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Congestive Cardiac Failure among Nigerian Children; Pattern and Outcome

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ABSTRACT

Background: Congestive Cardiac Failure (CCF) is an important cause of morbidity and mortality among children. It results from various causes, but there are only very few reports from the African sub-region.

Objectives: This study aimed to define the current trends in the prevalence and causes of CCF among children admitted to the Pediatrics Department of the Lagos State University Teaching Hospital (LASUTH).

Patients and Methods: This prospective study was conducted on all the consecutive patients admitted with diagnosis of CCF between January 2011 and December 2012. The data were analyzed using Microsoft Excel. Mean, median, and standard deviation were calculated as necessary. Continuous and discrete data were analyzed using student t-test and chi-square test, respectively. $P < 0.05$ was considered as statistically significant.

Results: Out of the 5705 children admitted to the Department of Pediatrics of LASUTH, 156 ones (2.73%) had CCF. The subjects' age ranged from 48 hours to 144 months, with the mean age of 37.1 ± 31.94 months. The common causes of CCF were Acute Lower Respiratory Tract Infections (ALRTI) (32.0%), Congenital Heart Diseases (CHD) (31.4%), and severe anemia (28.8%). Other less common causes were septicaemia (3.84%), acquired heart diseases (3.2%), and renal disorders (0.6%). The rate of mortality was 17.3%, and more than 90% of the deaths occurred within 48 hours of admission.

Conclusions: CCF remains a major cause of morbidity and mortality in Pediatric practice in Nigeria, with ALRTI, CHD, and severe anemia being the common causes.

►*Implication for health policy/practice/research/medical education:*
Performance of this study in the commercial capital of the most populous country in Africa (Nigeria) makes it likely to be more representative of the pattern in the developing world. This will ultimately help in developing necessary and adequate preventive measures for those in the region, which is likely to be different from those focused on in the developed world.

1. Background

Heart failure occurs when the heart cannot deliver adequate cardiac output to meet the metabolic needs of the body (1). In the early stages of heart failure, various compensatory mechanisms are evoked to maintain normal metabolic function (1). The clinical syndrome of heart failure is a final common pathway of most forms of cardiovascular disease (2). It is a common cause of morbidity and mortality in Pediatric emergency (3). Between 0.5% and 10% of pediatric emergency room admissions are cardiac, with Congestive Cardiac Failure (CCF) being one of the most common cardiac emergencies (4). CCF is responsible for one third of the referrals of children with Congenital Heart Diseases (CHD) to the cardiology clinic in infancy (5). Several studies have reported the prevalence of CCF to vary between 3% and 9% (3, 6-9). Thus, it is a pediatric emergency that must be anticipated and excluded in every acutely ill child (9).

Various studies have identified the leading causes

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of heart failure which are largely preventable (3, 6-9). Heart failure secondary to infectious diseases has been a recurring feature in developing countries, but is now rarely seen in developed countries. Scarce resources and poor resource management have been identified as reasons for this persistent menace. Lagunju and Omokhodion (8) in 2003 documented Acute Lower Respiratory Tract Infection (ALRTI) followed by severe anemia as the commonest cause of CCF among children in Ibadan. Adekanmbi et al. (6) in 2007 also documented severe anemia as the commonest cause followed by ALRTI among neonates and children in Sagamu. Similar results were also obtained by Oyedeji et al. (9) in 2010 among infants and children in Osogbo. In all the above-mentioned studies performed among Nigerian children, the commonest causes of CCF were ALRTI, severe anemia, and CHD. Similarly, Julius et al. (10) documented infections, anemia, Rheumatic Heart Disease (RHD), and CHD as the common causes of CCF among Kenyan pediatric population. On the contrary, CHD and cardiac surgeries accounted for 61% - 82% of cases of heart failure in infants in the U.S. (11). Studies on heart failure in children in European tertiary care facilities, each covering 10 years, showed that slightly more than half of the pediatric heart failure cases were due to CHD (12, 13).

