-5D-5L index scores with the estimated EQ-5D-5L index scores from the predictors in the regression models. To further understand the sensitivity of these patient-reported outcome measures as well as the EQ-5D-5L across health conditions, we conducted independent samples t-tests to see if there were significant score differences between patients who: (1) have numb feet versus do not have numb feet, and (2) have diabetes versus do not have diabetes.

A sample size of 116 patients would achieve 99.7% power to detect an R^2 of 0.200 attributed to 3 independent variables using an F-Test with a significance level of 0.05.

3. Results

3.1. Demographic Characteristics

The study sample consisted of 55% female, 93.4% white, with a mean age of 44 years old (range from 18 to 80). About 9% of the participants identified as Hispanic or Latino. About 66% of the participants completed some college courses. Approximately 64% of the participants said they did not drink alcohol, 86% did not smoke, and 94% reported that they did not have diabetes. 51% reported that there was another area that limited their current activities besides their foot and ankle problem. About 23% of the participants stated that their feet were numb and 8% reported that they had rheumatoid arthritis.

3.2. Instrument Characteristics

Descriptive summary (range, minimum, maximum, mean, standard deviation) of the scores from all of the instruments was presented in **Table 1**. All these instruments were moderately to highly correlate with each other (See **Table 2**). The highest correlation between the health preference measure and the patient-reported outcome measures was between the EQ-5D-5L and the LE CAT, $r(116) = 0.612$, p < 0.0001. As expected, the PRO instruments were moderately to highly correlate with each other. The highest correlation among the instruments was between the LE CAT and the PF CAT, $r(116) = 0.801$, p < 0.0001.

3.3. Regression Analyses

To predict the EQ-5D-5L index scores, six linear regression models were run and their results were summarized in **Table 3**. The PF CAT and the LE CAT were not included in the same model because they were highly correlated. All the predictors separately or combined significantly predicted the EQ-5D-5L scores (p < 0.0001). The LE CAT was the best individual predictor; it alone accounted for 37% of the variability in the EQ-5D-5L. When combining patient-reported outcome measures, the best predicting model was the one consisting of the LE CAT,

Table 1. Descriptive statistics of the instruments.

Instruments	Range	Minimum	Maximum	Mean	Std. Dev.
EQ-5D-5L	0.88	0.12	1.00	0.68	0.18
LE CAT	68.10	12.70	80.80	52.92	13.93
PF CAT	48.10	22.20	70.30	40.14	7.62
Depression CAT	45.60	34.20	79.80	51.36	9.91
Pain CAT	36.70	38.60	75.30	61.51	7.29

Table 2. Pearson product-moment correlations among the instruments.

Instruments	EQ-5D-5L	LE CAT	PF CAT	Depression CAT	Pain CAT
EQ-5D-5L	1.000				
LE CAT	0.612	1.000			
PF CAT	0.538	0.801	1.000		
Depression CAT	−0.446	−0.393	−0.349	1.000	
Pain CAT	−0.502	−0.476	−0.406	0.474	1.000

Table 3. Predicting the EQ-5D-5L index scores.

Models	Predictors	R^2	Adjusted R^2
1	LE CAT	0.375	0.370
2	PF CAT	0.289	0.283
3	Depression CAT	0.199	0.192
4	Pain CAT	0.252	0.245
5	LE CAT, Depression CAT & Pain CAT	0.454	0.439
6	PF CAT, Depression CAT & Pain CAT	0.413	0.398

Depression CAT and Pain CAT; they explained for 43.9% of the variance in EQ-5D-5L. **Table 4** presents the actual EQ-5D-5L index scores versus the predicted EQ-5D-5L index scores from the six regression models. All predicted scores were essentially identical to the actual scores ($p > 0.99$).

