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Detection of changes of functioning over time after asthma exacerbation in children with the use of PROMIS domains

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Abstract

Objectives

Patient reported outcome measures, such as the Patient Reported Outcomes Measurement Information System (PROMIS) may be utilized to understand experiences of patients. The purpose of this study was to determine the ability of PROMIS domains to detect changes in pain, physical functioning, and asthma impact over time for children experiencing asthma exacerbation.

Methods

Our prospective cohort study included children presenting to the emergency department (ED) for asthma exacerbation. Children completed PROMIS surveys in the ED, 7-10 days, and 1-3 months post-discharge. We used linear mixed models adjusted for age, gender, acute care utilization, and child global health to determine changes in PROMIS T-scores. We used self-reported child health response (Much better now versus a little better now or worse) at discharge as an anchor to determine if change in PROMIS scores corresponded with changes in health. A change was statistically significant if the 95% CI did not include 0.

Results

Our study included 63 children who presented to the ED for acute asthma exacerbation. We identified that children improved significantly in all domains over time. There was improvement over time following discharge from ED for all pain and physical functioning domains, and asthma impact. Using the clinical anchor, those with considerable improvement in asthma symptoms had improved T scores from 4-17.

Conclusions

PROMIS domains of pain, physical functioning, depression, fatigue, peer relationships, and asthma impact are responsive to changes in health states over time. These domains may be used to measure clinically significant change in children experiencing asthma exacerbation.

Keywords Pediatrics, Quality of Life

Introduction

In 2019, more than 5.1 million children under 18 years were living with asthma in the United States with 44.3% of these children reporting having had at least one asthma attack within the prior 12 months (1). These children reported to the ED for asthma exacerbation nearly 770 000 times with 4.5% resulting in hospital admission (1). The experience and burden of acute asthma exacerbation over time from the patient perspective is not well understood in the pediatric population. One way to better interpret this experience is through the use of child patient reported outcomes (cPROs) with the use of the Patient Reported Outcomes Measurement Information System (PROMIS).

PROMIS is funded by the National Institutes of Health with the goal of assessing physical, mental, and social aspects of health in adults and children (2). PROMIS domains, such as global health and asthma impact, have been developed and validated in pediatric asthma patients (3-5). Recently, new pediatric PROMIS domains have been developed including pain behavior, pain quality (sensory), pain quality (affective), physical stress experience, physical activity, and strength impact (6). While these new domains have been found to be valid and reliable to use for children presenting with acute exacerbation in the ED, their responsiveness to changes in cPROs over time has not been examined (6). In addition, while the Pediatric-25 Profile domains have been found to be valid and reliable, they have not been utilized to examine changes in cPROs over time (7).

The overall objective of this study was to increase the usability of these new PROMIS domains by providing the longitudinal validity of the measures for use in children with an acute asthma exacerbation. Specifically, the aim of this study was to determine the responsiveness of PROMIS domains of pain and physical health in children with an asthma exacerbation followed from time of presentation to an ED to one to three months post the acute presentation. We hypothesized that patient functioning in physical and pain domains would improve significantly over time.

Methods

Study subjects

This study includes a convenience sample of children with asthma ages 8 to 18 years old from the emergency department (ED) at Children's Wisconsin during May 2016 to June 2017. To be eligible for participation, all children had to be presenting to the ED with asthma exacerbation, be able to speak and understand English, provide assent/consent, and have a healthcare provider diagnosis of asthma. Subject demographic information was provided by parents, including: age, gender, ethnicity, and race. Subject asthma severity was determined using self-reported child global health scores.

Study design

This was a prospective cohort study of children with asthma. cPROs were collected for children who presented with an asthma exacerbation at the time of the ED visit (Time 0), 7–10 days later (Time 1), and 1–3 months later (Time 2). If data were not available at 1-3 months, data was collected up to 6 months post the exacerbation and utilized for Time 2. With the aid of hospital, clinic, and research staff, follow-up surveys were provided to study subjects while at clinic visits or at home at appropriate time intervals. Surveys were completed via email, post mail, telephone, or while in clinic for follow-up appointment. Study participants completed the PROMIS questionnaires either electronically via REDCap (Research Electronic Data Capture) or using paper forms.

