

# Demographic Characteristics and Risk Factors Affecting the Development of Postpartum Acute Kidney Injury in Somalia: Single-Center Experience

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**Background and Aim:** Although postpartum acute kidney injury (PPAKI) is declining in developing countries, it is still a leading cause of maternal and fetal morbidity and mortality. The study aimed to determine the causes, risk factors, and the outcomes of patients with postpartum acute kidney injury managed at Mogadishu Somali Turkey Training and Research Hospital, in Mogadishu, Somalia over a two years period.

**Methods:** This study was conducted retrospectively at Mogadishu Somali-Turkey Training and Research Hospital, Somalia's largest teaching and referral hospital. During a two-year period (January 2020 to December 2021), we evaluated women who had acute kidney injury during the postpartum period and were hospitalized in our hospital. The data was also evaluated for postpartum admission day and hospital stay. The requirement for dialysis and the results were documented. Maternal outcomes are categorized as follows: Complete recovery after discharge/follow-up, chronic dependence on hemodialysis and death during admission.

**Results:** We studied 79 postpartum AKI patients. The mean age of the participants was  $28.67 \pm 6.14$ . Most patients (51%) were aged 20–30, followed by 30–40 (29%). According to self-reported comorbidities, most individuals had no history of chronic diseases, 8 (10.1%) had hypertension and 3 (3.8%) had heart failure, and DM and HTN 2(2.5%). The most common causes of PPAKI were eclampsia (24.1%), hemorrhagic shock, intrauterine mortality (16.5%), placenta abruptio and uterine rupture (8.9%). Hemorrhage (5.1%) and placenta previa (2.5%). The patient's outcome was associated with age ( $p=0.04$ ), platelet ( $p=0.024$ ), and hospital stay ( $p=0.009$ ).

**Conclusion:** Postpartum acute kidney injury is very common in underdeveloped nations. Preeclampsia/Eclampsia, obstetric bleeding, and intrauterine death are the leading causes of postpartum acute kidney injury in Somalia. This tragic scenario may be avoided by providing appropriate antenatal care and raising awareness among Somali women about the benefits of antenatal care provided by public institutions.

**Keywords:** postpartum AKI, pregnancy-related acute kidney injury, Somalia, eclampsia

## Introduction

Acute kidney injury (AKI) is a sudden loss of kidney function that causes urea and other nitrogenous waste products to be retained, as well as extracellular volume and electrolyte imbalance.<sup>1</sup> AKI diagnosed between the time of childbirth and six weeks after delivery was referred to as postpartum AKI.<sup>2</sup> Postpartum acute kidney injury (PPAKI) is a common cause of obstetric AKI. Over the second half of the 20th century,<sup>3</sup> the incidence of PRAKI has decreased dramatically,

with a low incidence of 1.5–2.8% in developed countries<sup>4</sup> and a higher prevalence of 15–20% in developing countries.<sup>5</sup> Even though, pregnancy-related acute kidney injury (PRAKI) is becoming less common in developing countries, it is still a major cause of maternal and fetal morbidity and mortality.<sup>6</sup>

The maternal mortality rate (MMR) in Somalia is high and reported to be 692 per 100,000 live births, as per the Somalia Health Demographic Survey report, 2020. The MMR in Somalia has decreased from 732 in 2015 to 692 in 2020, according to the Maternal Mortality Estimation Inter-Agency Group for Somalia. Even though there is a decrease, it is still high when compared to neighboring nations like Kenya (362 per 100,000), Ethiopia (412 per 100,000), and Uganda (412 per 100,000).<sup>7</sup> Maternal conditions are the leading cause of death in women between the ages of 15 and 49 in Somalia.<sup>8</sup> High fertility rates, poor contraceptive uptake, low skilled birth attendance rate, inadequate access to maternal health services, inadequate access to emergency obstetric care, and the usage of female circumcision are all factors that contribute to Somalia's high maternal mortality rate. In the five years preceding the Somalia Health Demographic Survey report, 68% of women did not have any antenatal care (ANC) visit during their most recent pregnancy. At least once, 31% of those who went to get ANC obtained it from qualified persons (doctors/clinical officers or nurses/midwives/auxiliary midwives). A doctor or clinical officer provided ANC to 12% of women, while a midwife, nurse, or auxiliary midwife provided care to 19%.<sup>7</sup>

