Cardiology in the Young

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Relationship between non-cardiac chest pain and internalizing problems in pre-school aged children

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Abstract

Objective: Non-cardiac chest pain is a common and persistent problem for children; yet, typically, there is no clear medical cause. To date, no behavioural and/or psychological factors have been studied to explain chest pain in a pre-school paediatric sample. We hypothesized that pre-school children with medically unexplained chest pain would have higher rates of behavioural problems compared to healthy controls. *Methods*: We assessed 41 pre-school children with non-cardiac chest pain and 68 age matched children with benign heart murmurs as the control group using the Child Behaviour Check List-1 1/2–5 to evaluate emotional and behavioural problems. *Results*: Internalizing problem scores comprising emotionally reactive, anxiety/depression, and somatic complaints were higher in children with non-cardiac chest pain than in the control group. Among the possible factors, the factor that is related to behaviour problem scores, in univariate analysis, was a significant and inverse correlation between maternal education and behaviour problem scores. Also, maternal employment status was associated with behavioural problems. Children with a housewife mother were more susceptible to having such behavioural problems. Based on multiple regression analyses, being in the non-cardiac chest pain group was found to be significantly related to internalizing problems in our total sample. *Conclusions*: These results suggest that pre-school children with non-cardiac chest pain may experience increased levels of certain behavioural comorbidities. Systematic behavioural screening could increase the detection of behavioural problems and improve care for this population. Future studies of non-cardiac chest pain in pre-school children should include larger samples and comprehensive diagnostic assessments as well as long-term follow-up evaluations.

Chest pain is a common symptom in childhood, affecting about 10% of the population and rarely associated with cardiac disease.[1,2] Rare, cardiac causes of chest pain in paediatrics may include coronary artery disease, arrhythmia, coronary artery vasospasm, and structural abnormalities of the heart.[3,4] Most paediatric chest pain cases, however, are not found to be associated with a specific medical problem.[2] Chest pain in the absence of causal organic pathology may be classified as non-cardiac chest pain. There may be many causes of non-cardiac chest pain – musculoskeletal, gastrointestinal, pulmonary, and psychological.[5,6] The appropriate management of these patients is the investigation and treatment of the underlying cause when acute cardiac disease has been ruled out.[7,8] In fact, cognitive, behavioural, and physiological problems in children may influence somatic development by serving as agents for prompting and reinforcing the child's behaviour in relation to pain and illness.[9] Therefore, unexplained somatic symptoms may be the most frequent presentation of cognitive, behavioural, and physiological problems in paediatric practice.[10] Psychogenic chest pain in children can occasionally result from anxiety or depression triggered by recent stressors in their personal or family life.[11] One clinical study in youngsters with non-cardiac chest pain showed higher rates of anxiety, anxiety sensitivity, and physiological arousal compared to asymptomatic youngsters with benign heart murmur.[12] Another study in children and adolescents with non-cardiac chest pain suggested that youngsters with non-cardiac chest pain may have a high level of anxiety (56%), but depressive symptoms are rare.[13] Psychiatric symptoms were found in about 75% of another sample of youngsters with non-cardiac chest pain, with anxiety being the most common symptom.[14] However, to the best of our knowledge, there has been no research investigating behavioural and physiological factors associated with non-cardiac chest pain in pre-school children to date. We have hypothesized that behavioural problems start as early as pre-school age, and these problems may emerge as somatic complaints such as non-cardiac chest pain in pre-school children. In the current study, we aimed first to determine behavioural comorbidities in

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Table 1. Socio-demographic characteristics of non-cardiac chest pain and control groups

Socio-demographic characteristics n (%)	Non-cardiac chest pain (n = 41)	Control (n = 68)	p
Median age (month) (range)	48 (36–58)	48 (32–60)	NS
Female	21(51%)	41 (60%)	NS
Maternal age median (years) (range)	33 (22–41)	32 (24–45)	NS
Maternal education (under the high school)	12 (29%)	21 (30%)	NS
Maternal employment (housewife)	27 (66%)	54 (79%)	NS
Paternal age median (years) (range)	36 (22–50)	35 (26–47)	NS
Paternal education (under the high school)	11 (27%)	15 (22%)	NS
Paternal employment (Regular)	39 (95%)	63 (92%)	NS

*NS: Not significant.

pre-school children who had been referred to our paediatric cardiology clinic for complaints of chest pain but which had, in fact, been diagnosed as non-cardiac chest pain.

