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FREQUENCY OF RENAL DYSFUNCTION IN PATIENTS ADMITTED WITH ACUTE DECOMPENSATED HEART FAILURE AT A TERTIARY CARE HOSPITAL

Original Research

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Acknowledgement: The authors gratefully acknowledge NICVD Karachi for their support in data collection.

Conflict of Interest: None
Grant Support & Financial Support: None

ABSTRACT

Background: Acute decompensated heart failure (ADHF) is a critical clinical condition frequently complicated by renal dysfunction, which significantly worsens patient outcomes. The cardiorenal interaction poses diagnostic and therapeutic challenges, particularly in low-resource settings. Globally, renal dysfunction is recognized as an independent predictor of mortality in heart failure patients. In Pakistan, where comorbidities like diabetes and hypertension are highly prevalent, local data on renal impairment in ADHF remains limited, necessitating focused research to guide early risk identification and integrated management strategies.

Objective: To determine the frequency of renal dysfunction in patients admitted with acute decompensated heart failure at a tertiary care hospital.

Methods: A descriptive cross-sectional study was conducted over six months in the Adult Cardiology Department of the National Institute of Cardiovascular Diseases, Karachi. A total of 140 patients aged 18–75 years, with a primary diagnosis of ADHF, were enrolled using consecutive non-probability sampling. Serum creatinine, blood urea nitrogen (BUN), and estimated glomerular filtration rate (eGFR) were measured using standard protocols. Renal dysfunction was defined as eGFR < 60 mL/min/1.73 m² using the CKD-EPI equation. Data were analyzed using SPSS version 26, applying descriptive statistics, stratification, and inferential tests with $p<0.05$ considered significant.

Results: The mean age was 61.0 ± 9.0 years and mean BMI was 27.2 ± 3.5 kg/m². Males constituted 62.9% and 72.1% of patients were from urban areas. Hypertension was present in 75.7%, diabetes mellitus in 58.6%, and ischemic heart disease in 50.0% of cases. NYHA class III and IV were observed in 50.7% and 25.0%, respectively. The mean serum creatinine was 1.9 ± 0.6 mg/dL, BUN 26.4 ± 7.3 mg/dL, and eGFR 48.7 ± 19.6 mL/min/1.73 m². Renal dysfunction was noted in 77.9% of patients.

Conclusion: Renal dysfunction was highly prevalent in patients admitted with ADHF and strongly associated with advanced functional class and comorbid conditions. These findings support routine renal assessment to guide comprehensive management in heart failure care.

Keywords: Acute Heart Failure, Blood Urea Nitrogen, Cardiorenal Syndrome, Comorbidity, Creatinine, Glomerular Filtration Rate, Renal Dysfunction.

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INTRODUCTION

Heart failure (HF) remains a pressing global health concern, affecting an estimated 38 million individuals worldwide and associated with a prognosis that in some cases is worse than that of certain malignancies (1,2). Chronic heart failure is known for its substantial mortality burden, with a reported five-year mortality rate of up to 60% in men and 45% in women (3). Among these patients, those experiencing acute decompensated heart failure (ADHF)—a sudden or gradual worsening of HF symptoms—face particularly poor outcomes. Despite advances in medical management, the one-year mortality following hospitalization for ADHF persists at approximately 20% to 30%, and the risk escalates with repeated admissions (4-6). These alarming figures underscore the importance of addressing the various comorbidities that frequently accompany ADHF, especially renal dysfunction, which has emerged as an independent and significant predictor of poor prognosis in this population (7). Renal dysfunction is prevalent among individuals with heart failure and complicates the clinical picture considerably. The interplay between cardiac and renal systems, often referred to as the cardiorenal syndrome (CRS), is multifactorial and not fully understood (8). Mechanisms likely involve a combination of pre-existing chronic kidney disease (CKD), hemodynamic alterations, neurohormonal dysregulation, systemic inflammation, and adverse effects of acute therapies such as diuretics and vasodilators. Furthermore, renal congestion and hypoperfusion may exacerbate this dysfunction. Interestingly, the severity of renal impairment does not necessarily correlate with the extent of systolic dysfunction in heart failure with reduced ejection fraction (HFrEF), but it may have closer associations with diastolic dysfunction in heart failure with preserved ejection fraction (HFpEF) (9).

