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Concurrent validity of the PROMIS® pediatric global health measure

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Abstract

Purpose To evaluate the concurrent validity of the PROMIS Pediatric Global Health measure (PGH-7), child-report and parent-proxy versions.

Methods Surveys were administered via home computer on two separate occasions (December, 2011 and August/September, 2012) to a convenience sample of 4636 children 8–17 years old and 2609 parents who participated in a national Internet panel. Data analysis included: (1) evaluations of differences in PGH-7 scores between groups defined by sociodemographics, clinical characteristics, and access to health care; (2) associations with 15 PROMIS pediatric measures; and (3) correlations with two health-related quality-of-life instruments, the KIDSCREEN-10 and PedsQL-15.

Results PGH-7 scores were lower for children with chronic conditions, Hispanic ethnicity, low socioeconomic status, and barriers to accessing health care. The PGH-7 showed excellent convergent and discriminant validity with PROMIS pediatric measures of physical, mental, and social health. The PGH-7 was strongly correlated with the KIDSCREEN-10, which assesses positive health, and moderately correlated with the PedsQL-15, which assesses problems with a child's health.

Conclusions The PGH-7 measures global health, summarizing a child's physical, mental, and social health into a single score. These properties make it a useful clinical, population health, and research tool for applications that require an efficient, precise, and valid summary measure of a children's self-reported health status. Future research should prospectively evaluate the PGH-7's capacity to detect change that results from alterations in clinical status, transformations of the healthcare delivery system, and children's health development.

Abbreviations

PRO	Person-reported outcome
PROMIS	Patient-reported outcomes measurement information system
PGH	Pediatric global health
IEP	Individualized educational program
EAP	Expected A posteriori

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Introduction

An individual's assessment of an outcome that comes directly from the individual without interpretation by a clinician or anyone else is called a person-reported outcome (PRO). Children as young as 8 years have the

cognitive and socioemotional skills to complete self-reported PROs [1, 2]. A pediatric PRO may be an expression of how a child feels physically or emotionally, what a child can do in terms of executing actions or participating in desired activities, or how a child evaluates their health or life. Summary assessments of a person's self-reported health overall, across physical, mental, and social dimensions, have been called *global health* [3].

The most widely used global health measure is the single item that asks: "Overall, how would you rate your health?" Response options range from poor to excellent. The item's simplicity, applicability across the lifespan, lack of intellectual property restrictions, and usefulness as a predictor of healthcare utilization [4] and mortality [4, 5] account for its inclusion in many health and healthcare surveys. Despite these advantages, this single item lacks variation, particularly within pediatric populations. Eight in ten children say their health is excellent or very good [6], a ceiling effect that limits discrimination of levels of health status and detection of important changes in health.

Compared with single-item indicators, multi-item scales improve precision, discrimination of population health, and sensitivity to change. The National Institute of Health's Patient-Reported Outcomes Measurement Information System (PROMIS®) has developed multi-item scales for adult self-reported global health [3], and recently one for child self-reported global health (PGH-7) [7]. The two measures are based on the same conceptual framework [8]. Together they comprise a life course approach (from ages 8–85 years) for measurement of global health that is freely available via the PROMIS Web site (www.nihpromis.org).

The purpose of this manuscript is to evaluate the concurrent validity of PGH-7. We present known-group assessments regarding how well the PGH-7 discriminates pediatric populations by sociodemographic characteristics, clinical characteristics, and differences in access to care. To examine convergent and discriminant validity, we present the PGH-7's associations with 15 other measures of pediatric self-reported health. Lastly, we contrast the PGH-7 with the KIDSCREEN-10 and PedsQL measures, which provide summary assessments of health-related quality of life.

Methods

The Institutional Review Board of the Children's Hospital of Philadelphia approved study procedures (protocols 10-007684 and 12-009560). Informed consent for child participants was obtained from parents and assent was obtained from children.

Data collection and study samples

We collected survey data via home computers on two separate occasions: December, 2011 (Sample 1) and August–September, 2012 (Sample 2). Participants were recruited from a national Internet panel maintained by Op4G, a private research community whose approximately 250,000 members participate in Internet-based surveys using their home computers. Op4G participants are volunteers, and although they are spread across the USA, the panel is not nationally representative (see Op4G.com for more detail).

Questionnaires were administered in English and available in child-report and parent-proxy versions. Parents were asked to decline participation if their child had a cognitive limitation that precluded him or her from responding independently.

For study sample 1, five study forms were used. Each contained the PGH-7 and a subset of the following PROMIS pediatric measures: psychological stress experiences, physical stress experiences, life satisfaction, positive affect, meaning and purpose, family belonging, or family involvement. Participants were randomly assigned to complete one of the five forms. For study sample 2, participants were randomly assigned to complete one of two study forms. Each contained the PGH-7, KIDSCREEN-10, the PedsQL-15, and a subset of the following PROMIS pediatric domains: physical function mobility, physical function upper extremity, pain interference, fatigue, anxiety, anger, depression, and peer relationships.

For both study samples, we specified the participant quotas for age–gender-form combinations based on the Census 2010 age–gender distributions of US children. Op4G sent e-mail invitations in waves to members with children. Those who screened positive as having children aged 8–17 years were eligible to participate. Email invitations were stopped for a given age–gender-form group once the quota had been satisfied. The e-mail system that Op4G used did not allow for recording of the number of members contacted, so participation rates could not be computed for this study.