PROMIS domains are funded by the National Institutes of Health (NIH) and distributed by HealthMeasures. They are developed to measure physical, mental, and emotional health of both the general population and patients with chronic conditions (8). Pediatric PROMIS self-report questionnaires are designed for ages 8-17 years old (8). The PROMIS domains utilized in this study have been found to be valid and reliable for this patient population (6). All PROMIS domains are publicly available and can be accessed online. (<http://healthmeasures.net/search-view-measures>).

Our primary outcomes were the changes in PROMIS T-scores for pain (pain behavior and pain quality [sensory and affective]) and physical functioning (physical stress experience, physical activity, and strength impact) domains. Our secondary outcomes were the changes in PROMIS T-scores for pain (pain interference) and physical functioning (physical function mobility) and other domains included in Pediatric-25 profile, consisting of: anxiety, depressive symptoms, peer relationship, and fatigue. The PROMIS T-score for asthma impact were from the PROMIS Asthma Impact Short Form questionnaire.

Analyses

Readability scores of the PROMIS domain surveys were calculated with the Flesch-Kincaid Grade Level calculation $0.39 \left(\frac{\text{total words}}{\text{total sentences}} \right) + 1.8 \left(\frac{\text{total syllables}}{\text{total words}} \right) - 15.9$ (9, 10). The score calculated coincides with an expected reading ability of a given grade level in the United States. For example, a score of 2.0 would coincide with the expected reading level of a second grader (10).

Descriptive statistics, including mean and standard deviation, were used to report demographic and baseline clinical characteristics of the study cohort. PROMIS measures were scored on a T-score metric with a mean of 50 and standard deviation (SD) of 10 (11). 50 represented the mean of the child sample in which the item response theory (IRT) parameters for the measures were estimated. A higher score on PROMIS domains indicates more of the concept, for example, a higher T-score on PROMIS fatigue domain means more fatigue.

We used three distinct methodologies to determine the responsiveness of PROMIS domains: 1) longitudinal model, 2) distribution-based method, and 3) anchor-based method.

Longitudinal model to detect change over time

A longitudinal model, specifically a linear mixed model, was utilized to assess if PROMIS T-scores were significantly different at distinct timepoints. This model was ideal due to its ability to allow for variations in the data, providing for the ability to include subject data that may contain some missing variables. This was done under the assumption that these missing data are random. Missing data were modeled based on the distribution of random effects, including linear predictors in the model (12, 13). Each PROMIS domain was modeled independently. The models included random intercept and random time trend to account for heterogeneity between subjects. These models included the timepoint as our variable of interest, and were adjusted for gender, age, and child global health (Poor/Fair, Good, Very Good/Excellent).

Distribution-based method

We used effect size and standard error of measurement (SEM) as the distribution-based methods to describe the responsiveness of the PROMIS domains (14). Effect size and SEM may be utilized to estimate minimal important difference (MID) for cPROs which is a metric utilized to determine the smallest change in score that would be important to a patient or clinician (14). To determine the effect size, we used PROMIS scores between asthma exacerbation (Time 0) and the

follow up time points (Time 1 and Time 2). We calculated the difference in mean scores between (a) exacerbation (Time 0) and 7 to 10 days and (Time 1), (b) exacerbation (Time 0), and 1 to 3 months (Time 2). Effect sizes at each time point were calculated using the difference in mean scores divided by the standard deviation of scores in the ED. Based on Cohen's statistics, effect size of 0.2 was small, 0.5 was moderate, and >0.8 was large (15). The SEM was calculated using the formula $SEM = \sigma \sqrt{1 - \text{reliability}}$, where σ was the SD at the ED (Time 0), and reliability was the IRT reliability of the domain as the ratio of true variance between scores and the variance between measured scores (16, 17). We also determined the proportion of subjects who reported an improvement of at least one SEM at later timepoints.