Place of delivery also plays an important role in determining the outcome and the complication of the pregnancy. According to the Somalia Health Demographic Survey report, 2020, only 32% of Somalia births are attended by a competent health professional, such as a doctor/clinical officer or a nurse/midwife/auxiliary midwife. According to the data, one out of every five births (21%) occurred in a health facility in the five years before the survey, with the vast majority of births (79%) delivered at home. The survey shows that 2% of mothers deliver their babies through caesarian section.

In many parts of the world, the primary cause of PRAKI is hypertensive diseases of pregnancy, such as pre-eclampsia and eclampsia; hemolysis, elevated liver enzymes, low platelets (HELLP) syndrome, which account for nearly 75% of all cases.<sup>9,10</sup>

Postpartum acute kidney injury burdens the already strained health care system in Somalia, where the number of noncommunicable diseases has recently increased, as one study in Mogadishu reported that around 45% of hospital admissions were related to kidney diseases.<sup>11</sup>

The study aimed to determine the causes, risk factors and the outcomes in patients with postpartum acute kidney injury managed at Mogadishu Somali Turkey Training and Research Hospital, in Mogadishu, Somalia over a two years period.

## Materials and Methods

This retrospective cross-sectional design study was carried out at Mogadishu Somali-Turkey Training and Research Hospital in Mogadishu, the capital of Somalia, which is the largest teaching and referral hospital in the country.

Ethical approval was obtained prior to data collection from the Institutional Review Board (IRB) of Mogadishu Somali Turkey Training and Research Hospital, and patient consent was waived due to the retrospective design of our study. Patients' data were obtained from the medical record system and anonymously analyzed to protect patient privacy. This study complies with the Declaration of Helsinki.

## Inclusion Criteria

All postpartum patients who were previously healthy and developed acute kidney injury and fulfilled the diagnostic definition of acute kidney within the guidelines of Kidney Disease Improving Global Outcome (KDIGO).

## Exclusion Criteria

Patients with evidence of kidney disease before pregnancy, have a history of kidney stone disease, have small kidney sizes, and elevated serum creatinine before gestation have been excluded from the study.

History, clinical observations, hemogram, renal function tests, electrolytes, liver functions, and ultrasonography were collected and studied for women who presented with acute kidney injury in the postpartum period and were admitted to

our hospital for two years (January 2020 to December 2021). The data were also examined from the day of postpartum admission and the length of stay in the hospital. The need for dialysis was also documented, as was the outcome. Maternal outcome has been classified as follows: • Complete recovery at discharge/follow-up. • Chronic hemodialysis dependent: Patients who required continuous hemodialysis at the time of discharge and for more than 3 months after discharge. • Death- those who died during the admission.

Acute kidney injury is defined according to Kidney Disease Improving Global Outcome (KDIGO) Guidelines as any of the following: a) Increase in serum creatinine (SCr) by X0.3 mg/dl (X26.5  $\mu\text{mol/l}$ ) within 48 hours; b) an increase in SCr to X1.5 times baseline, which is known or presumed to have occurred within the previous 7 days; c) urinary volume of 0.5 mL/kg/h for 6 hours.<sup>12</sup>

Pre-eclampsia was defined by three signs: hypertension [systolic blood pressure (SBP) 140 mm Hg and/or diastolic blood pressure (DBP) 90 mm Hg]; edema; and proteinuria after 20 weeks of pregnancy.

Eclampsia was defined by the presence of generalized convulsions and/or loss of consciousness during pregnancy or postpartum.

Sepsis was defined as per surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock 2021 definition of life-threatening organ dysfunction caused by a dysregulated host response to infection.<sup>13</sup>

IBM's SPSS software version 22.0 was used to analyze the data. The median standard deviation was used to represent the results. Fisher's exact and Chi-square tests were utilized.

