Anxiety and Psychosocial Stress as Predictors of Headache and Abdominal Pain in Urban Early Adolescents

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Objective To examine the relations among anxiety, psychosocial stress, and headache and abdominal pain complaints within the context of the Biobehavioral Model of Pediatric Pain. **Methods** Adolescents from urban schools serving a predominantly African-American population completed measures of pain, anxiety, witnessing violence, problem situations, and victimization at the end of the seventh grade (N = 502) and 6 months later (longitudinal N = 289). **Results** A high prevalence of weekly headaches (40%) and abdominal pain (36%) was reported. Anxiety partially mediated relations between psychosocial stress and pain at Time 1, particularly for problem situations. Longitudinal models showed that adolescents reporting higher levels of pain at Time 1 reported greater increases in victimization and anxiety at Time 2. Changes in pain were positively correlated with changes in anxiety and stress variables. **Conclusions** Implications for understanding the causes and correlates of headache and abdominal pain in normal children are discussed.

Key words abdominal pain; anxiety; headache; stress.

Somatic complaints during childhood are usually considered transient "growing pains" that are part of normal development. These complaints are often characterized by pains that occur in the absence of identifiable organic etiology, and headaches and abdominal pain complaints are particularly common. Epidemiological studies estimate that frequent abdominal pain is experienced by 10–30% of school-age children (Farrell, 1984; Ingersoll, Grizzle, Beiter, & Orr, 1993), and 75% of adolescent boys and girls experience headaches at least monthly (Linet, Stewart, Celentano, Zeigler, & Sprecher, 1989; Sillanpaa, 1983). During adolescence, girls tend to report more pain and life interference because of pain than boys (Miaskowski, 1999; Unruh, 1996); however, the extent to which this gender difference is due to menstrual-related complaints for girls has yet to be considered. Epidemiological studies of gender differences in clinical pain problems during adulthood have demonstrated specific gender distributions; women as compared with men report greater pain with the same pathology (Miaskowski, 1999). Unfortunately, however, both clinicians and researchers have largely ignored potential or actual differences in how boys and girls develop various pain complaints. Frequent pain complaints are often associated with increased psychosocial risk. For example, children suffering from nonorganic pain (i.e., not associated with a specific disease or injury) suffer levels of emotional distress and impairment equivalent to that of children with organic physical problems (Walker & Greene, 1989). In spite of this common clinical phenomenon, minimal empirical attention has been devoted to understanding the psychosocial correlates and course of pain complaints across development.

Perhaps the most well-developed conceptual model of pediatric pain is the Biobehavioral Model of Pediatric Pain (Varni, Blount, Waldron, & Smith, 1995). This model defines antecedents (e.g., stress, injury), which play a causal role in pain onset or exacerbation; concomitants

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(e.g., depression, anxiety), which can occur prior to and during a pain episode; and consequences (e.g., reduction in school activities, behavioral problems), which extend beyond pain relief and may include long-term psychological, social, and physical disability of childhood pain. Several studies have demonstrated cross-sectional support for this model (e.g., Varni et al., 1996; von Weiss et al., 2002). Unfortunately, there is a lack of research examining the directional relations among stress, affective experience, and the physical manifestations of pain.

According to the Biobehavioral Model of Pediatric Pain, a fundamental antecedent to recurrent pain is stress. Although previous investigations have examined the impact of discrete, negative life events (e.g., parental divorce, failed grade) on children's pain, more research has emphasized the importance of episodic daily stressors (or hassles) as precipitants of pain (Miller, 1996). This approach implies that it is the cumulative effect of frequent minor demands (e.g., school stress, disagreements with peers) that are significant for children and that tax their resources. Relative to negative life events, daily hassles have shown considerable promise as an antecedent to pain complaints. One recent study showed that children who experienced episodic daily stressors reported more abdominal pain, and this association was stronger for clinic patients than for healthy children (Walker, Garber, Smith, Van Slyke, & Claar, 2001). Adolescents living in urban environments characterized by high rates of violence are apt to face frequent daily stress. Numerous studies have documented the chronic, deleterious psychosocial effects that result from chronic exposure to community violence and victimization (e.g., Martinez & Richters, 1993). The impact of this often-chronic stress on children's developing physical health, however, has only been explored in a handful of studies. In a large, multisite study conducted within six public schools, Singer, Anglin, Song, and Lunghofen (1995) found that exposure to high levels of community violence was associated with increased somatic complaints. Similarly, children who are victimized at school tend to have poorer physical health than children who have not been victimized (Karin-Natvig, Albrektsen, & Qvarnstrom, 2001; Rigby, 1999). Collectively, these findings lend correlational support to the Biobehavioral Model of Pediatric Pain and show that pain complaints may be provoked by stress, and children residing in high-risk urban areas may be particularly at risk as a result of elevated levels of both episodic stress (i.e., hassles) and chronic stress (i.e., exposure to community violence, victimization). To examine the impact of stress on children's pain complaints as theorized in the Biobehavioral Model of Pediatric Pain, researchers assessed in this study several indices of stress thought to be particularly relevant for urban children including experiencing problem situations (e.g., peer provocation, perceived injustice), witnessing violence, and victimization.

Equally important, the affective experience of anxiety appears to play a significant role in pain expression. Anxiety has been shown to correlate with pain complaints in both normal (e.g., Barrios, Hartmann, & Shigetomi, 1984; Faust & Forehand, 1994) and clinic samples (e.g., Beidel, Christ, & Long, 1991; Jolly et al., 1994). In one of the few prospective studies, Faust and Forehand (1994) examined a directional model of the relation between anxiety, familial and peer stress, and physical complaints in a community sample over a 1-year period. Findings supported the mediational role of anxiety in the stress-physical complaint relation, and the authors speculated that the perception of stress might be filtered through an affective processing system, rather than directly leading to physical complaints. This notion of anxiety serving a mediating role has considerable importance for understanding the relation between stress and the expression of pain complaints. Expanding on the Biobehavioral Model of Pediatric Pain, which theorizes a bidirectional relation between pain and emotional distress, we hypothesized a directional relation in which the effect of stress on children's pain was mediated by anxiety. Building on the findings of recent studies showing that psychosocial stress was a significant antecedent to pain complaints, this study attempted to extend the Biobehavioral Model of Pain by hypothesizing a directional pathway from stress and anxiety to pain. In addition, the work by Faust and Forehand (1994) provided further insight into the possible role anxiety may play in mediating psychosocial stress on subsequent pain complaints during adolescence.

Previous research in this area has been limited almost exclusively to pediatric and clinical populations. Children who seek medical attention tend to represent severe cases. Because such samples are self-selected, they also tend to include a disproportionate number of children and families with greater access to health care resources and economic advantage (e.g., medical insurance). As such, it is unclear whether some of the characteristics identified in these studies reflect pain complaints or exposure to health care services. Current understanding of the experiences of pain complaints has been limited by a dearth of research examining normative samples of adolescents and the natural course of these complaints across development. Equally important, very few studies have included adolescents from diverse racial and ethnic groups. This

study focuses on an underserved and understudied group of urban, mostly African-American children. Because the perception and report of pain may be somewhat culturally determined, it is vital to better understand these constructs in diverse cultural groups. This research is especially important given the diverse stressors these children may experience (Barbarin, 1993; Farrell, Ampy, & Meyer, 1998).

