Internalizing Symptoms and Functional Disability in Children With Noncardiac Chest Pain and Innocent Heart Murmurs

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Objective To examine the occurrence of internalizing symptoms and functional disability in children with noncardiac chest pain (NCCP) compared with children with innocent heart murmurs (IHMs). **Method** 67 children with NCCP (*M* [*SD*] age = 12.61 [2.63]; 68.7% Caucasian) and 62 children with IHM (*M* [*SD*] age = 12.67 [2.62]; 50% Caucasian) were recruited from pediatric cardiology offices. Children and parents completed measures of psychological functioning and functional disability during a first visit to the cardiologist before diagnosis. **Results** Children with NCCP reported greater levels of anxiety, depression, and anxiety sensitivity than children with IHM. Children with NCCP and their parents reported greater levels of functional disability and somatization than children with IHM and their parents. **Conclusion** Children with NCCP experience greater levels of psychosocial distress and impairment than similarly physically healthy children with IHM. Consideration of psychosocial influences on NCCP would likely be beneficial in aiding assessment and treatment.

Key words children; functional disability; innocent heart murmurs; internalizing symptoms; noncardiac chest pain.

Nearly 10% of all school-age children experience chest pain, a common presenting symptom in children seeking health care services (Garber, Walker, & Zeman, 1991; Selbst, Ruddy, Clark, Henretig, & Santilli, 1988). In at least 80% of pediatric patients seeking medical evaluation, no cardiac etiology for the pain is found, and the patient receives a diagnosis of noncardiac chest pain ([NCCP] Lam & Tobias, 2001). NCCP is the most frequently given diagnosis for complaints of pediatric chest pain (Selbst, Ruddy, & Clark, 1990; Tunaoglu et al., 1995; Veeram Reddy & Singh, 2010). Chest pain is a persistent problem, with several investigations indicating pain continues in the majority of children for 1–3 years after the initial diagnosis (Lam & Tobias, 2001; Lipsitz et al., 2004; Selbst et al., 1990). Considering the prevalence and duration of NCCP, elucidating the factors surrounding its occurrence is a necessary pursuit, but one that is not adequately addressed in the literature.

In adults, chest pain frequently has a cardiac etiology. However, in children and adolescents, a cardiac etiology for chest pain is found in only 2–5% of cases presenting to pediatric primary care physicians and 3–7% of those presenting to cardiology clinics (Thull-Freeman, 2010). In the majority of children seen in cardiology clinics, the physiological influences of the pain are labeled as idiopathic or unknown (McDonnell, White, & Grady, 2012). Because a cardiac disorder is not the cause of NCCP, the question remains as to the possible contributors to children's NCCP and pain-related disability. Thus far, the pediatric medical literature has focused primarily on alternative physical

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conditions that may contribute to the perception of pain in the child's chest. However, according to the biopsychosocial theory of pain, the biological origin of the pain may not be the most critical area for examination, as psychological and social factors also contribute to the occurrence, maintenance, and disability associated with pain (Gatchel, Peng, Peters, Fuchs, & Turk, 2007). The most prevalent psychosocial factors that have been studied thus far are patients' internalizing symptoms (Kamphaus, Distefano, & Lease, 2003), including anxiety, depression, anxiety sensitivity, and somatization. Gilleland and colleagues (2009) found that children's levels of NCCP were positively associated with higher rates of additional somatic symptoms. These findings suggest NCCP may be a part of an overall constellation of somatic symptoms experienced by these children. In support of NCCP as part of a larger pattern of somatic symptoms, Santalahti, Aromaa, Sourander, Helenius, and Piha (2005) found that the occurrence of one somatic symptom predicts the occurrence of additional somatic symptoms in their longitudinal study. Some reports in the pediatric literature suggest that somatic complaints, such as chest pain, may actually be the most common manifestation of psychosocial distress in pediatric settings (Campo & Fritsch, 1994).

