Reexamining the Factor Structure of Somatization Using the Children’s Somatization Inventory (CSI-24) in a Community Sample

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Objective Pediatric somatization studies have used the 35-item Child Somatization Inventory (CSI-35) or psychometrically refined 24-item CSI (CSI-24). Exploratory factor analysis of the CSI-24 has identified a single factor that did not show good model fit in confirmatory factor analysis (CFA). Further evaluation of the CSI-24 factor structure is needed. Methods The present study examined alternative factor structures of the CSI-24 in a community sample (N = 233, ages 8–15). Results The CFA showed good fit for a single CSI-24 factor, better fit for multiple factor models, and best fit for a single, six-item factor. Construct validity for that factor was found in significant correlations with anxiety, depression, functional disability, and quality of life. Conclusions Results are consistent with a single somatization factor, but research is needed to verify the factor structure in different, race/ethnic/demographic, and clinical groups.

Key words adolescents; children; confirmatory factor analysis; exploratory factor analysis; medically unexplained symptoms; somatization.

Introduction

Physical symptoms with unknown etiology, sometimes described as medically unexplained symptoms (MUSs) (Eminson, 2007) or functional somatic symptoms (Beck, 2008), are common among children and adolescents (Eminson, 2007). MUS can be impairing and comprise a small but important number of costly medical visits that increase exposure to needless medical tests and procedures (Beck, 2008; Rief & Broadbent, 2007). From a psychiatric perspective, children with MUS may be classified as having a somatoform disorder (Walker, Beck, Garber, & Lambert, 2009).

Within the past few years, both Beck (2008) and Eminson (2007) reviewed the literature on MUS (which Beck termed functional somatic symptoms, but we will refer to as MUS herein because it is a more neutral term; see Eminson, 2007) in children and adolescents. Both Eminson and Beck presented basic models for examining the processes that develop and maintain MUS. Eminson proposed a model in which child, parent, and professional factors influence one another and contribute to the development of MUS. Among the hypothesized factors involved in this process are anxiety, attention to bodily functions, preoccupation with physical functioning due to a mood disorder or other process, and developmental difficulties in describing emotional or physiological processes. Beck posited a similar model, in which child (age, gender, puberty, and stress reactivity), social (social support and peer acceptance), and environmental factors (family characteristics, rewards, and social factors such as SES) contribute to MUS as moderated by coping, depression/negative affectivity, and social or academic competence.
Studies with adults have led to the development of multicompontent MUS models (Rief & Broadbent, 2007) that may also be applicable to children and adolescents. These models are based on the premise that individuals experience constant sensory stimulation from internal and external sources that is conveyed via neural impulses to the brain. Various cortical processes filter out sensory “noise” to prevent overtaxing higher cortical processes with irrelevant input. Rief and Broadbent’s multicompontent perception-filter model (Rief & Barsky, 2005; Rief & Broadbent, 2007) posits that the filtering process, or higher level cortical processes affecting symptom interpretation, can be distorted and, when this occurs, MUS result. Factors affecting the filtering system include selective attention, anxiety, depression, and a lack of distractors. Factors affecting cortical perception and interpretation of symptoms include excitability (which could include temperament factors associated with intensity and threshold of responsiveness), memory (e.g., schema that predispose indiduals to interpret symptoms as catastrophic), and prior traumatic experiences.

Conceptual frameworks such as the perception filter model could be used to guide the study of factors contributing to the experience of somatization as a general characteristic or trait (i.e., individual differences in the number of MUS a person tends to experience) or as a disorder. When studying somatization as a trait, it is crucial that a sound measure be used.

Presently, the Children’s Somatization Inventory (CSI) (Walker, Garber, & Greene, 1991) is the instrument most commonly used to assess somatization among children and adolescents and is considered to be a well-established measure among scales of internalizing/externalizing symptoms (Holmbeck et al., 2008). The CSI was developed to assess children’s reports of 35 different symptoms that may occur in the absence of an identified medical disease. The 35-item CSI (CSI-35) contains items from four of the six categories included in the DSM-IV somatization disorder category and has been used in numerous studies of children with MUS, including children experiencing headaches and abdominal pain.

Reacting to different methods researchers have developed for scoring the CSI-35, the original developers noted that these alternative approaches reflect differences in the way somatization is dimensionalized (Walker et al., 2009). The use of a single summary “total” score (summing all 35 CSI-35 items) implies the concept of a single, underlying dimension of somatization. Such an approach was used in the original publication when examining the CSI-35 responses of children with abdominal pain (Walker et al., 1991), although no factor analytic procedures were used in that study to support the single-factor approach.

