

CLINICAL AND ECHOCARDIOGRAPHIC FEATURES OF HEART FAILURE IN NORTH-EASTERN NIGERIA: A SINGLE-CENTER STUDY

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Abstract

Background: Heart failure (HF) is a major cardiovascular disorder with a growing burden in sub-Saharan Africa. Epidemiological data shows regional variations in aetiology and patient characteristics across Nigeria. There is a paucity of contemporary data from North-Eastern Nigeria, a region with unique socio-economic and health challenges.

Objective: To describe the clinical presentation, aetiology, and echocardiographic characteristics of heart failure patients at a tertiary hospital in Gombe, North-Eastern Nigeria.

Methods: This was a hospital-based, cross-sectional study conducted at the Federal Teaching Hospital, Gombe, from January to December 2022. Ninety consecutively recruited, newly diagnosed HF patients (using the Framingham criteria) underwent clinical evaluation and transthoracic echocardiography. Data on socio-demographics, clinical features, and echocardiographic parameters were collected and analysed using SPSS version 20.

Results: The mean age of the patients was 44.4 ± 18.6 years, with a female preponderance (65.6%, n=59/90). The majority of patients (85.6%) presented in New York Heart Association (NYHA) functional class III or IV, with a median symptom duration before presentation of 4 weeks. Hypertensive heart disease (HHD) was the leading cause of HF (47.8%, n=43), followed by peripartum cardiomyopathy (PPCM) (26.7%, n=24). Echocardiography revealed severe systolic dysfunction with a mean left ventricular ejection fraction (LVEF) of $35.4\% \pm 9.8\%$. Most patients (70%) had an LVEF below 40%. The mean left ventricular mass index (LVMI) was significantly elevated at $184.8 \pm 74.5 \text{ g/m}^2$.

Conclusion: Heart failure patients in North-Eastern Nigeria are remarkably young and predominantly female, presenting with advanced symptomatic disease and severe systolic dysfunction. HHD and PPCM are the predominant aetiologies. These findings underscore the critical need for aggressive public health measures targeting hypertension control, improved maternal health services, and early diagnosis to mitigate the severe burden of HF in this region.

Keywords: Heart Failure, Echocardiography, Hypertension, Peripartum Cardiomyopathy, Nigeria, North-East.

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Introduction

Heart failure (HF) is a global pandemic, a complex clinical syndrome that represents the common end-stage pathway for a multitude of cardiac diseases.[1] It is associated with significant morbidity, mortality, and immense economic burden on healthcare systems worldwide.[2] In the United States and Europe, HF predominantly affects the elderly, with coronary artery disease (CAD) being the leading underlying cause.[1, 3] However, the epidemiological and aetiological profile of HF in sub-Saharan Africa (SSA) presents a strikingly different picture, often characterized by a younger age of onset and a predominance of non-ischaemic causes.[4, 5]

The pattern of heart failure in SSA is largely attributable to mechanical dysfunction arising from hypertension, rheumatic heart disease (RHD), and various forms of cardiomyopathy.[6] Hypertension, in particular, has been identified as a central driver of the HF epidemic on the continent, often earning the grim moniker of being the greatest cardiovascular health challenge after HIV/AIDS.[7] Hospital-based studies from various parts of Africa consistently report hypertensive heart disease (HHD) as the leading cause of HF admissions.[8, 9] Other significant contributors include idiopathic dilated cardiomyopathy (DCM), peripartum cardiomyopathy (PPCM), and RHD, with ischaemic heart disease playing a comparatively minor, though increasing, role.[10, 11]

Nigeria, as the most populous nation in Africa, bears a significant portion of this burden. Several studies from different geopolitical zones of the country have provided valuable insights into the national profile of HF. Studies from Abuja,[12] Port Harcourt,[13] and Abeokuta[14] have highlighted HHD, DCM, and RHD as the predominant aetiologies. A consistent finding across these studies is the relatively young age of affected patients, typically presenting

in their fifth and sixth decades, which is decades younger than their counterparts in high-income countries.[12, 14]

However, Nigeria is a nation of vast diversity, and significant regional disparities in healthcare access, socioeconomic status, and disease patterns exist. North-Eastern Nigeria, in particular, faces unique challenges, including higher poverty indices, lower literacy rates, and profound insecurity, which have collectively strained an already fragile healthcare system.[15] These factors can profoundly influence health-seeking behaviour, disease presentation, and ultimately, the clinical profile of conditions like HF.