To assess the degree of correlation between the actual EQ-5D-5L scores and the predicted EQ-5D-5L scores from the regression models, we computed the intraclass correlations (See **Table 5**). The intraclass correlation for the LE CAT was 0.708, the highest among the individual predictors. The intraclass correlation for the LE CAT, Depression CAT, and Pain CAT combined was 0.770. The intraclass correlation for the PF CAT, Depression CAT, Pain CAT combined was 0.740.

3.4. Instrument Scores by Health Conditions

Between participants that did and did not have numb feet, only the LE CAT showed significant difference in mean scores ($p = 0.002$) (See **Table 6**). When investigating participants that did and did not have diabetes, both the LE CAT ($p = 0.01$) and the PF CAT ($p = 0.02$) demonstrated that there was a significant difference in scores.

4. Discussion

In this study, we investigated whether the EQ-5D-5L preference scores could be mapped from the LE CAT, PF CAT, PROMIS Depression CAT, and/or PROMIS Pain CAT measures using regression estimation methods. We examined the correlations between the instruments, the differences in scores by health conditions, the variance

Table 4. Mean actual and predicted EQ-5D-5L index scores from various PRO measures.

	EQ-5D-5L scores	(SE)
Actual	0.675070	(0.016749)
Predicted from		
LE CAT	0.675069	(0.010257)
PF CAT	0.675069	(0.009004)
Depression CAT	0.675069	(0.007464)
Pain CAT	0.675069	(0.008401)
LE CAT, Depression CAT & Pain CAT	0.675069	(0.011284)
PF CAT, Depression CAT & Pain CAT	0.675069	(0.010769)

Table 5. Intraclass correlation correlations (ICC) of the actual EQ-5D-5L index scores with the predicted EQ-5D-5L index scores from various PRO measures.

Predicted EQ-5D-5L index scores from	ICC	95% CI
LE CAT	0.708	[0.577, 0.798]
PF CAT	0.621	[0.452, 0.738]
Depression CAT	0.500	[0.277, 0.654]
Pain CAT	0.576	[0.386, 0.706]
LE CAT, Depression CAT & Pain CAT	0.770	[0.668, 0.841]
PF CAT, Depression CAT & Pain CAT	0.740	[0.624, 0.820]

Table 6. Mean score differences by health condition.

Instruments	Numb feet/No numb feet	With diabetes/Without diabetes
	Score difference (p-value, 2-tailed)	Score difference (p-value, 2-tailed)
EQ-5D-5L	0.0556040 (0.162)	0.0116280 (0.087)
LE CAT	8.3926758 (0.002)*	13.9024902 (0.001)*
PF CAT	3.1059093 (0.063)	6.8559633 (0.002)*
Depression CAT	1.1560133 (0.598)	1.6158585 (0.678)
Pain CAT	2.9609238 (0.064)	0.4800786 (0.867)

Note: *$p < 0.05$.

accounted for when predicting EQ-5D-5L scores, and intraclass correlations between the actual and predicted EQ-5D-5L scores.

All of the instruments were significantly correlated with each other, with the LE CAT and the PF CAT having the highest correlation, which was expected. Given that the LE CAT had the highest correlation with the EQ-5D-5L index scores ($r = 0.612$), this suggested that the LE CAT could be best mapped to the EQ-5D-5L. The correlations of the EQ-5D-5L with the PF CAT, the Depression CAT and the Pain CAT were all relatively high, at $r = 0.538$, −0.446, and −0.502 respectively.

We conducted regression analyses to assess the effects of the patient-reported outcome measures on the EQ-5D-5L index scores. We found that the LE CAT scores alone accounted for 37% of the variance in the EQ-5D-5L scores, which was much more than we expected. The PF CAT, Depression CAT, and Pain CAT, each alone predicted 28.3%, 19.2%, and 24.5% of the variance in the EQ-5D-5L respectively. When including

the Depression CAT and the Pain CAT scores with the LE CAT and PF CAT measures in separate models, the variance explained increased to over 40% for the PF CAT and 45% for the LE CAT. These findings demonstrated that if we were going to pick a single instrument as a proxy for the EQ-5D-5L preference scores in this patient population, it would be the LE CAT. When including more than one patient-reported outcome measures to predict the EQ-5D, the LE CAT, the Depression CAT, and the Pain CAT accounted for the most of the variance in the models. While adopting a combination of patient-reported outcome measures did not minimize the number of items needed, it provided physicians more options for instruments that can be used when health preference assessments were unavailable.

