Residência RP Pediátrica
Publicação Oficial da Sociedade Brasileira de Pediatria
ISSN-Online: 2236-6814

Submitted on: 12/20/2024
Approved on: 05/30/2025

ORIGINAL ARTICLE

Heart murmur in childhood: descriptive study of an outpatient clinic at a reference hospital in Southern Brazil

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Keywords:
Heart auscultation; Heart murmurs; Heart Defects, congenital, Observer variation; Diagnosis.

Abstract

Introduction: Heart murmurs are the main condition that requires referral to the pediatric cardiology service. **Objective:** To describe the profile of cases referred for heart murmur to the cardiology service of a pediatric hospital. **Methods:** Observational, descriptive and retrospective study accomplished in a tertiary pediatric hospital in Florianópolis, Santa Catarina. Patients between 0 and 15 years old who were referred for heart murmur evaluation between 2018 and 2022 were included. The research was approved by the Human Research Ethics Committee of the institution. **Results:** Of the 142 included, the predominant profile was males (n = 77; 54,2%) and infants (n = 51; 35,9%). Around 44 (31,0%) cases were initially identified in Primary Health Care and 96 (67,6%) were described in other care contexts. Overall, 94 (66,2%) records indicate that the identification was performed by pediatricians. In cardiology consultations, heart murmur was identified in 97 (68,3%) cases, being described mainly as systolic (n = 91; 93,8%), at the left sternal border (n = 78; 80,4%) and with soft timbre (n = 47; 48,4%). The main diagnostics were innocent heart murmur (n = 72; 50,7%) and murmur to be clarified (n = 17; 11,9%), and, of the pathologies found, the most prevalent were interatrial communication (n = 11; 7,7%) and patent foramen ovale (n = 11; 7,7%). **Conclusions:** The main profile of the referred patients was male and infant with a non-pathological murmur initially screened by a pediatrician.

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Resid Pediatr. 2025;15(4). DOI: 10.25060/residpediatr-2025.v15n4-1384-en

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INTRODUCTION

The first clinical manifestation of a significant heart disease may be the incidental identification of a heart murmur[1], which consists of an auscultatory sound derived from vibrations caused by alterations in blood flow[2]. Although the abnormal auscultation is often the only clinical sign in children with congenital heart disease, symptoms such as feeding difficulties, cyanosis, chest pain, fatigue, palpitations, syncope, and impaired growth may also be present and should be investigated[3]. Management following the finding of a heart murmur aims to determine whether there is a possibility of a life-threatening condition[4]. It is estimated that cardiovascular malformations occur in 0.4–1.4% of live births, and among these, approximately 25% are classified as severe defects requiring specialized care and interventions during the first year of life[5,6]. Furthermore, the literature reports that in 20–30% of cases, the diagnosis of congenital heart disease is made late or incorrectly[7], increasing the risk of morbidity and mortality associated with this condition. Therefore, timely recognition of the pathology is crucial for a favorable prognosis[8]. The evaluation of heart murmurs accounts for the greatest number of referrals to pediatric cardiology services[4] and, considering the possibility of an underlying disease, is also a source of anxiety and distress for patients and families[9]. However, it is estimated that about 50% of children present a heart murmur at some point in life[10] and that 60% of murmurs referred for cardiology evaluation are innocent[11]. Thus, it is evident that medical skills to distinguish a benign murmur from a pathological one are essential to avoid unnecessary referrals, minimize personal distress, and improve timely diagnosis[4,9,10]. In light of this, the present study aims to describe the clinical and epidemiological profile of children referred to a state referral center in pediatric cardiology due to the identification of a heart murmur during a previous consultation. The objective is to analyze aspects of the evaluation and the main outcomes.

METHODS

This is an observational, descriptive, and retrospective study based on data collected from the electronic medical records of a tertiary pediatric hospital in Florianópolis. The selected data correspond to the period between January 2018 and December 2022. The study was approved by the institution's Human Research Ethics Committee under approval number 6.264.995 (CAAE 72646123.2.0000.5361).

All patients aged 0 to 15 years (incomplete) who were evaluated for heart murmurs and other cardiac sounds were included. The search was performed in the Micromed® electronic medical record system using the following ICD-10 codes: R01 (Heart murmurs and other cardiac sounds); R01.0 (Innocent cardiac murmur); R01.1 (Unspecified cardiac murmur); R01.2 (Other cardiac sounds); Z00 (General examination and investigation of persons without reported complaints or diagnosis); Z00.0 (General medical examination); Z00.1 (Routine child health examination); Z01 (Other special examinations and investigations of persons without reported complaint or diagnosis); and Z03 (Medical observation and evaluation for suspected diseases and conditions). Cases were excluded when referrals were made due to findings other than the identification of a heart murmur during a previous consultation.

