In-hospital Mortality and its Associated Factors among People with Acute Heart Failure Presented to Emergency Department at Haramaya University Hiwot Fana Comprehensive Specialized Hospital, Harar Eastern Ethiopia

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Background: Acute heart failure is a sudden and severe condition in which the heart is unable to pump blood efficiently to meet the body's demands. This results in a rapid accumulation of fluid in the lungs and/or other parts of the body, leading to symptoms such as shortness of breath, fatigue, fluid retention, and swelling in the legs or abdomen. Despite its high burden, there are paucity of data in study setting. Therefore, this study aimed to assess in-hospital mortality and its associated factors among people with acute heart failure presented to emergency department at Hiwot Fana Comprehensive Specialized Hospital, Harar Eastern Ethiopia.

Methods: An institution-based cross-sectional study with a retrospective chart review was conducted among 256 patients diagnosed with acute heart failure between January 2020 and January 2022. Data were retrieved and extracted from April to May 2022. Data were extracted using a checklist, and analyzed using Statistical Package for Social Science 23. Multivariable binary logistic regression was employed to identify factors associated with in-hospital mortality. Adjusted odds ratios with corresponding 95% confidence intervals were calculated to show the strength of the associations. Factors with p-value < 0.05 were declared statistically significant.

Results: Of the 256 study participants, 64.9% (95% CI: 59.0%–70.7%) had acute decompensated heart failure, and the majority (86.3%) were classified as New York Heart Association class IV. Major precipitating factors were identified in 70% of the cases, with pneumonia being the most common (53.1%). Comorbid conditions were present in 53.1% of the participants. In-hospital mortality was 13.6% (95% CI: 12.91% – 14.28%). Multivariable analysis showed that initial triage scores >7 (AOR=3.25; 95% CI: 1.08-9.78), low diastolic blood pressure (AOR= 5.81; 95% CI: 1.79 – 18.91), and low left ventricular ejection fraction (AOR= 3.53; 95% CI: 1.31 – 9.53) were factors associated with in-hospital mortality.

Conclusion: This study highlights the significant concern of in-hospital mortality of acute heart failure. It further reveals that acute decompensated heart failure accounts for the majority of acute heart failure cases, with pneumonia emerging as the leading precipitating factor. Key associated factors of in-hospital mortality include a high initial triage score, low diastolic blood pressure, and reduced left ventricular ejection fraction. Enhanced monitoring and tailored care plans for patients with low diastolic blood pressure or reduced ejection fraction should be in place to prevent deterioration.

Keywords: Acute Heart Failure, Clinical profiles, Emergency Medicine Department, Hiwot Fana Comprehensive Specialized Hospital, In-hospital Mortality

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Introduction

Acute heart failure (AHF) is a clinical syndrome characterized by the rapid onset or worsening of heart failure symptoms, necessitating urgent medical intervention (Gheorghiade *et al*., 2005). The clinical presentation of AHF is heterogeneous and often categorized into distinct phenotypes, such as acutely decompensated heart failure, cardiogenic shock, pulmonary edema, and right side heart failure (Parissis *et al.,* 2010). The EuroHeart Failure survey highlighted that a significant proportion of patients hospitalized for AHF exhibit varying degrees of congestion and perfusion abnormalities, complicating management and prognostication (Chioncel *et al*., 2017). The management of AHF has evolved, with recent guidelines emphasizing a comprehensive approach that includes both pharmacological and non-pharmacological interventions (Arrigo *et al*., 2016). Diuretics remain the

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cornerstone of treatment for managing fluid overload, while vasodilators may be employed to alleviate symptoms of congestion (Arrigo *et al.,* 2016). Recent studies have underscored the importance of early identification and management of congestion and perfusion status in AHF patients (Mauro *et al*., 2023).