The psychometric properties of the CSI-35 when treated as a single, overall total score have been examined in numerous studies (see Supplementary Data). Evidence supporting the concurrent (Cronbach & Meehl, 1955) or convergent (Campbell & Fiske, 1959) validity of the CSI-35 (i.e., correlations with other measures of the same underlying construct) has been found in studies showing moderate or high correlations (i.e., r ≥ .4) of the CSI-35 with other somatization scales (Garber, Walker, & Zeman, 1991). Support for the construct or nomological (Cronbach & Meehl, 1955) validity of the CSI-35 (i.e., somatization as measured by the CSI-35 is correlated with other theoretical constructs as hypothesized) comes from studies showing the relationship between higher levels of somatization and anxiety (Garber et al., 1991; Lichter et al., 2001; Meesters, Muris, Ghys, & Rooijmans, 2003; Walker et al., 1991), anxiety sensitivity (Muris, Vlaeyen, & Meesters, 2001), catastrophic thinking (Vervoort, Goubert, Eccleston, Bijttebier, & Crombez, 2006), depression (Garber et al., 1991; Lichter et al., 2001; Meesters et al., 2003; Walker et al., 1991), self-worth (Lichter et al., 2001), and self-reported pain (Kaczynski, Simons, & Claar, 2011; Muris & Meesters, 2004).

Studies of the factor structure of a measure are directly relevant to its construct validity (Cronbach & Meehl, 1955). Several studies have examined the structure of somatic complaints using the CSI-35. Using principal components analysis (PCA) with a community sample of 540 children and adolescents (73% White), Grades 2–12, Garber, Walker, and Zeman (1991) identified a four-factor solution for the CSI-35. These factors were described as conversion/pseudoneurological, cardiovascular, gastrointestinal, and pain/weakness. A similar four-factor solution with conversion/pseudoneurological, cardiovascular, gastrointestinal, and pain/weakness factors was also identified with a modified, 37-item version of the CSI in a sample of 600 10–12 year old, radiation-exposed children from the Chernobyl region (Lichter et al., 2001). In contrast, in a Dutch community sample of 479 children (Meesters et al., 2003), a three-factor solution using PCA was identified, including factors of pain/weakness, gastrointestinal symptoms, and pseudoneurological symptoms. PCA of the responses of parents of the children yielded a four-factor solution similar to that found in the prior studies with child respondents.

More recently, Walker et al. (2009) revised the original, 35-item version of the CSI used in those studies, in a sample of 417 patients (87.8% White), aged 8–18 years,
attending a clinic for children with abdominal pain. The revision eliminated 11 items with poor psychometric properties, resulting in a 24-item version of the CSI (CSI-24). Although all prior empirical studies had identified three- or four-factor solutions, consistent with the initial conceptualization of somatization, Walker et al. (2009) hypothesized a one-factor solution consisting of a single, dominant somatization factor, possibly accompanied by several smaller factors that could be more specific to a given physical system. In a PCA with this clinical sample, Walker et al. (2009) identified a two-factor solution, consisting of a large first factor coupled with a second factor on which only one item loaded >.40. Given the limited evidence for the second factor, they concluded that a single-factor model best fit the data. Noting that no prior studies had included a confirmatory factor analysis (CFA), they then conducted a CFA of the single-factor measurement model of the CSI-24 in a second sample of 459 children. The resulting CFA solution, however, was problematic given that one of the two indices of model fit that was reported (CFI = .74) indicated the model fit the data poorly. While Walker et al. (2009) concluded that the CFA supported the single-factor PCA with additional clusters of symptoms, no CFA was conducted to test alternative, competing factor models. Thus, the structure of the CSI-24 remains uncertain.

Walker et al.’s (2009) tests of the factor structure of the CSI-24 were conducted with two clinic samples. While studies of the CSI-35 have been conducted with both clinical and community samples, the factor structure of the CSI-24 has only been examined in a single clinic setting and has not yet been examined in a community sample. Since clinic and community samples differ in important respects, differences in factor structures in these two types of samples may emerge. Among child psychiatry patients, clinically referred children differ from community samples of children in important ways, including increased symptom occurrence (i.e., intensity, frequency, or number of symptoms reported) and greater comorbidity (Caron & Rutter, 1991). Likewise, children seen in medical clinics may differ from others in the community not only with respect to factors associated with their presenting problem (e.g., more intense, frequent pain) but also, given the association between somatization and emotional problems, may have higher levels of comorbidity with emotional or behavior problems. Such differences could substantially alter the factor structure of the measure being examined (Craighead, Smucker, Craighead, & Ilardi, 1998; Pestle, Chorpita, & Schiffman, 2008). Studies of risk factors that might contribute to the development of MUS, and to the stability of MUS once they emerge, need to be done at the community level, but before such research can be conducted, a fuller understanding of the factor structure of the CSI-24 in community samples is required.