Parents completed a questionnaire first and then asked their child to complete a separate questionnaire. Parents were instructed to allow their child to complete the questionnaire privately. In Sample 1, once we had met pre-established quotas, parents completed the consent materials only before asking their child to complete the child-respondent questionnaire.

Measures

Table 1 summarizes the variables and measures by study sample and respondent.

Table 1 Measures and variables by respondent and study sample

Variable name	Categories/definition	Sample 1 Respondent		Sample 2 Respondent	
		Child	Parent-proxy	Child	Parent-proxy
Child characteristics					
Age	8–12 years; 13–17 years	X	X	X	X
Gender	Male; female	X	X	X	X
Race	White; Black/African-American; Asian/Pacific Islander; other	X	X	X	X
Ethnicity	Hispanic/Latino; Non-Hispanic/Latino	X	X	X	X
Individualized educational program	Child's school has provided an individualized educational program to guide delivery of special education supports: yes; no		X		
Health insurance	Child's type of healthcare insurance coverage during the past 12 months: public; private; uninsured		X		X
Household composition	One adult caregiver at home; more than one adult caregiver at home		X		X
Family income	Annual household income: <$40,000; $40,000 or more		X		X
Geographic residence	Northeast; Southwest; Southeast; Midwest; West	X	X		
Access to care barriers	Difficulty or delays obtaining medical care, dental care, or behavioral health care: yes; no, for each of the six variables				X
Parent characteristics					
Relationship to child	Mother; father; other		X		X
Age	18–34 years; 35–44 years; 45+ years		X		X
Educational attainment	Some high school; high school; some college or technical degree or associate's degree; college degree or higher		X		X
Child's health status					
Chronic conditions	Presence of attention deficit hyperactivity disorder, autism spectrum disorder, asthma, diabetes, depression/anxiety, or other chronic condition; any of these (yes/no) and indicators for each one (yes/no)		X		
Special healthcare need	Child has a chronic condition that is associated with a functional limitation, high use of medical services, need for specialized care, or an emotional/behavioral problem: yes; no				
PROMIS pediatric global health	Health overall across physical, mental, and social dimensions (seven-item scale)	X	X	X	X
PROMIS pediatric family belonging	Feelings, beliefs, and experiences of being a valued member of the family (eight-item scale)	X	X		
PROMIS pediatric family involvement	Consistency and quality of the child's activities with family members (eight-item scale)	X	X		
PROMIS pediatric psychological stress	Thoughts or feelings about self and the world in the context of environmental or internal challenges (eight-item scale)	X	X		
PROMIS pediatric physical stress	Physically experienced sensations, such as arousal, agitation, pain, and gastrointestinal distress, that are associated with responses to internal or external challenges (eight-item scale)	X	X		
PROMIS pediatric meaning and purpose	A sense that life has purpose and there are good reasons for living (eight-item scale)	X	X		
PROMIS pediatric life satisfaction	Global and context-specific evaluations of one's life (eight-item scale)	X	X		
PROMIS pediatric positive affect	Momentary positive or rewarding affective experiences such as pleasure, joy, elation, contentment, and happiness (eight-item scale)	X	X		
PROMIS pediatric upper extremity function	Activities that require use of the shoulder, arm, or hand, such as writing, using buttons, or opening containers (eight-item scale)			X	X
PROMIS pediatric mobility	Activities of physical mobility such as getting out of bed or a chair or running (eight-item scale)			X	X
PROMIS pediatric pain interference	Consequences of pain on social, cognitive, emotional, physical, and recreational activities and enjoyment in life (eight-item scale)			X	X

Table 1 continued

Variable name	Categories/definition	Sample 1		Sample 2	
		Respondent		Respondent	
		Child	Parent-proxy	Child	Parent-proxy
PROMIS pediatric fatigue	Overwhelming, debilitating and sustained sense of exhaustion that decreases one's ability to do school work and to function at one's usual level in family or social roles (eight-item scale)			X	X
PROMIS pediatric anxiety	Fear, worry, and hyperarousal (e.g., nervousness) that reflect autonomic arousal and the experience of threat (eight-item scale)			X	X
PROMIS pediatric anger	Angry mood (e.g., irritability, reactivity), aggression (verbal and physical), and attitudes of hostility and cynicism (eight-item scale)			X	X
PROMIS pediatric depression	Negative mood (e.g., sadness), decrease in positive affect (e.g., loss of interest), negative views of the self (e.g., worthlessness, low self-esteem), and negative social cognition (e.g., loneliness, interpersonal alienation) (eight-item scale)			X	X
PROMIS pediatric peer relationships	Quality of relationships with friends and other acquaintances (eight-item scale)			X	X
KIDSCREEN-10	General health-related quality of life (ten-item scale)			X	X
PedsQL-15 summary score	Global assessment of health-related quality of life that encompasses problems with physical functioning, emotional functioning, social functioning, and school functioning (15-item scale)			X	X
PedsQL physical health	Physical functioning assessed as problems with walking, running, and lifting objects (five-item subscale)			X	X
PedsQL psychosocial health	Composite of emotional, social, and school functioning subscales (ten-item scale)			X	X
PedsQL emotional function	Evaluates problems with anxiety, anger, and sadness (four-item subscale)			X	X
PedsQL social function	Assesses problems with peer relationships (three-item subscale)			X	X
PedsQL school function	Evaluates problems attention, memory, and school work (three-item subscale)			X	X

