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Research Article

Prevalence of congenital heart diseases among primary school children in the Niger Delta Region of Nigeria, West Africa

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Abstract

Introduction: Congenital heart diseases (CHD) are leading causes of childhood morbidity and mortality especially in developing countries. Community-based studies are important in ascertaining the burden of the disease.

Objectives: The study was set out to determine the prevalence and types of CHD among primary school children in Port Harcourt Local Government Area (PHALGA) of Rivers State, Niger Delta, Nigeria.

Methods: A total of 1,712 primary school pupils were selected by multistage sampling from twelve schools in PHALGA. A questionnaire was used to obtain information from pupil's parents on their child's biodata and symptoms suggestive of heart disease. General physical and cardiovascular system examinations were carried out on each selected pupil, following which those with symptoms and/or signs suggestive of heart disease had echocardiographic confirmation of their cardiac status.

Results: The 1,712 subjects were aged 5-14 (mean 8.48 ± 2.30) years. 874 (51.1%) were females while males were 838 (48.9%). The study revealed that 31 pupils had congenital heart diseases confirmed by echocardiography, giving a prevalence of 18.1 per 1,000 pupils. The commonest cardiac defects seen were acyanotic CHD in 30 (96.8%) pupils while cyanotic CHD was seen in only one (3.2%) pupil. Among the acyanotic CHD, atrial septal defects (83.9%) followed by ventricular septal defects (9.7%) were the commonest. CHD occurred with higher frequency among females (64.5%) and among the younger age group of 5-9 years (61.3%) though these were not statistically significant ($p > 0.005$).

Conclusion: Cardiac examination as part of compulsory health screening at primary school entry will help detect children with CHD, reduce delay in diagnosis for intervention, avert debilitating morbidity and assure a better quality of life.

More Information

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Introduction

Congenital heart diseases (CHD) are of public health concern worldwide as they contribute significantly to childhood morbidity and mortality [1,2]. This is particularly so in developing countries, especially in sub-Saharan Africa, where non-communicable diseases in the paediatric age group are emerging major health and socioeconomic issues but facilities for early diagnosis and management are often lacking [2-6]. Congenital heart diseases (CHD) account for 8-12 / 1000 live births and approximately 30% to 40% of all congenital defects worldwide, occurring either in isolation or as part of other syndromic anomalies [7-9].

Children with CHD, especially those with critical lesions, usually present early in neonatal period, infancy and early childhood with increasing severity of their morbid state that often result in early mortality without intervention [2]. Some children with less severe lesions may survive beyond early childhood into adolescence and even adulthood, albeit with increasing morbidity and functional incapacity that result in poor quality of life and psychosocial drain for the affected

individuals and also constitute appreciable financial burden on the family and community [2,10].

Children with CHD, whose diagnosis were missed in early childhood, could be found in schools and may be symptomatic with fast breathing, cough and effort intolerance [11,12]. Others with less critical lesion may be asymptomatic but have a cardiac murmur detected during routine examination [13,14]. A heightened awareness of CHD and its presentation beyond early infancy or childhood may help detect these children within the context of the school health programme and bring their attention to a paediatric cardiologist to mitigate the development of fatal complications.

Population-based studies on congenital heart diseases in Nigeria are scarce. Existing studies on CHD are mostly hospital-based and retrospective and thus may not be representative of the true burden of the disease. The only Nigerian study which has reported the prevalence of CHD among school children is that by Yilgwan, et al. [15], in Jos, Plateau State, where CHD prevalence was found to be 0.72%. Congenital heart disease has been demonstrated to be a major cause of sudden death in school children, especially where routine screening is not the norm [16].

We therefore set out to determine the prevalence and types of CHD among primary school children in Port Harcourt Local Government Area (PHALGA) of Rivers State, in the Niger Delta region of Nigeria. The findings of this study may suggest the need to incorporate cardiac screening examination into school entry medical examination under the existing School Health Programme in the country and within the West African sub-region as a means of early detection of lesions with potential of impacting negatively on the health and by extension the school performance of children.

Subjects and Methods

This cross-sectional survey was carried out among school children aged 5-14 years in Port Harcourt Local Government Area of Rivers State, from September to December, 2014. The local government is one of the 23 local government areas of Rivers State. Rivers State is located in the Niger Delta region of Nigeria, West Africa which harbours many oil exploitation and exploration activities. Port Harcourt Local Government Area has three main school districts: Township, Trans Amadi and Diobu with a total of 133 schools (37 public and 96 private schools) and an estimated total school enrolment of 55, 277. The schools were selected proportionately by multistage sampling. The primary schools were first stratified into the school districts and then into public and private schools. Thereafter, simple random sampling technique was used to select a total of 12 primary schools consisting of 4 schools each from each of the school districts. A list of all the primary schools in PHALGA obtained from Rivers State Ministry of Education formed the sampling frame used to recruit subjects into the study. A sample size of 1,712 was used for the study based on a conservative estimate of 50% and a chosen error margin of 0.025. Based on the sample size of 1,712 and 12 selected schools, an average of 142 pupils were recruited from each school selected with an average of 24 pupils per arm selected by simple random sampling from a comprehensive list of all pupils using table of random numbers.