PCA, however, may not be the best method for identifying the latent structure of somatization (Brown, 2006; Costello & Osborne, 2005; Floyd & Widaman, 1995). While often recommended to identify underlying factors that provide an empirical summary of the data (Tabachnik & Fidell, 2001), PCA is actually not an estimation method based on the common factor model. The common factor model assumes that the score on each manifest indicator (e.g., item on a questionnaire) reflects the common variance associated with an underlying, latent factor, and the unique variance specific to that particular indicator. PCA, in contrast, assumes that the scores on measured variables have perfect reliability (Thompson, 2004), which is rarely if ever true, and does not differentiate between common and unique variance. Thus, rather than attempting to explain the correlations among, say, a set of measured items in a questionnaire, PCA attempts instead to explain the total variance in each observed measure. As such, PCA is better suited for use as a data-reduction technique than as a way to test hypotheses about common factor structure (Bryant & Yarnold, 1995). A procedure such as principal axis factor (PAF) analysis, which does not assume perfect measurement reliability, may be more appropriate (Brown, 2006; Costello & Osborne, 2005; Floyd & Widaman, 1995), but might yield either a single factor or multiple factors.

We tested the following hypotheses:

1. Using the 24-items of the CSI-24 identified using PCA by Walker et al. (2009), a CFA will show a good model fit for a single-factor model. This is a direct test of the structure that Walker et al. sought to confirm.

2. Three- and four-factor solutions, which had been identified in prior work but not examined using CFA, will show poorer fit than single-factor solutions.

3. Using PAF without specifying the number of factors to be extracted, a single factor will be identified and subsequent CFA will show good model fit. However, because PAF differs from PCA, constituent items that would constitute the single somatization factor in CFA and PAF will differ. Model fit will be better for the latent structure of the CSI-24 based on PAF versus PCA because the former is more capable of identifying underlying common factor structure.
In addition, since the CSI-24 is relatively new, evidence concerning its nomological validity has not yet had a chance to develop in support of the construct validity of this measure. Walker et al. (2009), however, report that the correlation between the CSI-35 and CSI-24 is .99, so it is unlikely that the studies providing support for the construct validity of the CSI-35 would have differed substantially had they used the CSI-24 instead. Nonetheless, it is important to examine the construct validity of the CSI-24 itself directly. Accordingly, we hypothesized:

(4) The CSI-24 will show good construct validity as evidenced by moderate correlations with measures of anxiety and depression (as found in previous work with the CSI-35). In addition, higher levels of somatization will be associated with higher levels of functional disability and poorer illness-related quality of life.

(5) Factors emerging from PAF will show good construct validity based on correlations with anxiety, depression, functional disability, and quality of life.

Finally, we examined whether the factor structures identified by PAF and PCA differed in the magnitude of their relationship with anxiety and depression. Lacking a specific rationale for hypotheses generation, we did not predict which factors would show the stronger relationship to anxiety, depression, functional disability, and quality of life.

**Methods**

**Participants**

This report is part of a series examining the prevalence of abdominal pain and headache in school-age children. There were 495 families at two public schools who were mailed information about the study, of whom 233 (47.1%) returned signed consents and completed study measures. No children whose parents consented were excluded.

For the 233 children who participated in the study, the mean age was 11.80 years (range 8–15 years), and 109 (43.8%) were male. The sample was diverse: 48 (21.3%) White, 75 (32.2%) Black, 53 (22.7%) Latino, 19 (8.2%) Asian, 5 (2.1%) mixed race, and 25 (10.7%) Other, with 8 (3.4%) providing no information about ethnicity.

Two prior reports from this data set described the prevalence of abdominal pain (Saps et al., 2009) and headache (Nyame et al., 2010). Significant correlations between somatization and headache were reported but were not reported for abdominal pain.

**Measures**

**CSI**

The CSI is a child-completed questionnaire assessing the perceived severity of 35 somatic symptoms derived from the list of symptoms for somatization disorder in DSM-III-R, with additional items from the Hopkins Symptom Checklist and one item, constipation, added because of its frequent occurrence in patients seen in pediatric GI clinics. Children are asked to describe “how much you were bothered by” each symptom, with responses ranging from “not at all” to “a whole lot.” The 35 original items of the CSI (CSI-35) were administered, with the 24 items of the revised CSI-24 used in analyses. In the present study, internal consistency (i.e., Cronbach’s \( \alpha \)) of the CSI-35 was .94 and of the CSI-24, .92.