We also examined the intraclass correlation to assess whether the EQ-5D-5L index scores can be accurately estimated by the patient-reported outcome measures. Findings indicate that the patient-reported outcome measures can accurately predict the EQ-5D-5L index scores. Alone, the PF CAT had an ICC of 0.621 and the LE CAT had an intraclass correlation of 0.708. This again shows that the LE CAT is a better proxy of the EQ-5D-5L, but the PF CAT also does a very good job. When we examine the intraclass correlations of the PF CAT and the LE CAT combined with the Depression CAT and Pain CAT, the intraclass correlations are largely demonstrating good agreement. The LE CAT with the Depression CAT and Pain CAT had a slightly better intraclass correlation of 0.770 compared to 0.740 of the PF CAT with the Depression and Pain CAT. As a result, we would assert that the LE CAT, Depression CAT, and Pain CAT together are a good approximation of the EQ-5D-5L preference index. If clinicians or researchers were only interested in using a single patient-reported outcome measure, the LE CAT would be the best proxy choice for EQ-5D-5L.

Finally, we tested for score differences for each instrument (LE CAT, PF CAT, Depression CAT, Pain CAT, EQ-5D-5L) with patients who had two different types of health conditions. Most of the instruments were not sensitive enough to demonstrate significant mean score differences in measuring patients with numb feet and diabetes. Only the LE CAT was able to significantly discriminate patients with numb feet versus patients without numb feet. Both the LE CAT and the PF CAT were able to significantly discriminate patients with diabetes and without diabetes. This finding spoke to the possibility that the LE CAT or the PF CAT could be a potentially better tool for conducting cost-effectiveness research or economic analyses.

5. Conclusion

Taken together, our results demonstrate that the LE CAT or a combination of the LE CAT with the Depression CAT and Pain CAT can be a useful proxy for the EQ-5D-5L preference index. Physicians or researchers interested in conducting cost-utility analyses have the choice of using either the EQ-5D-5L, the LE CAT, the PF CAT, the Depression CAT, or the Pain CAT individually or in combination. Further research is needed to confirm the results of this study in a larger patient population.

Acknowledgements

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Appendix 1. European quality of Life-5 dimensions (EQ-5D).

Concept	Question	Coded Level
	Under each heading, please tick the ONE box that best describes your health TODAY	
Mobility		
	I have no problems in walking about	1
	I have slight problems in walking about	2
	I have moderate problems in walking about	3
	I have severe problems in walking about	4
	I am unable to walk about	5
Self-Care		
	I have no problems washing or dressing myself	1
	I have slight problems washing or dressing myself	2
	I have moderate problems washing or dressing myself	3
	I have severe problems washing or dressing myself	4
	I am unable to wash or dress myself	5
Usual Activities (e.g. work, study, housework, family or leisure activities)		
	I have no problems doing my usual activities	1
	I have slight problems doing my usual activities	2
	I have moderate problems doing my usual activities	3
	I have severe problems doing my usual activities	4
	I am unable to do my usual activities	5
Pain/Discomfort		
	I have no pain or discomfort	1
	I have slight pain or discomfort	2
	I have moderate pain or discomfort	3
	I have severe pain or discomfort	4
	I have extreme pain or discomfort	5
Anxiety/Depression		
	I am not anxious or depressed	1
	I am slightly anxious or depressed	2
	I am moderately anxious or depressed	3
	I am severely anxious or depressed	4
	I am extremely anxious or depressed	5

Appendix 2. Lower extremity (LE) physical function CAT item bank.