NCCP has also been associated with anxiety sensitivity. Often defined as the ''fear of fear,'' anxiety sensitivity represents a particular cognitive vulnerability to the development of anxiety symptoms through heightened interoceptive awareness. Children with increased anxiety sensitivity perceive changes in autonomic symptoms (e.g., racing heartbeat, trembling hands, or chest pain) with greater sensitivity and often make faulty catastrophic attributions about these sensations as being dangerous or harmful (Eley, Stirling, Ehlers, Gregory, & Clark, 2004). In support of this, Gilleland et al. (2009) found that fear of physiological arousal, a component of anxiety sensitivity, was associated with more severe chest pain. Previous research on NCCP suggests that 1–3 years after diagnosis in a cardiology clinic, children with NCCP report higher current anxiety sensitivity and fear of physiological arousal when compared with children with innocent heart murmurs (IHMs) (Lipsitz et al., 2004), an appropriate comparison group for children with NCCP due to the benign nature of the cardiac condition. Anxiety sensitivity and catastrophic attributions have been found in other pain populations to be related to levels of disability, even when controlling for severity of pain (Lynch, Kashikar-Zuck, Goldschneider, & Jones, 2006). In this manner, anxiety sensitivity may play a salient role in the development and maintenance of NCCP.

Lipsitz et al. (2004) found elevated anxiety and, in particular, physical anxiety in children with NCCP when compared with children diagnosed with IHM. In a later study (Lipsitz et al., 2005), these investigators found 56% of the children with NCCP met DSM-IV-TR criteria for an anxiety disorder, with panic disorder being the most frequent type. More recently, Lipsitz and colleagues (2012) reported that 70% of the children with NCCP in their study met diagnostic criteria for an anxiety disorder, compared with 41% of children with IHM. Many of the children met criteria for panic disorder, which shares symptoms with NCCP, including possible chest pain, chest tightness, and catastrophic interpretation or fear that their symptoms may lead to death or injury (Eley et al., 2004). Using an unstructured interview, Tunaoglu et al. (1995) found psychiatric symptoms in 75% of children with NCCP, with anxiety being the most prevalent symptom. Although levels of depressive symptomatology were not elevated in some studies (Gilleland et al., 2009; Lipsitz et al., 2004), Yildirim et al. (2004) found 10% of the children with NCCP in their study met diagnostic criteria for depression, consistent with Lipsitz and colleagues' (2012) 9% of their sample who met criteria for depression. More research is needed to determine whether depressive symptoms consistently present in children with NCCP.

Functional disability is a complex and multidimensional construct that may be relevant to children with NCCP. For school-aged populations, missed days of school and low involvement in social and extracurricular activities have previously served as indicators of functional disability (Gil et al., 2003; Lynch et al., 2006) in addition to standardized indices (Walker & Green, 1991). For children with NCCP, one study has examined functional disability and found no differences between children with NCCP and IHM (Lipsitz et al., 2012). Of note, the assessment was conducted weeks after the children and parents had been provided with a benign cardiac diagnosis indicating no activity restrictions were medically necessary. Assessment of impairment using standardized indices, as well as involvement in school activities, should be conducted to evaluate the extent of functional disability associated with this condition as perceived by the parent and child prior to diagnosis.

The goal of the current study was to evaluate differences in several domains of psychosocial functioning for children with NCCP versus those with IHM. Most prior research has assessed psychosocial functioning of children with NCCP weeks to years following their diagnosis. In some of these studies, an IHM comparison group was incorporated. Unique to this investigation, the

psychological functioning of children with either NCCP or IHM was assessed at the time of the cardiology clinic visit and before receiving their diagnostic feedback. Thus, assessment was standardized according to the important medical event of their cardiac diagnostic evaluation. Murmurs are the most frequent cause for referral to pediatric cardiologists in the United States, although most murmurs are identified in childhood and resolve by adolescence (Geggel et al., 2002). For both patient groups, the diagnostic process typically includes an initial examination by a pediatrician and referral to a pediatric cardiologist. At the cardiologist's office, the visit includes the collection of family medical history, physical examination, electrocardiogram, and possibly an echocardiogram if deemed necessary (Thull-Freeman, 2010). Neither patient group knew the benign nature of their cardiac condition at the time of referral and evaluation (Geggel et al., 2002), even though referring physicians may have provided differing messages about possible diagnoses to their patients. The two groups differed in that children with NCCP volunteered that they had chest pain, and their report eventually led to a referral. Thus, in the case of NCCP, the child's and family's attentional and interpretation processes influence initiation of referral for medical evaluation and possible intervention. In contrast, children and adolescents with IHM were told by a physician that their heart was making an unusual sound and a referral for further evaluation was needed.