**State-Trait Anxiety Inventory**

The State-Trait Anxiety Inventory (STAIC) (Spielberger, Edwards, Lushene, Montuori, & Platzek, 1973), trait version, is a 20-item self-report of children’s anxiety. Internal consistency in prior studies ranges from .82 to .87, concurrent validity between .63 and .75, and construct validity, .29 and .54 (Myers & Winters, 2002). Internal consistency in the present report was .82.

**Children’s Depression Inventory**

The Children’s Depression Inventory (CDI) (Kovacs, 1985) is a 27-item self-report scale of depression for children and young adolescents. Internal consistency in prior studies ranges from .59 to .88, concurrent validity is described as moderately high (Myers & Winters, 2002), and construct validity has been demonstrated in studies examining its relationship to self-esteem, locus of control, cognitive distortions, and underachievement (Myers & Winters, 2002). Internal consistency in the present report was .88.

**Pediatric Functional Disability Inventory**

The Pediatric Functional Disability Inventory (FDI) (Walker & Greene, 1991) assesses functional limitations (e.g., walking up stairs, doing things with friends, school attendance, etc.) in children with physical disorders. Internal consistency in prior research ranges from .86 to.91; construct validity has been demonstrated by correlations of the FDI with pain, school-related disability, and somatic complaints (Claar, Walker, & Smith, 1999; Walker & Greene, 1991). Internal consistency in the present sample was .86.

**Pediatric Quality of Life Inventory**

The Pediatric Quality of Life Inventory (PedsQL) (Varni, Seid, & Kurtin, 2001) is a child self-report measure of
health-related quality of life. The generic core scales are not specific to any particular type of disorder. Internal consistency in the original normative sample was .88. The construct validity of the scale is reflected in significant correlations with measures of morbidity and illness burden (Varni et al., 2001). Internal consistency in the present sample was .91.

**Procedure**

Parents of children in Grades 3 through 8 in two Chicago Public Schools were invited by mail to participate. Children of parents who provided written consent to participate then completed the original CSI-35 and other psychological questionnaires at their school. There were no exclusion criteria. Questionnaires were administered by research assistants in the children’s classrooms early in the school year. Research assistants then returned weekly for the next 24–36 weeks to obtain reports on the frequency with which the child was experiencing pain. The study was approved by the Institutional Review Board at the investigator’s institution.

**Data Analysis**

The 24 items of the CSI-24 all loaded at medium to high levels in Walker et al.’s (2009) PCA and were therefore used as manifest indicators of the underlying single-factor structure examined in the CFA in the present report. Analyses to examine underlying structure were then conducted using PAF with oblimin rotation of the factors. Since it was not known how many factors might emerge when a PAF was conducted in a community sample, no predetermination was made concerning the number of factors to include in the initial PAF. Eigenvalues and scree plots were then reviewed to determine the optimal number of factors extracted. In addition, because three- and four-factor structures had been identified using PCA in prior studies with the CSI-35, PAFs were conducted that specified three- and four-factor solutions with the CSI-24.

CFAs were then conducted for each model specified in the exploratory analyses, using the items with factor loadings of absolute value ≥ .30 as manifest indicators of underlying factors. In choosing goodness of fit indices, we followed Brown’s method (2006) of reporting chi-square, but not in interpreting the results of chi-square tests because the values are often inflated by large sample sizes. In assessing goodness-of-fit, an absolute fit index (standardized root mean square residual, SRMR), a fit index adjusting for model parsimony (root mean square error of approximation, RMSEA), and comparative fit indices (non-normed fit index, NNFI, and comparative fit index, CFI) were used. Models were described as showing “good” fit if they met criteria on all four fit indices, with criteria as follows: SRMR (< .08), RMSEA (≤ .05), NNFI (>.9), and CFI (>.9). Since models were not nested, chi-square difference tests could not be used to compare models; therefore, Akaike’s Information Criterion (AIC) were used to compare models with lower AICs indicating better model fit.

**Results**

**Descriptive Statistics and Correlations Between Scale Items**

The correlations among the 24 items of the CSI-24 are available at Supplementary Data. With few exceptions, the correlations between items were statistically significant but low to moderate. Means and standard deviations for the CSI-24 items are also available at Supplementary Data.

Hypothesis 1: Using the 24-items of the CSI-24 identified using PCA by Walker et al. (2009), CFA will show a good model fit for a single-factor model.