While the Sub-Saharan Africa Survey of Heart Failure (THESUS-HF) provided a multi-country perspective,[5] and studies from North-Western Nigeria (e.g., Kano[16] and Zaria[17]) have contributed to the understanding of HF in the northern region, there is a distinct scarcity of recent, detailed data from North-Eastern Nigeria. An earlier study from the region by Antony in 1980 reported idiopathic DCM as the commonest cause of HF,[18] but the epidemiological transition over the past four decades likely places hypertension at the forefront today.

This study, therefore, aims to fill this critical knowledge gap by providing a detailed contemporary description of the clinical and echocardiographic profile of heart failure patients presenting to a major tertiary referral center in Gombe, North-Eastern Nigeria. The findings will be crucial for informing local public health interventions, guiding clinical practice, and planning resource allocation to address the specific challenges of HF management in this underserved region.

Methods

Study Design and Setting

This was a hospital-based, cross-sectional analytical study conducted at the Cardiology Unit of the Department of Internal Medicine, Federal Teaching Hospital (FTH), Gombe,

between January and December 2022. FTH Gombe is a 400-bed tertiary health institution serving as a referral center for Gombe State and neighbouring states including Bauchi, Yobe, Borno, Adamawa, and Taraba. The cardiology unit manages an average of 20-25 newly diagnosed HF patients monthly.

Study Population and Sampling

The study participants consisted of ninety (90) consecutively recruited, newly diagnosed heart failure patients. Heart failure was diagnosed using the validated Framingham Criteria,[19] which requires the concurrent presence of two major or one major and two minor criteria. Patients aged 18 years and above who provided informed consent were included.

Ethical Consideration

Ethical approval for the study was obtained from the Research and Ethics Committee of the Federal Teaching Hospital, Gombe (Ref: NHREC/25/10/2013). Written informed consent was obtained from every participant before enrolment into the study.

Data Collection

Data collection was performed using a structured study questionnaire and involved three main protocols:

- 1. Clinical Evaluation:** The principal investigator obtained detailed demographic data (age, sex, marital status, occupation) and clinical history, including symptoms attributable to HF and their duration. A thorough physical examination with emphasis on the cardiovascular system was performed. Functional status was classified according to the New York Heart Association (NYHA) criteria.[20] Anthropometric measurements (weight and height) were taken, and Body Surface Area (BSA) was calculated using the Mosteller formula.[21]
- 2. Echocardiography:** Conventional transthoracic echocardiography was performed on all subjects using an I-VIS60 Digital Color Doppler Ultrasound system

(Chison medical imaging Co Ltd. China) equipped with a 3.5-MHz transducer. Examinations were conducted following the recommendations of the American Society of Echocardiography (ASE).[22, 23] Parameters measured or calculated included:

- Left ventricular internal dimension in diastole and systole (LVIDd, LVIDs).
- Posterior wall thickness and interventricular septal thickness in diastole (PWTd, IVSTd).
- Left ventricular ejection fraction (LVEF) was calculated using the Teichholz formula.[24]
- Left ventricular mass (LVM) was calculated using the formula of Devereux and Reichek[25] and indexed to BSA to obtain the Left Ventricular Mass Index (LVMI).
- Left atrial diameter (LAD) and aortic root diameter (ARD).
- Diastolic function was assessed via mitral inflow Doppler (E and A waves, E/A ratio). Left ventricular systolic dysfunction (LVSD) was categorized as: normal (LVEF $\geq 50\%$), mild (LVEF 40-49%), moderate (LVEF 30-39%), and severe (LVEF $< 30\%$).
- **3. Aetiological Classification:** The aetiology of HF was determined based on clinical history, physical examination, and echocardiographic findings, following standard clinical definitions.

