



School of Nursing

Acute Kidney Injury and Its Associated Factors Among Patients Admitted to Adult Intensive Care Unit in Public Hospitals of Addis Ababa, Ethiopia, 2024

By: Lata Adugna Malasa

**A Thesis Submitted to the Department of Emergency and Critical Care,
School of Nursing; Saint Paul's Hospital Millennium Medical College;
Presented in Partial fulfilment of the requirements for the Degree of
Masters in Critical Care Nursing Practitioner**

August, 2024

Addis Ababa, Ethiopia

**Acute Kidney Injury and Its Associated Factors Among Patients
Admitted to Adult Intensive Care Unit in Public Hospitals of
Addis Ababa, Ethiopia, 2024**

By: Lata Adugna Malasa

Advisors: Hirut Megersa (Assistant professor, PhD fellow)

Kokeb Gezahegn (BSc; MSc)

**A Thesis Submitted to the Department of Emergency and Critical Care,
School of Nursing; Saint Paul's Hospital Millennium Medical College;
Presented in Partial fulfillment of the requirements for the Degree of
Masters in Critical Care Nursing Practitioner**

August, 2024

Addis Ababa, Ethiopia

Abstract

Background: Acute kidney injury is a clinical syndrome characterized by a sudden decrease in or loss of kidney function. Despite the higher rates of acute kidney injury along with mortality in intensive care units, the magnitude and associated factors of acute kidney injury among adult ICU admitted patients were not thoroughly investigated in the study area. This study aims to ascertain the magnitude and associated factors of AKI in the adult ICU of a public hospital in Addis Ababa, Ethiopia.

Method: A multicentre cross-sectional study was conducted among adult intensive care unit admitted patients in public hospitals of Addis Ababa, Ethiopia, from 1st January 2022 to 31st December 2023. Using simple random sampling four Hospitals was selected among the twelve public hospital provides ICU services in the city. 266 study participants were included in the study and data was collected retrospectively from the patient charts. After completing data collection by Kobo Toolbox Collect software, it was exported in excel format, and then the data was imported to SPSS version 27 for further processing and analysis. In the bivariate analysis, Variables with a p-value of less than 0.25 were included to multivariate analysis to identify any possible association among them. The strength of association was assessed by calculating an adjusted odd ratio (AOR) along with a 95% confidence interval (CI). Finally, a p-value of less than 0.05 was used to determine statistical significance.

Results: Among the 266 study participants, 27.1% of adult ICU-admitted patients in public hospitals of Addis Ababa experienced acute kidney injury, with a 95% CI of ([21.8 - 32.8]). Patients with diabetes mellitus (AOR = 3.08; 95% CI: [1.52-6.25]), Contrast usage (AOR = 5.1; 95% CI: [2.34-11.15]), hypertension (AOR = 6.02; 95% CI: [1.9-19.14]), vasopressor usage (AOR = 14.99; 95% CI: 4.32-52), WBC $>12 \times 10^9$ (AOR=2.46;95%CI:[1.27-4.77])and increased length of ICU stay (AOR = 2.01; 95% CI: [1.04-3.9]) were identified as independent factors of acute kidney injury.

Conclusion: This study has assessed magnitude and associated factors of AKI among patients admitted to adult intensive care unit in public hospitals of Addis Ababa, Ethiopia. Accordingly, the magnitude of Acute Kidney Injury among Adult Intensive Care Unit admitted patients was 27.1%. It was found that patients with Hypertension, Contrast Usage, Diabetes Mellitus, vasopressor usage, increased WBC count and increased length of ICU stay were significantly associated with the acute kidney injury.

Keywords: Acute kidney injury (AKI), Adult intensive care unit, Associated factors of Acute kidney injury.

Acknowledgement

First and foremost, I express my gratitude to Almighty God for my success in this research project. Second, I like to express my gratitude to St. Paul's Hospital Millennium Medical College, Department of Emergency and Critical Care Nursing, for allowing me to conduct this research and for all of their efforts in ensuring the research's success.