Investigating a clinic sample using PCA, Walker et al. (2009) found that the 24 items of the CSI-24 had medium-to-high standardized loadings on a single underlying somatization factor. In the present study, we examined the single-factor structure for the 24 items of the CSI in our community sample. Overall, model fit for the single-factor model was good according to all four fit-indices (Table I). Confirming Hypothesis 1, these results are consistent with the existence of a single latent somatization factor in the community sample.

Hypothesis 2: Three- and four-factor solutions will show poorer fit than single-factor solutions.

Factor analyses of responses to the CSI-35 among community samples identified three- or four-factor structures for somatization. Since Walker et al. (2009) eliminated items with poor psychometric properties from the CSI-35 when creating the CSI-24, it was not possible to determine if the exact items on those three- and four-factor structures showed good model fit in CFAs. However, it was possible to specify three- and four-factor solutions using PAF factor analysis with the CSI-24 and then determine how well the resulting models fit the data. Items with factor loadings ≥ .3 in the absolute value in those three- and four-factor EFAs were analyzed using CFA (see Supplementary Data for factor loadings). The factors thus identified included a general somatization factor with items including pain (headache, sore muscles, and stomach
ache), cardiopulmonary (faint/dizzy and rapid heartbeat), GI (food makes sick, bloating/gassy, and nausea), and autonomic (hot/cold spells) and general weakness/lethargy (low energy and body weakness). A second factor included the absence of various neuromuscular symptoms (joint pain, arm/leg pain, back pain, sore muscles, and heaviness). Similar to the first factor, the third and fourth factors included symptoms from a variety of systems, including cardiopulmonary (chest/heart pain and breathing trouble), autonomic (hot/cold spells and swallowing problems), neurological (numbness), and gastrointestinal (constipation and diarrhea).

Presently, there is no theoretical rationale to determine whether or not cross-loadings of manifest indicators on different latent factors are appropriate for somatization symptoms, so models with and without cross-loadings were analyzed. The model without cross-factor loadings (Model 3) showed good model fit for all fit indices (Table I). Similarly, when cross-loadings were allowed (Model 4), model fit was again good on all four indices. For the four-factor models, model fit was again good both with (Model 5) and without (Model 6) cross-factor loadings. Comparison of AICs for the three- and four-factor models with the single-factor models showed that each multifactor was a better fit than the single latent-factor model for all 24 CSI-24 items (Model 1), although not as good as the single-factor model (Model 2) based on six CSI items described above.

Hypothesis 3: Using PAF, a single factor will be identified, and CFA will show a good model fit. Model fit will be better for the latent structure of the CSI-24 based on PAF than based on PCA because the former is better for identifying underlying common factor structure.

Since there was no consistent evidence for a particular factor structure based on the CSI-24 and CSI-35, a PAF with oblimin rotation was conducted with the school sample without specifying the number of factors to be extracted. Due to the large number of items, data from the entire sample were included in the PAF. Factor loadings are available at Supplementary Data. Six factors were identified with eigenvalues >1. The first factor explained 34.99% of the common variance, with each additional factor explaining a much smaller portion of the variance, between 4.49% and 5.91%. The scree plot, however, is consistent with a single-factor solution. The single somatization factor includes cardiopulmonary (chest pain, breathing problems, and rapid heartbeat), gastrointestinal (food makes you sick and swallowing difficulty), and autonomic (hot/cold spells) symptoms. Excluded are neuromuscular symptoms (numbness, back pain, and limb heaviness) identified in the PCA as part of the single somatization factor, as well as symptoms of faintness/dizziness and constipation. Cronbach’s $\alpha$ for the 6-item single factor was .82. Means and standard deviations for the six items are available at Supplementary Data.

Since only six items were included in the single factor derived from the PAF, we had sufficient sample size to split the sample in half randomly and then use CFA to assess the replicability of the single-factor PAF solution for six items across the two random subsamples. Using the SPSS-19 randomization function, the full sample was divided into a test sample ($n = 118$) and a holdout sample ($n = 115$). In both the test and holdout samples, the CFA model consisting of a single somatization factor for the six items derived from the community-based PAF (Model 2) showed a good overall fit according to all four fit indices. AICs for both the test and holdout sample analyses indicated that the single-factor CFA model for six items (first identified via PAF) is a better fit to the CSI responses of