Inclusion criteria included pupils in primary 1-6 in selected schools whose parents/guardian gave consent for the study while pupils whose parents did not give consent and who had acquired heart disease were excluded.

Ethical considerations

Ethical clearance for the study was obtained from the Research and Ethics Committee of the University of Port Harcourt Teaching Hospital. Notification and permission to carry out the study was also obtained from Rivers State Ethical Committee, as well as from Rivers State Ministry of Education. Thereafter, notification and permission for the study was obtained from all head teachers of the selected schools. The investigators also attended one scheduled Parent Teacher Association (PTA) meeting in the selected schools to educate and enlighten parents about CHD and the need for their consent. Subsequently, a written informed consent was obtained from parents/guardians of selected pupils.

Clinical assessment

A pre-tested self-administered questionnaire was used to obtain information from subjects' parents/guardians on their ward's biodata, relevant medical history including symptoms suggestive of heart disease if any, past medical and antenatal history.

All selected subjects had detailed general physical and cardiovascular system examination in a quiet room by five paediatric residents and one of the investigators. Any child noted to have cardiac murmur or other findings suggestive of cardiac disease by the research assistants were immediately re-examined by one of the investigators on the field. Subjects with findings suggestive of cardiac disease were then pooled (per school) and taken to the University of Port Harcourt Teaching Hospital (UPTH) by the investigators at a scheduled date and time accompanied by a school representative or parents/guardians where necessary. They had echocardiography done using colour Doppler Macromaxx echocardiography machine (Sonosite, Macromaxx 2005-2008 with 4.7 MHz transducer) at no cost and their cardiac status was further evaluated. All echocardiography were done according to the guidelines of American Society of Echocardiography using the standard subcostal, apical, parasternal long and short axis and suprasternal views [17]. Congenital heart disease was defined as structural abnormality of the heart such as defects in cardiac septation, abnormalities of ventriculo-arterial connections, rudimentary or absent chambers, abnormalities of ventricular inflow and outflow and abnormal vascular connections and structures [7,17].

Data from the study was analyzed using Statistical Package for Social Sciences (SPSS) Software version 20.0. $p < 0.05$ was considered as statistically significant.

Results

General characteristics of the subjects

A total of 1,712 subjects aged 5-14 (mean 8.48 ± 2.30) years participated in the study of which 874 (51.1%) were females while males were 838 (48.9%). Table 1 shows the general characteristics of subjects studied. The females were taller and heavier than their male counterparts. The pulse rate of the females was significantly higher than that of the males. Both sexes were similar with respect to their body mass index, systolic blood pressure, diastolic blood pressure and arterial oxygen saturation.

Symptoms and signs of cardiac disease obtained from the subjects

Among the 1,712 subjects screened, 7 (0.41%) reported symptoms suggestive of cardiac disease while 41 (2.4%) had signs suggestive of cardiac disease. Six (14.6%) out of the 41 pupils with signs also had symptoms. Some subjects had single signs such as irregular pulse, cardiac murmur and precordial bulge while others had multiple signs as shown in table 2. Among the pupils with multiple signs, cardiac murmur and cardiomegaly were the most recurring in 6 (14.6%) pupils.

Table 1: General Characteristics of the 1712 Primary School Children Screened for Congenital Heart Diseases in PHALGA.

Parameter	Male N = (838)	Female N = (874)	Student's t-test	*p* - value
Mean Age ± SD (Years)	8.39 ± 2.4	8.56 ± 2.23	1.6	0.123
Mean Height ± SD (cm)	130.5 ± 12.8	132.2 ± 12.6	2.8	0.005*
Mean Weight ± SD (Kg)	28.0 ± 8.2	29.1 ± 9.3	2.5	0.012*
Mean BMI ± SD (Kg/m^2)	16.2 ± 2.4	16.2 ± 2.8	0.6	0.536
Mean PR ± SD (bpm)	93.4 ± 13.9	96.3 ± 13.1	4.5	0.000*
Mean SBP ± SD (mmHg)	94.4 ± 12.9	95.0 ± 12.8	1.0.	0.319
Mean DBP ± SD (mmHg)	60.1 ± 9.6	50.0 ± 9.6	0.1	0.906
Mean SPO_2 ± SD (%)	97.5 ± 2.4	91.6 ± 2.2	0.9	0.393

SD: Standard Deviation; BMI: Body Mass Index; PR: Pulse Rate; SBP: Systolic Blood Pressure; DBS: Diastolic Blood Pressure; SPO_2: Arterial Oxygen Saturation; *Statistically Significant

Table 2: The Signs of Cardiac Disease seen in the Study Population.