Methods

For this prospective cross-sectional study, patients were recruited from the paediatric cardiology department of Dr. Sami Ulus Children's Hospital between 2018 and 2019. A total of 116 children aged between 3 and 5 years were included in the study. All patients with chest pain underwent a comprehensive cardiac examination and laboratory test including their history, physical examination, electrocardiogram, complete blood count, cardiac enzymes, 24 hour rhythm Holter record, and echocardiogram. Those patients who showed no evidence of cardiac disease or other obvious medical pathology were considered eligible for this study. Patients were excluded if they were known to have any psychiatric disease, developmental delay, organic brain disease, or chronic organic problem. Informed consent forms were obtained from patients and their parents. The general development of children was evaluated by the Denver-II Developmental Screening Test, and only children with normal development were included in the study. Socio-demographic characteristics were also collected for all participants.

The Child Behaviour Check List-1 1/2-5 was used to evaluate any emotional/behavioural problems of the children. The Child Behaviour Check List-1 1/2-5 was completed by parents while they were waiting in the outpatient clinics. It is the most commonly used assessment method for the identification of behavioural and psychiatric disorders in children with a specificity of 83% and a sensitivity of 66%.[15,16] It has 100 items for children aged from 1.5 to 5 years. It results in a Total Behaviour Problems score and two broadband scores, Internalizing Problems and Externalizing Problems. Internalizing problems comprises emotionally reactive, anxious/depressed, somatic complaints, and withdrawn subscale measures. Externalizing problems comprise attention problems and aggressive problem subscale measures. The total problems comprise both internalizing and externalizing problems. The respondent rates how well each item describes the child, from 0 (it is not true at all) to 2 (it is completely true). It has been validated for Turkish children. The items of the Child Behaviour Check List-1 1/2-5 were translated into Turkish with an internal consistency coefficient of 0.82.[17,18] Cross informant correlations of the Child Behaviour Check List-1 1/2-5 on 62 mothers' ratings were found to be satisfactory ranging from 0.54 to 0.84, p b 0.001, across all scales, and test–retest coefficients of internalizing, externalizing, and total problem scales were found to be 0.72, 0.84, and 0.78; p b 0.001, respectively.[18,19] In this study, we used total/raw scores and higher scores reflected more problematic behaviour. The study was approved by the local ethics and research committee of the hospital.

Statistical analysis

SPSS (Statistical Package for the Social Sciences Inc; Chicago, IL, ABD) Windows 20.0 was used for the statistical analysis of the data acquired in this study. Nominal variables were presented as numbers and percentages, while measured variables were presented as mean and standard deviation. Normal distribution of samples was detected by Kolmogorov–Smirnov analysis. The Student-t test was used for the variables that were normally distributed, and the Mann–Whitney U test was used for the variables that were not normally distributed. The correlations between continuous variables were assessed with the Spearman rank correlation coefficient. Linear regression analysis was performed to determine factors associated with Internalizing problems. Statistical significance for all analyses was assumed at $p < 0.05$.

Results

A total of 109 pre-school children were included in the study; 41 of them were children with non-cardiac chest pain, and 68 of them were healthy children taken as a control group. The median ages of the non-cardiac chest pain and control groups were the same (48 months) with a range between 32 and 60 months. There were no differences in gender, age, parents' ages, maternal employment, and parental education between the non-cardiac chest pain and control groups. All patients with non-cardiac chest pain had recurrent (40% two or three times and the rest more than three times) and episodic pain that was occurred in a variety of locations in the chest. The majority of non-cardiac chest pain patients (2/3) had no other physical symptoms concurrent with chest pain. But, 1/3 of non-cardiac chest pain patients had other functional psychosomatic, such as headache and abdominal pain. The socio-demographic data of both the non-cardiac chest pain and control groups are shown in Table 1. In our total samples, the scores of internalizing problems and anxiety problems were significantly higher in the non-cardiac chest pain group when compared to the control group ($p = 0.001$ and $p = 0.02$, respectively). The scores relating to being withdrawn, having sleep problems, attention problems, and aggressive behaviour did not differ between the two groups. Also, externalizing problems, other problems, and total

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Table 2. Behavioural problem scores of non-cardiac chest pain and control groups

Scores Mean ± SD or Median (Range)	Non-cardiac chest pain (n = 41)	Control (n = 68)	p
Emotionally reactive	6.4 ± 4.2	3.8 ± 3.3	0.001
Anxious/depressed	6.1 ± 3.5	4.3 ± 3	0.01
Somatic complaints	5.6 ± 3.5	3.5 ± 2.4	0.002
Withdrawn	2 (0–8)	2 (0–8)	NS
Sleep problems	3.5 ± 2.8	3.1 ± 2.6	NS
Attention problems	2.2 ± 2	2.4 ± 1.7	NS
Aggressive behaviour	7.4 ± 5.8	8 ± 6	NS
Internalizing problems	20.2 ± 10.5	13.6 ± 9.5	0.001
Externalizing problems	9.7 ± 7.2	10.4 ± 7.2	NS
Other problems	9.4 ± 5.7	9.2 ± 5.9	NS
Total problems	42.9 ± 21.3	36.4 ± 21.3	NS
Affective problems	3.5 ± 2.4	3.1 ± 2.7	NS
Anxiety problems	6.4 ± 3.6	4.8 ± 3.2	0.02
Pervasive developmental problems	3 (0–14)	3 (0–15)	NS
Attention deficit/hyperactivity problems	4.2 ± 2.9	4.7 ± 2.7	NS
Oppositional defiant problems	2 (0–10)	2 (0–10)	NS

*NS: Not significant.

