

**RESEARCH
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Evaluation of Anxiety and Depression Levels in Children with Chest Pain Using a Standardized Scale

ABSTRACT

Objective: Chest pain in children may be caused by psychogenic disorders. We aimed to evaluate the relationship between chest pain and the levels of anxiety and depression in children.

Methods: Children admitted to a pediatric cardiology unit with the complaint of chest pain and healthy controls were included. History of the cases, physical examination findings, and the results of biochemical tests, electrocardiogram, 24-h Holter monitoring and echocardiographic examination were recorded. The group with chest pain and the control group were compared using the Revised Child Anxiety and Depression Scale-Child Version.

Results: A total of 100 children with chest pain [46 (46.0%) boys and 54 (54.0%) girls; mean age, 12.5 years] and 55 healthy controls [25 (45.5%) boys and 30 (54.5%) girls; mean age, 13.1 years] were included into the study. The psychiatric scale was applied to children aged 8-18 years (93 cases with chest pain and 54 control subjects). The scores of all the subscales were statistically higher in the group with chest pain than in the control group (generalized anxiety disorder: 7.39 ± 3.4 versus 5.48 ± 2.6 , $P=0.001$; major depressive disorder: 8.84 ± 6.1 versus 6.27 ± 4.7 , $P=0.009$; panic disorder: 9.07 ± 6.1 versus 4.92 ± 4.7 , $P=0.000$; separation anxiety disorder: 5.53 ± 3.7 versus 3.77 ± 3.3 , $P=0.005$; obsessive-compulsive disorder: 6.48 ± 3.6 versus 4.74 ± 3.3 , $P=0.005$; social anxiety disorder: 10.1 ± 5.5 versus 7.81 ± 4.9 , $P=0.010$).

Conclusions: There seems to be an association between increased levels of anxiety and depression disorders and chest pain in children. A comprehensive psychiatric assessment should be carried out in pediatric chest pain cases in addition to some basic cardiac evaluations.

Keywords: Anxiety, Chest Pain, Children, Depression.

Göğüs Ağrısı Olan Çocuklarda Standart Bir Ölçek Kullanılarak Anksiyete ve Depresyon Düzeylerinin Araştırılması

ÖZET

Amaç: Çocukluk çağında görülen göğüs ağrıları psikojenik kökenli olabilir. Bu çalışmada çocuklarda görülen göğüs ağrısı ile anksiyete ve depresyon düzeyleri arasındaki ilişkiyi değerlendirmeyi amaçladık.

Gereç ve Yöntem: Pediatrik kardiyoloji bölümüne göğüs ağrısı şikayeti ile başvuran olgular ve kontrol grubunu oluşturan sağlıklı çocuklar çalışmaya dahil edildi. Hastaların hikayesi, fizik muayene bulguları ile biyokimyasal testlerin, elektrokardiyografik incelemenin, 24-saatlik Holter monitörizasyonunun ve ekokardiyografik incelemenin sonuçları kaydedildi. Göğüs ağrısı olan grup ile kontrol grubu, Çocuk Anksiyete ve Depresyon Ölçeği-Yenilenmiş ölçeği kullanılarak karşılaştırıldı.

Bulgular: Göğüs ağrısı olan toplam 100 çocuk [46 (%46,0) erkek ve 54 (%54,0) kız; ortalama yaşı: 12,5 yıl] ve 55 sağlıklı kontrol [25 (%45,5) erkek ve 30 (%54,5) kız; ortalama yaşı: 13,1 yıl] çalışmaya dahil edildi. Psikiyatrik ölçek ile değerlendirme 8-18 yaş arasındaki çocuklara (göğüs ağrısı grubundaki 93 hastaya ve kontrol grubundaki 54 olguya) uygulandı. Göğüs ağrısı grubunda tüm alt ölçek skorları, kontrol grubuna göre anlamlı olarak daha yüksek bulundu (yaygın anksiyete bozukluğu: 7.39 ± 3.4 ve 5.48 ± 2.6 , $P=0.001$; majör depreatif bozukluk: 8.84 ± 6.1 ve 6.27 ± 4.7 , $P=0.009$; panik bozukluk: 9.07 ± 6.1 ve 4.92 ± 4.7 , $P=0.000$; ayrılık anksiyetesi bozukluğu: 5.53 ± 3.7 ve 3.77 ± 3.3 , $P=0.005$; obsesif-kompülsif bozukluk: 6.48 ± 3.6 ve 4.74 ± 3.3 , $P=0.005$; sosyal anksiyete bozukluğu: 10.1 ± 5.5 ve 7.81 ± 4.9 , $P=0.010$).

