ARSI UNIVERSITY

COLLEGE OF HEALTH SCIENCES

DEPARTMENT OF INTERNAL MEDICINE

PREVALENCE OF ACUTE KIDNEY INJURY AND ASSOCIATED FACTORS AMONG ACUTE HEART FAILURE PATIENTS ADMITTED AT ASELA REFERRAL AND TEACHING HOSPITAL, ARSI UNIVERSITY, ASELLA, CENTRAL ETHIOPIA.

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A THESIS SUBMITTED TO DEPARTMENT OF INTERNAL MEDICINE, COLLEGE OF HEALTH SCIENCE ARSI UNIVERSITY, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE SPECIALITY CERTIFICATE IN INTERNAL MEDICINE

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Arsi University College of Health Sciences Department of Internal Medicine Research Proposal Submission Form

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Title of the research project	**Prevalence of acute kidney injury and associated factors among acute heart failure patients admitted at Asela referral and teaching hospital, Arsi university, Asela, central Ethiopia.**
Duration of study	**February to December, 2025**
Study area	**Arsi University, CoHS, Asela teaching and referral hospital**
Total estimated cost of the Study	**34,830 ETB**
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Acknowledgement

First of all I express special thanks to the almighty God for his help for my success in my postgraduate education and for preparation of this research proposal. And then, I would like to extend my appreciation and thanks to my advisors Dr. Koricho Sime and Dr Gizachew Abdeta for their continued supports, valuable advice, constructive comments & correction in the preparation of my research proposal. I would like to extend my heartfelt gratitude to Arsi University, College of Health Sciences, and Department of Internal Medicine for giving me this chance for preparation of research proposal.

Acronyms/Abbreviations

AF- Atrial fibrillation

AHF- Acute heart failure

AHR- Adjusted hazard ratio

AOR- Adjusted odds ratio

AKIN- Acute kidney injury network

AKI- Acute kidney injury

AU- Arsi University

ARTH- Asela Referal and Teaching Hospital

BUN- Blood urea nitrogen

CKD- Chronic Kidney Disease

CoHS- College of health science

Cr- Creatinine

COR- Crude odds ratio

DCMP- Dilated cardiomyopathy

ECG- Electrocardiography

EF- Ejection fraction

eGFR- Estimated glomerular filtration rate

ETB- Ethiopian Birr

HDU- High dependency Unit

HFrEF- Heart failure with reduced ejection fraction

HFpEF- Heart failure with preserved ejection fraction

ICU- Intensive care unit

IHD- Ischemic heart disease

KDIGO- Kidney disease improving global outcomes

NYHA- New York Heart Association

RHD- Rheumatic heart disease

RIFLE- Risk, Injury, Failure, loss, End stage

SD- Standard deviation

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ABSTRACT

Introduction: Heart failure often leads to hospitalization and can directly impact other organs, such as the kidneys. Acute kidney injury (AKI) is a common complication in patients hospitalized for acute decompensated heart failure (ADHF) and is associated with worse outcomes. However, there are limited data on the magnitude of AKI among hospitalized ADHF patients in resource-limited settings such as Ethiopia.

Objective: To assess the prevalence of acute kidney injury and associated factors among acute heart failure patients admitted at Asela Teaching and Referral Hospital, central Ethiopia, from May to December 2025.

Methodology: An institution-based cross-sectional study was conducted to determine the prevalence of acute kidney injury and associated risk factors among acute heart failure patients at Asela Teaching and Referral Hospital. A total of 180 admitted patients were included. Data were collected using structured questionnaires and analyzed using EPI Info and SPSS version 27. Descriptive statistics were summarized using frequencies, percentages, and medians. Bi-variate logistic regression was performed to identify candidate variables ($p < 0.2$), which were entered into multivariable logistic regression. Associations were reported using adjusted odds ratios with 95% confidence intervals, and $p < 0.05$ was considered statistically significant.

Results: A total of 121 patients admitted with acute decompensated heart failure were included in the study. Acute kidney injury occurred in 29 patients, giving a prevalence of 24% (95%CI17.2-32.3%. In multivariable logistic regression analysis, diabetes mellitus (AOR=67.74; 95%CI: 6.53-702.34; p<0.001), presence of infection (AOR=27.78; 95%CI: 3.40-227.28; p=0.002) , and atrial fibrillation (AOR=17.75;95%CI 3.09-101.81;p=0.001) were independently associated with the development of AKI.

Conclusion: Acute kidney injury was a common complication among patients admitted with acute decompensated heart failure. Diabetes mellitus, infection, and atrial fibrillation were identified as independent predictors of AKI.

Keys- acute decompensated heart failure, acute kidney injury

1. Introduction

1.1 Background

Heart failure (HF) is a clinical syndrome caused by a structural and/or functional cardiac abnormality, resulting in reduced cardiac output and/or elevated intra cardiac pressure at rest or during stress (1). Heart failure is a global pandemic affecting 26 million people worldwide(2). In Ethiopia, hospital-based studies show that heart failure (HF) accounts for 16% of medical admissions and 23.9% of cardiovascular follow-up visits, primarily affecting middle-aged adults (48.3 to 53.6 years) .Heart failure has direct consequences on other organs, particularly the kidneys. The heart and kidneys interact in a complex, interdependent manner in both acute and chronic conditions, potentially leading to dual-organ dysfunction (3).

Acute decompensated heart failure (ADHF) refers to previously diagnosed or new-onset HF presenting with rapid worsening of signs and symptoms of HF(4). Acute kidney injury (AKI), which is defined as an abrupt decrease in the glomerular filtration rate (GFR) sufficient to eliminate nitrogenous waste products and other uremic toxins, is a common complication in patients admitted for ADHF (5). Globally, the prevalence of AKI among AHF patients varies widely, ranging from 25% to 70%, depending on the population studied and the diagnostic criteria used (6).

Despite the growing recognition of the importance of AKI in AHF patients, there is limited data on its prevalence and associated factors in the Ethiopian context. Understanding the epidemiology of AKI in AHF patients is crucial for developing evidence-based strategies to reduce the burden of this complication and improve patient outcomes.

The prevalence of AKI in admitted heart failure patients varies due to the different definitions used to define AKI. A systematic review and meta-analysis of studies primarily from developed countries (the U.S., Canada, Europe, and Israel) found that the prevalence of AKI in hospitalized patients with ADFF was 47.4% (7). According to the Acute Decompensated Heart Failure National Registry of America, approximately 30% of patients admitted to the hospital for acute decompensated heart failure (ADHF) have acute or chronic renal insufficiency (8)

There is a paucity of data in Africa regarding the true magnitude of AKI and its associated factors among patients with HF. In the Sub-Saharan Africa Survey of Heart Failure (THESUS–HF), a multi-center observational study of patients with acute heart failure (AHF) across 9 sub-Saharan countries, including Ethiopia, the prevalence of renal dysfunction (eGFR < 30) was reported as 7.7%. However, the study was not specifically designed to investigate acute kidney injury (AKI), and only 10 patients from Ethiopia were included due to the late involvement of the country in the study (9) . An institution-based cross-sectional study from Somalia found the prevalence of AKI in ADHF patients to be 8.3% (10). Another hospital-based study performed at Tikur Anbesa Hospital in Ethiopia showed elevated serum Cr (Cr > 1.2 mg/dl) in 40% of patients admitted for ADHF (11). A study done at north west Ethiopia Gonder reveals that the overall prevalence of AKI in ADHF patients was 25.1% , while Older age; co-morbid diabetes mellitus, hypertension, or sepsis; a previous history of AKI; and the use of loop diuretics were associated with the occurrence of AKI.(12)

Additionally, increased baseline serum creatinine (SCr), a history of AKI, older age, hemodynamic abnormalities at admission, and sepsis are strong predictors of AKI (13)(14)(15)

Electrocardiograph and electrocardiograph features, such as the presence of diastolic dysfunction and atrial fibrillation (AF), have also been reported to predict the occurrence of AKI (16)(17). Acute kidney injury in patients with ADHF is linked to poorer short- and long-term outcomes, including higher mortality, hospitalization, and readmission rates and worsening of heart failure progression (3,13,18,19). A meta-analysis has shown that the presence of AKI in hospitalized ADHF patients is associated with a 5.14-fold increase in mortality (7). Ethiopia is the second most populous country in Africa, with a population of more than 120 million people. The literature, mostly from developed nations, has indicated that AKI complicates a significant proportion of patients admitted for ADHF, with varying prevalence results (7,15,16,19). However, data on the magnitude of AKI in low-resource settings such as Ethiopia are lacking. The aim of this study was to assess the magnitude and factors associated with AKI in patients with ADHF admitted to Arsi University, Asela, Ethiopia.