Signs	No. of Pupils N = 41	Percentage (%)
Irregular pulse	13	31.7
Cardiac murmur	12	29.3
Cardiac murmur and Cardiomegaly	6	14.6
Cardiac murmur, Irregular pulse and Cardiomegaly	2	4.9
Cardiac murmur and Irregular pulse	2	4.9
Irregular pulse and Bradycardia	1	2.4
Cardiac murmur, Respiratory distress, Cardiomegaly and Gallop rhythm	1	2.4
Respiratory distress, Cardiomegaly and Gallop rhythm	1	2.4
Cardiac murmur, Cyanosis and Digital clubbing	1	2.4
Cardiomegaly, Precordial bulge Cardiac murmur and Loud P_2	1	2.4
Precordial bulge	1	2.4
Total	41	100

Prevalence and types of congenital heart diseases in the subjects

A total of 42 (2.45%) subjects with symptoms and/or signs of cardiac disease had echocardiography done; following which 31 were confirmed to have congenital heart diseases. This gave a prevalence of CHD of 18.1 per 1,000 pupils. The prevalence of CHD among subjects aged 5-9 years in the study population was 1.1% while that of age group 10-14 years was 0.7%. Among the females in the study population, the prevalence of CHD was 0.70% and 0.47% within the age groups 5-9 years and 10-14 years respectively, while for their male counterparts, the prevalence of CHD was 0.41% and 0.23% in age groups 5-9 years and 10-14 years respectively.

Among the 31 subjects identified with congenital heart diseases, one (3.2%) had cyanotic CHD while the rest 30 (96.8%) were acyanotic CHD. Of those with acyanotic CHD, atrial septal defect was the commonest in 26 (83.9%) subjects, followed by ventricular septal defect in 3 (9.6%) subjects. The only case of cyanotic CHD was Tetralogy of Fallot (TOF) (3.2%) as shown in table 3. The commonest ASD seen was ostium secundum ASD in 25 (80.7%) subjects. All the cases of ASD detected in this study had defects ranging from 3-7mm, while for VSD cases the defects were between 2-3mm. Majority, 16 (61.5%) of the 26 cases of ASD had irregular pulse as a sign. Fifteen (57.70%) of the 26 pupils with atrial septal defects were within age group 5-9 years while the remaining 11 (42.3) were within age group 10-14 years. All the 3 pupils with ventricular septal defects were within age group 5-9 years. Among the children with ASD, 15 (57.7%) were females while 11 (42.3%) were males. All the subjects with VSD were females.

Discussion

The prevalence of CHD among school children varies considerably from region to region. These variations depend partly on the methodology used. In the present study, the prevalence of CHD among primary school children aged 5 to 14 years diagnosed by clinical examination and then echocardiographic confirmation was found to be high at 18.1

Table 3: Types of Congenital Heart Diseases.

Types of CHD	Number	Percentage (%)
Acyanotic CHD		
ASD		
Secundum (4-7 mm)	25	80.7
Primum (3 mm)	1	3.2
VSD		
Perimembranous (2 mm)	1	3.2
Muscular (3 mm)	1	3.2
Subaortic (2 mm)	1	3.2
Pulmonary Stenosis (PS)	1	3.2
Cyanotic CHD		
TOF	1	3.2
Total	31	100.0

ASD: Atrial Septal Defect; VSD: Ventricular Septal Defect; PS: Pulmonary Stenosis; TOF: Tetralogy of Fallot

per 1,000. This is in contrasts to the prevalence of 1.01 per 1,000 children reported in Egypt by Bassili, et al. [14], among school children. This is probably because in this present study, all the children screened who had clinical findings suggestive of heart disease had confirmatory echocardiography unlike Bassili, et al. [14], who studied children who only had access to echocardiography for confirmation and characterization of their cardiac defects through their School Health Insurance System. The prevalence of CHD reported in this study is also higher than the prevalence of 3.9 per 1,000 children observed by McLaren, et al. [18], in South Africa in a similar study. The variation in the prevalence reported could be due to the fact McLaren et al used only cardiac auscultation as screening tool while in this study both cardiac auscultation and echocardiography were used which would have enhanced detection rate of CHD.