## Results

We analyzed a total of 79 postpartum patients with acute kidney injury. The mean age of the study participants was  $28.67 \pm 6.14$ . Most of the patients 41 (52%), were between 20–30 years old, followed by 30–40 years, which constitutes 29(36.7%) whereas less than 20 years and more than 40 years reported 8.9%, and 2.5% respectively (Table 1).

**Table 1** Demographics and Clinical Characteristics of the Study Population

Factors	Frequency/Mean	Died	Survived	$\chi^2$	P-value
<b>Age Group (Years)</b>					
<20	7(8.9%)	2(28.6%)	5(71.4%)	9.052	0.029*
20–30	41(52%)	7(17.1%)	34(82.9%)		
31–40	29(36.7%)	0(0.0%)	29(100.0%)		
>40	2(2.5%)	1(50.0%)	1(50.0%)		
<b>Comorbidities</b>					
No Comorbid	65(82.3%)	10(15.4%)	55(84.6%)	2.466	0.651
Hypertension	8(10.1%)	0(0.0%)	8(100.0%)		
Heart Failure	3(3.8%)	0(0.0%)	3(100.0%)		
Diabetes with HTN	2(2.5%)	0(0.0%)	1(100.0%)		
Hypothyroidism	1(1.3%)	0(0.0%)	2(100.0%)		
<b>Cause of Postpartum AKI</b>					
Eclampsia	19(24.1%)	1(5.3%)	18(94.7%)	19.350	0.152
Sepsis	4(5.1%)	2(50%)	2(50%)		
Uterine rupture	7(8.9%)	0(0.0%)	7(100.0%)		

(Continued)

**Table 1** (Continued).

Factors	Frequency/Mean	Died	Survived	$\chi^2$	P-value
Placenta previa	2(2.5%)	0(0.0%)	2(100%)		
PPH	4(5.1%)	1(25.0%)	3(75.0%)		
Intrauterine death	13(16.5%)	1(7.7%)	12(92.3%)		
Hemorrhagic Shock	13(16.5%)	3(23.1%)	10(76.9%)		
Placenta abruptio	7(8.9%)	0(0.0%)	7(100.0%)		
Eclampsia and Sepsis	1(1.3%)	0(0.0%)	1(100.0%)		
Uterine rupture Plus Hemorrhagic Shock	2(2.5%)	0(0.0%)	2(100.0%)		
Eclampsia Plus Placenta previa Plus Hemorrhagic Shock	1(1.3%)	0 (0.0%)	1(100.0%)		
Placenta previa Plus Intrauterine death	1(1.3%)	0 (0.0%)	1(100.0%)		
Eclampsia Plus Uterine rupture	3(3.8%)	1(33.3%)	2(66.7%)		
Eclampsia Plus Hemorrhagic Shock	1(1.3%)	0(0.0%)	1(100.0%)		
Sepsis Plus Hemorrhagic Shock	1(1.3%)	1(100.0%)	0(0.0%)		
Urine Output					
Anuric	57(72.15%)	7(25.9)	20(74.1)	2.1	0.67
Oliguric	24(27.84%)	3(5.8)	49(94.2)		
Duration of stay					
5 days	11.48±11.02	7(30.43)	16(69.56)	9.5	0.009*
5–10 days		2(7.69)	24(92.30)		
>10 days		1(3.33)	29(96.66)		
USG					
Not done	8(10.1%)	2(25.0%)	6(75.0%)	4.424	0.219
Normal Abdominal	17(21.5%)	4(23.5%)	13(76.5%)		
Renal Parenchymal Disease	51(64.6%)	4(7.8%)	47(92.2%)		
Unilateral/Bilateral Renal Atrophy	3(3.8%)	0(0.0%)	3(100.0%)		

**Note:** \*p values <0.05 are statistically significant.

**Abbreviations:** IUD, Intrauterine death; USG, ultrasound AKI acute kidney injury; PPH, postpartum hemorrhage.

For self-reported comorbidities, most of the patients reported that they had no history of chronic diseases 65(82.3%) while 8 (10.1%) and 3(3.8%) have hypertension and heart failure; the remaining 1 (1.3%), 2(2.5%) had a hypothyroidism, DM and HTN, respectively (Table 1).