1.2 Statement of the problem

Cardio-renal syndrome had become an active area of interest in the past decade. Numerous studies have demonstrated that renal dysfunction and worsening renal function (WRF) are common in patients who are admitted for heart failure and appear to be associated with poor in-hospital and post-discharge outcomes. Its etiology has not been completely understood, and its prediction during hospitalization remains challenging. The evaluation of renal impairment during hospitalization should take into consideration the underlying renal substrate (e.g., predisposing clinical comorbidity such as diabetes and hypertension), initiating mechanisms (e.g., in-hospital therapies such as diuretics), and amplifying factors (neurohormonal and hemodynamic profile changes).(20)

In patients with AHF, worsening of acute renal injury is a common comorbidity with multi-factorial mechanisms and heterogeneous prognostic impacts among studies. The development of decreased kidney function during treatment affects the response to diuretic therapy and is associated with important clinical outcomes, including mortality. Further research into the causes of AKI among HF hospitalizations is, therefore, important as it will enable the development of treatment strategies to prevent AKI in HF hospitalizations and, consequently, benefit both the patients and health care system. (21)

1.3. Significance of the study

Even though the association between HF and renal dysfunction is well known there is a paucity of research on the incidence and consequences of AKI among patients hospitalized with HF generally and particularly in Africa and Ethiopia.

This study will contribute to the management of ADHF patients who are at increased risk of developing AKI (type 1 CRS). It will show the clinical profile of ADHF patients, their laboratory parameters and management and outcome. The results will help to improve the practice of treating ADHF patients in our set up.

2. Literature Review

2.1. Burden of the disease

A total of 2,010,095 hospitalizations for HF were identified from the National Inpatient Sample database (USA) from January 2012 through September 2015, it was found that that incidence of new-onset AKI was ~ 20%. In this study in-hospital mortality was higher in the HF with AKI group (adjusted OR 3.63, P ≤ 0.001) and higher among patients with HFrEF (adjusted OR 3.85), as opposed to patients with HFpEF (adjusted OR 3.21). Similarly, length of stay and cost of care for the HF with AKI group were significantly higher as well. New-onset AKI among hospitalizations for HF poses a significant health problem, since the prevalence of HF is increasing globally.(22)

A systematic search of MEDLINE revealed 8 studies on the relationship between WRF and mortality in 18,634 patients with HF. WRF developed in 4,734 (25%) patients and was associated with a higher risk for mortality (odds ratio [OR] 5 1.62; 95% confidence interval [CI] 1.45e1.82, P < .001) and hospitalization (OR 5 1.30, 95% CI 1.04e1.62, P 5 .022). The severity of WRF was also associated with greater mortality. Patients with impaired renal function at baseline were more prone to progressive renal function loss. In this systematic search it was concluded that WRF predicts higher rates of mortality and hospitalization in patients with HF.(23)

Across 2002–2013, the incidence of D-AKI doubled from 0.51% to 1.09%. It was found that male sex, younger age, African-American and Hispanic race, and various comorbidity and procedures, such as sepsis and mechanical ventilation, to be independent predictors of AKI in HF hospitalizations. D-AKI was associated with higher odds of in-hospital mortality and adverse discharge. In conclusion the incidence of D-AKI in HF hospitalizations doubled across 2002–2013. Despite declining in-hospital mortality, LoS, and cost, D-AKI was associated with worse outcomes.(14)

In one study old age, diabetes, hypertension and acute coronary syndromes increased the risk of WRF. In-hospital furosemide doses as well as discharge treatment were similar in WRF and no-

WRF patients. Serum creatinine elevation was the strongest independent determinant of a longer hospital stay. (21)

In a prospective cohort of 412 patients hospitalized for heart failure, comparison of a spectrum of worsening renal function definitions (absolute creatinine elevations ≥0.1 to ≥0.5 mg/dL and 25% relative elevation from baseline) and associations with 6-month mortality, readmission, and functional decline were looked at. Larger creatinine elevations predicted the highest risk of death, yet even minor changes in renal function were associated with adverse outcomes. (24)

In a nested case-control study on 382 subjects who were hospitalized with HF the association of medications, fluid intake/output, and weight with WRF was assessed. It was shown that several medical strategies, including the use of CCBs and a higher dose of loop diuretics, but not ACE inhibitors, were associated with a higher risk of WRF. Although assessment of in hospital diuresis was limited, WRF could not be explained by greater fluid loss in these patients. (25)

In prospective study which enrolled 299 patients across eight European countries. Nearly one-third of patients [72 of 248 patients, 29% (95% CI 26–32%)] developed WRF during hospitalization. The risk of WRF in this group was independently associated with serum creatinine levels on admission, pulmonary oedema, and a history of atrial fibrillation. Although the mortality of WRF patients was not increased significantly, the length of stay was 2 days longer [median 11 days (90% range (4–41) vs. 9 days (4–34), P ¼ 0.006]. The re-hospitalization rate was similar in both groups. (16)

In a population based study in Spain a total of 30 529 patients with HF were included. There were 5294 AKI episodes in 3970 patients (13.0%) and incidence of 3.3/100 HF patients/year were recorded. They were more frequent in women with diabetes and hypertension. The study demonstrated the worse prognostic value of sudden renal function decline in HF patients and pointed to those with more future risk who require review of treatment and closer follow-up. (26)

At University of Glasgow UK, data from a post hoc analysis of the Diuretic Strategies in Patients with Acute Decompensated Heart Failure trial, in which patients who were hospitalized with congestion were randomized to a high versus low dose intravenous diuretic regimen. Improvement in eGFR at 72 hours was independently associated with increased risk of the

composite end point of death, hospitalization for HF or visit to the emergency department. The association may reflect inadequate optimization of fluid balance. (27)

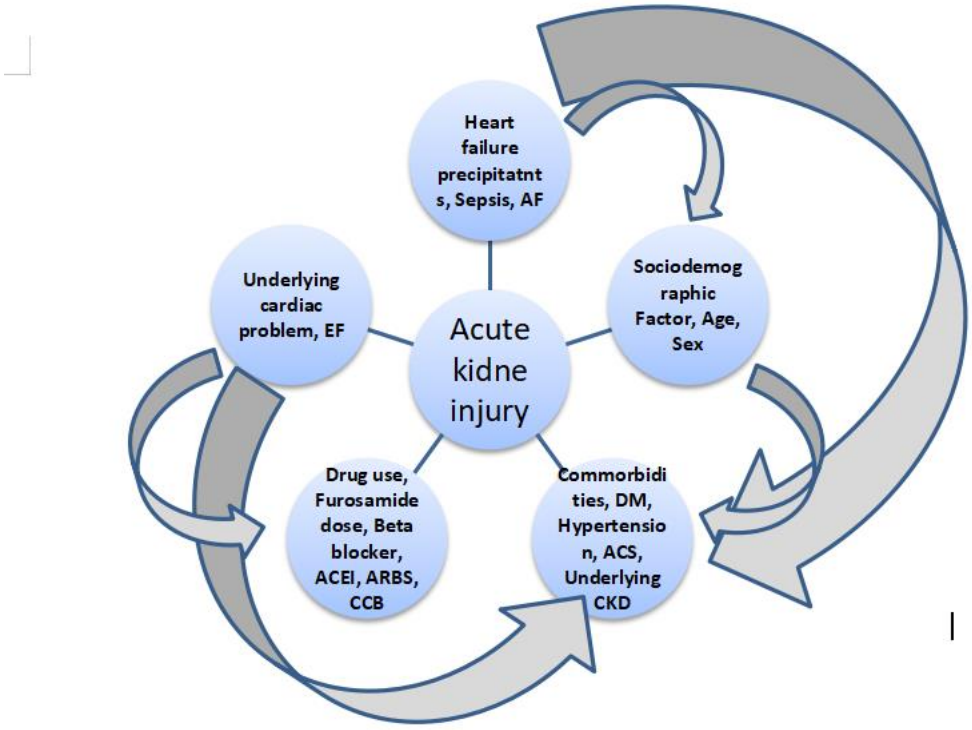
In a study done in Romania, AKI was associated with a higher risk of mortality in patients with HFmrEF when compared with those with HFrEF, suggesting a stronger prognostic impact of AKI in patients with HFmrEF. (28)

In a study done in China a total of 1,005 patients were enrolled. The incidence of ACKI was higher than that of AKI. The proportion of patients with diuretic resistance was higher among patients with preexistence CKD than among those without CKD (16.9% vs. 9.9%, P = 0.002). Compared with AKI, ACKI was associated with higher risk for in-hospital mortality long hospital stay, and failure in renal function recovery. Preexistence CKD and development of acute worsening of renal function during hospitalization were the independent risk factors for in-hospital death after adjustment of the other risk factors. The RIFLE classification predicted all-cause and cardiac mortality in both AKI and ACKI. Patients with ACKI were at greatest risk of adverse short-term outcomes in ADHF.(29)

In a cohort of 196 patients admitted for AHF to the Cardiology Department at Nhan Dan Gia Dinh Hospital, Viet Nam, from July 2016 to March 2017 WRF developed in 43.4%. In 80.0% of patients, WRF occurred within 48 hours of admission.(30)

Figure 1: conceptual framework for prevalence of AKI in ADHF patients admitted to ARTH, 2025.

