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Factor Structure of the Pediatric Symptom Checklist with a Pediatric Gastroenterology Sample

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Abstract Pediatric gastrointestinal disorders are commonly experienced by youth and have been shown to be associated with increased rates of psychosocial difficulties. Aim of the current study was to extend development of the Pediatric Symptom Checklist (PSC), a brief parent-completed measure designed to assess children's behavioral and emotional functioning, by examining its factor structure in a pediatric gastroenterology sample. Parents of 176 children ages 4–16 years visiting a pediatric gastroenterologist completed the PSC. The factor structure of the PSC was examined using principal component analysis. Parallel analysis was utilized to determine the number of factors to retain and indicated that three factors existed within the data. A principal component analysis with varimax rotation identified factors measuring internalizing, externalizing, and attention difficulties. The three factors that emerged on the PSC provide initial support for the utility of the PSC in pediatric gastroenterology clinics.

Keywords Pediatric psychosocial screening · Pediatric gastroenterology · Principal component analysis · Pediatric Symptom Checklist

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Pediatric gastroenterology is one of the most utilized pediatric subspecialties (Forrest et al., 1999), and past research has shown that youth experiencing gastrointestinal symptoms experience higher rates of psychosocial problems compared to other youth (Banez & Cunningham, 2009; Campo et al., 2004). Pediatric gastrointestinal disorders include a wide range of disorders affecting the gastrointestinal tract. Recurrent abdominal pain (RAP), generally thought of as a functional gastrointestinal disorder, and Inflammatory Bowel Disease (IBD), a chronic disease of the digestive tract, are two disorders that have been studied extensively in terms of the associated psychosocial difficulties (Banez & Cunningham, 2009). A recent assessment of psychiatric symptoms in youth ages 8–15 with RAP found that 81% of those assessed met criteria for an anxiety or depressive disorder. In contrast, only 13.2% of pain-free control subjects not diagnosed with RAP met criteria for an anxiety or depressive disorder (Campo et al., 2004). High prevalence rates for depressive and anxiety disorders ranging from 25 to 60% have also been identified in youth with IBD (Banez & Cunningham, 2009). Higher rates of psychiatric diagnoses and psychological distress have also been documented in youth suffering from a variety of functional gastrointestinal disorders including functional dyspepsia, constipation, and esophageal motility disorders (Whitehead, 1996). A recent investigation comparing a heterogeneous sample of youth presenting in gastroenterology subspecialty clinics compared to healthy controls found that the youth seeking gastroenterology care had higher rates of internalizing problems and lower rates of adaptive and social skills (Hommel et al., 2010). Together, these data indicate the need for the assessment of psychosocial problems in youth presenting with gastrointestinal symptoms.

Research on strategies for aiding physicians in the detection of psychosocial problems has primarily focused on assessment measures designed to identify children experiencing behavioral and emotional symptoms (Hayutin, Reed-Knight, Blount, Lewis, & McCormick, 2009). Unfortunately, many measures that are psychometrically valid and reliable for children and adolescents are not practical for wide scale use in a pediatric gastroenterology practice for several reasons, including long test length and administration time, format (i.e., semi-structured interview), scope (i.e., symptom specific measures), and the need for professional training for interpretation. One measure designed to be used as a broad screening tool in medical settings is the Pediatric Symptom Checklist (PSC) (Jellinek & Murphy, 1988). The PSC is not a diagnostic tool but rather is a brief, 35-item, parent-completed screening measure for emotional and behavioral problems validated for use with children ages 4–16 years. Pediatricians' use of the PSC is associated with higher rates of detection of psychosocial issues (Jellinek et al., 1999; Murphy, Arnett, Bishop, Jellinek, & Reede, 1992a) and higher referral rates compared to when no psychosocial screening measure is utilized (Murphy et al., 1992a).