The purpose of this study was to examine the relations among anxiety, psychosocial stress, and headache and abdominal pain in urban early adolescents. We began by examining the prevalence and characteristics (i.e., frequency, intensity, and duration) of headache and abdominal pain complaints. Gender differences were explored based on previous studies that have reported gender differences in clinical pain presentation (Myers, Riley, & Robinson, 2003; Smith, Martin-Herz, Womack, & McMahon, 1999). Next, the directional relations between anxiety, psychosocial stress, and pain across a 6-month period were investigated. The literature in this area was expanded by an examination of stressors that may be particularly relevant for children and adolescents who grow up in urban neighborhoods (e.g., victimization, exposure to community violence, stressful problem situations). Consistent with the Biobehavioral Model of Pediatric Pain (Varni et al., 1995), we hypothesized that compared with adolescents who experienced lower levels of anxiety and psychosocial stress those with higher levels would report more headache and abdominal pain at the subsequent time point. Extending beyond the Biobehavioral Model of Pediatric Pain, we further theorized that the effect of stress on children's pain might diminish after controlling for anxiety. In short, it was speculated that the experience of frequent daily stress might activate cognitive-affective processing which is expressed by children as physical pain complaints. These pain complaints may be exhibited as a subsequent behavioral manifestation of the affective experience of anxiety initiated by frequent stress. This hypothesis was investigated using latent variable path models to test the direct effects of the three stress factors on pain complaints and the possible mediational role of anxiety on these relations. It was hypothesized that the emotion of anxiety might account for the relation between stress and pain.

Method

Participants

Data were collected as part of a larger study of students in the public school system of a large city in the southeastern United States.[1] These data represented 12-month and 18-month follow-up for an evaluation of a sixth-grade violence prevention program. The variables examined in this study were not the primary focus of the prevention program, and analyses demonstrated that the intervention program did not produce significant changes on any of these variables (Farrell, Meyer, & White, 2001). Measures were administered to adolescents in all nonspecial education classrooms at three participating middle schools at the end of the seventh grade (Time 1; June, 1997) and the fall of the eighth grade (Time 2; November, 1997). Data were obtained from 528 children at Time 1. Of these, data were excluded from 12 students who were missing more than one half of their data, 3 for whom data on gender were not obtained, and 11 who were classified random responders based on statistical criteria (Farrell, Danish, & Howard, 1991). The final sample of 502 students included 255 girls and 247 boys. Absentees, transfers, and nonparticipation resulted in attrition across the two time points. Data at Time 2 were available for 289 of the students who participated at Time 1 (157 girls, 132 boys).

At Time 1, the majority of students (96%) identified themselves as African American or Black, 2% identified themselves as Caucasian American or White, and the remainder endorsed other minority groups or marked Other. Age ranged from 11.0 to 14.4 years (M = 12.3 years, SD = 0.6). In a previous study of students from this school system (Farrell, Danish, & Howard, 1992), about 52% of the students were eligible for the federally subsidized school lunch program, and 20% lived in subsidized housing. Demographic data for two cohorts at all eight middle schools in this school system reported by Farrell and Danish (1993) indicated that the majority of children lived in families where the father was absent (54%). More than one third of these children's fathers and mothers had not finished high school, and less than 10% had college degrees.

Measures

Headache and Abdominal Pain Complaints

Students were asked to complete separate anchored rating scales assessing the frequency, intensity, and duration of

[1]Data for this study were collected and coded to ensure that data were not linked to the names of students. All measures were reviewed and approved by the school system, the confidentiality of the data was assured, and students were given the option of not participating. The study was reviewed and granted a waiver of consent from the university and the funding agency based on qualifications for an exemption under Section 46.101(b) category 1 of 45 Code of Federal Regulations (CFR) 46.

headaches and stomachaches in the past month. These items were rated on a Likert-type scales assessing frequency (1, "never or rarely, I usually don't get headaches" to 5, "almost every day"), intensity (1, "I don't get headaches," 2, "usually mild pain," to 5, "usually severely painful"), and duration (1, "I don't get headaches," 2, "less than 1 h," to 7, "more than 2 days") separately for headaches and stomachaches. For abdominal pain, girls were instructed to report only those instances of stomachaches that were not associated with menstrual discomfort (e.g., cramping, bloating). Headache and abdominal pain indexes were computed by summing the three pain attributes (i.e., frequency, intensity, and duration) to yield an index score. Alphas for the headache index and abdominal pain index were .74 and .73, respectively. To examine the impact of pain on psychosocial functioning, researchers assessed the extent to which the pain complaints limited or restricted the adolescent's ability to engage in common daily activities including school, homework, socializing, and household chores. Items were rated on a five-point anchored scale ranging from 1, "never" to 5, "almost every day." Alpha for the pain interference index was .87.

Problem Situations

The Interpersonal Problem Situations Inventory for Urban Adolescents (Farrell et al., 1998) was used to assess the frequency of stressful or problematic situations. This scale was designed to capture difficult situations typically encountered by urban adolescents. The content and construct validity of this measure was established in a series of studies reported by Farrell et al. (1998). Specific items were derived from focus groups of urban adolescents who were asked to identify situations that presented the biggest problems for them. Analyses of the content of these items resulted in the identification of separate scales representing peer provocation (e.g., "people tease you about the way you look"), perceived injustice (e.g., "the teacher punished you unfairly"), and environmental stress (e.g., "you can't concentrate at school because there is too much noise in the hallway or classroom"). Students are asked to rate the frequency of occurrence in the past year for 14 items using a five-point anchored scale ranging from 1, "never" to 5, "almost every day." Alpha coefficients for the three subscales were .71, .74, and .59, respectively.

Exposure to Violence

Exposure to community violence was assessed using subscales from the Children's Report of Exposure to Violence (Cooley, Turner, & Beidel, 1995). The original self-report measure assessed witnessing violence through multiple modes. For this study, only the subscales reflecting first-hand witnessing (i.e., "seeing someone beaten up"), the relationship to the victim (e.g., stranger, familiar people), and victimization were examined. Four items were added to reflect one's proximity to the violent events. Students are asked to rate the lifetime frequency of these events using a four-point anchored scale ranging from "never" to "many times." The original scale and its subscales have demonstrated good test–retest reliability, internal consistency, and construct validity (Cooley et al., 1995). Internal consistency (coefficient alpha) was .89 for the total scale; coefficients for the subscales were .78 (proximity), .78 (victim-known), .82 (victim-stranger), and .54 (victimization).

Anxiety

The Revised Children's Manifest Anxiety Scale (RCMAS; Reynolds & Richmond, 1985) was used to assess anxiety. This 37-item self-report scale was designed to measure manifest or trait anxiety in children. We used a modified system for scoring this measure recommended by White and Farrell (2001) to address criticisms that the original subscales do not represent well-defined or stable factors (Chorpita, Albano, & Barlow, 1988; Gresham et al., 1989) and concerns about content validity (Lonigan, Hooe, David, & Kistner, 1999). The modified scoring represents a theoretically derived structure generated by experts in child anxiety (White & Farrell, 2001). The expert-derived factor structure eliminated seven items from the original scoring system that reflected dysphoric mood and low self-concept (e.g., "other people are happier than I am"). This modified scoring provides three construct and content valid dimensions of anxiety (anxious arousal, social concerns, and worry) as well as a higher order factor reflecting total anxiety. Alpha coefficients were .72, .74, and .76 for anxious arousal (seven items), worry (eight items), and social evaluation/oversensitivity (six items), respectively.

Procedure

Questionnaire booklets were coded with identification numbers and administered by project staff to all students during homeroom period. Staff read instructions that assured adolescents that their responses would be confidential, and that school officials would not handle completed questionnaires; students were given the option to return the questionnaires blank. Absent students were identified, and surveys were administered

to the majority of these students the following week. These same procedures were followed for both survey administrations.