Large-scale studies have further highlighted the scope and implications of renal dysfunction in this setting. The Acute Decompensated Heart Failure National Registry (ADHERE), which analyzed over 118,000 hospitalizations, reported that only 9% of patients had normal renal function on admission, while the majority exhibited varying degrees of renal impairment—ranging from mild to kidney failure (10). Similarly, data from the Swedish Heart Failure (SwedeHF) and Stockholm Creatinine Measurement (SCREAM) registries revealed that deterioration in renal function within one year was strongly associated with increased long-term mortality, regardless of ejection fraction category (11,12). These findings collectively point toward a clear and critical link between renal function and survival outcomes in heart failure patients. Despite the recognized importance of renal function in ADHF, clinical management remains challenging. Therapeutic strategies aimed at relieving congestion or enhancing cardiac output may inadvertently worsen renal function. This delicate balance frequently results in cautious or even suboptimal treatments that fail to adequately stabilize either organ system. The lack of local data regarding the burden of renal dysfunction in ADHF populations, particularly within tertiary care settings in developing countries, represents a significant gap in clinical evidence. Quantifying the frequency and severity of renal impairment in hospitalized ADHF patients is vital to guiding timely interventions, optimizing therapy, and improving prognostic assessments (13).

The current study is designed to address this gap by determining the frequency of renal dysfunction among patients admitted with acute decompensated heart failure at a tertiary care hospital. This objective seeks to provide insight into the extent of renal compromise in this high-risk group and to inform future management strategies aimed at mitigating the impact of renal dysfunction on cardiovascular outcomes.

METHODS

This study was conducted as a descriptive, cross-sectional analysis at the Department of Adult Cardiology, National Institute of Cardiovascular Diseases (NICVD), Karachi, Pakistan. The research was carried out over a duration of six months following the approval of the synopsis by the College of Physicians and Surgeons Pakistan (CPSP), and ethical clearance was obtained from the Institutional Ethical Review Board prior to initiation of data collection. Informed and written consent was secured from all participants or their legal guardians, ensuring compliance with ethical standards for human research (14,15). The study population comprised patients aged between 18 and 75 years of either gender who were admitted with a primary diagnosis of acute decompensated heart failure (ADHF). Diagnosis of ADHF was established based on clinical criteria and confirmed through radiographic and biochemical assessments as outlined in the operational definitions. Patients with a past history of ADHF or those unwilling to participate were excluded from the

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study. A non-probability consecutive sampling technique was employed to recruit participants who met the eligibility criteria. The calculated sample size was 140, based on an anticipated frequency of renal dysfunction in ADHF patients of 63%, a 95% confidence level, and a margin of error of 8%. The sample size formula used was $n = z^2 \times p \times (1-p) / e^2$, and the calculation was performed using an online tool (16,17).

Demographic variables such as age, gender, body mass index (BMI), and residential status were documented at admission. Relevant comorbid conditions including hypertension, diabetes mellitus, and ischemic heart disease were recorded from the patients' medical histories or medication use. Each patient's functional status was assessed using the New York Heart Association (NYHA) classification system. Venous blood samples (5 mL) were collected under sterile conditions and sent to the institutional laboratory for analysis of serum creatinine and blood urea nitrogen (BUN) using standard laboratory protocols. Estimated glomerular filtration rate (eGFR) was calculated using the CKD-EPI formula according to gender and serum creatinine levels, as defined in the study's operational definitions. Renal dysfunction was categorized based on eGFR thresholds (18). All study variables were recorded on a pre-designed structured proforma. Data analysis was performed using IBM SPSS Statistics for Windows, version 26.0. Categorical variables such as gender, residence, comorbidities, NYHA class, and presence of renal dysfunction were presented as frequencies and percentages. The normality of quantitative data including age, BMI, serum creatinine, BUN, and eGFR was evaluated using the Shapiro-Wilk test. Normally distributed continuous data were expressed as mean and standard deviation, while non-normally distributed variables were presented as median and interquartile range. Stratification was performed for potential effect modifiers including age, gender, BMI, residence, comorbid conditions, and NYHA class to observe their influence on the frequency of renal dysfunction. Post-stratification, comparisons were made using the chi-square test for categorical variables. Independent sample t-tests were used to compare means between groups when data were normally distributed, and the Mann-Whitney U test was applied for non-normally distributed data. A *p*-value of less than 0.05 was considered statistically significant for all inferential analyses (19).

