



Characteristics, Outcomes, and Predictors of Mortality of Acute Kidney Injury in a Rural Tertiary Hospital in Southern Nigeria

Mojeed O. Rafiu^{1*}, Fatelyn Okakah², Grace O. Osadonor², Dew I. Orié², Ndidi N. Akerele¹, Sulaiman D. Ahmed¹, Adewale E. Adetunji³, Airenakho Emorinken⁴, Christian E. Erohubie¹, Orebowale Olugbemide⁵, Chukwuemeka O. Azubike^{1,6}

¹Nephrology Unit, Department of Internal Medicine, Irrua Specialist Teaching Hospital, Irrua, Edo State, and Department of Medicine, Faculty of Clinical Sciences, College of Medicine, Ambrose Alli University, Ekpoma, Edo State, Nigeria.

²Public Health and Community Medicine Department, Irrua Specialist Teaching Hospital, Irrua, Edo State, and Community Medicine Department, Faculty of Clinical Sciences, College of Medicine, Ambrose Alli University, Ekpoma, Nigeria.

³Nephrology Unit, Paediatrics Department, Irrua Specialist Teaching Hospital, Irrua, and Paediatrics Department, Faculty of Clinical Sciences, College of Medicine, Ambrose Alli University, Ekpoma, Nigeria.

⁴Rheumatology Unit, Department of Internal Medicine, Irrua Specialist Teaching Hospital, Irrua, and Department of Medicine, Faculty of Clinical Sciences, Ambrose Alli University, Ekpoma, Nigeria.

⁵Endocrinology Unit, Department of Internal Medicine, Irrua Specialist Teaching Hospital, Irrua, and Department of Medicine, Faculty of Clinical Sciences, Ambrose Alli University, Ekpoma, Nigeria.

⁶Medical Physiology Department, College of Medicine, University of Benin, Benin, Edo State, Nigeria.

Abstract

Context: Acute kidney injury (AKI) is a major contributor to global morbidity and mortality in critically ill patients. In Nigeria, AKI is commonly associated with preventable conditions, particularly infections; however, data on its characteristics, outcomes, and predictors of mortality are limited.

Objective: This study assessed the characteristics, outcomes, and predictors of mortality among patients with AKI at the Irrua Specialist Teaching Hospital (ISTH), Edo State.

Materials and Methods: A hospital-based retrospective study was conducted on 200 patients diagnosed with AKI at ISTH. Associations between variables and mortality were assessed using the chi-square test and Fisher's exact test. Binary logistic regression was used to determine the predictors of mortality at a level of significance of $p < 0.05$.

Results: The mean participant age was 45.11 ± 23.18 years, with a male predominance (69%). Most cases of AKI were community-acquired (182, 91%), and sepsis/infection was the leading cause of AKI (115, 57.5%). Overall, 162 participants (81%) presented with stage 3 disease, 157 participants (78.5%) required dialysis, 19 participants (9.5%) achieved complete renal recovery, and the mortality rate was 27.5%. Mortality was significantly associated with higher Kidney Disease: Improving Global Outcomes (KDIGO) stage ($p = 0.024$), elevated blood urea nitrogen ($p = 0.022$), presence of complications ($p = 0.001$), dialysis requirement ($p = 0.025$), and intensive care unit (ICU) admission ($p = 0.001$). ICU admission (AOR = 0.035, 95% CI = 0.008 – 0.146, $p < 0.001$), dialysis requirement (AOR = 0.313, 95% CI = 0.100 – 0.983, $p = 0.047$), and place of residence (AOR = 0.430, 95% CI = 0.187 – 0.989) were identified as independent predictors of

mortality.

Conclusion: AKI in this setting is predominantly community-acquired and infection-related. Mortality is primarily driven by clinical severity and complications rather than by the underlying cause. Strengthening early detection, infection control, and

Corresponding Author:

Mojeed Olaitan Rafiu

Irrua Specialist Teaching Hospital, Irrua, Edo State, Nigeria.

raphymoj2012@gmail.com | ORCID: 0000-0001-6289-0967

DOI: 10.61386/imj.v19i4.1351

access to renal and critical care services are essential to improve outcomes in resource-limited settings such as ours.

Keywords: AKI, outcomes, characteristics, ISTH, predictors, mortality.

Introduction

Acute kidney injury (AKI) is a rapid and critical deterioration of renal function. This breakdown in physiological homeostasis disrupts fluid, electrolyte, and acid-base balance, ultimately precipitating systemic nitrogenous waste accumulation. For clinical and research standardization, AKI was defined by the Kidney Disease: Improving Global Outcomes (KDIGO) criteria using specific thresholds of serum creatinine elevation and urine output reduction.¹ Globally, an estimated 13.3 million individuals develop AKI annually; about 85% of these cases occur in low- and middle-income countries (LMICs), where constrained diagnostic and therapeutic infrastructure compounds the disease burden.² Beyond its immediate clinical toll, AKI substantially complicates inpatient management, expanding median hospital stays by roughly three days and incurring an average additional expenditure of \$7,500 per patient.³ Furthermore, mounting evidence links AKI to long-term sequelae, notably the progression to chronic kidney disease (CKD) and heightened cardiovascular morbidity.⁴ Despite advancements in critical care and nephrology, AKI-associated mortality remains strikingly high, spanning 10.8% to 77% depending on the healthcare setting.⁵ Globally, the condition contributes to nearly 1.7 million deaths each year, disproportionately affecting LMICs.⁶ In hospitalized cohorts specifically, AKI elevates the risk of death up to sixfold, with reported mortality rates across Sub-Saharan Africa (SSA) ranging from 10.9% to 58%.⁷ The etiology of AKI is inherently multifactorial, and pre-existing comorbid conditions markedly increase patient vulnerability while exacerbating clinical trajectories.⁸ Etiologically, AKI is categorized into prerenal, intrinsic renal, and postrenal mechanisms.^{1,9} In high-income countries (HICs), the clinical profile is predominantly hospital-acquired, frequently triggered by major surgical procedures, radiocontrast exposure, or nephrotoxic therapeutic agents.¹⁰⁻¹³ Conversely, in LMICs—particularly across SSA—community-acquired AKI predominates, frequently driven by severe endemic infections and

