Parental Anxiety Levels Before and After Pediatric Cardiology Evaluation in Asymptomatic Children with Heart Murmurs: A Prospective Study

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Abstract

Background

Cardiac murmurs are common in childhood, yet their detection often triggers significant parental anxiety. The aim of this study is to measure the anxiety levels of parents of newborns and children referred to pediatric cardiology due to heart murmurs, using the State Anxiety Scale questionnaire before and after examination, and to investigate the effect of expert assessment and echocardiography on parental anxiety.

Methods

This prospective study included parents of 241 asymptomatic children (under 24 months) referred for an initial cardiac evaluation due to a murmur. Parental anxiety was measured using the State-Trait Anxiety Inventory (STAI) before and after a comprehensive clinical evaluation including echo. Participants were categorized based on echo findings: normal, transient functional abnormalities, and hemodynamically insignificant heart disease.

Results

The mean pre-consultation anxiety score was 51.17 ± 6.34, which significantly decreased to 45.89 ± 7.84 following the evaluation (t (240) = 10.44; $p < 0.001$; Cohen's d = 0.67). While anxiety levels dropped significantly across all echo groups ($p < 0.001$), no statistical difference was found between the groups regarding the amount of anxiety reduction ($p = 0.108$). Sub-item analysis revealed that the consultation primarily reduced negative emotions (e.g., tension, worry) rather than immediately increasing positive emotional states. According to the regression analysis results, the only significant independent variable that increased anxiety before the examination was "family history of heart disease" (β = 2.129; $p = 0.031$), while after the examination, it was determined that none of the examined demographic or socioeconomic variables had a significant effect on anxiety ($p > 0.05$).

Conclusions

Pediatric cardiology evaluation and echocardiography significantly alleviate parental anxiety, regardless of the clinical severity of the findings. The reassurance provided by specialized consultation acts as a powerful intervention that transcends socioeconomic boundaries. Clinicians should prioritize early and detailed communication, particularly for families with a history of cardiac disease, to effectively manage the psychological burden of a heart murmur referral.

INTRODUCTION

Cardiac murmurs are a common physical examination finding in childhood and the neonatal period and are the most frequent reason for referrals to pediatric cardiology clinics (1, 2). Studies show that a heart murmur can be detected in approximately 50% to 80% of children at some point in their lives, but the vast majority of these murmurs are innocent or functional murmurs not associated with a structural or physiological abnormality in the heart (3–6). Although pathological murmurs indicative of structural heart disease account for less than 1% of all cases, it may not always be possible for physicians to differentiate between benign and pathological murmurs solely through physical examination (3, 7). This situation leads to asymptomatic children often being referred to a pediatric cardiologist for further evaluation to rule out serious heart disease (1, 2). Notifying a family that a heart murmur has been detected in their child, and the subsequent referral process, can cause significant anxiety and worry for parents. Parents often tend to associate the term "murmur" with serious heart disease, the need for surgery, or a risk of sudden death, which can lead to misconceptions, even to the point of restricting their children's physical activities (5, 7, 8). Even if the child is asymptomatic or the referring physician suggests that the murmur is likely benign, this is not always enough to reduce the perceived threat level of the parents, and this period of uncertainty can negatively affect the parents' overall well-being (1, 2, 5). Even when a specialist diagnoses an innocent heart murmur, it has been observed that some parents still harbor concerns that their child has heart disease (5, 8, 9). A detailed physical examination, and especially echocardiographic evaluation, performed by a pediatric cardiologist is the most reliable method to eliminate diagnostic uncertainty, rule out structural heart diseases, and reassure the family (9–11). Studies in the literature show that after expert consultation, echocardiography (ECHO), and detailed information, parents experience a significant decrease in anxiety levels and an increase in their understanding of the disease (9, 10). However, while debates continue regarding the routine use and cost-effectiveness of ECHO, its role in alleviating parental anxiety is undeniable (3, 10). The aim of this study is to measure the anxiety levels of parents of newborns and children referred to pediatric cardiology due to heart murmurs, using

the State Anxiety Scale (STAI) questionnaire before and after pediatric cardiology evaluation, and to investigate the effect of expert evaluation on parents' anxiety levels.