<table>
<thead>
<tr>
<th>Model</th>
<th>Satorra–Bentler Chi-square (df)</th>
<th>RMSEA</th>
<th>NNFI</th>
<th>CFI</th>
<th>SRMR</th>
<th>AIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1: Clinic-based single-factor model [all CSI-24 items; (Walker et al.)]</td>
<td>313.37* (252)</td>
<td>.032</td>
<td>.99</td>
<td>.99</td>
<td>.065</td>
<td>409.37</td>
</tr>
<tr>
<td>Model 2: Single-factor, PAF-derived (six items)</td>
<td>Test sample</td>
<td>12.08 (9)</td>
<td>.34</td>
<td>.99</td>
<td>1.0</td>
<td>.057</td>
</tr>
<tr>
<td></td>
<td>Holdout sample</td>
<td>10.46 (9)</td>
<td>.037</td>
<td>.99</td>
<td>1.0</td>
<td>.051</td>
</tr>
<tr>
<td>Model 3: Three-factor, no cross-loadings</td>
<td>127.68 (132)</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>.063</td>
<td>205.68</td>
</tr>
<tr>
<td>Model 4: Three-factor, cross-loadings</td>
<td>209.46 (202)</td>
<td>.013</td>
<td>1</td>
<td>1</td>
<td>.082</td>
<td>311.45</td>
</tr>
<tr>
<td>Model 5: Four-factor, no cross-loadings</td>
<td>150.7 (129)</td>
<td>.027</td>
<td>.99</td>
<td>.99</td>
<td>.061</td>
<td>234.7</td>
</tr>
<tr>
<td>Model 6: Four-factor, cross-loadings</td>
<td>188.93 (162)</td>
<td>.027</td>
<td>.99</td>
<td>.99</td>
<td>.062</td>
<td>284.93</td>
</tr>
</tbody>
</table>

Note. The items from the CSI-24 were used in all analyses. RMSEA = root mean square error of approximation; NFI = non-normed fit index; CFI = comparative fit index; SRMR = standardized root mean square residual; AIC = Akaike information criteria.

* $p < .01$.
Correlations Between Scales
Total scores for the CSI-35 and CSI-24 correlated .98 (p < .001), and the six-item single-factor somatization scale derived via PAF correlated .85 (p < .001) with CSI-35 total score, and .86 (p < .001) with CSI-24 total score, in the community sample.

Hypothesis 4: The CSI-24 will show good construct validity by correlating moderately well with measures of anxiety, depression, and functional disability, and will be associated with poorer illness-related quality of life.

Hypothesis 5: Factors emerging from the PAF will show good construct validity based on correlations with anxiety, depression, functional disability, and quality of life.

In previous studies, construct validity for the CSI-35 and CSI-24 was reported in relation to a single factor “total score,” in order to allow for comparisons with prior work. The construct validity of the single-factor model for six CSI items identified in the present study was assessed by correlating the total score on the six items with the child’s self-reported measures of anxiety, depression, functional disability, and quality of life. Correlations between all three measures of somatization and each of the psychological measures were moderate in magnitude and significant in the predicted direction. For CSI-35 total score, correlations were—anxiety: .57 (p < .01); depression: .53 (p < .01); quality of life: — .69 (p < .01); and functional disability: .63 (p < .01). For CSI-24 total score, correlations were—anxiety: .57 (p < .01); depression: .53 (p < .01); quality of life: — .68 (p < .01); and functional disability: .62 (p < .01). For the six-item single factor, correlations were—anxiety: .43 (p < .01); depression: .41 (p < .01); quality of life: — .62 (p < .01); and functional disability: .62 (p < .01). Fisher’s r-to-z-transformations were performed to allow comparisons of the magnitudes of the correlations for each of measures of anxiety, depression, quality of life, or functional disability. None of the correlations for the three different measures of somatization were significantly different from one another.

Discussion
The present study contributes to our understanding of the latent structure of somatization by (a) examining single and multiple factor models in a single sample so that they could be compared directly; (b) examining models based on PAF, which is better suited to identify latent structure of a construct than is the PCA approach used in prior work, and employing CFA rather than relying solely on EFA procedures to confirm model fit; (c) determining whether model fit for these alternative models was acceptable in a community sample; and (d) assessing the degree to which good model fit could be replicated in a second sample, since each model studied previously was tested only with a single sample.

In testing Hypothesis 1, we sought to determine whether the single-factor model provided some support for a general factor of somatization as measured by the CSI-24. When the single factor underlying the 24 items of the CSI was examined using CFA in this community sample, model fit was good across all fit indices. This result differs from Walker et al.’s (2009) findings, which revealed that model fit was not good for a single factor. As in prior studies, the single-factor model loading on 24 items correlated significantly with other key constructs, including anxiety and depression (Hypothesis 4).