Examinations of the PSC's psychometric properties have demonstrated good reliability and validity in several samples of general pediatric outpatients (Jellinek, Little, Murphy, & Pagano, 1995; Jellinek, Murphy, & Burns, 1986; Jellinek et al., 1988; Murphy, Jellinek, & Milinsky, 1989; Walker, LaGrone, & Atkinson, 1989). Recently, use of the PSC has been extended to youth receiving subspecialty care including pediatric neurology (Anderson et al., 1999) and youth receiving treatment for sickle cell disease and type 1 diabetes mellitus (Stoppelbein et al., 2005). Within the pediatric neurology sample it was found that the PSC had adequate sensitivity and specificity compared to the Child Behavior Checklist (Achenbach, 1991), a more lengthy measure of psychosocial problems (Anderson et al., 1999).

Given the utility of the PSC as a screening tool for identifying youth experiencing psychosocial difficulties in medical settings, researchers have become increasingly interested in the domains measured by the PSC, which can be determined by examining the measure's factor structure. In a sample of children ages 2–18 visiting a health maintenance organization (HMO), a two factor structure of internalizing and externalizing symptoms was found (Bernal & Estroff, 2000). Conclusions are limited, however, because only a subset of the 35 items on the PSC was found to load on the two factors, leaving multiple items not assigned to a factor. Gardner and colleagues utilized factor analytic techniques in a primary care population to develop a shortened, 17-item version of the PSC with 3 factors consisting of internalizing, externalizing, and attention problems (Gardner et al., 1999). Like Bernal and Estroff (2000), these findings are limited by the fact that only 17 items comprise the three scales. A shortened scale decreases the specificity of the measure compared to the full 35-item measure. In another study of children visiting a primary care practice, Gardner and colleagues obtained a 4-factor solution for the 35-item PSC with internalizing, externalizing, attention, and school factors identified (Gardner, Kelleher, & Pajer, 2002). Finally, the factor structure of the PSC has been evaluated in a sample of chronically ill youth seeking subspecialty care for sickle cell disease and type 1 diabetes mellitus (Stoppelbein et al., 2005). Interestingly, the authors found that a 4-factor solution best represented the data with the factors comprised of internalizing, externalizing, attention, and chronic illness-related problems.

In sum, past studies examining the factor structure of the PSC using mainly primary care and one chronic illness sample have been somewhat equivocal as to the most accurate complete factor structure for the full 35-item measure. Thus far, results have consistently revealed at least an internalizing and externalizing factor. However, the presence and characteristics of additional factors, when present, have been less consistent and seemingly dependent upon the sample. Further, the particular items that load on the more consistently identified internalizing and externalizing factors vary across investigations, as does the total number of items from the original PSC that are retained in factor analytic investigations. Finally, Stoppelbein and colleagues (2005) called for additional research to evaluate the factor structure of the PSC in youth with other pediatric subspecialty needs to increase applicability beyond patients with neurological difficulties, sickle cell disease, and type 1 diabetes mellitus.

The current study sought to examine the factor structure of the PSC in a pediatric gastroenterology sample to provide data on the domains of psychosocial difficulties measured within pediatric gastroenterology subspecialty care. Given the variations in factors that have been identified in other patient samples, an investigation of the factor structure of the PSC specific to pediatric gastroenterology is needed to provide evidence as to the domains assessed in this unique patient population. Valid assessment of psychosocial problems in youth receiving medical care from a pediatric gastroenterologist is valuable for several reasons. First, psychosocial problems may be contributing to the child's physical symptoms since psychosocial problems have been shown to exacerbate gastrointestinal symptoms (Banez & Cunningham, 2009). Identification of ongoing psychosocial problems could lead to gastrointestinal symptom reduction once the psychosocial problems are successfully treated. Psychosocial problems could also result from or simply co-occur with children's gastrointestinal symptoms. Regardless

of directionality, successful treatment of psychosocial problems could reduce these children's suffering and increase their quality of life. The first step in this process is identification of psychosocial problems with an assessment instrument such as the PSC that has been shown to have psychometrically valid factors for these unique patients. Sole use of a total PSC score without factor scores can fail to identify children who only display problems that cluster on one factor and may not have a total PSC score above the recommended cutoff used for identification of psychosocial problems. For children both above and below the total score cutoff, psychometrically sound factors are valuable for helping physicians identify areas of functioning in need of further assessment and make appropriate referrals for follow-up care. Documentation of the factor structure of the PSC within a pediatric gastroenterology sample could also provide support for the applicability of this measure for assessing psychosocial difficulties within this subspecialty group.