Variables assessed in this investigation included anxiety, anxiety sensitivity, depression, reports of somatic symptoms, and measures of functional disability as assessed through standard indices, school absences, and the child's reported extracurricular involvement. It was hypothesized that children with NCCP would have higher levels of somatic symptoms and functional disability, as well as higher levels of depression, anxiety, and anxiety sensitivity than children with IHM.

Methods

Participants

Participants included 67 children and adolescents diagnosed with NCCP and 62 children and adolescents with IHM. Children ranged from 8 to 18 years old. Sample size was determined a priori using G*POWER (Faul, Erdfelder, Buchner, & Lang, 2009). The sample size needed to achieve a recommended power of .80 in a one-tailed test at $\alpha = .05$ for multivariate analysis of variance with a presumed medium effect size (.25) and eight response variables was 70 participants per group. Demographic information is presented in Table I. Although ethnicity was dichotomized for analyses into Caucasian and Other, self-reported ethnicity was 68.7% Caucasian, 25.3% African American, and 6% Hispanic for the NCCP group, and 50% Caucasian, 35.5% African American, 1.5% Hispanic, and 13% biracial for the IHM group. Approximately 18 potential participants (14%) declined participation because of time demands or for unknown reasons. Exclusion criteria were non-English-speaking parents or children ($N = 1$), guardian not present at the time of the evaluation ($N = 1$), incomplete measures ($N = 12$), child older than age 18 years ($N = 1$), having a prior diagnosis of a medical disorder that could account for the child's physical symptoms and disability ($N = 2$ children with cerebral palsy), receiving a diagnosis during the current visit of a cardiac condition that was not benign ($N = 6$ referred for possible murmurs), not receiving a definitive diagnosis at the end of the cardiac evaluation ($N = 4$ with chest pain who were scheduled for more testing), or complaining of chest pain during a murmur evaluation ($N = 1$). Children with a dual diagnosis of IHM and NCCP were retained in the chest pain group if the referral was for symptoms of chest pain, and IHM was found for the first time during the cardiology evaluation ($N = 2$).

Table I. *Demographic Information*

	NCCP ($N = 67$)	IHM ($N = 62$)	
Factor	*M* (*SD*)	*M* (*SD*)	*t*
Age			
Range: 8–18	12.61 (2.63)	12.67 (2.62)	−0.142
	Frequency (%)	Frequency (%)	χ^2
Sex			.297
Male	39 (58.20)	39 (62.90)	
Female	28 (41.80)	23 (37.10)	
Ethnicity			4.66*
Caucasian	46 (68.70)	31 (50.00)	
Other	21 (31.30)	31 (50.00)	
Family income			3.40
<$20,000	5 (7.50)	8 (12.90)	
$20,000–$34,999	9 (13.40)	9 (14.50)	
$35,000–$54,999	8 (11.90)	9 (14.50)	
$55,000–$74,999	13 (19.40)	6 (9.7)	
$75,000+	25 (37.20)	27 (43.50)	
Family marital status			3.55
Single/never married	5 (7.50)	10 (16.10)	
Partnered/committed relationship	1 (1.50)	2 (3.20)	
Married	51 (76.10)	40 (64.5)	
Separated/divorced	9 (13.40)	8 (12.90)	
Widowed	1 (1.50)	2 (3.20)	

Note. *$p < .05$; **$p < .01$.