Data Analysis

Data were analysed using the Statistical Package for Social Sciences (SPSS) for Windows, Version 20 (IBM Corp., Armonk, NY). Continuous variables were presented as mean \pm standard deviation (SD) for normally distributed data, and median with interquartile range (IQR) for skewed data. Categorical variables were expressed as frequencies and percentages (n, %). Descriptive statistics were used to summarize the socio-demographic,

clinical, and echocardiographic characteristics of the patient population.

Results

Socio-Demographic and Clinical Characteristics

A total of 90 heart failure patients were recruited and analysed. The socio-demographic and clinical characteristics are summarized in Table 1.

The mean age of the patients was 44.4 ± 18.6 years, with a range from 18 to 85 years. There was a distinct female preponderance, with 59 females (65.6%) and 31 males (34.4%). The majority of the patients were married (75.6%, n=68), and 17.8% (n=16) were widowed.

The clinical presentation was notably severe. Half of the patients (50.0%, n=45) presented in NYHA functional class IV, while 35.6% (n=32) were in class III. Only 11.1% (n=10) and 3.3% (n=3) presented in class II and I, respectively. This indicates that 85.6% of the patients had advanced, symptomatic HF at presentation.

The median duration of HF symptoms before presentation was 4 weeks (IQR: 6 weeks). A third of the patients (33.3%, n=30) presented within two weeks of symptom onset, while 23.3% (n=21) had symptoms for over 8 weeks before seeking tertiary care.

The anthropometric measures showed a mean weight of 62.3 ± 10.8 kg and a mean Body Mass Index (BMI) of 22.8 ± 3.8 kg/m².

Table 1: Socio-demographic and Clinical Characteristics of Heart Failure Patients (N=90)

Characteristic	Value
Age (years), Mean \pm SD	44.4 \pm 18.6
Sex, n (%)	
Male	31 (34.4)
Female	59 (65.6)

Characteristic	Value
Marital Status, n (%)	
Single	1 (1.1)
Married	68 (75.6)
Divorced	5 (5.6)
Widowed	16 (17.8)
NYHA Class at Presentation, n (%)	
Class I	3 (3.3)
Class II	10 (11.1)
Class III	32 (35.6)
Class IV	45 (50.0)
Duration of Symptoms (weeks), Median (IQR)	
Weight (kg), Mean \pm SD	62.3 \pm 10.8
Body Mass Index (kg/m ²), Mean \pm SD	22.8 \pm 3.8

Aetiology of Heart Failure

The aetiological distribution of heart failure in the study population is detailed in Table 2. Hypertensive heart disease (HHD) was the predominant cause, accounting for 47.8% (n=43) of all cases. Peripartum cardiomyopathy (PPCM) was the second most common aetiology, responsible for 26.7% (n=24) of cases. Dilated cardiomyopathy (DCM) was found in 12.2% (n=11) of patients, while rheumatic heart disease (RHD), specifically rheumatic mitral valve disease, accounted for 11.1% (n=10). Rare causes included ventricular septal defect (VSD) and cor pulmonale, each constituting 1.1% (n=1) of the cohort. Ischaemic heart disease was not identified as a primary aetiology in any patient.

Table 2: Aetiology of Heart Failure in the Study Population (N=90)

Aetiology	Frequency, n	Percentage, %
Hypertensive Heart Disease (HHD)	43	47.8
Peripartum Cardiomyopathy (PPCM)	24	26.7
Dilated Cardiomyopathy (DCM)	11	12.2
Rheumatic Heart Disease (RHD)	10	11.1
Ventricular Septal Defect (VSD)	1	1.1
Cor Pulmonale	1	1.1
Total	90	100.0

Echocardiographic Characteristics

The echocardiographic parameters revealed significant structural and functional abnormalities, as shown in Table 3. The patients exhibited marked left ventricular dilation, with a mean LVIDd of 5.99 ± 0.99 cm and a mean LVIDs of 4.90 ± 1.00 cm. The mean left ventricular ejection fraction (LVEF) was severely reduced at $35.4\% \pm 9.8\%$.

