

# Contemporary aetiology of Heart Failure in a Teaching Hospital in Ghana: a prospective study

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## Research Article

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# Abstract

## Background

Heart failure (Heart Failure) is recognized as a global public health disease associated with high morbidity and mortality. It is suggested that the main underlying causes of HF in developing countries differ from those identified in well-resourced countries. This study therefore presents the cardiovascular risk factors and the causes of HF among admitted patients in a teaching Hospital in Ghana.

## Method

The study prospectively recruited 140 consecutive patients admitted for heart failure at the Medical department of the Korle Bu Teaching Hospital from March to October, 2014. The study evaluated the cardiovascular risk factors and the aetiologies of heart failure, and compared the risk factors and aetiologies with patient's age and gender.

## Results

The mean age of the study participants was  $51.3 \pm 16.8$  years. The commonest cardiovascular risk factors observed were hypertension (46.5%), history of previous HF (40.7%), excessive alcohol use (38.6%), and family history of heart disease (29.3%); predominantly hypertension (68.3%). The major causes of HF were hypertensive heart disease (30.7%), dilated cardiomyopathy (29.3%), ischaemic heart disease (13.6%) and valvular heart disease (12.9%). HF caused by hypertensive heart disease (88.4% vs 11.6%;  $p = 0.015$ ), dilated cardiomyopathy (58.5% vs 41.5%;  $p = 0.004$ ) and ischaemic heart disease (100.0% vs 0.0%;  $p = 0.004$ ) were high in patients aged 40 years and above compared to those below 40 years.

## Conclusion

The major causes of heart failure in adults admitted to Korle Bu Teaching Hospital were hypertensive heart disease, dilated cardiomyopathy, ischaemic heart disease and valvular heart disease significantly high among patients aged 40 years and above. The main cardiovascular risk factors identified among the heart failure patients were hypertension, excessive alcohol use, family history of heart disease and personal history of previous heart failure diagnosis.

## Background

Heart failure (HF) has been singled out as an emerging epidemic [1–3]. In developing countries, the main underlying causes of HF are suggested to be different from those identified in well-resourced countries [4–7]. About 90% of HF in sub-Saharan Africa are attributed mainly to hypertensive heart disease,

cardiomyopathy, rheumatic heart disease, congenital heart disease and pericardial diseases [8]. Cardiovascular disease is common in the general population and resulted in 17.3 million deaths worldwide in 2013 [9]. Several risk factors have been identified as contributing to the initial myocardial injury that eventually results in chronic heart failure and/or sudden cardiac death through mechanisms including endothelial dysfunction, cardiac remodeling, neurohormonal adaptations, diastolic and systolic dysfunction [10].

HF is a common terminal condition among many common chronic cardiovascular diseases in Ghana and accounted for about 8% of all admissions [11] and also responsible for about 10% of mortalities at the department of medicine in Korle-Bu Teaching Hospital in the early 1970s [12]. However, only a few hospital based studies have characterized the aetiological factors of HF [13–15], and recent data on acute HF are limited in Ghana and in developing countries. This gap in research can potentially mitigate against efforts at prevention, control and management and there is thus an urgent need to characterize the risk factors and causes of acute heart failure in Ghana. The Korle-Bu Teaching Hospital is the premier and largest tertiary hospital in Ghana receiving referrals from all over the country and sub-region. This study therefore presents the cardiovascular risk factors and the causes of AHF at the Korle Bu Teaching Hospital.

## **Method**

### **Study design and setting**

This was a hospital based cross-sectional case study recruiting every consecutive patient who was admitted for acute heart failure during the study period at the Department of Medicine & Therapeutics (DOMT) of the Korle-Bu Teaching Hospital (KBTH). KBTH is a tertiary referral center located in the national capital of Ghana, Accra with 1600 bed capacity and twelve different departments. The DOMT is a 134-bed facility operating under four teams and has a patient flow of about 300 per month. The department runs a 24-hour emergency service and admits patients through the emergency department, outpatient clinics and other specialist clinics. Referrals are received mainly from the southern sector of Ghana but also from all the 16 regional hospitals, district hospitals, private hospitals and specialist clinics. Other referrals are received from polyclinics, maternity homes and some health centers.

