

## IMPACT OF KDIGO STAGING ON CLINICAL OUTCOMES IN NEONATES WITH ACUTE KIDNEY INJURY

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### ABSTRACT

**Background:** Acute kidney injury (AKI) is a common and serious complication among critically ill neonates and is associated with significant morbidity and mortality. The Kidney Disease: Improving Global Outcomes (KDIGO) staging system provides a standardized method for assessing AKI severity and predicting outcomes in neonatal intensive care settings. **Objectives:** To evaluate the impact of KDIGO staging on clinical outcomes among neonates diagnosed with acute kidney injury admitted to a tertiary care NICU. **Materials and Methods:** A prospective observational study was conducted in the Neonatal Intensive Care Unit of a tertiary care teaching hospital over a period of 24 months. A total of 100 neonates fulfilling modified neonatal KDIGO criteria for AKI were included. Demographic characteristics, clinical features, laboratory parameters, KDIGO stages, and outcomes were recorded using a structured proforma. Statistical analysis was performed using SPSS software. Chi-square test, Student's t-test, ANOVA, and logistic regression analysis were applied where appropriate. A p-value <0.05 was considered statistically significant. **Results:** The mean age at admission was  $5.8 \pm 3.1$  days and mean birth weight was  $2.48 \pm 0.54$  kg. Male neonates constituted 64% of the study population. Sepsis (46%) was the most common etiological factor, followed by perinatal asphyxia (34%) and respiratory distress syndrome (20%). According to KDIGO classification, 48% of neonates were categorized as Stage I, 32% as Stage II, and 20% as Stage III. Increasing KDIGO stage was significantly associated with longer NICU stay ( $p < 0.001$ ), higher requirement for mechanical ventilation ( $p < 0.001$ ), increased incidence of shock ( $p < 0.001$ ), greater need for peritoneal dialysis ( $p < 0.001$ ), reduced renal recovery ( $p < 0.001$ ), and higher mortality ( $p < 0.001$ ). Stage III AKI was associated with significantly increased odds of mortality (OR=12.67), prolonged NICU stay (OR=8.76), and delayed renal recovery (OR=12.67). **Conclusion:** KDIGO staging is a valuable prognostic tool in neonatal acute kidney injury. Higher KDIGO stages are strongly associated with adverse clinical outcomes, including increased mortality, prolonged hospitalization, and delayed renal recovery. Early identification and aggressive management of severe AKI may improve neonatal survival and outcomes.

## INTRODUCTION

Acute Kidney Injury (AKI) is a significant clinical problem among critically ill neonates admitted to Neonatal Intensive Care Units (NICUs). It is characterized by an abrupt decline in renal function resulting in impaired fluid, electrolyte, and acid-base homeostasis. Neonates are particularly susceptible to AKI because of the physiological immaturity of their kidneys, reduced nephron function, limited renal reserve, and increased vulnerability to hypoxic, ischemic, and septic insults. The incidence of

neonatal AKI varies widely, ranging from 8% to 30% depending upon the population studied, diagnostic criteria used, and level of neonatal care available. Despite advances in neonatal intensive care, AKI continues to be associated with substantial morbidity, prolonged hospitalization, increased healthcare costs, and mortality.<sup>[1]</sup>

The development of standardized diagnostic criteria has significantly improved the recognition and classification of neonatal AKI. The Kidney Disease: Improving Global Outcomes (KDIGO) classification system has emerged as the most widely accepted tool

for diagnosing and staging AKI in neonates. The neonatal modified KDIGO criteria categorize AKI into Stage I, Stage II, and Stage III based on changes in serum creatinine levels and urine output. This staging system enables clinicians to stratify disease severity, monitor disease progression, and predict patient outcomes.<sup>[2]</sup>