Demographic, clinical, diagnostic, therapeutic, and follow-up variables were collected and analyzed as described below:

phic: age according to the Marcondes classification[12] and sex;

- Clinical:
  - Past medical history: symptoms at birth and history of comorbidities;
  - Referral-related: level of healthcare at which the heart murmur was identified, the professional who detected it, and the age at initial identification;
  - Consultation-related: symptomatology, characterization of cardiac auscultation, and analysis and plan during the consultation.
- Diagnostic: examinations performed and findings obtained;
- Therapeutic: chosen management approach;
- Case outcome.

For analysis purposes, patients were considered to have heart disease if they presented abnormalities on echocardiographic examination. Those with a normal echocardiogram report, as well as those in whom cardiovascular alteration was ruled out even without the exam being requested, were considered non–heart disease patients.

Data were described using descriptive measures and tables. For qualitative variables, frequency and percentage measures were applied. Microsoft Excel® software was used.

RESULTS

A total of 435 medical records were analyzed, of which 142 (32.6%) were eligible for the study after exclusion criteria were applied. Among those included, males predominated (n = 77; 54.2%), especially among those who were ultimately found not to have heart disease. Regarding age at the first consultation, infants (n = 51; 35.9%) and preschoolers (n = 47; 33.1%) were the most represented in the sample (Table 1).

Comorbidities were recorded in 34 (23.9%) charts, with asthma (n = 9; 6.3%), autism spectrum disorder (ASD) and/or attention deficit hyperactivity disorder (ADHD) (n = 4; 2.8%), and low weight for age (n = 4; 2.8%) being the most frequently reported. As for the presence of signs and/or symptoms at birth, 26 (18.3%) records documented findings, with the most common being the identification of a heart murmur at birth (n = 20; 14.1%) and cyanosis (n = 4; 2.8%) (Table 1).

Table 1. Clinical and demographic characteristics of cases seen due to previous identification of altered cardiac auscultation in a pediatric referral hospital, Florianópolis, 2018–2022.

Variable	Sample (n = 142)		Heart disease? (%)	
	n	%	No (n = 107)	Yes (n = 35)
Sex				
Feminine	65	45,7	44,8	50,4
Masculine	77	54,2	55,1	49,6
Age range				
Newborn	2	1,4	0,9	2,8
Infant	51	35,9	30,8	51,4
Preschool	47	33,1	34,5	28,5
School	28	19,7	21,5	14,3
Adolescent	14	9,9	12,1	2,8
Comorbidities				
Absent	108	76,1	75,7	77,2
Gifts	34	23,9	24,3	22,8
Asthma	9	6,3	5,6	8,6
TEA* and/or ADHD †	4	2,8	3,7	0
Low weight for age	4	2,8	3,7	0
Chromosomal/genetic syndromes	3	2,1	1,9	2,9
Cleft lip and/or palate	3	2,1	1,9	2,9
Malnutrition	2	1,4	1,9	0
Hypothyroidism	2	1,4	0,9	2,9
Overweight	2	1,4	0	5,7
Delay at DNPM‡	2	1,4	1,9	0
Signs and/or symptoms at birth				
Absent	116	81,7	83,2	77,2
Gifts	26	18,3	16,8	22,8
Heart murmur	20	14,1	11,2	22,9
Dyspnea	2	1,4	1,9	0
Cyanosis	4	2,8	2,8	2,8
Fatigue	1	0,7	0	2,8
Bradycardia	1	0,7	0,9	0
Anoxia and/or seizures	1	0,7	0,9	0

Source: Prepared by the authors (2024).
Note: * ASD = Autism Spectrum Disorder; † ADHD = Attention Deficit Hyperactivity Disorder; ‡ DNPM = Neuropsychomotor Development.

Regarding the initial identification of the heart murmur—the reason for referral—medical record entries indicate that 44 (31.0%) were identified in the context of Primary Health Care (PHC), while 96 (67.6%) occurred in other medical care settings. Overall, 94 (66.2%) had documentation of a murmur identified by a pediatrician, representing 91.43% of cases subsequently confirmed as pathological during consultation and 57.94% of cases without cardiovascular

abnormalities. Identification of a heart murmur in emergency care settings was reported in 7 records, accounting for 7.3% of identifications made outside PHC.