Data Analysis

Data were analyzed using structural equation modeling with latent variables (Bollen, 1989). Separate analyses were conducted on measurement models that specified the relations between the observed variables (i.e., scores on the various measures) and the latent variables they were believed to represent, and latent variable models that specified the pattern of relations among the latent variables. The fit of each model was examined based on several criteria including the comparative fit index (CFI), the Tucker–Lewis fit index (TLI), and the root mean square error of approximation (RMSEA). Models with CFIs and TLIs greater than .90 are generally considered to have an acceptable fit (Bentler, 1992). Browne and Cudeck (1993) suggested that RMSEA values of 0.05 reflect a close-fitting model, and models with values of 0.10 or higher should not be accepted. Data were analyzed using Version 2 of Mplus (Muthén & Muthén, 1998). One of its important features is a maximum likelihood estimation procedure that uses all cases within the data set, including those with missing data. This procedure uses the Expectation Maximization (EM) algorithm (Little & Schenker, 1995) to estimate means, variances, and covariances among the manifest variables. This feature allowed model estimates to be calculated using all cases that provided data at both time points, but that might have had data missing on a specific scale. The EM algorithm is a preferred method of imputation largely because it uses an iterative process to improve the prediction of missing values as more missing data is imputed (Little & Schenker, 1995).

Results

Attrition Analyses

Time 1 data on demographic variables and measures were used to examine differences between adolescents from whom data were obtained at both time points (N = 289) and those who were missing data at Time 2 (N = 213). Attrition was higher among boys (46%) than among girls (38%), $\chi^2(1, N = 502) = 3.40$, $p < .05$. No differences were found for ethnicity. Adolescents who participated at both time points reported less pain interference because of headache or abdominal pain, $F(1,457) = 4.60$, $p < .05$, and a lower frequency of abdominal pain, $F(1,457) = 4.73$, $p < .05$, with effect sizes (d coefficients) of .20 for both. No differences related to attrition were found for anxiety or for headache frequency. In terms of psychosocial stress, compared with children who were missing at Time 2, those who participated at both time points reported lower levels of environmental stressors, $F(1,470) = 5.67$, $p < 05$, stress associated with unfair treatment, $F(1,470) = 6.04$, $p < .05$, first-hand witnessing violence directed at a stranger, $F(1,489) = 7.22$, $p < .01$, and witnessing violence near in proximity, $F(1,489) = 7.60$, $p < .01$; effect sizes ranged from .21 to .25. No attrition effects were found on stress associated with peer provocation, witnessing violence directed at someone you know, or victimization. Students across the three schools had similar scores across the measures examined within this study with one exception.[2]

Descriptive Statistics

Prevalence of headache, abdominal pain, and pain interference are reported separately by gender in Table I. Pain frequency was recoded to reflect the percentage of children reporting any pain (vs. none) and to reflect the percentage of children reporting at least weekly pain. A substantial percentage of the total sample reported at least weekly headache (40%) and abdominal pain (36%). Consistent with past research, most percentages were significantly higher among girls than among boys. A small group of adolescents reported almost daily headaches and abdominal pain, 10 and 9%, respectively. The majority had not sought medical attention for pain (81% for both headache and abdominal pain). Many adolescents reported using medication for pain relief, with girls more likely than boys to use medication at least once per month for abdominal pain (37 vs. 21%) and headache (55 vs. 39%). Mean differences on headache and abdominal pain characteristics were also described. Girls reported significantly higher frequency, $F(1,473) = 12.93$, $p < .01$, and duration of headache, $F(1,471) = 4.93$, $p < .05$, with effect sizes (d coefficients) ranging from .15 to .32; no differences were evident on headache intensity. Similarly, girls reported higher frequency, $F(1,470) = 10.29$, $p < .01$, intensity, $F(1,470) = 13.87$, $p < .01$, and duration of abdominal pain, $F(1,470) = 10.44$, $p < .01$, with effect sizes ranging from .22 to .35.

Although data on prevalence and attributes of pain complaints highlight the extent of the problem, the

[2]A series of ANOVAs were conducted on all measures used in this study to examine differences across the three school sites. One significant difference was found indicating that students at one of the schools reported higher rates of victimization than those at the other two schools, $F(2, 457) = 44.2$, $p < .001$. No differences were found on the three pain variables, three measures of witnessing violence, or on the three anxiety scales.

Table I. Prevalence of Headache, Abdominal Pain, and Indexes of Pain Interference for Girls ($n = 238$), Boys ($n = 240$), and the Total Sample ($N = 478$) at Time 1

	Pain occurrence						
	Total		Girls		Boys		
Variable[a]	Any	Weekly	Any	Weekly	Any	Weekly	χ^{2b}
Headache	64.3	40.1	69.6	46.4	59.0	33.9	5.85**
Stomachache	67.7	36.1	76.2	42.2	59.4	30.1	15.22**
Medication use for headache	74.6	23.5	78.7	30.6	70.4	16.0	4.22**
Medication use for stomachache	55.5	10.6	63.2	14.9	47.6	6.1	11.48**
	Pain interference						
Schoolwork	59.7	17.3	65.5	21.7	54.0	12.9	6.58**
Social activity	62.9	16.2	65.5	21.2	60.3	11.3	1.42
Daily routine	59.2	15.8	64.0	18.2	54.4	13.4	4.58*
Class absence	58.7	14.3	60.8	17.3	56.7	11.2	0.82

Of the total sample ($N = 502$), data were unavailable for 24 children who did not have complete data on the pain measures.

[a]Data were recoded to reflect any and weekly variable reports.

[b]Based on gender differences for any versus none.

*$p < .05$. **$p < .01$.

degree of life interference because of pain may provide a more meaningful indicator of psychosocial functioning. Data on pain interference were analyzed for both prevalence and mean differences. Responses were recoded to reflect "any" (vs. "none") and at least "weekly" interference caused by pain (Table I). Many adolescents reported experiencing headaches or stomachaches that interfered with their participation in social and academic activities. Prevalence rates representing at least weekly interference with completing schoolwork were 22% for girls and 13% for boys. Importantly, a significant portion of children reported missing class on a weekly basis because of headache or abdominal pain, and interference in social activities and daily routine because of pain was also commonly endorsed. Significant mean differences were found for all interference indexes including schoolwork, $F(1,471) = 8.55$, $p < .01$, social activity (e.g., spending time with friends), $F(1,471) = 5.41$, $p < .05$, and daily routine (e.g., chores), $F(1,471) = 6.03$, $p < .05$, with girls reporting more interference than boys. Effect sizes ranged from .21 to .27.

