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Determinants of readmission amongst hospitalized patients with heart failure in Ghana and Nigeria: a prospective cohort study

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Abstract

Background Readmission following hospitalization for acute heart failure (HF) is an adverse prognostic event. Readmission rates for HF in African countries are variable, ranging from 1.53 to 25% in the first 30 days, and 12.2% to over 50% at 180 days. Few studies done in the African region have identified several determinants of HF readmission including New York Heart Association functional class, heart failure phenotype, older age, amongst others. This study sought to explore determinants of readmission amongst a contemporary cohort of adult patients hospitalized with HF in Ghana and Nigeria.

Methods This was a multicenter prospective cohort study, with 30- and 90-day follow-up after recruitment, conducted from June 2021 to April 2022, in two tertiary teaching hospitals in Ghana and Nigeria. A total of 201 adult patients who presented with acute heart failure at the two study sites were consecutively enrolled.

Results In this cohort of 201 patients (mean age (SD) 58.8 (15.6) years, 44.3% women), 8.0% and 13.9% were readmitted at 30- and 90-days, respectively. The odds of readmission at 30-days were higher in participants from Nigeria (OR = 4.3, 95% CI – 0.02–0.75, $p = 0.039$) and those with duration of heart failure diagnosis of 1 month to < 1 year (sub-acute HF) (OR = 4.0, 95% CI – -0.00-0.27, $p = 0.045$). Every unit increase in pulse rate was associated with almost 5-fold higher odds of readmission at 30-days (OR = 4.7, 95% CI – 0.00-0.01, $p = 0.031$). The odds of 90-day readmission were higher in participants with New York Heart Association functional class III-IV at discharge (OR = 5.1, 95% CI – -0.03–0.42, $p = 0.025$).

Conclusion Heart failure patients with sub-acute HF, higher pulse rates at baseline and higher NYHA functional class at discharge, may represent a vulnerable group at high risk of readmission in Ghana and Nigeria. Future studies should explore the mechanisms underlying this observation and consider interventions to reduce the risk of readmission amongst this unique patient population.

Clinical trial number Not applicable.

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Keywords Heart failure, Readmission, Ghana, Nigeria

Background

Heart failure (HF) is a global public health problem which affects over 64 million people worldwide [1]. Whilst prevalence was decreasing or stabilising in most high-income countries (HICs) from 1990 to 2019, Western sub-Saharan Africa experienced an increasing trend of 6.98% [2].

Heart failure accounts for approximately 1–2% of adult hospital admissions and is the commonest cause of hospitalization in persons above 65 years in HICs [1]. Limited data from Africa show that HF is a common cause of hospitalization and death among adults [3], accounting for over 9% of hospital admissions in a Nigerian study [4], and being the leading cause of cardiovascular admissions in a hospital in Ghana [5]. Readmission rates for HF in African countries range from 1.53 to 25% in the first 30 days, and 12.2% to over 50% at 180 days [4, 6, 7].

HF readmission is considered a marker of poor quality of care, indicating a lack of a comprehensive care model that addresses critical disease-modifying components [6]. A limited number of studies in the African continent, examining determinants of HF readmission, reported a broad range of factors including being elderly, having lower body mass index, lower literacy, lower serum sodium level, renal dysfunction, NYHA functional class, heart failure type, suboptimal pharmacotherapy, amongst others [4, 6, 7]. A large readmissions database in the United States showed that readmission was highest amongst racial and ethnic minorities, individuals with Medicare (public) insurance, and urban residence, but lower in high income groups [8]. With marked clinical heterogeneity of HF from one geographical region to another and the emergence of new HF phenotypes over the years, a context-specific approach to reducing HF readmissions is important. Identifying current context-specific determinants of HF readmission in this evolving clinical syndrome can help in planning preventive strategies to mitigate adverse outcomes. In this study, we explored the determinants of 30- and 90-day hospital readmission amongst a contemporary cohort of adult patients with a diagnosis of HF in two teaching hospitals in Ghana and Nigeria.