Revised and developed from (12)(14)(15)



3. Objective

3.1. General objective

- To assess the prevalence AKI and its associated factors among heart failure patients admitted at ARTH, AU, Asela, Ethiopia, 2025G.C.

3.2. Specific objectives

- To determine prevalence of AKI in heart failure patients at ARTH, AU, Asela, Ethiopia, 2025G.C
- To identify risk factors associated with acute kidney injury at ARTH, AU, Asela, Ethiopia, 2025G.C

4. Method and Materials

4.1 Study area

The study was conducted at Arsi University, College of health science (CoHS), Asella teaching referral hospital which is Located in the town of Asella. Asella is a town in central Ethiopia which is located in the Arsi Zone of the Oromia Region about 156 kilometers from Addis Ababa, the capital city of the country. Arsi University established in 2014. Since 1964 Asella teaching and referral hospital was serving populations in Arsi and the nearby zones with current population of 3.8 million. The hospital has 321 beds with more than 6 departments (Internal Medicine, Surgery, Pediatrics, Gynecology and Obstetrics, Orthopedics and Oncology). The hospital is involved in training undergraduate and postgraduates in different specialties in 04 major departments (Internal Medicine, Surgery, Pediatrics and Child Health and Gynecology and Obstetrics). The hospital has been improving its health service delivery, currently has modern investigation modalities like Digital X-rays, portable X-ray, different types of Ultrasound, Electrocardiography, Computerized tomography scan and culture service. The Department of internal medicine has a separate ward with 36 bed including HDU and share ICU with other department of 6 beds .the department has 24 specialists, 2 sub specialists,36 residents, 24 nurses

4.2 Study design and period

Institution based cross-sectional study design was used to determine the prevalence of acute kidney injury and associated risk factors among acute heart failure at ,AU,ARTH. Data was collected from May 20, to December 20, 2025.

4.3 Source and Study population

4.3.1 Source population

- All acute heart failure patients who admitted at Asela referral and teaching hospital during the study period.

4.3.2 Study population

- All acute heart failure patients who fulfill eligibility criteria and admitted at Asela referral an teaching hospital during the data collection period.

4.4 Eligibility Criteria

4.4.1 Inclusion criteria

All Men or women age 18 and above

4.4.2 Exclusion Criteria

Age less than 18 years

Incomplete or missing medical records

Patient with any malignancy

Patients with pre-existing chronic kidney disease

4.5 Study Flow Diagram

The overall procedure of the study, including participant selection, data collection, and analysis, is summarized in Figure 2

Heart failure patients admitted to ARTH, Asela, Ethiopia, 2025 G.C.

↓

Patients assessed for eligibility based on medical records

↓

Excluded patients (n = 12)
Age less than 18 years
Incomplete or missing medical records
Patient with any malignancy
Patients with pre-existing chronic kidney disease

↓

Eligible heart failure patients included in the study (N = 121)

↓

Data collection from patient medical records

- Socio-demographic characteristics
- Clinical and comorbid conditions
- Laboratory and imaging findings

↓

Assessment of acute kidney injury status

↓

Data entry, coding, and data cleaning

↓

Statistical analysis

- Descriptive statistics
- Bivariable logistic regression analysis
- Multivariable logistic regression analysis

Figure 2**:** Study flow diagram of heart failure patients admitted to ARTH, , Asela, Ethiopia, 2025 G.C.

4.6 Sample size and sampling procedures

4.6.1 Sample size determination

The sample size was calculated using the single proportion formula

$$n = \frac{(Z_{\frac{\alpha}{2}})^2 \text{ pq}}{d^2}$$

Z α/2 = is standard normal variant (at 5% type 1 Error (P <0.05) it is 1.96

d = margin of error was taken as 0.05.

p = expected proportion of the population with the event of outcome (prevalence) –the

Prevalence of WRF in HF patients at TASH was 25.1%.(12)

q =1-p: the probability of non-occurrence of the event of interest.

The calculated sample size is **288** patients.

Since the population size is less than 10,000 we need additional correction with

$$n = \frac{n_0}{1 + \frac{n_0}{N}}$$

n = Final sample size

n_0= Initial sample size (288)

N= Source population size (180)

The final calculated sample size is 121 patients with10% loss added.

4.2.2 Sampling procedure

Convenience sampling method was used.

4.7. Data Collection Method

Data on socio demographics variables and comorbidity were collected by chart review. Heart failure and renal injury related factors will be collected from chart. The data was collected by trained Nurse and medical interns.

4.8 Study variables

4.8.1 Outcome variables

- Acute kidney Injury

4.8.2 Independent variables

- Age
- Comorbidities (DM, hypertension)
- Drug use (diuretics, ACE-I, ARB, beta blockers)
- Specific causes of heart failure
- Precipitant of heart failure

4.9 Operational definitions

- **AKI**: AKI was defined according to KDIGO (kidney disease improving global outcome) According to the KDIGO criteria, AKI is defined by "[a]n abrupt (within 48 hours) reduction of kidney function, defined as an absolute increase in serum creatinine of more than or equal to 0.3mg/dl, a percentage increase in serum creatinine of more than or equal to 50% (1.5-fold from baseline), or a reduction in urine output (documented oliguria of less than 0.5ml/kg per hour for more than six hours).
- AKI staging according to KDIGO-
    - Stage 1: 1.5–1.9 times baseline (i.e. An increase of 50% to 99% from baseline) or ≥0.3 mg/dl (≥26.5 μmol/l) increase
    - Stage 2: 2.0–2.9 times baseline

- Stage 3: 3.0 times baseline OR Increase in serum creatinine to ≥4.0 mg/dl (≥353.6 μmol/l) OR Initiation of renal replacement therapy

- **ADHF**; based on clinical diagnosis of ADHF documented on the patients' medical record ADHF was defined as either new-onset HF or de-compensation of chronic HF with symptoms sufficient to warrant hospitalization.
- **Cardio-renal syndrome**- encompasses a spectrum of disorders involving both the heart and kidneys in which acute or chronic dysfunction in 1 organ may induce acute or chronic dysfunction in the other organ. It represents the confluence of heart-kidney interactions across several interfaces. These include the hemodynamic cross-talk between the failing heart and the response of the kidneys and vice versa, as well as alterations in neuro-hormonal markers and inflammatory molecular signatures characteristic of its clinical phenotypes.

4.10 Data collection procedures

Pretest was conducted on 6 ADHF patients at ARTH prior to the actual data collection and outside the defined study period (before May 20, 2025). Data extraction tools were adapted from a previous study conducted in Northwest Ethiopia, Gondar, and modified to fit the context of current study. Data was collected by trained nurses and medical interns and supervised by medical residents. A format that contains study variables of interest was prepared.

4.11 Data quality control

Pretest was done on 6 ADHF patients admitted at ARTH before May 20, 2025. The data was collected by nurses and medical interns from patients' chart documented by the clinicians. The principal investigator coordinated and supervised the process of data collection. The data collection format was checked for its completeness and any gap identified was corrected immediately.

4.12 Data processing and analysis

Data was checked for completeness, edited, coded and entered into SPSS version 27.0 statistical software for cleaning and analysis. Frequencies and proportion were used to describe study subjects and socio-demographic characteristics. Continuous variables were expressed as means ±

standard deviation. Tables and graphs were used to present results. Bivariate and multivariate binary logistic regression analyses were done to identify factors associated with AKI and WRF, Statistical significance was considered at the level of significance of 0.05%, and adjusted odds ratio (AOR) with 95% confidence interval (CI) was used to present the estimates of the strength of the association.

4.13 Ethical considerations

Ethical clearance was obtained from Asela College of Health Sciences research committee. Then, official letter was delivered to data manager. Moreover, after getting permission, patient's charts that fulfill the criteria were selected. Confidentiality of data collected was kept and names of the patients were not included during data collection and information gained was exposed to third party.

4.14 Results Dissemination plan

The final result of this study will be presented for a research defense at Arsi University, Asela Referral and Teaching hospital and disseminated to Internal medicine department, Hospital Administrative, policy makers, regional and federal health bureau for service improvements and research coordinating office for publication of the research work.