Thirdly, I also thank my advisors, Mrs. Hirut Megersa (Assistant professor, PHD Fellow) and Mrs. Kokeb Gezahegn (BSc, MSc), for their continual encouragement and support throughout this research work. Finally, I like to convey my sincere gratitude to the data collectors for their commitment and to my friends and family for their continuous support in this research project.

Table of Contents

<i>Abstract.....</i>	<i>I</i>
<i>Acknowledgement</i>	<i>II</i>
<i>Table of Contents</i>	<i>III</i>
<i>List of Tables.....</i>	<i>VI</i>
<i>List of Figures.....</i>	<i>VII</i>
<i>List of Acronyms and Abbreviations</i>	<i>VIII</i>
<i>1. Introduction</i>	<i>1</i>
<i>1.1. Background.....</i>	<i>1</i>
<i>1.2. Statement of the problem.....</i>	<i>2</i>
<i>1.3 Significance of the study</i>	<i>4</i>
<i>2. Literature Review.....</i>	<i>5</i>
<i>2.1. Prevalence of AKI among ICU admitted patients.....</i>	<i>5</i>
<i>2.2. Demographic Related Factors of Acute Kidney Injury (AKI)</i>	<i>6</i>
<i>2.3. Clinical Related Factors of Acute Kidney Injury (AKI).....</i>	<i>7</i>
<i>2.4. Intervention Related Factors of Acute Kidney Injury (AKI)</i>	<i>8</i>
<i>2.5. laboratory Related Factors of Acute Kidney Injury (AKI)</i>	<i>9</i>
<i>3. Objectives</i>	<i>11</i>
<i>3.1. General Objective</i>	<i>11</i>
<i>3.2. Specific Objectives</i>	<i>11</i>
<i>4. Methods and Materials</i>	<i>12</i>
<i>4.1. Study setting.....</i>	<i>12</i>
<i>4.2. Study Period.....</i>	<i>13</i>
<i>4.3. Study design</i>	<i>13</i>
<i>4.4. Source and Study population</i>	<i>13</i>
<i>4.4.1 Source population.....</i>	<i>13</i>
<i>4.4.2 Study population.....</i>	<i>13</i>

4.4.3 Sampling unit	13
4.4.4 Inclusion criteria	14
4.4.5 Exclusion criteria	14
4.5. Sample Size determination.....	14
4.6. Sampling Procedures	15
4.7. Measurements	16
4.7.1. Study Variables.....	16
4.8. Operational Definitions	17
4.9. Data Collection tools and Procedures	17
4.10. Data Quality Control and Management	18
4.11. Data processing and analysis	18
4.12. Ethical Consideration	19
4.13. Dissemination of Results.....	19
5. Results.....	20
5.1. Distribution of demographic characteristics among adult ICU admitted patients in selected public hospitals of Addis Ababa, Ethiopia,2024(n=266).	20
5.2. Clinical related profiles among adult ICU admitted patients in public hospitals of Addis, Ababa, Ethiopia,2024(n=266).	20
5.3. Laboratory related profiles among adult ICU admitted patients in public hospitals of Addis, Ababa, Ethiopia,2024(n=266).	21
5.4. Intervention related profiles among adult ICU admitted patients in public hospitals of Addis, Ababa, Ethiopia,2024(n=266).	22
5.5. magnitude of Acute Kidney Injury (AKI) among adult ICU admitted patients in public hospitals of Addis, Ababa, Ethiopia.,2024(n=266).	23
5.6. Factors Associated with Acute kidney injury (AKI) among adult ICU admitted patients in public hospitals of Addis, Ababa, Ethiopia.,2023(n=266).	24
6. Discussion.....	27
6.1. Strength and limitations of the study.....	29

