

Prevalence and associated clinical features of cardiac murmurs among primary school children in Calabar, Nigeria

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Key words: murmur, cardiac symptoms, school health.

Contributions: all the authors made a substantive intellectual contribution. All the authors have read and approved the final version of the manuscript and agreed to be held accountable for all aspects of the work.

Conflict of interest: the authors declare no potential conflict of interest.

Funding: none.

Ethics approval and consent to participate: ethical approvals were obtained from the University of Calabar Teaching Hospital and Cross River State Health Research Ethics Committees. Permissions were obtained from the Cross River State Universal Basic Education Board, as well as the authorities of the participating schools.

Informed consent: written informed consent was obtained from legally authorized representatives for anonymized patient information to be published in this article.

Patient's consent for publication: legally authorized representatives gave their written consent to use the patients' personal data for the publication of this case report and any accompanying images.

Availability of data and materials: all data generated or analyzed during this study are included in this published article.

Received: 28 March 2025.

Accepted: 12 May 2025.

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Annals of Clinical and Biomedical Research 2025; 5:529

doi:10.4081/acbr.2025.529

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Abstract

Auscultation for Cardiac Murmurs (CM) is a cost-effective means of diagnosing cardiac disease. This study was aimed at determining the prevalence of CM and its associated clinical features among primary school children aged 5-12 years in Calabar.

This was a descriptive cross-sectional study. The subjects were 450 pupils, selected using multistage sampling methods from 32 primary schools in Calabar municipal area council of Cross River State, Nigeria. Participants socio-demographics were obtained. Weight and height were taken and Body Mass Index (BMI) calculated. Cardiovascular examination with CM grading were done. Pack Cell Volume (PCV) was measured for children with cardiac murmur. Data were analysed using the Statistical Package for Social Sciences (SPSS) version 27 with p-value <0.05 as significance. Thirty-one of the pupils had CM giving a prevalence of 6.9%. Males, low socioeconomic group, and low BMI were significantly associated with the presence of a cardiac murmur with male sex as an independent predictor of CM. Cough and pallor were the commonest symptom and sign respectively seen in children with CM. Majority of CM were of grade 1 and 2, early systolic and located on the left lower sternal border. The prevalence of CM was high with male sex been an independent predictor. The commonest symptom and sign seen in children with CM were cough and pallor respectively. It is recommended that routine screening for cardiac murmurs be done among school pupils.

Introduction

The presence of a cardiac murmur is a common reason for referral for cardiology care amongst children.¹ Cardiac murmurs may be innocent or pathological. The prevalence of innocent murmurs in children ranges from 5 to 80%,^{1,2} while pathological murmurs from 0.34 to 47% globally.^{3,4} In Nigeria, studies among school children have prevalence between 0.34% to 1.8%.^{3,5} Other works done⁶⁻¹⁰ on the prevalence of cardiac disease in the paediatric age group in Nigeria focused on hospital-based populations and patients with known diagnosis while the general population has been largely under assessed.

The diagnosis of cardiac disease includes thorough history taking to detect symptoms and physical examination for signs. Auscultation for heart murmurs forms part of the physical examination and remains a cost-effective means of detecting cardiac disease on the field and in clinical practice.^{1,8} The use of auscultation method in detecting cardiac murmur has sensitivity ranges from 64 to 94% and specificity of 95 to 100%.¹¹ Children with undiagnosed heart disease may remain undetected into adolescence and adulthood.¹² The school age period presents an opportunity for children

to be screened using history, physical examination including auscultation for heart murmurs and pulse oximetry. Thereafter, cases of murmur should undergo echocardiography to determine their clinical significance.

This study was aimed at determining the prevalence and associated clinical features of cardiac murmurs among primary school children aged 5-12 years in Calabar and their sociodemographic characteristics.

Materials and Methods

This was a descriptive cross-sectional study of primary school children aged 5 to 12 years carried out in Calabar Municipal Area Council of Cross River state, Nigeria. The minimum sample size was calculated using the formula¹³ $n = Z^2pq/d^2$. Where n = desired sample size (when population >10,000), Z = the standard normal deviation (usually set at 1.96), p = the proportion in the population with attribute to previous study (50%) due to lack of similar study among primary schools in the area. $q = 1.0 - P = 1.0 - 0.50 = 0.5$, d = degree of accuracy desired (0.05).

The minimum sample size was 384, but with addition of 20% probability of non-response it amounted to 461. However, 450 participants were finally enrolled in the study.