Procedures

Participants were recruited from three outpatient cardiology clinics in the southeastern United States. All participants were first-time patients to the cardiologists' office, and individuals referred by their pediatricians for chest pain or heart murmur evaluations were approached by a researcher to participate in the study. Informed parental consent and child assent were obtained, along with Health Information Portability and Accountability Act release before participating. Children completed the measures during the office visit before receiving diagnostic feedback from the cardiologist. Measures included demographic information and self-report inventories. Medical chart review was used to determine diagnosis and relevant medical history for exclusionary purposes. Only children and adolescents with a diagnosis of NCCP or an IHM were retained in the database. Participants volunteered and received no compensation. Institutional review board approval for the study was obtained from the investigating university.

Measures

Measures included in the study were self-report questionnaires. Children completed measures of functional disability (Functional Disability Inventory [FDI-C]), somatic symptoms (Child Somatization Inventory [CSI-C]), depression (Children's Depression Inventory [CDI]), anxiety (Multidimensional Anxiety Scale for Children [MASC]), and anxiety sensitivity (Anxiety Sensitivity Inventory for Children [ASIC]). Parents completed measures of the child's functional disability (FDI-P), somatization (CSI-P), and demographics, as well as reported on the child's school attendance and participation in school and extracurricular activities.

Functional Disability

The child-report and parent-report versions of the Functional Disability Inventory (FDI-C, FDI-P; Walker & Green, 1991) were completed to assess the extent to which the child's physical symptoms had impaired participation in everyday activities during the past 2 weeks (e.g., making it through the day without a nap). Fifteen items were rated on a 5-point Likert scale from 0 (*Not at all*) to 4 (*A whole lot*). The FDI has acceptable established internal consistency and established reliability and validity (Claar & Walker, 2006). Cronbach's alpha for our sample was .90 for the FDI-P and .84 for the FDI-C. As an additional measure of functional disability, parents reported the number of partial and complete school days their child missed during the past 12 months due to physical illness. Parents also answered the ''How active is your child in school-related and/or extracurricular activities? (e.g., sports, band, clubs)'' and rated their involvement from 1 (*Not at all active*) to 3 (*Very active*).

Child Somatization Inventory

The CSI—parent- and child-report versions (CSI-C, CSI-P; Garber, et al., 1991) were completed to assess how much the child was bothered by 35 somatic complaints (e.g., stomach ache, joint pain) over the past 2 weeks. Each symptom was rated on a 5-point Likert scale from 0 (*Not at all*) to 4 (*A whole lot*). The CSI has established construct validity and internal consistency (Walker & Garber, 2003). For this sample, Cronbach's alpha was .80 for the CSI-P and .90 for the CSI-C.

Children's Depression Inventory

The CDI (Kovacs, 1992) is a 27-item child self-report inventory designed to measure the presence and severity of depressive symptoms. Each item provided three statements for endorsement. The child selected the item that most described them during the past 2 weeks. The self-report statements were scored from 0 (absence of symptom) to 2 (definite symptom) with total scores ranging from 0 to 54. Normalized *t*-scores were used in analyses for this study. The CDI has been shown to have good internal consistency and validity (Kovacs, 2003). Cronbach's alpha for total depressive symptoms in this sample was .88. For the five factors of the CDI, Cronbach's alpha was .76 for negative mood, .60 for interpersonal problems, .56 for ineffectiveness, .71 for anhedonia, and .64 for negative self-esteem. The ineffectiveness subscale was excluded from further analyses due to poor internal consistency in this sample.

Multidimensional Anxiety Scale for Children

The MASC (March, 1997) was completed by the child to assess major dimensions of anxiety symptomatology. The self-report MASC consisted of 39 items with a 4-point Likert scale. Children and adolescents endorsed the extent to which statements were 0 (*Never true about me*) to 3 (*Often true about me*). Normalized *t*-scores were used in analyses. Satisfactory internal consistency and reliability have been reported (March, Sullivan, & Parker, 1999; Rynn et al., 2006). Cronbach's alpha for this sample was .87 for the total score. Internal consistency for the four factors and accompanying components of the MASC was .82 for physical symptoms encompassing .75 for both tense/restless and somatic/autonomic, .77 for harm avoidance encompassing .61 for perfectionism and .73 anxious coping, .82 for social anxiety encompassing .87 for humiliation/rejection and .61 for performance in public, and .62 for separation anxiety/panic.