PROMIS pediatric global health (PGH-7)

The PGH-7 has seven items, each with five response options, covering children's general, physical, mental, and social health [7]. The item wordings are: (1) In general, would you say your health is: (poor–excellent); (2) In general, would you say your quality of life is: (poor–excellent); (3) In general, would you rate your physical health: (poor–excellent); (4) In general, would you rate your mental health, including your mood and ability to think: (poor–excellent); (5) How often do you feel really sad? (never–always); (6) How often do you have fun with friends? (never–always); and, (7) How often do your parents listen to your ideas? (never–always)

The measure was developed with input from experts, parents, and children. All items were well understood by children as young as age 8 years in cognitive interviews. The PGH-7 has no floor effects and about 5 % score at the ceiling. It has excellent internal consistency [Cronbach's alpha: 0.88 (child) and 0.84 (parent-proxy)] and 2-week test–retest reliability [intraclass correlation coefficients of 0.73 (child) and 0.74 (parent-proxy)]. The scale is unidimensional and without differential item functioning by age, gender, race, or ethnicity [7].

Items have been calibrated using the item response theory graded response model. Scoring was done using the Bayesian Expected A Posteriori (EAP) estimation procedure, which accounts for the pattern of responses on each item [9]. The item parameter estimates previously reported [7] were used for scoring.

PROMIS pediatric measures

For study sample one, eight-item short forms for newly developed PROMIS pediatric measures for psychological stress experiences [10], physical stress experiences [10], positive affect [11], life satisfaction [11], meaning and purpose [11], family belonging, and family involvement were administered. They were scored in the direction of their names (e.g., high scores on the stress measures indicate greater levels of stress) and scaled to a mean 0 and standard deviation of 1 using the EAP methodology.

For study sample 2, eight-item short forms were administered for the PROMIS pediatric measures for upper extremity function [12], mobility [12], fatigue [13], pain interference [14], anxiety [15], depressive symptoms [15], anger [16], and peer relationships [17]. These measures were also scored using the EAP methodology.

KIDSCREEN-10

The KIDSCREEN-10 provides a Rasch-scaled summary score, based on ten items [18], and was derived from the 52-item KIDSCREEN [19, 20]. The KIDSCREEN is a generic measure of children's health-related quality of life that was developed simultaneously in several countries to ensure cross-cultural relevance and harmonization of the conceptual framework and the item-level concepts. The KIDSCREEN-10 score encompasses physical (physical well-being), psychological (psychological well-being, moods, and emotions), social (social support and friends, social acceptance), family (relationship with parents, autonomy), and school-related dimensions of health and quality of life for children and adolescents between the ages of 8 and 17 years [21]. Statistical analyses show that the items of the KIDSCREEN are understood similarly across different cultures, age groups, and genders and for different diseases and disorders.

PedsQL

The Pediatric Quality of Life Inventory Generic Core Scales (PedsQL 4.0) were developed to measure the health-related quality of life of children and adolescents. They are available as self-reported and parent-proxy-reported versions. We used the 15-item short form, which provides a total score and subscales for physical health (five items), emotional functioning (four items), social functioning (three items), and school functioning (three items). The response options for the PedsQL items ask children to rate how much of a "problem" they are experiencing with a given item concept. The pediatric scales have good reliability, and children without health conditions achieve higher scores than do those who are chronically or acutely ill [22].

Sociodemographics

In both study samples, parents provided information on the child's age, gender, race, ethnicity, insurance, household composition, family income, parental age, and parental educational attainment. We obtained the three-digit zip codes from parents and linked them to census data to determine region of residence. In study sample 1, parents reported whether their child had received an individualized educational program (IEP) from his or her school.

Children with chronic conditions

Parents were asked whether their child had a health condition that was expected to last more than 12 months, and, if so, they were asked to provide the name of the condition. Parents were also administered the Children with Special Health Care Needs Screener, a measure of chronic health problems that require health services or cause functional limitations [23, 24].

Access to care

In study sample 2, parents responded to six questions on difficulty or delays in obtaining medical care, dental care, and behavioral health care in the past 12 months. The questions were modified items from the Household Survey, Access to Care Section of the Medical Expenditure Panel Survey [25]. Items were modified to make them self-report.

Data analysis

To evaluate the concurrent validity of the PGH-7, we started by constructing a set of hypotheses that were based on well-established empirical associations. We expected children with lower socioeconomic status, presence of chronic conditions, or educational needs requiring special education interventions to score lower on the PGH-7 than counterparts. Furthermore, we expected that children with poorer access to care, indicative of unmet health needs, would have lower PGH-7 scores.

Regarding convergent and discriminant validity, we hypothesized that measures of physical symptoms (PROMIS pain interference, fatigue, and physical stress experiences) and emotional distress (PROMIS anxiety, anger, depressive symptoms, and psychological stress experiences) would be negatively associated with the PGH-7. Measures of children's positive psychological experiences (PROMIS positive affect, life satisfaction, meaning and purpose), their social relationships (PROMIS peer relationships, family belonging, and family involvement), and physical functioning (PROMIS upper extremity function and mobility) were expected to positively correlate with the PGH-7.