5. Results

5.1. Socio demographic characteristic

A total of 121 acute heart failure patients were included in the study, of whom 70 (57.9%) were male and 51 (42.1%) were female. The mean age of the participants was 51.6 ± 14.6 years. Most participants were farmers (103; 85.1%). Regarding educational status, 53 (43.8%) had completed primary education, while 45 (37.2%) had no formal education. The majority of participants were married (105; 86.8%) and resided in rural areas (111; 91.7%). In terms of religion, 65 (53.7%) of the participants were Muslim (Table 1 and figures 2 to 8 below).

Table 1- shows socio demographically characteristics of study population, among acute heart failure patients admitted at Asela Teaching and Referral Hospital, central Ethiopia, from May to December 2025.

Sociodemographic characteristics	Category	Frequency
Sex	Male	70(57.9%)
	Female	51(42.1%)
Age	below 60	90(74.4%)
	Above 60	31(25.6)
Occupation	unemployed	10(8.3%)
	Daily laborer	1(0.8%)
	Merchant	3(2.5%)
	Government employee	4(3.3%)
	farmer	103(85.1%)
Education status	No formal education	7(5.8%)
	Read and write	50(41.3%)
	Primary education	53(43.8%)
	High school	7(5.8%)
	College and above	4(3.3%)
Marital status	Single	11(9.1%)
	Married	105(86.8%)
	Divorced	1(0.8%)
	Widowed	4(3.3%)
Residence	Urban	10(8.3%)
	Rural	111(91.7%)
Religion	Orthodox	45(37.2%)
	Muslim	65(53.7%)
	Protestant	11(9.1%)

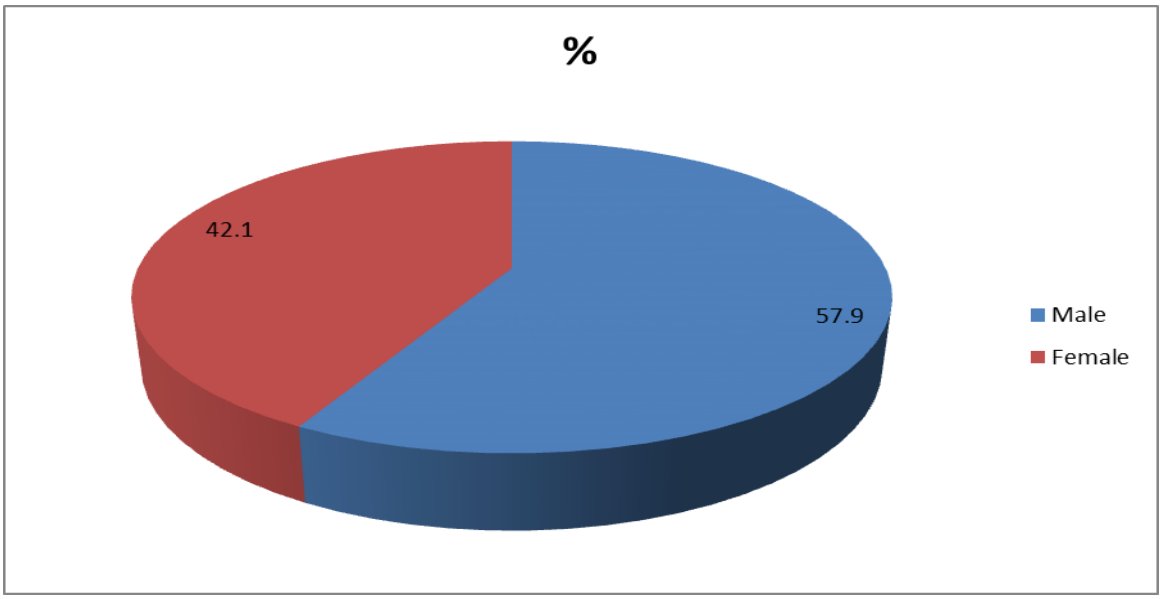


Figure 3- Pie chart shows Sex distribution of study population, among acute heart failure patients admitted at Asela Teaching and Referral Hospital, central Ethiopia, from May to December 2025.

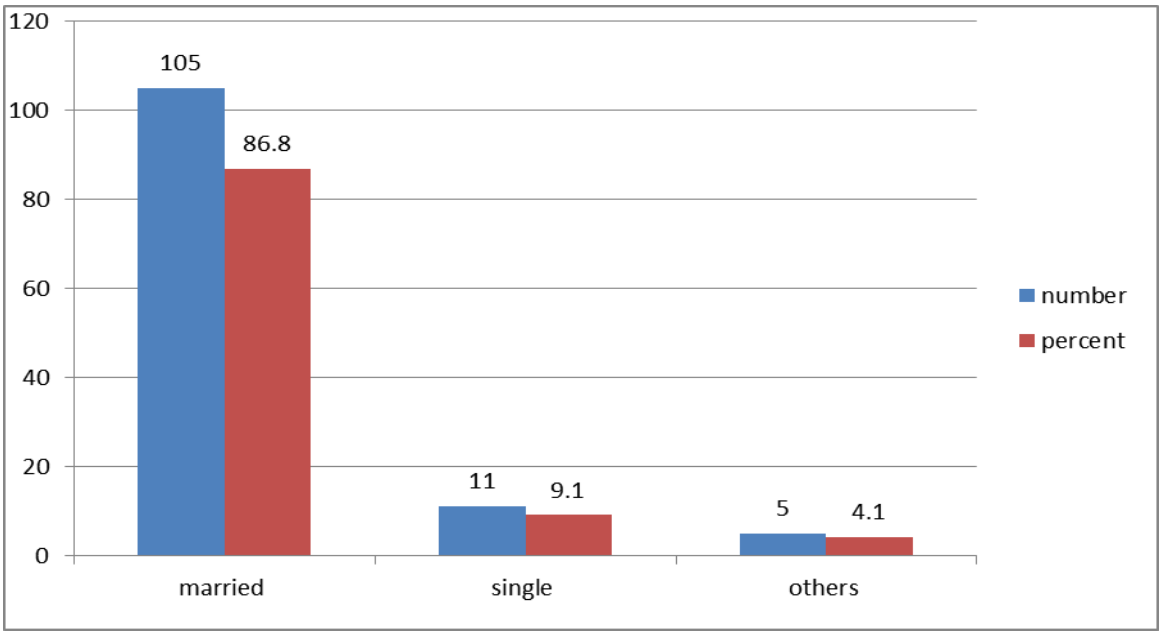


Figure 4 – bar chart shows Marital status distribution of prevalence of study population, among acute heart failure patients admitted at Asela Teaching and Referral Hospital, central Ethiopia, from May to December 2025.