Methods

Study design and setting

This was a prospective cohort study of adults admitted with HF in two tertiary hospitals in Nigeria and Ghana – the University of Ilorin Teaching Hospital (UITH), Ilorin, Nigeria and Korle Bu Teaching Hospital (KBTH), Accra, Ghana. The UITH is a 600-bed facility and referral centre, responsible for in-patient and emergency care of patients across Kwara State. The Korle Bu Teaching Hospital (KBTH) is the third largest referral center in Africa with a 2,000-bed capacity located in Accra, Ghana. Patients are admitted to the wards via the department's outpatient service, the emergency department or through direct referrals from other peripheral health facilities.

Study population

Adult patients aged 18 years or older, admitted with a primary diagnosis of HF who gave informed consent and met the modified Framingham criteria for the diagnosis of HF [9] were recruited from June, 2021 to April, 2022. Patients with a previously established major medical co-morbidity including end-stage renal disease, chronic obstructive pulmonary disease, chronic pulmonary embolism and malignancy were excluded from this study.

Sample size determination

We calculated the sample size with the Fisher's formula [10] using data from a previously published study [7] and data on HF admissions for the year 2020 from both hospitals. The prevalence (p) of admissions for HF was estimated at 12.1% for UITH and 8% for KBTH. The standard score (z) was 1.96 at 95% CI, desired margin of error was 5% and we anticipated an attrition rate of 5%. A total minimum sample size of 187 was calculated (KBTH – 95; UITH – 92).

Clinical and echocardiographic evaluations

We consecutively recruited patients from the emergency rooms and medical wards of UITH and KBTH until the sample size was achieved. A structured questionnaire was used by trained research assistants to record data collected from all participants. Data collected at baseline included sociodemographic data, medical history, comorbidities, lifestyle risk factors, patient social and financial support systems, New York Heart Association (NYHA) functional class, physical examination findings, laboratory data and echocardiographic data.

Physical examination parameters consistent with a diagnosis of HF were confirmed based on the Framingham criteria [9]. Additional physical examination findings collected included pulse rate, blood pressure, and body mass index (BMI). All patients had a standard 2D, M-mode, and Doppler transthoracic echocardiogram done by cardiologists, or their cardiology trainees under supervision, in the hospital in which they were admitted. In KBTH, a General Electric Healthcare Vivid T8 Ultrasound system equipped with a 3.5 MHz cardiac transducer was used while an SSI-8000 Sonoscape ultrasound machine equipped with a 2.0 MHz probe was

used in UITH. Complete echocardiographic studies were reviewed and data on ejection fraction was collected. Data on the cause of HF was taken at discharge. This was based on the final diagnosis of the patient by the admitting team established after complete clinical evaluation and echocardiography.

Follow up assessment Participants were given a study card with contact details of the principal investigator and research assistants to facilitate follow-up. Participants and/or their caregivers were contacted at least two days to days 30 and 90 post-discharge respectively, to remind them of their follow-up visit and to collect data on readmission status (including the cause of readmission if readmitted) and mortality.

Statistical analysis

Data was analysed using Statistical Package for the Social Sciences (SPSS) software version 20. Participants' characteristics were summarized as mean (SD) for continuous variables and percentages for categorical variables. Chi-square analysis/two-sided Fischer's exact test was used to compare characteristics of patients readmitted with those not readmitted at 30- and 90-day follow-up, for categorical variables. For continuous variables, a parametric test (independent t-test) was used for normally distributed data whilst non-parametric tests were used for other continuous data. Univariate analysis was done using binary logistic regression. Variables that were found to be statistically significant in the univariate analysis at a p-value of ≤ 0.1 as well as age, gender, country and health insurance, were included in the model for multivariate analysis. Significant determinants of readmission at 30- and 90-days were then determined based on the odds ratio with p-value < 0.05.

