Original Article

Pattern and Outcome of Heart Failure amongst Children Admitted in an Emergency Pediatric Unit of a Tertiary Hospital in Sokoto State, North-Western Nigeria

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Abstract

Context: Heart failure (HF) is a major cause of mortality in the emergency pediatric unit (EPU). It is the usual presentation of many structural cardiac and non cardiac diseases. An audit of the causes of heart failure is necessary to ensure adequate management and prevention. **Aim:** We describe the pattern and outcome of children with HF admitted to an EPU of a tertiary hospital in Sokoto. **Materials and Methods:** This was a cross-sectional study conducted in the EPU over 24 months (May 2019 to April 2021). Children aged 1 month to 15 years admitted with heart failure were recruited consecutively. The demographic characteristics, cause of heart failure, and outcome were entered into a proforma. Data were analyzed using IBM SPSS version 25. **Results:** One hundred and fifty-five out of 7158 children (2.2%) had HF. Majority of these 103 (66.5%) were aged 1 month to 5 years. The age range was 1–180 months with a mean of 55.4 (±53.7) months and a median of 36 (IQR: 86 months). Males accounted for 84 (54.2%) with a ratio of 1.18:1. The commonest causes of heart failure were congenital heart disease (CHD) 40: 25.8%; severe anemia 34: 21.9%; bronchopneumonia 30: 19.4%; rheumatic heart disease (RHD) 18: 11.6%; and dilated cardiomyopathy 16: 10.3%. There were 45(29.0%) deaths, of which CHD, RHD and severe anaemia accounted for the highest mortality. **Conclusion:** Structural heart diseases like CHD and RHD, in addition to severe anemia and bronchopneumonia, are significant causes of heart failure and mortality in this environment. A holistic approach to prevention is necessary to reduce the burden.

Keywords: Heart failure, pattern, outcome, children, EPU, Sokoto

Introduction

Heart failure is a condition in which the heart cannot deliver adequate cardiac output to meet the metabolic demands of the body either at rest or during stress. There is also an inability of the heart to adequately dispose of the systemic and pulmonary venous return resulting in congestion of one or both venous systems.[1,2] Various compensatory mechanisms are activated by the body in response to a failing heart but may become ineffective after a while resulting in severe clinical manifestations of heart failure. A working definition of heart failure is a progressive clinical and pathophysiological syndrome caused by cardiac or noncardiac abnormalities that result in characteristic signs and symptoms including edema, respiratory distress, growth failure, exercise intolerance, and accompanied by circulatory, neurohormonal, and molecular derangements.[3]

Heart failure is a major cause of mortality, morbidity, and health-care expenditure in children. Due to the diversity of causes of heart failure and lack of standard classifications, it has been difficult to give accurate estimates of incidence, prevalence, and outcomes of heart failure in children. In the United States, it is estimated that 11,000–14,000 children are hospitalized yearly,[4] while in Europe admission rates for heart failure range between 10.4% and 34% per year.[5,6] Studies

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in Nigeria mainly from north-central and southern regions reported on the prevalence of cases seen in the emergency room as ranging between 2.7% and 16.7%.[7-11] The causes vary from cardiac to noncardiac etiologies. While cardiomyopathies were initially more prevalent in the United States, congenital heart disease (CHD) from more recent data is becoming more common there due to the survival of cases of complex CHDs with palliated surgeries.[12] In Nigeria, previous studies[7-10] have shown that preventable childhood illnesses like acute lower respiratory tract infections and severe anemia account for the top two causes of heart failure in the emergency unit amongst children; however more recently with increased availability of echocardiographic services, structural heart diseases especially CHDs presenting with bronchopneumonia in infancy are becoming more frequently recognized.[13]

It is important to study the prevalence of heart failure in Sokoto, North-Western Nigeria, where such data have not been reported before to ascertain the prevailing causes, pattern, and outcome of heart failure in children for appropriate preventive measures to be put in place where possible.

Methods

Study area

The study was carried out at the emergency pediatric unit (EPU) of Usmanu Danfodiyo University Teaching Hospital, which is a tertiary health facility located in Sokoto, the Sokoto State capital. The hospital serves as a referral center for the people of the States of Sokoto, Zamfara, and Kebbi, and the neighboring countries of Niger and Benin Republics in the sub-region.[14] The emergency pediatric unit comprises a 20-bed unit for the admission and care of critical cases who are later transferred to the pediatric medical ward within or after 24 h as they stabilize.