Table 3. Correlations between maternal and paternal education level and behavioural problems

	Maternal education level (years)	Paternal education level (years)
Emotionally reactive score	r = −0.338 p = 0.03	r = −0.226 p = NS
Anxious/depressed score	r = −0.329 p = 0.04	r = −0.243 p = NS
Somatic complaints score	r = −0.365 p = 0.01	r = −0.157 p = NS
Internalizing problems score	r = −0.346 p = 0.02	r = −0.223 p = NS

*NS: Not significant.

Table 4. Relationship between maternal employment status and behavioural problems

	Housewife (n = 27)	Regular working (n = 14)	p
Emotionally reactive	7.5 ± 4.1	4.2 ± 3.5	0.01
Anxious/depressed	7.3 ± 3.1	3.7 ± 3.1	0.001
Somatic complaints	6.7 ± 3.6	3.6 ± 2.5	0.007
Internalizing problems	23.4 ± 9.3	14 ± 10	0.003

problem scores were similar in both the non-cardiac chest pain and control groups (Table 2). Additionally, affective problems, pervasive developmental problems, attention deficit/hyperactivity problems, and oppositional defiant problems did not differ between the non-cardiac chest pain group and the control group. Among possible factors related to behaviour problem scores, in correlation analysis, the maternal education level was correlated inversely with emotionally reactive scores ($r = -0.338$, $p = 0.03$), anxious/depressed scores ($r = -0.329$, $p = 0.04$), somatic complaints scores ($r = -0.365$, $p = 0.01$), and internalizing problem scores ($r = -0.346$, $p = 0.02$) in the non-cardiac chest pain group (Table 3). There were no significant correlations among the paternal education level and emotionally reactive, anxious/depressed, somatic complaints, and internalizing problems scores ($r = -0.226$, $p = 0.13$; $r = -0.243$, $p = 0.11$; $r = -0.157$, $p = 0.3$; and $r = -0.223$, $p = 0.18$, respectively) in the non-cardiac chest pain group (Table 3). Maternal employment status (housewife or regular working) was also associated with emotionally reactive, anxious/depressed, somatic complaints, and internalizing problems (Table 4). After all, these factors were evaluated in univariate analysis, and multiple regression analysis was finally carried out and being in the non-cardiac chest pain group was found to be significantly related to Internalizing problems in our total sample (multiple $R = 0.142$, $p = 0.001$).

Discussions

This is the first study examining psychological comorbidity in pre-school children with non-cardiac chest pain. In the present study, we identified behavioural problems, especially Internalizing problems, in a group of pre-school children with non-cardiac chest pain and no developmental delay. As we hypothesized, behavioural problems in children can be a reason for non-cardiac chest pain and start as early as pre-school years. Chest pain is among the most prevalent causes of paediatric visits to the emergency department and the second most common reason for referral to a paediatric cardiologist.[2,3] Although a cardiac cause for chest pain is uncommon in children, concern for this possibility by the family and primary care physicians prompts referral to the paediatric cardiologist.[4,5] Non-cardiac chest pain is defined as recurrent chest pain that is indistinguishable from cardiac chest pain with regards to their medical history and physical examination. However, medical testing reveals no evidence of cardiac disease.[6,7] Psychological comorbidity is common among patients with non-cardiac chest pain and especially those with functional chest pain. Multiple factors from biological, psychological, social, familial, and developmental domains are potentially relevant to the aetiology of this ailment.[9,10] There are a lot of diagnostic studies about psychological comorbidity in children and adolescents with non-cardiac chest pain that have consistently revealed high rates of psychopathology. Lipsitz et al[13] investigated 27 children and adolescents with non-cardiac chest pain, and they found current anxiety disorder diagnosis in 15 (56%) of them. Tunaoglu et al[14] showed 75% psychiatric disorder and 21% anxiety symptoms in 74 youngsters with non-cardiac chest pain in a paediatric cardiology service, based on the Diagnostic Statistical Manual of Mental Disorders, Third Edition-R. Another study in children and adolescents with non-cardiac chest pain who were admitted to a paediatric emergency department showed high rates of psychopathology (27 of 32 children, 84%) using the Diagnostic Statistical Manual of Mental Disorders, Fourth Edition, and a large percentage of the sample (81%) had anxiety disorder.[20] Lipsitz et al[21] found a higher prevalence of Diagnostic Statistical Manual of Mental Disorders, Fourth