Stratified random sampling based on ownership of the schools into public and private was first used to select the subjects. There were 80 private schools and 24 public schools (ratio 3:1), giving a total of 104 primary schools in the area. A total of 8 public schools and 24 private schools were selected using simple random sampling. The number of participants recruited from each selected school was done by proportionate allocation based on a sampling frame. Each of the selected schools was stratified based on classes and subjects proportionately allocated for the classes. Thereafter, simple random sampling method was used to select the required number of pupils per class in a given school using the class register. Ethical approvals were obtained from the University of Calabar Teaching Hospital and Cross River State Health Research Ethics Committees. Permissions were obtained from the Cross River State Universal Basic Education Board, as well as the authorities of the participating schools. In addition, parents gave consents.

The 450 subjects recruited met the inclusion criteria which include: apparently healthy primary school children aged 5 to 12 years, children whose parents/guardians gave consent and those from 7 to 12 years gave assent while children with known heart disease on treatment and those that have undergone cardiac surgeries were excluded. Pretested semi-structured questionnaires were used to note socio-demographic characteristics and cardiovascular symptoms. Weight and height were taken and body mass index (BMI) calculated. Cardiovascular examination was done by a paediatrician who ensured that the murmurs were correctly identified and characterised. PCV was measured for children with cardiac murmur. Children with cardiac murmurs were referred to the Paediatric Cardiology Unit, University of Calabar Teaching Hospital, Calabar for echocardiography and follow up. Data was analysed using SPSS version 27. Descriptive statistics such as frequencies, percentages and bar charts were computed. Inferential statistics such as Chi-square test, Fisher's exact test and binary logistic regression of independent predictors were computed. All analysis were done at a 95% level of significance with $p < 0.05$ as significance.

Results

Prevalence of cardiac murmurs among study population

Thirty-one of the primary school children presented with a cardiac murmur giving a prevalence of 6.9% (Figure 1).

Clinical presentations (symptoms and signs) of the study participants

Symptoms

The total number of children with symptoms was 18 (4%). The most common symptoms reported by parents was cough (3.1%), fast breathing (3%), and easy fatiguability (2.4%) in the general population. No parent reported cyanosis or squatting in their child. Two children (0.4%) with cardiac murmurs had a history of sore throat. Seven children (1.6%) with cardiac murmurs reported cardiac related symptoms of cough, chest pain, and fast breathing (Figure 2).

Clinical signs

The most common sign was pallor in 30 (6.7%), followed by tachycardia 13(2.9%), fever 10 (2.2%), tachypnoea 8(1.8%) and the least was hepatomegaly 3(0.7%). Amongst the children with cardiac murmurs, 3 had pallor (9.7%), 2(6.5%) had jaundice while 1(3.2%) had hepatomegaly (Figures 3 and 4).

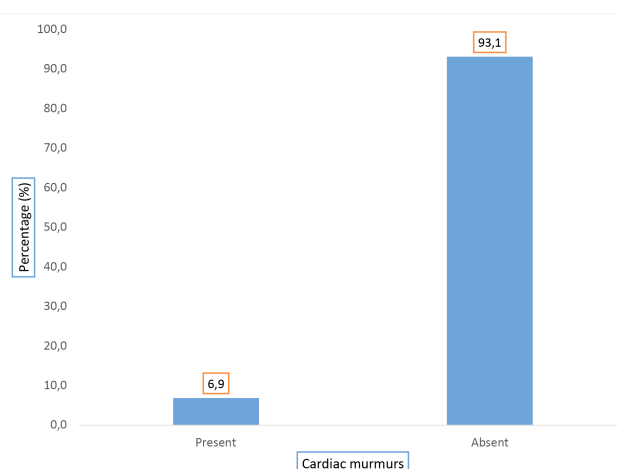


Figure 1. Prevalence of cardiac murmurs among 450 pupils.

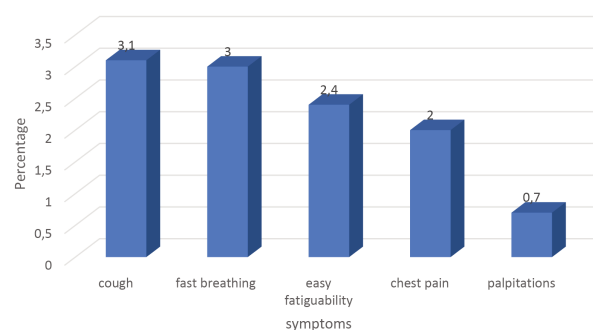


Figure 2. Frequency of cardiac related symptoms in primary school children.