### **Study population, and inclusion and exclusion criteria**

This study involved all adult patients who were admitted and managed for AHF in all four medical wards and the emergency department of the Korle-Bu Teaching Hospital from March to October 2014. Consecutive patients 18 years and above who were admitted with initial diagnosis of AHF and who met the modified Framingham criteria [16] for the diagnosis of HF were included in the study.

*Major criteria included:*

Paroxysmal nocturnal dyspnoea, neck vein distention, pulmonary rales, radiographic cardiomegaly (cardiothoracic ratio > 0.50), acute pulmonary oedema, S3 gallop, and hepatojugular reflux.

*Minor criteria included:*

Bilateral ankle oedema, nocturnal cough, dyspnoea on ordinary exertion, hepatomegaly, pleural effusion, tachycardia (heart rate >120/min) and weight loss of more than 4.5Kg in 5 days in response to treatment of congestive HF [16]. Minor criteria were acceptable only if they could not be attributed to another medical condition. The diagnosis of HF required that two major or one major and two minor criteria were present concurrently together with echocardiographic evidence of structural heart disease [16].

*Exclusion criteria*

Patients who did not meet the Framingham criteria, were unable to complete full diagnostic evaluation, pregnant and less than 18 years were excluded from the study.

### **Sample size determination**

The sample size for the study was determined using the formula for single cross-sectional survey based on the parameter; earlier studies in Ghana, the expected prevalence (p) of AHF among medical admissions of 8%,<sup>9</sup> the standard score (z) of 1.96 at 95% confidence interval, desired margin of error of 5% and a 20% non-response rate. A total of 140 minimum sample size was determined.

### **Data collection and case definition**

A standard questionnaire which was administered by the principal investigator and a trained research assistant was used to collect data including demographic characteristics (including age, sex, ethnicity, religion, occupation, educational status and marital status), history of hypertension, diabetes, dyslipidaemia, smoking history, drug history and previous diagnosis of HF, and family history of heart diseases after informed consent was obtained. Clinical examination was done for all patients within 24 hours after admission. Chest X-ray, echocardiographic, and electrocardiographic data were collected within five days of admission by a senior cardiology fellow and validated by an experienced consultant cardiologist. Fasting blood sugar was done the morning after admission. All other laboratory investigations were done within the index admission.

### **Data analysis**

Data collected were entered, cleaned, and analyzed using SPSS version 20 software. Descriptive analysis of the cardiovascular risk factors and causes of heart failure was done and expressed as frequencies or percentages. Continuous variables were summarized using mean and measure of spread using standard deviation and range were also calculated. The Chi-squared test and the Fisher's exact test (where appropriate) were used to examine the association between the cardiovascular risk factors and heart failure. Statistical significance was set at  $p < 0.05$ .

# Results

The mean age of the study participants was  $51.3 \pm 16.8$  years. There were more males (56.4%) than females (43.6%). Patients were mostly urban settlers (78.6%). Socio-demographic characteristics of the patients are presented in Table 1.

## Prevalence of cardiovascular risk factors among Heart failure patients

Table 2 presents the cardiovascular risk factors among the patients. The commonest cardiovascular risk factors observed among participants were hypertension (46.5%), history of previous HF (40.7%), excessive alcohol use (38.6%), and family history of heart disease (29.3%) which was predominantly hypertension (68.3%).

The history of hypertension (89.2% vs 10.8%;  $p < 0.001$ ), diabetes (95.5% vs 4.5%;  $p = 0.016$ ) and the BMI ( $p = 0.027$ ) were significantly prevalent among patients aged 40 years and above compared to those aged below 40 years. Male patients compared to female patients had high prevalence of smoking (92.5% vs 4.8%;  $p < 0.001$ ), and alcohol use (85.2% vs 14.8%;  $p < 0.001$ ). However, more females than males (70.8% vs 29.2%;  $p = 0.001$ ) had BMI of 30kg/m and above.