Anchor-based method

An anchor-based method was utilized through the use of a global assessment of change in asthma symptoms question as an anchor. At Time 1 and 2, subjects answered the question: "Since you went home from the Emergency department/hospital, how would you rate your asthma symptoms now?" Response options included: "Much better now," "A little better now," "The same now," "A little worse now," or "Much worse now." Responses were dichotomized as "much better now" compared to "a little better now or worse". Scores of those responding of "a little worse now" or "much worse now" were combined for analysis. Based on subject response, we calculated the mean and 95% confidence interval for change in PROMIS scores and which were considered significant if the confidence interval did not include 0.

Results

63 subjects, ages 8-18 years, were enrolled in the study in the ED at time of acute asthma exacerbation. Asthma exacerbation was defined as a child presenting to the ED who had wheezing or respiratory distress, had a health care provider diagnosis of asthma, and had used a reliever medication in the prior year. The readability scores of the PROMIS domain surveys were 1.7, 1.5, and 2.1 for the new PROMIS domains, the Pediatric-25 Profile, and the Asthma Impact Short Form questionnaire, respectfully. These scores correlated to reading levels consistent with first and second grade. Table 1 displays the demographics of the subjects included in the study. All 63 subjects completed surveys in the ED (Time 0) and at 7–10 days (Time 1). 59 subjects completed surveys at 1–3 months (Time 2). The remaining 4 subjects completed surveys in the ED (Time 0), 7-10 days (Time 1), and 6 months (Time 2), as response at 1–3 months was missing for them. Table 2 displays the mean and standard deviation of the scores at the timepoints.

Longitudinal model to detect change over time

Table 3 displays the estimates for changes in PROMIS domains over time adjusted for gender, age at ED visit, and child global health score. All domains showed a significant improvement in cPROs between Time 0 and Time 1 as well as Time 0 and Time 2, with the exception of the physical activity and peer relationship domains which were only significant for change between Time 0 and Time 1. The pain behavior, pain quality (affective), pain interference, physical stress experience, strength impact, and asthma impact domains showed significant changes in cPROs between Time 0 and Time 2. The physical activity domain was the only domain to have significant impact in regard to age at Time 0 (score estimate 0.8 and 95% CI -1.6 – 0.1). The only domains to show a significant change in reference to child global health are pain behavior—which showed a significant change between reporting poor/fair health versus very good/excellent health (score estimate 5.3, 95% CI 0.6 – 10.0)—and fatigue—which showed a significant change between reporting good health versus very good/excellent health (score estimate 6.2, 95% CI 0.2 – 12.1). No

domains were found to show a significant change in reference to gender or acute care utilization following ED visit.

Distribution-based method

Table 4a shows the effect size and SEMs for all the PROMIS domains. All the pain domains had a large effect size at both Time 1 and 2. The physical functioning domains all had a moderate effect size at Time 1 and a moderate to large effect size at Time 2, with the exception of physical impact, which did not have a significant effect size at Time 2. The asthma impact domain had a large effect size at both Time 1 and 2. The remaining domains had a small to moderate effect sizes at both Time 1 and 2. This is with the exception of the peer relationship domain that did not have a significant effect size at Time 2. These results demonstrate the responsiveness and usefulness of all domains at Time 1 and all domains, except physical activity and peer relationships at Time 2.

In Table 4b, the SEM estimate for all domains was less than five, indicating a 95% confidence that the true score estimate is less than ± 10 of the mean for all domains. More than 50% of patients had a greater than or equal to 1 SEM improvement in scores of PROMIS pain domains, supporting clinically relevant change in scores. For the physical functioning domains, only the physical stress experience domain reported greater than 50% of patients with greater than or equal to 1 SEM improvement in score at Time 1 and all domains, except physical activity, had greater than or equal to 50% of patients with greater than or equal to 1 SEM improvement in score at Time 2. These domains may be more clinically relevant at Time 2 than Time 1. For the remaining domains, anxiety and asthma impact reported greater than 50% of patients with greater than or equal to 1 SEM improvement in score at Time 1 and 2 and fatigue at Time 2.