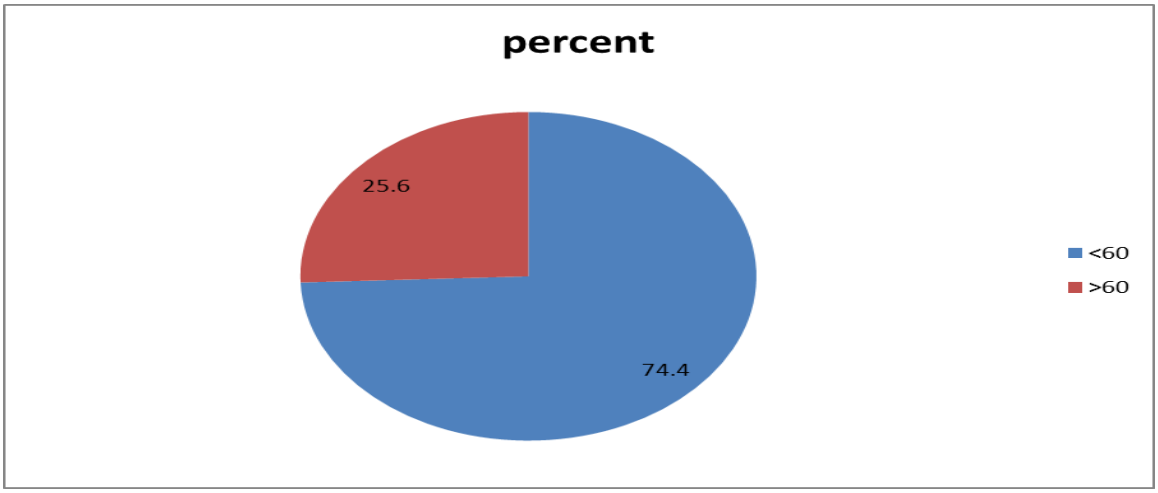
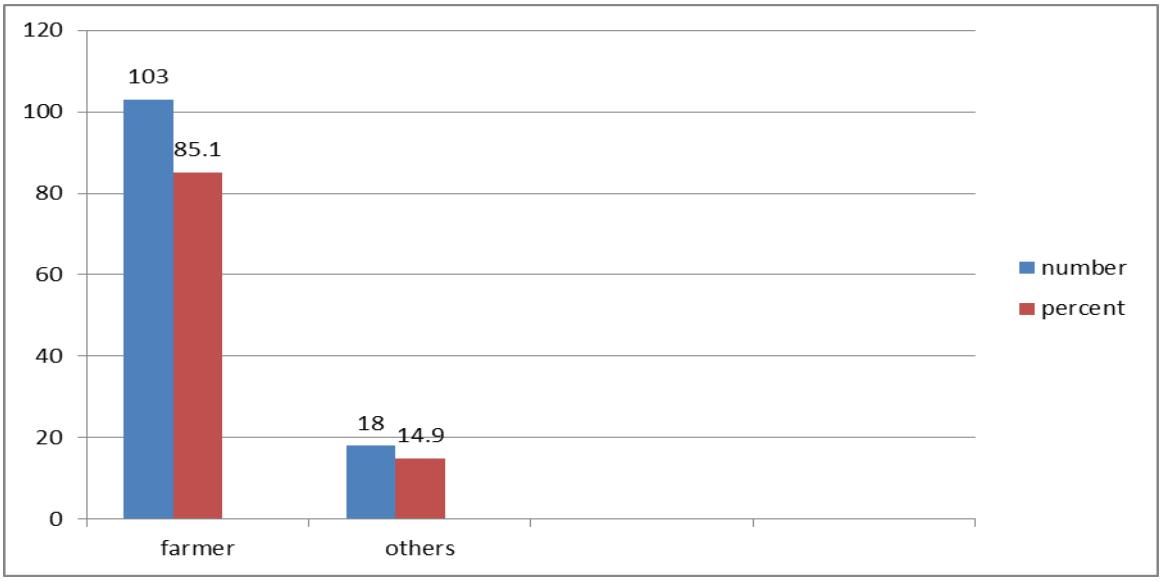
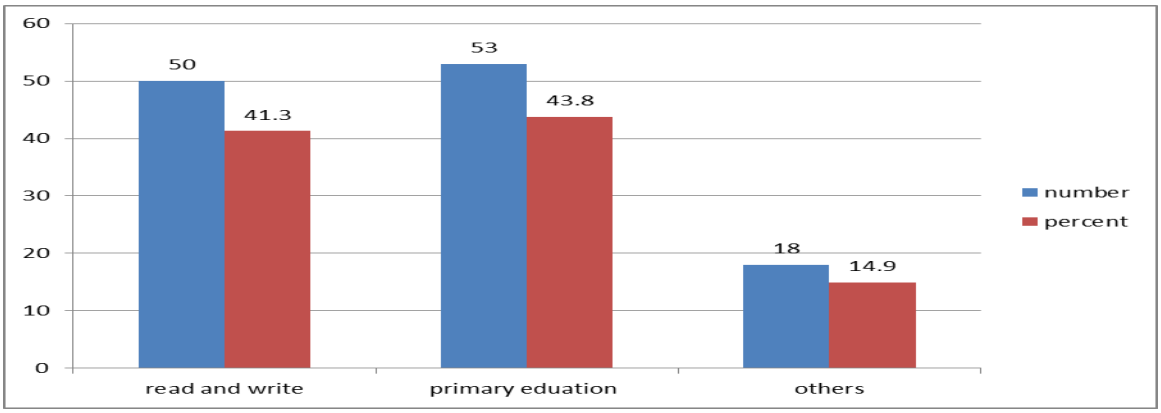


Figure 5 - pie chart shows Age distribution of prevalence of study population, among acute heart failure patients admitted at Asela Teaching and Referral Hospital, central Ethiopia, from May to December 2025.



Others =unemployed, daily laborer, merchant and government employee

Figure 6 – bar chart shows occupation distribution of prevalence of study population, among acute heart failure patients admitted at Asela Teaching and Referral Hospital, central Ethiopia, from May to December 2025.



Others =no formal education, high school and college and above

Figure 7- bar chart shows educational status distribution prevalence of study population, among acute heart failure patients admitted at Asela Teaching and Referral Hospital, central Ethiopia, from May to December 2025.

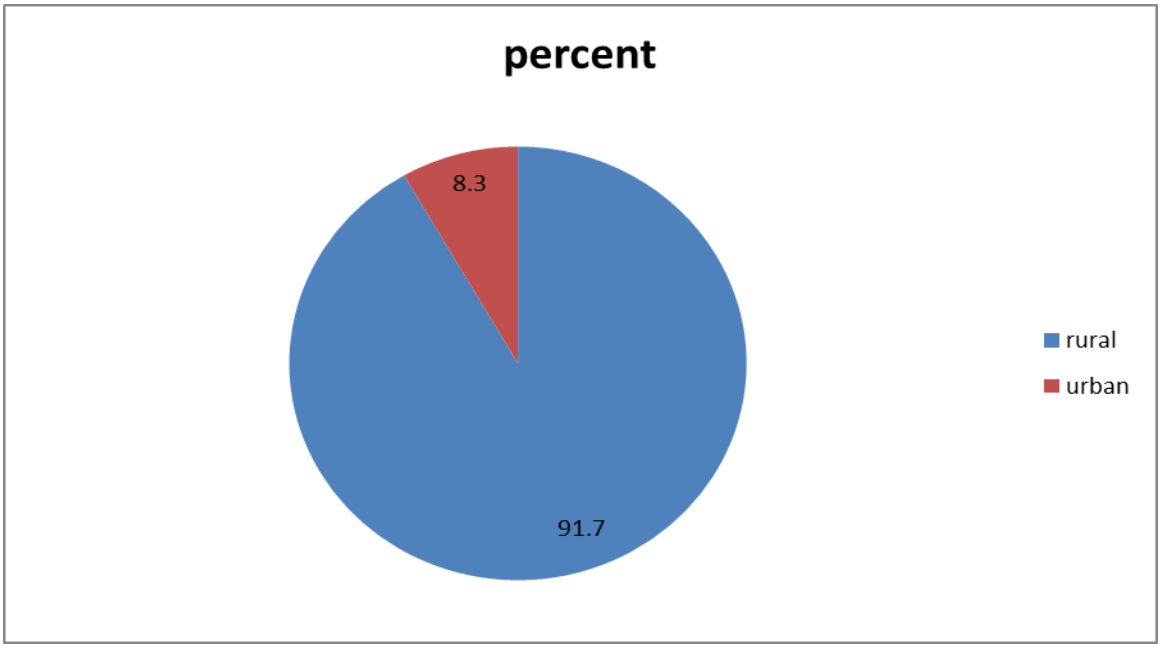


Figure 8 – pie chart shows residence of prevalence of study population, among acute heart failure patients admitted at Asela Teaching and Referral Hospital, central Ethiopia, from May to December 2025.

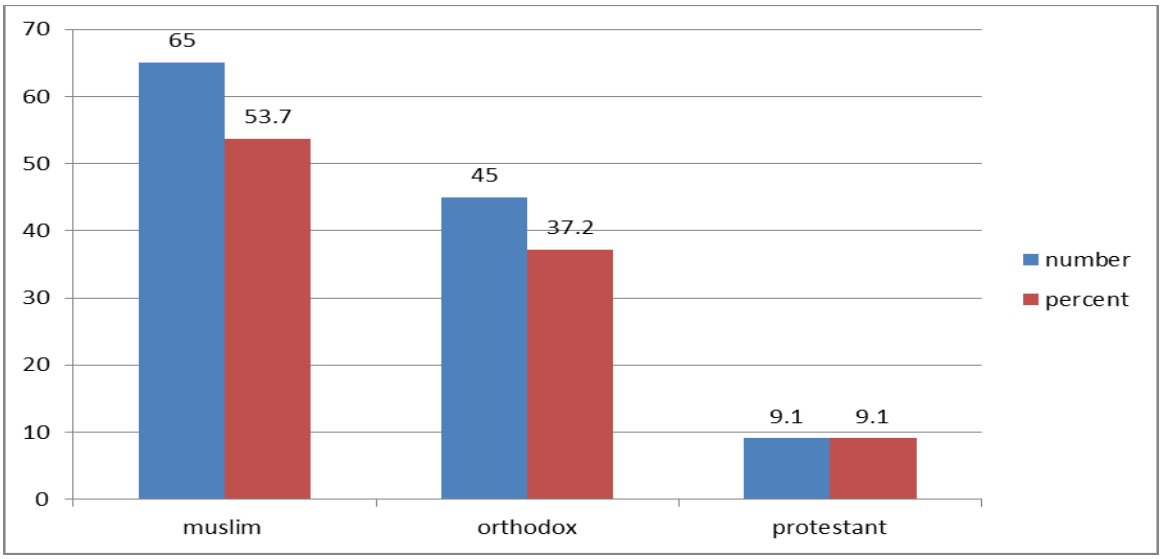


Figure 9- bar chart shows religion distribution prevalence of study population, among acute heart failure patients admitted at Asela Teaching and Referral Hospital, central Ethiopia, from May to December 2025.