Despite significant advances in the management of chronic heart failure, in-hospital mortality remains high, ranging from 4 to 12% (Abraham *et al*., 2005; Damasceno *et al*., 2012; Chioncel *et al.,* 2017). The prognosis is particularly poor for patients requiring admission to the cardiac care unit and those needing inotropes and/or vasopressors. Post-discharge mortality rates are also concerning, with one in five patients dying within a year following hospitalization for acute decompensated heart failure. The early post-discharge period is especially critical, as 10% of patients die within the first three months, making this phase highly vulnerable. This remains true in low and middle income countries with in-hospital mortality rates ranging from 5% to 15% (Abraham *et al*., 2005). Moreover, patients who survive hospitalization face a high risk of readmission and long-term mortality, with studies indicating that approximately 25% of patients are readmitted within 30 days (Chioncel *et al.,* 2017). Factors contributing to in-hospital mortality includes the severity of heart failure at presentation, comorbidities, and the effectiveness of the initial management strategy (Fonarow and Committee, 2003).

Although extensive research has been conducted on AHF, most studies have been population-based, with limited focus on hospital-based settings. This study seeks to address that gap of contemporary in-hospital mortality and associated factors of AHF in a context where healthcare infrastructure is relatively under developed. Gaining a deeper understanding on the determinants of mortality in such environments can offer valuable insights for optimizing patient management and informing context-specific treatment strategies. Accordingly, this study aimed to assess the in-hospital mortality and its associated factors among people with AHF presented to emergency department at Hiwot Fana Comprehensive Specialized Hospital, Harar Eastern Ethiopia.

Materials and Methods

Study Setting, Design, and Period

The study was conducted at Haramaya University Hiwot Fana Comprehensive Specialized Hospital (HUHFCSH) in Harar, Eastern Ethiopia. The hospital has a capacity of 300 beds and employs approximately 700 healthcare providers. It functions as a teaching hospital, offering both undergraduate medical programs and postgraduate residency training under the medical school. The HARME Emergency Medical Center, located 900 meters from the main hospital building, receives about 12,477 patient visits annually. An institution-based cross-sectional study design was employed. The study included patients who presented between January 7, 2020, and January 7, 2022. Data extraction took place from April to May, 2022.

Population and Sampling

Annually, the Emergency Medicine Department of HUHFCSH receives approximately 12,477 patient visits. For this study, all patients diagnosed with acute heart failure (AHF), whether managed as outpatients or admitted to the hospital during the study period, were considered for inclusion. Patients with incomplete medical records were excluded from the study.The sample consisted of all AHF patients who met the inclusion criteria within the study timeframe. A consecutive sampling method was employed, enrolling every eligible AHF patient presenting to the Emergency Medicine Department during this period.

Data Collection Instruments and Procedures

The data collection tool was developed by the investigators and validated with a Cronbach's alpha of 0.59. A retrospective chart review was conducted by examining patients' medical records. Data were collected by two B.Sc. nurses using a structured hardcopy checklist and recorded on extraction form covering the period from admission to discharge. The data included demographic variables (e.g., age, gender), comorbidities, details of medication used during hospitalization, clinical presentations observed at admission, and echocardiographic findings. Additionally, management strategies and in-hospital outcomes of AHF patients were obtained through a thorough review of medical charts.

Operational Definition/Definition of Terms

Precipitating factors: Factors attributed to the cause of AHF as determined by the treating physician.

In-hospital mortality: Refers to AHF patients who died in the hospital after being kept in the emergency department or admitted to the ward (Tigabe *et al.,* 2021).

New-onset heart failure: AHF occurring in patients without a prior history of heart failure (Chioncel *et al*., 2017).

New York Heart Association: Functional classification categorizes AHF into four classes based on symptom severity and physical limitations. Class I, class II, class III and class IV (Russell *et al*., 2009).

Acute heart failure hemodynamic profile: Classifying into different clinical profiles based on hemodynamic status and fluid accumulation. As A, B, C and L (Marini *et al*., 2023).

Triage: categorizing as red, orange, yellow and green by adding various parameters of patient's vital signs, including respiratory rate, heart rate, systolic blood pressure, temperature, oxygen saturation, and level of consciousness (Torun and Durak, 2019).

Acute heart failure: The diagnosis of AHF is based on the physician's evaluation at the time of the patient's assessment (Ponikowski *et al.,* 2016).