Anxiety Sensitivity Inventory for Children

The ASIC (Laurent, Schmidt, Catanzaro, Joiner, & Kelley, 1998) assessed the child's trait-like tendency to respond to autonomic arousal with fear, with subscales of fear of physiological arousal and fear of mental catastrophe. For example, ''When my stomach is upset, I worry that I might be seriously ill.'' The 12-item inventory is endorsed on a 4-point Likert scale from 0 (*Not true*) to 3 (*True*), with higher levels indicating higher symptomatology. Cronbach's alpha was .83 for the overall total, with subscale alphas of .83 and .74, respectively.

Results

Preliminary Analyses

The *t*-tests and chi-square analyses were conducted to determine whether the two groups differed on demographic variables. Because of a relatively small number of individuals in each non-Caucasian category, ethnicity was dichotomized into Caucasian and other for comparison analyses. The NCCP group comprised significantly more Caucasian participants [χ^2 (1) = 4.66, $p < .05$] than the IHM group, which is consistent with other research on NCCP (Lipsitz et al., 2012; Lipsitz et al., 2005). No significant differences on any other demographic factors were found between the two groups. Because of the significant difference between groups on ethnic composition, ethnicity was entered as a covariate in further analyses using multivariate analysis of covariance (MANCOVA) to examine differences between children with NCCP and IHM.

In testing assumptions for MANCOVA, it was determined that all variables of interest were positively skewed. Therefore, log transformations were conducted to normalize these variables. Multivariate effects were evaluated using MANCOVA to examine the overall effect of group membership, with univariate analysis of covariance (ANCOVA) used to isolate the sources of multivariate effects. For analyses of group differences on subscales, a Bonferroni procedure was used, with the alpha level set at .05 divided by the number of subtest comparisons conducted. Partial eta-squared (η_p^2) was used as a measure of effect size and was interpreted using Cohen's (1988) criteria (small effect = 0.01, moderate effect = 0.06, large effect = 0.14).

Between-Groups Analyses

Controlling for the effect of ethnicity as a covariate in the samples, a statistically significant multivariate effect of group membership was found on the dependent variables using MANCOVA between children with NCCP and IHM: Wilks's $\lambda = .676$, $F(12, 102) = 4.074$, $p < .000$, $\eta_p^2 = .324$. Between-groups differences on functional disability, somatization, anxiety sensitivity, anxiety, and depression were analyzed using ANCOVA with results presented in Table II[1].

Functional Disability

Significant differences were found in functional disability using FDI for both parent- and child-report, with children with NCCP experiencing a greater degree of functional disability. Although significant differences in full days of school missed were not found, children with NCCP did miss significantly more partial days of school. Parents of children with NCCP also reported that their children were significantly less active in extracurricular activities than children with IHM.

Internalizing Symptoms

Both parent- and child-report indicated greater somatic symptoms for children with NCCP than for those with IHM.[2] Children with NCCP reported experiencing greater anxiety sensitivity. At the subscale level, children with NCCP reported greater fear of physiological arousal [$F(3, 123) = 10.127$, $p < .000$, $\eta_p^2 = .139$; NCCP: $M = 5.13$, $SD = 4.44$, IHM: $M = 2.30$, $SD = 3.30$], but similar levels of mental catastrophe [$F(3, 123) = 1.851$, $p = .161$, $\eta_p^2 = .029$; NCCP: $M = 1.06$, $SD = 2.14$, IHM: $M = 0.57$, $SD = 1.36$) as children with IHM. Children with NCCP reported greater symptoms of anxiety than children with IHM, with 3% of children with NCCP falling in the clinical severity range (*t*-score ≥ 65), compared with no children in the IHM group. Analyses of the MASC subscales indicated children with NCCP reported greater physical symptoms [$F(1, 124) = 59.724$, $p < .000$, $\eta_p^2 = .325$; NCCP: $M = 49.27$, $SD = 8.67$, IHM: $M = 39.29$, $SD = 5.81$], including tense/restless [$F(1, 124) = 17.275$, $p < .000$, $\eta_p^2 = .122$; NCCP: $M = 45.44$, $SD = 8.80$, IHM: $M = 39.74$, $SD = 6.15$] and somatic/autonomic symptoms [$F(1, 124) = 84.104$, $p < .000$, $\eta_p^2 = .404$; NCCP: $M = 52.92$, $SD = 9.12$, IHM: $M = 40.81$, $SD = 5.92$) than children with IHM.