There is a need for regular updates on the prevalence and causes of heart failure in children. This may help identify shift in patterns so as to be able to make appropriate diagnosis and institute management. There is also a need to know the prevalence and causes of CCF among children in Lagos, because Lagos is a major city in Nigeria and careful search has not revealed any studies on CCF in children from Lagos.

2. Objectives

This study aims to determine the prevalence of CCF as well as its causes and outcomes among patients admitted to Pediatric Emergency Unit and pediatric ward of the Lagos State University Teaching Hospital (LASUTH), Ikeja, Lagos.

3. Patients and Methods

All the patients aged 1 day to 12 years admitted to the pediatric ward of LASUTH over a two year period (January 2011 - December 2012) were evaluated for heart failure and were consecutively recruited into the study.

Heart failure was diagnosed by simultaneous presence of at least 3 of the following criteria, with number 1 being inclusive:

1. Tender hepatomegaly, with the liver edge palpable at least 3 cm below the right costal margin along the mid-clavicular line (4)

2. Significant tachycardia: defined as a resting heart rate greater than the upper limit of normal for age; i.e., greater than 160 beats/minute in infancy, 140 beats/minute at 2 years, 120 beats/min at 4 years, and 100 beats/minute at 6 years and above. In the patients with fever, an allowance of 10 beats/minute was made for every degree centigrade rise in above-normal temperature (4).

3. Tachypnoea: defined as a resting respiratory rate above normal with respect to age (4).

4. Cardiomegaly: defined as a cardiothoracic ratio greater than 60% in the first five years of life and greater than 50% in children above 5 years of age (4).

The participants' information, including name, age, sex, causes of heart failure, length of hospital stay, and complications, was recorded. In addition, all the patients were examined and followed up until an outcome was determined.

Packed cell volume was estimated for all the subjects. Other relevant laboratory investigations, including echocardiography, were also performed to further determine the cause of heart failure. All the patients were managed promptly as emergencies following standard hospital guidelines and protocol for heart failure.

The data were analyzed using Microsoft Excel. Mean, median, and standard deviation were calculated as necessary. Continuous and discrete data were analyzed using student t-test and chi-square test, respectively. $P < 0.05$ was considered as statistically significant.

4. Results

A total of 5705 children were admitted to the Pediatric Emergency Unit of LASUTH during the study period. Among these children, 156 ones had cardiac failure, giving a prevalence of 2.73% for CCF.

The subjects' age ranged from one day to 12 years, with the mean ± standard deviation of 37.1 ± 31.94 months. Age and sex distribution of the 156 patients has been presented in Table 1. Accordingly, infants comprised 59.6% of the study population. Besides, there were 82 males and 74 females, giving a male to female ratio of 1.08:1.

Three leading causes of heart failure in each age group were ALRTI (32.0%), CHD (31.4%), and severe anemia (28.8%) (Table 2).

The mean packed cell volume in various causes of anemia has been illustrated in Table 3. Packed cell volume of the patients with severe anemia ranged from 5% to 17%. Additionally, the underlying causes of anemia were malaria (N = 32, 71.1%), sepsis (N = 4, 8.88%), sickle cell disease (N = 6, 13.3%), and ALRTI (N = 5, 11.1%). The lowest mean packed cell volume was observed among the patients who had malaria and sepsis.

Considering the pattern of congenital heart defects seen in the patients and confirmed by echocardiography, ventricular septal defects were the most common form of congenital heart defect. It was found in 36 patients (33.3%). Two of the patients with Tetralogy of Fallot presented with infective

Table 1. Age and Sex Distribution of the Patients

Age Group	Male	Female	Total (%)
Neonates	2	3	5 (3.2)
1 - 12 months	48	45	93(59.6)
> 12 - 60 months	23	20	43 (27.5)
> 60 months	9	6	15 (9.6)