Data Processing and Analysis

Data were edited, cleaned, coded, entered, and analyzed using the Statistical Package for Social Science version 23. Descriptive analysis was performed to summarize the baseline characteristics, clinical features, management, and in-hospital outcomes of AHF patients. The information is presented in frequencies and percentages using figures and table. Multivariable logistic regression was employed to determine the factors associated with in-hospital mortality. The Hosmer-Lemeshow goodness-of-fitness test was used to assess the model's fit (value of 0.853). Both crude odds ratios (COR) and adjusted odds ratios (AOR) with the corresponding 95% confidence intervals (CI) were calculated to demonstrate the strength of association. Variables with a p-value ≤ 0.2 in the COR were candidate for a multivariable logistic regression model A p-value < 0.05 in the multivariable regression model was considered to declare statistically significant association.

Data Quality Control

To ensure the integrity and reliability of the data collection process, multiple quality assurance measures were implemented, including meticulous data verification by the principal investigator for completeness, accuracy, and clarity prior to analysis. Comprehensive training sessions equipped data collectors and supervisors with essential skills, covering the study's purpose, sampling procedures, and data extraction techniques. A structured checklist were employed to minimize variability, while pilot testing identified and resolved potential challenges. Continuous supervision and real-time feedback further ensured consistency and maintained high standards throughout the process.

Ethical Approval

Ethical clearance was obtained from Haramaya University College of Health and medical sciences, Institutional Health Research Ethics Review Committee, (IHRERC/073/2022) and supporting letter was received from Hiwot Fana comprehensive specialized hospital chief executive director. The hospital administers were informed about the importance of this study in improving the management of patients admitted with heart failure in the particular context. All methods were performed in accordance with the declaration of Helsinki.

Results

Socio-demographic characteristics of participants

A total of 280 patients with acute heart failure (AHF) were admitted to the HARME Medical Emergency Center of Hiwot Fana Comprehensive Specialized Hospital. Of these, 256 patients were included in the study, yielding a response rate of 91.5%. Twenty-four patients were registered in the department's registry, but their medical records could not be retrieved. Among the study participants, 62.5% were female, with a mean age of 48.67 ± 13.03 years. Of the total patients, 90 (35.1%) had new-onset (de novo) heart failure, while 166 (64.9%) were admitted with acute decompensated heart failure (Table 1).

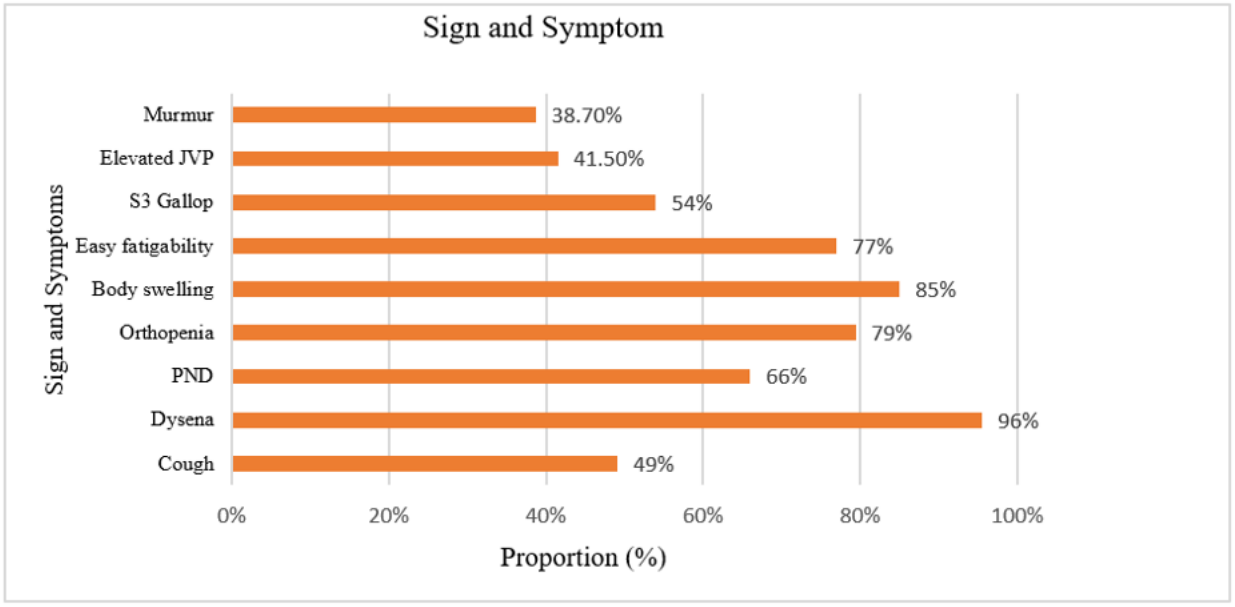
Table 1: Socio-demographic characteristics and clinical profile of AHF patients admitted to emergency department of HUHFCSH, Harar Eastern Ethiopia 2022 (n= 256)