Anchor-based method-General health question-Improvement in asthma symptoms

In Table 5a, at Time 1, there was a significant change for all PROMIS domains (except for peer relationships) in subjects who reported they had considerable improvement compared to Time 0 in the ED. For subjects reporting they had a little improvement or were worse at Time 1, the pain quality (sensory), pain quality (affective), peer relationships, and asthma impact domains displayed a significant change. In Table 5b, at Time 2, there was a significant change for all PROMIS domains (except physical activity and peer relationships) in subjects who reported considerable improvement compared to asthma exacerbation in the ED. For this same timepoint, only the pain quality (sensory), and pain quality (affective) domains displayed a significant change for subjects who reported a little improvement or were worse.

Discussion

Our study shows that the PROMIS domains of pain and physical functioning, excluding physical activity, and others including anxiety, depressive symptoms, fatigue, peer relationships, and asthma impact, are responsive to changes in health status for children with an acute asthma exacerbation. Our study found that PROMIS domains may detect significant changes in a patient's pain and physical functioning one week and one-to-three months following an acute asthma exacerbation. The magnitude of change in PROMIS scores over time ranged from moderate to large in all domains (excluding physical activity and peer relationships) reflecting the high level of impairment experienced by children during asthma exacerbation.

Our study was the first to assess patient pain and physical functioning over time after presentation to the ED with asthma exacerbation. Pain is not well studied in asthma, but has

previously been identified to be significant in asthma and to change over time (6, 7, 18). Li et al. (19) identified change in health related quality of life in children with asthma over time noting that change is related to asthma control and socio-demographic characteristics, but did not examine change following acute exacerbation. Forrest et al. (5) assessed global health PROs in children presenting to the ED for treatment of asthma, who were found to have improved PROMIS Pediatric Global Health scales over time—up to eight weeks after initial presentation. It was identified that while pain may be experienced at the time of asthma exacerbation, it is expected to improve over time, even when controlling for other factors such as age, gender, acute care utilization, and child global health score. This was true for all pain domains and physical functioning domains (with the exception of physical activity) where subjects reported an improvement in pain 7–10 days and 1–3 months after presenting to the ED. A similar pattern was found for the asthma impact domain with continuous improvement over time. Improvements in PROMIS scores over time presented in this study indicate that these tools are sensitive to changes and can be used for clinical care as well as outcomes in therapeutic trials.

In addition to statistically significant continuous improvement in pain domains and asthma impact over time, these domains all had large changes as displayed by their large effect sizes. This reinforces that many aspects of pain improve simultaneously over time following exacerbation. Physical functioning domains also had statically significant change over time following exacerbation. However, their effect sizes were not as large at 7–10 days, but did increase in strength at 1–3 months, aside from physical activity. This indicates that improvement may be best assessed at that time.

Our anchor was based on child self-report result of their asthma symptoms since the ED visit. For patients reporting “much better now”, there was a higher mean change in scores compared to patients reporting “a little better now or worse”, providing a strong clinical anchor to support the change noted with the PROMIS surveys and further reflecting the utility of these domains over time.

Our study had a few limitations, including recruiting a convenience sample of children with asthma who presented to the ED and was comprised of participants who were mostly African American with an asthma exacerbation. Our study was limited to a single ED in Milwaukee, Wisconsin. Our patients were only recruited from English-speaking families. These factors may limit the generalizability of our study.