Relations Among Variables At Time 1

Before examining the theoretical models, the cross-sectional measurement model representing the relations between the measures at Time 1 and the latent variables was examined (Fig. 1). Within this model, scores on the headache pain index, abdominal pain index, and pain interference scale measured a factor labeled pain. A problem situations factor was measured by the peer provocation, perceived injustice, and environmental stress scales of the Interpersonal Problem Situations Inventory for Urban Adolescents. A witnessing violence factor was measured by the proximity, victim-stranger, and victim-known scales of the Children's Report of Exposure to Violence. Because victimization was believed to represent a distinct construct from witnessing violence, it was represented by a separate factor measured by the four items in the victimization scale. An anxiety

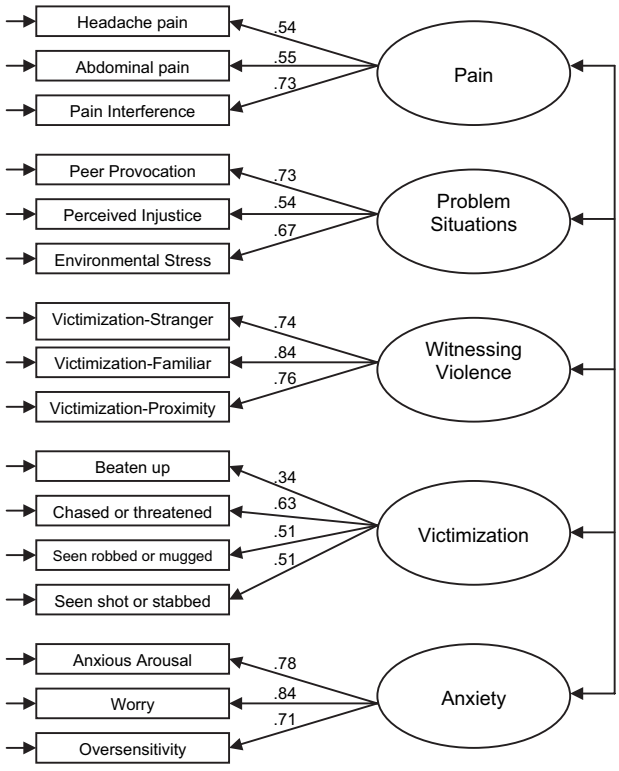

Figure 1. Measurement model representing relations between observed variables and latent factors.

factor was measured by the anxious arousal, worry, and social evaluation/oversensitivity scales of the RCMAS.[3]

Multiple group analyses were used to test the measurement model and examine gender differences. All models specified the same pattern of relations between observed and latent variables, but differed in the extent to which they constrained parameter estimates to have the same values across gender. The first model tested, constrained all loadings to be the same for girls and boys, but allowed correlations among factors to differ across gender. This model had an acceptable fit, $\chi^2(210, N = 502) = 429.6$, CFI = .90, TLI = .88, RMSEA = .065. A second, more restrictive model in which the correlations among latent variables were constrained to the same values across gender was then tested. The fit of this more restrictive model did not significantly differ from that of the first model based on the results of a chi-square difference test, $\chi^2(10, N = 502) = 16.6$, and resulted in fairly minor changes in fit indices, CFI = .89, TLI = .88, RMSEA = .064. Because of the absence of gender differences in the measurement model, data for girls and boys were pooled in all subsequent analyses. This made it possible to examine the direct impact of gender on specific variables within the model and also afforded a more appropriate sample size for the models being tested.

Analyses of the measurement model using data pooled across gender, indicated that the model fit the data well, $\chi^2(94, N = 502) = 260.1$, CFI = .92, TLI = .90, RMSEA = .059. Loadings representing relations between the observed variables and the five latent variables were all significant at $p < .001$, with standardized values ranging from .34 to .84 (8 of the 16 loadings were .70 or higher, all but one were at least .50). Correlations among the latent variables were all significant at $p < .01$ (Table II). The pattern of correlations was consistent with a model in which the anxiety factor mediated the relation between the pain factor and other latent variables. The problem situations, witnessing violence, and victimization factors were all significantly correlated with pain, with values ranging from .37 to .41. All three factors, particularly problem situations, were also significantly correlated with the anxiety factor. Finally, the anxiety and pain factors were significantly correlated.

Latent variable path models were used to examine the hypotheses regarding the extent to which anxiety mediated the impact of the external stressors on pain. Within each model, gender and the three external stressors (i.e., problem situations, witnessing violence, and victimization factors) were considered exogenous variables that predicted anxiety, which in turn predicted pain. Separate models were examined for each external stressor. Gender was included in each model to control for gender effects on the anxiety and pain factors. All three models fit the data well, $\chi^2(30, N = 502) = 91.1$, CFI = .95, TLI = .92, RMSEA = .064 for problem situations; $\chi^2(30, N = 502) = 80.3$, CFI = .96, TLI = .95, RMSEA = .058 for witnessing violence; and $\chi^2(30, N = 502) = 68.6$, CFI = .97, TLI = .96, RMSEA = .039 for victimization. For each model, the effect of anxiety on pain was significant with standardized path coefficients ranging from .42 to .46. Paths linking each of the factors representing external stress to the anxiety factor were also significant. The problem situations factor had the strongest impact on anxiety with a standardized coefficient of .43 compared with .28 for victimization and .17 for witnessing violence factors. Each of the factors also had a significant direct effect on pain. Witnessing violence and victimization had stronger direct effects (βs = .32) compared with problem situations (β = .18). These findings are consistent with partial mediation (Baron & Kenny, 1986) in that each factor had both direct and indirect effects on pain. Anxiety played the strongest

Table II. Intercorrelations Among Latent Variables in Measurement Model at Time 1

Variable	Pain	Problem situations	Witnessing violence	Victimization	Anxiety
Pain	—				
Problem situations	.37	—			
Witnessing violence	.39	.34	—		
Victimization	.41	.61	.60	—	
Anxiety	.53	.45	.17	.25	—

All correlations are significant at $p < .01$.

[3]At the request of the reviewers, one-way ANOVAs were conducted to examine racial/ethnic differences on the 14 manifest variables included in the measurement model at Time 1. Because of the small number of students representing other ethnic groups (i.e., 2-4), analyses were restricted to a comparison of African American (N = 480) and White (N = 12) students. There were no significant differences between the two ethnic groups on the majority of variables including pain variables, two of the three measures of problem situations, witnessing violence measures, two of the four victimization items, or on the anxiety scales at $p < .05$. Significant mean differences were found on three variables. White students reported higher levels of peer provocation (M = 13.6 vs. 10.08; $F(1, 465) = 6.47$, $p < .05$) and higher frequencies of having been beaten up (M = 2.0 vs. 1.5; $F(1, 479) = 6.91$, $p < .01$) and been chased or threatened (M = 1.9 vs. 1.3; $F(1, 479) = 10.48$, $p < .001$). These differences should be interpreted within the context of the school setting in which White students represent a minority within a predominantly African-American student population. It should also be noted that other variables that may be confounded with ethnicity such as family income and neighborhood effects were not examined within this study.

mediating role for problem situations, where nearly half of the effect of problem situations on pain was mediated by anxiety.

A combined model that included all three exogenous variables was also examined. Unlike the separate models that isolated the impact of each variable, the combined model took the influence of all three exogenous variables into account. This model had an acceptable fit, $\chi^2(105, N = 502) = 299.1$, CFI = .91, TLI = .88, RMSEA = .061. A path diagram representing this inclusive model is depicted in Fig. 2. To reduce the complexity of this figure, it does not display paths that were not significant, disturbance terms, or correlations among the exogenous variables. These parameters were, however, included in the model. Because the parameters in this model are partial coefficients, they need to be interpreted within the context of the full model. Whereas the results of the individual models indicated that all three exogenous factors had a significant impact on anxiety; problem situations is the only factor that had a significant impact on anxiety after controlling for shared variance. Similarly, the direct effects of problem situations and victimization on the pain factor were no longer significant after controlling for variance shared with other variables in the model. Within the combined model, gender significantly predicted both anxiety and pain (with higher scores on both variables for girls). The impact of problem situations on pain was fully mediated by anxiety. This was evident from the significant paths linking problem situations to anxiety and anxiety to pain and the absence of a significant direct effect of problem situations on pain. In contrast, witnessing violence was the only exogenous factor that had a direct effect on pain. These findings partially supported the original hypotheses.