In conducting CFA, it is important to realize that many models showing a good fit will also have equivalent models that could also fit as well or better (Brown, 2006; Kline, 2011). As a result, testing alternative models is important. Based on many prior studies showing that the single somatization factor correlated in the expected manner with other psychological constructs, we hypothesized that the single-factor model would fit the CSI data better than models with three or four factors (Hypothesis 2). In fact, the three- and four-factor models showed better fit than the single-factor model for all 24 CSI items. Better fit for the multiple factor models is consistent with the Walker et al.’s untested model of multiple factors that are both general and specific to certain symptom clusters. In identifying the three- and four-factor models tested in Hypothesis 2, we specified that the PAF solutions extract 3 and 4 factors, respectively. In testing Hypothesis 3, PAF was conducted without specifying the number of factors, allowing the best fit to emerge. In doing so, a single-factor solution emerged consisting of six CSI items. In the subsequent CFA examining a six-item single-factor model, model fit was good in both an initial test sample of randomly selected study participants and a second holdout sample that included the remaining participants. For both samples, model fit was better for the six-item single factor than for the single factor consisting of all 24 CSI items and was better than alternative models with three and four factors. Thus, when using a PAF procedure that is better suited for identifying underlying latent structure,
the present study supports a single-factor structure that includes six CSI items.

Along with the results of the CFA, support for the construct validity of the six-item single-factor model comes from the high internal consistency of the six-item factor and from the high correlations of the six-item single factor with the total scores of the CSI-24 and CSI-35 and with anxiety, depression, functional disability, and quality of life (Hypothesis 5). The correlations of the six-item single were not significantly different from those for the CSI-24 and CSI-35 total scores.

Presently, the theoretical significance of the six-item single factor is unclear. It is noteworthy that the six symptoms it comprises differ from the others in the CSI-24 in some important respects. All but one of those six symptoms involve sensations experienced in the viscera (difficult swallowing, chest/heart pain, breathing trouble rapid heartbeat, and food makes sick); the remaining autonomic symptom (hot cold spells) is also likely to be experience in the trunk region. This latter symptom is different from many other CSI symptoms that affect limbs (sore muscles, etc.), the head (headache), back (back pain), and sensory processes (blurred vision and voice loss).

Second, these six items differ from some others on the CSI because they can only be perceived internally and typically auditory or visual perception is not involved in detecting their presence. Thus, they differ from CSI-24 symptoms of vomiting, diarrhea, blurred vision, and voice loss.

Finally, only one of the six-item single factor symptoms involves visceral pain (chest/heart), while numerous other CSI-24 symptoms involve pain occurring in separate limbs, head, and back. These other pain symptoms include headache, back pain, sore muscles, stomach aches, joint pain, and arm/leg pain. The exception is abdominal pain, which does include visceral sensations but was not identified in the six-item single factor. Five of the symptoms of the six-item single factor may be experienced less intensely than the level of sensation involved in pain.

These primarily visceral sensations may be particularly important in the process of somatization. Ness and Gebhart observed that visceral pain is thought to be a separate, specific type of deep pain. Possibly, the qualities associated with deep pain may be associated with other nonpainful visceral sensations. Such symptoms may affect perception filter processing by being less intense than pain but still difficult to ignore, and more ambiguous than other sensations because they cannot be confirmed or denied by other sensory modalities (e.g., vomiting that confirms the legitimacy of the underlying illness, touching the sore muscle that increases discomfort). This nonspecificity makes such symptoms more likely to be influenced by other psychological processes, including anxiety and depression, and leads to increased selective attention because these symptoms are hard to confirm or deny. Along with replicating the latent structure of somatization as measured by the CSI, future studies are needed to examine the construct validity of the six-item single factor and to understand the role that somatization plays in the perception filtering process that gives rise to clinically significant, impairing symptoms.