The common causes of PRAKI were eclampsia 19 (24.1%), hemorrhagic shock, intrauterine death (16.5%), placenta abruptio and uterine rapture in 8.9%, followed by sepsis, postpartum hemorrhage 5.1%, and placenta previa 2.5% (Table 1).

The mean of laboratory test results reported that Aspartate Aminotransferase, Alanine Transaminase, white blood cell count, hemoglobin, serum creatinine urea, sodium, potassium uric acid and albumin were 216.9±445.3, 146.3±268.8, 16.6±9.17, 7.58±2.36, 15.7±79.00, 136.4±85.95, 129.6±13.34, 10.2±47.40, 9.5±3.08, 2.86±2.42, respectively (Table 2).

**Table 2** Laboratory and Clinical Characteristics of the Study Population

Laboratory and Clinical Characteristics	Frequency/Mean	Died	Survived	$\chi^2$	P-value
<b>Glucose</b>					
Hypoglycemia	109.67±53.73	2(28.6%)	5(71.4%)	2.010	0.366
Normal		6(12.5%)	42(87.5%)		
Hyperglycemia		2(8.3%)	22(91.7%)		
<b>AST</b>				0.461	0.395
Normal	216.91±445.3	2(8.7%)	21(91.3%)		
Abnormal		8(14.3%)	48(85.7%)		
<b>ALT</b>				1.950	0.145
Normal	146.29±268.77	3(7.5%)	37(92.5%)		
Abnormal		7(17.9%)	32(82.1%)		
<b>Urea (mg/dL)</b>				0.611	0.575
Normal	136.37±85.95	0(0.0%)	4(100.0%)		
Abnormal		10(13.3%)	65(86.7%)		
<b>Sodium (mmol/L)</b>				3.387	0.184
Low Sodium	129.56±13.34	8(13.6%)	51(86.4%)		
Normal		1(5.6%)	17(94.4%)		
High Sodium		1(50.0%)	1(50.0%)		
<b>Potassium (mmol/L)</b>				3.016	0.221
Low Potassium	10.15±47.40	1(14.3%)	6(85.7%)		
Normal		4(8.0%)	46(92.0%)		
High Potassium		5(22.7%)	17(77.3%)		
<b>Uric Acid</b>				7.626	0.022*
Low Uric acid	9.51±3.08	1(100.0%)	0(0.0%)		
Normal		2(7.4%)	25(92.6%)		
High Uric Acid		7(13.7%)	44(86.3%)		
<b>Albumin</b>				0.774	0.679
Low Albumin	2.86±2.42	10(13.5%)	64(86.5%)		
Normal		0(0.0%)	2(100.0%)		
High Albumin		0(0.0%)	3(100.0%)		
<b>CPR</b>				1.113	0.372
Normal	76.46±56.79	0(0.0%)	7(100.0%)		
Abnormal		10(13.9%)	62(86.1%)		

(Continued)

**Table 2** (Continued).

Laboratory and Clinical Characteristics	Frequency/Mean	Died	Survived	$\chi^2$	P-value
<b>Platelet</b>				8.725	0.013*
Low Platelet		4(12.9%)	27(87.1%)		
Normal		3(7.1%)	39(92.9%)		
High platelet		3(50.0%)	3(50.0%)		

**Note:** \*P-values < 0.05 are statistically significant.

**Abbreviations:** SD, standard deviation; ALT, Alanine transaminase; AST, Aspartate transaminase; CRP, C-reactive protein.

The mean hospital stays were  $11.48 \pm 11.02$  days. 27 (34.2%) patients became dialysis-dependent, while 42 (53.2%) had a full renal recovery, 10 deaths were recorded, giving a maternal mortality rate of 12.7% (Figure 1).