obstetric complications.¹⁰⁻¹³ A meta-analysis by Kahindo et al. underscored the complex, heterogeneous nature of AKI in SSA, identifying infectious diseases, intravascular volume depletion, and toxic exposures as primary drivers.¹¹ This stands in contrast to patterns in Western cohorts, where sepsis and cardiac surgery serve as the main causative factors.¹² These geographic disparities illustrate a dual global challenge: advanced medical systems struggle with iatrogenic and inpatient onset, whereas resource-constrained regions continue to confront preventable insults linked to suboptimal sanitation, inadequate maternal healthcare, and unmonitored exposure to nephrotoxic pharmaceutical and herbal formulations.¹⁰⁻¹³

A broad spectrum of prognostic determinants consistently dictates the clinical outcomes of AKI. Advanced age (≥ 60 years) is a major risk factor for adverse outcomes, as structural renal senescence, frailty, and a higher prevalence of systemic co-pathologies, such as hypertension, diabetes mellitus, and cardiovascular disease, impair organ recovery.¹⁴ Notably, poorer clinical outcomes, including elevated inpatient mortality, higher ICU admission rates, and prolonged hospitalization, have been observed in older male cohorts compared to females.¹⁵ This disparity likely reflects physiological and hormonal differences in renal vascular dynamics, along with a higher likelihood of exposure to risk factors such as smoking and hypertension.

The degree of structural and functional renal impairment correlates directly with patient prognosis; advanced stages routinely necessitate renal replacement therapy, accelerate estimated glomerular filtration rate (eGFR) decline, and portend higher inpatient mortality.¹⁶ In routine practice and clinical trials, the KDIGO staging matrix serves as the standard tool to stratify severity.¹ Patients requiring intensive care admission and organ support exhibit particularly guarded prognoses, as critical illness often involves concurrent sepsis, hemodynamic collapse, and multi-organ dysfunction syndrome.^{3,17} Indeed, multi-organ involvement represents a grave prognostic indicator, reflecting severe physiological stress that curtails the capacity for renal recovery.^{17,18} Ultrasonographically confirmed ascites has also been identified as a strong independent predictor of mortality.¹⁸ Additionally, comorbidity independently worsens mortality, as concurrent chronic conditions limit therapeutic windows and blunt regenerative potential.^{8,19}

Collectively, these predictors emphasize the complex determinants of AKI outcomes and underline the imperative for early risk stratification and targeted interventions in vulnerable populations.

These epidemiological contrasts have profound clinical and public health implications. In high-income settings, AKI predominantly affects older adults and hospitalized patients undergoing complex surgical or pharmacological interventions.^{10,12,20} In contrast, LMICs face a burden concentrated in younger populations presenting with community-acquired cases secondary to infection, pregnancy-related complications, and nephrotoxins.^{11,21} Despite a few existing hospital-level reports, there remains a notable deficit of robust data characterizing AKI demographics, risk profiles, and prognostic determinants within West Africa, including Nigeria.²² Addressing this empirical gap is crucial for delineating regional disease dynamics and informing tailored management strategies. Therefore, this study evaluated the clinical characteristics, outcomes, and independent predictors of mortality among patients diagnosed with AKI at a rural tertiary medical center.

Materials and Method

Study Site: The study was conducted at the Irrua Specialist Teaching Hospital (ISTH), located in Irrua, the administrative headquarters of the Esan Central Local Government Area in Edo State, Nigeria. The ISTH serves as a referral center for various states in the South-South and parts of the North-Central geopolitical zones in Nigeria. It has a bed capacity of more than 400 beds.

Study Design, population and Duration: This was a retrospective analytical cross-sectional study. This study involved a review of the medical records of patients diagnosed with AKI at the Irrua Specialist Teaching Hospital (ISTH), Edo State, over 2 years, from January 2023 to December 2024. The inclusion criteria were as follows: all patients diagnosed with AKI according to the KDIGO criteria during the study period who had complete case records containing demographic, clinical, laboratory, and outcome data in the hospital's electronic medical record (EMR). The exclusion criteria were as follows: patients with CKD or end-stage renal disease (ESRD) before admission and those with incomplete or missing clinical, laboratory, or outcome data. AKI was staged based on KDIGO criteria.¹

Sample Size Determination and Sampling Techniques:

The sample size determination was guided by Cochran's formula, using the overall pooled incidence of 15.0% for AKI in Nigeria to arrive at a final figure of 200.^{23,24} This study employed purposive sampling. Thus, 200 case records of patients who fulfilled the inclusion criteria were consecutively selected for analysis. Data were collected using a structured data extraction form specifically designed for this study.

Statistical Analysis: The collected data were entered into a spreadsheet and analyzed using IBM SPSS Statistics, Version 23. Continuous variables were summarized using summary statistics, such as means and standard deviations, whereas categorical variables were described using frequencies and proportions. A chi-square test and Fisher's exact test were used to test the associations between categorical variables. Binary logistic regression was used to determine predictors of mortality. The level of significance was set at $P < 0.05$.