METHODS

Our study included children under 24 months of age who were referred to the pediatric cardiology outpatient clinic of Recep Tayyip Erdoğan University/Education and Research Hospital by a pediatrician or family physician for their first cardiological evaluation due to the detection of a murmur in any area, and one parent of these children, regardless of parental affiliation, who agreed to participate in the study. Those caring for infants with chromosomal or congenital anomalies, suspicious findings on prenatal ultrasound, or symptoms suggestive of underlying cardiovascular or respiratory disorders were excluded from the study. All the babies were healthy and stable during the examination. Parents (mother and/or father) of children found to have heart murmurs during examinations were administered the Structured STAI. Before the examination, parents were asked and recorded information about their child's age, education level, family history of heart disease or cardiac murmur, number of children in the family, the patient's birth order (first, second, third), and whether the child had any complaints at the time the murmur was detected and when they presented to the pediatric cardiology outpatient clinic. The initial STAI questionnaire was completed by parents prior to the pediatric cardiology examination. Following a detailed pediatric cardiology examination, including an ECHO, the findings were explained in detail, a written report was provided to the parents, and a follow-up appointment was scheduled if necessary. After the pediatric cardiology examination, parents were asked to complete the STAI questionnaire once again. STAI is an anxiety test that measures situational anxiety levels. The situational anxiety scale determines how an individual feels at a particular moment and under specific circumstances. It is a self-administered test consisting of 20 easy-to-take questions. The total weighted score obtained for the direct statements is subtracted from the total weighted score obtained for the inverse statements. A predetermined and unchanging value is added to this number. For the State Anxiety Scale, this unchanging value is 50. The total score obtained ranges from 20 to 80. A high score indicates a high level of anxiety, while a low score indicates a low level of anxiety. Generally, a score of 40 or higher on the STAI scale indicates a significant level of anxiety (12, 13). The STAI State Inventory is a commonly used method for assessing anxiety that may arise from a medical condition. The study investigated whether the anxiety levels of families experiencing heart murmurs decreased as a result of pediatric cardiology examinations and detailed information provided to the families.

The study was approved by our hospital's clinical research ethics committee with decision number 2024/311 dated 26/12/2024.

Statistical analysis was performed using IBM SPSS software version 25.0 (IBM Corp., Armonk, NY). Survey scores are presented as mean ± standard deviation. A paired-pair Student's t-test was utilized to compare STAI scores before and after cardiological consultation. Based on ECHO findings, infants were divided into three groups: infants with normal echocardiograms; infants with transient functional abnormalities; and infants with hemodynamically insignificant heart disease (please see below for abnormalities included in each group). Within-group comparisons (i.e., before-after consultation) were performed using paired Student's t-test, while between-group comparisons were made using one-way ANOVA with Tuckey test for multiple comparisons. Multivariate linear regression analysis was applied to investigate the role of various parameters on STAI scores.

RESULTS

The study included a total of 241 children and their parents between September 2025 and January 2026. 48.5% (n = 117) of the children were girls and 51.5% (n = 124) were boys. At the time of application, 96.7% of the children (n = 233) had no complaints. Of the children examined, 55.2% (n = 133) were their first child, 28.6% (n = 69) were their second child, 11.2% (n = 27) were their third child, and 5% (n = 12) were their fourth or later child. The characteristics of the study population are presented in Table 1.

According to the ECHO findings, 25.7% (n = 62) of the children were normal, 61.4% (n = 148) had transient functional abnormalities (130 with Patent Foramen Ovale, 7 with thin Patent Ductus Arteriosus, 11 with Peripheral Pulmonary Stenosis), and 12.9% (n = 31) had hemodynamically insignificant heart diseases (22 with Atrial Septal Defect, 5 with Ventricular Septal Defect, 1 with Bicuspid Aorta, 3 with Mitral Regurgitation). The most frequently detected ECHO finding was Patent Foramen Ovale (PFO) at 53.9% (n = 130).