6.1.1. Strength	29
6.1.2. Limitations.....	29
7. Conclusion.....	30
8. Recommendation	31
9. References.....	32
Appendix	36
Information Sheet	40
Declaration.....	41

List of Tables

<i>Table 1:sample size determination with the different variables</i>	<i>15</i>
<i>Table 2:Distribution of clinical related profiles among adult ICU admitted patients in selected public hospitals of Addis Ababa, Ethiopia,2024(n=266)</i>	<i>20</i>
<i>Table 3:Distribution of laboratory related profiles among adult ICU admitted patients in public hospitals of Addis, Ababa, Ethiopia.2024(n=266)</i>	<i>21</i>
<i>Table 4:Distribution of Interventional related profiles among adult ICU admitted patients in public hospitals of Addis, Ababa, Ethiopia.,2024(n=266)</i>	<i>22</i>
<i>Table 5:Bivariable and multivariable binary logistic regression analysis for factors associated with acute kidney injury among ICU admitted patients in selected public hospitals of Addis Ababa, Ethiopia,2024(n=266)</i>	<i>25</i>

List of Figures

<i>Figure 1:Conceptual framework of AKI risk factors among ICU admitted patients in public hospitals of Addis Ababa, Ethiopia(13, 15, 38, 40).....</i>	<i>10</i>
<i>Figure 2:Schematic presentation of sampling procedure on Acute kidney injury and its associated factors among ICU admitted patients in selected public hospitals of Addis Ababa, Ethiopia,2024.....</i>	<i>16</i>
<i>Figure 3:prevalence of AKI among ICU admitted patients in selected public hospitals of Addis Ababa, Ethiopia,2024(n=266).</i>	<i>23</i>
<i>Figure 4:AKI classification of ICU admitted patients in selected public hospitals of Addis Ababa, Ethiopia,2024(n=266).....</i>	<i>24</i>

List of Acronyms and Abbreviations

ACEI - Angiotensin Converting Enzyme Inhibitor

AICU-Adult Intensive Care Unit

AKI - Acute Kidney Injury

APACHE-SCORE -Acute Physiology and Chronic Health Evaluation Score

ARB - Angiotensin Receptor Blocker

ARF - Acute Renal Failure

COPD-Chronic Obstructive Pulmonary Disease.

CRP-C-Reactive Protein

EMR-Electronic Medical Record

G.C-Gregorian Callender

GFR -Glomerular Filtration Rate

HF-Heart Failure

HIV-Human Immunodeficiency Virus

KDIGO-kidney Disease Improving Global Outcome

MAP-Mean Arterial Pressure

MICU-Medical Intensive Care Unit

MSOF -Multiple System Organ Failure

PH-Potential of Hydrogen

RTR-Renal Transplant

SA-AKI-Sepsis Associated Acute Kidney Injury

SCr. -serum Creatinine

SICU-Surgical Intensive Care Unit

SOFA SCORE-Sequential Organ Failure Assessment Score

SPHMMC-Saint's Paul's Hospital Millennium Medical College

SSA-Sub-Saharan Africa

U/O -Urine out-put

USA-United states of America

1. Introduction

1.1. Background

Acute Kidney Injury (AKI) is a syndrome which can result from a wide array of clinical conditions which share common clinical characteristics(1).It encompasses a broad spectrum of decline in renal function from small decreases in glomerular filtration rate (GFR) to complete loss of renal function requiring renal replacement therapy(2).

AKI causes a build-up of waste products in patients' blood and makes it hard for kidneys to keep the right balance of fluid in the body it can also affect other organs such as the brain, heart, and lungs(3).

Until 2004, there were no standard criteria of diagnosis of AKI(4). That year, the Acute Dialysis Quality Initiative (ADQI) group developed the Risk, Injury, Failure, Loss and End stage (RIFLE) system through a broad consensus of experts from around the world with the aim of standardizing the definition of AKI for clinical and research purpose(4). In light of subsequent researches that showed even slight increments are associated with mortality, the RIFLE criteria was further modified to acute kidney injury network (AKIN) and lately the kidney disease improving global outcome (KDIGO) definition has been endorsed(5).