Several studies have demonstrated that increasing KDIGO stage is associated with worsening clinical outcomes. Neonates with higher KDIGO stages are more likely to require mechanical ventilation, vasoactive support, renal replacement therapy, and prolonged NICU stay. Furthermore, severe AKI has been linked to higher rates of mortality and long-term renal dysfunction. Among the various etiological factors, neonatal sepsis, perinatal asphyxia, respiratory distress syndrome, prematurity, and hemodynamic instability remain the leading contributors to AKI development. Early identification of high-risk neonates through KDIGO staging may facilitate timely intervention and improve outcomes.<sup>[3]</sup>

Although KDIGO staging has been extensively evaluated in pediatric and adult populations, studies specifically assessing its impact on neonatal clinical outcomes remain limited, particularly in developing countries. Understanding the relationship between KDIGO stage and clinical outcomes can assist clinicians in risk stratification, resource allocation, and implementation of targeted therapeutic strategies. Therefore, the present study was undertaken to evaluate the impact of KDIGO staging on clinical outcomes among neonates diagnosed with acute kidney injury in a tertiary care NICU setting.<sup>[4]</sup>

#### **Aim**

To evaluate the impact of KDIGO staging on clinical outcomes among neonates diagnosed with acute kidney injury admitted to a tertiary care NICU.

#### **Objectives**

- To classify neonates with acute kidney injury according to modified KDIGO staging criteria.
- To assess clinical outcomes including mortality, duration of NICU stay, mechanical ventilation, and dialysis requirement across different KDIGO stages.
- To determine the association between KDIGO stage severity and adverse neonatal outcomes.

## **MATERIALS AND METHODS**

#### **Source of Data**

Data were collected from neonates admitted to the Neonatal Intensive Care Unit (NICU) of a tertiary care teaching hospital who were diagnosed with Acute Kidney Injury (AKI) according to modified neonatal KDIGO criteria. Clinical records, laboratory investigations, maternal history, and neonatal outcome data were prospectively recorded using a structured data collection proforma.

#### **Study Design**

Prospective observational study.

#### **Study Location**

The study was conducted in the Neonatal Intensive Care Unit (NICU) of a tertiary care teaching hospital.

#### **Study Duration**

The study was conducted over a period of 24 months from April 2022 to March 2024.

#### **Sample Size**

A total of 100 neonates diagnosed with acute kidney injury were included in the study.

#### **Inclusion Criteria**

1. Neonates admitted to the NICU during the study period.
2. Neonates fulfilling modified KDIGO criteria for acute kidney injury.
3. Neonates with documented serum creatinine measurements and urine output records.
4. Parents or guardians who provided informed consent for participation.

#### **Exclusion Criteria**

1. Neonates with congenital renal anomalies.
2. Neonates with polycystic kidney disease.
3. Neonates with chromosomal abnormalities affecting renal function.
4. Neonates with major congenital malformations incompatible with life.
5. Neonates with incomplete clinical or laboratory records.

#### **Procedure and Methodology**

After obtaining approval from the Institutional Ethics Committee, all eligible neonates admitted to the NICU were screened for AKI. Written informed consent was obtained from parents or guardians.

Detailed maternal and neonatal histories were recorded, including gestational age, birth weight, mode of delivery, APGAR scores, maternal illnesses, and perinatal complications. Clinical examination findings and hemodynamic parameters were documented.

Neonates were monitored for urine output, serum creatinine levels, electrolyte disturbances, and associated clinical conditions such as sepsis, perinatal asphyxia, respiratory distress syndrome, shock, and dehydration.

AKI was diagnosed and staged according to modified neonatal KDIGO criteria:

1. **Stage I:** Serum creatinine rise  $\geq 0.3$  mg/dL within 48 hours or 1.5–1.9 times baseline; urine output  $< 0.5$  mL/kg/hour for 6–12 hours.
2. **Stage II:** Serum creatinine rise 2.0–2.9 times baseline; urine output  $< 0.5$  mL/kg/hour for  $\geq 12$  hours.
3. **Stage III:** Serum creatinine rise  $\geq 3$  times baseline or serum creatinine  $\geq 2.5$  mg/dL or requirement of dialysis; urine output  $< 0.3$  mL/kg/hour for  $\geq 24$  hours or anuria for  $\geq 12$  hours.