Sonuç: Bu sonuçlar, çocukluk çağında artmış anksiyete ve depresyon düzeyleri ile göğüs ağrısı arasındaki ilişkinin varlığına işaret etmektedir. Göğüs ağrısı olan çocukların bazı temel kardiyak incelemelere ek olarak kapsamlı bir psikiyatrik değerlendirme yapılması uygundur.

Anahtar Kelimeler: Anksiyete, Göğüs Ağrısı, Çocuk, Depresyon

INTRODUCTION

Chest pain in children and adolescents is a common cause of admission to emergency, general pediatrics and pediatric cardiology departments. In contrast to adult population, chest pain secondary to cardiac causes is rare during childhood. In the routine clinical practice, however, further evaluations directed at identifying some severe and potentially fatal cardiac disorders may be carried out unnecessarily in a considerable ratio of children with non-cardiac etiologies (1).

Chest pain with cardiac causes accounts for 0.5-5% of all chest pain cases in children (1,2). The majority of pediatric chest pain occurs idiopathically or is related to non-cardiac causes such as musculoskeletal, pulmonary, gastrointestinal or psychogenic disorders. These non-cardiac causes are usually benign in nature and are self-limiting (3).

A detailed history, physical examination and electrocardiographic evaluation will enable an easy exclusion of cardiac causes in most of the affected children, and no further examination will be needed. However, in routine practice, almost all of these children are referred to a pediatric cardiology unit which increases the anxiety levels of both the children and the parents. We aimed to evaluate the association between the levels of various anxiety and depression disorders and chest pain in children using a standardized psychiatric scale.

MATERIAL AND METHODS

Study Groups: This study included 100 children who admitted to a pediatric cardiology unit between September 2019 and January 2020 and 55 healthy controls without a known chronic disease. The Revised Child Anxiety and Depression Scale-Child Version (RCADS-CV) was applied to 93 cases with chest pain, and to 54 children in the control group.

Firstly, the etiology of the pain was evaluated. Pain characteristics including the presence of palpitations, relationship of the pain with exercise and symptoms of gastrointestinal reflux were recorded in the group with chest pain, and the scores of RCADS-CV subscales were compared between the patient and control groups.

Written informed consent from the parents and written assent from the children/adolescents were obtained before beginning the evaluation. The Local Ethical Committee of our Institute gave approval for the study, which was performed in accordance with the Declaration of Helsinki (Protocol number of ethical approval: 158; 22.05.2020).

Electrocardiographic Examination: A resting, lying 12-lead electrocardiogram (ECG) using Nihon Kohden ECG machine (speed, 25 mm/sec; acquisition sensitivity, 10 mm/mV ± 2%) was carried out in all the cases with chest pain, and the heart rate, QTc, and P-R intervals were recorded.

Echocardiographic

Examination:

Echocardiographic examination was performed in all the cases in the patient group. It was carried out by a pediatric cardiologist using Philips Affiniti 70C Ultrasound Machine (Philips Healthcare, Andover, USA). The ejection fraction, shortening fraction, left ventricular end-diastolic diameter, interventricular septum and left ventricular posterior wall thickness were measured by M-mode echocardiography in all the patients. Left and right ventricular outflow obstructions were evaluated using long- and short-axis images.

Electrocardiographic Holter Monitoring:

When 24-h Holter monitoring was thought to be indicated, Holter monitor electrodes were placed by a nurse in the pediatric cardiology department. Holter rhythms were recorded by Biomedical Instruments Holter Recorder.

Evaluation of Anxiety and Depression

Levels: The RCADS-CV includes 47 items, and consists of six subscales (generalized anxiety, major depression, panic disorder, separation anxiety, obsessive compulsive disorder and social anxiety disorder). The inter-scale reliability of RCADS-CV is excellent with a Cronbach's alpha reliability coefficient of 0.95, and coefficients for RCADS-CV subscales range from 0.75 to 0.86, demonstrating good internal consistency (4). The mean ± standard deviation scores of each subscale in various groups were calculated and compared.

Statistical Analysis: The Statistical Package for the Social Sciences 22.0 (IBM SPSS 22) program was used for the statistical analysis. Continuous variables were presented as the mean ± standard deviation, whereas categorical variables were presented as the number (percentages) of cases. In the comparison of numerical variables, Student's t test and ANOVA test were used. A *P* value <0.05 was considered as statistically significant.