The present study is a principal component analysis of the PSC that was completed by the caregivers of children seen in a pediatric gastroenterology clinic. Since the factor structure of the PSC has not been evaluated in a pediatric gastroenterology sample, no a priori hypotheses were made concerning the factor structure. Identification of the most appropriate factor structure will aid pediatric gastroenterologists in accurately assessing youth experiencing psychosocial problems that may be co-occurring with, exacerbating, and/or secondary to their gastrointestinal symptoms.

Method

Participants

Participants were caregivers (mothers $n = 155$; fathers $n = 16$; other $n = 5$) of 176 4- to 16-year-old ($M = 9.61$, $SD = 3.65$) children attending a medical appointment with one of six pediatric gastroenterologists in a large clinic in the southeastern United States. Demographic data for the sample are included in Table 1. Inclusion criteria were that participants should be primary caregivers bringing a child between the ages of 4–16 years to an outpatient appointment. Exclusion criteria were that the child was developmentally delayed or the caregivers were non-English speaking. However, no potential participants were excluded due to these criteria. Children were seen at the pediatric gastroenterology practice for the following reasons as indicated primarily by self-report by parents and secondarily by chart review: 26% abdominal pain, 16% constipation or encopresis, 12% reflux, 7% vomiting, 7% Inflammatory Bowel Disease, 4% diarrhea, 4% weight loss, 2% infection, <1% anal fissure, <1% dysphagia, <1% hemochezia, <1% anemia, <1% pancreatitis, and 21% other/chose not to indicate. Percentages sum to greater than 100 due to patients having more than one reason for seeking care.

Table 1 Demographic characteristics of the sample

Variable	*N*	%
Child's gender		
Male	96	54.5
Female	80	45.5
Race		
White	141	80.6
African American	21	12.0
Asian	3	1.7
Hispanic	2	1.1
Other/missing	9	4.6
Annual family income		
Under $10,000	3	1.7
$10,000–24,999	13	7.4
$25,000–49,999	31	17.6
$50,000–74,999	37	21.0
$75,000–99,999	27	15.3
$100,000 and above	55	31.2
Did not report	10	5.7

Measures

Background Information

Parents provided information about the child's age and race, family income, and reason for the visit.

Pediatric Symptom Checklist (PSC) (Jellinek & Murphy, 1988). The PSC is a 35-item measure designed to screen for emotional and behavioral dysfunction. Parents rated each of the items as occurring "often," "sometimes," or "never," with numeric values of 2, 1, and 0, respectively. Total sum scores range from 0 to 70. The authors of the PSC indicate that a score of 28 or higher for children ages 6–16 (24 or higher for ages 4–5) suggests a need for additional assessment and may warrant a referral to a mental health provider. The PSC has been shown to be a reliable and valid instrument. The construct validity of the PSC has been established in studies comparing it with other parent-report measures of child psychosocial functioning (Simonian & Tarnowski, 2001; Walker et al., 1989) and clinician interview ratings (Navon, Nelson, Pagano, & Murphy, 2001) in a variety of settings. Evaluations of the instrument's sensitivity and specificity have shown that both are high, with sensitivity estimates ranging from 77 to 95% and specificity estimates ranging from 68 to 100%

(Stoppelbein et al., 2005). Test–retest reliability and internal consistency have also been good (Jellinek et al., 1986, 1988, 1995).

Procedure

Participants in the current study were part of a larger study aimed at increasing parent-pediatrician communication about children's psychosocial issues (Hayutin et al., 2009). All procedures were in accordance with Institutional Review Board approval. Participants were recruited consecutively in the waiting room. Written, informed consent was obtained prior to participation in accordance with Institutional Review Board guidelines. Parents completed the questionnaire on background information and the PSC in the waiting room prior to or after seeing their physician. Seventy percent of participants completed the PSC after being seen by their physician; the remaining 30% completed the measure prior to being seen. No differences existed on PSC scores for those who completed the measure before or after being seen by their physician $F(1, 174) = .11$, $p = .74$.