Variable	Description	Frequency	Percentage
Age	18-30	28	10.9%
	31-40	71	27.7%
	41-50	77	30.1%
	51-60	49	19.2%
	≥ 61 years	31	12.1%
Sex	Male	96	37.5%
	Female	160	62.5%
Triage score	> 7 (Red)	66	25.8%
	5- 6 (Orange)	60	23.4%
	3- 4 (Yellow)	51	19.9%
	0 -2 (Green)	79	30.9%
Residency	Urban	59	23.0%
	Rural	197	77.0%
Acute heart failure type	New heart failure	90	35.2%
	Acute decompensated	166	64.8%
Comorbidities	Hypertension	40	29.4%
	Diabetics Mellitus	27	19.8%
	Renal Disease	22	16.2%
	Liver Disease	14	10.3%
	COPD	31	22.8%
	Old Stroke	2	1.5%
New York Heart Association	III	35	13.7%
	IV	221	86.3%
Hemodynamic profile	A	13	5.0%
	B	189	74.0%
	C	43	16.7%
	L	11	4.3%

COPD: Chronic obstructive pulmonary disease

Clinical profile and precipitant factors

Upon admission, 221 (86.3%) were classified as New York Heart Association (NYHA) functional class IV, while 35 patients (13.7%) presented with class III. In terms of hemodynamic profiling, most patients (74%) were categorized as profile B (Table 1). The mean systolic blood pressure was 107.5 ± 15.25 mmHg, while the mean diastolic blood pressure was 61.8 ± 19.02 mmHg. Similarly, the mean pulse rate at admission was 101.2 ± 15 beats/min, and the mean oxygen saturation was 88 ± 9.37%.On admission, most patients presented with multiple symptoms. Dyspnea was the most common, affecting 246 patients (96%), followed by peripheral edema in 217 patients (85%), orthopnea in 202 patients (79%), and easy fatigability in 197 patients (77%) (Figure 1).



JVP: Jugular Venous Pressure, PND: Paroxysmal Nocturnal Dyspnea

Figure 1: The common sign and symptom among people with AHF admitted to emergency department of HUHFCSH, Harar Eastern Ethiopia, 2022 (n= 256).

Among the 256 participants, 136 (53.1%) had documented comorbid conditions. The most common comorbidities identified were hypertension (29.4%), diabetes mellitus (19.8%), chronic obstructive pulmonary disease (22.8%), and renal disease (16.2%).

Precipitating factors were identified among 180 (70%) patients. Pneumonia accounted for 54.1% of precipitants. The remaining precipitating factors included non-compliance with medication (30%), atrial fibrillation (7.7%), anemia (7.7%), and hyperthyroidism (0.5%) (Figure 2).