Ethical Consideration: Ethical approval was obtained from the Irrua Specialist Teaching Hospital Health Research Ethics Committee (ISTH-HREC) with protocol number (ISTH/HREC/20252111/778). Since the study involved a review of existing patient records, informed consent from individual patients was waived by the Ethics Committee. All extracted data were anonymized using unique study codes to ensure confidentiality and privacy of the participants. Access to the data was restricted to the research team, and electronic data were stored in password-protected files, whereas the hard copies were securely stored. This study was conducted in accordance with the principles of the Declaration of Helsinki and the relevant national guidelines for research ethics.

Result

A total of 200 records of patients who met the inclusion criteria were reviewed for this study. Table 1 shows that the patients were predominantly middle-aged adults (mean age 45.11 ± 23.18 years), with the largest proportions in the 21–40 and 41–60-year groups. There was a marked male predominance (69%), and most patients were married (68.5%). Traders/business individuals constituted the largest occupational group, indicating a predominance of informal sector employment in the area. Additionally, most patients (77%) resided in rural areas.

Table 1: Socio-Demographic Characteristics of Patients (n=200)

Variable	Frequency (n)	Percentage (%)
Age group		
<20 years	34	17.0
21–40 years	55	27.5
41–60 years	53	26.5
≥61 years	58	29.0
Mean Age ± SD	45.11 ± 23.176	
Sex		31.0
Female	62	69.0
Male	138	
Marital status		
Divorced	2	1.0
Married	137	68.5
Single	55	27.5
Widowed	6	3.0
Occupation		
Trader/Business	63	31.5
Student	36	18.0
Farmer	36	18.0
Civil servant/Professional	33	16.5
Others	17	8.5
Artisan/Skilled worker	15	7.5
Place of residence		
Rural	154	77.0
Urban	46	23.0

SD = Standard Deviation.

Table 2: Comorbidity Pattern, Causes, Types and Stages of AKI among patients (n = 200)

Variable	Frequency (n)	Percentage (%)
Pre-existing comorbidities		
Hypertension	88	44.0
Diabetes mellitus	28	14.0
HIV infection	6	3.0
Cardiovascular disease	3	1.5
Others	17	8.5
None	80	40.0
Clinical setting of AKI		
Community-acquired	182	91.0
Hospital-acquired	18	9.0
Documented causes of AKI		
Sepsis/Infection	115	57.5
Intrinsic renal diseases	40	20.0
Obstructive uropathy	13	6.5
Obstetric causes	12	6.0
Hypovolemia/Dehydration	5	2.5
Others	13	6.5
Type of AKI		
Intrinsic	97	48.5
Postrenal	10	5.0
Prerenal	93	46.5
KDIGO Stage of AKI		
Stage 1	9	4.5
Stage 2	29	14.5
Stage 3	162	81

Intrinsic renal diseases include acute glomerulonephritis, acute tubular necrosis, and acute interstitial nephritis. Others = Post-surgical AKI, malignant hypertension, drug-induced AKI, and herbal medications

Table 2 presents the causes and types of AKI in these patients. A considerable proportion of patients had pre-existing comorbidities, with hypertension being the most prevalent (44%), whereas 40% had no comorbidities. Most cases of AKI were community-acquired (91%). Sepsis/infection was the leading cause (57.5%), followed by intrinsic renal disease (20%), with other causes, such as obstructive

uropathy and obstetric factors, being less common. In terms of AKI classification, AKI was predominantly intrinsic (48.5%) and prerenal (46.5%), whereas postrenal AKI was rare (5%). The majority (81%) of patients were in the KDIGO stage 3 AKI group.

Table 3: Biochemical and Clinical Characteristics of Patients with AKI.

Variable	Frequency (N=200)	Percentage (%)
Serum creatinine at presentation		
<1.5 mg/dl	7	3.5
1.5–2.9 mg/dl	32	16.0
3.0–4.9 mg/dl	42	21.0
≥5.0 mg/dL	119	59.5
Blood urea nitrogen (BUN) at presentation		
<20 mg/dL	2	1.0
20–39 mg/dL	7	3.5
40–79 mg/dL	24	12.0
≥80 mg/dL	167	83.5
Duration from the onset of symptoms to presentation		
≤2 days	37	18.5
3–7 days	84	42.0
8–14 days	58	29.0
>14 days	21	10.5
Presence of complications*		
Pulmonary edema/respiratory failure	34	17.0
Uraemic Encephalopathy	38	19
Hyperkalemia	21	10.5
Others	101	50.5
Presence of multi-organ dysfunction		
No	112	56.0
Yes	88	44.0
Requirement for ICU admission/ventilatory support		
No	179	89.5
Yes	21	10.5

*Some patients had more than one complication. Others = Hyponatremia, Heart failure, anemia, bleeding, and gastrointestinal disturbances.

Table 3 shows the biochemical and clinical characteristics of patients with AKI. Most patients presented with severe disease, as evidenced by high serum creatinine (≥5.0 mg/dL: 59.5%), elevated blood urea nitrogen (≥80 mg/dL: 83.5%), and predominance of KDIGO stage 3 (81.0%). The majority presented within 3–7 days of symptom onset (42.0%). Clinical complications were common, including pulmonary edema (17.0%), encephalopathy (19%), and hyperkalemia (10.5%). Nearly half of the patients (44.0%) had multi-organ dysfunction, whereas a smaller proportion (10.5%) required ICU admission or ventilatory support. Overall, the findings indicate late presentation with advanced disease and significant complications.

Table 4 presents the clinical outcomes of patients with AKI. Most patients had prolonged hospital stays, with the highest proportion staying for 15–30 d

Table 4: Clinical Outcomes of Patients with AKI

Variable	Frequency (n)	Percentage (%)
Duration of hospital stay		
1–7 days	39	19.5
8–14 days	64	32.0
15–30 days	81	40.5
>30 days	16	8.0
Need for dialysis		
Yes	157	78.5
No	43	21.5
Renal recovery status		
Partial	120	60.0
Complete	19	9.5
No recovery	61	30.5
Mortality outcome		
Alive	145	72.5
Dead	55	27.5

Recovery status was determined using the electrolyte profile, urea and creatinine levels, and urine output at the end of admission.