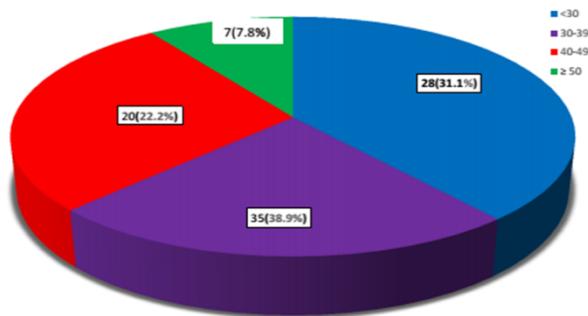
The distribution of patients based on LVEF categories is presented in Figure 1. The majority of patients (70%, n=63) had severe or moderate systolic dysfunction, with 38.9% (n=35) in the 30-39% EF range and 31.1% (n=28) with an EF less than 30%. Only 7.8% (n=7) of patients had a preserved EF ($\geq 50\%$).

Evidence of significant left ventricular hypertrophy was present, with a mean LVMI of 184.8 ± 74.5 g/m². The mean left atrial diameter was enlarged at 34.3 ± 17.7 cm. Diastolic function assessment showed a mean E/A ratio of 1.69 ± 0.79 .

Table 3: Echocardiographic Characteristics of Heart Failure Patients (N=90)

Echocardiographic Parameter	Value (Mean \pm SD)
LVIDd (cm)	5.99 ± 0.99
LVIDs (cm)	4.90 ± 1.00
IVSTd (cm)	1.05 ± 0.29
PWTd (cm)	0.99 ± 0.30
Left Ventricular Ejection Fraction (%)	35.4 ± 9.8
Left Ventricular Mass (g)	257.3 ± 95.1
Left Ventricular Mass Index (g/m ²)	184.8 ± 74.5
Left Atrial Diameter (cm)	34.3 ± 17.7
Aortic Root Diameter (cm)	22.8 ± 11.1
E/A Ratio	1.69 ± 0.79

Figure 1: Pie Chart Showing Classification of Patients Based on Ejection Fraction



Discussion

This study provides a detailed contemporary profile of heart failure patients in North-Eastern Nigeria. The key characteristics of this cohort are the young age of onset, the striking female preponderance, the late and severe stage of presentation, and the dominance of hypertensive heart disease and peripartum cardiomyopathy as underlying causes, accompanied by severe echocardiographic derangements.

The mean age of 44.4 years in our study is consistent with the well-documented trend of HF affecting a younger demographic in SSA compared to high-income countries.[5, 12] This finding aligns with reports from Kano (46.9 years)[16] and is slightly lower than the mean age of 52.3 years in the multi-country THESUS-HF study.[5] This younger age profile can be attributed to the high prevalence of aetiologies like RHD, PPCM, and DCM, which manifest in early to middle adulthood. Furthermore, hypertension and its complications present at a younger age in Africans,[26] and as the primary aetiology here, it drives the early onset of HF. This contrasts sharply with Western populations, where HF is predominantly a disease of the elderly, with a mean age of 76 years, largely due to the high burden of ischaemic heart disease.[3] The economic impact of HF in this young, productive population is

devastating, leading to significant loss of productive years and increased dependency.

A remarkable finding of our study is the female preponderance (65.6%), which differs from several other Nigerian studies where males were either predominant or equally affected. [12, 13, 27] This disparity is largely explained by the very high prevalence of peripartum cardiomyopathy (PPCM), which accounted for over a quarter of all HF cases and exclusively affects women. The 26.7% prevalence of PPCM in our cohort is one of the highest reported in hospital-based studies in Nigeria and highlights PPCM as a major women's health issue in this region. This could be linked to regional factors such as poor antenatal care attendance, traditional birthing practices, and specific nutritional deficiencies.[28] Furthermore, gender differences in health-seeking behaviour, where women in this socio-cultural context might be more likely to seek hospital care when critically ill, may also contribute to this observed preponderance.[29]