The latest classification of AKI proposed by the Acute Kidney Injury Working Group of KDIGO (kidney disease: Improving Global Outcomes), is based on the previous two classifications, and had the aim of unifying the definition of AKI. The KDIGO classification defines AKI as an increase in serum creatinine (SCr) of at least 0.3 mg/dl within 48 h, or an increase in SCr to more than 1.5 times baseline which is known or presumed to have occurred within the prior 7 days, or a urine output (UO) decrease to less than 0.5 ml/kg/h for 6 h.(6). Based on kidney disease improving global outcome (KDIGO), AKI is classified into stages I, II, and III for severity criteria(6).

Since acute dialysis therapy's initial notable effect, the death rate from AKI in intensive care unit (ICU) patients has remained between 50 and 80 percent. AKI independently raises morbidity and mortality, even while multiple system organ failure (MSOF) and other comorbidities add to its high death rate(7, 8).

1.2. Statement of the problem

Globally, acute kidney injury affects 13.3 million people annually, of whom about 85% live in developing countries(7).According to an article review done at Oregon Health and Science University in Portland, USA, patients with sepsis have the highest frequency of AKI, which ranges from 20% to 50% overall in the ICU and can have a mortality rate of above 50%(9). AKI incidence on all adult ICU patients admitted to the University Hospital in Central Norway of 53.5 %. The incidence according to KDIGO AKI stages 1, 2, and 3 was 26.2, 11.7, and 15.7%, respectively(10). The other issue in Africa is the interpretation of data on the incidence of AKI due to the non-uniformity of cohorts. Because some studies include only adults, while others include both adults and children. The burden of AKI in SSA is unknown, but mortality is likely to be high due to poor access to health care(9).

A study done in Sudan found that out of the 211 patients, 61 of them experienced renal impairment while they were in the intensive care unit. The patients' mean age was 41 ± 5 days, with 36% being female and 64% being male. After an average of 5 days of admission, renal impairment developed. Another study conducted in Egypt showed, almost two- thirds (62.2%) of the study patients in had AKI(11, 12). In Tanzania 55.3% of ICU patients were diagnosed with AKI. Of these, 80% were diagnosed within 24 hours of admission. Acute kidney injury stage 3 accounted for 35% of patients with AKI(13). Another study conducted in Ethiopia revealed, the overall incidence rate of acute kidney injury was 13.4%(14).

Study conducted in Omdurman teaching Hospital, Sudan showed that ICU mortality was 31%, for patients with renal impairment it was 41% which was greater than the 23% mortality of those patients with normal renal function(12). Study conducted in Jimma Medical Center, Southwest Ethiopia showed that, the overall in-hospital rate of mortality was 12.8%. Of those patients discharged with improved renal function, 13% had sustained reversal and the other 40.2% had a late reversal. The average duration of late reversal was 11.30 days. The minimum and maximum duration of late reversal were 8 and 21 days respectively. Patients discharged with non-recovery AKI were 30.5%. The probability of survival among the proportion of patients with stage 3 AKI decreases with time compared to patients with stage 1 and stage 2 AKI.(15). A study conducted in South Ethiopia, revealed that the prevalence of AKI among ICU admitted patients were 40.4%(16).

This study aims to ascertain the prevalence of AKI and associated factors of it in the adult critical care unit of a public hospital in Addis Ababa. Despite the higher rates of acute kidney injury (AKI) along with mortality in intensive care units (ICU), the prevalence and associated

factors of AKI among adult ICU admitted patients were not thoroughly investigated in this study area. The studies also inconsistent about the prevalence of AKI among ICU admitted patients. Therefore, further research is needed to better understand the prevalence and associated factors to develop prevention techniques that enhance the outcomes of the disease. As a result, it makes sense and is relevant to the topic to look at this particular situation in this area.