(40.5%). A large majority of patients required dialysis (78.5% of patients). Regarding renal recovery at the end of admission, most patients had partial recovery (60%), while a small proportion achieved complete recovery (9.5%), and a notable proportion had no recovery (30.5%). The overall mortality rate was 27.5%, indicating a considerable burden of poor outcomes in patients with acute kidney injury (AKI). Table 5 presents the association between sociodemographic characteristics and mortality

Table 5: Association between Sociodemographic factors and Mortality Outcome of AKI

Variable	Mortality outcome		χ^2	P-value
	alive n(%)	dead n(%)		
Age group			6.126	0.1056
≤ 20 years	25 (73.5)	9 (26.5)		
21–40 years	40 (72.7)	15 (27.3)		
41–60 years	44 (83.0)	9 (17.0)		
≥ 61 years	36 (62.1)	22 (37.9)		
Sex			0.106	0.745
Female	44 (71.0)	18 (29.0)		
Male	101 (73.2)	37 (26.8)		
*Marital status			9.421	0.0197
Divorced	0 (0.0)	2 (100.0)		
Married	102 (74.5)	35 (25.5)		
Single	41 (74.5)	14 (25.5)		
Widowed	2 (33.3)	4 (66.7)		
Occupation			9.924	0.0774
Artisan/skilled worker	6 (40.0)	9 (60.0)		
Civil servant/professional	25 (75.8)	8 (24.2)		
Farmer	25 (69.4)	11 (30.6)		
Student	29 (80.6)	7 (19.4)		
Others	12 (70.6)	5 (29.4)		
Place of residence			6.644	0.0099
Rural	119 (77.3)	35 (22.7)		
Urban	26 (56.5)	20 (43.5)		

*Fisher's exact test was used due to small expected cell counts

outcomes, showing that age and sex were not significantly associated with mortality ($p > 0.05$). However, marital status was significantly associated with mortality ($p = 0.0197$), with higher mortality observed among widowed and divorced participants. Place of residence was also significantly associated with mortality ($p = 0.0099$), with urban residents having a higher proportion of deaths than rural ones. Table 6 presents the association between the causes of

Table 6: Association between Cause of Acute Kidney Injury and Mortality Outcome

Cause of AKI	Alive n (%)	Dead n (%)	Fisher's Exact Value	P-value
Sepsis/Infection	81(70.4)	34(29.6)	2.213	0.9571
Hypovolemia/Dehydration	4(80.0)	1(20.0)		
Intrinsic renal diseases	29(72.5)	11(27.5)		
Nephrotoxic drugs	2(100.0)	0(0.0)		
Obstetric causes	9(75.0)	3(25.0)		
Obstructive uropathy	9(69.2)	4(30.8)		
Others	11(84.6)	2(15.4)		

AKI and the mortality outcomes. No statistically significant association was found between the different causes of AKI and mortality (Fisher's exact test value = 2.213, $P = 0.957$). Although sepsis/infection accounted for the highest proportion of both survivors and deaths, variations in mortality across other causes, such as intrinsic renal diseases, obstructive uropathy, and obstetric causes, were not statistically significant.

Table 7 presents the association between

Table 7: Association between Comorbidity and Mortality Outcome

Presence of comorbidity	Mortality outcome		χ^2	P-value
	Alive n(%)	Dead n(%)		
Diabetes mellitus	2 (66.7)	1 (33.3)	3.3	0.509
Heart disease	7 (100.0)	0 (0.0)		
Liver disease	3 (60.0)	2 (40.0)		
Others	4 (66.7)	2 (33.3)		
Hypertension	27 (75.0)	9 (25.0)		

comorbidities and mortality. There was no statistically significant relationship between the presence of comorbidities and mortality ($\chi^2 = 3.3$, $P = 0.509$).

Table 8 presents the association between AKI characteristics and mortality. The KDIGO stage of AKI ($p = 0.024$) and BUN level at presentation ($p = 0.022$) were significantly associated with mortality,

with higher stages and elevated BUN linked to mortality. The presence of complications ($p = 0.001$), need for dialysis ($p = 0.025$), and ICU admission/ventilatory support ($p = 0.001$) were also significantly associated with mortality in the univariate analysis.

Table 9. Multivariable binary logistic regression

Table 8: Association between the characteristics of AKI and Mortality (n = 200)

Variable	Mortality outcome		χ^2	P-value
	Alive n(%)	Dead n(%)		
KDIGO stage of AKI at presentation			7.435	0.024
Stage 1	9(100.0)	0 (0.0)		
Stage 2	25(86.2)	4 (13.8)		
Stage 3	111(68.5)	51 (31.5)		
Serum creatinine at presentation			6.623	0.085
<1.5 mg/dL	6(85.7)	1 (14.3)		
1.5–2.9 mg/dL	24(75.0)	8 (25.0)		
3.0–4.9 mg/dL	24(57.1)	18 (42.9)		
≥5.0 mg/dL	91(76.5)	28 (23.5)		
Blood Urea Nitrogen (BUN) at presentation			9.625	0.022
<20 mg/dL	0(0.0)	2 (100.0)		
20–39 mg/dL	7(100.0)	0 (0.0)		
40–79 mg/dL	20(83.3)	4 (16.7)		
≥80 mg/dL	118(70.7)	49 (29.3)		
Duration from onset of symptoms to presentation			6.840	0.077
≤2 days	21(56.8)	16 (43.2)		
3–7 days	66(78.6)	18 (21.4)		
8–14 days	44(75.9)	14 (24.1)		
>14 days	14(66.7)	7 (33.3)		
Presence of complications			68.891	0.001
Yes	62(59.0)	43 (41.0)		
No	83(87.4)	12 (12.6)		
Need for dialysis			5.042	0.025
Yes	108(68.8)	49 (31.2)		
No	37(86.0)	6 (14.0)		
ICU admission/ventilatory support			39.883	0.001
Yes	3(14.3)	18 (85.7)		
No	142(79.3)	37 (20.7)		