The main complaint during consultation was solely the prior finding of a heart murmur in an asymptomatic patient in 98 records (69.0%), while an association with symptoms was reported in 44 cases (31%). The most prevalent symptoms were dyspnea (n = 19; 13.4%), fatigue (n = 19; 13.4%), chest pain (n = 10; 7.0%), and cyanosis (n = 10; 7.0%) (Table 2).

On physical examination during the cardiology consultation, heart sounds were normal in 122 records (85.9%), whereas in 17 cases (12.0%) auscultatory abnormalities were identified. Among the altered heart sounds (n = 17), splitting of the second heart sound (S2) was described in 14 records (82.3%), characterized as variable in 8 cases (57.1%) and fixed in 5 cases (35.7%). The description of heart sound auscultation was omitted in 3 (2.1%) of the medical records analyzed.

Additionally, a heart murmur was identified in 97 records (68.3%) and was described mainly as systolic (n = 91; 93.8%), with intensity grade 1 (n = 33; 34.0%), grade 1 to 2 (n = 18; 18.6%), and grade 2 (n = 18; 18.6%) on the 6-grade Levine Scale13. Regarding murmur location, the left sternal border (LSB) was the most frequently reported site (n = 78; 80.4%), with the lower LSB being the most common subdivision (n = 29; 37.2%). As for murmur quality, a soft murmur was reported in 47 cases (48.4%), whereas a harsh murmur was noted in 4 records (4.1%) (Table 3).

In the sample, no records identified diastolic murmurs or murmurs with intensity above grade 3, and no semiological features such as thrills were documented.

Regarding complementary evaluation, diagnostic tests were requested for 119 cases (83.8%), with the most frequently ordered being, in descending order, echocardiogram (n = 101; 71.1%), electrocardiogram (n = 75; 52.8%), and chest radiography (n = 38; 26.8%). Among the echocardiograms, 37 (26.0%) were reported as normal for age, and 40 (28.1%) showed abnormalities. Among the identified heart defects, the most prevalent were atrial septal defect (n = 11; 7.7%), valvular pulmonary stenosis (n = 10; 7.0%), and ventricular septal defect, as shown in Table 4.

The main final clinical assessments described in the analyzed medical records were, in order of frequency, functional or innocent heart murmur (n = 72; 50.7%), murmur of unclear significance (n = 17; 11.9%), and normal cardiological examination (n = 13; 9.1%). Thus, in 107 cases no cardiovascular pathology was identified after evaluation, while 35 patients were diagnosed with heart disease.

Regarding the management adopted following diagnostic assessment, 134 patients (94.4%) did not receive any treatment recommendation. Among those who required therapeutic intervention, 6 patients (75%) needed pharmacological treatment—4 (50%) received diuretics and 2 (25%) received angiotensin-converting enzyme inhibitors. In addition, 6 patients (75%) underwent interventional treatment for correction of the identified heart defect. The conditions involved included ventricular septal defect, patent ductus arteriosus, atrial septal defect, aortic coarctation, bicuspid aortic valve, and valvular pulmonary stenosis.

Regarding follow-up, 88 patients (62%) were discharged from the pediatric cardiology service and referred back to primary health care for continued monitoring.

DISCUSSION

In the present study, the predominant profile of patients seen in the pediatric cardiology service due to a prior finding of a heart murmur consisted of male children. This prevalence is consistent with the profile of individuals with congenital heart disease found in studies by Braht et al.[14] (2018) and Rodríguez[15] (2018). Pace et al.[16] (2018), however, observed that male predominance was more relevant when critical heart defects were considered, whereas in non-critical defects, there was a similar distribution between sexes. Thus, when comparing the groups, the equitable distribution observed among children with heart disease aligns with this study, given the outpatient nature of the cases analyzed.

Infants were the age group with the highest representation in the sample. Studies indicate that the detection of auscultatory abnormalities in newborns or children in the first 12 months of life requires a more directed and detailed investigation, which may explain the prevalence of care in this age group[17],[18]. This is justified because symptoms are often nonspecific, and the risk of delayed diagnosis in patients with heart disease is significant—estimated at 20–30%[3].

Regarding the initial identification of the heart murmur that led to referral for specialized evaluation, most records indicated that the murmur was identified by a pediatrician. This finding is consistent with the literature described by Amaral et al.[17] (1995) and Kobinger[18] (2003), who highlight appropriate pediatric assessment as essential to avoid unnecessary referrals and tests, considering that several risk factors and prognostic indicators—such as associated symptoms and hemodynamic repercussions—must be evaluated.