Table 2. Etiology of Heart Failure in Different Age Groups

Diagnosis	Neonates	1 – 12 mths	>12 - 60 mths	> 60 months	Total (%)
ALRTI	0	33 (66)	15 (30)	2 (04)	50 (32.1)
CHD	2 (04)	35 (71)	10 (20)	2 (04)	49 (31.4)
Severe anemia	3 (07)	19 (42)	17 (38)	6 (13)	45 (28.9)
AHD	0	0	1 (20)	4 (80)	5 (3.2)
AGN	0	0	0	1	1 (0.1)
Sepsis	0	6 (100)	0	0	6 (3.9)
Total	5 (03)	93 (60)	43 (27.4)	15 (9.6)	156 (100)

Abbreviations: ALRTI, acute lower respiratory tract infections; CHD, congenital heart disease; AHD, acquired heart disease; AGN, acute glomerulonephritis. Acquired heart diseases: Tuberculous, pericarditis, infective endocarditis, and myocarditis.

Table 3. Causes of Anemia, Packed Cell Volume Ranges, and Mean Packed Cell Volume in Each Category

Causes of Anemia	PCV Range (%)	Number of Patients	Mean PCV (%)
Malaria	5 - 15	32	11.4
Sepsis	9 - 14	4	11.6
Sickle cell disease	10 - 13	6	12.6
ALRT	11 - 17	5	14

Abbreviations: PCV, packed cell volume; ALRTI, acute lower respiratory tract infection

endocarditis. Duration of admissions was between 6 hours to 2 months.

Considering mortality pattern, 27 patients (17.3%) died among whom, 13 (48.2%) were male and 14 (51.8%) were female, with male/female ratio of 1:1.07. No significant gender difference was observed regarding the mortality pattern (P = 0.67). The pattern of mortality with respect to age has been presented in Figure 1.

Accordingly, 95% of the mortalities occurred within 48 hrs of admission. Moreover, the commonest causes of death within 48 hours were severe anemia (30%) ALRTI (25%), CHD (20%), sepsis (10%), infective endocarditis (5%), and tuberculous pericarditis (5%).

5. Discussion

Heart failure is a major and growing public health problem (14). The current study aimed to determine the prevalence of CCF and its causes and outcomes among the patients admitted to Pediatric Emergency Unit and pediatric ward of LASUTH, Ikeja, Lagos. According to the results, CCF accounted for 2.73% of admissions in pediatric emergency and pediatric wards, which is similar to the prevalence of 3.3% recorded over four decades ago in an earlier study in Ibadan, Nigeria (3). It is, however, lower than the rate observed in the previous studies (6, 8, 9). Comparison of the prevalence rates and causes of CCF between the present study and other Nigerian studies has been shown in Table 4. The immediate reason for the observed differences is not clear, but one reason may be variation of relative contributions of different morbidities to hospital admissions from one locality to the other, resulting in variation in the prevalence of cardiac failure among the admitted patients. Differences in admission policies may play a role, as well. In all the studies (Table 4), the commonest causes are ALRTI, severe anemia, and CHD.

ALRTI still remains the leading cause of heart failure in developing countries (15), while CHD and cardiomyopathies are the leading causes in the developed world (10). In the U.S., CHD and cardiac surgeries accounted for 61 - 82% of heart failure cases among infants (11). Two studies on heart failure in children from European tertiary care facilities, each covering 10 years, showed that slightly more than half of the pediatric heart failure cases reported in both studies were due to CHD (12, 13). Thus, there is a need for regular updates and more advances in healthcare delivery system, putting emphasis on prevention, early detection, and prompt and effective management of infectious processes (16). In the present study, about 60% of the subjects were infants.