Children with NCCP reported greater symptoms of depression, with 10.4% of children with NCCP falling in the

[1]The main effects of child age and child sex were explored, as well as their interaction with group membership. No statistically significant main effects or interactions were found for the variables of interest.

[2]As requested during editorial review, the associations between functional disability and somatization were examined. Correlations between functional disability and somatization were as follows within the NCCP and IHM groups, respectively. FDI-P and CSI-P: $r = .757$, $p < .001$ and $r = .405$, $p < .001$; FDI-C and CSI-C: $r = .710$, $p < .001$ and $r = .770$, $p < .001$.

Table II. *Between-Groups ANCOVA*

	NCCP *M* (*SD*)	IHM *M* (*SD*)	*F*	*p*	η_p^{2a}
Factor					
Functional disability					
Parent report (FDI-P)	4.15 (5.92)	1.16 (3.16)	18.93**	.000	.143
Range (*N*):	0–34 (67)	0–18 (62)			
Child report (FDI-C)	6.84 (7.19)	2.03 (2.46)	26.18**	.000	.188
Range (*N*):	0–47 (66)	0–10 (61)			
Full days of school missed	3.23 (4.36)	2.59 (3.40)	0.18	.671	.002
Range (*N*):	0–24 (66)	0–22 (62)			
Partial days of school missed	1.17 (2.30)	0.44 (1.00)	4.10*	.045	.035
Range (*N*):	0–11 (66)	0–4 (62)			
Extracurricular activity level	1.35 (0.75)	1.63 (0.55)	5.80*	.018	.049
Range (*N*):	0–2 (66)	0–2 (62)			
Somatization					
Parent report (CSI-P)	12.36 (11.18)	5.63 (7.80)	28.93**	.000	.204
Range (*N*):	2–67 (67)	0–34 (62)			
Child report (CSI-C)	17.64 (13.00)	7.89 (9.00)	26.47**	.000	.190
Range (*N*):	1–67 (66)	0–39 (61)			
Anxiety					
Child report (MASC)	45.76 (9.43)	41.50 (8.73)	5.73*	.018	.048
Range (*N*):	26–68 (66)	25–61 (61)			
Anxiety sensitivity (ASIC)	6.21 (5.32)	2.87 (4.08)	15.41**	.000	.120
Range (*N*):	0–24 (67)	0–21 (61)			
Depression					
Child report (CDI)	47.06 (9.91)	41.11 (5.54)	11.02**	.001	.089
Range (*N*):	34–79 (67)	34–59 (61)			

Note. Analyses performed on log transformed variables; *$p < .05$; **$p < .01$; [a]Partial eta-squared (η_p^2), a measure of effect size, interpreted as .01, small effect; .06, medium effect; .14, large effect.

clinical range, compared with no children in the IHM group. Children reported greater depressive symptoms on the subscales of the CDI including Anhedonia, which represents a low enjoyment of activities [$F(1, 124) = 7.869$, $p = .006$, $\eta_p^2 = .059$; NCCP: $M = 47.55$, $SD = 9.61$, IHM: $M = 42.23$, $SD = 7.88$) and negative self-esteem [$F(1, 124) = 11.526$, $p < .001$, $\eta_p^2 = .325$; NCCP: $M = 47.25$, $SD = 8.81$, IHM: $M = 42.74$, $SD = 5.61$) than children with IHM.