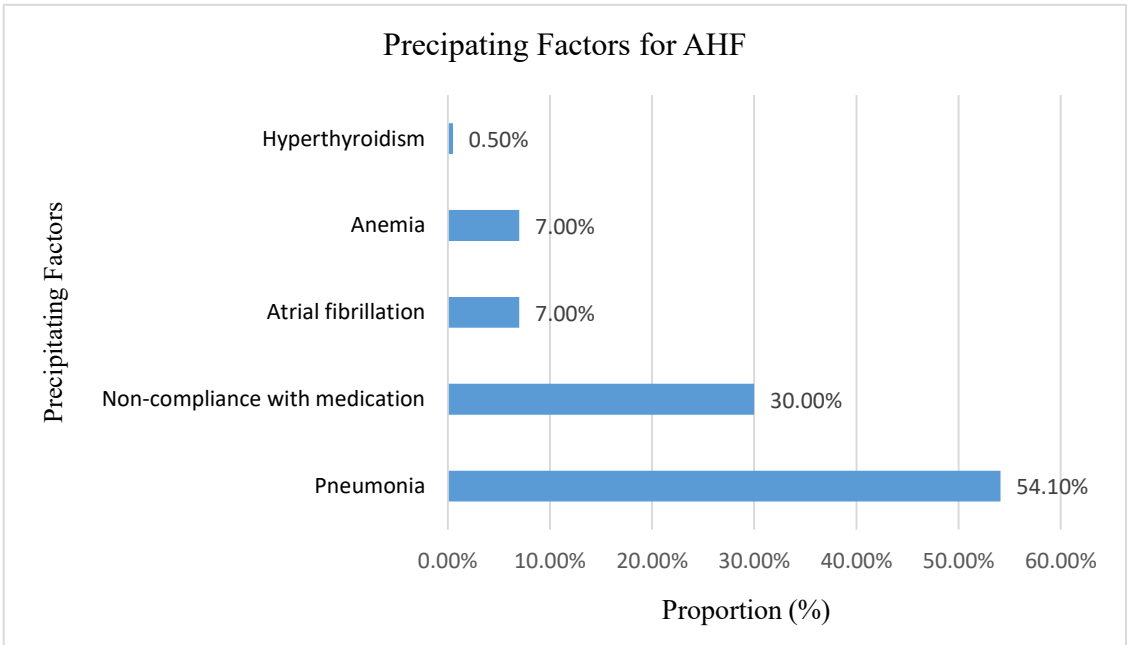


Figure 2: Common precipitant factors among people with AHF patients admitted to emergency department of HUHFCSH, Harar, Eastern Ethiopia, 2022 (n= 256)

Imaging, and laboratory profiles with type of cardiac diseases

Electrocardiogram (ECG) recordings were available for 110 (43.0%) patients. The identified ECG abnormalities included atrial fibrillation in 34 (13.3%) patients, sinus tachycardia in 31 (12.1%) patients, atrial flutter in one (0.4%) patient, AV block in three (1.2%) patients, pathological Q waves in eight (3.1%) patients, and ST segment elevation in seven (2.7%) patients.

Echocardiography reports for 118 patients was retrieved and show that ischemic heart disease was found in 37 patients (31.4%) and hypertensive heart disease in 28 patients (23.7%). The mean left ventricular ejection fraction was 44.00 ± 11.24. Among the patients, 43 (36.4%) had heart failure with reduced ejection fraction, while 75 (63.6%) had heart failure with preserved ejection fraction (Table 2).

Table 2: Types of cardiac diseases among AHF patients admitted to emergency department of HUHFCSH, Harar, Eastern Ethiopia, 2022 (n= 256)

Type of cardiac disease	Frequency	Percent (%)
Ischemic heart disease	37	31.4%
Hypertension heart disease	28	23.7%
Dilated cardiomyopathy	17	14.4%
Valvular heart disease	23	19.5%
Right side heat failure	13	11%

Treatment and in-hospital mortality

During hospitalization, 248 (96.8%) patients were treated with furosemide. Following furosemide, the most used agents included spironolactone 129 (50.3%) patients), atorvastatin 82 (32%) patients), and aspirin 58 (22.6%) patients). At discharge, the most prescribed medications for heart failure patients were furosemide 212 (82.7%), angiotensin-converting enzyme inhibitors 199 (77.8%), beta-blockers 160 (62.5%), aspirin 114 (44.7%), spironolactone126 (49.2%), and digoxin 59 (23.2%).

The in-hospital mortality rate in this study was 13.6% (95% CI: 12.91 – 14.28) while 84.4% of patients were discharged with symptom improvement. The median (IQR) duration of hospitalization for non-survivors was 4 days (1-6 days). Additionally, 2.2% of patients left against medical advice, and the median (IQR) length of hospital stay for discharged patients was eight days (4–12 days).