However, especially within the context of the Brazilian Unified Health System (SUS), this concept must be broadened to include Primary Health Care (APS), since after the implementation of the Family Health Strategy (ESF), it became the main gateway to the system. In the present study, 31% of the cases had the murmur initially identified in APS. In this model of care, multidisciplinary work is essential, and each ESF team must include at least one general practitioner or family health specialist or family and community physician, one generalist or family health nurse, one nursing assistant or technician, and community health workers[19],[20]. Thus, physicians working in primary care must be prepared for proper clinical assessment and capable of determining the need for referral to specialists, avoiding parental anxiety and unnecessary use of health resources[3],[21].

Table 2. List of complaints reported during cardiology consultation among cases referred due to prior identification of abnormal cardiac auscultation in a pediatric referral hospital, Florianópolis, 2018–2022.

Symptoms during consultation	Sample (n = 142)		Heart disease? (%)	
	n	%	No (n = 107)	Yes (n = 35)
Absent	98	69	72	60
Gifts	44	31	28	40
Dyspnea	19	13,4	11,2	20
Fatigue	19	13,4	8,4	28,5
Chest pain	10	7	3,7	17,1
Cyanosis	10	7	4,7	14,3
Palpitation	8	5,6	4,7	8,6
Low weight gain	6	4,2	2,8	5,7
Syncope	2	1,4	1,9	0
Cough	2	1,4	0,9	2,8
Headache	1	0,7	0,9	0
Blurred vision	1	0,7	0,9	0
Skin pallor	1	0,7	0,9	0
Epistaxis	1	0,7	0	2,5
Seizures	1	0,7	0,9	0
Delay at DNPM*	1	0,7	0,9	0

Source: Prepared by the authors (2024).
Note:* DNPM = Neuropsychomotor Development.

In our sample, 23.9% of cases were associated with previous health conditions, with a proportionally similar distribution between children with and without heart disease. Low weight for age and malnutrition were reported in 2.8% and 1.4% of records, respectively, representing 11.8% and 5.8% of the cases with associated comorbidities. However, when comparing children with and without heart disease, these conditions were not significant among those with heart disease, diverging from the well-established association in the literature between congenital heart defects and nutritional status abnormalities[22].

In addition, conditions such as ASD and ADHD were reported in 11.8% of cases with associated comorbidities, and neuropsychomotor developmental delay in 5.8%. When comparing the groups, these conditions were also not present among children with heart disease, differing from the literature. Paula et al.[23] (2020), for example, demonstrated that the association between congenital heart disease and impaired motor, cognitive, and language development is significant and may often indicate disease severity.

Regarding symptomatology in the cardiology consultation, 69% of cases were asymptomatic, corroborating the literature, given that most heart murmurs present with absent or nonspecific clinical signs[24]. Symptom reports were more representative in the group with heart disease, with dyspnea, fatigue, and chest pain being the most common. These symptoms, although strongly associated with cardiovascular diseases, are common in several conditions and must be carefully assessed within the context of differential diagnosis[3,18].

In the physical examination, the predominant murmur profile was systolic, low intensity (grade I), soft in quality, located along the left sternal border (particularly its lower region), and without radiation. This pattern is consistent with characteristics of innocent murmurs described in the literature[18,24,25], and was much more prevalent among children without heart disease. Sumski et al.[21] (2020) highlighted key characteristics of innocent murmurs, such as: being more audible in hyperdynamic states, systolic or continuous in timing (never isolated in diastole), short duration, low intensity, absence of thrills or extra sounds (clicks, snaps), localization to a small and well-defined area, absence of altered heart sounds, and normal complementary exams. However, the presence of a pathological murmur must always be ruled out, as diagnosis based solely on auscultatory characteristics can be challenging and depends on adequate training and examiner experience[21].

Regarding complementary investigation, the most frequently requested examinations were echocardiography, electrocardiography, and chest X-ray. Previous studies indicate these as essential tests when clinical suspicion is present[18,25,26], but emphasize that ordering these tests should be prudent, to avoid iatrogenic harm and unnecessary costs to the health

Table 3. Characteristics of heart murmurs identified during cardiology consultations among cases referred for prior abnormal cardiac auscultation in a pediatric referral hospital, Florianópolis, 2018–2022.