RESULTS

The analysis included 140 patients diagnosed with acute decompensated heart failure. The mean age of the study population was 61.0 ± 9.0 years, while the mean body mass index (BMI) was 27.2 ± 3.5 kg/m², reflecting a moderately overweight cohort consistent with regional cardiac trends. Males comprised a greater proportion of the study population (62.9%) compared to females (37.1%). A majority of the participants resided in urban areas (72.1%), with the remaining 27.9% from rural settings. Comorbidity analysis revealed that hypertension was present in 75.7% of the patients, diabetes mellitus in 58.6%, and ischemic heart disease in 50%. The New York Heart Association (NYHA) classification indicated that 50.7% of patients were in class III, followed by 25.0% in class IV, 22.1% in class II, and only 2.1% in class I, demonstrating that the majority presented with advanced functional limitation.

Regarding renal function, the mean serum creatinine level was 1.9 ± 0.6 mg/dL, while the mean blood urea nitrogen (BUN) was 26.4 ± 7.3 mg/dL. The estimated glomerular filtration rate (eGFR) had a mean value of 48.7 ± 19.6 mL/min/1.73 m², suggesting moderate renal impairment across the cohort. Based on the operational definition (eGFR < 60 mL/min/1.73 m²), renal dysfunction was identified in 77.9% of the patients, while only 22.1% maintained preserved renal function.

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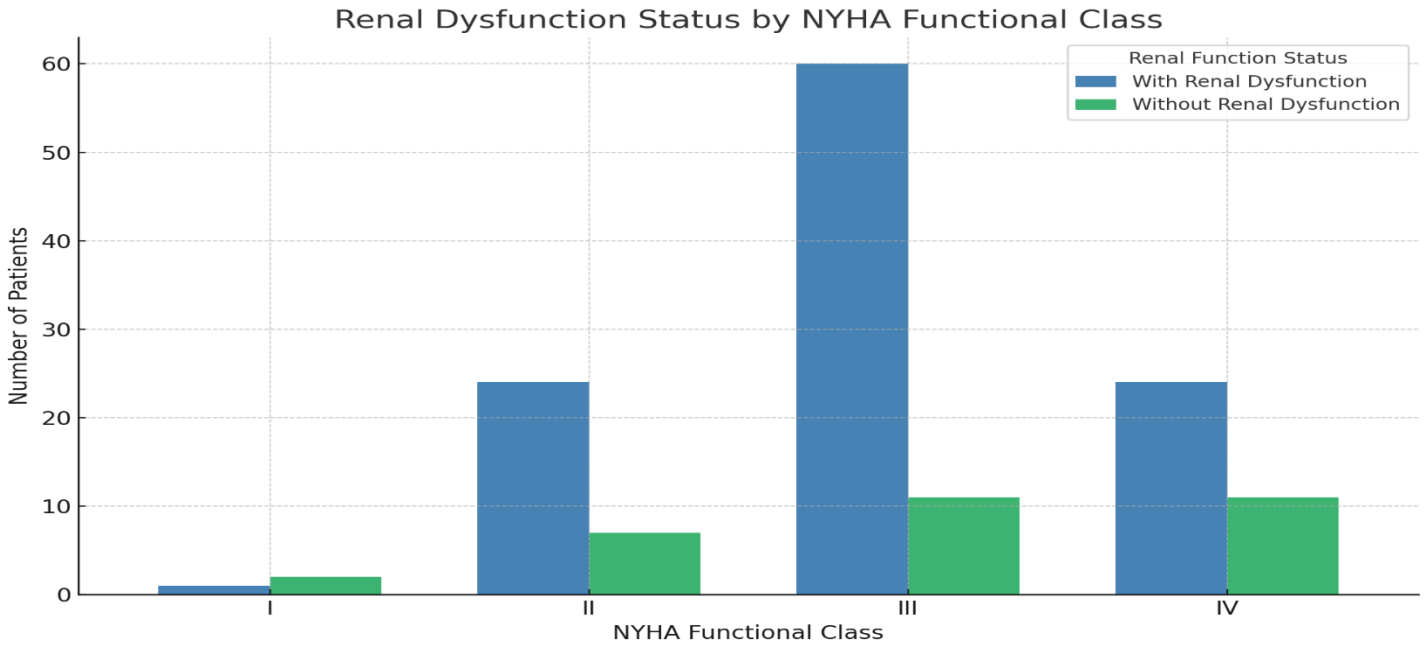

Figure 1 Renal dysfunction across NYHA classes

Renal dysfunction was observed in 1 of 3 NYHA I patients, 24 of 31 NYHA II, 60 of 71 NYHA III, and 24 of 35 NYHA IV patients. The chart shows higher prevalence of renal impairment with worsening NYHA class.