RESULTS

Among the 100 children with chest pain, 46 (46.0%) were male and 54 (54.0%) were female. In the control group with 54 children, 25 (45.5%) were male and 30 (54.5%) were female. As RCADS-CV is applicable only to children older than 8 years, it was carried out in 93 cases with chest pain and 54 healthy controls.

Table 1 shows the underlying disorders linked to chest pain and the characteristics of pain in the patient group. Altogether, 58 (58%) cases described the pain as sharp, 19 (19%) as squeezing, whereas 23 (23%) patients could not define the character of the pain. The history of 10 children (10%) revealed the presence of chronic chest pain. Six (6%) cases were found to have an underlying cardiac disorder including minimal mitral insufficiency + mild mitral valve prolapse (*n*=2), hypertrophic cardiomyopathy (*n*=1), restrictive

cardiomyopathy (n=1), mitral valve prolapse (n=1), grade 1 pulmonary insufficiency + trace aortic insufficiency (n=1). Electrocardiographic examination revealed mild abnormalities (including sinus arrhythmia, sinus tachycardia and right

bundle branch block) in 8 (8%) cases. Holter monitoring was carried out in 12 patients, and displayed no rhythm disorder which may cause chest pain in any of the cases.

Table 1. Underlying disorders and pain characteristics in cases with chest pain (n = 100).

	Pain description n (%)			Pain with exercise n (%)	Palpitations n (%)	GER n (%)
	Sharp	Squeezing	Undefined			
Idiopathic (n=62)	37 (59.6)	12 (19.3)	13 (20.9)	21 (33.8)	40 (64.5)	18 (29.0)
Musculoskeletal (n=15)	7 (46.7)	2 (13.3)	6 (40.0)	10 (66.7)	8 (53.3)	4 (26.7)
Psychogenic (n=8)	5 (62.5)	2 (25.0)	1 (12.5)	4 (50.0)	4 (50.0)	4 (50.0)
Cardiac (n=6)	3 (50.0)	2 (33.3)	1 (16.7)	5 (83.3)	5 (83.3)	4 (66.7)
Gastrointestinal (n=5)	3 (60.0)	1 (20.0)	1 (20.0)	1 (20.0)	5 (100.0)	2 (40.0)
Respiratory (n=3)	3 (100.0)	0	0	2 (66.7)	2 (66.7)	0
Other (n=1)	0	0	1 (100.0)	0	1 (100.0)	0
Total number (%)	58 (58.0)	19 (19.0)	23(23.0)	43 (43.0)	65 (65.0)	36 (36.0)

GER = gastroesophageal reflux.

Gastrointestinal disorders were identified in 5 (5%) cases. They included gastritis (n=2), inflammatory bowel disorder (n=1), Celiac disease (n=1) and constipation (n=1). However, detailed history suggested mild gastrointestinal reflux in 32

(32%) cases. In the comparison of anxiety and depression levels using the RCADS-CV, scores of the patient group were found to be statistically higher than those of the control group in all the subscales (Table 2).

Table 2. Anxiety and depression scores in patient and control groups.

	Chest pain (n = 93)	Control (n = 54)		
	Mean ± SD	Mean ± SD	t	P
Generalized anxiety disorder	7.39 ± 3.4	5.48 ± 2.6	3.485	0.001*
Major depressive disorder	8.84 ± 6.1	6.27 ± 4.7	2.643	0.009*
Panic disorder	9.07 ± 6.1	4.92 ± 4.7	4.292	0.000*
Separation anxiety disorder	5.53 ± 3.7	3.77 ± 3.3	2.881	0.005*
Obsessive compulsive disorder	6.48 ± 3.6	4.74 ± 3.3	2.886	0.005*
Social anxiety disorder	10.10 ± 5.5	7.81 ± 4.9	2.606	0.010*

SD = standard deviation.

*Significant at P < 0.05.

In the comparison of male and female subjects with chest pain, girls had statistically higher mean scores of major depression, panic disorder, obsessive compulsive disorder and social

anxiety disorder, whereas scores of generalized anxiety disorder and separation disorder were not significantly different between girls and boys with chest pain (Table 3).

Table 3. Anxiety and depression scores according to sex in cases with chest pain.

	Male (n = 43)	Female (n = 50)		
	Mean ± SD	Mean ± SD	t	P
Generalized anxiety disorder	6.83 ± 3.2	7.88 ± 3.6	-1.149	0.151
Major depressive disorder	7.23 ± 5.3	10.20 ± 6.5	-2.402	0.018*
Panic disorder	6.79 ± 4.9	11.00 ± 6.3	-3.554	0.001*
Separation anxiety disorder	5.46 ± 3.2	5.60 ± 4.1	-0.174	0.862
Obsessive compulsive disorder	5.62 ± 3.0	7.22 ± 3.8	-2.166	0.033*
Social anxiety disorder	8.37 ± 4.8	11.70 ± 5.7	-3.055	0.003*

SD = standard deviation.