1.3 Significance of the study

The goal of this research is to assess the Magnitude and associated factors of acute kidney injury (AKI) among patients admitted to the adult intensive care unit. The results will be used to close the gaps that have been discovered. As a result, it can be utilized to improve quality, reduce patient length of stay, and death, as well as contribute to public health by making ICU services more accessible in hospitals. It also explores the risk factors in the present resource limited setup which are generally preventable. This can ultimately enhance patient outcomes while reducing the burden on healthcare resources.

Stakeholders with the ability to provide capacity building, such as training, would be able to provide this and other services following the reporting of the recommendations for each relevant body. The gathered data might also be lays the foundation for future studies.

2. Literature Review

The definition of AKI has been continuously evolving and being multidimensional. In fact, it has advanced significantly from clinical to biochemical and further to molecular level. Acute kidney injury (AKI) in intensive care unit has been a common occurrence and often devastating syndrome which is difficult to treat; with high financial burden to patients and healthcare systems(17).

2.1. Prevalence of AKI among ICU admitted patients

According to the study conducted at two large tertiary hospitals respectively, in USA, shows that 37.2% patients developed AKI(18). A study conducted at the College of Clinical Medicine of Henan University of Science and Technology, Luoyang, China revealed that, AKI incidence was of 33%(19). A study conducted at Assis Gurgacz College in Brazil's single intensive care unit, showed that, AKI that did not require dialysis was present in 53.2% of patients, but AKI that did require dialysis was present in 12.4% of patients(20). Multicentre, prospective study conducted in Australia and New Zealand who received intravenous fluid resuscitation, revealed that, 11% patients developed AKI(21).

Another study conducted from 2010 to 2015 in the intensive care unit of St. Olavs Hospital, Trondheim University Hospital in Central Norway reveals AKI incidence rate among ICU patients was 53.5%(10). According to the study conducted at Sheba Medical Centre in Israel from July 2007 to November 2020 reveals that 51% of patients acquired AKI while in the hospital(22). A retrospective cross-sectional study conducted between January 2018 and December 2019 at the SICU of Jordan University Hospital (JUH), revealed that, 32.7% of patients experienced AKI(23).

An additional study carried out at Jordan University Hospital revealed that 42.8% of them experienced acute kidney injury (AKI) while they were in the medical intensive care unit (MICU)(24). In a study conducted in Jordan, AKI incidence was 25.3%(25). According to the study conducted at Oman, showed that the incidence of AKI was found to be 55.2% overall(26). A study conducted at Gadjah Mada University, Yogyakarta, Indonesia, revealed that, AKI developed in 14.3% patients(27).

The study conducted at a tertiary-care hospital in India showed that AKI was observed in 74% individuals (28). In a prospective descriptive case series that conducted in the medical intensive

care unit (ICU) at Shifa International Hospital in Islamabad, Pakistan, the frequency of AKI was 68.55%(29).

In a case-control study conducted at two of Johannesburg, South Africa's largest hospitals, Sepsis-associated acute kidney injury (SA-AKI) occurred at a rate of 51%(30). According to another study conducted at a tertiary teaching hospital in Zambia the incidence of AKI was 52.9%(31). A study conducted in the intensive care unit (ICU) of COVID-19 patients, in Democratic Republic of the Congo showed that 29% of patients had an AKI diagnosis(32). A multicentre prospective cohort study in four Alexandria Teaching Hospitals in Egypt, showed that 39.6% had AKI at ICU admission and 37.4% developed AKI after 24 hours of ICU admission(11).

A prospective observational study conducted in Northern Tanzania showed that, more than half(55.3%)of the ICU patients had an AKI diagnosis(33). By the descriptive prospective cohort study conducted at the Omdurman Teaching Hospital in Sudan, 28.9% of the patients experienced renal impairment while receiving ICU care(12). The cross-sectional study conducted in the intensive care unit of Fedail Hospital in Khartoum, Sudan, showed that prevalence of acute renal injury was (39%)(34).