Item Number	ID*	Items**
1	PFA1	Does your health now limit you in doing vigorous activities, such as running, lifting heavy objects, participating in strenuous sports?
2	PFA3	Does your health now limit you in bending, kneeling, or stooping?
3	PFA4	Does your health now limit you in doing heavy work around the house like scrubbing floors, or lifting or moving heavy furniture?
4	PFA5	Does your health now limit you in lifting or carrying groceries?
5	PFA6	Does your health now limit you in bathing or dressing yourself?
6	PFA7	How much do physical health problems now limit your usual physical activities (such as walking or climbing stairs)?
7	PFA8	Are you able to move a chair from one room to another?
8	PFA9	Are you able to bend down and pick up clothing from the floor?
9	PFA10	Are you able to stand for one hour?
10	PFA11	Are you able to do chores such as vacuuming or yard work?
11	PFA12	Are you able to push open a heavy door?
12	PFA13	Are you able to exercise for an hour?
13	PFA14	Are you able to carry a heavy object (over 10 pounds)?
14	PFA15	Are you able to stand up from an armless straight chair?
15	PFA19	Are you able to run or jog for two miles?
16	PFA21	Are you able to go up and down stairs at a normal pace?
17	PFA23	Are you able to go for a walk of at least 15 minutes?
18	PFA25	Are you able to do yard work like raking leaves, weeding, or pushing a lawn mower?
19	PFA29	Are you able to pull heavy objects (10 pounds) towards yourself?
20	PFA30	Are you able to step up and down curbs?
21	PFA31	Are you able to get up off the floor from lying on your back without help?
22	PFA32	Are you able to stand with your knees straight?
23	PFA33	Are you able to exercise hard for half an hour?
24	PFA37	Are you able to stand for short periods of time?
25	PFA39	Are you able to run at a fast pace for two miles?
26	PFA41	Are you able to squat and get up?
27	PFA42	Are you able to carry a laundry basket up a flight of stairs?
28	PFA45	Are you able to get out of bed into a chair?
29	PFA49	Are you able to bend or twist your back?
30	PFA51	Are you able to sit on the edge of a bed?
31	PFA53	Are you able to run errands and shop?
32	PFA56	Are you able to get in and out of a car?
33	PFB1	Does your health now limit you in doing moderate work around the house like vacuuming, sweeping floors or carrying in groceries?
34	PFB3	Does your health now limit you in putting a trash bag outside?
35	PFB5	Does your health now limit you in hiking a couple of miles on uneven surfaces, including hills?
36	PFB7	Does your health now limit you in doing strenuous activities such as backpacking, skiing, playing tennis, bicycling or jogging?
37	PFB8	Are you able to carry two bags filled with groceries 100 yards?
38	PFB9	Are you able to jump up and down?
39	PFB10	Are you able to climb up five steps?
40	PFB11	Are you able to wash dishes, pots, and utensils by hand while standing at a sink?