5.2. Prevalence of AKI and clinical characteristics of participants

Among the study participants, 29 patients (24.0%) developed acute kidney injury (AKI). The occurrence of AKI was frequently accompanied by infection, which was present in 27 patients (93.1%), and all AKI cases received antibiotic treatment during hospitalization. Regarding the etiology of acute decompensated heart failure (ADHF), ischemic heart disease (IHD) was the leading cause, accounting for 64 cases (52.9%). Rheumatic valvular heart disease (RVHD) was the second most common etiology, identified in 28 patients (23.14%), follow by dilated cardiomyopathy (DCMP), which was observed in 16 patients (13.22%), (figure 9).

Infection was the most common precipitating factor for heart failure exacerbation, reported in 55 patients (45.5%). This was followed by discontinuation of heart failure medications in 36 patients (29.8%), ischemia in 13 patients (10.7%), atrial fibrillation in 12 patients (9.9%), and thyrotoxicosis in one patient (0.8%).Echocardiographic findings revealed that the majority of patients had heart failure with reduced ejection fraction (HFrEF), defined as an ejection fraction of less than 40%, which was present in 74 patients (61.16%). Heart failure with mid-range

ejection fraction (41–49%) was observed in 24 patients (19.83%), while 23 patients (19.01%) had preserved ejection fraction (≥50%).

Clinically, most participants presented with advanced disease severity. New York Heart Association (NYHA) functional class IV was recorded in 92 patients (76.0%), while the remaining 29 patients (24.0%) were classified as NYHA class III. According to the American College of Cardiology/American Heart Association (ACC/AHA) staging system, 119 patients (98.3%) were categorized as stage C heart failure, and 2 patients (1.7%) were classified as stage D at presentation. Vital sign assessment showed that pulse rate was within the normal range (60–100 beats per minute) in 72 patients (59.5%). Tachycardia was observed in 48 patients (39.7%), while only one patient (0.8%) had bradycardia. Peripheral edema was present in all participants, with the majority exhibiting grade 2 or grade 3 edema (56 patients each; 46.3%). Grade 4 edema was noted in 7 patients (5.8%), and grade 1 edema in 2 patients (1.7%).

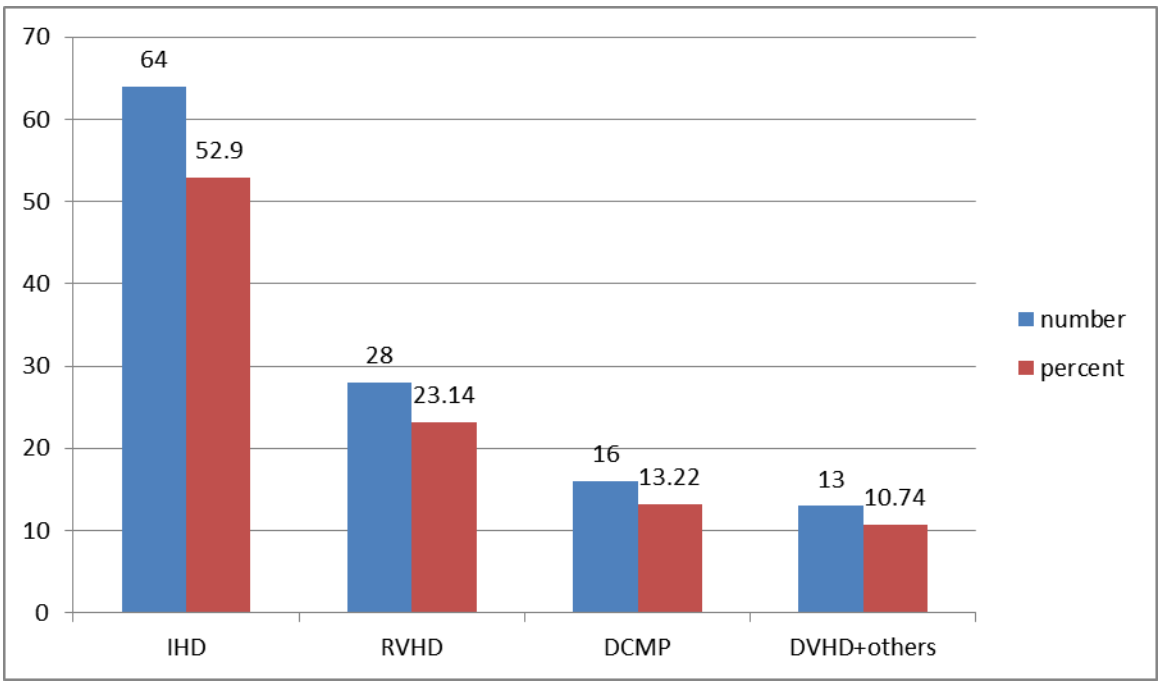
With regard to lifestyle and comorbid conditions, most participants reported adherence to salt restriction (87; 71.9%), whereas 34 patients (28.1%) continued consuming salt-containing foods. Atrial fibrillation was documented in 29 patients (24.0%), and infective endocarditis was diagnosed in 12 patients (9.9%).Concerning pharmacologic management, all participants were receiving furosemide therapy. The majority were treated with spironolactone (104; 86.0%), beta-blockers (101; 83.5%), angiotensin-converting enzyme inhibitors (86; 71.1%), and aspirin (84; 69.4%). Digoxin was prescribed to 33 patients (27.3%), while only 2 patients (1.7%) were receiving angiotensin receptor blockers (Table 2).

Table 2- shows prevalence of AKI and clinical characteristics of study population,among acute heart failure patients admitted at Asela Teaching and Referral Hospital, central Ethiopia, from May to December 2025.

variable	**Category**	**Acute kidney injury**	
Cause heart failure		Yes	No
	RVHD	11(39.3%)	17(60.7%)
	DCMP	5(31.25%)	11(68.75%)

	IHD	8(12.5%)	56(87.5%)
	DVHD	4(40%)	6(60%)
	Others	1(33.33%)	2(66.67%)
Ejection fraction	Reduced <40%	17(22.97%)	57(57.03%)
	Mid-range 41-49%	3(12.5%)	21(87.5%)
	Preserved >50%	9(39.1%)	14(60.9%)
Precipitant of heart	infection	19(34.55%)	36(64.45%)
failure	AFIB	4(33.33%)	8(66.67%)
	Drug discontinuation	4(11.11%)	32(88.89%)
	ischemia	1(7.7%)	12(92.3%)
	Anemia	1(25%)	3(75%)
NYHA class	Class3	4(13.8%)	25(86.2%)
	Class4	25(27.2%)	67(72.8%)
Beta blockers	Yes	26(25.74%)	75(74.26%)
	No	3(15%)	17(85%)
ACEI	Yes	20(23.26%)	66(76.74%)
	No	9(25.71%)	26(74.29%)
ARB	Yes	1(50%)	1(50%)
	No	28(23.53%)	91(76.47%)
Spironolactone	Yes	25(24.04%)	79(75.96%)
	No	4(23.53%)	13(76.47%)
Digoxin	Yes	15(45.45%)	18(54.55%)
	No	14(15.9%)	74(84.1%)
Patient on	Yes	25(39.7%)	38(93.1%)
anticoagulants	No	4(6.9%)	54(78.53%)
Infection of any source	Yes	27(41.54%)	38(58.46%)
	No	2(3.57%)	54(96.43%)

Key words: ACEI=angiotensin converting enzyme inhibitor, ARB=angiotensin receptor blocker, AFIB=atrial fibrillation, DVHD=degenerative valvular heart disease, DCMP=dilated cardiomyopathy, IHD=ischemic heart disease, RVHD=rheumatic valvular heart disease



Key words: IHD=ischemic heart disease, RVHD=rheumatic valvular heart disease, DCMP=dilated cardiomyopathy, DVHD=degenerative valvular heart disease, others =hypertensive, congenital heart disease.

Figure 10: bar chart shows cause of heart failure, among acute heart failure patients admitted at Asela Teaching and Referral Hospital, central Ethiopia, from May to December 2025.

5.3 Behavioral risk factors and comorbidity

A higher proportion of acute kidney injury (AKI) was observed among patients with diabetes mellitus. Of the 29 patients who developed AKI, 25 (86.21%) has diabetes mellitus. With regard to glucose-lowering therapy, insulin was used by 12 patients (41.4%), metformin by 10

patients (34.5%), while 7 patients (24.1%) were not receiving any diabetes medication at the time of admission.

Hypertension was identified in 21 patients (72.4%) with AKI. Among these patients, 16 (55.2%) were receiving ACE inhibitor or angiotensin receptor blocker therapy, and 4 (13.8%) were on beta-blockers. All patients with AKI were receiving diuretics.