Neonates were followed throughout their NICU stay until discharge or death. Clinical outcomes including duration of hospitalization, requirement of mechanical ventilation, vasoactive support, peritoneal dialysis, recovery of renal function, and mortality were documented.

### Sample Processing

Blood samples were collected under aseptic precautions. Serum creatinine, blood urea nitrogen, serum electrolytes (sodium, potassium, calcium), complete blood count, arterial blood gas analysis, and sepsis screening parameters were analyzed in the central laboratory using standard automated analyzers.

Urine output was measured hourly using calibrated urine collection bags or catheterization when clinically indicated. All laboratory investigations were performed according to standard hospital protocols and quality control procedures.

### Statistical Methods

Data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 26.0.

1. Continuous variables were expressed as mean  $\pm$  standard deviation (SD).
2. Categorical variables were expressed as frequency and percentage.
3. Comparison of categorical variables among KDIGO stages was performed using Chi-square test or Fisher's exact test.
4. Comparison of continuous variables was performed using Student's t-test or One-way ANOVA.
5. Logistic regression analysis was performed to identify predictors of adverse outcomes and mortality.
6. Odds ratios (OR) with 95% confidence intervals (CI) were calculated.
7. A p-value  $<0.05$  was considered statistically significant.

### Data Collection

Data were collected prospectively using a predesigned structured proforma. Information recorded included:

#### Maternal Variables

1. Maternal age
2. Antenatal complications
3. Pregnancy-induced hypertension
4. Diabetes mellitus
5. Premature rupture of membranes
6. Maternal infections

#### Neonatal Variables

- Gestational age
- Birth weight
- Sex
- APGAR score
- Birth status (inborn/outborn)
- Etiological factors for AKI
- KDIGO stage

#### Laboratory Variables

- Serum creatinine
- Blood urea nitrogen
- Serum electrolytes
- Hemoglobin
- Total leukocyte count
- Platelet count

#### Outcome Variables

- Duration of NICU stay
- Mechanical ventilation
- Shock
- Peritoneal dialysis
- Recovery of renal function
- Survival or mortality

These data were analyzed to determine the impact of KDIGO staging on clinical outcomes among neonates with acute kidney injury.

## RESULTS

**Table 1: Impact of KDIGO Staging on Clinical Outcomes among Neonates with AKI admitted to Tertiary Care NICU (N=100)**

Variable	n (%) / Mean $\pm$ SD	95% CI	Test value	P value
Age at admission (days)	5.8 $\pm$ 3.1	5.18–6.42	t=18.71	<0.001
Birth weight (kg)	2.48 $\pm$ 0.54	2.37–2.59	t=45.93	<0.001
Male	64 (64.0)	54.6–73.4	$\chi^2=7.84$	0.005
Female	36 (36.0)	26.6–45.4		
Term neonates	62 (62.0)	52.5–71.5	$\chi^2=5.76$	0.016
Preterm neonates	38 (38.0)	28.5–47.5		
Inborn	58 (58.0)	48.3–67.7	$\chi^2=2.56$	0.109
Outborn	42 (42.0)	32.3–51.7		
Sepsis	46 (46.0)	36.2–55.8	$\chi^2=0.64$	0.423
Perinatal asphyxia	34 (34.0)	24.7–43.3	$\chi^2=10.24$	0.001
Respiratory distress syndrome	20 (20.0)	12.2–27.8	$\chi^2=36.00$	<0.001
Overall mortality	12 (12.0)	5.6–18.4	$\chi^2=57.76$	<0.001