Study design

This was a cross-sectional study conducted over 2 years (May 2019 to April 2021).

Study population

Study population comprised children aged 1 month to 15 years admitted into the EPU with features of HF.

Inclusion criteria

Children who presented with the criteria for diagnosing heart failure were selected. Any child with tender hepatomegaly occurring with significant tachycardia by age thresholds (>160 beats per minute [bpm] in infants, >150 bpm in children aged 1–2 years, >140 bpm in children aged >2–4 years, >120 bpm in children aged >4–6 years, and > 100 bpm in children aged >6 years) and significant tachypnea by age thresholds (>60 breaths per minute in infants <2 months, >50 breaths per minute in infants aged 2 months to 12 months, >40 bpm in children aged >1 year, or presence of clinical cardiomegaly which is displaced apex beat in the presence of a normally located trachea or cardiothoracic ratio on X-ray of >55% in those <5 years and >50% in those aged 5 years and above) was considered to have HF.[8]

Exclusion criteria

Exclusion criteria comprised children who presented with tender liver but no sign of decompensation.

Care rendered for patients with HF

Patients admitted with HF were nursed in cardiac position or propped up in case of infants. They were placed on bed rest and also on oxygen via nasal prongs after confirming the saturation level by pulse oximetry. Relevant investigations like full blood count, packed cell volume, blood film for malaria parasites, blood glucose, electrolytes, and urea and creatinine level were carried out. The relevant radiological investigations like chest roentgenogram, echocardiography, and electrocardiography were done as soon as possible when the patient was stabilized. They were also commenced on empirical antibiotics, diuretics, and inotropes depending on the cause of heart failure. Packed cell blood was transfused in the presence of severe anemia.

Echocardiographic assessment

For those with suspected structural heart disease, in addition to the clinical diagnosis of heart failure above, the presence of significant heart murmurs, cyanosis, abnormal chest X-rays, and electrocardiography were used to select them for echocardiographic assessment. The transthoracic echocardiography was performed for such patients using Sonoscape SSI 5000 echo machine (Sonoscape Yizhe, China) mounted with a five-PI transducer of 3.5–7 MHz. Two-dimensional echocardiography was used to assess the structures for defects and valvular abnormalities while flow direction and pressure gradients were assessed with color flow and continuous wave Doppler, respectively. M-mode was used for the measurement of ventricular systolic function. The diagnosis of RHD was based on World Heart Federation echocardiographic criteria and the diagnosis of dilated cardiomyopathy was made in the presence of dilated left ventricle associated with global hypokinesia and systolic dysfunction.[15,16]

Data collection

The information retrieved included demographics, clinical features, diagnosis, investigations, complications, and outcomes.

Data entry and analysis

All relevant data were entered into a proforma sheet and then analyzed using SPSS statistical software version 25. Quantitative data were expressed as means and standard deviation while categorical variables were expressed as proportions. Chi-square or, where necessary, Fisher's exact test was used to test for statistical significance. A *P* value of <0.05 was considered statistically significant.

Ethical considerations

Ethical approval for the study was obtained from the Ethics Committee of Usmanu Danfodiyo University Teaching Hospital Sokoto (UDUTH/HREC/2017/No 613).

Results

Of the 7158 children admitted during the study period, 155 had heart failure accounting for 2.2% of the total admissions. This gives an incidence of 21.6 per 1000 of the admitted cases.

Age and gender distribution

The majority, 103 (66.5%), were aged 1 month to 5 years while age range was between 1 and 180 months (1 month–15 years) with a mean of 55.4 (±53.7) months and a median of 36 (IQR: 86 months) months. Almost half of the under-5s, 44 of 103 (42.7%), were below 12 months of age.

Males accounted for the majority with 84 cases (54.2%) in a ratio of 1.18:1. Among the 103 under-5s, the majority were males (64.1%), while among those above 5 years, majority were female, 21/52 (67.7%). Table 1 shows the distribution of cases by age and gender.

Monthly distribution

The highest number of admissions in the two-year period occurred from January to March, accounting for 66 (62.9%) being the first 3 months of the year, and the least number of cases were seen in May. Figure 1 shows the distribution by month.