Most patients with AKI were never smokers (96.6%), and none were current smokers. Regarding HIV status, 65.5% had unknown serostatus, while 34.5% were HIV-seronegative. Statin therapy was reported in 24 patients (82.8%) with AKI (Table 3).

Table 3- shows behavioral risk factors and comorbidity,among acute heart failure patients admitted at Asela Teaching and Referral Hospital, central Ethiopia, from May to December 2025.

Comorbidity	Category	Acute kidney injury	
Smoking status		Yes	No
	Current smoker	0	1(100%)
	Ex-smoker	1(14.29%)	6(85.76%)
	Never	28(24.78%)	85(75.22%)
HIV status	Positive	0	0
	Negative	10(23.26%)	33(76.74%)
	Unknown	19(24.36%)	59(75.64%)
Diabetes	Yes	25(64.1%)	14(35.9%)
	No	4(4.88%)	78(95.12%)
Glucose lowering drugs	Insulin	12(57.14%)	9(42.86%)
	Metformin	10(62.5%)	6(37.5%)
	No treatment	7(8.33%)	77(91.67%)
Hypertension	Yes	21(33.33%)	42(66.67%)
	No	8(13.8%)	50(86.2%)
ACEI/ARB use	Yes	21(24.14%)	67(75.86%)
BB use	Yes	26(25.74%)	75(74.26%)

Diuretics use	Yes	29(24%)	92(76%)
Statin Use	Yes	24(24.49%)	78(75.51%)

key words ; ACEIs=angiotensin converting enzyme inhibitors, ARB=angiotensin receptor blocker, BB=beta blockers, HIV=human immunodeficiency virus

5.4. Laboratory characteristics

Serum electrolyte levels were measured for all study participants. At admission, 66 patients (54.5%) had hyponatremia (<136 mmol/L), 54 patients (44.6%) had normal serum sodium levels (136–145 mmol/L), and 1 patient (0.8%) had hypernatremia (>145 mmol/L). During hospitalization, 83 patients (68.6%) developed hyponatremia, while 38 patients (31.4%) maintained normal serum sodium levels; no cases of hypernatremia were observed.

Regarding serum potassium at admission, the majority of patients had hypokalemia (<3.5 mmol/L), observed in 83 patients (68.6%). Normal potassium levels (3.5–5.0 mmol/L) were present in 38 patients (31.4%), while hyperkalemia (>5.0 mmol/L) was detected in 4 patients (3.3%) (Table 4)

Table 4- shows laboratory characteristics of study population, among acute heart failure patients admitted at Asela Teaching and Referral Hospital, central Ethiopia, from May to December 2025.

Variable	Category	Acute kidney injury	
		Yes	No
Sodium at admission	Hyponatremia(<136)	17(25.76%)	49(74.24%)
	Normal (136-145)	12(22.22%)	42(77.78%)
	Hypernatremia>145	0	1(100%)
Sodium during admission	Hyponatremia <136	21(25.3%)	62(74.7%)
	Normal (136-145)	8(21.05%)	30(78.95%)
	Hypernatremia (>145)	0	0
Potassium at admission	Hypokalemia(<3.5)	1(9.09%)	10(90.91%)
	Normal(3.5-5)	27(25.47%)	79(74.53%)
	Hyperkalemia(>5)	1(25%)	3(75%)
Potassium during admission	Hypokalemia <3.5)	1(9.09%)	10(90.91%)
	Normal (3.5-5)	27(25.47%)	79(74.53%)
	Hyperkalemia(>5)	1(25%)	3(75%)

5.5. Factors associated with acute kidney injury

Bi-variable logistic regression analysis showed that the development of acute kidney injury (AKI) was associated with diabetes mellitus, atrial fibrillation, presence of any source of infection, hypertension, NYHA functional class III, and digoxin use. Variables with a p-value < 0.2 in the bi-variable analysis were entered into the multivariable logistic regression model.

In the multivariable analysis, three variables remained independently associated with the development of AKI. Diabetes mellitus was the strongest predictor of AKI (AOR = 67.74, p < 0.001). The presence of any source of infection was also significantly associated with AKI (AOR = 27.78, p = 0.002). In addition, atrial fibrillation showed a significant independent association with AKI (AOR = 17.74, p = 0.001). Other variables, including hypertension, NYHA functional class, digoxin use, and age, did not show independent associations with AKI in the multivariable analysis (Table 5).

Table 5- Bivariate and multivariate logistic regression analysis of patients with ADHF admitted at ARTH, Asela, Ethiopia

Variables	Category	AKI		COR	AOR	P
		Yes	No			
Diabetes	Yes	25(64.1%)	14(35.9%)	34.81 (10.498, 115.499)	67.740 (6.533, 702.343)	<0.001**
	No	4(4.88%)	78(95.12%)	1		
Any source of Infection	Yes	27(41.54%)	38(58.46%)	19.184 (4.302, 85.555)	27.778 (3.395, 227.275)	0.002**
	No	2(3.57%)	54(96.43%)	1		
Atrial fibrillation	Yes	18(62.1%)	11(39.1%)	12.050 (4.525, 32.087)	17.746 (3.093, 101.809)	0.001**
	No	11(11.96%)	81(88.04%)	1	1	

Hypertension	Yes	21(33.33%)	42(66.67%)	3.125 (1.256, 7.778)	0.279 (0.027, 2.852)	0.282
	No	8(13.8%)	50(86.2%)	1	1	
NYHA class	Class 3	4(13.8%)	25(86.2%)	1	1	
	Class 4	25(27.2%)	67(72.8%)	2.332 (0.738, 7.373)	0.949 (0.113, 7.956)	0.961
Age in years	< 60	21(23.33%)	69(76.67%)	1	1	
	>60	8(25.8%)	23(74.2%)	1.143 (0.446, 2.929)	1.144 (0.172, 7.595))	0.889
sex	Male	16(22.86%)	54(77.14%)	1	1	
	Female	13(25.5%)	38(74.5%)	1.15(0.50,2.64)	–	0.74
Ejection fraction	Reduced (<40%)	17(22.97%)	57(57.03%)	1	1	
	Midrange (41-49%)	3(12.5%)	21(87.5%)	0.48(0.13,1.77)	–	0.270
	Preserved (>50%)	9(39.1%)	14(60.9%)	2.15(0.81,5.69)	–	0.120
ACEI use	Yes	20(23.3)	66(76.7%)	1	1	
	No	9(25.7%)	26(74.3%	1.14(0.47,2.77)	–	0.770
Furosemide use	Yes	29(24%)	92(76%)	–	–	–
	No	0	0	–	–	–
Beta blockers	Yes	26(25.7%)	75(74.3%)	1	–	
	No	3(15%)	17(85%)	0.51(0.14,1.92)	–	0.321

ARB use	Yes	1(50%)	1(50%)	3.25(0.20,52.80)	_	0.410
	No	28(23.5%)	91(76.5%)	1	_	

Key: variable with p-value <0.25 in bi-variable analysis were entered into multivariable logistic regression model. COR- crude odds ratio, AOR- adjusted odds ratio, *p<0.05, ** p<0.01, ARTH=asela referral and teaching hospital, ADHF=acute decompensated heart failure, ACEI =angiotensin converting inhibitor, ARB=angiotensin receptor blocker.

6. Discussion

In the present study, acute kidney injury (AKI) occurred in 24% (29 out of 121) of patients admitted with acute decompensated heart failure (ADHF). This prevalence is highly comparable to findings from a similar study conducted in Northwest Ethiopia (Gondar), which reported an AKI prevalence of 25.1% among ADHF patients [12]. The consistency between these studies suggests a relatively stable burden of AKI in ADHF within comparable low- and middle-income healthcare settings, where patient profiles, diagnostic capacity, and management strategies may be similar.

However, the prevalence observed in this study is substantially lower than the 47.4% reported in a meta-analysis of studies from developed regions such as the United States and Europe [7]. This discrepancy may be attributed to several factors. Studies from high-income countries often include older populations with a higher burden of chronic comorbidities and differences in diagnostic sensitivity may lead to higher detection rates of AKI in developed settings (31,32).

Conversely, the prevalence of AKI in this study is markedly higher than that reported from a tertiary care hospital in Somalia (8.3%) [10].

Within Ethiopia, variability has also been documented. A study conducted at Tikur Anbessa Specialized Hospital reported elevated serum creatinine levels (Cr >1.2 mg/dL) in 40% of patients admitted with ADHF. The higher proportion observed in that study may be partly explained by the use of absolute creatinine thresholds rather than standardized AKI definitions, differences in baseline renal function, or the inclusion of patients with pre-existing renal impairment. Collectively, these findings underscore that variations in AKI prevalence are likely driven by differences in patient demographics, heart failure etiology, comorbidity profiles, severity of illness at presentation, and the diagnostic criteria used to define AKI.