Statistical Analyses

To determine the factor structure of the PSC, an exploratory principal component analysis was conducted. Past research evaluating the factor structure of the PSC has relied on two primary methods for determining the number of factors to retain: the Kaiser or eigenvalues greater than 1 criteria (K1) and an examination of the scree plot, a plot of extracted factors and their eigenvalues. The K1 criteria indicates that factors with eigenvalues greater than 1 should be retained, while the scree plot examination indicates that only those factors occurring above a straight line drawn through the smaller eigenvalues should be retained (Hayton, Allen, & Scarpello, 2004; Ledesma & Valero-Mora, 2007; Pett, Lackey, & Sullivan, 2003). Although both are commonly used methods for specifying factors, a body of research has shown that the K1 criteria consistently overfactors (i.e., leads researchers to incorrectly retain too many factors) while the scree test is overly subjective (see Hayton et al., 2004, for a review).

Given the shortcomings of the two criteria used in past research to specify factors, the current study utilized parallel analysis (PA) (Horn, 1965) to determine the appropriate number of factors to retain within the PSC. PA has been shown to be the most accurate method for specifying factors when conducting principal component analysis and exploratory factor analysis, (O'Connor, 2000) though it is often underutilized due to its increased complexity compared to other methods (Glorfeld, 1995; Hayton et al., 2004; Velicer, Eaton, & Fava, 2000). Theoretically, PA rests on the assumption that true factors can be accurately specified when these factors account for more variance and have larger eigenvalues than parallel factors produced from a random data set having the same sample size and number of variables as the data set being evaluated (Hayton et al., 2004). Therefore, the decision of how many factors to retain when using PA is based on the number of factors in the data set with eigenvalues larger than those from the random data set. For a detailed description of PA please see Hayton et al. (2004). All analyses were conducted using SPSS version 16.0.

Results

The total mean PSC score for children in the study was 15.82 ($SD = 10.46$; range = 0–51). Twenty-four children (14%) scored 28 or higher, indicating a level of psychosocial difficulties warranting further attention may be present.

Prior to beginning principal component analysis, two tests were used to determine if the analyses were appropriate for the sample. Bartlett's Test of Sphericity was significant ($\chi^2 = 2390.835$, $p = .000$), indicating that principal component analysis was appropriate since the correlation matrix was not an identity matrix. The Kaiser–Meyer–Olkin Measure of Sampling Adequacy equaled .83, indicating an adequate sample size (Field, 2005). PA revealed 3 factors when the eigenvalues of the sample data set were compared to the eigenvalues corresponding to the 95th percentile of the random data set (Ledesma & Valero-Mora, 2007). Following the identification of 3 factors using PA, the sample was analyzed using a principal component analysis with a varimax rotation constrained to 3 factors. The resulting factor loadings of items on the 3 scales are presented in Table 2. The 3-factor solution accounted for 41.81% of the variance (Table 3) and identified factors of items measuring internalizing, externalizing, and attention difficulties. Table 3 details the values of the initial eigenvalues and the rotated sums of squares with the amount of variance accounted for by each factor.

Based on past research using the PSC and empirical guidelines for evaluating factor loadings, factor loadings greater than .30 were used to identify items that load on each of the factors (Pett et al., 2003; Stoppelbein et al., 2005). All items met these criteria except for one. Item number 20, "visits doctor with doctor finding nothing wrong", loaded on factor 1, internalizing symptoms, with a factor loading of .26. The determination of whether to retain item 20 or to remove it from factor 1 was made based on the reliability estimates as measured by alpha coefficients of factor 1 both with and without item 20. With item 20 retained, factor 1 demonstrated an alpha coefficient