To assess known-group validity, we performed multivariable linear regressions that included all available sociodemographic and clinical characteristics. The dependent variable was child-reported PGH-7 score. Because of the multiple comparisons, a critical value of 0.01 was used for detection of differences between groups. Separate regressions were performed for sample 1 only, sample 2

only, and both samples combined. Because the PGH-7 score was centered at mean zero with standard deviation of one, beta coefficients represented multivariable adjusted differences between groups expressed in standard deviation units.

We estimated the associations between the child-reported PGH-7 score and access to care indicators using T tests to compare mean child PGH-7 scores between groups for each binary indicator. Cohen's d was computed as a measure of effect size.

Finally, we computed the PGH-7's correlation with other PROMIS pediatric measures, the KIDSCREEN-10, and the PedsQL scales using polychoric correlations calculated in StataMP (version 13).

Results

Overall 7245 individuals participated in the two surveys: 4636 children 8–17 years old and 2609 parents of these children. We contrasted the two study samples and found several differences (Table 2). To determine whether we could combine these samples for some analyses, we examined each of the seven items in the PGH-7 for uniform and non-uniform differential item functioning (DIF) by sample, using the LORDIF R package [26], and found no substantive DIF, using a criterion of 2 % change in Mcfadden's pseudo-R^2.

Figure 1 shows the box plot distributions of PGH-7 scale scores, for both the child and parent-proxy versions, by the five categories from the general health item. The PGH-7 increases monotonically for both child and parent-proxy respondents. Figure 1 also shows variation in global health within each general health response option.

Known-group analyses were done using multivariable regression that controlled for covariates in Table 2. The PGH-7 was positively correlated with socioeconomic status (i.e., income and parent educational attainment) and negatively associated with presence of a chronic condition or special healthcare need (Table 3). Children with chronic conditions had PGH-7 scores that were from 0.53 to 1.30 standard deviation units lower than counterparts without those conditions. The 26 % of children in study sample 2 with a special healthcare need had PGH-7 scores 0.78 standard deviation units lower than the 74 % of children without a special healthcare need.

Regardless of the specific access barrier, children with more difficulties obtaining health care had lower PGH-7 scores (range −0.48 to −0.67 standard deviation unit differences) than those who did not experience access barriers (Table 4). The effect size was largest for delays in obtaining needed behavioral health care.

The PGH-7 was correlated in the hypothesized directions with 15 PROMIS measures of pediatric self-reported health, demonstrating excellent convergent and discriminant validity (Table 5). PGH-7 correlations were lowest with physical functioning measures (child 0.24–0.32; parent-proxy 0.26–0.35), intermediate for physical symptoms (child −0.28 to −0.55; parent-proxy −0.25 to −0.54) and negative psychological functioning (child −0.41 to −0.55; parent-proxy −0.27 to −0.55), and highest with social health (child 0.57–0.60; parent-proxy 0.42–0.58) and subjective well-being (child 0.68–0.73; parent-proxy 0.65–0.74).

The PGH-7 was strongly correlated with the KIDSCREEN-10 and had moderate correlations with the PedsQL (Table 6).

Discussion

Global health represents a summary assessment of a person's overall health. This study provides evidence from cross-sectional analyses in support of the construct validity of PGH-7 as a short multi-item scale of global health for children. It can be administered as a self-report for children 8–17 years old, and a parent-proxy tool for children 5-17 years-old. PGH-7 scale scores detect more variation in children's global health than the single-item general health rating, suggesting that it may be more useful for population health surveys. Another important limitation of a single global health summary score is that it does not capture the multi-dimensionality of child health.

The strengths of our work were the large samples we obtained to evaluate the measure across diverse groups; the contrasts with a large number of domain-specific measures of physical, mental, and social health; and, the associations with existing health-related quality-of-life measures. Assessment of the representativeness of the study samples was limited by the method used for recruiting participants from the Internet panel. Denominator information on the number of participants contacted could not be collected, which prevented us from computing participation and response rates. Although the sample was obtained from across the country, it cannot be considered nationally representative, but instead should be considered a national convenience sample. This limitation is particularly important when interpreting the absolute levels of global health, which are likely to be higher than a national probability sample, assuming that less healthy children are less likely to participate in Internet surveys. Finally, administration of the survey via home computers does not allow for monitoring of the potential impact of parental presence on children's responses to health questions.