Discussion

The prevalence of cardiac murmur (CM) in this study was 6.9% (Tables 1-3). This is similar to 6% seen in Lahore, Pakistan,¹⁴ but a little higher than 4% and 3.9% seen in Turkey^{15,16} and 2.7% in China.² It is however much higher than previous studies in Nigeria of 0.34%, 0.68% and 0.7% in Benin, Port-Harcourt (South-South) and Jos (North Central) respectively.^{3,5,6} Adequate steps were taken to ensure quality control in this study as pupils were examined in near optimal conditions. The stethoscope used in this study was a Lithmann paediatric stethoscope and all subjects who had further investigations were re-examined. The reason for the high prevalence rate of cardiac murmurs in this study could not be fully explained, it may be due to the community-based nature of the study which would revile the true prevalence of the condition in the community unlike hospital-based study. However, differences in cardiac murmur prevalence can exist in the same country within different geographical regions over time. For instance, in India, Periwal *et al.*,¹⁷ Jose and Gomathi¹⁸ and Kumari *et al.*¹⁹ reported 1.83%, 1.63% and 0.59%. respectively. Periodic multicentre studies are needed to further evaluate regional country differences. The increase in prevalence of murmur with increasing age in this study reflected the number of participants recruited per age

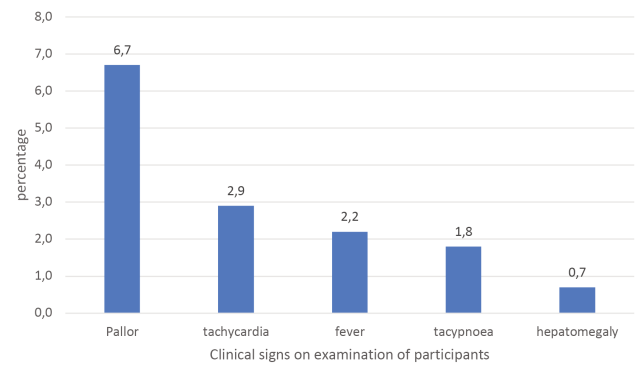


Figure 3. Clinical signs among study participants.

Table 1. Location of the cardiac murmurs (n=31).

Location	Frequency	Percentage
Apex	7	22.6
Left lower sternal border	16	51.6
Upper left sternal border	8	25.8
Total	31	100.0

Table 2. Relationship between cardiac murmurs and age, sex, nutritional status and socioeconomic class (n=450).

Variable	Present n=31	Cardiac murmurs Absent n=419	Total n=450	Test statistic	p
Age group/years					
5-7	8 (9.0)	81 (91.0)	89 (100.0)	FET 3.612	0.304
8-9	10 (6.6)	142 (93.4)	152 (100.0)		
9-10	13 (7.6)	159 (92.4)	172 (100.0)		
11-12	0 (0.0)	37 (100.0)	37 (100.0)		
Sex					
Male	20 (9.4)	193 (90.6)	213 (100.0)	χ^2 3.943	0.047*
Female	11 (4.6)	226 (95.4)	237 (100.0)		
Socioeconomic class					
High	10 (6.3)	149 (93.7)	159 (100.0)	χ^2 12.574	0.002*
Middle	7 (3.6)	189 (96.4)	196 (100.0)		
Lower	14 (14.7)	81 (85.3)	95 (100.0)		
BMI category					
Underweight	7 (13.7)	44 (86.3)	51 (100.0)	FET 9.713	0.009*
Normal	12 (4.4)	262 (95.6)	274 (100.0)		
Overweight	8 (13.1)	53 (86.9)	61 (100.0)		
Obese	4 (6.3)	60 (93.7)	64 (100.0)		

*Statistically significant. ² chi square; (%) = percentage of total in category. FET, Fisher's Exact Test; BMI, Body Mass Index.

Table 3. Binary logistic regression of independent predictors of cardiac murmurs among primary school children.