analysis was performed to identify independent predictors of mortality among patients with AKI in the ISTH. The model was statistically significant ($\chi^2 = 54.493$, $p < 0.001$) and explained 34.5% of the variance in mortality (Nagelkerke $R^2 = 0.345$). The Hosmer–Lemeshow test indicated a good model fit ($p = 0.819$), and the model correctly classified 80.0% of the cases. After adjusting for potential confounders, ICU admission was found to be a significant predictor of mortality (AOR, 0.035; 95% CI, 0.008–0.146; $p < 0.001$). Place of residence also significantly predicted mortality (AOR = 0.430, 95% CI: 0.187–0.989, $p = 0.047$). Dialysis requirement significantly predicted mortality (AOR, 0.313; 95% CI: 0.100–0.983; $p = 0.047$). KDIGO stage showed a statistical trend but lacked statistical significance as an independent predictor of mortality (AOR, 0.254; 95% CI, 0.061–1.048; $P = 0.058$).

Discussion

Table 9: Multivariable Binary Logistic Regression Analysis of Predictors of Mortality among Patients with AKI (n = 200)

Variable	Adjusted OR	95% CI	P-value
KDIGO Stage			
Stage 1–2 (Ref)	1.00	—	—
Stage 3	0.254	0.061–1.048	0.058
Blood Urea Nitrogen (BUN)			
<80 mg/dL (Ref)	1.00	—	—
≥80 mg/dL	0.509	0.128–2.016	0.336
ICU Admission			
No (Ref)	1.00	—	—
Yes	0.035	0.008–0.146	<0.001*
Place of Residence			
Rural (Ref)	1.00	—	—
Urban	0.430	0.187–0.989	0.047*
Marital Status			
Married (Ref)	1.00	—	—
Others (Single/Widowed/Divorced)	0.667	0.304–1.462	0.312
Dialysis Requirement			
No (Ref)	1.00	—	—
Yes	0.313	0.100–0.983	0.047*

The findings of this study showed that the mean age of patients with AKI was 45.11 ± 23.18 years, and sepsis/infection was the leading cause (57.5%), with the majority of cases being community-acquired (91%). This finding closely aligns with the results from other Nigerian tertiary centers, as documented by a study at the University of Abuja Teaching Hospital, Nigeria, which reported a mean age of 45.0 ± 17.3 years, and the most common cause of AKI was sepsis/infection, accounting for 62% of cases.²⁵ Beyond Nigeria, infection remains a global driver of AKI, even if not the most common cause in high-income countries.²⁶ The pattern of etiologies of AKI consistently implicates infection/sepsis as the leading cause, as reported in another study.²⁷ In contrast, evidence from developed countries, as reported in global epidemiological studies, shows that AKI is more commonly hospital-acquired and associated with surgical procedures, nephrotoxic medications, and critical illness.^{12,13} Our study showed a male preponderance of AKI; this aligns with the report by Loutradis et al. in a study conducted in Birmingham, which concluded that the risk of AKI was higher in men.²⁸ However, the latter study also found that AKI-related mortality risk in men was not independent of existing comorbidities.²⁸

We observed that the clinical outcomes, including a high dialysis requirement (78.5%), prolonged hospital stay, and a mortality rate of 27.5%, were comparable to those reported in another Nigerian

tertiary hospital in an urban setting.²⁹ At the Obafemi Awolowo University Teaching Hospitals (OAUTH) Complex, studies have reported mortality rates ranging from approximately 25% to 35% among patients with AKI.²⁹ Similar patterns have been observed in other African settings, as documented by studies from Groote Schuur Hospital, which reported an overall mortality rate of 38.8%, but a higher mortality in AKI patients admitted to the ICU who required dialysis.³⁰ Mortality is, however, reported to be lower in upper-middle-income (UMIC) and HIC in a study that compared the characteristics and outcomes of critically ill patients with AKI in the context of COVID-19.³¹ This difference in mortality of AKI based on country income level can be extrapolated to other causes of AKI due to earlier detection and more advanced supportive care in HIC.³¹ The high dialysis requirement observed in this study likely reflects late presentation and greater disease severity, a pattern consistent with other African settings but less common in developed healthcare systems, where early-stage AKI is more frequently identified and managed promptly.

Furthermore, age and sex were not significantly associated with mortality, whereas marital status and urban residence were significantly associated with mortality in the present study. Similar findings regarding sex have been reported in studies conducted at the OAUTH Complex, where no consistent sex differences in mortality among patients with AKI were observed.³² However, the study at OAUTH found that age ≥ 65 years independently predicted mortality, in contrast to the observation in our index study.³² Skalsky et al. investigated the association between AKI and long-term all-cause mortality risk among elderly and younger patients in the context of acute myocardial infarction and found that AKI, though associated with an increased risk of long-term all-cause mortality in the 2 groups, was stronger among younger patients.³³ Our study was not restricted to patients with myocardial infarction, and the mortality investigated in our study was short-term rather than long-term all-cause mortality. This may explain the differences between our observations. The unexpectedly high mortality rate among urban residents may be attributable to a referral bias. Urban dwellers are more likely to seek care at tertiary facilities during advanced disease stages because of increased health awareness and accessibility. Simultaneously, AKI cases in rural populations may

remain underrepresented in tertiary hospitals such as ISTH. This observation is not commonly reported in studies conducted in other African tertiary hospitals. A study by Ghazi et al. reported that patients who lived in the most disadvantaged areas had 10% greater odds of developing AKI and 25% greater odds of not recovering from AKI by hospital discharge.³⁴ The observation by Ghazi et al. is therefore in contrast to our finding because referral bias was probably eliminated in their study. In addition to its significant association with mortality, our study demonstrated that urban residency was an independent predictor of mortality in patients with AKI. To the best of our knowledge, this has not been reported previously.