Results

Characteristics of the study population

The mean age (SD) of the study participants was 58.8 (15.6) years and 44.3% were women (Table 1). Hypertension was the major comorbidity [140 (69.7%)]. 130 (64.7%) patients were admitted with new-onset symptoms of HF of less than one-month duration. The most prevalent HF phenotype was HF with reduced ejection fraction (HFrEF) [147 (73.1%)] (Supplementary Table 2) and hypertensive heart disease was the commonest cause of HF [67 (33.3%)] (Supplementary Table 2).

Diuretics were the most prescribed medications [195 (97.0%)]. Angiotensin converting enzyme inhibitors (ACE-I) were more commonly prescribed over angiotensinogen receptor blockers (ARBs) for renin-angiotensin-aldosterone-system inhibition (RAASi). Two key heart failure medications, ARNIs (angiotensinogen receptor/neprilysin inhibitor) and sodium-glucose co-transporter 2 (SGLT2) inhibitors were less frequently prescribed. Most patients were admitted at NYHA functional class III-IV [175 (87.1%)], however, by discharge, the predominant functional class was NYHA I-II [186 (92.5%)].

Hospital readmission rate

The 30- and 90-day all-cause readmission rates were 8.0% and 13.9% respectively. Mortality rate was 5.0% at 30-days and 17.9% at 90-days. Significant determinants of hospital readmission at 30-day follow-up included higher baseline pulse rate, HF diagnosis of one month to one year (sub-acute HF), and coming from Nigeria (Table 2). 90-day all-cause readmission was significantly associated with a higher NYHA functional class of III-IV at discharge.

Discussion

The 30-day and 90-day all-cause readmission rates in this cohort of adult patients hospitalized with acute HF in Ghana and Nigeria were 8% and 13.9%, respectively. While there are no studies in Ghana examining HF readmission rates, there are no studies in Nigeria or Ghana examining 90-day readmission rate. One study in Nigeria found a 30-day readmission rate of 1.53% [7]. In Tanzania, 30-day readmission rate was 25% [6]. Variations in readmission rates may be attributable to differing clinical profiles of patients recruited in these cohorts.

A duration of HF diagnosis of one month to one year (sub-acute HF), was a significant determinant of all-cause readmission at 30-days, with increased odds of all-cause readmission in this category of patients as compared with those diagnosed with HF for over a year (chronic HF) prior to recruitment. In addition, every unit increase in baseline pulse rate was associated with almost 5-fold higher odds of readmission at 30-days. 90-day all-cause readmission was significantly associated with a higher NYHA functional class of III-IV at discharge compared with NYHA Class I-II.

The relationship between duration of HF diagnosis and HF outcomes such as readmission has not been widely studied leading to uncertainty of the impact of this parameter on HF outcomes. Limited studies examining readmission amongst patients with HF in Africa did not explore this relationship [4, 6, 7]. However, studies done in HICs have shown variable associations. Yeoh et al. and Greene et al.'s multinational studies recruiting large cohorts of HF patients living in the US, Asia and Europe, showed that readmission was less in patients with new-onset HF compared with those diagnosed for longer durations, similar to findings in this study [11–13]. An arbitrary cut-off for new-onset HF was set at < 2 months by Yeoh et al. [11, 12] Some HIC studies have additionally demonstrated a graded relationship between HF duration and readmission in contrast with