When comparing the situational anxiety levels of parents before and after cardiology examination; it was found that the mean total anxiety score before the examination was 51.17 ± 6.34, while after the examination this value decreased significantly to 45.89 ± 7.84 ($t(240) = 10.44$; $p < 0.001$). When the impact of this change was analyzed, it was found that the difference had a moderate-to-large impact ($d = 0.67$). The change observed particularly in items directly related to anxiety (Direct) ($d = 0.92$) reveals a significant reduction in the negative emotional burden on parents after the examination. The results are given in Table 2.

According to the ECHO findings, parental anxiety was statistically significantly reduced ($p < 0.001$) in all groups (normal, transient functional abnormalities, hemodynamically insignificant heart disease), the data are explained in Table 3. No statistically significant difference was

found in the comparison of the amount of decrease in anxiety scores of the groups (ANOVA) ($F(2, 238) = 2.24$; $p = 0.108$).

When comparing pre- and post-consultation STAI sub-item scores according to ECHO groups, no overall significant change was observed in terms of positive emotional expressions (Reverse items). Although there were minor changes in all groups regarding the items "'I am relaxed'" and "I feel content" after the consultation, these differences were not statistically significant ($p > 0.05$). Regarding the item "I feel calm," a significant change in post-consultation scores was detected only in the group of transient functional abnormalities ($p = 0.014$). More significant results were obtained when negative emotional expressions (Direct items) were evaluated. In the item " I am tense," a significant decrease in post-consultation scores was observed in all groups (Normal: $p < 0.001$; Transient functional abnormalities: $p < 0.001$; Hemodynamically insignificant heart disease: $p = 0.043$). Similarly, significant reductions were observed in all three groups after consultation for the items "I feel upset" and "I am worried" ($p < 0.001$ in all comparisons). The results are given in Table 4.

According to the results of the multivariate linear regression analysis conducted to determine the demographic and clinical factors affecting the anxiety levels of parents before and after the examination; the presence of a family history of heart disease in the pre-examination period was found to be the only independent variable with a statistically significant effect on anxiety scores ($\beta = 2.129$; $p = 0.031$). Parental gender was found to have a borderline significant relationship with pre-examination anxiety levels ($p = 0.051$). In contrast, variables such as parental age, education level, income level, birth order, and number of children in the family did not have a significant effect on pre-examination anxiety ($p > 0.05$). When STAI scores were examined after the examination, it was determined that none of the tested demographic or socioeconomic variables had a statistically significant relationship with anxiety level ($p > 0.05$).

Table 1
Demographic and Clinical Characteristics of the Participants (N = 241)

Characteristics	n (%) or Median (Min–Max)
Age (Years)	31 (18–51)
Gender	
Female (Mother)	154 (63.9%)
Male (Father	87 (36.1%)
Education Level	
University	115 (47.7%)
High School	96 (39.8%)
Primary Education	30 (12.4%)
Monthly Income Level	
0–30.000 TL	82 (34.0%)
30.001–50.000 TL	66 (27.4%)
50.001–75.000 TL	58 (24.1%)
75.001-100.000 TL	17 (7.1%)
100.001-150.000 TL	13 (5.4%)
150.001 TL and above	5 (2.1%)
Total Number of Children in the Family	
One child	127 (52.7%)
Two children	73 (30.3%)
Three children	27 (11.2%)
Four or more	14 (5.8%)
Family History of Heart Disease	
Yes	55 (22.8%)
No	186 (77.2%)
Echocardiography Groups	
Normal	62 (25.7%)
Transient functional abnormalities*	148 (61.4%)
Hemodynamically insignificant heart disease**	31 (12.9%)

Transient functional abnormalities*: Patent Foramen Ovale (PFO), tiny Patent Ductus Arteriosus (PDA), mild Peripheral Pulmonary Stenosis (PPS). Hemodynamically insignificant heart disease**: Atrial Septal Defect (ASD), Ventricular Septal Defect (VSD), Bicuspid Aorta (BA), Mitral Regurgitation (MR).