Our study observed a significant association between the severity of AKI, as defined by KDIGO staging, and mortality. This agrees with the report of Abebe et al. in a hospital-based observational study at Jimma Medical Centre, Southwest Ethiopia.³⁵ However, beyond the severity of AKI, Abebe et al. also found that hyperkalemia, duration of AKI, and a short length of hospital stay also predicted 30-day in-hospital mortality in the 203 patients studied.³⁵ Similarly, studies from South Africa have demonstrated that although infections are common causes of AKI, mortality is more strongly influenced by the presence of complications and organ dysfunction.²² In developed countries, studies from the United Kingdom also support the conclusion that etiology alone is not a strong predictor of outcome, with disease severity and quality of care playing more significant roles.⁵ The lack of a significant association between comorbidities and mortality in this study is in contrast with the report by Jahantigh et al. in a study conducted on ICU patients at the University of Medical Science, Iran.³⁶ The difference may be attributed to the predominance of acute, infection-related AKI in African settings, where the immediate severity of illness outweighs the influence of chronic comorbidities.

In our study, markedly increased BUN levels were significantly associated with mortality, beyond the severity of AKI defined by KDIGO. This is expected, as the extent of the increase in serum BUN is also an indicator of the severity of AKI. However, despite the significant association, BUN level did not predict mortality in our study. In contrast, Chen et al. used data from two publicly available critical care databases and reported that BUN was an independent predictor of 30-day and a-year mortality among patients with vasculitis and AKI.³⁷ Chen et al.

identified a BUN level of 32 mg/dl, above which the mortality risk was strikingly increased.³⁷ The differences in observations may be due to differences in patient characteristics. While the study by Chen et al. was restricted to patients with vasculitis, our study included all patients with AKI who met our inclusion criteria, regardless of their etiological factors. Further studies are needed to elucidate whether BUN has different effects on mortality in patients with AKI based on patient characteristics and specific etiological factors. The study by Chen et al. also had more power based on sample size compared to our study.³⁷

In this study, ICU admission emerged as a strong independent predictor of mortality; previous studies did not use ICU admission as an independent variable to predict mortality but investigated the predictors of mortality in patients with AKI admitted to the ICU. Saxena et al. reported that hypotension, Glasgow Coma Scale score, metabolic acidosis, Acute Physiologic Assessment and Chronic Health Evaluation (APACHE 2) score, elevated serum creatinine, late AKI stage, and serum urea levels at the time of diagnosis of AKI, the use of mechanical ventilation, increased leukocyte count and high serum potassium level were significantly associated with in-hospital mortality in patients with AKI admitted to the ICU of a rural tertiary hospital in India.³⁸ The need for dialysis was also reported to be an independent predictor of mortality in this study. The need for dialysis in patients with AKI reflects the severity of the renal impairment. This finding is comparable to reports from research at Lagos University Teaching Hospital (LUTH), Idi-Araba, Lagos, Nigeria, where outcomes among patients with AKI were strongly influenced by access to dialysis, with patients requiring or unable to receive indicated dialysis experiencing higher mortality.³⁹ The presence of complications also predicted mortality in patients with AKI in this study. This is consistent with the observation by Li et al., who retrospectively analyzed 1049 patients with AKI at Changsha First Hospital, and found that the presence of complications like anemia and organ failure, among other variables, independently predicted 90-day and 1-year mortality in the patients.⁴⁰

Overall, this study demonstrates that the pattern of AKI observed at ISTH is consistent with findings from other tertiary hospitals in SSA, characterized by infection-related, community-acquired AKI, late presentation, and high mortality, but differs from that

in developed settings, where AKI is more often hospital-acquired and occurs in older patients with multiple comorbidities.^{12,20} The identification of ICU admission, dialysis requirement, presence of complications, and urban residence as key predictors of mortality highlights the dominant role of disease severity and access to care in determining outcomes, while also underscoring the influence of socio-demographic context. These findings have important implications for clinical practice and public health, emphasizing the need for early detection, strengthened infection prevention and control, timely referral, and improved access to renal replacement therapy and critical care services to reduce the burden and mortality of AKI in resource-limited settings worldwide. The limitations of this study include its single-center design, which reduces generalizability. Second, it was a retrospective study; hence, the possibility of selection and information biases could not be excluded, and the causality of mortality could not be established.

Conclusion

AKI in rural southern Nigeria is mainly community-acquired and is primarily caused by infections. Mortality is primarily driven by disease severity and clinical factors rather than etiology or baseline comorbidities. The significant predictors of mortality were the need for dialysis, urban residency, and ICU admission, underscoring the central role of organ dysfunction and critical illness in determining outcomes. Overall, the findings reinforce the need for early detection, timely intervention, improved infection control, and strengthened critical care capacity in resource-limited settings to reduce the burden and mortality associated with AKI.