Conclusion

Patients experiencing asthma exacerbations may be expected to have improvement in pain and physical function, in addition to anxiety, depressive symptoms and strength impact, over time. These findings support the use of PROMIS domains in assessing pain and physical functioning in patients experiencing asthma exacerbation over time to aid investigators in better interpreting clinically relevant change future asthma studies. In addition, it may be of benefit for future studies to examine pain as an outcome in asthma exacerbation as this is not a commonly studied experience in this patient population. The PROMIS measures utilized in this study and others available may be found on the Health Measures website at <https://www.healthmeasures.net/index.php>.

Disclosure Statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

Declaration of Interest

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Table 1. Demographics and baseline clinical characteristics of children with asthma in the study.

	N (%)
Patient characteristics	ED (N = 63)
Age at enrollment	
8 – 12 years	50 (79.4)
13 – 18 years	13 (20.6)
Age (years) at enrollment, child self-report, mean (SD).	10.9 (2.4)
Gender, female	30 (47.6)
Ethnicity, Hispanic or Latino ^a	7 (11.1)
Race ^b	
Black	37 (58.7)
White	15 (23.8)
Others/>1 Race	10 (15.9)

^aEthnicity not reported for 8 subjects.

^bRace not reported for 1 subject.

Table 2. Mean and standard deviation of PROMIS scores at time of acute asthma exacerbation, 1st follow-up and 2nd follow-up times.

		ED Visit (Time 0) Mean (SD)	7-10 days (Time 1) Mean (SD)	1-3 months or 6 months (Time 2) Mean (SD)
Pain Domains				
	Pain Behavior	53.2 (8.5)	44.4 (13.0)	41.0 (13.8)
	Pain Quality (Sensory)	48.9 (8.7)	41.4 (10.3)	39.5 (9.3)
	Pain Quality (Affective)	51.1 (7.7)	42.3 (9.2)	39.5 (7.5)
	Pain Interference	57.0 (10.9)	49.7 (11.7)	47.2 (11.3)
Physical Function Domains				
	Physical Stress Experience	65.3 (8.4)	58.4 (10.7)	55.3 (12.1)
	Physical Activity	49.8 (8.6)	47.2 (8.2)	48.6 (9.7)
	Strength Impact	37.1 (6.5)	40.1 (9.0)	43.7 (10.0)
	Physical Function Mobility	44.0 (8.7)	47.2 (8.9)	48.5 (9.0)
Other Domains				
	Anxiety	52.0 (11.3)	44.3 (10.6)	44.4 (10.8)
	Depressive Symptoms	47.6 (9.3)	44.5 (8.6)	43.5 (7.6)
	Fatigue	54.1 (11.8)	50.0 (12.7)	47.4 (12.4)
	Peer Relationships	49.2 (9.4)	51.5 (8.7)	50.3 (9.5)
	Asthma Impact	60.3 (9.0)	50.1 (11.8)	45.9 (12.0)

Table 3. Mixed model estimates for changes in PROMIS scores over time of domains in reference to gender, age at ED visit, child global health score¹.

Pain domains										
Time Point	Pain Behavior		Pain Quality (Sensory)		Pain Quality (Affective)		Pain Interference			
	PROMIS score	95% CI	PROMIS score	95% CI	PROMIS score	95% CI	PROMIS score	95% CI		
7-10d vs ED (Time 1 vs Time 0)	-8.8**	-12.1 to -5.6	-7.5**	-10.2 to -4.8	-8.8**	-11.5 to -6.2	-7.3**	-9.9 to -4.6		
1-3 m vs ED (Time 2 vs Time 0)	-12.2**	-15.9 to -8.5	-9.4**	-12.1 to -6.7	-11.6**	-13.8 to -9.4	-9.7**	-12.4 to -7.0		
7-10d vs 1-3 m (Time 1 vs Time 2)	-3.4*	-6.2 to -0.6	-1.9	-4.0 to 0.2	-2.7**	-4.6 to -0.8	-2.4*	-4.6 to -0.2		
Physical functioning domains										
Time Point	Physical Stress Experience		Physical Activity		Strength Impact		Physical Function Mobility			
	PROMIS score	95% CI	PROMIS score	95% CI	PROMIS score	95% CI	PROMIS score	95% CI		
7-10d vs ED (Time 1 vs Time 0)	-6.8**	-9.8 to -3.9	-2.6**	-4.5 to -0.7	3.0*	0.6 to 5.4	3.2**	1.0 to 5.4		
1-3 m vs ED (Time 2 vs Time 0)	-10.0**	-13.0 to -7.1	-1.2	-3.9 to 1.5	6.6**	4.1 to 9.2	4.5**	2.1 to 6.9		
7-10d vs 1-3 m (Time 1 vs Time 2)	-3.2**	-5.5 to -0.9	1.4	-1.1 to 3.8	3.6**	1.1 to 6.1	1.2	-0.7 to 3.2		