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Edition psychiatric disorders in children and adolescents with non-cardiac chest pain than in a control sample with innocent heart murmur (74% versus 38%), and anxiety was again found to be the most common (70%) among psychiatric disorders. Another study by Lipsitz et al showed that youngsters who had been diagnosed several years earlier with non-cardiac chest pain reported more current symptoms of anxiety, anxiety sensitivity, and physiological arousal than children with benign murmurs.[12] Depressive symptoms have also been reported in between 4 and 15% of youngsters with non-cardiac chest pain in previous studies.[13,14] Consistent with these studies, we showed significantly higher rates of emotionally reactivate, anxiety/depression, and internalizing problems in pre-school children with non-cardiac chest pain when compared to controls.

The influence of mind and emotions over physical well-being has been well recognized in medicine. Psychosomatic complaints are by definition clinical symptoms with no underlying organic pathology. Chest pain is one of the most common psychosomatic symptoms seen in paediatric aged groups. The prevalence of psychosomatic complaints in children and adolescents has been reported to be between 10 and 25%.[22,23] Symptoms peak around the age of 7 in boys and the ages of 6 and 16 in girls.[22,23] In our study population, the non-cardiac chest pain group had significantly higher somatic complaint scores than the control group. This indicated that psychosomatic complaints can emerge as early as pre-school age. Additionally, majority of children with non-cardiac chest pain had no other system complaints, but a subset of children with non-cardiac chest pain had broader somatization, such as headache or abdominal pain. Similarly, a previous study about broader somatization reported that other somatic complaints, such as headaches, abdominal pain, fatigue, and dizziness, occurred in approximately 30% of children with non-cardiac chest pain.[24]

Among the possible factors (maternal education, paternal education, and maternal employment status) related to behaviour problems, the maternal education level is one of the most constant characteristics of socio-economic status and is related to accessibility to health services in developing countries.[25] This might be why we found a negative and significant correlation between behavioural problems and the maternal education level. Maternal employment status is another important characteristic of higher socio-economic status in which the children of working mothers are known to have a higher opportunity of pre-school education, higher quality of home environment, and better behavioural status. Consequently, the current study considers maternal employment status as a potential factor influencing the behavioural status of children with non-cardiac chest pain. We found that children with housewife mothers were more susceptible to have behavioural problems compared to children with working mothers in the non-cardiac chest pain group.

Internalizing problems interferes with a child's quality of life during a sensitive developmental period and can be costly for individual families and health services. These childhood behavioural problems may be treated relatively easily with both cognitive behaviour therapy and positive family assistance. Initial management of behaviour problems often involves helping parents to learn effective behaviour strategies to promote desirable behaviours in their children. If initial behaviour management strategies fail, the child should be referred for further specialist evaluation. When behavioural concerns are related to an underlying medical condition, concerns warrant a review by a developmental paediatrician, psychologist, or psychiatrist for the need of therapeutic interventions including pharmacological or behavioural therapies.[26] However, when left untreated, internalizing problems often run a chronic or recurrent course and lead to substantial disability. Therefore, early detection and intervention are crucial.

To the best of our knowledge, this is the first study among pre-school aged children regarding the behavioural changes of children with non-cardiac chest pain. We used the Child Behaviour Check List-1 1/2-5, which is the most commonly preferred tool to assess behavioural adjustment for children. It is also important to use standardized assessment tools for each culture as we did in this study. Our findings may contribute to current literature regarding behavioural problems in pre-school children with non-cardiac chest pain and the implementation of intervention strategies, since Internalizing problems interferes with a child's quality of life during the sensitive developmental period of pre-school ages and may be costly for individuals, families, and health services. These childhood behavioural problems may be readily treatable with both cognitive behaviour therapy and positive family assistance. However, when left untreated, Internalizing problems often run a chronic or recurrent course and lead to substantial disability. Therefore, early detection and intervention are crucial.

There are several limitations to the current investigation, which are important to note. This investigation included a relatively small number of participants. Future studies of pre-school children with non-cardiac chest pain should include systematic diagnostic evaluations in larger, diverse samples, recruited from multiple medical settings, and an investigation of maternal and paternal somatization and other potentially important factors that may influence a child's non-cardiac chest pain. Follow-up assessments should be conducted over time to examine the persistence of behavioural problems in this population.

Conclusion

In conclusion, physicians should consider the possibility of behavioural problems in pre-school children with chest pain after ruling out cardiac and other acute medical causes. Current findings highlight the importance of behavioural screening with the help of a short screening test such as the Child Behavioural Check List in pre-school children with non-cardiac chest pain. Systematic screening may increase the recognition of psychological symptoms in this population and facilitate appropriate treatment for those with Internalizing problems.

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Conflicts of Interest. None.

Ethical Standards. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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