Causes of heart failure

The commonest cause of heart failure was CHD in 40 (25.8%), followed by severe anemia in 34 (21.9%), then bronchopneumonia in 30 (19.2%). Rheumatic heart disease (RHD) followed accounting for 18 (11.6%) while dilated cardiomyopathy and myocarditis cases accounted for 16 (10.3%) and 6 (3.9%), respectively. When these three types of acquired heart diseases were combined, they accounted for 40 cases (25.8%) similar to the proportion of those with CHDs. This is shown in Figure 2.

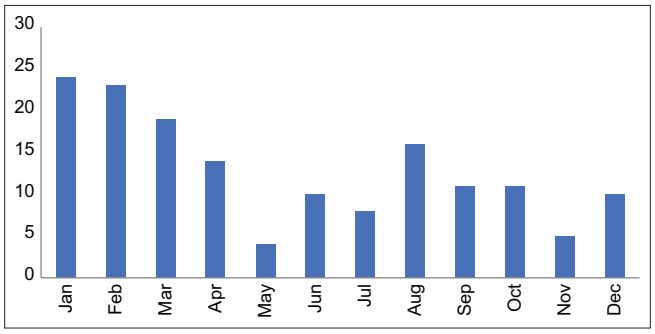

Figure 1: Showing the monthly distribution of the cases for the 2-year period

In Table 2, the details of the causes of heart failure with their gender distribution are outlined. CHD, severe anemia, and bronchopneumonia were more common in males while the acquired heart diseases (RHD and dilated cardiomyopathy) were more prevalent among the females.

The causes of heart failure according to age in Table 3 show that CHDs, anemia, and bronchopneumonia were more prevalent among the under-5s as causes of heart failure while RHD was exclusively in those above 5 years. Dilated cardiomyopathy was more among the under-5s. Others of noncardiac origin (renal, tuberculosis) were more amongst the older children.

Out of the 40 patients with CHD, majority had acyanotic CHD, mainly large ventricular septal defects alone or in combination with other left-to-right shunts in 13 (32.5%). This was followed by double outlet right ventricle in five (12.5%). The commonest cyanotic CHD presenting was transposition of the great arteries (TGA) in five patients (12.5%) followed by truncus arteriosus in three (7.5%).

The commonest cause of anemia was severe malaria followed by sickle cell anemia and severe acute malnutrition. Two patients had arrhythmias complicating RHDs.

Outcome of treatment of heart failure

Forty-five patients (29.0%) died during admission and the number of deaths was highest for CHD, followed by RHD,

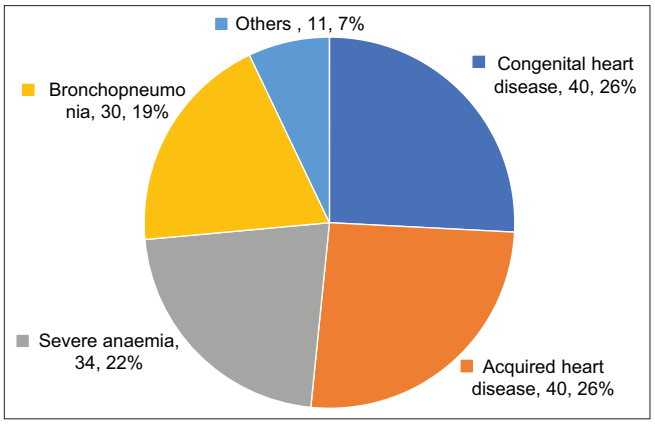

Figure 2: Causes of heart failure amongst the admitted cases

Table 1: Distribution of cases of heart failure by age and gender

Variable	Male	Female	Total	Test of significance
Mean age (months)	45.7 (±47.9)	67.1 (±58.1)	55.4 (±53.7)	t=−2.5
				P=0.13
Age category				
1.0 month to<1 year	25 (56.8)	19 (43.2)	44 (28.4)	
1 year to <5 years	38 (64.4)	21 (35.6)	59 (38.1)	χ^2=7.13
5-10 years	11 (45.8)	13 (54.2)	24 (15.5)	P=0.07
10-15 years	10 (35.7)	18 (64.3)	28 (18.1)	
Total	84 (35.7)	71 (35.7)	155 (35.7)	