Longitudinal Prediction of Headache and Abdominal Pain Complaints

A longitudinal latent variable model was used to examine relations among problem situations, witnessing violence, victimization, anxiety, and pain factors at Time 1 and their changes from Time 1 to Time 2. Consistent with the Biobehavioral Model of Pediatric Pain, which hypothesizes a bidirectional effect between pain and emotional distress, it was hypothesized that greater anxiety at Time 1 would be associated with greater increases in subsequent pain at Time 2, 6 months later. Also as posited in the Biobehavioral Model of Pediatric Pain, we hypothesized a directional relation between stress and pain: it was hypothesized that greater stress (i.e., problem situations, witnessing violence, victimization) at baseline would be related to greater increases in subsequent pain. In the absence of prior definitive research, it was hypothesized that greater stress at baseline would also be associated with greater increases in anxiety. This model included five Time 1 factors and five Time 2 factors. Relations between the observed variables and the factors within each time point were based on the cross-sectional measurement model. Factor loadings were constrained such that each Time 1 loading was identical to its corresponding Time 2 loading. For each observed variable, the measurement error at Time 1 was allowed to correlate with that variable's measurement error at Time 2 because repeated measurement of the same

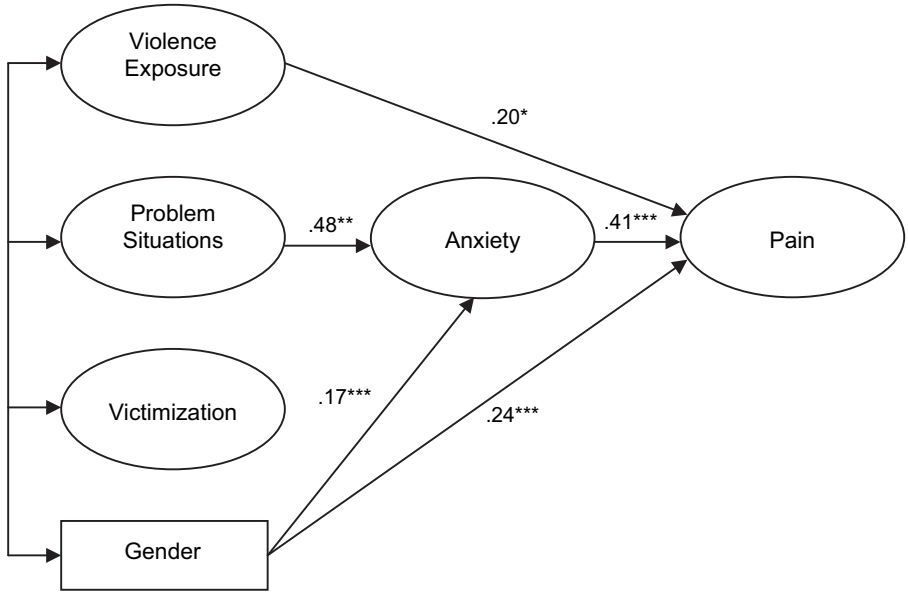

Figure 2. Combined cross-sectional latent variable path model representing hypothesized relations among external stressor, anxiety, and pain at Time 1. To decrease the complexity of the figure, the figure does not show indicator variables for latent factors, paths that were not significant, disturbance terms, or relations between observed variables and latent variables.

Table III. Correlations Between Latent Variables at Time 1 and Changes in Latent Variables From Time 1 to Time 2

	Time 1 to Time 2 changes				
Time 1 variables	Pain	Problem situations	Witnessing violence	Victimization	Anxiety
Pain	.76***	.09	−.01	.31*	.14*
Problem situations	.02	.61**	.13	.41***	.13*
Witnessing violence	.05	.22**	.83***	.23***	−.01
Victimization	.12	.18*	−.08	.23*	.16*
Anxiety	.01	.06	−.07	.16	.69***
Gender[a]	.13*	−.11	.02	−.14	.00

Diagonal elements and values associated with gender are standardized path coefficients from regression of Time 2 factors on gender and Time 1 factors.
[a]Coded 0, "boys"; 1, "girls."
*$p < .05$. **$p < .01$. ***$p < .001$.

variable often results in correlated measurement errors (Kessler & Greenberg, 1981). Gender and Time 1 factors were considered correlated exogenous variables. Each Time 2 factor was regressed on gender and its Time 1 counterpart. This structure resulted in disturbance terms for each Time 2 factor that represented residual change from Time 1 to Time 2 after partialling out gender.

The overall fit of the longitudinal model was acceptable, $\chi^2(436, N = 289) = 797.2$, CFI = .90, TLI = .88, RMSEA = .054. Path coefficients representing the relations between Time 1 factors and their corresponding Time 2 factors were all significant at $p < .05$ (see diagonal values in Table III). Victimization had the lowest stability ($\beta = .23$); standardized path coefficients for the other factors ranged from .61 (problem situations) to .83 (witnessing violence). Gender was significantly related to residual changes in pain, with girls reporting greater increases in pain. Correlations between Time 1 factors and residual changes from Time 1 to Time 2 are also reported in Table III. Victimization at Time 1 was not related to subsequent increases in pain, as hypothesized. In contrast, students reporting higher levels of pain at Time 1 tended to report greater increases in victimization and in anxiety at Time 2. Students who reported higher frequencies of problem situations at Time 1 tended to report greater increases in victimization and anxiety at Time 2. Time 1 levels of witnessing violence were positively correlated with changes in problem situations and victimization. Finally, students reporting higher levels of victimization showed greater increases in problem situations and anxiety.

Correlations among changes in factors from Time 1 to Time 2 are reported in Table IV. Seven of the 10 correlations between residual changes were significant. In particular, changes in pain were positively correlated with changes in the problem situations and anxiety factors (*r*s = .11 and .26). These findings suggest that, in general, adolescents who reported increases in one of these variables from Time 1 to Time 2 tended to report increases in the others.

Table IV. Correlations Among Changes in Latent Variables From Time 1 to Time 2

	Pain	Problem situations	Witnessing violence	Victimization	Anxiety
Pain	—				
Problem situations	.23**	—			
Witnessing violence	−.03	.11*	—		
Victimization	.10	.26**	.23***	—	
Anxiety	.14**	.25***	.06	.14*	—

Correlations among disturbance terms from regression of Time 2 factors on gender and Time 1 factors.
*$p < .05$. **$p < .01$. ***$p < .001$.

Discussion

This study examined relations among anxiety, psychosocial stress, headache, and abdominal pain in a predominantly African American sample of adolescents residing in an urban school system. Unlike many past investigations, this study explored the types of stress most germane to adolescents residing in urban areas (i.e., witnessing violence, victimization, problem situations) and attempted to identify a mechanism by which emotional stress may influence the experience of physical pain (i.e., headache and stomach pain). The prevalence rates and characteristics of headache and abdominal pain reported by adolescents in this study were higher and more severe than those reported in many previous studies. Whereas other school-based studies have found that weekly headache and abdominal pain is reported by approximately 20 and 10% of adolescents, respectively (Ingersoll et al., 1993); over one third of this sample reported weekly headache (40%) and stomachache (36%). A similar percentage of adolescents reported rarely (or never) experiencing these pains.

Because the perception and expression of pain is likely to be somewhat culturally determined, these findings need to be validated in other similar samples. Consistent with most past research that has found marked gender differences in pain report (e.g., Miaskowski, 1999; Unruh, 1996), girls in this study reported more pain complaints and more life interference attributable to the pain than did boys. Gender differences were not, however, found in the measurement model tested, indicating that the structure of measures of these pain constructs does not differ as a function of gender.