Table 1 General Characteristics of Study Population

Characteristic	Ghana (*n* = 101)	Nigeria (*n* = 100)	Pooled (*n* = 201)	*p*-value
Age (years), Mean ± SD	58.7±15.3	59.0±16.1	58.8±15.6	0.908
Age category ≥ 60 (years), n (%)	51(50.5)	56(56.0)	107(53.2)	0.434
Female, n (%)	49(48.5)	40(40.0)	89(44.3)	0.200
Not married, n (%)	39(38.6)	23(23.0)	62(30.8)	0.017
Educational level, n (%)				
No formal education	17(16.8)	21(21.0)	38(18.9)	0.002
Basic & Secondary[†]	69(68.3)	45(45.0)	114(56.7)	
Tertiary	15(14.9)	34(34.0)	49(24.4)	
Have no help with self-care, n (%)	6(5.9)	2(2.0)	8(4.0)	0.279
Have no health insurance, n (%)	17(16.8)	98(98.0)	115(57.2)	< 0.001
BMI (kg/m^2), Median (IQR)	25.8(4.8)	23.2(4.6)	24.1(5.0)	< 0.001
Pulse rate(bpm), Median (IQR)	75(18)	82(24)	80(23)	0.041
SBP(mmHg), Median (IQR)	122(32)	120(32.5)	120(32.5)	0.178
Lifestyle risk factors, n (%)				
Infrequent physical activity[∞]	94(93.1)	35(35.0)	129(64.2)	< 0.001
Positive smoking history	11(10.9)	13(13.0)	24(11.9)	0.645
Positive alcohol history	58(57.4)	11(11.0)	69(34.3)	< 0.001
Comorbidities, n (%)				
Hypertension	82(81.2)	58(58.0)	140(69.7)	< 0.001
Diabetes	26(25.7)	17(17.0)	43(21.4)	0.131
Stroke	4(4.0)	7(7.0)	11(5.5)	0.373
Laboratory parameters, n (%)[a, c]				
Sodium (mmol/L)				
<135	29(28.7)	35(35.7)	64(32.2)	0.241
135–145	61(60.4)	58(59.2)	119(59.8)	
>145	11(10.9)	5(5.1)	16(8.0)	
Potassium (mmol/L)				
<3.5	45(45.9)	20(19.8)	65(32.7)	< 0.001
3.5–5.5	51(52.0)	75(74.3)	126(63.3)	
>5.6	2(2.0)	6(5.9)	8(4.0)	
eGFR < 60 (ml/min/1.72m^2)	36(35.6)	36(36.7)	72(36.2)	0.873
EF(%), Median(IQR)	35(24.5)	32(14)	33(17.7)	0.525
HF type, n (%)				
HFrEF	68(67.3)	79(79.0)	147(73.1)	0.014
HFmrEF	10(9.9)	13(13.0)	23(11.4)	
HFpEF	23(22.8)	8(8.0)	31(15.4)	
Duration of HF diagnosis[a](years), Mean ± SD	1.5±2.9	0.3±0.6	0.9±2.2	< 0.001
Duration of HF diagnosis[a], n (%)				
<1 month (new-onset HF)	60(60.6)	70(70.0)	130(65.3)	0.026
1 month to ≤ 1 year (sub-acute HF)	9(9.1)	15(15.0)	24(12.1)	
>1 year (chronic HF)	30(30.3)	15(15.0)	45(22.6)	
On ≥ 2 HF medications, n (%)	65(64.4)	58(58.0)	123(61.2)	0.355
Previously hospitalized for HF, n (%)	46(45.5)	21(21.0)	67(33.3)	< 0.001
NYHA Class III - IV on admission, n (%)	76(75.2)	99(99.0)	175(87.1)	< 0.001
NYHA Class III - IV on discharge, n (%)	12(11.9)	3(3.0)	15(7.5)	0.029
Drug Therapy				
Diuretics	101(100)	94(94.0)	195(97.0)	0.014
Aldosterone Antagonist	25(24.8)	59(59.0)	84(41.8)	< 0.001
RAASi				
ACE-inhibitor	77(76.2)	58(58.0)	135(67.2)	0.006
ARB	5(5.0)	10(10.0)	15(7.5)	0.191
ARNI (Sacubitril/Valsartan)	4(4.0)	1(1.0)	5(2.5)	0.369
Beta-blocker	72(71.3)	43(43.0)	115(57.2)	< 0.001

Table 1 (continued)