Table 2: Causes of heart failure with their gender distribution

Diagnosis	Male	Female	Total	Test of significance
Congenital heart disease	25 (29.8)	15 (21.1)	40 (25.8)	
Severe anemia	22 (26.2)	12 (16.9)	34 (21.9)	χ^2=22.4
Bronchopneumonia	21 (25.0)	9 (12.7)	30 (19.4)	*P*=0.008
Acute rheumatic fever/Rheumatic heart disease	4 (4.8)	14 (19.7)	18 (11.6)	
Dilated cardiomyopathy	4 (4.8)	12 (16.9)	16 (10.3)	
Myocarditis	3 (3.6)	3 (4.2)	6 (3.9)	
Acute glomerulonephritis	2 (2.4)	3 (4.2)	5 (3.2)	
Tuberculosis	2 (2.4)	1 (1.4)	3 (1.9)	
Sepsis	0 (0.0)	2 (2.8)	2 (1.3)	
Others	1 (1.3)	0 (0.0)	1 (0.6)	
Total	**84 (100)**	**71 (100)**	**155 (100)**	

Table 3: Causes of heart failure amongst the admitted cases according to age

Diagnosis	>5 years	>5 years	Total	Test of significance
Congenital heart disease	36 (35.0)	4 (7.7)	40 (25.8)	
Severe anemia	27 (26.2)	7 (13.5)	34 (21.9)	χ^2=76.8
Bronchopneumonia	27 (26.2)	3 (5.8)	30 (19.4)	*P*=0.000
Acute rheumatic fever/Rheumatic heart disease	0 (0.0)	18 (34.6)	18 (11.6)	
Dilated cardiomyopathy	9 (8.7)	7 (13.5)	16 (10.3)	
Myocarditis	1 (1.0)	5 (9.6)	6 (3.9)	
Acute glomerulonephritis	1 (1.0)	4 (7.7)	5 (3.2)	
Tuberculosis	0 (0.0)	3 (5.8)	3 (1.9)	
Sepsis	2 (1.9)	0 (0.0)	2 (1.3)	
Others	0 (0.0)	1 (1.9)	1 (0.6)	
Total	**103 (100)**	**52 (100)**	**155 (100)**	

severe anemia, and bronchopneumonia as shown in Table 4. The complications associated with mortality were infective endocarditis, especially in CHD and those with trisomy 21. Also, arrhythmias complicated the course of two females with RHD and one with Dilated Cardiomypathy (DCM).

The structural heart diseases accounted for high mortality so their details were further delineated. The details of the structural heart diseases with their specific mortality are shown in Table 5. RHDs accounted for the highest burden of structural heart disease out of 80 cases (22.5%). It also accounted for the highest number of mortality cases. However, case fatality rates were higher for the complex CHD being 100% for cases of TGA, hypoplastic left heart syndrome, and tetralogy of fallot (TOF). The case of TOF had right ventricular failure from severe right ventricular hypertrophy while the mortality case with Atrial septal defect (ASD) was a dysmorphic child with septicemia. Only the cases of isolated Patent ductus arteriosus (PDA) and congenital mitral valve abnormality had no mortality.

Table 4: Causes of mortality

Diagnosis	Alive	Dead	Total
Congenital heart disease	22 (55.0)	18 (45.0)	40 (25.8)
Severe anemia	28 (82.4)	6 (17.6)	34 (21.9)
Bronchopneumonia	25 (83.3)	5 (16.7)	30 (19.4)
Acute rheumatic fever/Rheumatic heart disease	10 (55.6)	8 (44.4)	18 (11.6)
Dilated cardiomyopathy	13 (81.3)	3 (18.8)	16 (10.3)
Myocarditis	5 (83.3)	1 (16.7)	6 (3.9)
Acute glomerulonephritis	4 (80.0)	1 (20.0)	5 (3.2)
Tuberculosis	2 (66.7)	1 (33.3)	3 (1.9)
Sepsis	1 (50.0)	1 (50.0)	2 (1.3)
Others	0 (0.0)	1 (100.0)	1 (0.6)
Total	**110 (71.0)**	**45 (29.0)**	**155 (100)**