Table 2 Participant characteristics by survey sample

Characteristic	Sample 1 n (%)	Sample 2 n (%)
Survey respondents		
Child	3635	1001
Parent-proxy	1608	1001
Child participants		
Age (years)		
8–12	2357 (65 %)	501 (50 %)
13–17	1278 (35 %)	500 (50 %)
Gender		
Female	1680 (46 %)	361 (36 %)
Male	1955 (54 %)	640 (64 %)
Ethnicity		
Hispanic/Latino	370 (10 %)	164 (16 %)
Non-hispanic/Latino	3265 (90 %)	837 (84 %)
Race		
White	2948 (81 %)	628 (63 %)
Black/African-American	282 (8 %)	111 (11 %)
Asian/Pacific Islander	170 (4 %)	141 (14 %)
Other	235 (7 %)	121 (12 %)
Geographic area		
Rural	559 (15 %)	
Urban/suburban	3076 (85 %)	n/a
Geographic region in the USA		
Northeast	589 (16 %)	
Southwest	325 (9 %)	
Southeast	1097 (30 %)	
Midwest	1001 (28 %)	
West	623 (17 %)	n/a
Chronic condition		
No	1215 (76 %)	
Yes	393 (24 %)	n/a
Specific chronic conditions		
Attention deficit hyperactivity disorder	102 (6 %)	
Autism spectrum disorder	98 (6 %)	
Asthma	28 (2 %)	
Diabetes	26 (2 %)	
Depression/anxiety	16 (1 %)	
Other chronic conditions	111 (7 %)	n/a
Special healthcare need		
Yes		235 (26 %)
No	n/a	654 (74 %)
Annual household income		
Less than $40,000	483 (30 %)	410 (41 %)
$40,000 or more	1125 (70 %)	591 (59 %)
Health insurance		
Public	498 (31 %)	314 (32 %)
Private	1015 (63 %)	600 (60 %)
Uninsured	95 (6 %)	78 (8 %)

Table 2 continued

Characteristic	Sample 1 n (%)	Sample 2 n (%)
Individualized educational program		
Yes	342 (21 %)	
No	1266 (79 %)	n/a
Family composition		
One adult caregiver at home	242 (15 %)	249 (25 %)
More than one adult caregiver at home	1366 (85 %)	752 (75 %)
Parent-proxy participants		
Relationship to child		
Mother	1190 (74 %)	525 (52 %)
Father	288 (18 %)	392 (39 %)
Other	130 (8 %)	84 (8 %)
Age (years)		
18–34	440 (28 %)	321 (32 %)
35–44	724 (46 %)	400 (40 %)
45+	424 (27 %)	280 (28 %)
Educational attainment		
Some high school	28 (2 %)	63 (6 %)
High school/GED	271 (17 %)	192 (20 %)
Some college/technical degree/associate's degree	658 (41 %)	270 (28 %)
College degree or higher	651 (40 %)	445 (46 %)

Fig. 1 Distribution of the PGH-7 scores for each category of the general health item. The graphs show the distributions of the PGH-7, separately for child self-report and parent-proxy, for each response option from the general health item. The *boxes* provide the PGH-7 scores for the 25th (*lower lines of the boxes*), 50th (*middle lines*), and the 75th (*upper lines of the boxes*) percentiles
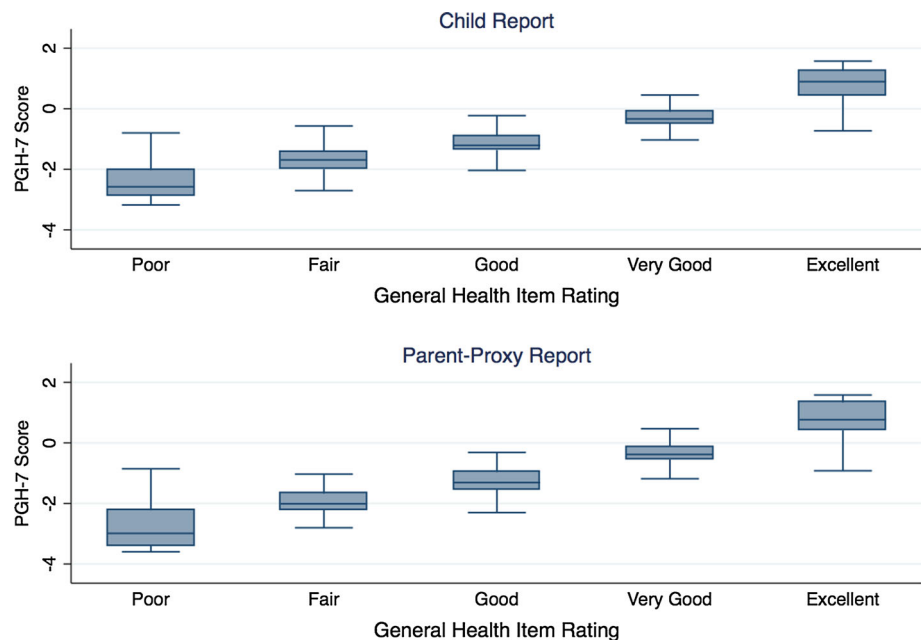
Our results demonstrated that global health was lower for children from low-income families, with Hispanic ethnicity, living in single-parent families, and with parents who had low educational attainment as compared with counterparts. We did not detect, after controlling for socioeconomic status, differences in global health by race

categories. Using a new measure of self-reported health, we have corroborated the well-established health disparities that are unfortunately characteristic of US children. We suggest that because of its simplicity, good psychometric properties, variability in the population, and ability to detect health disparities, the PGH-7 should be considered

Table 3 Multivariable regression adjusted sociodemographic and clinical correlates of the child-reported PGH-7