Characteristic	Ghana (*n* = 101)	Nigeria (*n* = 100)	Pooled (*n* = 201)	*p*-value
SGLT2i	3(3.0)	0(0.0)	3(1.5)	0.246
Digoxin	29(28.7)	15(15.0)	44(21.9)	0.019

[a]Missing data: 2

[†]Basic and secondary level education refers to primary level up to senior secondary school education

[∞]Physical activity levels were self-reported. Weekly physical activity on at least 5 days per week was recorded as frequent whilst infrequent physical activity was recorded if this standard was not met

[c]eGFR was calculated using the Modification of Diet in Renal Disease Study equation for estimating eGFR

ACE-angiotensin converting enzyme, ARNI-angiotensinogen receptor/neprilysin inhibitor, BMI-Body mass index, bpm-beats per minute, DBP-Diastolic blood pressure, EF-ejection faction, HF-Heart failure, HFrEF-HF with reduced ejection fraction, HFmrEF-HF with mildly reduced ejection fraction, HFpEF-HF with preserved ejection fraction, NYHA-New York Heart Association, RAASi- renin-angiotensin-aldosterone inhibitor, SBP-Systolic blood pressure, SD-Standard deviation, SGLT2I-Sodium-glucose cotransporter-2 inhibitor

Table 2 Multivariate regression analysis of determinants of 30-day and 90-day readmission

Characteristic	30-day Readmission		90-day Readmission	
	Adjusted OR(95% CI)	*p*-value	Adjusted OR(95% CI)	*p*-value
Country				
Ghana	Reference	0.039	Reference	0.096
Nigeria	4.25(0.02–0.75)		2.77(-0.07-0.85)	
Age(years)[a]	0.08(0.00-0.08)	0.784	0.04(-0.003-0.003)	0.834
Sex				
Male	Reference	0.406	Reference	0.178
Female	0.69(-0.10-0.04)		1.81(-0.156-0.029)	
Educational level				
No formal education	-	-	Reference	0.630
Basic & Secondary[†]			0.23(-0.16-0.15)	0.123
Tertiary			2.38(-0.03-0.27)	
Financial support				
Has health insurance	Reference	0.733	Reference	0.609
No health insurance	0.12(-0.16-0.11)		0.26(-0.231-0.135)	
Pulse rate(bpm)[a]	4.65(0.00-0.01)	0.031	3.34(0.00-0.01)	0.067
Duration of HF diagnosis[c]				
>1 year (chronic HF)	Reference	0.045	Reference	0.200
1 month to ≤ 1 year (sub-acute HF)	4.03(-0.00-0.27)	0.388	1.64(-0.056-0.269)	0.349
<1 month (new-onset HF)	0.75(-0.13-0.05)		0.88(-0.194-0.069)	
Previously hospitalized for HF[d]	-	-	0.47(-0.16-0.08)	0.494
NYHA Class at discharge				
NYHA I – II	-	-	Reference	0.025
NYHA III - IV			5.05(0.028–0.417)	

[a]Data inputted as continuous variable

[c] Missing data: 2

[d] Reference category is patients not previously hospitalized for HF

[†]Basic and secondary level education refers to primary level up to senior secondary school education

bpm-beats per minute, HF-Heart failure, NYHA-New York Heart Association

our findings, which showed that the risk for readmission was highest in patients with an HF duration of diagnosis of one month to one year (sub-acute HF) as compared with patients with chronic HF for over a year [11, 13, 14]. These contrasting findings may be explained by differing sociodemographic and clinical profiles of HF patients recruited in this cohort of West African patients with HF as compared with those in HIC studies. Patients with HF in the HIC studies appear to have more comorbidities and advanced disease requiring advanced HF therapy including device therapy indicating more severe disease with associated higher risk of readmission.