Discussion

The study showed the pattern of heart failure among admitted children in a tertiary facility and the outcome. The prevalence of heart failure was 2.2% which was lower than other reported cases of heart failure admitted in pediatric emergencies across the country. The lowest reported figure was 2.73% by Falase[7] from Lagos while the highest was 16.7% by Duru[17] from Bayelsa. These figures may not be truly comparable for the different centers because of the different capacities of the emergency departments, different time frames of the studies, and also contribution of other locally prevalent disease conditions to the admission burden in addition to the patronage of the facility compared to others in the locality.[7]

The commonest cause of heart failure in this study was structural heart diseases comprising both congenital and acquired heart diseases like RHD accounting for equal

Table 5: Details of structural heart diseases and mortality

Diagnosis	Alive	Dead	Total
Acute rheumatic fever/Rheumatic heart disease	10 (55.6)	8 (44.4)	18 (22.5)
DCM	13 (81.3)	3 (18.8)	16 (20.0)
VSD	8 (61.5)	5 (38.5)	13 (16.3)
Myocarditis	5 (83.3)	1 (16.7)	6 (7.5)
TGA	0 (0.0)	5 (100)	5 (6.3)
DORV	4 (80.0)	1 (20.0)	5 (6.3)
PDA	3 (100)	0 (0.0)	3 (3.8)
AVSD	2 (50.0)	2 (50.0)	4 (5.0)
Truncus	2 (66.7)	1 (33.3)	3 (3.8)
TAPVC	1 (50.0)	1 ((50.0)	2 (2.5)
ASD	1 (50.0)	1 (50.0)	2 (2.5)
Congenital mitral regurgitation	1 (100)	0 (0.0)	1 (1.3)
Hypoplastic left heart	0 (0.0)	1 (100)	1 (1.3)
TOF	0 (0.0)	1 (100)	1 (1.3)
Total	**50 (62.5)**	**30 (37.5)**	**80 (100)**

TGA=transposition of the great arteries; TOF=tetralogy of fallot; DORV=Double outlet right ventricle; AVSD=Atrio-ventricular septal defect; TAPVC=Total anomalous pulmonary venous connection

proportion of the burden of the cases. However, when individual causes of heart failure were considered, CHDs predominated followed by acute lower respiratory infections, then severe anemia before RHDs and cardiomyopathies. This is quite different from previous reports[8-11,17-21] from other tertiary facilities in the country where acute lower respiratory infections followed by severe anemia in most cases account for the top burden of causes. CHDs usually come third in the category from other reports except in the study by Falase[7] from Lagos where the CHD cases almost equaled number of those with acute lower respiratory infections. The reason for this disparity with previous reports may be multiple. It could be due to timeline of the study being more recent compared to other reports with increased awareness and earlier presentation of cases with CHD to the hospital. Also, many of the patients admitted with lower respiratory infections and cardiomegaly on chest X-ray in the study facility are usually referred for echocardiography either at or after discharge which increases the rate of diagnosis of CHD. Whether this was done in other studies could not be ascertained; however, it was reported that it is just within the last decade that echocardiographic services and expertise are becoming increasingly accessible across centers in the country.[22] Due to the availability of pediatric echocardiographic services services in our facility, more referrals from neighboring states are also seen, which may account for the higher burden of structural heart disease. With respect to acute lower respiratory infections and CHDs, Sadoh in Benin, Nigeria and Jat, from India reported that prevalence of CHD among a cohort of children with pneumonia was high necessitating further evaluation of pneumonia cases even post-discharge.[13,23]

The rate of other acquired heart diseases is also high probably due to the prevailing poverty and other risk factors like overcrowding which leads to spread of causative agents of the infection in the family and community.[24] Among the CHDs causing heart failure, Ventricular septal defect (VSD) was the predominant similar to other studies in the country; however, when all causes of structural heart diseases are categorized, RHD was more predominant among the individual structural heart diseases and this is similar to the study by Solmon in Ethiopia.[25] This also goes to show the need for standardization of reporting mechanisms so that individual contributions of the different structural heart diseases to morbidity and mortality can be recognized, especially those that are highly preventable like RHD.[26]

The age distribution of all causes of heart failure favored those below the age of 5 years, especially infancy, which was similar to other studies being the age of likely presentation of conditions like bronchopneumonia and malaria, sickle cell anemia, and malnutrition due to the relative lower immunity compared to children above 5 years. CHDs with left-to-right shunt lesions present early with pneumonia accounting for the larger proportion of infants. Also, acquired heart diseases like RHD were seen more in older children while cardiomyopathy was more among the under-5s as shown in the previous report.[24,27]

Male preponderance among the cases of heart failure was seen in this report which was similar to other studies;[7,9,17] however, males were more affected with congenital heart lesions while females had more of the acquired heart diseases. In some series, RHD has been shown to affect more females while dilated cardiomyopathies patients are predominantly male.[24,28] However, Cucu[29] in a report on heart disease burden concluded that there was no evidence to support gender disparities in heart disease in children.