Continued

41	PFB12	Are you able to make a bed, including spreading and tucking in bed sheets?
42	PFB13	Are you able to carry a shopping bag or briefcase?
43	PFB14	Are you able to take a tub bath?
44	PFB24	Are you able to run a short distance, such as to catch a bus?
45	PFB32	Are you able to stand unsupported for 10 minutes?
46	PFB40	Are you able to stand up on tiptoes?
47	PFB42	Are you able to stand unsupported for 30 minutes?
48	PFB43	Does your health now limit you in taking care of your personal needs (dress, comb hair, toilet, eat, bathe)?
49	PFB44	Does your health now limit you in doing moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf?
50	PFB48	Does your health now limit you in taking a shower?
51	PFB49	Does your health now limit you in going for a short walk (less than 15 minutes)?
52	PFB50	How much difficulty do you have doing your daily physical activities, because of your health?
53	PFB51	Does your health now limit you in participating in active sports such as swimming, tennis, or basketball?
54	PFB54	Does your health now limit you in going OUTSIDE the home, for example to shop or visit a doctor's office?
55	PFC6	Are you able to walk a block on flat ground?
56	PFC7	Are you able to run five miles?
57	PFC10	Does your health now limit you in climbing several flights of stairs?
58	PFC12	Does your health now limit you in doing two hours of physical labor?
59	PFC13	Are you able to run 100 yards?
60	PFC20	Does your health now limit you in walking one hundred yards?
61	PFC29	Are you able to walk up and down two steps?
62	PFC32	Are you able to climb up 5 flights of stairs?
63	PFC33	Are you able to run ten miles?
64	PFC34	Does your health now limit you in walking several hundred yards?
65	PFC35	Does your health now limit you in doing eight hours of physical labor?
66	PFC36	Does your health now limit you in walking more than a mile?
67	PFC37	Does your health now limit you in climbing one flight of stairs?
68	PFC38	Are you able to walk at a normal speed?
69	PFC39	Are you able to stand without losing your balance for several minutes?
70	PFC40	Are you able to kneel on the floor?
71	PFC41	Are you able to sit down in and stand up from a low, soft couch?
72	PFC45	Are you able to get on and off the toilet?
73	PFC46	Are you able to transfer from a bed to a chair and back?
74	PFC47	Are you able to be out of bed most of the day?
75	PFC49	Are you able to water a house plant?
76	PFC52	Are you able to turn from side to side in bed?
77	PFC53	Are you able to get in and out of bed?
78	PFC54	Does your health now limit you in getting in and out of the bathtub?
79	PFC56	Does your health now limit you in walking about the house?

*The original item identifier from the PROMIS item bank; **Response options for questions 1 - 6; 33 - 36; 48 - 51; 53 - 54; 57 - 58; 60; 64 - 67; 78 - 79: 1 = Cannot do; 2 = Quite a lot; 3 = Somewhat; 4 = Very little; 5 = Not at all; for questions 7 - 32; 37 - 47; 52; 55 - 56; 59; 61 - 63; 68 - 77: 1 = Unable to do; 2 = With much difficulty; 3 = With some difficulty; 4 = With a little difficulty; 5 = Without any difficulty.

Appendix 3. Physical function (PF) CAT item bank.

Item Number	ID****	Items
1*	PFA10	Are you able to stand for one hour?
2	PFA11	Are you able to do chores such as vacuuming or yard work?
3	PFA12	Are you able to push open a heavy door?
4	PFA13	Are you able to exercise for an hour?
5	PFA14	Are you able to carry a heavy object (over 10 pounds)?
6	PFA15	Are you able to stand up from an armless straight chair?
7	PFA16	Are you able to dress yourself, including tying shoelaces and doing buttons?
8	PFA17	Are you able to reach into a high cupboard?
9	PFA18	Are you able to use a hammer to pound a nail?
10	PFA19	Are you able to run or jog for two miles?
11	PFA20	Are you able to cut your food using eating utensils?
12	PFA21	Are you able to go up and down stairs at a normal pace?
13	PFA22	Are you able to open previously opened jars?
14	PFA23	Are you able to go for a walk of at least 15 minutes?
15	PFA25	Are you able to do yard work like raking leaves, weeding, or pushing a lawn mower?
16	PFA28	Are you able to open a can with a hand can opener?
17	PFA29	Are you able to pull heavy objects (10 pounds) towards yourself?
18	PFA30	Are you able to step up and down curbs?
19	PFA31	Are you able to get up off the floor from lying on your back without help?
20	PFA32	Are you able to stand with your knees straight?
21	PFA33	Are you able to exercise hard for half an hour?
22	PFA34	Are you able to wash your back?
23	PFA35	Are you able to open and close a zipper?
24	PFA36	Are you able to put on and take off a coat or jacket?
25	PFA37	Are you able to stand for short periods of time?
26	PFA38	Are you able to dry your back with a towel?
27	PFA39	Are you able to run at a fast pace for two miles?
28	PFA40	Are you able to turn a key in a lock?
29	PFA41	Are you able to squat and get up?
30	PFA42	Are you able to carry a laundry basket up a flight of stairs?
31	PFA43	Are you able to write with a pen or pencil?
32	PFA44	Are you able to put on a shirt or blouse?
33	PFA45	Are you able to get out of bed into a chair?
34	PFA47	Are you able to pull on trousers?
35	PFA48	Are you able to peel fruit?
36	PFA49	Are you able to bend or twist your back?
37	PFA50	Are you able to brush your teeth?
38	PFA51	Are you able to sit on the edge of a bed?
39	PFA52	Are you able to tie your shoelaces?
40	PFA53	Are you able to run errands and shop?
41	PFA54	Are you able to button your shirt?
42	PFA55	Are you able to wash and dry your body?