References

1. Kellum JA, Lameire N, Aspelin P, Barsoum RS, Burdmann EA, Goldstein SL, et al. Kidney disease: improving global outcomes (KDIGO) acute kidney injury work group. KDIGO clinical practice guidelines for acute kidney injury. *Kidney Int Suppl.* 2012 Mar;2(1):1–138.
2. Mehta RL, Cerdá J, Burdmann EA, Tonelli M, García-García G, Jha V, et al. International Society of Nephrology's Oby25 initiative for acute kidney injury (zero preventable deaths by 2025): a human rights case for nephrology. *Lancet.* 2015 Jun 27;385(9987):2616–2643. doi:

- 10.1016/S0140-6736(15)60126-X.
3. Hoste EA, Bagshaw SM, Bellomo R, Cely CM, Colman R, Cruz DN, et al. Epidemiology of acute kidney injury in critically ill patients: The multinational AKI-EPI study. *Intensive Care Med.* 2015 Aug;41(8):1411–1423. doi: 10.1007/s00134-015-3934-7
4. Coca SG, Singanamala S, Parikh CR. Chronic kidney disease after acute kidney injury: A systematic review and meta-analysis. *Kidney Int.* 2012 Mar; 81(5):442–448. doi: 10.1038/ki.2011.379.
5. Chertow GM, Burdmann EA, Honour M, Bonventre JV, Bates DW, et al. Acute kidney injury, mortality, length of stay, and costs in hospitalized patients. *J Am Soc Nephrol.* 2005; 16(11):3365–3370. doi: 10.1681/ASN.2004090740.
6. Lameire N, Van Biesen W, Vanholder R. Acute kidney injury. *Lancet.* USA: Elsevier Science Inc., 360 Park Ave South, New York, NY 10010-1710 USA. 2008;372:1863–1865. <http://hdl.handle.net/1854/LU-518969>.
7. Olowu WA, Niang A, Osafo C, Ashuntantang G, Arogundade FA, Porter J, et al. Outcome of acute kidney injury in children in sub-Saharan Africa: a systematic review. *Lancet Glob Health.* 2016 Apr;4(4):e242-250. doi: 10.1016/S2214-109X(15)00322-8.
8. Mehta RL, Kellum JA, Shah SV, Molitoris BA, Ronco C, Warnock DG, et al. Acute Kidney Injury Network: Report of an initiative to improve outcomes in acute kidney injury. *Crit Care.* 2007;11(2):R31. doi: 10.1186/cc5713.
9. Ronco C, Bellomo R, Kellum JA. Acute kidney injury. *Lancet.* 2019 Nov 23;394(10212):1949–1964. doi: 10.1016/S0140-6736(19)3263-2.
10. Cerda J, Kashani K, Ostermann M, Basu RK, Bell S, Cantaluppi V, et al. The global epidemiology of acute kidney injury: challenges and opportunities. *Nat Rev Nephrol.* 2026 Mar;22(3):179-198. <https://doi.org/10.1038/s41581-025-01030-4>
11. Kahindo CK, Mukuku O, Wembonyama SO, Tsongo ZK. Prevalence and factors associated with acute kidney injury in Sub-Saharan African adults: A review of the current literature. *Int J Nephrol.* 2022 Mar 15;2022:5621665. doi: 10.1155/2022:5621665.
12. Bouchard J, Mehta RL. Acute kidney injury in Western countries. *Kidney Dis (Basel).* 2016 Oct;2(3):103-110. Doi: 10.1159/000445091.
13. Hoste EAJ, Kellum JA, Selby NM, Zarbock A, Palevsky PM, Bagshaw SM et al. Global epidemiology and outcomes of acute kidney injury. *Nat Rev Nephrol.* 2018 Oct;14(10):607-625. doi: 10.1038/s41581-018-0052-0.
14. Hou J, Zhang Y, Zhang J, Liu Y, Wang X, Wu Z, et al. Survival outcomes in older patients with different stages of acute kidney injury defined by the addition of urine output criteria. *Chin Med J (Engl).* 2023 May 5;136(9):1129-1131. doi: 10.1097/CM9.0000000000002607.
15. Cappadona F, Venturelli E, Marengo M, Prena S, Fiorentino M, Fabbri P, et al. Is sex-by-age interaction the missing factor in acute kidney injury epidemiology? *Nephrol Dial Transplant.* 2026 Mar 20;gfg064. doi: 10.1093/ndt/gfg064. <https://doi.org/10.1093/ndt/gfg064>
16. Chen YW, Wu MY, Mao CH, Yeh YT, Chen TT, Liao CT, et al. Severe acute kidney disease is associated with worse outcome among acute kidney injury patients. *Sci Rep.* 2022 Apr 20;12(1):6492. doi: 10.1038/s41598-022-09599-7.
17. Ballah A, Mohammed J, Njidda GA, Yahaya HB, Rosemary NM, Naziru I, et al. Outcome and determining characteristics of ICU patients with acute kidney injury in a low-income country: a multicenter experience. *J Crit Care Med (Targu Mures).* 2024 Oct 31;10(4):345-352. doi: 10.2478/jccm-2024-0037.
18. Aslaner MA, Cerit MN, Esen Ş. Can multiorgan sonographic parameters predict mortality in patients with acute kidney injury? *Journal of Medical Sonography.* 2024;40(5):427-433. doi: 10.1177/87564793241234867.
19. Pereira MB, Zanetta DMT, Abdulkader RCRM. The real importance of pre-existing comorbidities on long-term mortality after acute kidney injury. *PLoS ONE.* 2012 Oct;7(10):e47746. doi: 10.1371/journal.pone.0047746.
20. Susantitaphong P, Cruz DN, Cerda J, Abulfaraj M, Alqahtani F, Koulouridis I, et al. World incidence of AKI: a meta-analysis. *Clin J Am Soc Nephrol.* 2013 Sep;8(9):1482–14893. doi: 10.2215/CJN.00710113.
21. Adu D, Okyere P, Boima V, Matekole M, Osafo C. Community-acquired acute kidney injury in adults in Africa. *Clin Nephrol.* 2016 Supplement 1;86(13):48–52. doi: 10.5414/CNP86S121.
22. Aylward RE, van der Merwe E, Pazi S, van Niekerk M, Ensor J, Baker D, Freercks RJ. Risk