Most of the cases of heart failure were seen in the dry dusty months of the year which is a risk for transmission of causative agents of pneumonia which is also the commonest presentation of structural heart diseases. Studies have shown that pneumonia cases peak in March and also September to October during the rainy season.[30] More cases of severe anemia from malaria are also seen during the rainy season. Adequate dissemination of preventive information at the community level may help in this instance in curtailing this burden.

The main cause of mortality in this study was CHD compared to severe anemia in the study by Abdulkadir[9] in Ilorin. This could be proportional to the number of cases seen as severe anemia was the commonest cause of heart failure in that study. Other studies in the country also reported higher mortality amongst those with pneumonia, other lower respiratory tract infections, and anemia compared to structural heart diseases. However, it is known that combination of factors could be responsible for the high mortality among those with CHD in this study which may not be exclusive of infections (endocarditis), sepsis, and anemia which they are prone to by virtue of their compromised nutritional status though this was not assessed in this study. The case fatality rate was higher for complex CHDs but it was also

noteworthy that amongst the structural heart disease, the sheer number of mortalities was higher for RHD. This is of import because it is a readily preventable disease. However, it is also timely to put health insurance into proper shape to cover for surgical and other interventions for all structural heart diseases.

This study showed that the commonest cause of heart failure amongst admitted children in a single referral facility was CHD followed by severe anemia, bronchopneumonia, and RHD. However, when all structural heart diseases were individualized, RHD was topmost followed by DCM. RHD also was the highest single cause of mortality. Therefore, readily preventable causes are still predominant warranting more concerted efforts at the community for prevention. The study was limited by duration as a longer period would reveal better trends in data.

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Conflicts of interest

There are no conflicts of interest.