Discussion

As was hypothesized, children with NCCP experienced greater levels of functional disability and psychosocial distress than children with IHM. Specifically, children and parents of children with NCCP reported greater functional disability, including more partial days of school missed and less involvement in extracurricular activities, than children with IHM and their parents. Children with NCCP also reported greater levels of anxiety, anxiety sensitivity, and depression than children with IHM. Unlike most prior research in this area, these group differences were found at the time of the patients' cardiology evaluation, and before receiving diagnostic feedback.

Children with NCCP and their parents reported several times more functional disability, or impairment completing every day activities, when compared with children with IHM. As the FDI does not specifically ask about difficulties due to NCCP, functional disability is likely the result of NCCP as well as additional somatic symptoms. These results from data obtained using paper and pencil measures are supported by findings regarding school attendance, a developmentally appropriate measure of functional disability for children and adolescents. Although children with IHM and NCCP missed similar numbers of full days of school, missing partial days of school may still indicate impairment. Knowing that these children miss greater amounts of school, it is important to consider the long-term implications of school absenteeism, as longitudinal studies have shown that absenteeism is a risk factor for school drop-out, as well as economic, marital, social, and psychological problems in adulthood (Kearney, 2008). Although the causes for school absenteeism are unknown in this sample, literature on other idiopathic pain

populations suggests that parental activity restriction (e.g., allowing children to stay home from school because of pain) has been shown to predict symptom maintenance in some children (Walker, Claar, & Garber, 2002). Further studies of functional disability in children with NCCP should investigate the reasons for school absences. Parents also reported that their children with NCCP were less involved in extracurricular activities, a domain that is particularly important to the development of children and adolescents.

In support of the conceptualization that NCCP may be one symptom in a larger constellation of somatic symptom experiences, our sample of children with NCCP experience more than twice the level of somatic symptoms when compared with children with IHM. Somatic symptoms and fears of physiological arousal have been shown to account for a large percentage of the variance in chest pain severity for children with NCCP (Gilleland et al., 2009). Children with NCCP may also develop a tendency toward somatization through observation and modeling from their parents (Craig, Cox, & Klein, 2002). Parents may also inadvertently reinforce pain and illness behaviors, as parental worries about their child's emotional health have been shown to be related to higher pain-promoting behaviors, such as allowing the child to stay home from school or giving the child extra attention (Guite, Logan, McCue, Sherry, & Rose, 2009). Santalahti et al. (2005) have also demonstrated that these children are likely to continue to experience somatic symptoms in the future. A greater level of somatic symptoms may contribute to prior findings indicating that children with NCCP use more health services than children with IHM, and that their health care utilization is positively associated with both their and their parents' internalizing symptoms (Lee et al., 2012; Loiselle et al., 2012).

Children with NCCP reported higher anxiety than children with IHM, which is consistent with other research in NCCP (Lipsitz et al., 2004, 2005, 2012). In our investigation, 3% and 0% of children in the NCCP and IHM groups fell in the clinically significant range on measures of anxiety. These rates are generally similar to epidemiologic estimates of point prevalence for anxiety disorders in children at 2–4% (Costello et al., 2003; Meltzer, Gatward, Goodman, & Ford, 2003) and in contrast to higher estimates of anxiety disorders found in recent investigations of patients with NCCP (70%) and IHM (41%) by Lipsitz and colleagues (2012). It is unknown why these differences between anxiety prevalence exist between these two studies with similar sample types. Methodological differences (i.e., paper and pencil measures vs. structured interviews) may account for part of the effect. With regard to dimensions of anxiety, children with NCCP reported greater somatic symptoms of anxiety and feelings of tension and restlessness, which is consistent with the overall conceptualization that these children experience psychological distress as physiological symptoms. Children with NCCP also reported greater symptoms of anxiety sensitivity than children with IHM, consistent with prior research in NCCP (Lipsitz et al., 2004). Anxiety sensitivity is considered a partly heritable personality trait, and there is a growing body of literature supporting anxiety sensitivity as a risk factor for increased pain and disability (Gatchel et al., 2007). In terms of dimensions of anxiety sensitivity, our sample of children with NCCP also reported greater fears of physiological arousal, consistent with findings by Lipsitz and colleagues (2004), but they did not report greater fears of mental catastrophe. Greater anxiety and anxiety sensitivity, particularly fear of physiological arousal, may also be related to increased functional disability due to fear of pain, resulting in avoidance of activities that may result in pain, and perpetuating a cycle of avoidance, inactivity, and disability (Gatchel et al., 2007).