In LMICs like Ghana and Nigeria where patients experience significant barriers in accessing healthcare, it is plausible that patients with HF may delay substantially beyond one month before presenting to the hospital for care. Poor health-seeking behaviour upon initial symptom onset resulting in late presentation to the hospital for care is associated with worse outcomes [4, 7]. In addition, HF patients often present to a primary care facility

prior to being referred for specialist care in tertiary facilities like those in which the present study was conducted. These primary care facilities may lack the capacity to promptly diagnose and treat HF, leading to a delay in the initiation of comprehensive HF care at the very early stages of the disease, with an associated increased risk of unfavourable outcomes such as early readmission [3, 15]. Primary care providers need to be empowered to accurately diagnose and adequately treat HF in the community before upstream referrals are made. This may be achieved by supporting primary care providers with context-appropriate diagnostic and treatment algorithms, and the use of strategies like task-shifting and task-sharing at the community level to expand the HF care workforce [16].

A higher pulse rate on admission was associated with higher odds of readmission at 30-days follow up. This effect was similarly observed in the THESUS-HF registry where pulse rate was a predictor of readmission albeit at 60-days after discharge [17]. There is limited evidence on the association between admission pulse rate and readmission in acute HF patients. A high pulse rate is however a strong predictor of outcomes in HF [18]. In this study, patients with higher pulse rates on admission may have therefore represented a high-risk category who were more likely to be readmitted.

Akpa et al. similarly found that a higher NHYA functional class was a significant determinant of readmission, the odds of readmission being almost three-fold higher in patients in NHYA class IV [4]. NYHA functional class has been linked to readmission in other studies in the African region [6, 7] but is a less common predictor in Europe and the USA [19] likely due to more structured HF programs and comparatively better access to newer guideline-directed medical therapy. This suggests that failure to optimize symptom status prior to discharge may put patients at a higher risk for readmission.

Strengths and limitations

The strengths of our study include the multicentre approach and complete follow-up data which makes interpretation of the outcome measures of readmission more reliable. There were however some limitations. Though we collected data on HF medication initiation in-hospital, we did not collect further data on uptitration of medications by discharge which could have influenced 30- and 90-day all-cause readmission. We could not assess the impact of newer heart failure medications such as ARNIs and SGLT2i on all-cause readmission, as very few patients were on these medications at the time of recruitment, likely because these medications were relatively new on the market, expensive and not routinely covered by health insurance in Ghana and Nigeria at the time we conducted the study.

Conclusion

In this cohort of Ghanaian and Nigerian patients presenting for hospitalization with HF, 30- and 90-day all-cause readmission rates were relatively high and were associated with sub-acute HF (duration of HF diagnosis of one month to one year), higher pulse rate and higher NYHA functional class III-IV at recruitment. Reducing readmissions among HF patients in Ghana and Nigeria may be achieved by exploring these determinants in future studies to aid in the development of context-appropriate interventions.

Abbreviations

ARNIs	Angiotensinogen receptor/neprilysin inhibitor
BMI	Body mass index
HF	Heart failure
HFrEF	Heart failure with reduced ejection fraction
HICs	High income countries
LMICs	Low-middle income countries
NYHA	New york heart association
SGLT2i	Sodium-glucose co-transporter 2 inhibitor
SPSS	Statistical package for the social sciences
SSA	Sub-saharan Africa

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Supplementary Information

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Supplementary material 1

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Author contributions

Conceptualization: DA, AI, ORH, OAS, MBA, EY, BT, GOData Acquisition: AI, DAData Analysis/interpretation: DA, AI, ORH, BTWriting of the manuscript: DA, ORH, AIAll others reviewed the manuscript.

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Data availability

All data generated or analyzed during this study are included in this manuscript.

Declarations

Ethics approval

The study was approved by the Institutional Review Board of KBTH (KBTH-IRB/000/2021) and the UITH Health Research Ethics Committee (UITH-ERC/PAN/2021/01/0115).

Consent for publication

Written informed consent was obtained after the aims and objectives of the study were thoroughly explained to the patients. All questionnaires were anonymized with a unique identified code known only to the study investigators.

Competing interests

The authors declare no competing interests.

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