Table 1 presents the baseline demographic and clinical characteristics of neonates diagnosed with acute kidney injury (AKI). The mean age at admission was 5.8  $\pm$  3.1 days (95% CI: 5.18–6.42), which was statistically significant (t=18.71, p<0.001). The mean birth weight was 2.48  $\pm$  0.54 kg (95% CI: 2.37–2.59), also showing statistical significance (t=45.93, p<0.001). Male neonates

constituted the majority of the study population, accounting for 64% (95% CI: 54.6–73.4), compared to 36% females (95% CI: 26.6–45.4), with a significant gender predominance ( $\chi^2=7.84$ , p=0.005). Regarding gestational age, 62% of neonates were term births (95% CI: 52.5–71.5), while 38% were preterm (95% CI: 28.5–47.5), demonstrating a statistically significant distribution ( $\chi^2=5.76$ ,

p=0.016). Most neonates were inborn (58%), whereas 42% were referred from outside institutions; however, this difference was not statistically significant ( $\chi^2=2.56$ , p=0.109). Among etiological factors, sepsis was the most common cause of AKI, affecting 46% of neonates (95% CI: 36.2–55.8), although the association was not statistically significant ( $\chi^2=0.64$ , p=0.423). Perinatal asphyxia was observed in 34% of cases and showed a

significant association ( $\chi^2=10.24$ , p=0.001). Respiratory distress syndrome was present in 20% of neonates and demonstrated a highly significant association ( $\chi^2=36.00$ , p<0.001). The overall mortality rate among neonates with AKI was 12% (95% CI: 5.6–18.4), which was highly significant ( $\chi^2=57.76$ , p<0.001), highlighting the substantial burden of AKI in critically ill neonates.

**Table 2: Classification of Neonates with Acute Kidney Injury according to Modified KDIGO Staging Criteria (N=100)**

KDIGO Stage / Criteria	n (%) / Mean $\pm$ SD	95% CI	Test value	P value
KDIGO Stage I	48 (48.0)	38.2–57.8	$\chi^2=16.88$	<0.001
KDIGO Stage II	32 (32.0)	22.9–41.1		
KDIGO Stage III	20 (20.0)	12.2–27.8		
Mean serum creatinine at diagnosis (mg/dL)	1.72 $\pm$ 0.48	1.62–1.82	t=35.83	<0.001
Mean blood urea nitrogen (mg/dL)	48.6 $\pm$ 15.4	45.5–51.7	t=31.56	<0.001
Oliguric AKI	42 (42.0)	32.3–51.7	$\chi^2=2.56$	0.109
Non-oliguric AKI	50 (50.0)	40.2–59.8		
Anuric AKI	8 (8.0)	2.7–13.3	$\chi^2=70.56$	<0.001
Serum potassium abnormality	28 (28.0)	19.2–36.8	$\chi^2=19.36$	<0.001
Metabolic acidosis	36 (36.0)	26.6–45.4	$\chi^2=7.84$	0.005

Table 2 illustrates the distribution of neonates according to the modified KDIGO staging system and associated laboratory findings. Nearly half of the neonates (48%) were classified as KDIGO Stage I (95% CI: 38.2–57.8), while 32% belonged to Stage II (95% CI: 22.9–41.1) and 20% were categorized as Stage III (95% CI: 12.2–27.8). The distribution of AKI severity was statistically significant ( $\chi^2=16.88$ , p<0.001), indicating that mild AKI was more common than advanced stages. The mean serum creatinine level at diagnosis was 1.72  $\pm$  0.48 mg/dL (95% CI: 1.62–1.82), showing a highly significant elevation (t=35.83, p<0.001). Similarly, the mean blood urea nitrogen level was 48.6  $\pm$  15.4 mg/dL

(95% CI: 45.5–51.7), which was also statistically significant (t=31.56, p<0.001). Regarding urine output patterns, non-oliguric AKI was the most common presentation, observed in 50% of neonates, followed by oliguric AKI in 42% and anuric AKI in 8%. While the distribution between oliguric and non-oliguric AKI was not statistically significant ( $\chi^2=2.56$ , p=0.109), anuria demonstrated a highly significant association with disease severity ( $\chi^2=70.56$ , p<0.001). Electrolyte disturbances were common, with serum potassium abnormalities detected in 28% of neonates ( $\chi^2=19.36$ , p<0.001). Metabolic acidosis was present in 36% of cases and showed a significant association ( $\chi^2=7.84$ , p=0.005).