## Causes of Heart Failure

Table 3 shows the main underlying causes of acute heart failure among patients. The major causes of AHF were hypertensive heart disease (30.7%), dilated cardiomyopathy (29.3%), ischaemic heart disease (13.6%) and valvular heart disease (12.9%). The commonest cause of dilated cardiomyopathy identified among patients was idiopathic (68.3%) and patients with valvular heart disease were mostly regurgitant valvular lesions.

## Comparison of the major causes of HF by gender and age

Table 4 presents the comparison of causes of acute heart failure by gender and age. There were no significant differences in the causes of HF between male and female patients.

However, patients aged 40 years and above compared to those aged less than 40 years were diagnosed more with hypertensive heart disease (88.4% vs 11.6%;  $p = 0.015$ ), dilated cardiomyopathy (58.5% vs 41.5%;  $p = 0.004$ ) and ischaemic heart disease (100.0% vs 0.0%;  $p = 0.004$ ).

# Discussion

The aim of the study was to examine the prevalence of cardiovascular risk factors and causes of heart failure at the Korle-Bu Teaching Hospital, the national referral center serving the southern sector of Ghana.

The study found that hypertension was the most common risk factor for HF. This is consistent with several studies done in Ghana [13,14,17] and other African countries [18-20]. Hypertension was most prevalent in patients aged 40 years and above. This finding is similar to the finding of a previous study where systolic blood pressure markedly increased with age [21]. A meta-analysis on several studies in Ghana has shown that hypertension detection, treatment and control rates are very poor [22]. This is due to several factors including poverty, illiteracy, poor accessibility to health care services and traditional beliefs about medication. In addition, medication non-adherence rates among patients with hypertension have been shown to be very high in a recent study [23]. This begs for urgent action to improve hypertension detection, treatment, and control rates in Ghana if the raging epidemic of HF is to be curtailed. The study found other risk factors including history of smoking, alcohol use, diabetes mellitus, previous heart failure, dyslipidaemia, and obesity, similar to the findings of previous studies [21,24]. Smoking and alcohol use were significantly higher in males whereas obesity (BMI of  $>30\text{kg/m}^2$ ) was significantly higher in females and those aged 40 years and above. This is consistent with the findings made in a previous study where the history of former or current smoking was frequent among male patients and female patients were more obese [24]. The current study found that the prevalence of diabetes mellitus was significantly higher in patients aged 40 years and above. This is in line with what has been reported elsewhere where the prevalence of DM temporally high among middle-aged patients presenting with acute heart failure [21]. Cardiovascular risk factors particularly dyslipidaemia, hypertension, diabetes mellitus and smoking are widespread in adults worldwide [25], which may possibly be due to urbanization, increase life expectancy and changes in lifestyles including unhealthy diets and lack of physical activity.

The study identified hypertensive heart disease and cardiomyopathies as the most common causes of HF in this study (30.7% and 29.3% respectively). Other common causes were ischaemic (13.6%) and valvular heart diseases (12.9%). This is similar to the findings of the studies by Owusu et al in Komfo Anokye Teaching Hospital in Kumasi [14,15], and Amoah et al [13] in the National Cardiothoracic Center in Accra. However, in this study fewer rheumatic heart diseases and more cardiomyopathies and ischaemic heart diseases were identified compared to the earlier studies. This probably reflects the changing lifestyle of Ghanaians, growing urbanization, and ageing population. Hypertensive heart disease results from chronic systemic arterial hypertension and has emerged as the commonest cause of HF in several studies in Africa [6,18,24]. The causes of hypertensive heart disease seem to be a likely gene-environment interaction whereby weight gain, high salt intake and psychosocial factors may facilitate the rapid development of hypertension and hypertensive heart disease in susceptible individuals [26]. It is clear from this study that hypertension remains a major health challenge in Ghana and other studies have shown that it remains undiagnosed and poorly controlled in a majority of the population [22].