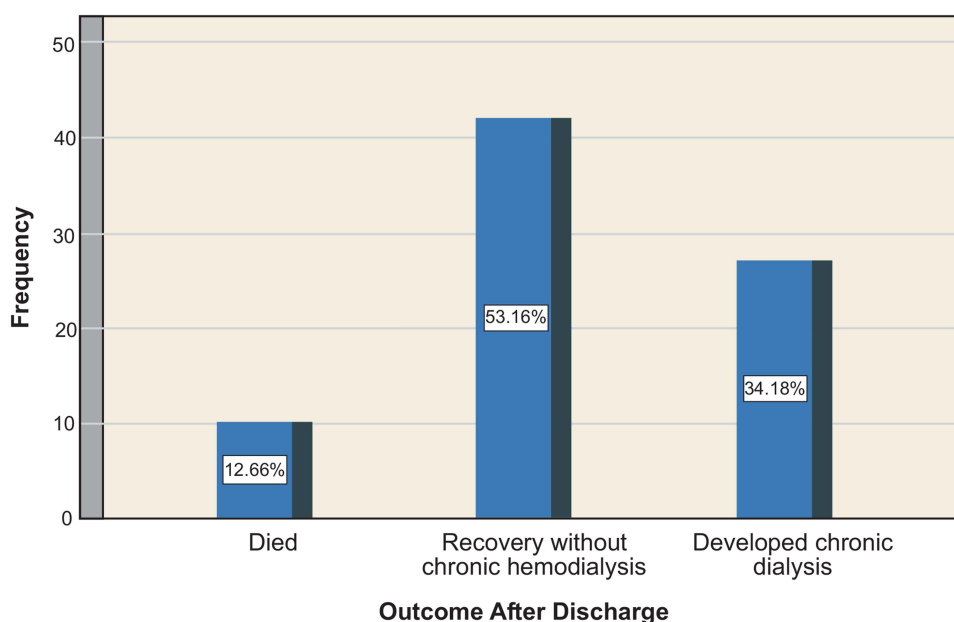
About 34% of postpartum patients had severe anemia during their presentation. Although it was not statistically significant, the probability of postpartum death was higher in mothers with severe and moderate anemia and fewer in mothers with mild anemia. On the contrary, surviving mothers were common in mothers without anemia (Figure 2).

There was a significant association between age ( $\chi^2=4.11$ ,  $p<0.04$ ), platelet ( $\chi^2=8.19$ ,  $p=0.024$ ), and duration of stay ( $\chi^2=9.5$ ,  $p=0.009$ , uric acid levels ( $p<0.022$ ) and the outcome of the patient (died and survived) (Table 2).