According to study conducted in Northwest Ethiopia, revealed that, the overall incidence rate of acute kidney injury was 13.4%(14). Another prospective study carried out at Jimma, Southwest Ethiopia showed that, 74% were diagnosed with AKI(35). An institution-based cross-sectional survey at Jimma University Medical Centre showed that the overall magnitude of AKI was 23.32%(36). A study conducted in South Ethiopia, revealed that the prevalence of AKI among ICU admitted patients were 40.4%(16). Institutional-based retrospective cross-sectional study conducted, in Addis Ababa, Ethiopia showed that, 21.4% patients developed acute kidney injury(37).

2.2. Demographic Related Factors of Acute Kidney Injury (AKI)

A study conducted at the Henan University of Science and Technology, Luoyang, China revealed that, advanced age were predictor factors of AKI(19). According to the study conducted among trauma patients admitted to the intensive care unit (ICU) indicated that advanced age and African American descent were risk factors for AKI(38). The study conducted in the intensive care unit of St. Olavs Hospital in Central Norway shows that higher

body weight were significantly associated with AKI(10). In a retrospective Cohort study at Jordan revealed that higher age were associated with an increased risk of AKI(25).

According to study conducted at two of Johannesburg, South Africa's largest hospitals showed that Patients being older than 55 were identified to be independent risk factors for AKI(30). A study conducted in Democratic Republic of the Congo revealed that Obesity were risk factors for AKI(32). A study conducted at four Alexandria Teaching Hospitals in Egypt showed that low education was associated with AKI at ICU admission(11). According to the cross-sectional study conducted in the ICU of Fedail Hospital in Khartoum, Sudan showed that age > 60 were factor significantly associated with the AKI in the ICU (34).

2.3. Clinical Related Factors of Acute Kidney Injury (AKI)

A study conducted at two large tertiary care university hospitals in USA shows that; anaemia, sepsis, congestive heart failure, hypertension, chronic kidney disease, and chronic liver disease were independent predictors of AKI(18). According to the study conducted at the Henan University of Science and Technology, Luoyang, China revealed that diabetes, hypertension, history of chronic kidney disease and chronic HF were predictor factors of AKI(19).According to systematic review study conducted among trauma patients admitted to the intensive care unit (ICU) indicated that persistent hypertension, diabetes mellitus, elevated Injury Severity Score, abdominal trauma, shock, increased length of ICU stay, reduced Glasgow Coma Scale (GCS) score, and sepsis were risk factors for AKI(38).

Multicentre study conducted in Australia and New Zealand who received intravenous fluid resuscitation indicated that Sepsis diagnosis at admission, illness severity score, and tachycardia, were among the variables that were substantially correlated with AKI(21). The study conducted in the intensive care unit of St. Olavs Hospital in Central Norway shows that hypertension, diabetes, heart disease, and chronic renal disease were significantly associated with AKI(10). According to retrospective Cohort study at Sheba Medical Centre in Israel revealed that an infection, a medical history of hypertension and minimum systolic blood pressure were significant predictors for in-hospital AKI(22).

According to the retrospective observational study conducted in Oman showed that the only significant predictor for the AKI was shock (26). In a retrospective study at Jordan revealed that diabetes mellitus were associated with an increased risk of AKI(25).

According to the study conducted in Indonesia showed that Sepsis and acute heart failure were independent predictors of AKI(27). According to a retrospective study conducted at a tertiary teaching hospital in Zambia the presence of HIV were a positive predictor of ICU-AKI(31).