Other domains										
Time Point	Anxiety		Depressive Symptoms		Fatigue		Peer Relationships		Asthma Impact	
	PROMIS score	95% CI	PROMIS score	95% CI	PROMIS score	95% CI	PROMIS score	95% CI	PROMIS score	95% CI
7-10d vs ED (Time 1 vs Time 0)	-7.7**	-10.7 to -4.6	-3.1*	-5.9 to -0.2	-4.1*	-7.3 to -0.9	2.3*	0.2 to 4.5	-10.3**	-13.1 to -7.4
1-3 m vs ED (Time 2 vs Time 0)	-7.6**	-10.8 to -4.4	-4.1**	-6.6 to -1.6	-6.7**	-9.8 to -3.7	1.1	-1.7 to 3.9	-14.4**	-17.7 to -11.2
7-10d vs 1-3 m (Time 1 vs Time 2)	0.1	-2.5 to 2.6	-1.1	-3.0 to 0.8	-2.6	-5.3 to 0.2	-1.2	-3.6 to 1.1	-4.2*	-7.0 to -1.4

[†]All timepoints adjusted for age at ED, gender (F vs M), and child global health (Poor/Fair vs Very Good/Excellent and Good vs. Very Good/Excellent).

* $p < 0.05$.

** $p < 0.01$.

Table 4. Effect size and SEM of PROMIS scores at follow-up time points since ED visit.

		N	7-10 days (Time 1)	1-3 months or 6 months (Time 2)
(a) Effect Size				
Pain Domains				
Pain Behavior		63	0.67*	0.82*
Pain Quality (Sensory)		63	0.68*	0.87*
Pain Quality (Affective)		63	0.84*	1.32*
Pain Interference		62	0.68*	0.89*
Physical Functioning Domains				
Physical Stress Experience		63	0.58*	0.84*
Physical Activity		63	0.34*	0.11
Strength Impact		63	0.32*	0.65*
Physical Function Mobility		62	0.37*	0.47*
Other Domains				
Anxiety		62	0.63*	0.59*
Depressive Symptoms		61	0.27*	0.42*
Fatigue		62	0.33*	0.56*
Peer Relationships		61	0.28*	0.10
Asthma Impact		62	0.91*	1.12*
(b) SEM				
			7-10 days (Time 1)	1-3 months or 6 months (Time 2)
	N	SEM	N (%) with ≥ 1 SEM with improvement	N (%) with ≥ 1 SEM with improvement
Pain Domains				
Pain Behavior	63	2.3	40 (63.5)	44 (69.8)
Pain Quality (Sensory)	63	3.3	41 (65.1)	45 (71.4)
Pain Quality (Affective)	63	3.5	40 (63.5)	49 (77.8)
Pain Interference	62	4.1	32 (51.6)	37 (59.7)
Physical Functioning Domains				
Physical Stress Experience	63	3.3	38 (60.3)	42 (66.7)
Physical Activity	63	2.5	14 (22.2)	20 (31.8)
Strength Impact	63	2.6	24 (38.1)	33 (52.4)
Physical Function Mobility	62	4.2	25 (40.3)	31 (50.0)
Other Domains				
Anxiety	62	4.9	32 (51.6)	32 (51.6)
Depressive Symptoms	61	4.6	23 (37.7)	25 (41.0)
Fatigue	62	4.8	28 (45.2)	32 (51.6)
Peer Relationships	61	4.5	22 (36.1)	20 (32.8)
Asthma Impact	62	3.0	44 (71.0)	50 (80.7)

*effect size >0.2 are significant.