Table 2
STAI Questionnaire Results Before and After Cardiology Consultation

Variable	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	Difference	t	df	p	Cohen's d (Effect Size)
Total Anxiety Score	51.17 ± 6.34	45.89 ± 7.84	-5.28	10.440	240	**< 0.001**	0.672
Direct Items	21,25 ± 5.19	15.11 ± 6.49	-6.14	14.406	240	**< 0.001**	0.928
Reverse Items	20.08 ± 5.00	19.22 ± 5.70	-0.86	2.613	240	**0.010**	0.168

SD: Standard Deviation, **df**: Degrees of Freedom (n-1), $p < 0.05$ is considered statistically significant. **Cohen's d criteria**: 0.2 = small, 0.5 = medium, 0.8 = large. **Direct (D)**: Items scored directly (reflecting negative emotions). **Reverse (R)**: Items scored in reverse (reflecting positive emotions).

Table 3
STAI Questionnaire Results Based on Echo Findings and Their Impact on Parental Anxiety

Echo Result Group	n	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	t	p	Cohen's d (Effect Size)
Normal	62	51.50 ± 6.24	47.95 ± 7.99	3.965	**< 0.001**	0.504 (Medium)
Transient functional abnormalities*	148	50.96 ± 6.62	45.25 ± 7.73	8.411	**< 0.001**	0.691 (Medium-Large)
Hemodynamically insignificant Heart Disease**	31	51.52 ± 5.16	44.84 ± 7.52	5.335	**< 0.001**	0.958 (Large)

STAI: State-Trait Anxiety Inventory, SD: Standard Deviation, *$p < 0.05$ is considered statistically significant*.

Transient functional abnormalities*: Includes Patent Foramen Ovale (PFO), tiny Patent Ductus Arteriosus (PDA), and mild Peripheral Pulmonary Stenosis (PPS).

Hemodynamically insignificant heart disease**: Includes Atrial Septal Defect (ASD), Ventricular Septal Defect (VSD), Bicuspid Aorta (BA), and Mitral Regurgitation (MR).

Tablo 4: Comparison of STAI Sub-item Scores Before and After Consultation Across Echo Groups

Item	Normal (Pre)	Normal (Post)	p	Transient Functional Abnormalities (Pre)	Transient Functional Abnormalities (Post)	p	Hemodynamically Insignificant HD (Pre)	Hemodynamically Insignificant HD (Post)	p
I am relaxed (R)	1.82 ± 0.56	1.85 ± 0.74	0.742	2.03 ± 0.78	1.95 ± 0.75	0.294	2.06 ± 0.81	2.16 ± 0.86	0.557
I feel content (R)	1.87 ± 0.74	1.81 ± 0.76	0.59	2.07 ± 0.83	1.95 ± 0.81	0.115	2.06 ± 0.63	2.03 ± 0.80	0.845
I feel calm (R)	1.90 ± 0.67	1.74 ± 0.68	0.124	2.08 ± 0.80	1.89 ± 0.83	**0.014**	1.90 ± 0.65	1.87 ± 0.72	0.839
I am tense (D)	2.06 ± 0.92	1.50 ± 0.80	**< 0.001**	2.04 ± 0.86	1.44 ± 0.72	**< 0.001**	2.19 ± 1.05	1.68 ± 1.05	**0.043**
I feel upset (D)	2.24 ± 0.94	1.58 ± 0.82	**< 0.001**	2.30 ± 0.85	1.58 ± 0.87	**< 0.001**	2.55 ± 0.68	1.58 ± 1.03	**< 0.001**
I am worried (D)	2.06 ± 0.92	1.50 ± 0.82	**< 0.001**	2.05 ± 0.90	1.45 ± 0.79	**< 0.001**	2.32 ± 1.01	1.65 ± 0.98	**0.001**

Data are presented as Mean ± Standard Deviation. Within-group comparisons were performed using the paired Student's t-test. HD: Heart Disease, (R): Reverse-scored items (representing positive emotions). (D): Direct-scored items (representing negative emotions), $p < 0.05$ is considered statistically significant.