Characteristics	Beta coefficient (*p* value)		
	Both studies (*n* = 2609)	Study 1 (*n* = 1608)	Study 2 (*n* = 1001)
Study			
Study 1	Referent	n/a	n/a
Study 2	**−0.16 (<0.001)**		
Age–gender group			
8–12-year-old males	Referent	Referent	Referent
8–12-year-old females	**0.19 (<0.001)**	**0.17 (0.004)**	0.17 (0.072)
13–17-year-old males	−0.03 (0.570)	−0.04 (0.584)	0.03 (0.749)
13–17-year-old females	−0.10 (0.082)	−0.16 (0.020)	−0.03 (0.750)
Ethnicity			
Hispanic	−0.14 (0.022)	0.05 (0.527)	**−0.26 (0.005)**
Non-hispanic	Referent	Referent	Referent
Race			
White	Referent	Referent	Referent
Black/African-American	0.02 (0.728)	0.01 (0.880)	0.07 (0.515)
Asian/Pacific Islander	0.06 (0.414)	−0.06 (0.563)	0.04 (0.689)
Other	−0.06 (0.370)	−0.04 (0.683)	0 (0.993)
Annual household income			
<$40,000	**−0.20 (<0.001)**	**−0.21 (<0.001)**	**−0.23 (0.003)**
$40,000+	Referent	Referent	Referent
Health insurance			
Public	−0.10 (0.024)	−0.06 (0.251)	0.06 (0.467)
Private	Referent	Referent	Referent
Uninsured	0.11 (0.177)	0.06 (0.512)	0.07 (0.577)
Family composition			
One adult caregiver	−0.06 (0.269)	0.02 (0.741)	**−0.22 (0.005)**
More than one adult caregiver	Referent	Referent	Referent
Parent-proxy age			
18–34 years	0 (0.965)	0.01 (0.852)	0.14 (0.141)
35–44 years	Referent	Referent	Referent
45+ years	0.03 (0.563)	0 (0.920)	0.03 (0.711)
Parent-proxy educational attainment			
Some high school	Referent	Referent	Referent
High school/GED	0.10 (0.313)	−0.15 (0.384)	0.23 (0.084)
Some college/technical degree	0.19 (0.054)	−0.02 (0.886)	0.25 (0.056)
College degree or higher	0.23 (0.020)	−0.04 (0.813)	**0.37 (0.004)**
Urbanicity			
Urban/suburban		Referent	
Rural		0.15 (0.013)	
Geographic region			
Northeast		Referent	
Southwest		−0.04 (0.681)	
Southeast		0.08 (0.224)	
Midwest		0.17 (0.015)	
West		0 (0.995)	
Chronic conditions			
Attention deficit hyperactivity disorder		**−0.53 (<0.001)**	
Asthma		**−0.56 (<0.001)**	

Table 3 continued

Characteristics	Beta coefficient (*p* value)		
	Both studies (*n* = 2609)	Study 1 (*n* = 1608)	Study 2 (*n* = 1001)
Autism		**−1.03 (<0.001)**	
Depression/anxiety		**−1.30 (<0.001)**	
Diabetes		**−0.97 (<0.001)**	
Other chronic conditions		**−0.58 (<0.001)**	
Individualized educational program			
Yes		0.01 (0.841)	
No		Referent	
Special healthcare need			
Yes			**−0.78 (<0.001)**
No			Referent

Empty cells denote that the survey did not collect data for that variable. Because the PGH-7 was scored on a scale with a mean of 0 and standard deviation of 1, beta coefficients represent differences between groups in standard deviation units. Only children whose parents also participated in the surveys were included in the analyses

Table 4 Barriers to accessing health care and child-reported PGH-7

Access barrier	*n* (%)	Child-reported PGH-7 (mean)	Cohen's d	*p* value
In the last 12 months, was your child *unable to obtain medical care*, tests, or treatments you or a doctor believed necessary?				
No	853 (85 %)	−0.08		
Yes	148 (15 %)	−0.62	−0.53	<0.001
In the last 12 months, was your child *delayed in getting medical care*, tests, or treatments you or a doctor believed necessary?				
No	838 (84 %)	−0.07		
Yes	163 (16 %)	−0.61	−0.54	<0.001
In the last 12 months, was your child *unable to obtain dental care*, tests, or treatments you or a dentist believed necessary?				
No	826 (82 %)	−0.08		
Yes	175 (18 %)	−0.56	−0.48	<0.001
In the last 12 months, was your child *delayed in getting dental care*, tests, or treatments you or a dentist believed necessary?				
No	807 (81 %)	−0.06		
Yes	194 (19 %)	−0.57	−0.51	<0.001
In the last 12 months, was your child *unable to obtain behavioral or mental health care*, tests, or treatments you or a doctor believed necessary?				
No	878 (88 %)	−0.09		
Yes	123 (12 %)	−0.69	−0.60	<0.001
In the last 12 months, was your child *delayed in getting behavioral or mental health care*, tests, or treatments you or a doctor believed necessary?				
No	860 (86 %)	−0.07		
Yes	141 (14 %)	−0.73	−0.67	<0.001

as a tool for monitoring population health of children and youth.

In a study that contrasted the PedsQL total scores for children with chronic conditions, Varni and colleagues found effect sizes of −0.73 for child self-report [22], which is comparable to what we found for presence of a special healthcare need (*d* = −0.78). Our hypothesis that the PGH-7 scores would be lower for children with IEPs was

not supported, probably because we controlled for the chronic and behavioral health conditions that are associated with the need for an IEP.