In multivariable analysis, diabetes mellitus emerged as an independent predictor of AKI among patients admitted with ADHF. Patients with diabetes had significantly higher odds of developing AKI compared with non-diabetic patients, even after adjustment for other clinical variables. This finding highlights diabetes as a critical risk factor associated with renal dysfunction in the context of ADHF. The underlying mechanisms are likely multifactorial, including pre-existing

diabetic nephropathy, endothelial dysfunction, micro-vascular disease, and reduced renal functional reserve. During episodes of acute cardiac de-compensation, these vulnerabilities render diabetic patients particularly susceptible to renal hypo-perfusion and ischemic injury(33). This result is consistent with findings from the Gondar study [12] and aligns with extensive literature demonstrating diabetes as a major contributor to cardio-renal syndrome.

The presence of infection was also identified as a strong independent predictor of AKI, with a markedly elevated adjusted odds ratio (AOR = 27.78), indicating a very strong association. This finding suggests that infection is significantly associated with renal dysfunction among patients with ADHF. Infection may contribute to AKI through systemic inflammatory responses, sepsis-related hypotension, altered renal auto-regulation, endothelial injury, and increased hemodynamic instability. In the setting of heart failure, where renal perfusion is already compromised, these factors may synergistically exacerbate kidney injury (34). This observation is consistent with previous studies from Northwest Ethiopia, which reported sepsis as a significant determinant of AKI in hospitalized patients with heart failure [12]. The strength of this association in the current study underscores the importance of early identification and aggressive management of infections in patients with ADHF to mitigate renal complications.

Atrial fibrillation (AFIB) was another variable found to be significantly associated with AKI, with an adjusted odds ratio of 17.74. AFIB may predispose patients to AKI through several mechanisms, including reduced cardiac output due to loss of atrial kick, irregular ventricular response leading to fluctuating renal perfusion, and increased risk of hypotension. Additionally, management of AF often involves medications such as anticoagulants, anti-arrhythmics, and rate-control agents, some of which may have nephrotoxic potential or exacerbate hemodynamic instability(35). The observed association in this study suggests that atrial fibrillation is more frequently present among ADHF patients with renal injury and may serve as a clinical indicator of increased vulnerability in this population .

In contrast, other variables—including hypertension, New York Heart Association (NYHA) functional class, digoxin use, and age—were not independently associated with AKI in the adjusted analysis. This suggests that within this study population, these factors did not significantly alter the risk of AKI once key conditions such as diabetes mellitus, atrial

fibrillation, and infection were taken into account. The lack of association with age may reflect the relatively younger age distribution of the cohort compared to studies from high-income countries. Similarly, the absence of an independent effect of hypertension may indicate that its impact on renal outcomes is mediated through long-term structural kidney damage rather than acute events during ADHF hospitalization.(36)

7. Limitations

The cross-sectional design limits the ability to establish temporal relationships and the observed odds ratios should therefore be interpreted with caution. As the study relied on retrospective medical record review, incomplete documentation may have introduced information bias, while exclusion of patients with incomplete clinical or laboratory data may have resulted in selection bias. Although acute kidney injury (AKI) was defined using predefined operational criteria, inconsistent monitoring of serum creatinine and electrolyte levels may have led to under-recognition or misclassification of AKI. In addition, prior history of AKI and important clinical outcomes, including length of hospital stay, in-hospital mortality, and longer-term outcomes, were not consistently documented, limiting assessment of the prognostic impact of AKI in patients with acute decompensated heart failure.

8. Conclusion

In conclusion, acute kidney injury was a common complication among patients hospitalized with acute decompensated heart failure, affecting approximately one in four patients. Diabetes mellitus, presence of infection, and atrial fibrillation emerged as strong independent predictors of AKI, underscoring their important contribution to the development of cardio-renal dysfunction in this population.

9. Recommendations

Clinicians should prioritize early identification and close monitoring of acute heart failure patients at high risk of AKI, particularly those with diabetes mellitus, infection, and atrial fibrillation. Hospital administrators should enhance laboratory capacity and documentation systems to support timely AKI detection, while policymakers should integrate AKI risk assessment into heart failure management guidelines, especially in resource-limited settings like us. Future prospective studies are needed to evaluate preventive strategies and the prognostic impact of AKI in acute heart failure.

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Annexes

Annex I: Questionnaires

Questionnaire prepared to assess prevalence of AKI and associated factors among acute heart failure patients

Date…….. Study Site……. Code……

Encircle only one correct response

Part 1: Socio demographic and economic factors

No	Question	Response	Skip to
1	Card number		
2	Place admission	Ward----ICU-----	
3	Age	…… years	
4	Occupation	1. Unemployed 2. Daily laborer 3. Merchant 4. Government employee 5. Private/NGO 6. Farmer 7. Other, specify…….	
5	Educational status	1. No formal education 2. Read and write 3. Primary education 4. High school 5. College and above	
6	Marital status	1. Single 2. Married 3. Divorced 4. Widowed	
7	Residence	1. Urban	

		2. Rural	
8	Religion	1. orthodox 2. Muslim 3. protestant 4. others	

Physical measures, behavioral risk factors and comorbidities

1, Smoking status	☐ Current smoker ☐ Ex-smoker ☐ Never smoker
2, HIV sero-status	☐ Positive ☐ Negative ☐ Unknown
3,Diabetes mellitus	☐ Yes ☐ No
4, Diabetes treatment	☐ Insulin ☐ Metformin ☐ sulfonylurea ☐ DPP4i ☐ others ____
5,Hypertension	☐ Yes ☐ No
6,Antihypertensive	☐ ACEI/CCB/Diuretics ☐ ARB ☐ CCB/BB/Diuretics ☐ Other _ ☐ No medication
7,Dyslipidemia	☐ Yes ☐ No
8,Lipid-lowering	☐ Statin ☐ Other: ____ ☐ No medication ☐ ND

Clinical characteristics, lab parameters and medications used

1, Cause of heart failure ☐ RVHD ☐ DCMP ☐ IHD DVHD ☐Other: ____

2, RVHD type of lesion ☐stenotic ☐ regurgitant ☐ mixed

3, Valve affected ☐MS ☐MR ☐TR ☐AS ☐AR others _____

4, Severity of affected valve ☐mild☐ moderate ☐severe

5, Ejection fraction ☐ <40% ☐ 41–49% ☐ ≥50% ☐ ND

6, HF stage ☐ Stage A ☐ stage B ☐ Stage C ☐ Stage D

7, NYHA class ☐ class II ☐ class III ☐ Class III ☐ Class IV

8, Precipitating Factors ☐ Infection ☐ AFIB ☐ Drug discontinuation
☐ Ischemia/MI ☐ Anemia ☐ Thyrotoxicosis ☐ Other: ____

9, Heart rate at presentation ☐ <60 ☐ 60–100 ☐ >100

10, Peripheral edema ☐ 1 ☐ 2 ☐ 3 ☐ 4

11, Atrial fibrillation ☐ Yes ☐ No

12, Infective endocarditis ☐ Yes ☐ No

13, Salt-containing diet ☐ Yes ☐ No

14, Furosemide ☐ Yes ☐ No

15, Beta-blocker ☐ Yes ☐ No

16, ACEI ☐ Yes ☐ No

17, ARB ☐ Yes ☐ No

18, Spironolactone ☐ Yes ☐ No

19, Digoxin ☐ Yes ☐ No

20, Anticoagulant ☐ Warfarin ☐ Aspirin ☐ Other: ____ ☐ None

21,Infection present ☐ Yes ☐ No ☐ ND

Site of infection _____

22, On antibiotics ☐ Yes ☐ No

Serum electrolytes follow up

Day	0	1	2	3	4	5	6	7
Na+								
K+								

Serial serum Creatinine values follow up

Day	0	1	2	3	4	5	6	7
Cr value								

Conclusion

Does the patient have AKI according to AKIN based on the above Cr values	Yes☐ No☐
If yes what is the change in serum cr value	_____
Does the patient have WRF	Yes☐ No☐
If yes what is the change in serum cr value	_____

Annex II: Investigator Assurance Form

I the undersigned nurse agree to accept all responsibilities for the scientific, ethical and technical conduct of the research project and for provision of required progress re-ports as per terms and conditions of the Research and Publication Committee and /or Department of Internal medicine, of Arsi University.

I also assert that this thesis is my original work, has not been presented for a degree in any other university and that all sources of materials used for the thesis have been accordingly acknowledged.

Name of Resident ……

Signature……

Date……

Approval of Advisors

1. Name of Advisor……

   Signature: ……..

   Date ……

2. Name of Advisor……

   Signature: .

   Date ……