Table 1: Mean and Standard Deviation of Age and BMI

	Mean	**Standard Deviation**
Age (Years)	61.04	9.009
BMI (kg/m²)	27.167	3.538

Table 2: Vertical Frequency and Percentage Table

Variable	**Category**	**Percentage**
Gender	Female	37.1
Gender	Male	62.9
Residence	Rural	27.9
Residence	Urban	72.1
Hypertension	No	24.3
Hypertension	Yes	75.7
Diabetes Mellitus	No	41.4
Diabetes Mellitus	Yes	58.6
Ischemic Heart Disease	No	50
Ischemic Heart Disease	Yes	50
NYHA Classification	I	2.1
NYHA Classification	II	22.1
NYHA Classification	III	50.7
NYHA Classification	IV	25

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Table 3: Renal Function Mean and Standard Deviation Table

	Mean	Standard Deviation
Serum Creatinine (mg/dL)	1.908	0.600
Blood Urea Nitrogen (mg/dL)	26.434	7.329
eGFR (mL/min/1.73 m²)	48.657	19.60

Table 4: Renal Dysfunction Frequency Table

Renal Dysfunction	Percentage
Yes	77.9
No	22.1

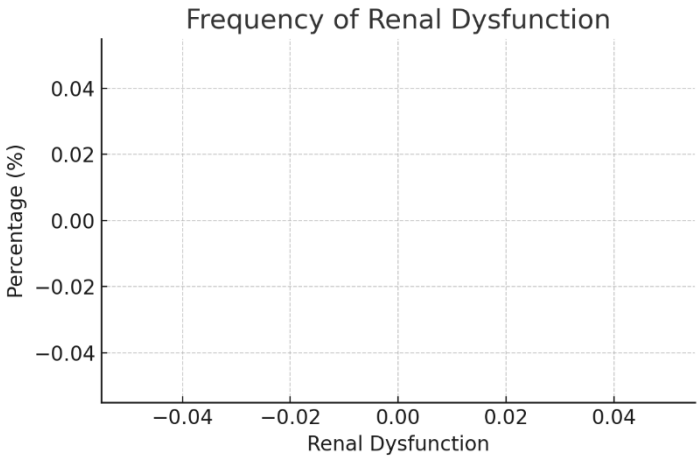

Figure 2 Frequency of Renal Dysfunction

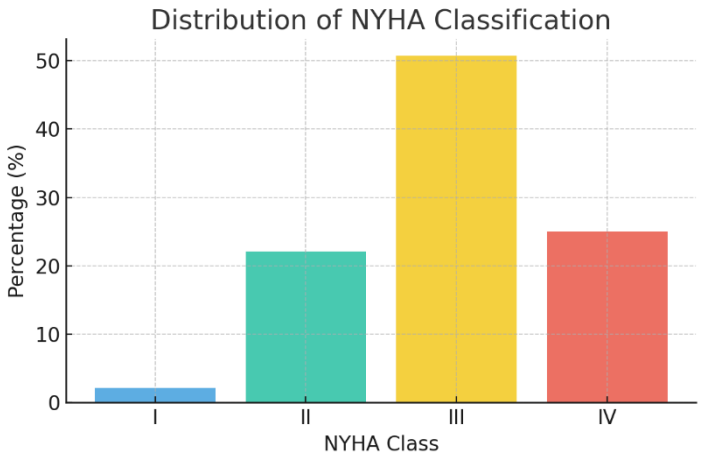

Figure 3 Distribution of NYHA Classificatiion

DISCUSSION

The findings of this study highlighted a significant burden of renal dysfunction among patients admitted with acute decompensated heart failure (ADHF), with 77.9% of patients exhibiting an estimated glomerular filtration rate (eGFR) below 60 mL/min/1.73 m². This prevalence is consistent with previously published international and regional literature that has established renal impairment as a frequent and prognostically relevant comorbidity in heart failure populations. Large registry-based studies, including the ADHERE registry, reported similar trends, identifying moderate to severe renal dysfunction in more than 60% of hospitalized ADHF patients. The results of the present study reaffirm these trends in the local Pakistani population, reflecting both the global significance of cardiorenal interplay and the contextual impact of regional health dynamics such as poor baseline cardiovascular health and high rates of uncontrolled hypertension and diabetes (20,21). The mean age of 61 years and predominance of male patients (62.9%) aligns with existing epidemiological patterns observed in tertiary cardiovascular care settings across South Asia. The high frequency of urban dwellers (72.1%) among the admitted cohort may reflect greater access to healthcare facilities in metropolitan centers rather than a lower disease burden in rural populations, as rural heart failure cases often remain underdiagnosed or are presented late. The burden of comorbidities in this study was striking, with hypertension in 75.7% and diabetes mellitus in 58.6% of patients, mirroring national surveillance data on the prevalence of non-communicable diseases in Pakistan. Such comorbid profiles significantly contribute to both the development and worsening of renal impairment in heart failure patients. These findings support the established pathophysiological concept of cardiorenal syndrome, where a combination of neurohormonal activation, hemodynamic instability, and systemic inflammation creates a bidirectional cascade of dysfunction between the heart and kidneys (22,23).

A particularly notable observation in this study was the advanced functional class of most patients at admission, with 75.7% classified as NYHA class III or IV. This corresponds with the high prevalence of renal dysfunction and supports previous findings that worsening