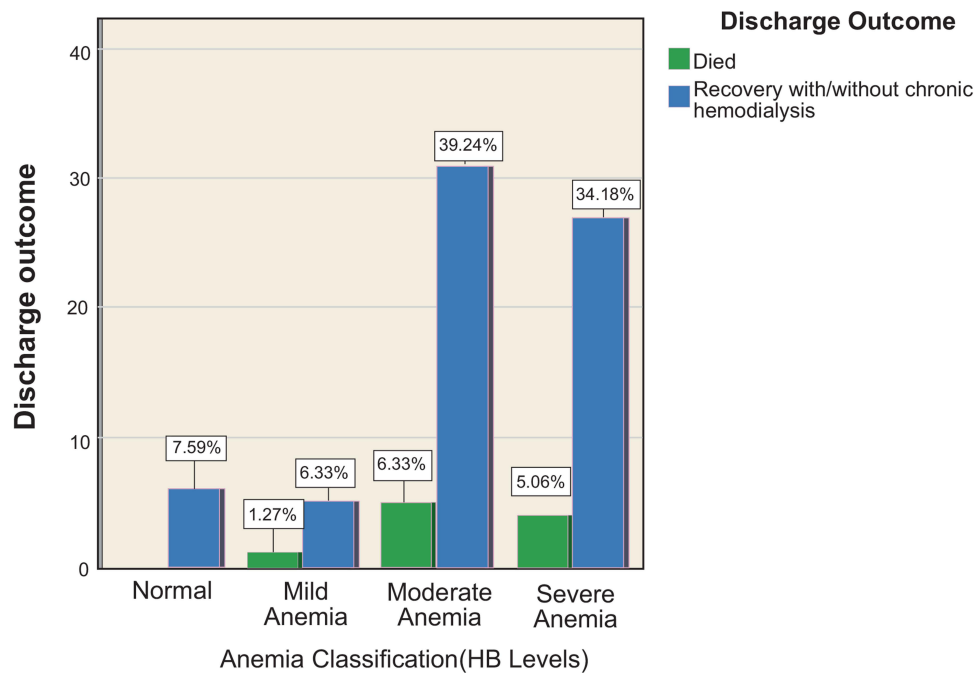
## Discussion

In developing countries, postpartum acute kidney injury is still quite common, and it has devastating consequences for both maternal and fetal survival. We could not find any previous papers on the prevalence of pregnancy-related AKI in Somalia, therefore, we cannot comment on any changes in the local prevalence of postpartum AKI in Somalia, but studies from neighboring countries showed a high prevalence of pregnancy-related acute kidney injury when compared to developed countries, with 13% from Ethiopia<sup>14</sup> and 3.2% from Kenya.<sup>15</sup>

To the best of our knowledge, this was the first study to determine the demographic characteristics and risk factors of postpartum AKI in Somalia.



**Figure 1** Outcomes of the study population.



**Figure 2** Classification of anemia according to WHO anemia classification.

The mean age of our study participants was  $28.67 \pm 6.14$  which is comparable to reports from other studies.<sup>5,14,16</sup> The study population consisted of young women whose peak age was between 20 to 30 years, which was younger than those reported in Nigeria.<sup>17</sup> This difference could be explained by the religious and cultural differences between the population. Our study population's young age could explain why 82.3% had no premorbid medical conditions.

Pre-eclampsia-eclampsia was the most common cause of postpartum acute kidney injury in our study, similar to previous studies in Kenya and Ethiopia.<sup>14,15</sup> Pre-eclampsia/eclampsia or HELLP syndrome, is the most common cause of AKI in pregnant women around the world.<sup>18</sup> In Goplani's<sup>5</sup> study, puerperal sepsis was the primary cause of AKI, however Khalil et al<sup>19</sup> observed that hemorrhage was the main cause of AKI in their study.

Over 75% of the patients had anemia, clearly demonstrating that the overall antenatal care of these patients was poor. In a study conducted in one of Mogadishu's internally displaced camps, the prevalence of anemia in pregnant patients was 44.4% and more than 50% of these participants never visited antenatal care.<sup>20</sup>

In our study, the maternal mortality rate was 12.7%, which is similar to a previous study conducted in Ethiopia<sup>14</sup> and almost another report from Pakistan that observed a maternal mortality rate of 15%.<sup>19</sup>

Using ANC package on a timely and frequent basis allows the delivery of essential services such as identification and management obstetric complications such as preeclampsia, tetanus toxoid immunization, intermittent preventive treatment for malaria during pregnancy (IPTp), and identification and management of infections such as HIV, syphilis, and other sexually transmitted infections (STIs). ANC also provides a chance for competent birth attendance to encourage healthy behaviors such as breastfeeding, early postnatal care, and planning of pregnancy spacing.<sup>21</sup>

## Limitations

This study has some limitations. First, we could not find any prior studies about the postpartum acute kidney injury from Somalia, to compare and contrast with our study results. Second, in the retrospective nature of our study, there may be some unmeasured confounders. Third, the sample size may be small, but this can be a foundation for similar studies with more sample sizes.



## Conclusion

Obstetrical complications like postpartum acute kidney injury are still common in developing countries. Preeclampsia/Eclampsia, obstetrical hemorrhages, and intrauterine death are the leading causes of postpartum acute kidney injury in Somalia. This disastrous scenario can be prevented only by providing adequate antenatal care, the provision of health facilities, and raising awareness among Somali women about the benefits of antenatal care provided by public hospitals.

## Disclosure

The authors declare no conflicts of interest in relation to this work.

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