References

1. Bernstein D. Heart failure. In: Kliegman RM, Stanson BF, St. Geme JW, Schor NF, Behrman R. editors. Nelson Textbook of Paediatrics. 20th ed. Philadelphia, PA: Elsevier; 2016. p. 2282.
2. Park MK. Pediatric Cardiology for Practitioners. 5th ed. Mosby/Elsevier; 2008. p. 680.
3. Hsu D, Pearson G. Heart failure in children: Part I: History, etiology, and pathophysiology. Circ Heart Fail 2009;2:63-70.
4. Rossano JW, Kim JJ, Decker JA, Price JF, Zafar F, Graves DE, *et al*. Prevalence, morbidity, and mortality of heart failure-related hospitalizations in children in the United States: A population-based study. J Card Fail 2012;18:459-70.
5. Massin MM AI, Dessy H. Epidemiology of heart failure in a tertiary pediatric center. Clin Cardiol 2008;31:388-91.
6. Sommers C, Nagel BH, Neudorf U, Schmaltz AA. Congestive heart failure in childhood. An epidemiologic study. Herz 2005;30:652-62.
7. Falase B, Animasahun B, Itiola J, Gbelee O, Kehinde O, Odunsanya O, *et al*. Congestive cardiac failure among Nigerian children; pattern and outcome. Int Cardiovasc Res J 2015;9:164-8.
8. Lagunju IA, Omokhodion SI. Childhood heart failure in Ibadan. West Afr J Med 2003;22:42-5.
9. Abdulkadir M, Bello S, Oladele D, Owolabi B, Suberu H, Adeoye P. Aetiology and outcome of childhood heart failure in an emergency paediatric unit in North Central Nigeria. Port Harcourt Med J 2017;11:161-5.
10. Anah M, Antia-Obong OE, Odigwe CO, Ansa V. Heart failure among paediatric emergencies in Calabar, South Eastern Nigeria. Mary Slessor J Med 2005;4:58-62.
11. Adekanmbi A, Ogunlesi TA, Olowu AO, Fetuga MB. Current trends in the prevalence and aetiology of childhood congestive cardiac failure in Sagamu. J Trop Pediatr 2007;53:103-6.
12. Rossano JW, Shaddy RE. Heart failure in children: Etiology and treatment. J Pediatr 2014;165:228-33.
13. Sadoh WE, Osarogiagbon WO. Underlying congenital heart disease in Nigerian children with pneumonia. Afr Health Sci 2013;13:607-12.
14. National Population Commission (2006). National Population Census. Federal Republic of Nigeria Official Gazette, 96 (2) :1-44. https://gazettes.africa/archive/ng/2009/ng-government-gazette-dated-2009-02-02-no-2.pdf. [Last accessed on 2022 May 19].
15. Lang RM, Badano LP, Mor-Avi V, Afilalo J, Armstrong A, Ernande L, *et al*. Recommendations for cardiac chamber quantification by echocardiography in adults: An update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr 2015;28:1-39.e14.
16. Reményi B, Wilson N, Steer A, Ferreira B, Kado J, Kumar K, *et al*. World Heart Federation criteria for echocardiographic diagnosis of rheumatic heart disease--An evidence-based guideline. Nat Rev Cardiol 2012;9:297-309.
17. Duru C, Mesiobi-Anene N, Akinbami F. Pediatric heart failure among emergency room admissions in a Tertiary Health Centre in Southern Nigeria. Niger J Cardiol 2016;13:62-6.
18. Otaigbe B, Tabansi P. Epidemiology of childhood heart failure in Port Harcourt, Nigeria. Port Harcourt Med J 2012;6:198-203.
19. Oyedeji O, Oluwayemi O, Oyedeji A, Okeniyi J, Fadero FF. Heart failure in Nigerian children. Cardiology 2010;5:18-22.
20. Bondi F, Jaiyesimi F. Heart failure in an emergency room setting. Niger J Paediatr 1990;17:37-41.
21. Onubogu U. Factors predicting heart failure in children admitted to a pediatric emergency ward in a developing country. J Int J Cardiovasc Sci 2020;33:673-85.
22. Ekure EN, Sadoh WE, Bode-Thomas F, Orogade AA, Animasahun AB, Ogunkunle OO, *et al*. Audit of availability and distribution of paediatric cardiology services and facilities in Nigeria. Cardiovasc J Afr 2017;28:54-9.
23. Jat NK, Bhagwani DK, Bhutani N, Sharma U, Sharma R, Gupta R. Assessment of the prevalence of congenital heart disease in children with pneumonia in tertiary care hospital: A cross-sectional study. Ann Med Surg (Lond) 2022;73:103111.
24. Sani UM, Ahmed H, Jiya NM. Pattern of acquired heart diseases among children seen in Sokoto, North-Western Nigeria. Niger J Clin Pract 2015;18:718-25.
25. Gebremariam S, Moges T. Pediatric heart failure, lagging, and sagging of care in low income settings: A hospital based review of cases in Ethiopia. Cardiol Res Pract 2016;2016:7147234.
26. Coates MM, Sliwa K, Watkins DA, Zühlke L, Perel P, Berteletti F, *et al*. An investment case for the prevention and management of rheumatic heart disease in the African Union 2021–30: A modelling study. Lancet Glob Health 2021;9:e957-66.
27. Lipshultz SE, Sleeper LA, Towbin JA, Lowe AM, Orav EJ, Cox GF, *et al*. The Incidence of pediatric cardiomyopathy in two regions of the United States. N Eng J Med 2003;348:1647-55.
28. Sadoh EW, Uzodimma CC, Daniels Q. Childhood acquired heart disease in Nigeria: An echocardiographic study from three centres. Afr Health Sci 2014;14:602-8.
29. Cucu IA, Chifiriuc MC. Congenital heart disease: Global burden and challenges to eliminate health disparities. Ann Public Health Rep 2018;2:26-9.
30. Oloyede I, Ijezie E. Epidemiological and seasonal variations of pneumonia in children admitted in the University of Uyo Teaching Hospital, Uyo, Akwa Ibom State, Nigeria: A retrospective 5-year study (2013-2017). Niger J Paediatr 2020;47:42-7.