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NYHA class correlates strongly with renal compromise and elevated mortality. Although NYHA class is a subjective measure, its correlation with biochemical markers of renal impairment in this cohort provides clinical relevance and underscores the importance of early intervention and monitoring in patients with even moderate symptoms of heart failure (24,25). While the overall results are consistent with global literature, the study also adds regional specificity to the data landscape by illustrating the renal profile of Pakistani ADHF patients. This contribution is particularly valuable given the underrepresentation of South Asian cohorts in major international trials. However, the study is not without limitations. Its cross-sectional design restricts the ability to infer causality or to observe longitudinal outcomes such as readmission rates, progression of renal dysfunction, or all-cause mortality. Additionally, data were derived from a single tertiary care center, which may limit generalizability, especially to rural or primary care settings where healthcare-seeking behaviors and clinical presentations may differ. Another limitation was the absence of advanced renal biomarkers, such as cystatin C or neutrophil gelatinase-associated lipocalin (NGAL), which could have enhanced the diagnostic precision for acute kidney injury and subclinical renal dysfunction (26).

Despite these limitations, the study's strengths lie in its structured methodology, use of validated eGFR calculations, and comprehensive inclusion of demographic, clinical, and biochemical variables. The incorporation of NYHA classification, comorbidity profiles, and renal indices offers a multidimensional perspective that enhances the interpretability of the findings. Importantly, the study also highlighted an unmet need: although high rates of renal dysfunction were identified, the absence of subgroup analysis prevented a deeper understanding of associations between renal dysfunction and specific variables such as diabetes, ischemic heart disease, or NYHA class. Future studies should incorporate these interactions through multivariate analyses and prospective follow-up designs (27). Moving forward, large-scale, multicenter studies are warranted to validate these findings and explore the impact of early renal monitoring on clinical decision-making and outcomes in heart failure management. There is also a need to integrate renal protection strategies into heart failure care, including personalized diuretic titration, fluid management protocols, and appropriate use of guideline-directed medical therapy. In resource-limited settings like Pakistan, such integrated approaches can potentially improve quality of life, reduce hospital stays, and lower mortality in this high-risk population (12,21).

CONCLUSION

This study concluded that renal dysfunction is a highly prevalent and clinically significant finding in patients admitted with acute decompensated heart failure. The close association between impaired renal function, advanced heart failure symptoms, and coexisting comorbidities underscores the need for routine renal assessment in this population. Recognizing renal impairment early in the course of heart failure management can support more informed clinical decisions, guide appropriate therapy, and ultimately improve patient outcomes. These findings emphasize the importance of integrating renal evaluation into standard heart failure protocols, particularly in regions with limited healthcare resources and a high burden of cardiovascular disease.

AUTHOR CONTRIBUTION

Author	Contribution
Aroona Kataria*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Rakesh Kumar	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
FNU Neelam	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Kainat Nasim	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Farhan Khan	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Rabia Adab	Substantial Contribution to study design and Data Analysis

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Author	Contribution
	Has given Final Approval of the version to be published
Deepak Kumar	Contributed to study concept and Data collection Has given Final Approval of the version to be published
Nasir Yaqoob	Writing - Review & Editing, Assistance with Data Curation

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