Factors associated with in-hospital mortality

Bivariable binary logistic regression was performed to assess factors associated with in-hospital mortality, including age, sex, place of residence, initial triage score, systolic blood pressure less than 90, diastolic blood pressure less than 60, precipitant factors, and low ejection fraction (less than 40).The multivariable regression employed on the variables revealed that an initial triage score classified as red (>7) (AOR = 3.25; 95% CI: 1.08–9.78), diastolic blood pressure less than 60 mmHg (AOR = 5.81; 95% CI: 1.79–18.91), and low ejection fraction (AOR = 3.53; 95% CI: 1.31–9.53) were independently associated with in-hospital mortality among patients with AHF. (Table 3).

Table 3: Factors associated with in-hospital mortality among people with AHF patients admitted at emergency department of HUHFCSH, Harar, Eastern Ethiopia 2022 (n= 256)

Variables	Categories	In-hospital mortality		COR* (95% CI#)	AOR** (95% CI)
		Yes	No		
Sex	Female	25	135	1.79 (0.80 – 4.02)	1.39 (0.31 – 6.22)
	Male	9	87	1	.
Residency	Rural	30	167	0.41 (0.13 – 1.2)	0.26 (0.03 – 2.54)
	Urban	4	55	1	1
Triage score	>= 7	21	45	6.35 (2.96 – 13.65) £	3.25 (1.08- 9.78) *
	< 7	13	177	1	1
Orthopnea	Yes	30	172	2.18 (0.73 – 6.48)	0.40 (0.09 – 1.78)
	No	4	50	1	1
Systolic blood pressure	Less than 90	26	125	2.52 (0.54 – 5.81) £	1.26 (0.35 –4.51)
	More than 90	8	97	1	1
Diastolic blood pressure	Less than 60	20	105	1.59 (0.76 – 3.31)	5.81 (1.79 – 18.91) *
	More than 60	14	117	1	1
New York Heart Association	IV	30	191	1.21 (0.41 – 3.69)	1.19 (0.27 - 5.25)
	III	4	31	1	1
Ejection fraction	Low ejection fraction (<40)	21	37	3.81 (1.65 – 8.79) £	3.53 (1.31 – 9.53) *
	Preserved ejection fraction (>= 40)	11	49	1	1.

Discussion

The in-hospital mortality rate observed in this study was 13.4%, aligning with some global and regional findings while showing notable variations compared to specific studies (Logeart *et al.,* 2013; Sulaiman *et al.*, 2015; Sinan et al., 2019). These differences can be attributed to disparities in healthcare infrastructure, patient demographics, clinical management protocols, and study methodologies (Joseph *et al.,* 2023). For instance, studies in Italy and India reported lower in-hospital mortality rates of 8% (Lombardi *et al*., 2020) and 11% (Harikrishnan *et al*., 2017), respectively. Studies from high-income countries such as the United States and European nations typically report mortality rates ranging from 5% to 10% (Maggioni *et al.,* 2013; Mentz and O'connor, 2016). The lower rates likely reflect better healthcare systems, early diagnosis, and advanced treatment protocols (Joseph *et al.,* 2023). The Sub-Saharan Africa Survey of Heart Failure reported a significantly lower mortality rate of 4.2% possibly due to the exclusion of cases such as acute ST-elevation myocardial infarction, severe renal failure, nephrotic syndrome, hepatic failure, or other causes of hypoalbuminemia (Damasceno *et al.,* 2012). These conditions often coexist in AHF cases and may have contributed to the higher mortality observed in our study.

In contrast, studies from other low-resource settings have reported higher mortality rates. A study in Ethiopia at Saint Paul's Hospital Millennium Medical College found an in-hospital mortality rate of 24.4% (Asfaw, 2020), while a study in Nigeria reported a rate of 15.7% (Ogah *et al*., 2014). These higher rates may be attributed to a greater burden of severe cases, as both facilities serve as tertiary care, primarily admitting critically ill and end-stage patients, which could contribute to higher mortality than observed in our study (Morris *et al*., 2022).