The main hypotheses of this study centered on the relations between psychosocial stress and pain complaints and the possible mediating role of anxiety. As hypothesized, positive associations were found among measures of stress, anxiety, and pain. Adolescents who reported more stress (i.e., problem situations, violence exposure, victimization) were more likely to report anxiety, headache, and abdominal pain. This cross-sectional finding is consistent with the growing literature documenting the deleterious effects of witnessing violence on children's mental and physical health (Singer et al., 1995). The urban children in this study appear to be particularly predisposed to experience pain and associated exposure to both chronic stress associated with community violence and episodic daily hassles (i.e., stress associated with problem situations). The correlational nature of these relations was consistent with theory (i.e., the Biobehavioral Model of Pediatric Pain; Varni et al., 1996) and past research (Faust & Forehand, 1994; Walker, Garber, & Greene, 1994) demonstrating that adolescents who suffer from increased stress and anxiety tend also to report more headache and abdominal pain.

This study extended the Biobehavioral Model of Pediatric Pain (Varni et al., 1995) by investigating a pathway in which the stress–pain association was mediated by anxiety. More specifically, it was hypothesized that the emotion of anxiety might partially account for the relation between stress and pain. Cross-sectional analyses revealed partial mediation—that is, the influence of stress on children's pain was partially diminished after controlling for anxiety. This finding was uniform across each of the measures of stress. These results generally supported the mediational role of anxiety and are consistent with the premise that anxiety, a cognitive-affective process, is influenced by external stress (Barlow, 2002; Lang & Cuthbert, 1984). It may be that the stress associated with coping with stressful circumstances may be associated with anxious cognitive processing, and as a result, headache and abdominal pain may be a physical manifestation of this affective state. Theoretically, it is plausible then that the emotion of anxiety may be associated with an underlying physiological predisposition to experience pain or to predispose somatic vigilance. These findings complement those of Faust and Forehand (1994) who found that anxiety among adolescents was activated by parental and peer stress, which accounted for the stress–pain relation. Interestingly, the mediational role of anxiety operated differently across the two domains of stress examined in this study. Although the impact of episodic stress (associated with problem situations) on pain complaints was fully mediated by anxiety, the impact of the two chronic stressors (i.e., witnessing violence and victimization) on pain were only partially mediated by anxiety. It may be that because episodic stress tends to fluctuate more overtime, these periodic pressures may have a more robust association with anxiety such that the emotion of anxiety more completely accounts for the relation between episodic stress and pain. This conclusion builds upon research on clinical samples of children indicating that minor daily stressors (i.e., hassles) have a more proximal impact on children's pain report (Walker et al., 2001) as compared to the more distal outcomes associated with either chronic stress or negative life events. Moreover, because anxious responding may be a characteristic response to stress, the emotion may increase (or decrease) substantially in relation to the stressor and as result the occurrence of recurrent pain complaints may fluctuate overtime. The differential influence of witnessing violence and problem situations may have also been influenced by differences in the time frame used to assess these constructs. Whereas the frequency of problem situations was based on the past year, witnessing violence represented lifetime occurrences. Because the problem situation measure represented more recent events it's impact may have been more strongly mediated by current levels of anxiety. These findings were consistent across the models examined separately for each stressor and in the combined model that examined shared variance among the stress factors.

The prospective study herein extended the cross-sectional findings of previous investigations by examining these relations across a six-month time frame to explore stress, anxiety, and pain during early adolescence. The longitudinal findings indicated that adolescent experiences with headache and abdominal pain were fairly stable over the six-month period examined. Although this time interval was relatively short, this finding is inconsistent with the commonly held notion that pain during adolescence is transient. Several Time 1

variables significantly predicted changes in other variables from Time 1 to Time 2. Witnessing violence predicted increases in stress associated with problem situations and victimization. Similarly, episodic stress associated with problem situations predicted increases in both victimization and anxiety. Interestingly, adolescents who reported higher levels of victimization at Time 1 showed greater increases in anxiety and episodic and chronic stress overtime. These longitudinal findings underscore the significant, predictive, and encompassing effect witnessing violence and exposure to high risk situations may have on psychosocial functioning and is consistent with the research of others (Martinez & Richters, 1993). In particular, these data suggest that adolescents in environments where witnessing violence is rather commonplace are more likely to encounter other problem situations and become victimized themselves. Contrary to our hypothesis that increased pain complaints would be a consequence of stress, victimization, and anxiety, no Time 1 variable of stress or anxiety predicted changes in pain overtime. In contrast, the longitudinal findings showed that pain complaints at Time 1 predicted increases in victimization and anxiety. Although these results provide some insights into the pathways proposed by the Biobehavioral Model of Pediatric Pain, we failed to find support for the notion that stress and anxiety are antecedents for pain onset or exacerbation across the 6-month time frame examined in this study. To the contrary, these findings point to pain as a precipitant to subsequent increases in anxiety and victimization. Although a reporting bias could exist in that adolescents who experience more pain are apt to report subsequent increases in stress and emotional distress, it may be that adolescents who experience frequent pain may be having a pain sensitive temperament (Chen, Craske, Katz, Schwartz, & Zeltzer, 2000), and this increased pain sensitivity may be associated with increased experiences and report of stress and distress or emotional sensitivity or vigilance. At a minimum, the experience of pain during childhood and adolescence may be considerable, may tax both physical and emotional resources, and may be an indicator of significant psychosocial risk. Because pain is not simply a sensory experience (it is inherently linked with suffering and emotional distress), it may be that children who experience pain are more vulnerable to the experience of the stress and anxiety. That is, pain may be a precipitant to make children more vulnerable to the effects of stressful life experiences. As a result, the pain itself may act as a stressor to increase the emotional turmoil experienced, which, in turn, may compromise the child's coping capacity. This may, in turn, lower the pain threshold resulting in a vicious cycle. Also, one of the more compelling longitudinal finding was the pattern of significant correlations among changes in different domains. Adolescents reporting Time 1 to Time 2 increases in anxiety and exposure to problem situations were also more likely to report increases in pain. This supports the notion that anxiety, pain, and stressors covary overtime and underscores the need for further research to clarify the factors that account for this covariation during the course of adolescence.

The study's focus on an urban, predominantly African American sample of early adolescents, and the impact of attrition on the longitudinal sample may limit the generalizability of the findings. Further work is needed to determine the extent to which these results can be generalized to children from different sociocultural backgrounds, to clinical samples, or to younger children or older adolescents. Analyses of race in this study were based on small samples and are likely to be confounded with other variables on which we did not collect data (e.g., family structure, socioeconomic status). A study of racial differences in children's pain report and behavior could make a contribution to the literature by including proper controls with a larger, more ethnically, and socioeconomically diverse sample. Conclusions based on the longitudinal analyses conducted in this study must also be tempered somewhat because of the influence of attrition on the final sample. Adolescents who participated at both time points tended to report less pain, less stress, and less life interference because of pain. As a result, our findings may underestimate the extent of childhood pain by portraying these relations in a significantly healthier sample of students who may be from more stable, less-stressed homes. In addition, although this study chose to focus on stressful situations that may be most germane to urban youth, future studies may benefit from including a measure of daily stress as well. It remains to be examined whether studies using a general measure of daily hassles would find similar results.