Table 2 Factor loadings for the Pediatric Symptom Checklist

Pediatric Symptom Checklist items	Factor loading		
	Internalizing symptoms	Externalizing symptoms	Attention symptoms
3. Tires easily, little energy	**.699**	.002	.075
22. Worries a lot	**.687**	.049	.069
27. Seems to be having less fun	**.685**	.230	.031
11. Feels sad, unhappy	**.683**	.330	−.007
24. Feels he or she is sad	**.592**	.496	.006
19. Is down on him or herself	**.577**	.305	.047
1. Complains of aches or pains	**.560**	.083	−.046
2. Spends more time alone	**.553**	.182	.240
13. Feels hopeless	**.538**	.290	.053
21. Has trouble sleeping	**.519**	.140	.279
10. Is afraid of new situations	**.479**	−.054	.059
30. Does not show feelings	**.479**	.219	.101
17. Absent from school	**.461**	−.092	.294
18. School grades dropping	**.406**	.396	.258
23. Wants to be with you more than before	**.386**	.078	.352
15. Less interested in friends	**.362**	.205	.325
20. Visits doctor with doctor finding nothing wrong	**.260**	−.118	.099
33. Blames other for his or her troubles	.185	**.753**	−.008
32. Teases others	.128	**.751**	−.036
16. Fights with other children	.131	**.633**	.187
35. Refuses to share	.073	**.631**	.163
12. Is irritable/angry	.467	**.625**	.028
34. Takes things that do not belong to him or her	−.064	**.559**	.240
29. Does not listen to rules	.179	**.507**	.466
5. Has trouble with a teacher	.187	**.480**	.339
31. Does not understand other people's feelings	.076	**.442**	.195
25. Takes unnecessary risks	−.085	**.429**	.407
26. Gets hurt frequently	.146	**.376**	.276
9. Distracted easily	.183	.182	**.752**
14. Has trouble concentrating	.212	.236	**.703**
4. Fidgety, unable to sit still	−.099	.255	**.623**
28. Acts younger than children his or her age	.206	−.016	**.622**
7. Acts as if driven by a motor	−.282	.282	**.613**
8. Daydreams too much	.259	.023	**.578**
6. Less interested in school	.365	.294	**.401**

Note: Boldface indicates highest factor loadings

Table 3 Values of initial eigenvalues and the rotated sums of squares loadings with the amount of variance accounted for by each factor

Factor	Initial eigenvalues			Rotation sums of squares loadings		
	Total	% Variance	Cumulative %	Total	% Variance	Cumulative %
I	9.22	26.36	26.26	5.75	16.43	16.43
II	3.21	9.17	35.53	4.89	13.97	30.39
III	2.20	6.29	41.81	4.00	11.42	41.81

Table 4 Factor correlations and factor alpha coefficients for the PSC

Factor	*M*	*SD*	1	2	3	4
1. Internalizing symptoms ($n = 17$)	8.24	5.76	(.87)			
2. Externalizing symptoms ($n = 11$)	4.70	4.35	.52	(.83)		
3. Attention symptoms ($n = 7$)	3.59	3.00	.42	.65	(.80)	
4. Total scale ($n = 35$)	15.82	10.46	.86	.85	.73	(.91)

Note: Alpha coefficient reliability estimates of internal consistency appear in the parentheses on the diagonal. All correlations significant at $p < .01$

of .868. With item 20 removed, factor 1 demonstrated an alpha coefficient of .871. The item was retained on factor 1 given that the internal consistency of factor 1 was not appreciably higher with item 20 removed and since it was close to meeting the .30 cutoff. See Table 4 for the means and standard deviations for each of the factors, correlations among the three identified factors and the total score, and Cronbach's alpha coefficients of reliability for each of the factors and the total scale. All reliability values are considered to be acceptable (Field, 2005).

Discussion

The current study examined the factor structure of the PSC in a pediatric gastroenterology sample. Three factors emerged consisting of items measuring internalizing, externalizing, and attention-related symptoms. Unique to the current study is the use of PA to determine the appropriate number of factors to retain. Past research on principal component analysis and exploratory factor analysis has shown PA to be the most accurate and parsimonious method for determining factor retention, though it is currently underutilized by many researchers who rely instead on eigenvalues greater than 1 or the scree plot (Glorfeld, 1995; Hayton et al., 2004; Velicer et al., 2000).