Adequate access to health care allows individuals to maintain good health by preventing illness, limiting the impact of acute episodes, and managing chronic conditions to avoid exacerbations or complications. As health improves, the need for medical care decreases. Our study

Table 5 PGH-7 correlations with PROMIS pediatric measures

| | Physical health | | | | | Mental health | | | | | | | | Social health | | |
| | Functioning | | Symptoms | | | Emotional distress | | | | Subjective well-being | | | Relationships | | |
	Upper extremity function	Mobility	Pain interference	Fatigue	Physical stress experiences	Anxiety	Anger	Depressive symptoms	Psychological stress experiences	Positive affect	Life satisfaction	Meaning and purpose	Peer relationships	Family belonging	Family involvement
Child self-report															
Sample size	500	500	500	500	1015	500	500	500	1024	992	1049	1029	500	1032	1032
PGH-7 Scale	0.24	0.32	−0.28	−0.31	−0.55	−0.43	−0.41	−0.46	−0.55	0.72	0.73	0.68	0.57	0.60	0.59
Parent-proxy report															
Sample size	500	500	500	500	450	501	501	501	451	437	484	445	501	457	456
PGH-7 Scale	0.26	0.35	−0.25	−0.27	−0.54	−0.31	−0.27	−0.32	−0.55	0.74	0.72	0.65	0.42	0.58	0.55

found that difficulties or delays in obtaining health care were associated with poorer global health. This result agrees with a prior national study that found the same association between global health and delayed access to care [27].

Our cross-sectional findings suggest a next step in this work should be to examine how the PGH-7 changes over time as children's access to care improves, say by obtaining new insurance coverage as a result of the Affordable Care Act's insurance coverage provisions.

The PGH-7 was positively associated with physical functioning, subjective well-being, peer relationships, and family relationships, and negatively associated with physical symptoms and emotional distress. These findings provide evidence in support of the convergent and discriminant validity with other pediatric measures of self-reported health. The correlations were strongest between the PGH-7 and the PROMIS subjective well-being, intermediate with stress and social relationships, and lowest for the physical symptoms, emotional distress, and physical functioning. This pattern of relationships provides insight into the health-related determinants of children's sense of feeling healthy overall (i.e., their global health).

The PGH-7 was strongly associated with the KIDSC-REEN-10, suggesting that the two measures assess a similar construct. However, it had moderate correlations with the PedsQL, indicating that the two measures assess overlapping but different constructs. The differences in the strength of associations are likely due to the item content. Like the PGH-7, most of the KIDSCREEN-10 items assess positive attributes of health with low ends of the latent trait indicative of lack of health and high ends indicative of high levels of positive health. The PedsQL, however, uses items that focus on impairments (problems with) in functioning, so low scores suggest impairment, while high scores are indicative of lack of impairment.

An important next step for research is assessment of the prospective validity of the PGH-7, that is, how the measure changes over time in response to alterations in children's clinical status, clinical quality improvement programs, or population-level healthcare delivery system reform.

The PGH-7 is an efficient measure of pediatric global health, requiring just 1–2 minutes to complete. It has minimal ceiling and floor effects and discriminates self-reported global health across the full population as well as subgroups defined by socioeconomic status, chronic disease, and access to care. It measures general health perceptions and summarizes a child's physical, mental, and social health in a single score. These properties make it a useful clinical, population health, and research tool for applications that require an efficient, precise, and valid summary measure of a children's self-reported health status.

Table 6 PGH-7 correlations with the KIDSCREEN and PedsQL among 1001 children and their parents

Items/scale	KIDSCREEN-10	PedsQL					
		Summary score	Physical health	Psychosocial health	Emotional function	Social function	School function
Child-report	0.69	0.41	0.37	0.40	0.39	0.36	0.36
Parent-proxy report	0.68	0.36	0.37	0.26	0.39	0.33	0.28