DISCUSSION

This study investigated the anxiety levels of parents of children under 24 months of age who were referred to the pediatric cardiology outpatient clinic due to heart murmur, and the effects of expert evaluation and ECHO on this condition. Our study showed a statistically significant and clinically moderate-to-large effect size decrease in parents' STAI scores following a detailed examination and ECHO performed by a pediatric cardiologist (from 51.17 to 45.89; $p < 0.001$; d = 0.672). This result strongly parallels findings in the literature indicating that the stress experienced by families whose children have a heart murmur can be alleviated with the intervention of a specialist physician. For example, Akrivopoulou et al. reported a significant decrease in situational anxiety scores after cardiological examination in parents of asymptomatic newborns and infants, and noted that after the interview, the parents felt calmer, less tense, and less anxious (9). Similarly, Bårdsen et al. also showed that evaluation by a pediatric cardiologist significantly reduced parental anxiety (8). In a study conducted in Turkey by Beşiroğlu Çetin et al., the average STAI score of parents referred to cardiology was found to be 41.36, and it was emphasized that hearing a heart murmur caused significant anxiety in parents (1). The relatively higher pre-examination anxiety level (51.17) found in our study compared to the literature may be due to the young age of our patient group (under 24 months) and the feeling of uncertainty associated with this being their first cardiological examination; however, our findings confirm that echocardiography and expert information play a fundamental role in alleviating this high anxiety and reassuring the family, as also stated by Ip et al (6).

In our study, when patients were grouped according to their ECHO findings (normal echocardiography, transient functional abnormalities, and hemodynamically insignificant heart disease), a significant decrease in anxiety scores was observed in the parents of all three groups after cardiological evaluation (Table 3; $p < 0.001$). A comparison of the amount of decrease in anxiety scores between the groups (ANOVA) revealed no statistically significant difference ($p = 0.108$).

The six-item short form of the STAI scale has been described in the literature as having high validity and reliability in measuring situational anxiety in busy outpatient settings without imposing additional time burden on parents (7, 14, 15). A statistically significant decrease ($p < 0.001$) was observed in the sub-analysis based on the short scale of the STAI form (Table 4).

In their study examining the effect of ECHO findings on parental anxiety, Akrivopoulou et al. similarly divided patients into three groups and found no significant difference in anxiety scores between the three groups before the examination (9). This situation shows that when parents first come to the clinic, they experience a high level of uncertainty and stress created simply by the word "murmur," regardless of the actual anatomical condition of their child's heart. The underlying reasons for this high level of anxiety experienced by parents are well-defined in the literature. In a study by Geggel et al. on parents of children with an innocent heart murmur (Still's murmur), it was shown that families often equated the murmur with a serious heart condition. The study found that 49% of parents were worried about medication use, 41% about sports restrictions, 29% about heart surgery, and 13% about sudden death; furthermore, 19% of mothers blamed themselves for a mistake they made during pregnancy (5). Similarly, in the study by Bårdsen et al., it was reported that 71% of parents had major concerns about murmurs, such as seeing them as a "sign of serious illness" or an "increased risk of future heart disease" (8). The fact that parents come to the clinic with such fears explains why initial anxiety levels remain consistently high, regardless of the findings of the echocardiogram (normal results or minor defects).

On the other hand, although anxiety levels decreased significantly in all three groups after expert consultation and ECHO in the study by Akrivopoulou et al., the anxiety levels of parents in the group with hemodynamically insignificant heart disease on specific short STAI items such as "feeling calm," "being worried," and "being tense" remained statistically significantly higher than those in the group with normal ECHO (9). However, in our study, the decrease in anxiety among families with transient functional abnormalities detected on ECHO was similar to that among families with normal ECHO findings, indicating the success of the physician's communication with the family and the way they conveyed the ECHO findings. Ip et al. emphasized that incidental and hemodynamically insignificant findings such as PFO or small patent ductus arteriosus (PDA) detected during ECHO do not increase anxiety in parents when carefully explained and reassured by the physician (6). In conclusion, the clinical assessment and reassurance provided by a pediatric cardiologist, supported by ECHO, can alleviate parents' misconceptions (fear of surgery, medication, or restrictions) and reduce their anxiety levels to the same level as a parent with a normal ECHO result, even if a structural difference of clinical significance is detected in the child (e.g., PFO, which we detect in 53.9% of cases).