In this study, factors significantly associated with in-hospital mortality included low ejection fraction (EF < 40%), low diastolic blood pressure (< 60 mmHg), and a high initial triage score (red, > 7). These findings align with results from other studies, emphasizing the importance of early risk stratification in AHF patients. For instance, a study conducted in India found that systolic dysfunction was a strong predictor of in-hospital mortality in AHF patients (Chopra *et al,* 2019). Similarly, a Nigerian study revealed that patients with left ventricular ejection fraction ≤ 40% had a significantly

higher risk of death during hospitalization (Ogah *et al*., 2014). Our study also demonstrated that patients with an initial triage score of red had three times the odds of dying, which is consistent with literature highlighting the prognostic value of early triage assessments in AHF management (Passantino *et al*., 2015).

The association between low diastolic blood pressure (< 60 mmHg) and increased mortality in this study is consistent with existing evidence linking hypotension to poor outcomes in AHF patients (Lee *et al*., 2006; Tringali, Oberer and Huang, 2013). Reduced perfusion pressure in patients with low diastolic blood pressure can compromise organ function and may contribute to higher mortality, as seen in previous studies (Mancia and Grassi, 2014). This finding emphasizes that low diastolic blood pressure in AHF patients is a critical indicator of poor prognosis. Interventions aimed at stabilizing blood pressure, especially in patients presenting with hypotension, may improve survival outcomes by preserving organ function and preventing further complications.

Regarding comorbidities, this study identified hypertension, diabetes mellitus, and chronic obstructive pulmonary disease as the most prevalent conditions in AHF patients. These findings align with the results of a study conducted in Uganda, where hypertension (35.8%), HIV (11.3%), renal disease (8.0%), and diabetes (7.3%) were similarly common in AHF patients (Okello *et al.,* 2014). Hypertension is a known risk factor for both the development and progression of heart failure, while diabetes and COPD further complicate management and worsen prognosis (Petrie and Touyz, 2018). The coexistence of these conditions increases the likelihood of heart failure exacerbations and poor outcomes (Correale *et al.,* 2021). Comprehensive management of comorbidities in AHF patients is essential.

Strength and Limitation

This study has identified in-hospital mortality, its associated factors, and the evaluation of immediate treatment outcomes within a controlled clinical setting. However, several limitations should be considered. The findings have limited generalizability to non-hospitalized populations, as the study focused exclusively on patients admitted to the emergency center. Additionally, the emphasis on short-term outcomes may not capture long-term prognoses, and the potential for selection bias exists, as more severe cases are likely to be hospitalized. Variability in hospital care protocols may also influence outcomes. Furthermore, the use of secondary data introduces challenges in verifying the reliability and completeness of recorded information. Lastly, the cross-sectional nature of the study limits the ability to establish clear temporality between exposure factors and in-hospital mortality.

Conclusion

The in-hospital mortality rate for people with AHF in this study was 13.6%, highlighting the severity of the condition and the importance of timely and effective interventions. Key risk factors of mortality were a high initial triage score, low diastolic blood pressure, and reduced left ventricular ejection fraction. To improve patient outcomes, it is crucial to enhance triage systems for early identification of high-risk patients, closely monitor and manage diastolic blood pressure, routinely assess left ventricular function using echocardiography, and implement tailored interventions for high-risk groups.

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Competing Interests

The author declare that they have no competing interests.

Funding Statement

This study was not funded by any organization.

List of Abbreviations

ADHF, acute decompensated heart failure; AF, atrial fibrillation; AHF, acute heart failure; AOR, adjusted odds ratio; CI, confidence interval; COR, crude odd ratio; COPD; Chronic obstructive pulmonary disease DBP; Diastolic blood pressure ED; Emergency department, RHD, rheumatic heart disease; DCM, dilated cardiomyopathy; HUHFCSH; Haramaya University Hiwot Fana Comprehensive Specialized Hospital, HTN, hypertension; IHD, ischemic heart disease; IQR, interquartile range; LVEF, left ventricular ejection fraction; NYHA, New York Heart Association; SD, standard deviation.

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