Variable	Reference category	Odds Ratio (OR)	95% Confidence Interval	p
Sex				
Male				
Female		1.929	0.872-4.267	0.105
Socioeconomic class				
Upper				
Middle		0.926	0.703-5.276	0.202
Lower		0.468	0.185-1.181	0.108
BMI				
Normal BMI				
Underweight		0.811	0.323-9.633	0.060
Overweight		0.372	0.372-3.365	0.842
Obese		0.644	0.194-2.142	0.473

OR>1 increased likelihood of event. OR, Odds Ratio; BMI, Body Mass Index.

group category. It was not surprising that the age group 11-12 years consisting of only 8.2% of the population had no recorded case of cardiac murmurs. It may further explain why following logistic regression, age was not found to be an independent predictor of cardiac murmurs. In addition, as much as 90% of children with untreated Congenital Heart Disease (CHD) die by adolescence especially in a country like Nigeria where definitive treatment is limited.^{10,20} The incidence of CHD is reducing with increasing age of the child and acquired heart disease increasing with age may also account for this observation.²¹

More males than females had cardiac murmurs in this study. Statistically, the odds of a male child having a CM were 1.9 times more than that of a female child. Male was an independent predictor of CM. Although the reason for this is unclear, it is in keeping with a previous work done a decade ago in Calabar showing male preponderance of cardiac disease.¹⁰

Children of lower socioeconomic background were more likely to have cardiac murmurs in this study. This is in agreement with findings by researchers in Thailand,²² Pakistan¹⁴ and India¹⁷ who had previously noted that such children had higher murmur prevalence. Murmurs in lower socioeconomic class children could be due to poverty and overcrowding as a risk factor for higher AHD from RHD.¹⁷ However, following logistic regression of the influence of socioeconomic class on the presence of cardiac murmurs, it was found that this parameter did not exert an independent influence on the presence of cardiac murmurs in this study.

The relationship between BMI categories and cardiac murmur was statistically significant ($p=0.009$). Most of the children with CM were in the underweight category (13.1%) followed by overweight (13.1%). This is supported by previous finding that underweight children had more murmurs due to thinner chest wall.¹ However, binary logistic regression of the abnormal BMI categories (underweight, overweight and obese) were not independent predictor of the presence of a cardiac murmur.

Parents reported cardiac related symptoms in 18(4%) of the children. This is higher than 0.4% reported by Ujuanbi *et al.*⁶ in Port-Harcourt. In this study, further history was elicited from the children before examination and corroborated with parents on the phone and this may account for the difference observed. Although cough, fast breathing, chest pain and easy fatigability were the commonest in the general population, cough was the commonest symptom seen in children with cardiac murmurs. Children with pallor constituted 6.7% of the population in this study compared to 0.68% seen by Sadoh *et al.*³ in Benin in a school-based study for

RHD. The limitation of this finding is that only the children with murmurs had PCV done and as such, may not be conclusive. This may be a pointer to the general nutritional level in the study locality with 11.3% of the study population having BMI less than the 5th centile classified as underweight. Tachycardia was seen in 2.9% of the children examined. No child with murmur was febrile or had tachycardia when examined in school.

Majority of the murmurs (83.9%) were grade 1 and 2, early systolic (61.3%) and located at the left lower sternal border (51.6%). These types of murmurs may be mainly innocent murmurs which are due to turbulence of blood flow within the vasculature²³ and are in keeping with a study done in China, where 97.4% of the murmurs of same grade were innocent.²⁴ Innocent murmurs are mainly grade 2 or lower, short in duration, single, systolic, small, limited to small area and non-radiating over a large area.^{2,25}

In conclusion, the prevalence of CM was high in this study. Male sex was an independent predictor of CM. Low socioeconomic status and low BMI were associated with cardiac murmurs. Cough and pallor were the commonest symptom and sign respectively seen in children with CM. Majority of the CM were grades 1 and 2, early systolic and located at the left lower sternal border. It is recommended that routine screening for CM be done among school pupils.

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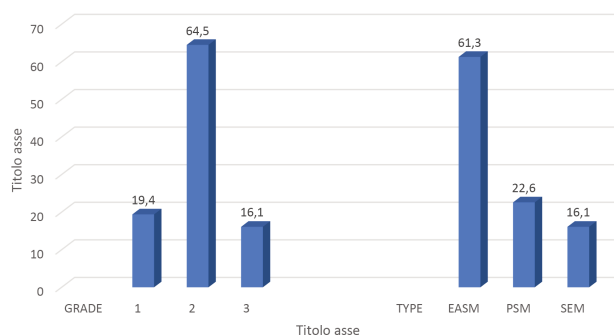


Figure 4. Grade and type of murmurs (n=31). EASM, Early Systolic Murmur; PSM, Pan Systolic Murmur; SEM, Systolic Ejection Murmur

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