Reliance on self-report measures is also a limitation. Cultural, socioeconomic, and regional differences may be significant factors in children's environments and may directly influence susceptibility to and self-report of emotional distress and pain. Although the self-report measures of headache and abdominal pain used in this study were designed to reflect pain typology (e.g., frequency, intensity, duration), the extent to which these measures reflect diagnostic and/or clinically meaningful criterion is not clear. This concern reflects the larger

need for reliable and valid self-report measures of recurrent pains in children and adolescents (McGrath & Gillespie, 2001). Children's perceptions of distress (both physical and emotional) are uniquely internal experiences best reported by the child. Confidence in these self-report findings is bolstered by research showing considerable agreement between parent and child report of pain complaints and behaviors (White, Alday, & Spirito, 2001). Self-report is also an important source of information about exposure to community violence in that other sources such as parents tend to underestimate the amount of violence children have witnessed (Richters & Martinez, 1993). Nonetheless, the sole reliance on self-report measures makes it likely that some of the covariance among measures was associated with shared method variance. Future research in this area may be complemented by the inclusion of a secondary reporter of children's pain complaints including parents, teachers, or pediatricians. Moreover, although this study investigated multiple pain types during adolescence, it may be that this assessment reflects somatization rather than separate pain complaints (i.e., headache and stomachache). This potential shortcoming is partially offset by the relatively low prevalence of somatization disorders in community samples of children and adolescents (1%, Garber, Walker, & Zeman, 1991) and the school-based rather than clinic-based design of this study. Finally, although this study attempted to utilize psychometrically sound measures, several of these measures assessed variable time frames, ranging from the past month to the past year. In this study, stressors were assessed using a longer time frame (e.g., problem situations were assessed for the past year, and violence exposure and victimization were assessed for lifetime presence) than pain complaints (i.e., past month). Notably, this study examined some aspects of exposure to violence (i.e., first-hand witnessing, the relationship to the victim, victimization, and proximity to the event); however, other modes of violence exposure that were not examined in this study (e.g., hearing reports of violence in neighborhood, school, or home) may also produce significant anxiety in adolescents. Future research may want to consider these other forms of violence exposure and work to minimize the impact of the differential assessment time frames.

Despite these limitations, these findings reveal the pervasiveness of pain complaints among normal adolescents and highlight possible avenues for future research. Foremost among these directions is developing a better understanding of the causes and correlates of childhood pains. Preliminary support was found for the mediating role of anxiety in the relation between stress and pain, but the function of emotions as potential causes, correlates, and consequences of pain requires further study. Future studies might assess a broader range of emotions (e.g., anger, depression, frustration) that may be important for understanding pain during adolescence. A related issue concerns the directionality of this relation. Future research might also employ more refined measurement approaches such as daily monitoring (i.e., pain diaries) or hand-held monitoring devices (i.e., pocket personal computers [PCs], activity watches). The methodology of pain assessment can have marked influences on reporting, and use of real-time approaches to pain assessment have been shown to have advantages in clinical trials (i.e., Williams et al., 2004) and may help guard against any over- or underreporting biases. Daily telephone interviews have also shown some recent promise in assessing the proximate processes related to stress and illness (e.g., Walker et al., 2001) and may provide more appropriate data to examine precipitants and consequences of pain episodes. In particular, they would provide more frequent assessment of changes in variables such as anxiety, stress, and pain that may be required to capture causal relations among them. Of course, the extent to which these efforts aimed at improved assessment alter attrition and retention in studies remains to be seen.

Although this study focused on normal school children rather than a clinic population, a large percentage of children reported significant headache and abdominal pain. Future research focused on those adolescents who experience frequent pain is necessary to identify those who may be in need of clinical intervention. Future studies may also want to assess for somatization to distinguish between recurrent pain complaints and more pervasive patterns of impairment. Because few children in this sample sought medical attention for their pain, clinical researchers may want to collaborate with school systems to play a larger role in school-based prevention and/or intervention. Effective cognitive behavioral treatments exist for recurrent headache (Alday, White, & Spirito, 2001; Hillier & McGrath, 2001; Holden, Deichmann, & Levy, 1999) and recurrent abdominal pain (Janicke & Finney, 1999), and future clinical efforts aimed at delivery of these empirically supported treatments via school-based programs may be most successful at identifying and treating those children most in need of help. Future research is needed to replicate these findings and assist in the identification of those children most in need of intervention. Finally, although this study found preliminary support for the persistence of

pain during a short time period during early adolescence, prospective studies covering a longer time course are needed to better understand short-term risk and protective factors that lead to long-term pain and suffering.

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References

Alday, C. S., White, K. S., & Spirito, A. (2001). Behavioral treatment for pediatric headache: Developmental considerations in assessment and treatment. *Journal of Psychological Practice, 7*, 77–87.

Barbarin, O. A. (1993). Coping and resilience: Exploring the inner lives of African American children. *Journal of Black Psychology, 19*, 478–492.

Barlow, D. H. (2002). *Anxiety and its disorders: The nature and treatment of anxiety and panic* (2nd ed.). New York: Guilford Press.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*, 1173–1182.

Barrios, B. A., Hartmann, D. P., & Shigetomi, C. (1984). Fears and anxieties in children. In E. J. Mash & L. G. Terdal (Eds.), *Behavioral assessment of childhood disorders* (pp. 259–304). New York: Guilford Press.

Beidel, D. C., Christ, M. A., & Long, P. J. (1991). Somatic complaints in anxious children. *Journal of Abnormal Child Psychology, 19*, 659–670.

Bentler, P. M. (1992). On the fit of models to covariances and methodology to the *Bulletin*. *Psychological Bulletin, 112*, 400–404.

Bollen, K. A. (1989). *Structural equations with latent variables*. New York: John Wiley.

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 136–162). Newbury Park, CA: Sage.

Chen, E., Craske, M. G., Katz, E. R., Schwartz, E., & Zeltzer, L. (2000). Pain-sensitive temperament: Does it predict procedural distress and response to psychological treatment among children with cancer. *Journal of Pediatric Psychology, 25*, 269–278.

Chorpita, B. F., Albano, A. M., & Barlow, D. H. (1988). The structure of negative emotions in a clinical sample of children and adolescents. *Journal of Abnormal Psychology, 107*, 74–85.

Cooley, M. R., Turner, S. M., & Beidel, D. C. (1995). Assessing community violence: The children's report of exposure to violence. *Journal of the American Academy of Child and Adolescent Psychiatry, 34*, 201–208.

Farrell, M. K. (1984). Abdominal pain. *Pediatrics, 74*, 955–957.

Farrell, A. D., Ampy, L. A., & Meyer, A. L. (1998). Identification and assessment of problematic interpersonal situations for urban adolescents. *Journal of Clinical Child Psychology, 27*, 293–305.

Farrell, A. D., & Danish, S. J. (1993). Peer drug associations and emotional restraint: Causes or consequences of adolescents' drug use? *Journal of Consulting and Clinical Psychology, 61*, 327–334.

Farrell, A. D., Danish, S. J., & Howard, C. W. (1991). Evaluation of data screening methods in surveys of adolescents' drug use. *Psychological Assessment, 3*, 295–298.

Farrell, A. D., Danish, S. J., & Howard, C. W. (1992). Risk factors for drug use in urban adolescents: Identification and cross-validation. *American Journal of Community Psychology, 20*, 263–286.

Farrell, A. D., Meyer, A. L., & White, K. S. (2001). Evaluation of Responding in Peaceful and Positive Ways (RIPP): A school-based prevention program for reducing violence among urban adolescents. *Journal of Clinical Child Psychology, 30*, 451–463.