Table 5. Mean with 95% confidence interval of change in scores of PROMIS domains over time among subjects reporting a little better now/worse or much better now in given domain since ED visit (Time 0).

	Much better now			A little better now/worse		
(a) 7-10 days (Time 1)	N	Mean change in PROMIS score since Time 0	95% CI	N	Mean change in PROMIS score since Time 0	95% CI
Pain Domains						
Pain Behavior	41	-11.3	-15.3 to -7.2	21	-4.9	-10.0 to 0.3
Pain Quality (Sensory)	41	-10.2	-13.5 to -6.9	21	-3.2	-7.2 to 0.8
Pain Quality (Affective)	41	-11.6	-14.9 to -8.4	21	-4.1	-7.5 to -0.6
Pain Interference	40	-9.1	-12.6 to -5.6	21	-4.4	-8.2 to -0.6
Physical functioning domains						
Physical Stress Experience	41	-9.4	-12.9 to -6.0	21	-2.0	-6.9 to 3.0
Physical Activity	41	-3.0	-5.1 to -0.9	21	-2.0	-5.9 to 2.0
Strength Impact	41	5.1	2.1 to 8.1	21	-0.5	-4.1 to 3.1
Physical Function Mobility	40	4.3	1.6 to 6.9	21	2.2	-1.2 to 5.7
Other domains						
Anxiety	40	-10.6	-14.4 to -6.8	21	-2.9	-7.1 to 1.4
Depressive Symptoms	40	-4.1	-7.7 to -0.5	20	-2.0	-6.4 to 2.4
Fatigue	40	-4.7	-8.8 to -0.7	21	-3.9	-8.7 to 0.9
Peer Relationships	40	0.7	-1.7 to 3.0	20	5.8	1.7 to 9.9
Asthma Impact	40	-14.0	-17.5 to -10.5	21	-4.2	-7.0 to -1.5
	Much better now			A little better now/worse		
(b) 1-3 months/6 months (Time 2)	N	Mean change in PROMIS score since Time 0	95% CI	N	Mean change in PROMIS score since Time 0	95% CI
Pain Domains						
Pain Behavior	46	-15.5	-19.5 to -11.4	13	-1.0	-7.7 to 5.7
Pain Quality (Sensory)	46	-12.0	-14.8 to -9.2	13	-1.5	-7.0 to 3.9
Pain Quality (Affective)	46	-13.5	-15.8 to -11.1	13	-4.3	-7.9 to -0.8
Pain Interference	45	-11.5	-14.8 to -8.2	13	-5.0	-9.3 to -0.6
Physical functioning domains						
Physical Stress Experience	46	-12.1	-15.5 to -8.8	13	-2.2	-7.6 to 3.3
Physical Activity	46	-2.1	-5.3 to 1.1	13	1.0	-4.8 to 6.7
Strength Impact	46	8.0	4.9 to 11.0	13	2.3	-2.2 to 7.0
Physical Function Mobility	45	6.5	4.0 to 9.0	13	-2.2	-7.9 to 3.5
Other domains						
Anxiety	45	-9.5	-12.9 to -6.0	13	2.1	-3.5 to 7.8
Depressive Symptoms	45	-4.7	-7.6 to -1.8	12	-0.1	-5.0 to 4.8
Fatigue	45	-8.5	-12.0 to -4.9	13	-2.2	-6.9 to 2.5
Peer Relationships	45	0.6	-2.6 to 3.8	12	1.9	-5.1 to 8.9
Asthma Impact	45	-17.4	-20.9 to -13.9	13	-3.3	-8.5 to 1.9