An anonymous reviewer made the insightful observation that several of the symptoms of the six-item factor are associated with asthma, that most participants in the present study are African Americans and Latinos among whom rates of asthma may be high, particularly in Chicago, and that the factor structure may thus have been influenced by the high rates of asthma symptoms in this particular sample. Two of the six symptoms, trouble breathing and chest pain, may be closely associated with asthma, whereas two others, fast heart beat and swallowing difficulties, may occur but are less closely related to the key symptoms of the disorder and are more likely to be related to other conditions; two others, food makes sick and hot/cold spells, appear to be unrelated. In addition, while many studies (Kattan et al., 1997) show that rates of asthma-associated morbidity are higher among inner city children and adolescents, data on the increased prevalence of asthma among inner city children are less compelling. The most recent report from the CDC (Centers for Disease Control and Prevention, January 12, 2011) indicates higher asthma rates for African Americans (11.1%) than non-Hispanic Whites (7.8%), but lower asthma rates for Hispanics (6.3%). That report did not present data on inner-city children and adolescents, nor is it clear that the differences between these specific subgroups are statistically significant. It is unclear whether having larger proportions of African Americans and Hispanics in our sample would produce a different factor structure than the primarily Caucasian samples that Walker et al. (2009) analyzed.
Other researchers (Evans et al., 1987) have reported small, nonsignificantly higher rates of asthma for African Americans compared to Whites. Surveying inner-city youth in the Bronx, for example, Crain et al. (1994) found that lifetime prevalence of asthma was higher among Latinos (17.9%) and Blacks (11.6%) than Whites (8.6%), but ethnic differences in point prevalence were not significant. Since the CSI-24 assesses recent symptoms, point prevalence is perhaps more important than lifetime prevalence. Regarding Chicago, Weiss and Wagener (1990) found the rate of asthma mortality was higher in Chicago than the surrounding area but also noted that mortality from asthma is “an unlikely event” and quite distinct from its prevalence. Overall, it seems unlikely that a 3–4% increase in asthma prevalence among minorities would radically alter the latent structure of the CSI-24. Increased morbidity (Otsuki et al., 2010; Weil et al., 1999) among inner-city children, however, may lead to more frequent episodes of wheezing and could affect the latent structure of the CSI.

The need for further research on somatization and MUS in children and adolescents is substantial. The developers of the CSI-24 (Walker et al., 2009) noted that future research should assess whether the CSI factor structure they identified generalizes to other clinical and community populations. The present study partly addresses that agenda, but additional studies are needed with other clinical samples and community samples of differing ethnic compositions. In addition, the factor structure of somatization may differ in community samples in which children with acute and chronic illness are included versus those in which they are excluded. In the present study, children with such illnesses were included to be consistent with the way the Child Somatization Inventory has typically been used in prior work (i.e., 12 of the 13 studies included in table of validity studies, available in the Supplementary Data, did not eliminate subjects based on chronic or acute illness). Nonetheless, it is possible that the factor structure might be different if children with such problems were eliminated, and this warrants attention in future research.

Our findings also raise the possibility that a core subset of symptoms may reflect the latent structure of somatization in children and adolescents. Further studies of symptom structure are needed to determine the degree to which asthma morbidity influences the six-item somatization factor we have discovered. Understanding the latent structure of somatization is important if research on somatization and MUS in children and adolescents is to make significant advances. If the underlying structure of somatization is not well understood, for example, then researchers may miss opportunities to determine how other psychological factors, such as anxiety and depression, contribute to different components of somatization. A fuller understanding of the factors associated with somatization may improve our approaches to treating somatoform disorders and help us understand how somatization as a trait-like characteristic contributes to clinically significant MUS.

A great deal of attention in recent years has gone to emphasizing the importance of translational research, the process in which the findings of basic scientific studies are adapted to practical applications. Advancing our understanding of somatization processes, somatoform disorders, and measures of somatization to a clinically relevant level is an important overall target. As yet, however, the clinical utility of the CSI has not been established. Studies of the CSI are still occurring at the basic clinic research level prior to being able to be applicable to individual patient use. For example, studies reporting the ability of the CSI, alone or in conjunction with other procedures, to identify children with somatoform disorders are not available. Studies of the sensitivity/specificity of the CSI, measures of receiver operating characteristics that would identify appropriate cutoff scores with clinical utility, are unavailable. Researches demonstrating that somatization tendencies are moderators of the response to treatment or pain or other MUS are not available but are important for understanding whether the CSI may be useful as a predictor or treatment responsiveness.

A limitation of the present study is our inability to replicate the factor structures in a second, entirely independent sample, and further research is needed to accomplish this. In addition, while the present study included a diverse sample, further studies with larger sample sizes are needed to determine whether the factor structure of the CSI-24 varies across ethnic groups and across different developmental stages, using multigroup CFA procedures to test hypotheses about configural, metric, and scalar invariance (Brown, 2006). To obtain the broadest possible range of child participants in the current school-based study, contact with parents was limited. As a result, the range of demographic information we obtained was limited, and the absence of information about marital and socioeconomic status restricts the generalizability of our findings.

Supplementary Data

Supplementary data can be found at: http://www.jpepsy.oxfordjournals.org/.
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anxiety sensitivity, and learning experiences.
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