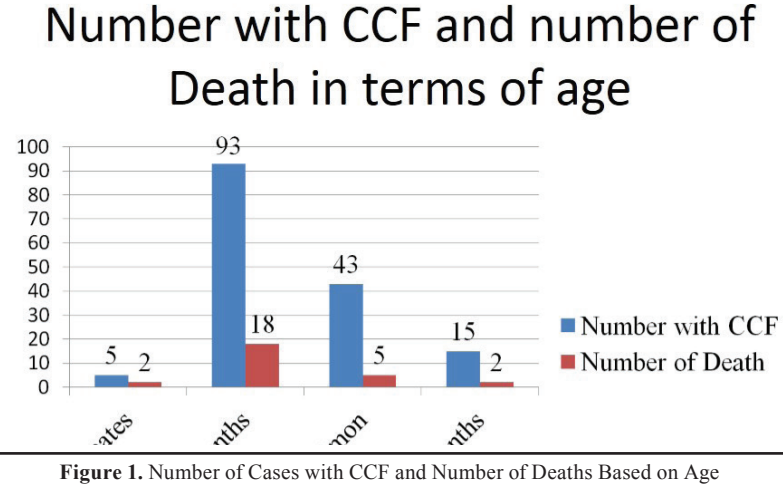

Figure 1. Number of Cases with CCF and Number of Deaths Based on Age

Table 4. Comparison of Some Studies on Congestive Cardiac Failure among Nigerian Children

	Index Study	Bondi et al., 1990	Adekanbi et al., 2006	Lagunju et al., 2003	Oyedeji et al., 2010
Duration (months)	24	12	12	10	6
Total admissions	5705	2776	1552	1713	319
Total with CCF	156	91	109	100	35
Age range	1 day to12 years	1 day to12 years	1 day to13 years	8 days to14 years	1 month to13 years
Prevalence of CCF (%)	2.73	3	7.02	5.8	9
Three common causes (%)					
ALRTI	32	35.2	29	36	37.2
CHD	31.4	18.7	10.5	25	5.8
Severe anemia	28.8	26.3	46	28	57.1

Abbreviations: CCF, congestive cardiac failure; ALRTI, acute lower respiratory tract infection; CHD, congenital heart disease

Hence, it was not surprising that the leading causes of CCF were ALRTI, CHD, and severe anemia. This is comparable to the findings obtained by Lagunju and Omokhodion7, Adekanmbi et al. (6), and Oyedeji et al. (9). Due to the recent advances in surgical and interventional strategies, morbidity and mortality associated with structural heart have reduced significantly in developed countries (17). However, CHD is still a common cause of heart failure in developing countries (8). In our study, ventricular septal defect was the commonest structural defect. Utilization of two dimensional, M mode, and color Doppler echocardiography facilitated diagnosis of structural CHD (6, 18). Nevertheless, delay in surgery due to logistic, technical, and socioeconomic reasons explains the high mortality despite diagnosis (19, 20), as illustrated in Figure 1. Therefore, increasing public awareness to encourage early presentation and providing facilities for corrective surgery are still needed in this region which, if available and affordable, will reduce the incidence and prevalence of heart failure (21). Of particular note is the fact that CHD was responsible for CCF in up to one third of the subjects in the current study. This rate is higher than that observed in most other Nigerian studies. The higher proportion of congenital heart disease reported in this study and the one performed by Lagunju and Omokhodion (8) might be attributed to the increasing availability of diagnostic facilities, such as echocardiography, and trained staff at these two centers. However, the studies by Adekanbi et al. (6) and Oyedeji (9) did not mention anything about performance of echocardiography on patients with CCF, which may explain the smaller number of patients with heart failure and CHD in their studies (Figure 2).

In our study, four subjects had tetralogy of Fallot that is an obstructive lesion in which, CCF is not a common mode of presentation. However, these patients presented with features of infective endocarditis, which is one of the reasons why a patient with an obstructive lesion an present with CCF. Tetralogy of fallot carries a higher risk for infective endocarditis due to the associated multiple cardiac lesions (22).

Moreover, severe anemia complicated by heart failure accounted for a prevalence of 28.8%, with malaria being the leading cause, which was in line with the previous researches (7). Nevertheless, healthcare policies that embrace effective control measures and prompt diagnosis and treatment of malaria cannot be overemphasized in developing countries to reduce its attending complications.

In the current study, the mean of packed cell volume was 11.8% ranging from 5% to 17% among the subjects whose CCF was secondary to severe anemia. However, the lowest mean of packed cell volume was 11.4% found in those with malaria.