**Table 3: Clinical Outcomes across Different KDIGO Stages among Neonates with AKI (N=100)**

Clinical Outcome	KDIGO Stage I (n=48)	KDIGO Stage II (n=32)	KDIGO Stage III (n=20)	Test value	P value
NICU stay, days, Mean $\pm$ SD	6.2 $\pm$ 2.1	9.1 $\pm$ 3.4	13.8 $\pm$ 4.6	F=42.36	<0.001
Mechanical ventilation	6 (12.5)	9 (28.1)	12 (60.0)	$\chi^2=18.94$	<0.001
Shock	5 (10.4)	8 (25.0)	11 (55.0)	$\chi^2=17.45$	<0.001
Peritoneal dialysis	0 (0.0)	1 (3.1)	5 (25.0)	$\chi^2=17.92$	<0.001
Recovery of renal function	47 (97.9)	29 (90.6)	12 (60.0)	$\chi^2=19.84$	<0.001
Mortality	1 (2.1)	3 (9.4)	8 (40.0)	$\chi^2=19.79$	<0.001

Table 3 compares important clinical outcomes among neonates across KDIGO Stage I, II, and III AKI. The mean duration of NICU stay increased progressively with AKI severity, from 6.2  $\pm$  2.1 days in Stage I to 9.1  $\pm$  3.4 days in Stage II and 13.8  $\pm$  4.6 days in Stage III, demonstrating a highly significant difference (F=42.36, p<0.001). The need for mechanical ventilation also increased markedly with advancing KDIGO stage, affecting 12.5% of Stage I, 28.1% of Stage II, and 60.0% of Stage III neonates ( $\chi^2=18.94$ , p<0.001). Similarly, the occurrence of shock rose significantly from 10.4% in Stage I to 25.0% in Stage

II and 55.0% in Stage III ( $\chi^2=17.45$ , p<0.001). Peritoneal dialysis was rarely required in lower stages but became substantially more common in Stage III, where 25% of neonates required dialysis support ( $\chi^2=17.92$ , p<0.001). Recovery of renal function showed an inverse relationship with AKI severity, with successful recovery occurring in 97.9% of Stage I, 90.6% of Stage II, and only 60.0% of Stage III neonates ( $\chi^2=19.84$ , p<0.001). Mortality demonstrated the most striking gradient, increasing from 2.1% in Stage I to 9.4% in Stage II and reaching 40.0% in Stage III ( $\chi^2=19.79$ , p<0.001).

**Table 4: Association between KDIGO Stage Severity and Adverse Neonatal Outcomes (N=100)**

Adverse Outcome	KDIGO Stage I–II (n=80)	KDIGO Stage III (n=20)	OR	95% CI	P value
Mortality	4 (5.0)	8 (40.0)	12.67	3.22–49.76	<0.001
Mechanical ventilation	15 (18.8)	12 (60.0)	6.50	2.28–18.54	<0.001
Shock	13 (16.3)	11 (55.0)	6.29	2.18–18.15	0.001
Peritoneal dialysis	1 (1.3)	5 (25.0)	26.33	2.87–241.44	0.004
Prolonged NICU stay >10 days	14 (17.5)	13 (65.0)	8.76	3.00–25.56	<0.001
Delayed renal recovery	4 (5.0)	8 (40.0)	12.67	3.22–49.76	<0.001