Dilated cardiomyopathy was the second most common aetiology of HF identified in this study. Dilated cardiomyopathy has indeed been shown to be a common cause of HF in sub-Saharan Africa from earlier studies [27,28]. Several important causes of dilated cardiomyopathy have been identified in sub-Saharan

Africa including HIV cardiomyopathy, peripartum cardiomyopathy, myocarditis, alcohol induced cardiomyopathy and genetic/familial forms [28]. Familial disease accounts for 30-50% of cases depending on the extent to which investigations are done to identify the underlying cause. The current study identified idiopathic dilated cardiomyopathy (65.1%) as the commonest cause of dilated cardiomyopathy comparable to the 50% identified by Felker et al [29] among 1230 patients evaluated with initially unexplained cardiomyopathy. The high proportion of idiopathic dilated cardiomyopathy observed in the current study could probably be because of incomplete investigations in this study. Echocardiography is not very sensitive in differentiating the underlying causes of dilated cardiomyopathy. Furthermore, cardiac MRI and coronary angiography were not performed so one is likely to misclassify some cases of ischaemic heart disease as dilated cardiomyopathy and vice versa. Similarly, viral screening and serological tests were not done in this study. In the study by Felker et al [29], the prognosis of patients with ischaemic cardiomyopathy, infiltrative cardiomyopathy and HIV-associated cardiomyopathy was poorer than those with idiopathic cardiomyopathy. It is therefore of utmost importance to fully evaluate HF patients with dilated cardiomyopathy for any probable underlying causes.

Furthermore, ischaemic heart disease was found as more common than primary valvular heart disease in the aetiology of HF. This finding is at variance with the findings in earlier studies in Ghana [13,15], the heart of Soweto [7] and the THESUS-HF studies [6]. In Ghana, several studies have shown high prevalence of traditional cardiovascular risk factors for coronary artery disease, such as hypertension, obesity, diabetes mellitus, dyslipidaemia and sedentary lifestyle [17,22,30]. This could therefore account for ischaemic heart disease becoming common as observed in this current study.

Our current study found only 12.9% of the HF was due to primary valvular heart disease. Moreover, most of the valvular heart diseases were degenerative rather than rheumatic, reflecting the ageing population. A similar low prevalence of rheumatic heart disease as a cause of contemporary HF was found in Abeokuta, Nigeria in a recent registry in which only 2.4% of the 452 HF patients had rheumatic heart disease [19]. Both studies were done in urban communities in Africa where living standards and environmental conditions are better, thus may not be a true reflection of the general population.

Congenital heart diseases were very few in this study, like that found in the Abeokuta HF registry where only 2 congenital heart disease cases were identified in the 452 adults with HF [19]. This may be due to either patients still going to see their pediatric doctors because of long-term relationship or some of them not living long enough into adulthood as a result of lack of resources for corrective heart surgeries in most places in sub-Saharan Africa. However, congenital heart diseases have been identified as very common cause of heart failure in earlier study [13,14]. This is probably due to the differences in the age range of patients included in the studies. Whereas Amoah et al [13] included patients 4 months to 95 years, in our current study, only adults 18 years and above were recruited.

The study found that hypertensive heart disease, cardiomyopathies and ischaemic heart diseases were predominant in patients aged 40 years and above. This is consistent with the finding made in a similar

study among heart failure patients in a tertiary hospital in Kumasi, Ghana [14]. It has been stipulated that enhancements in public health have led to the high prevalence of chronic diseases among the ageing population [31].

### **Study limitation**

A major limitation of this study is the inability to do natriuretic peptides on admission. This test was not routinely available in the facility during the time of the study. Diagnosis of ischaemic cardiomyopathy was based on echocardiography with no coronary angiography. Additionally, virological and serological tests were not done to investigate the underlying cause of dilated cardiomyopathies. Past history of heart failure was established mainly by clinical history and may suffer from recall bias. The definition of hypertensive heart disease used for this study might have missed out patients with end-stage hypertensive heart disease with thinned walls.