Although not found in some prior research of children with NCCP (Lipsitz et al., 2004), our sample of children with NCCP reported greater levels of depressive symptoms than children with IHM. About 10% of our sample of children with NCCP fell in the clinical severity range for depression. This is much higher than epidemiological estimates of rates of depression in children (~2%) and adolescents (~4–8%) and comparable with the findings by Lipsitz and colleagues (2012), in which 9% of their sample met diagnostic criteria for depression (Fleming & Offord, 1990; Lewinsohn, Clarke, Seeley, & Rohde, 1994). For children with pain, depressive symptoms have been shown to be a powerful predictor of pain-related disability (Kashikar-Zuck, Goldschneider, Powers, Vaught, & Hershey, 2001). For children with NCCP, this may be particularly relevant, as they also reported greater symptoms of anhedonia and negative self-esteem. These children are less involved in extracurricular activities than their peers and enjoy these activities less than children with IHM. Lower participation also reduces opportunities for the establishment of self-efficacy and self-esteem. Internalizing symptoms and functional disability may result from a common process, such as using maladaptive coping strategies (e.g., catastrophizing, avoidance) that have been shown to contribute to increased pain (Kashikar-Zuck, Vaught, Goldschneider, Graham, & Miller, 2002).

In terms of limitations, the study was cross-sectional in design. This precluded investigation as to whether the development of internalizing symptoms and functional disability preceded or followed the development of chest pain

for children with NCCP, as could be examined using a longitudinal design. Longitudinal studies of children with NCCP and psychological distress and functional disability are especially critical, owing to the possibility of reciprocal relationships and interactions between these variables. Although consistent with prior research on NCCP, our study examined a relatively small number of children with NCCP and IHM, and recruitment was from one part of the country; thus, future studies should attempt to recruit larger and geographically diverse samples to replicate these findings. Finally, considering the biopsychosocial nature of pain, the assessment of family variables and parental psychopathology would result in a more thorough understanding of factors that may be associated with the development and maintenance of pain for these children.

Taking into consideration that no cardiac etiology was identified for the chest pain, as well as our results, it is likely that psychosocial factors contributed to the child's experience of pain and disability. Guite and colleagues (2009) found that for parents of children with chronic pain who held stronger beliefs that the origin of the pain was exclusively medical also reported higher levels of child functional disability. Not receiving a clear medical explanation for chest pain symptoms may not resolve parents' or children's concerns. Educating parents and children about psychosocial factors shown to contribute to pain may be helpful steps toward alleviating pain, as research in other pain populations suggests that visits to the doctor for physical symptoms may be part of an established pattern of inappropriate medical health care seeking associated with emotional and behavioral concerns (Campo et al., 2007). Increased awareness of psychological factors associated with pain may facilitate parents seeking other forms of care for their children, such as cognitive behavioral therapy for pain. These findings emphasize the need for increased consideration of child psychological functioning in the care of children with NCCP.

The cardiologist's focus during the evaluation of pediatric patients with chest pain is on the importance of ruling out cardiac etiologies and the well-being of the child, and the importance of this focus is not to be understated. Receiving a benign diagnosis may be both reassuring and sufficient for some patients and their families. For others, the addition of an evaluation of child and family psychological factors via psychosocial screening instruments (e.g., Hayutin et al., 2009) may prove to be instructive in identifying contributors to pediatric chest pain for many patients and assist the referring primary care physicians and cardiologists in identifying psychosocial factors related to the child's pain. This information could be used to route families to psychological resources if needed and reduce future strain and unnecessary costs for the health care system. If left untreated, it is likely that many of these children will continue to experience high levels of psychological distress and functional disability.

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