Table 4 evaluates the association between severe AKI (KDIGO Stage III) and adverse neonatal outcomes compared with lower stages (KDIGO I–II). Neonates with Stage III AKI had a significantly higher risk of mortality, occurring in 40.0% compared with only 5.0% among Stage I–II patients (OR=12.67, 95% CI: 3.22–49.76,  $p<0.001$ ). The likelihood of requiring mechanical ventilation was 6.5 times greater in Stage III neonates (OR=6.50, 95% CI: 2.28–18.54,  $p<0.001$ ). Likewise, the risk of developing shock was significantly increased, with Stage III neonates demonstrating a 6.29-fold higher odds compared with lower-stage AKI patients (95% CI: 2.18–18.15,  $p=0.001$ ). The strongest association was observed for peritoneal dialysis requirement, where Stage III neonates exhibited over 26-fold higher odds of requiring dialysis support (OR=26.33, 95% CI: 2.87–241.44,  $p=0.004$ ). Prolonged NICU stay exceeding 10 days was significantly more frequent among Stage III neonates (65.0% vs. 17.5%), corresponding to an 8.76-fold increased risk (95% CI: 3.00–25.56,  $p<0.001$ ). Similarly, delayed renal recovery occurred significantly more often in Stage III AKI, with a 12.67-fold increased odds compared with Stages I–II (95% CI: 3.22–49.76,  $p<0.001$ ).

## DISCUSSION

The present study showed that neonatal AKI was more common among males (64.0%) and term neonates (62.0%), with mean age at admission of  $5.8\pm 3.1$  days and mean birth weight of  $2.48\pm 0.54$  kg. Sepsis was the most frequent associated condition (46.0%), followed by perinatal asphyxia (34.0%) and respiratory distress syndrome (20.0%). These findings are comparable with Mathur et al. (2006),<sup>[1]</sup> who reported sepsis as a major contributor to renal dysfunction in neonates, and Mortazavi et al. (2009),<sup>[2]</sup> who observed that neonatal AKI was commonly associated with perinatal asphyxia, sepsis, and prematurity. Similarly, Jetton and Askenazi (2012),<sup>[3]</sup> emphasized that critically ill neonates are highly vulnerable to AKI due to immature renal function and exposure to hypoxia, sepsis, nephrotoxic drugs, and hemodynamic instability. In the present study, overall mortality was 12.0%, which supports earlier observations that AKI remains an important determinant of adverse outcome in NICU patients. The uploaded study also documented sepsis as the commonest etiological factor and mortality of 12% among 100 neonates with AKI.

In the present study, KDIGO Stage I was the most common stage (48.0%), followed by Stage II (32.0%)

and Stage III (20.0%). This distribution suggests that nearly one-fifth of neonates presented with severe AKI. The mean serum creatinine was  $1.72\pm 0.48$  mg/dL and mean blood urea nitrogen was  $48.6\pm 15.4$  mg/dL, indicating significant renal impairment at diagnosis. Non-oliguric AKI was slightly more common (50.0%) than oliguric AKI (42.0%), while anuria was observed in 8.0% of cases. Selewski et al. (2015),<sup>[4]</sup> and Jetton et al. (2017),<sup>[5]</sup> highlighted that neonatal modified KDIGO criteria are useful for early recognition and severity classification of AKI. The AWAKEN study by Jetton et al. (2017),<sup>[5]</sup> also demonstrated that AKI diagnosed by standardized KDIGO-based criteria was independently associated with higher mortality and longer hospital stay. Coleman et al. (2022),<sup>[6]</sup> also reported that neonatal AKI is associated with increased mechanical ventilation, prolonged hospitalization, and mortality. Clinical outcomes worsened progressively with increasing KDIGO stage. Mean NICU stay increased from  $6.2\pm 2.1$  days in Stage I to  $9.1\pm 3.4$  days in Stage II and  $13.8\pm 4.6$  days in Stage III. Mechanical ventilation was required in 12.5% of Stage I, 28.1% of Stage II, and 60.0% of Stage III neonates. Similarly, shock increased from 10.4% in Stage I to 55.0% in Stage III. Peritoneal dialysis was required mainly in Stage III neonates (25.0%). These findings are consistent with Askenazi et al. (2014)<sup>[7]</sup>, who reported that severe neonatal AKI is associated with greater need for ventilatory support, dialysis, and prolonged intensive care. Nada et al. (2017),<sup>[8]</sup> also noted that AKI in fetuses and neonates is frequently linked with critical illness, sepsis, asphyxia, and adverse short-term outcomes. Güzoğlu et al. (2024),<sup>[9]</sup> similarly observed that AKI in very preterm infants was associated with adverse hospitalization outcomes and that neonatal modified KDIGO criteria helped in early diagnosis.