The severity of presentation is a major concern. The fact that 85.6% of our patients presented in NYHA class III or IV, with half being in class IV, indicates a critical failure in the early diagnosis and management of cardiac diseases in the community. This finding is more severe than reports from the THESUS-HF registry, where 51% presented in class III/IV,[5] and studies from Cameroon[8] and Ghana,[9] which reported more patients in class II. This late presentation can be attributed to a confluence of factors prevalent in North-Eastern Nigeria, including poor health literacy, reliance on patent medicine vendors and unorthodox care as first-line treatment, poverty, and the significant barriers to accessing specialist care posed by distance and insecurity.[15] The median symptom duration of 4 weeks before presentation supports this pattern of delayed care-seeking. The low mean BMI (22.8 kg/m²) further suggests the presence of cardiac cachexia, a complication of advanced

and chronic HF,[30] reinforcing the finding of late-stage disease. Malnutrition could also have played a role.

Regarding aetiology, our study confirms the central role of hypertension in driving the HF epidemic in Nigeria, with HHD accounting for 47.8% of cases. This is consistent with findings from Abuja (62.6%),[12] Zaria,[17] and other parts of SSA. [5, 8] This underscores the urgent need for effective, population-wide hypertension control programs. The significant burden of RHD (11.1%) reflects the persistent failure of primary and secondary prevention of streptococcal infections in the region. The 12.2% prevalence of DCM is similar to reports from other parts of Nigeria[12, 13] and indicates a substantial burden of undiagnosed inflammatory disease and idiopathic myocardial disease. The complete absence of ischaemic heart disease as a primary aetiology, while surprising, aligns with its historically low prevalence in SSA, though recent data suggests it is on the rise.[11]

The echocardiographic data objectively confirms the clinical severity. The mean LVEF of 35.4% indicates severe systolic dysfunction on a population level, which is comparable to findings from Ilorin (32.9%)[31] and Abuja (42.9%),[12] and worse than reports from European registries.[32] The high mean LVMI of 184.8 g/m² signifies pronounced left ventricular hypertrophy, a hallmark of HHD and a key factor in the pathogenesis of HF in this population. This finding is similar to a report from Ilorin (196.9 g/m²)[31] and reflects the long-standing, uncontrolled pressure overload on the left ventricle. The enlarged left atrial diameter is a marker of chronically elevated left ventricular filling pressures, commonly seen in both systolic and diastolic HF.

Study Limitations

This study has some limitations. As a single-center study, the findings may not be fully

generalizable to the entire North-Eastern population or to patients in primary and secondary health facilities. The cross-sectional design provides a snapshot in time and cannot establish causal relationships or track outcomes. The aetiological classification was based on clinical and echocardiographic findings without coronary angiography, which could have led to an under-diagnosis of ischaemic heart disease. Despite these limitations, the study provides invaluable contemporary data from an under-represented region.

Conclusion and Recommendations

This study highlights the profile of heart failure in North-Eastern Nigeria that is characterized by young age, female preponderance, late and severe clinical presentation, and a preponderance of HHD and PPCM, with severe systolic dysfunction and left ventricular hypertrophy on echocardiography.

Based on these findings, we recommend the following:

- 1. Public Health Interventions:** There should be aggressive, community-based hypertension screening and control programs tailored to the region. Early detection and sustained treatment of hypertension are paramount to reducing the incidence of HHD.
- 2. Maternal Health Strengthening:** The high burden of PPCM calls for improved access to quality antenatal and postnatal care, including echocardiographic screening for at-risk women and education on seeking care for peripartum cardiac symptoms.
- 3. Health System Strengthening:** Efforts to improve early diagnosis and referral are critical. This includes training primary healthcare workers to recognize HF symptoms, establishing referral pathways, and public health education to discourage delays in seeking appropriate care.

4. **Further Research:** Large, prospective, multi-center studies incorporating follow-up data are needed to determine the mortality rates, prognostic factors, and long-term outcomes of HF patients in this region to guide management strategies effectively.

Addressing the burden of heart failure in North-Eastern Nigeria requires a concerted effort that targets its root causes and the systemic barriers to early and effective care.

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