*Significant at P < 0.05.

When children with chest pain were stratified into two groups according to their age, cases aged 12 years or older were observed to have significantly higher scores in the subscales of generalized anxiety disorder, major depression, panic disorder, whereas the mean score of

separation anxiety was higher in children younger than 12 years.

No difference was observed regarding the scores of obsessive compulsive disorder and social anxiety between the two groups (Table 4).

Table 4. Anxiety and depression scores according to age in cases with chest pain.

	≥ 12 years (n = 57)	<12 years (n = 36)		
	Mean \pm SD	Mean \pm SD	t	P
Generalized anxiety disorder	8.12 \pm 3.4	6.25 \pm 3.2	2.606	0.011*
Major depressive disorder	10.10 \pm 6.4	6.80 \pm 5.1	2.617	0.010*
Panic disorder	10.80 \pm 6.0	6.22 \pm 5.0	3.843	0.000*
Separation anxiety disorder	4.71 \pm 2.9	6.83 \pm 4.3	-2.771	0.007*
Obsessive compulsive disorder	7.00 \pm 3.7	5.66 \pm 3.2	1.757	0.082
Social anxiety disorder	10.50 \pm 6.0	9.61 \pm 4.7	0.800	0.426

SD = standard deviation.

*Significant at P < 0.05.

Among the children with chest pain, those reporting palpitations among the admission complaints had higher scores of panic disorder than

the cases without palpitation, whereas no difference was observed regarding the scores of other subscales (Table 5).

Table 5. Anxiety and depression scores according to the presence or absence of palpitations in cases with chest pain.

	Palpitations (n = 60)	No palpitations (n = 33)		
	Mean \pm SD	Mean \pm SD	t	P
Generalized anxiety disorder	7.66 \pm 3.5	6.90 \pm 3.4	1.004	0.318
Major depressive disorder	9.63 \pm 6.4	7.42 \pm 5.5	1.667	0.099
Panic disorder	10.40 \pm 6.6	6.60 \pm 4.0	3.020	0.003*
Separation anxiety disorder	5.05 \pm 3.8	6.42 \pm 3.2	-1.727	0.088
Obsessive compulsive disorder	6.86 \pm 3.7	5.78 \pm 3.2	1.388	0.169
Social anxiety disorder	10.50 \pm 5.3	9.60 \pm 6.0	0.753	0.454

SD = standard deviation.

*Significant at P < 0.05.

DISCUSSION

The findings of this study suggest that chest pain in children and adolescents is associated with increased levels of anxiety and depression disorders. In the modern era, psychiatric disorders in children are considered to occur more frequently due to some conditions such as weakened family ties by technology, competition at school, expectations of success from the social environment, putting too much pressure on children and less natural living environments (5,6).

Chest pain is the second most common cause of admission to pediatric cardiology clinics after heart murmurs. The etiology of chest pain in pediatrics is broad, and only a minority of the cases are due to an underlying cardiac pathology (1-3,5-7). In the present study, 6% of the children with chest pain had a cardiac disorder demonstrated by echocardiographic examination (1-3,5), a finding consistent with the literature.

The character of chest pain in children has been mostly reported as sharp in nature (5,7). Among our cases, 58% had sharp pain. In addition, 7-45% of children with chest pain may have the pain for longer than 6 months (8,9). The percentage of chronic chest pain was 10% among our patients. Chest pain especially of musculoskeletal origin tends to recur in children with rapid growth and development.

An electrocardiographic examination is recommended in all children with chest pain. It is

cheap and is easily obtained at almost every primary health facility. In addition, primary care physicians can be reassured that most cardiac pathologies can be reliably excluded when the patient's history, physical examination, and ECG are normal.

In the study of Selbst et al. including 191 children with chest pain, 16% of the cases were found to have an abnormality on ECG examination (8). We identified mild ECG abnormalities in 8% of our patients with chest pain, however, the majority of these abnormalities were thought not to be related to chest pain. Among the abnormal electrocardiographic findings suggesting a cardiac cause for chest pain are ventricular hypertrophy, high-grade atrioventricular block, pathologic ST segment or T-wave changes, ventricular or atrial ectopy, low QRS voltages, PR-segment depression, or a prolonged QTc >470 ms (10).