Identification of the factor structure of the PSC in a pediatric gastroenterology sample is especially important given that gastrointestinal problems are some of the most common complaints of youth (Forrest et al., 1999) and since youth experiencing gastrointestinal symptoms experience higher rates of psychosocial problems compared to other children (Banez & Cunningham, 2009; Campo et al., 2004; Hommel et al., 2010). For pediatric gastroenterologists who incorporate the PSC into their assessment of youth's symptoms, the current principal component analysis will be useful for determining specific domains of difficulty, as opposed to sole reliance on a patient having a high total score as the criteria for referral. The identification of one or more specific areas of difficulty, be it internalizing, externalizing, or attention problems, may speed the process by which youth receive appropriate additional referral, assessment and treatment.

The three factors that emerged are similar to factor structures of the PSC identified in past work with non-gastroenterology samples, therefore providing support for the extension of the use of the measure in pediatric gastroenterology samples (Bernal & Estroff, 2000; Gardner et al., 1999). However, unlike the prior research by Bernal and Estroff (2000) and Gardner et al. (1999), the three factors that emerged in the current investigation included all 35 items from the original PSC. Also, differing from prior research with a mixed sample of patients who have diabetes or sickle cell disease, the current study did not identify a chronic illness difficulties factor, which is perhaps contributed to by the heterogeneous sample of youth with varying levels of gastrointestinal symptom severity (Stoppelbein et al., 2005). This difference from past work is important and suggests that the functioning of the average child who presents for pediatric gastroenterology care is not best represented by a separate chronic illness factor in addition to factors representing internalizing, externalizing, and attention problems. Those items that loaded on the chronic illness difficulties factor in Stoppelbein and colleagues' (2005) investigation primarily loaded on the internalizing factor within the current investigation, with the exception of the item, "Gets hurt frequently" loading on the externalizing factor. Further examination of individual item loadings reveals several other differences compared to past studies analyzing the factor structure of the PSC, providing additional justification for the use of the current factor structure for youth seeking pediatric gastroenterology care. Interestingly, item 20 on the PSC, "Visits doctor with doctor finding nothing wrong," had the weakest loading on the three identified factors compared to the other 34 items on the PSC. These findings replicate past work by Stoppelbein et al. (2005) who examined a chronic illness sample and also found a similar lower loading for item 20. It may be that item 20 is a less accurate measure of the constructs identified in these two investigations for youth with chronic illnesses and gastrointestinal symptoms.

One possible limitation of the current study is its inclusion of a heterogeneous sample of patients with different gastroenterology symptoms. While this means that the results are not uniquely representative to any one group, such as patients with IBD or RAP, the heterogeneous sample provides greater external validity to the factor structure that emerged since it is generalizable to a broad sample of youth seeking pediatric gastroenterology care. Additionally, means and standard deviations for the different factors should aid in identifying those children who are meaningfully different from this sample. For

example, one standard deviation (10.46) above the mean for the total scale (15.82) is similar to the recommended cutoff of 28 for referral suggested by the authors of the PSC. A similar approach could be utilized for the three individual factors. Further evaluations of the validity of the factors on the PSC should be undertaken using concurrent measures such as the Child Behavior Checklist, (Achenbach, 1991) as well as other indices such as patients' existing psychiatric diagnoses or teachers' reports of children's behavioral difficulties displayed at school. Finally, the predominantly Caucasian, middle- to high-income sample used in the current study may also limit generalizability to families from different ethnic and income groups. Specifically, the rates of psychosocial problems found in the current sample may underestimate rates that would be found with a low-income sample based on past research with the PSC that has found higher rates of psychosocial dysfunction in economically disadvantaged samples (Murphy, Reede, Jellinek, & Bishop, 1992b).

Routine use of the PSC and the derived subscales from this investigation in pediatric gastroenterology clinics could increase the likelihood that youth experiencing psychosocial difficulties are identified and referred for follow-up care. Identification could also aid pediatric gastroenterologists in determining if patients are experiencing psychosocial difficulties that may be influencing their current physical complaints. Past research has shown the PSC to be feasible for routine, large-scale use in pediatric outpatient settings, lending support to the adoption of the PSC by busy pediatric gastroenterologists interested in screening for psychosocial difficulties (Jellinek et al., 1999). Results of the current study lend support to the extension of the PSC to pediatric gastroenterology and provide a psychometrically valid factor structure to aid in better understanding assessment results.

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