## **Conclusion**

The study has shown clearly that the major causes of acute heart failure in adults admitted to Korle-Bu Teaching Hospital were hypertensive heart disease, dilated cardiomyopathy, ischaemic heart disease and valvular heart disease irrespective of the gender. Hypertensive heart disease is the most common aetiologic factor especially in patients aged 40 years and above. Whilst efforts at controlling rheumatic heart disease and other infections should continue, equally greater policy attention should be given to non-communicable diseases like hypertension, diabetes, and coronary artery disease to reduce HF burden in Ghana.

## **Abbreviations**

HF  
Heart Failure  
KBTH  
Korle Bu Teaching Hospital  
BMI  
Body Mass Index  
HIV  
Human Immunodeficiency Virus

## **Declarations**

### **Ethics approval and consent to participant**

The study was approved by the Ethical and Protocol Review Committee of the University of Ghana Medical School (Protocol number: MS-Et/M.8 – P3.1/2013-2014). Informed written consent was obtained

after the aims and objectives of the study were thoroughly explained to the patients. Confidentiality was assured to all participants, and they were identified only with a unique identification number.

We confirm that all methods were performed in accordance with the relevant guidelines and regulations.

### **Consent for publication**

Not applicable

### **Availability of data and materials**

The dataset generated during the current study is not publicly available due to issues of confidentiality but are available from the corresponding author on reasonable request.

### **Competing interest**

The authors declare no competing interest.

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### **Authors' contributions**

FA conceived and designed the study, supervised data collection, conducted the analysis and interpretation of data regarding baseline data, and final diagnosis, and assisted in drafting of the initial manuscript. FAA, AD, RO, FF and JAA assisted in interpretation of the data. JK assisted in the design of the study, and interpretation of data. BYAA assisted in the interpretation of data and drafted the initial manuscript. All the authors read, reviewed, and approved the final manuscript.

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## Tables

**Table 1: Socio-demographic characteristics**

<b>Characteristics</b>	<b>Frequency</b>	<b>Percent</b>
<b>Age (years)</b>		
18-39	35	25.0
40-59	59	42.1
60-70	26	18.6
Above 70	20	14.3
<b>Sex</b>		
Male	79	56.4
Female	61	43.6
<b>Ethnicity</b>		
Akan	58	41.4
Ga	34	24.3
Ewe	26	18.6
Hausa	4	2.9
Others	18	12.9
<b>Residence</b>		
Rural	30	21.4
Urban	110	78.6
<b>Religion</b>		
Christian	125	89.3
Islam	11	7.9
Others	4	2.9
<b>Marital status</b>		
Single	26	18.6
Married	85	60.7
Separated	4	2.9
Divorced	10	7.1
Widowed	15	10.7
<b>Occupational status</b>		

Unemployed	14	10.0
Self-employed	21	15.0
Civil servant	17	12.1
Banker	3	2.1
Trader	25	17.9
Artisan	3	2.1
Farming	10	7.1
Others	47	33.6
<b>Educational status</b>		
Primary	50	35.7
Secondary	41	29.3
Tertiary	32	22.9
No formal education	17	12.1