Approximately 1-8% of pediatric chest pain cases can be attributed to gastrointestinal disorders including gastroesophageal reflux, esophagitis, gastritis, peptic ulcer and constipation (4,11). Gastroesophageal reflux can cause retrosternal chest pain which may be aggravated by eating or by lying down in supine position. We identified a gastrointestinal disorder that may be associated with chest pain in 5% of the cases although a detailed history revealed the presence of mild gastrointestinal reflux in 32 (32%) cases.

We found the mean scores of all the subscales constituting RCADS-CV to be significantly higher in children with chest pain than in the control group. Similarly, in a recent study including 76 children aged 8-18 years who had chest pain without a cardiac etiology or any other organic cause of chest pain, Kenar et al. have demonstrated non-cardiac chest pain in children and adolescents to be associated with increased levels of anxiety (6).

Chest pain may be a presenting symptom of some psychiatric disorders. However, in the majority of the affected cases, it may not be easy to differentiate whether the anxiety disorder causes the pain or chest pain is the cause of elevated anxiety levels. Chest pain may not solely cause increased anxiety levels in the affected children, but also cause their parents to become stressful. We are in the opinion that although non-cardiac chest pain may have significantly contributed to higher anxiety scores in our patients, referral to a pediatric cardiology unit may also have increased their anxiety levels. In fact, most of the cardiac pathologies associated with chest pain can be reliably excluded with the history, physical examination and an ECG by a primary care physician or a pediatrician. Informing and reassuring the child and the parents will decrease their anxiety levels considerably in most instances.

We found the scores of the subscales major depression, panic disorder, obsessive compulsive disorder and social phobia higher in girls with chest pain than in boys. Selbst et al. have also found psychogenic chest pain to be more common in girls than in boys (9), whereas Irdem et al. have reported a higher prevalence of psychosomatic symptoms in girls although the difference was statistically not significant (5). In fact, almost all anxiety subtypes and depression disorders have been reported to be more common in girls in the general population (12,13).

In a clinical study, children and adolescents with non-cardiac chest pain aged 7-18 years have been found to show higher levels of anxiety, anxiety sensitivity and physiological arousal than children with benign cardiac murmurs (14). Another study including children and adolescents with non-cardiac chest pain revealed a high frequency (56%) of anxiety disorders in cases with chest pain although they had rarely depressive symptoms (15). Garber et al. have reported that 10% of 540 students with a grade range of 2-12 were bothered by chest pain within the last 2 weeks (16). In another study, 4% of high school students reported experiencing chest pain at least weekly

throughout the past 12 months (17). In the study of Tunaoglu et al., a psychiatric interview was conducted to 74 children with chest pain, and 55 (74.3%) were found to have a pathologic symptomatology including anxiety, conversion disorder, depression, somatization disorder, avoidance disorder and behaviour disorders (18).

We found the anxiety and depression scores in the subscales of generalized anxiety disorder, major depression and panic disorder to be statistically higher in children aged 12 years or older than those younger than 12 years. Epidemiologic data indicate that the frequency of anxiety and depression disorders shows a tendency to increase following the onset of puberty (12,19). Our finding of significantly higher anxiety and depression scores in half of the subscales in children aged 12 years or older may at least partially be explained by physiological changes related to puberty.

The sensation of palpitations may activate the sympathetic nervous system, and cause panic disorders. Among the patients with chest pain, we found higher scores of panic disorder in children with palpitations, whereas there was no difference regarding other subscales between patients with and without palpitations.

Although we included a moderate number of children with chest pain and used a standardized scale to evaluate the anxiety and depression levels in affected cases, our study has some limitations. Firstly, it is a cross-sectional study, and we cannot establish a cause-and-effect relationship. Longitudinal studies are needed to conclude precisely whether anxiety and depression disorders cause chest pain or chest pain itself increases anxiety and depression levels. Secondly, we used self-evaluation scales for the determination of anxiety and depression levels. Some structured clinical interviews would probably enable a more accurate assessment in subjects with chest pain. Lastly, cases included in our study were seen in a tertiary health care center and therefore do not reflect the community.

In conclusion, chest pain in children and adolescents seems to be associated with increased levels of anxiety and depression. A comprehensive psychiatric evaluation may help to identify a possible underlying disorder in pediatric chest pain cases. Psychogenic disorders may constitute a higher percentage of "idiopathic" non-cardiac chest pain than previously thought. Large-scale studies may enable to assess the contribution of increased anxiety levels to chest pain, particularly in adolescents.

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