Continued

43	PFA56	Are you able to get in and out of a car?
44	PFA8	Are you able to move a chair from one room to another?
45	PFA9	Are you able to bend down and pick up clothing from the floor?
46	PFB10	Are you able to climb up five steps?
47	PFB11	Are you able to wash dishes, pots, and utensils by hand while standing at a sink?
48	PFB12	Are you able to make a bed, including spreading and tucking in bed sheets?
49	PFB13	Are you able to carry a shopping bag or briefcase?
50	PFB14	Are you able to take a tub bath?
51	PFB15	Are you able to change the bulb in a table lamp?
52	PFB16	Are you able to press with your index finger (for example ringing a doorbell)?
53	PFB17	Are you able to put on and take off your socks?
54	PFB18	Are you able to shave your face or apply makeup?
55	PFB19	Are you able to squeeze a new tube of toothpaste?
56	PFB20	Are you able to cut a piece of paper with scissors?
57	PFB21	Are you able to pick up coins from a table top?
58	PFB22	Are you able to hold a plate full of food?
59	PFB23	Are you able to pour liquid from a bottle into a glass?
60	PFB24	Are you able to run a short distance, such as to catch a bus?
61	PFB25	Are you able to push open a door after turning the knob?
62	PFB26	Are you able to shampoo your hair?
63	PFB27	Are you able to tie a knot or a bow?
64	PFB28	Are you able to lift 10 pounds above your shoulder?
65	PFB29	Are you able to lift a full cup or glass to your mouth?
66	PFB30	Are you able to open a new milk carton?
67	PFB31	Are you able to open car doors?
68	PFB32	Are you able to stand unsupported for 10 minutes?
69	PFB33	Are you able to remove something from your back pocket?
70	PFB34	Are you able to change a light bulb overhead?
71	PFB36	Are you able to put on a pullover sweater?
72	PFB37	Are you able to turn faucets on and off?
73	PFB39	Are you able to reach and get down a 5 pound object from above your head?
74	PFB40	Are you able to stand up on tiptoes?
75	PFB41	Are you able to trim your fingernails?
76	PFB42	Are you able to stand unsupported for 30 minutes?
77	PFB56	Are you able to lift one pound (a full pint container) to shoulder level without bending your elbow?
78	PFB8	Are you able to carry two bags filled with groceries 100 yards?
79	PFB9	Are you able to jump up and down?
80	PFC13	Are you able to run 100 yards?
81	PFC29	Are you able to walk up and down two steps?
82	PFC31	Are you able to reach into a low cupboard?
83	PFC32	Are you able to climb up 5 flights of stairs?
84	PFC33	Are you able to run ten miles?
85	PFC38	Are you able to walk at a normal speed?