In our study, a multivariate linear regression analysis was conducted to determine the demographic and clinical factors affecting parents' anxiety levels before and after examination. The only independent variable that increased anxiety in the pre-examination period was "family

history of heart disease" (β = 2.129; $p = 0.031$). This finding presents a notable difference from data in the literature. For example, studies by Geggel et al., Bårdsen et al., Akrivopoulou et al., and Beşiroğlu Çetin et al. in our country have not shown a statistically significant relationship between a family history of heart disease or murmur and parental anxiety (1, 5, 7–9).

This unique finding in our study demonstrates that suspected genetic predisposition in the family or previous negative experiences with heart disease are extremely stressful for parents at the time of their child's first visit to the outpatient clinic. On the other hand, the borderline significant relationship ($p = 0.051$) found between pre-examination anxiety level and parental gender in our study is partially consistent with the findings of Bårdsen et al., which showed that mothers exhibited significantly higher anxiety levels compared to fathers (8). In contrast, other sociodemographic variables such as parental age, education level, income level, birth order, and number of children in the family did not have a significant effect on pre-examination anxiety ($p > 0.05$). Although Bårdsen et al. and Akrivopoulou et al. stated in the literature that low educational level is a significant predictor of increased anxiety, our results support the findings of Geggel et al. and Beşiroğlu Çetin et al., which indicated that demographic data such as educational level or age are not associated with situational anxiety (1, 5, 7, 8). This indicates that the concern that "the child may have a heart problem" elicits a similar acute stress response in every parent, regardless of socioeconomic and educational status.

One of the most striking results of our study emerged when STAI scores were examined after the examination. Following expert evaluation and ECHO, it was determined that none of the tested demographic or socioeconomic variables (including family history of heart disease) were statistically significant in relation to anxiety levels ($p > 0.05$). This aligns with the finding of Akrivopoulou et al., who observed that post-examination anxiety became independent of education and all other factors (7). In conclusion, while specific factors such as family history may increase parental stress prior to the examination, the detailed echocardiographic assessment and family information process conducted by a pediatric cardiologist appears to have a powerful and equally reassuring effect, effectively offsetting the anxiety caused by all these clinical and demographic risk factors.

CONCLUSION

This study revealed that parents of children referred to the pediatric cardiology outpatient clinic due to heart murmurs experienced significantly high levels of anxiety prior to expert evaluation, and that this anxiety was shaped more by clinical uncertainty than by socioeconomic factors. A detailed physical examination by a pediatric cardiologist, echocardiographic imaging, and clear explanation of the findings to the family significantly reduce parental anxiety, regardless of the severity of the cardiac findings in the child. It has been determined that parents, especially those with a family history of heart disease, are initially at higher risk, and that prioritizing information campaigns for these families is necessary. In pediatric cardiology practice, recognizing and effectively managing parental anxiety is critical for establishing patient-physician trust and preventing unnecessary restrictions.

LİMİTATİONS

The limitations of our study include its single-center nature, the lack of data on the professional experience and patient approach of the referring physician, the fact that the post-examination questionnaire was measured early, and the absence of long-term follow-up.

Abbreviations

ASD
Atrial Septal Defect
BA
Bicuspid Aorta
ECHO
Echocardiography
HD
Heart Disease
MR
Mitral Regurgitation
PDA
Patent Ductus Arteriosus
PFO
Patent Foramen Ovale

PPS
Peripheral Pulmonary Stenosis
STAI
State Anxiety Scale
VSD
Ventricular Septal Defect

Declarations

Ethics approval and consent to participate: The study was approved by the Clinical Research Ethics Committee of Recep Tayyip Erdoğan University Training and Research Hospital (Date: 26/12/2024, Decision No: 2024/311). The study was conducted in accordance with the principles of the Declaration of Helsinki. Informed consent was obtained from the parents or legal guardians of all participants included in the study.

Availability of data and materials: The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

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