**Table 2: Cardiovascular risk factors for Heart failure**

Risk factors	Freq (%)	Sex, n(%)		P-value	Age		P value
		Male	Female,		< 40yrs	≥ 40yr	
Ever smoked	21(15.0)	20(95.2)	1(4.8)	<0.001*	3(14.3)	18(85.7)	0.219
Current smoking	7(5.0)	6(85.7)	1(14.3)	0.109	1(14.3)	6(85.7)	0.502
Alcohol use	54(38.6)	46(85.2)	8(14.8)	<0.001*	9(16.7)	45(83.3)	0.071
Current Alcohol use	28(20.0)	24(85.7)	4(14.3)	0.910	7(25.0)	21(75.0)	0.088
History of diabetes	22(15.7)	11(50.0)	11(50.0)	0.508	1(4.5)	21(95.5)	0.016*
History of hypertension	65(46.4)	37(56.9)	28(43.1)	0.913	7(10.8)	58(89.2)	<0.001*
History of Dyslipidaemia	20(14.3)	9(45.0)	11(55.0)	0.266	3(15.0)	17(85.0)	0.265
<b>BMI</b>							
<18.5	11(7.9)	3(27.3)	8(72.7)		6(54.5)	5(45.5)	
18.5-24.9	60(42.9)	43(71.7)	17(28.3)	0.001*	17(28.3)	43(71.7)	0.027*
25.0-29.9	45(32.1)	26(57.8)	19(42.2)		10(22.2)	35(77.8)	
30 and above	24(17.1)	7(29.2)	17(70.8)		2(8.3)	22(91.7)	
Previous history of heart failure	57(40.7)	32(56.1)	25(43.9)	0.955	14(24.6)	43(75.4)	0.921
Family history of heart disease	41(29.3)	23(56.1)	18(43.9)	0.959	7(17.1)	34(82.9)	0.163
<b>Specific family history of heart disease</b>							
Hypertension	28(68.3)	13(46.4)	15(53.6)		5(17.9)	23(82.1)	
Diabetes Mellitus	2(4.9)	2(100.0)	0(0.0)		0(0.0)	2(100.0)	
Stroke	3(7.3)	3(100.0)	0(0.0)	0.218	1(33.3)	2(66.7)	0.873
HPT + DM	7(17.1)	4(57.1)	3(42.9)		1(14.3)	6(85.7)	
Cardiomyopathy	1(2.4)	1(100.0)	0(0.0)		0(0.0)	1(100.0)	
*p<0.05							

**Table 3: Causes of heart failure**

<b>Underline cardiac pathology</b>	<b>Frequency</b>	<b>Percent</b>
Hypertensive heart disease (HHD)	43	30.7
Ischemic heart disease (IHD)	19	13.6
Dilated cardiomyopathy (DCM)	41	29.3
<i>Idiopathic</i>	<i>28</i>	<i>68.3</i>
<i>Alcoholic</i>	<i>7</i>	<i>17.1</i>
<i>Postpartum</i>	<i>5</i>	<i>12.2</i>
<i>Diabetic</i>	<i>1</i>	<i>2.4</i>
Cor pulmonale	5	3.6
Valvular heart disease (VHD)	18	12.9
Congenital heart disease (CHD)	2	1.4
Thyrotoxic heart disease	4	2.9
Pericardial disease	2	1.4
Endomyocardial fibrosis (EMF)	4	2.9
Hypertrophic cardiomyopathy (HCM)	1	0.7
Atrial myxoma	1	0.7

Table 4: Comparison of common causes of HF by gender and age

<b>Cause</b>	<b>Sex, n (%)</b>		<b>P value</b>	<b>Age in years, n (%)</b>		<b>P value</b>
	<b>Male</b>	<b>Female</b>		<b>&lt; 40</b>	<b>≥ 40</b>	
HHD	28 (65.1)	15 (34.9)	0.168	5 (11.6)	38 (88.4)	0.015*
DCM	22 (53.7)	19 (46.3)	0.671	17(41.5)	24 (58.5)	0.004*
IHD	11(57.9)	8 (42.1)	0.890	0 (0.0)	19 (100.0)	0.004*
VHD	9 (50.0)	9 (50.0)	0.556	8 (44.4)	10 (55.6)	0.075
OTHERS	9 (47.4)	10 (52.6)	0.392	5 (26.3)	14 (73.7)	0.887

HHD = hypertensive heart disease; DCM= dilated cardiomyopathy; IHD= ischaemic heart disease; VHD= valvular heart disease. \*p≤ 0.05.