Continued

86	PFC39	Are you able to stand without losing your balance for several minutes?
87	PFC40	Are you able to kneel on the floor?
88	PFC41	Are you able to sit down in and stand up from a low, soft couch?
89	PFC43	Are you able to use your hands, such as for turning faucets, using kitchen gadgets, or sewing?
90	PFC45	Are you able to get on and off the toilet?
91	PFC46	Are you able to transfer from a bed to a chair and back?
92	PFC47	Are you able to be out of bed most of the day?
93	PFC49	Are you able to water a house plant?
94	PFC51	Are you able to wipe yourself after using the toilet?
95	PFC52	Are you able to turn from side to side in bed?
96	PFC53	Are you able to get in and out of bed?
97	PFC6	Are you able to walk a block on flat ground?
98	PFC7	Are you able to run five miles?
99**	PFA1	Does your health now limit you in doing vigorous activities, such as running, lifting heavy objects, participating in strenuous sports?
100	PFA3	Does your health now limit you in bending, kneeling, or stooping?
101	PFA4	Does your health now limit you in doing heavy work around the house like scrubbing floors, or lifting or moving heavy furniture?
102	PFA5	Does your health now limit you in lifting or carrying groceries?
103	PFA6	Does your health now limit you in bathing or dressing yourself?
104	PFA7	How much do physical health problems now limit your usual physical activities (such as walking or climbing stairs)?
105	PFB1	Does your health now limit you in doing moderate work around the house like vacuuming, sweeping floors or carrying in groceries?
106	PFB3	Does your health now limit you in putting a trash bag outside?
107	PFB43	Does your health now limit you in taking care of your personal needs (dress, comb hair, toilet, eat, bathe)?
108	PFB44	Does your health now limit you in doing moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf?
109	PFB48	Does your health now limit you in taking a shower?
110	PFB49	Does your health now limit you in going for a short walk (less than 15 minutes)?
111	PFB5	Does your health now limit you in hiking a couple of miles on uneven surfaces, including hills?
112	PFB51	Does your health now limit you in participating in active sports such as swimming, tennis, or basketball?
113	PFB54	Does your health now limit you in going OUTSIDE the home, for example to shop or visit a doctor's office?
114	PFB7	Does your health now limit you in doing strenuous activities such as backpacking, skiing, playing tennis, bicycling or jogging?
115	PFC10	Does your health now limit you in climbing several flights of stairs?
116	PFC12	Does your health now limit you in doing two hours of physical labor?
117	PFC20	Does your health now limit you in walking one hundred yards?
118	PFC34	Does your health now limit you in walking several hundred yards?
119	PFC35	Does your health now limit you in doing eight hours of physical labor?
120	PFC36	Does your health now limit you in walking more than a mile?
121	PFC37	Does your health now limit you in climbing one flight of stairs?
122	PFC54	Does your health now limit you in getting in and out of the bathtub?
123	PFC56	Does your health now limit you in walking about the house?
124***	PFB50	How much difficulty do you have doing your daily physical activities, because of your health?

*Response options for questions 1 - 98: 1 = Unable to do; 2 = With much difficulty; 3 = With some difficulty; 4 = With a little difficulty; 5 = Without any difficulty; **Response options for questions 99 - 123: 1 = Cannot do; 2 = Quite a lot; 3 = Somewhat; 4 = Very little; 5 = Not at all; ***Response options for question 124: 1 = Can't do because of health, 2 = A lot of difficulty; 3 = Some difficulty; 4 = A little bit of difficulty; 5 = No difficulty at all; ****The original item identifier from the PROMIS item bank.

Appendix 4. PROMIS item bank v. 1.0—depression.

	In the past 7 days…	
Item Number	ID*	Items**
1	PAININ1	How difficult was it for you to take in new information because of pain?
1	EDDEP04	I felt worthless
2	EDDEP05	I felt that I had nothing to look forward to
3	EDDEP06	I felt helpless
4	EDDEP07	I withdrew from other people
5	EDDEP09	I felt that nothing could cheer me up
6	EDDEP14	I felt that I was not as good as other people
7	EDDEP17	I felt sad
8	EDDEP19	I felt that I wanted to give up on everything
9	EDDEP21	I felt that I was to blame for things
10	EDDEP22	I felt like a failure
11	EDDEP23	I had trouble feeling close to people
12	EDDEP26	I felt disappointed in myself
13	EDDEP27	I felt that I was not needed
14	EDDEP28	I felt lonely
15	EDDEP29	I felt depressed
16	EDDEP30	I had trouble making decisions
17	EDDEP31	I felt discouraged about the future
18	EDDEP35	I found that things in my life were overwhelming
19	EDDEP36	I felt unhappy
20	EDDEP39	I felt I had no reason for living
21	EDDEP41	I felt hopeless
22	EDDEP42	I felt ignored by people
23	EDDEP44	I felt upset for no reason
24	EDDEP45	I felt that nothing was interesting
25	EDDEP46	I felt pessimistic
26	EDDEP48	I felt that my life was empty
27	EDDEP50	I felt guilty
28	EDDEP54	I felt emotionally exhausted