Faust, J., & Forehand, R. (1994). Adolescents' physical complaints as a function of anxiety due to familial and peer stress: A causal model. *Journal of Anxiety Disorders, 8*, 139–153.

Garber, J., Walker, L. S., & Zeman, J. (1991). Somatization symptoms in a community sample of children and adolescents: Further validation of the children's somatization inventory. *Psychological Assessment, 3*, 588–595.

Gresham, F. M. (1989). Review of the Children's Manifest Anxiety Scale. In J. C. Conoley & J. J. Kramer (Eds.), *The tenth mental measurements yearbook* (pp. 695–697). Lincoln, NE: Buros Institute of Mental Measurements.

Hillier, L. M., & McGrath, P. A. (2001). A cognitive-behavioral program for treating recurrent headache. In P. A. McGrath & L. M. Hillier (Eds.), *The child with headache: Diagnosis and treatment* (pp. 183–219). Seattle, WA: International Association for the Study of Pain.

Holden, E. W., Deichmann, M. M., & Levy, J. D. (1999). Empirically supported treatments in pediatric psychology: Recurrent pediatric headache. *Journal of Pediatric Psychology, 24*, 91–109.

Ingersoll, G. M., Grizzle, K., Beiter, M., & Orr, D. P. (1993). Frequent somatic complaints and psychosocial risk in adolescents. *Journal of Early Adolescence, 13*, 67–78.

Janicke, D. M., & Finney, J. W. (1999). Empirically supported treatments in pediatric psychology: Recurrent abdominal pain. *Journal of Pediatric Psychology, 24*, 115–127.

Jolly, J. B., Wherry, J. N., Wiesner, D. C., Reed, D. H., Rule, J. C., & Jolly, J. M. (1994). The mediating role of anxiety in self-reported somatic complaints of depressed adolescents. *Journal of Abnormal Child Psychology, 22*, 691–702.

Karin-Natvig, G., Albrektsen, G., & Qvarnstrom, U. (2001). Psychosomatic symptoms among victims of school bullying. *Journal of Health Psychology, 6*, 365–377.

Kessler, R. C., & Greenberg, D. F. (1981). *Linear panel analysis: Models of quantitative change*. New York: Academic Press.

Lang, P. J., & Cuthbert, B. (1984). Affective information processing and the assessment of anxiety. *Journal of Behavioral Assessment, 6*, 369–395.

Linet, M. S., Stewart, W. F., Celentano, D. D., Zeigler, D., & Sprecher, M. (1989). An epidemiological study of headache among adolescents and young adults. *Journal of the American Medical Association, 261*, 2211–2216.

Little, R. J. A., & Schenker, N. (1995). Missing data. In G. H. Arminger, C. C. Clogg, & M. E. Sobel (Eds.), *Handbook of statistical modeling for the social and behavioral sciences* (pp. 39–75). New York: Plenum.

Lonigan, C. J., Hooe, E. S., David, C. F., & Kistner, J. A. (1999). Positive and negative affectivity in children: Confirmatory factor analysis of a two-factor model and its relation to symptoms of anxiety and depression. *Journal of Consulting and Clinical Psychology, 67*, 374–386.

Martinez, P., & Richters, J. E. (1993). The NIMH community violence project II. Children's distress symptoms associated with violence exposure. *Psychiatry, 56*, 55–65.

McGrath, P. A., & Gillespie, J. (2001). Pain assessment in children and adolescents. In D. C. Turk & R. Melzack (Eds.), *Handbook of pain assessment* (2nd ed., pp. 97–118). New York: Guilford Press.

Miaskowski, C. (1999). The role of sex and gender in pain perception and responses to treatment. In R. J. Gatchel & D. C. Turk (Eds.), *Psychosocial factors in pain: Critical perspectives* (pp. 401–411). New York: Guilford Press.

Miller, T. W. (1996). *Theory and assessment of stressful life events*. Madison, CT: International Universities Press.

Muthén, L. K., & Muthén, B. O. (1998). *Mplus user's guide*. Los Angeles, CA: Muthén & Muthén.

Myers, C. D., Riley, J. L., & Robinson, M. E. (2003). Psychosocial contributions to sex-correlated differences in pain. *Clinical Journal of Pain, 19*, 225–232.

Reynolds, C. R., & Richmond, B. O. (1985). *Revised Children's Manifest Anxiety Scale manual*. Los Angeles, CA: Western Psychological Services.

Richters, J. E., & Martinez, P. (1993). The NIMH community violence project. I. Children as victims of and witnesses to violence. *Psychiatry, 56*, 7–21.

Rigby, K. (1999). Peer victimisation at school and the health of secondary school students. *British Journal of Educational Psychology, 69*, 95–104.

Sillanpaa, M. (1983). Prevalence of migraine and other headaches during the first seven school years. *Headache, 23*, 15–19.

Singer, M. I., Anglin, T. M., Song, L., & Lunghofen, L. (1995). Adolescents' exposure to violence and associated psychological trauma. *Journal of the American Medical Association, 273*, 477–482.

Smith, M. S., Martin-Herz, S. P., Womack, W. M., & McMahon, R. J. (1999). Recurrent headache in adolescents: Nonreferred versus clinic population. *Headache, 39*, 616–624.

Unruh, A. M. (1996). Gender variations in clinical pain experience. *Pain, 65*, 123–167.

Varni, J. W., Blount, R. L., Waldron, S. A., & Smith, A. J. (1995). Management of pain and distress. In M. C. Roberts (Ed.), *Handbook of pediatric psychology* (pp. 105–123). New York: Guilford Press.

Varni, J. W., Rapoff, M. A., Waldron, S. A., Gragg, R. A., Bernstein, B. H., & Lindsley, C. B. (1996). Chronic pain and emotional distress in children and adolescents. *Journal of Developmental and Behavioral Pediatrics, 17*, 154–161.

Walker, L. S., Garber, J., & Greene, J. W. (1994). Somatic complaints in pediatric patients: A prospective study of the role of negative life events, child social and academic competence, and parental somatic symptoms. *Journal of Consulting and Clinical Psychology, 62*, 1213–1221.

Walker, L. S., Garber, J., Smith, C. A., Van Slyke, D. A., & Claar, R. L. (2001). The relation of daily stressors to somatic and emotional symptoms in children with and without recurrent abdominal pain. *Journal of Consulting and Clinical Psychology, 69*, 85–91.

Walker, L. S., & Greene, J. W. (1989). Children with recurrent abdominal pain and their parents: More somatic complaints, anxiety, and depression than other patient families. *Journal of Pediatric Psychology, 14*, 231–243.

von Weiss, R. T., Rapoff, M. A., Varni, J. W., Lindsley, C. B., Olson, N. Y., Madson, K. L., et al. (2002). Daily hassles and social support as predictors of adjustment in children with pediatric rheumatic disease. *Journal of Pediatric Psychology, 27*, 155–165.

White, K. S., Alday, C. S., & Spirito, A. (2001). Characteristics of children presenting to a behavioral treatment program for pediatric headache. *Journal of Clinical Psychology in Medical Settings, 8*, 109–117.

White, K. S., & Farrell, A. D. (2001). Structure of anxiety symptoms in urban children: A test of competing factor analytic models of the Revised Children's Manifest Anxiety Scale. *Journal of Consulting and Clinical Psychology, 69*, 333–337.

Williams, D. A., Gendreau, M., Hufford, M. R., Groner, K., Gracely, R. H., & Clauw, D. J. (2004). Pain assessment in patients with fibromyalgia syndrome: a consideration of methods for clinical trials. *Clinical Journal of Pain., 20*, 348–356.