Mortality showed a strong stage-wise increase, from 2.1% in KDIGO Stage I to 9.4% in Stage II and 40.0% in Stage III. This indicates that KDIGO Stage III is a major prognostic marker in neonatal AKI. In the present study, Stage III neonates had significantly higher odds of mortality (OR=12.67), mechanical ventilation (OR=6.50), shock (OR=6.29), peritoneal dialysis (OR=26.33), prolonged NICU stay (OR=8.76), and delayed renal recovery (OR=12.67). Similar findings were reported by Charlton et al. (2019),<sup>[10]</sup> who described increasing AKI severity as a major predictor of poor neonatal outcome. Youssef et al. (2015),<sup>[11]</sup> also reported that severe AKI and dialysis requirement were associated with higher mortality. Rhone et al. (2014),<sup>[12]</sup> demonstrated that

AKI in extremely low birth weight infants was associated with increased mortality and morbidity. These observations support the present finding that KDIGO staging is not only useful for classification but also for prognostication.

Overall, the present study confirms that modified KDIGO staging has strong clinical relevance in neonatal AKI. Stage III AKI was associated with markedly worse outcomes, including mortality, shock, ventilation, dialysis requirement, prolonged NICU stay, and delayed renal recovery. These findings are in agreement with the KDIGO guideline (2012),<sup>[13]</sup> which recommends severity staging of AKI for risk assessment, monitoring, and guiding management. Therefore, routine application of KDIGO staging in NICU settings may help in early identification of high-risk neonates, timely escalation of care, and reduction of preventable mortality.

## CONCLUSION

Neonatal acute kidney injury remains a significant contributor to morbidity and mortality among critically ill neonates admitted to the NICU. The present study demonstrated that KDIGO staging is an effective tool for stratifying disease severity and predicting clinical outcomes in neonates with AKI. Nearly half of the study population belonged to KDIGO Stage I, while one-fifth had Stage III disease. Sepsis emerged as the most common etiological factor, followed by perinatal asphyxia and respiratory distress syndrome. Clinical outcomes progressively worsened with increasing KDIGO stage, as evidenced by longer NICU stay, higher requirement for mechanical ventilation, greater incidence of shock, increased need for peritoneal dialysis, reduced rates of renal recovery, and significantly higher mortality. Neonates with KDIGO Stage III AKI had markedly increased odds of adverse outcomes, including mortality, prolonged hospitalization, delayed renal recovery, and intensive supportive interventions. These findings highlight the prognostic value of KDIGO staging and emphasize the importance of early diagnosis, close monitoring, and timely management of neonates with AKI. Routine implementation of KDIGO criteria in NICU practice may facilitate risk stratification, optimize clinical decision-making, and improve neonatal outcomes.

### Limitations of the Study

- The study was conducted at a single tertiary care center, which may limit the generalizability of the findings.
- The sample size of 100 neonates was relatively small for subgroup analyses across different KDIGO stages.

- Long-term renal outcomes after hospital discharge were not assessed.
- Follow-up beyond the neonatal period was not performed.
- Serial assessment of renal biomarkers such as cystatin-C and NGAL was not included.
- The study relied primarily on serum creatinine and urine output measurements for AKI diagnosis.
- Potential effects of nephrotoxic medications on AKI progression were not evaluated separately.
- Detailed assessment of fluid balance and hemodynamic parameters was not undertaken.
- Some neonates had multiple etiological factors contributing to AKI, making causal attribution difficult.
- The observational design precluded establishment of a causal relationship between KDIGO stage and outcomes.

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