Acyanotic congenital heart diseases were found to be more prevalent in this study representing 96.8% of all cases of CHD seen in the study population. Jarun, et al. [13], in Thailand and Saddiq, et al. [12], in Sudan found a similar trend among school children. In Nigeria, Yigwan, et al. [15], also reported acyanotic CHD as the commonest CHD among school children. This is probably because most children with cyanotic CHD tend to have more critical lesions with higher morbid state that result in early infant death without intervention. It is also remotely possible that some children with cyanotic CHD might have had early repair of their cardiac defects since attention might have been drawn to them much earlier by health professionals because of cyanosis and surgical intervention sought earlier if they can afford.

Atrial septal defect was the commonest (83.9%) acyanotic CHD seen in subjects in this study which is consistent with the findings of Chen, et al. [19] in Tibet and Bahadur, et al. [20], in Nepal among school children. Twenty-five of the twenty-six cases of ASD found in this study were asymptomatic, and in keeping with the findings of Muta, et al. [21], in a school study where most children with ASD were found to be asymptomatic and may not be detected until late childhood and beyond or during routine clinical examination. ASD, if undetected, may ultimately result in pulmonary hypertension and various forms of arrhythmias and increase in morbidity [22,23].

Ventricular septal defect was the second commonest acyanotic CHD in this survey and accounted for 9.6% (3 cases). All the children diagnosed with VSD in this study had small defects (< 5 mm), possibly explaining why they may have been missed in infancy since small VSDs may be asymptomatic. Cases of undetected VSD as identified in this study have a higher potential for development of complications such as infective endocarditis and congestive cardiac failure which can cause severe morbidity and death [24,25]. This further underscores the need for school screening medical examination to identify such children for intervention.

The only case of cyanotic CHD seen in the study population was Tetralogy of Fallot, accounting for 3.2%. This is comparable to a school-based study in Sudan by Saddiq, et al. [12], where TOF was the cyanotic CHD detected. On the contrary, Mukul, et al. [11] in India, observed no case of cyanotic CHD in their survey of school children. This is not surprising as children with cyanotic CHD tend to die early without intervention and also possibly because such children may be too sick to attend schools and might have dropped out of school.

Most cases of CHD (61.3%) in this survey were seen in the younger age group 5-9 years; and occurrence of CHD was less prevalent with increasing age. This is in agreement with report by Bassili, et al. [14], where majority of cases of CHD found were in children aged 5-10 years with a decline of CHD in children older than 10 years. The declining prevalence of CHD with increasing age is not surprising as most children with small VSD would have had spontaneous closure of their defects or those with more severe lesions would have died in early infancy or childhood without intervention. Those that survive with minor lesions and are asymptomatic may benefit from cardiac screening programme such as this one.

Majority of children (90.3%) with CHD in this survey were asymptomatic. For those that reported symptoms, easy fatigability was the commonest symptom reported. This is probably because, children identified with CHD in this study had minor lesions and easy fatigability is associated with increased systemic pressure as the children gets older. The most common signs identified in this study were irregular pulse and cardiac murmur. Cardiomegaly, left parasternal heave, loud P_2, digital clubbing, respiratory distress and central cyanosis are other signs elicited in pupils in this study. These findings are very important as observation of these cardiovascular signs during school entry medical examination or other health consultation should alert the doctor to the possibility of CHD in the child and expedite referral to a paediatric cardiologist for echocardiography and intervention where necessary. Furthermore, rhythm disorders could predispose to sudden cardiac events especially in children with asymptomatic congenital heart defects like the ones identified in the course of the present study.

The awareness rate of CHD among the parents/caregivers of pupils was found to be low. Only one child's caregiver was aware of her child's cardiac defect. This agrees with low awareness rates of CHD reported by Mukul, et al. [11], McLaren, et al. [18] and Marijon, et al. [26], among school children with CHD. This may be because majority of the children identified with CHD in this study were asymptomatic and did not show any sign of ill health, and as such attention was not drawn to their condition and in the absence of routine medical examination, remained unidentified. This may explain why many parents/caregivers of children with heart diseases seek qualified medical help only during emergencies. These reasons further highlight the need for health education on CHD among health workers, parents, teachers and other caregivers so that attention can be drawn to the condition early, for early intervention.

Despite the high prevalence of CHD reported among school children in this study, it is possible that some children with significant long-standing or severe CHD might have been missed since only pupils who were present in school were sampled. These sick children would have high absenteeism and school dropout rates.

Conclusion

This study underscores the need for cardiac examination as an integral part of school entry medical examination in the context of the School Health Programme (SPH); since the presence of some signs such as cardiac murmur, irregular pulse or both can suggest the presence of an underlying CHD for intervention as demonstrated in this study. This would help in mitigating the chronic morbidity and comparatively early mortality faced by these children.

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