- factors and outcomes of acute kidney injury in South African critically ill adults: a prospective cohort study. *BMC Nephrol.* 2019 Dec 10;20(1):460. doi: 10.1186/s12882-019-1620-7.
23. Cochran WG. *Sampling Techniques*. 3rd ed. New York: John Wiley & Sons; 1977.
 24. Adejumo AO, Edeki IR, Ojo OE, Mamven M, Waziri B, Effa E, et al. Incidence of acute kidney injury and associated mortality in Nigeria: a systematic review and meta-analysis. *BMC Nephrol.* 2026 Jan 19;27(1):160. doi: 10.1186/s12882-026-04747-x.
 25. Mamven M, Ajayi S, Galadima U, Nwanko E. Aetiological factors, outcomes, and mortality risk of acute kidney injury in hospitalized patients in a tertiary health center in Nigeria: An eleven-year review. *Annals of Clinical and Biomedical Research*. 2022; 3 (2) . <https://doi.org/10.4081/acbr.2022.230>
 26. Batte A, Shahrin L, Claire-Del Granado R, Luyckx VA. Infections and acute kidney injury: A global perspective. *Semin Nephrol.* 2023 Sep; 43 (5) : 151466 . doi : 10.1016/j.semnephrol.2023.
 27. Onu UC, Waziri B, Mbanefo NR. Acute kidney injury: Nigeria. *Kidney360.* 2024 Nov 1; 5 (11) : 1741 - 1743 . doi : 10.34067/KID.0000000575.
 28. Loutradis C, Pickup L, Law JP, Dasgupta I, Townend JN, Cockwell P, et al. Acute kidney injury is more common in men than women after accounting for socioeconomic status, ethnicity, alcohol intake and smoking history. *Bio Sex Differ.* 2021 Apr 8;12(1):30. doi: 10.1186/s13293-021-00373-4.
 29. Momoh AJ, Oguntade H, Omosule BO, Sanni IO, Fasaanu AN, Aremu OA, et al. Acute kidney injury in Ile-Ife: a report of epidemiology, treatment and outcomes of 113 managed cases. *Trop J Nephrol.* 2020;15(2):45–46.
 30. Dlamini TAL, Heering PJ, Chivese T, Rayner B. A prospective study of the demographics, management and outcome of patients with acute kidney injury in Cape Town, South Africa. *PLoS One.* 2017; 12 (6) : e0177460 . doi : 10.1371/journal.pone.0177460.
 31. ISCARIC Characterisation Group. Association of country income level with the characteristics and outcomes of critically ill patients hospitalised with acute kidney injury and COVID-19. *Kidney Int Rep.* 2023 Aug;8(8): 1514-1530. Doi: 10.1016/j.ekir.2023.05.015.
 32. Oluseyi A, Ayodele OE, Arogundade FA, Sanusi AA. Aetiologies and short-term outcomes of acute kidney injury in a tertiary hospital in Southwest Nigeria. *BMC Nephrol.* 2016; 17:15.
 33. Skalsky K, Romi M, Shiyovich A, Shechter A, Grinberg T, Gilutz H, et al. Mortality in patients post-myocardial infarction and acute kidney injury. *J Cardiovasc Dev Dis.* 2025 Apr 3;12(4):133. doi: 10.103390/jcdd12040133.
 34. Ghazi L, Parcha V, Takeuchi T, Butler CR, Baker E, Qates GR, et al. Association of neighbourhood social determinants of health with acute kidney injury during hospitalisation. *Clin J Am Soc Nephrol.* 2024 Nov 1;19(11):1371-1381. doi: 10.2215/CJN.0000000000000528.
 35. Abebe A, Kumela K, Belay M, Kebede B, Wobie Y. Mortality and predictors of acute kidney injury in adults: a hospital-based prospective observational study. *Sci Rep.* 2021;11:15672. <https://doi.org/10.1038/s41598-021-94946-3>
 36. Jahantigh M, Rezaee M, Daneshmand M, Karimian M, Ghezelbash M, Fakhar B, et al. Precipitating factors for mortality of individuals with acute kidney injury in ICU; collaboration of nephrologists and intensivists. *J Nephropathol.* 2025; 14 (2) : e27612 . doi : 10.34172/jnp.2025.27612.
 37. Chen S, Liu R, Zhang Y, Wang Y, Lmulti-organng X, et al. Prognostic value of blood urea nitrogen for acute kidney injury and mortality: a large cohort study using multivariate joint model and machine learning. *Diagnostics.* 2026; 16 (5) : 665 . <https://doi.org/10.3390/diagnostics16050665>
 38. Sexana A, Meshram SV. Predictors of mortality in acute kidney injury patients admitted to medicine intensive care unit in a rural tertiary care hospital. *Indian J Crit Care Med.* 2018 Apr;22(4):231-237. doi: 10.4103/ijccm.IJCCM_462_17.
 39. Bello BT, Raji YR, Sanusi AA, Braimoh RW, Amira CO. Acute kidney injury in Lagos: pattern, outcomes and predictors of in-hospital mortality. *Niger J Clin Pract.* 2017 Feb;20(2):194-199. doi: 10.4103/1119-3077.183258.
 40. Li S, Li Z, Li Y. Identification of risk factors and prediction models for mortality risk in patients with acute kidney injury: a retrospective cohort study. *PLoS One.* 2024 Oct 23;19(10):e3012482. Doi: 10.1371/journal.pone.0312482.