References

1. Rebok, G., Riley, A., Forrest, C., et al. (2001). Elementary school-aged children's reports of their health: A cognitive interviewing study. *Quality of Life Research, 10*(1), 59–70.
2. Bevans, K. B., Riley, A. W., Moon, J., & Forrest, C. B. (2010). Conceptual and methodological advances in child-reported outcomes measurement. *Expert Review Pharmacoeconomic Outcomes Research, 10*(4), 385–396.
3. Hays, R. D., Bjorner, J. B., Revicki, D. A., Spritzer, K. L., & Cella, D. (2009). Development of physical and mental health summary scores from the patient-reported outcomes measurement information system (PROMIS) global items. *Quality of Life Research, 18*(7), 873–880.
4. DeSalvo, K. B., Fan, V. S., McDonell, M. B., & Fihn, S. D. (2005). Predicting mortality and healthcare utilization with a single question. *Health Services Research, 40*(4), 1234–1246.
5. DeSalvo, K. B., Bloser, N., Reynolds, K., He, J., & Muntner, P. (2006). Mortality prediction with a single general self-rated health question. A meta-analysis. *Journal of General Internal Medicine, 21*(3), 267–275.
6. Bloom, B., Cohen, R. A., & Freeman, G. (2011). Summary health statistics for U.S. children: National Health Interview Survey, 2010. *Vital and Health Statistics. Series 10, Data from the National Health Survey, 250*, 1–80.
7. Forrest, C. B., Bevans, K. B., Pratiwadi, R., et al. (2014). Development of the PROMIS (R) pediatric global health (PGH-7) measure. *Quality of Life Research, 23*(4), 1221–1231.
8. Riley, W. T., Rothrock, N., Bruce, B., et al. (2010). Patient-reported outcomes measurement information system (PROMIS) domain names and definitions revisions: Further evaluation of content validity in IRT-derived item banks. *Quality of Life Research, 19*(9), 1311–1321.
9. Bock, R. D., & Mislevy, R. J. (1982). Adaptive EAP estimation of ability in a microcomputer environment. *Applied Psychological Measurement, 6*(4), 431–444.
10. Bevans, K. B., Gardner, W., Pajer, K., Riley, A. W., & Forrest, C. B. (2013). Qualitative development of the PROMIS® pediatric stress response item banks. *Journal of Pediatric Psychology, 38*(2), 173–191.
11. Ravens-Sieberer, U., Devine, J., Bevans, K., et al. (2014). Subjective well-being measures for children were developed within the PROMIS project: Presentation of first results. *Journal of Clinical Epidemiology, 67*(2), 207–218.
12. DeWitt, E. M., Stucky, B. D., Thissen, D., et al. (2011). Construction of the eight-item patient-reported outcomes measurement information system pediatric physical function scales: Built using item response theory. *Journal of Clinical Epidemiology, 64*(7), 794–804.
13. Lai, J. S., Stucky, B. D., Thissen, D., et al. (2013). Development and psychometric properties of the PROMIS((R)) pediatric fatigue item banks. *Quality of Life Research: An International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation, 22*(9), 2417–2427.
14. Varni, J. W., Stucky, B. D., Thissen, D., et al. (2010). PROMIS Pediatric Pain Interference Scale: An item response theory analysis of the pediatric pain item bank. *The Journal of Pain: Official Journal of the American Pain Society, 11*(11), 1109–1119.
15. Irwin, D. E., Stucky, B., Langer, M. M., et al. (2010). An item response analysis of the pediatric PROMIS anxiety and depressive symptoms scales. *Quality of Life Research, 19*(4), 595–607.
16. Irwin, D. E., Stucky, B. D., Langer, M. M., et al. (2012). PROMIS Pediatric Anger Scale: An item response theory analysis. *Quality of Life Research, 21*(4), 697–706.
17. Dewalt, D. A., Thissen, D., Stucky, B. D., et al. (2013). PROMIS Pediatric Peer Relationships Scale: Development of a peer relationships item bank as part of social health measurement. *Health Psychology, 32*(10), 1093–1103.
18. Ravens-Sieberer, U., Erhart, M., Rajmil, L., et al. (2010). Reliability, construct and criterion validity of the KIDSCREEN-10 score: A short measure for children and adolescents' well-being and health-related quality of life. *Quality of Life Research: An International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation, 19*(10), 1487–1500.
19. Ravens-Sieberer, U., Gosch, A., Rajmil, L., et al. (2005). KIDSCREEN-52 quality-of-life measure for children and adolescents. *Expert Review Pharmacoeconomics Outcomes Research, 5*(3), 353–364.
20. Ravens-Sieberer, U., Gosch, A., Rajmil, L., et al. (2008). The KIDSCREEN-52 quality of life measure for children and adolescents: Psychometric results from a cross-cultural survey in 13 European countries. *Value Health, 11*(4), 645–658.
21. KIDSCREEN Group. (2006). *The KIDSCREEN Questionnaires—quality of life questionnaires for children and adolescents—handbook.* Lengerich: Papst Science Publisher.
22. Varni, J. W., Burwinkle, T. M., & Seid, M. (2006). The PedsQL 4.0 as a school population health measure: Feasibility, reliability, and validity. *Quality of Life Research: An International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation, 15*(2), 203–215.
23. Bethell, C. D., Read, D., Neff, J., et al. (2002). Comparison of the children with special health care needs screener to the questionnaire for identifying children with chronic conditions—revised. *Ambulatory Pediatrics, 2*(1), 49–57.
24. Bethell, C. D., Read, D., Stein, R. E., Blumberg, S. J., Wells, N., & Newacheck, P. W. (2002). Identifying children with special health care needs: Development and evaluation of a short screening instrument. *Ambulatory Pediatrics, 2*(1), 38–48.
25. Agency for Healthcare Research and Quality. (2012). Medical Expenditure Panel Survey (MEPS). http://www.ahrq.gov/research/data/meps/index.html. Accessed December 13, 2014.

26. Choi, S. W., Gibbons, L. E., & Crane, P. K. (2011). lordif: An R package for detecting differential item functioning using iterative hybrid ordinal logistic regression/item response theory and Monte Carlo simulations. *Journal of Statistical Software, 39*(8), 1–30.

27. Simon, A. E., Chan, K. S., & Forrest, C. B. (2008). Assessment of children's health-related quality of life in the United States with a multidimensional index. *Pediatrics, 121*(1), e118–e126.