Characteristics of a heart murmur	Murmur identified (n = 97)		Heart disease? (%)	
	n	%	No (n = 72)	Yes (n = 25)
Location in the cardiac cycle				
Systolic	91	93,8	100	76
Systolic-diastolic	1	1	0	4
Continuous	3	3,1	0	12
Ignored	2	2,1	0	8
Intensity*				
I	33	34	36,1	28
I and II	18	18,6	16,6	24
II	18	18,6	18	19,9
II and III	3	3,1	1,3	7,9
III	14	14,4	13,8	16
Ignored	11	11,3	14	4,1
Topography				
Located in BEE†	78	80,4	80,6	80
Located in BEEM‡	11	14,1	11,1	12
Located in BEEB§	29	37,2	31,9	24
Located in BEEA‖	14	17,9	8,3	32
Undetermined	24	30,8	32	7,2
Located in BED¶	8	8,2	8,3	8
Ignored	19	19,6	11,1	12
Irradiation				
Present	7	7,2	1,4	24
To the right	2	33,4	0	8
Up	1	16,6	0	4
For other listening areas	3	50	1,4	7,9
Absent or Ignored	91	93,8	98,6	76
Change with decubitus§				
Present	6	6,2	7,2	3,6
Absent or Ignored	91	93,8	92,8	96,4
Timbre				
Gentle**	47	48,4	57,9	25
Rude	4	4,1	2,9	14,3
Ignored	46	47,5	39,2	60,7

Source: Prepared by the authors (2024).

Note:* Intensity standardized according to the Levine classification13, which grades intensity from I to VI; † LSB = Left sternal border; ‡ Mid-LSB = Mid left sternal border; § Lower-LSB = Lower left sternal border; || Upper-LSB = Upper left sternal border; ¶ RSB = Right sternal border; ** Includes murmurs described as soft, musical, vibratory, faint, and subtle.

Table 4. List of complementary diagnostic tests requested during cardiology consultations among cases referred for prior identification of heart murmur in a pediatric referral hospital, Florianópolis, 2018–2022

Additional tests	Sample (n = 142)	Frequency (%)
Electrocardiogram	**75**	**52,8**
Within normal range for age.	41	28,9
Outside the norm for his age.	18	12,7
DCRD*	12	8,4
Report not recorded in the medical file.	16	11,3
Chest X-ray	38	26,8
Within normal range for age.	24	16,9
Out^{s}ide the norm for his age.	14	9,8
Increased cardiac area	5	3,5
Report not recorded in the medical file.	**10**	**7**
Echocardiogram	101	71,1
Within normal range for age.	37	26
Outside the norm for his age.	40	28,1
Valvular pulmonary stenosis	10	7
Interatrial communication	11	7,7
Ventricular septal defect	7	4,9
Patent ductus arteriosus	7	4,9
Patent foramen ovale	6	4,2
Aortic stenosis	3	2,1
Tricuspid regurgitation	4	2,8
Cardiac mass†	2	1,4
Coarctation of the aorta	2	1,4
Systemic-pulmonary fistula	2	1,4
Mitral regurgitation	2	1,4
Report not recorded in the medical file.	24	16,9

Source: Prepared by the authors (2024).
Note:* RBBB = Right bundle branch conduction disorder; † Compatible with rhabdomyoma.

system[1,27]. Although the definition of an innocent murmur includes normal results in these tests, the literature does not support their routine request during initial evaluation, instead emphasizing individualized clinical assessment[21,28]. Amaral et al.[17] (1995) demonstrated that, when comparing initial clinical diagnosis (without tests) with final diagnosis (with tests), in children referred for murmurs, the diagnostic error rate was below 10%, reinforcing the value of clinical examination.

In this study, after cardiology evaluation, the clinical assessment of benignity was predominant: innocent murmurs accounted for 50.7% of cases, and normal cardiological examinations accounted for 9.1%, resulting in a total of 59.8%. Previous studies estimate that innocent murmurs occur in 50–60% of the pediatric population[3,29], consistent with our findings. Among children with cardiac abnormalities, the most frequent diagnoses were atrial septal defect, patent foramen ovale, pulmonary valve stenosis, ventricular septal defect, and patent ductus arteriosus—similar to patterns observed in previous literature[25,30].

Regarding management, 94.4% did not require treatment, and 62% were discharged from cardiology follow-up. As most of the sample had benign or innocent findings, studies indicate that continued follow-up and additional complementary tests are unnecessary and that discharge from specialized care is recommended to avoid iatrogenesis, family anxiety, and excessive burden on the system[1,25].

This study presents limitations inherent to its observational and retrospective design, using secondary data from medical records documented in routine clinical practice rather than collected specifically for research purposes.

In conclusion, the profile of patients most frequently referred for evaluation of heart murmurs at a reference pediatric hospital comprised male infants with murmurs initially identified by pediatricians. After specialized assessment, most cases were found to be non-pathological and required no therapeutic management, consistent with previous literature.

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