*The original item identifier from the PROMIS item bank; **Response options for questions: 1 = Never; 2 = Rarely; 3 = Sometimes; 4 = Often; 5 = Always.

Appendix 5. PROMIS item bank v1.0—pain interference.

		In the past 7 days…
Item Number	ID*	Items**
1	PAININ1	How difficult was it for you to take in new information because of pain?
2	PAININ3	How much did pain interfere with your enjoyment of life?
3	PAININ5	How much did pain interfere with your ability to participate in leisure activities?
4	PAININ6	How much did pain interfere with your close personal relationships?
5	PAININ8	How much did pain interfere with your ability to concentrate?
6	PAININ9	How much did pain interfere with your day to day activities?
7	PAININ10	How much did pain interfere with your enjoyment of recreational activities?
8	PAININ11	How often did you feel emotionally tense because of your pain?
9	PAININ12	How much did pain interfere with the things you usually do for fun?
10	PAININ13	How much did pain interfere with your family life?
11	PAININ17	How much did pain interfere with your relationships with other people?
12	PAININ18	How much did pain interfere with your ability to work (include work at home)?
13	PAININ19	How much did pain make it difficult to fall asleep?
14	PAININ20	How much did pain feel like a burden to you?
15	PAININ22	How much did pain interfere with work around the home?
16	PAININ31	How much did pain interfere with your ability to participate in social activities?
17	PAININ34	How much did pain interfere with your household chores?
18	PAININ35	How much did pain interfere with your ability to make trips from home that kept you gone for more than 2 hours?
19	PAININ36	How much did pain interfere with your enjoyment of social activities?
20	PAININ48	How much did pain interfere with your ability to do household chores?
21	PAININ49	How much did pain interfere with your ability to remember things?
22	PAININ56	How irritable did you feel because of pain?
23	PAININ14	How much did pain interfere with doing your tasks away from home (eg, getting groceries, running errands)?
24	PAININ16	How often did pain make you feel depressed?
25	PAININ24	How often was pain distressing to you?
26	PAININ26	How often did pain keep you from socializing with others?
27	PAININ29	How often was your pain so severe you could think of nothing else?
28	PAININ32	How often did pain make you feel discouraged?
29	PAININ37	How often did pain make you feel anxious?
30	PAININ38	How often did you avoid social activities because it might make you hurt more?
31	PAININ39	How often did pain make simple tasks hard to complete?
32	PAININ40	How often did pain prevent you from walking more than 1 mile?
33	PAININ42	How often did pain prevent you from standing for more than one hour?
34	PAININ46	How often did pain make it difficult for you to plan social activities?
35	PAININ47	How often did pain prevent you from standing for more than 30 minutes?
36	PAININ50	How often did pain prevent you from sitting for more than 30 minutes?
37	PAININ51	How often did pain prevent you from sitting for more than 10 minutes?
38	PAININ52	How often was it hard to plan social activities because you didn't know if you would be in pain?
39	PAININ53	How often did pain restrict your social life to your home?
40	PAININ55	How often did pain prevent you from sitting for more than one hour?
41	PAININ54	How often did pain keep you from getting into a standing position?

*The original item identifier from the PROMIS item bank; **Response options for questions: 1 = Not at all; 2 = A little bit; 3 = Somewhat; 4 = Quite a bit; 5 = Very much.