The mortality rate was 17% in the patients with CCF in this study. Although this rate is lower than that reported by Omokhodion and Lagunju (23), it is extremely high and translates to about one in every five subjects admitted

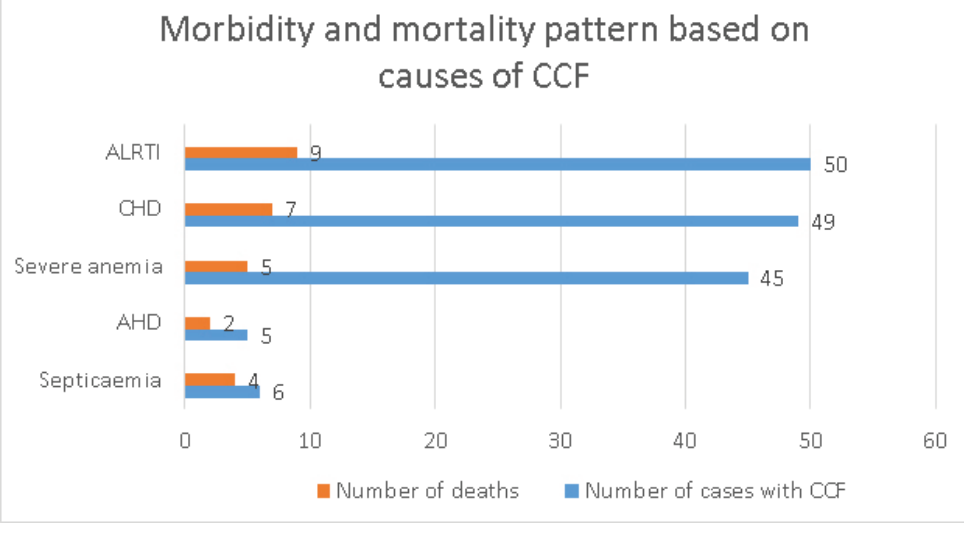

Figure 2. Morbidity and Mortality Pattern Based on the Causes of CCF

for CCF. This further emphasizes the need for early recognition and prompt treatment of CCF to avert mortality. Indeed, since most of the causes of CCF are infective and preventable, there is extreme need to strengthen all levels of prevention. Of particular interest is the fact that about 95% of the mortalities in our study occurred in the first 48 hours of admission, corroborating the need for early diagnosis and institution of prompt and effective treatment. Furthermore, severe anemia, ALRTI, and CHD were the common causes of mortality within 48 hours of admission, and more than 60% of the mortalities involved the subjects below one year of age. Hence, pediatric emergency and ward are recommended to be equipped with facilities and professional staff for early recognition and treatment of CCF. We also recommend an active surveillance for features of CCF in patients presenting in pediatric services centers, especially those with features of ALRTI, severe anemia, and CHD as well as children below one year of age, to avoid mortalities.

On the other hand, older patients presented with heart failure secondary to pericarditis and acute glomerulonephritis. Acquired heart diseases, such as RHD, has been found to be common in developing countries (10, 23). However, no cases of RHD were documented in this study, which may be attributed to improved socioeconomic status, appropriate nutrition, and judicious use of antibiotics (9).

Overall, heart failure is still a cause of morbidity and mortality in this area, and only a little improvement has taken place in this regard compared to an earlier study done over 4 decades ago. To reduce the incidence and prevalence of heart failure, it is essential to have a coordinated strategic community approach that embraces prevention as a priority. Besides, while treating patients with acute infectious diseases, more proactive measures are required to halt the progression of the disease and prevent mortality.

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Authors' Contribution

Study concept and design: Animasahun, Njokanma, and Itiola. Acquisition of data: Animasahun, Itiola, Falase, and Oke. Analysis and interpretation of data: Animasahun, Itiola, Njokanma, and Odusanya. Drafting of the manuscript: Animasahun, Itiola, and Odusanya. Critical revision of the manuscript for important intellectual content: Animasahun, Itiola, Falase, Gbelee, Kehinde, Odusanya, Njokanma, and Oke. Statistical analysis: Animasahun, Itiola, Falase, Odusanya, and Kehinde. Administrative, technical, and material support: Gbelee, Oke, and Njokanma. Study supervision: Oke, Odusanya, and Njokanma.

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