A study conducted in Democratic Republic of the Congo(DRC) revealed that the first wave of the COVID-19 pandemic were the risk factors for AKI(32). A multicentre study conducted at four Alexandria Teaching Hospitals in Egypt showed that Sepsis was associated with AKI at ICU admission(11). According to the study conducted in the intensive care units of a tertiary hospital in Northern Tanzania showed that AKI was independently correlated with diabetes and sepsis(33). By the study conducted at the Omdurman Teaching Hospital in Sudan shows that reduced consciousness and severe hypotension were the most common causes of AKI(12). According to the study conducted in the ICU of Fedail Hospital in Khartoum, Sudan showed that Chronic cardiovascular disorders, diabetes mellitus, hypertension, sepsis, and hypovolemia were factors significantly associated with the AKI in the ICU (34).

According to the study conducted in North west Ethiopia Sepsis, diabetes mellitus,, congestive heart failure, and Anaemia were found to be significant predictors of AKI among patients admitted to ICU(14). A study carried out at Jimma Medical Centre in Southwest Ethiopia revealed that hypovolemia, sepsis, hypertension, and heart failure, were the most common underlying comorbidities associated with AKI(35). The study conducted at South Ethiopia revealed that negative fluid balance and hypertension were independent predictors of AKI in the ICU(16). According to cross-sectional study conducted in Tikur Ambessa Specialised Hospital (TASH), Addis Ababa, Ethiopia, sepsis accounted for 43.2% of the AKI(39).

2.4. Intervention Related Factors of Acute Kidney Injury (AKI)

A study conducted at two large tertiary care university hospitals in USA shows that, nephrotoxin exposure were independent predictors of AKI (18). A systematic review conducted at the Henan University of Science and Technology, Luoyang, China indicated that, intravenous dobutamine were predictive factors of AKI(19).

A study conducted at Assis Gurgacz College in Brazil showed that, invasive mechanical ventilation were independent risk factors for AKI(20). Multicentre study conducted in Australia and New Zealand who received intravenous fluid resuscitation indicated that, mechanical ventilation were substantially correlated with AKI(21). A study conducted at the SICU of Jordan University Hospital (JUH), revealed that, the use of beta blocker and inotropes was found to be strongly related with AKI in ICU patients.(23).In a study conducted at Jordan revealed that ACEI/ARB use were associated with an increased risk of AKI(25).

According to the study conducted in South Africa showed that Patients needing inotropic support were identified to be independent risk factors for AKI(30). A study conducted in the intensive care units of a tertiary hospital in Northern Tanzania showed that AKI was independently correlated with vasopressor usage(33). According to the study conducted in the ICU of Fedail Hospital in Khartoum, Sudan showed that renal replacement therapy(RRT) were factor significantly associated with the AKI in the ICU (34).

According to the multicentre institution-based retrospective follow-up study conducted in North west Ethiopia Vasopressors were found to be significant predictors of AKI among patients admitted to ICU(14). Another study conducted at South Ethiopia revealed that patients with mechanical ventilation and vasopressor were independent predictors of acute kidney injury(16).

2.5. laboratory Related Factors of Acute Kidney Injury (AKI)

A systematic review study conducted at the Henan University of Science and Technology, Luoyang, China indicated that, N-terminal pro-B-type natriuretic peptide, creatinine > 1.0 mg/dL, index estimated glomerular filtration rate < 60 mL/min/1.73 m², blood urea nitrogen > 24 mg/dL, and serum albumin were predictor factors for AKI(19).According to systematic review study conducted among trauma patients admitted to the intensive care unit (ICU) indicated that elevated APACHE II score were risk factors for AKI(38).

A study conducted at Assis Gurgacz College in Brazil showed that, urea and high creatinine were independent risk factors for AKI at the time of admission(20).Multicentre, prospective secondary analysis in Australia and New Zealand who received intravenous fluid resuscitation indicated that, baseline estimated glomerular filtration rate were substantially correlated with AKI(21). According to the study at Sheba Medical Centre in Israel revealed that maximum tacrolimus trough level, haemoglobin level, and albumin level at admission were significant predictors for in-hospital AKI(22).

In a study conducted at Jordan revealed that erythrocyte sedimentation rate and CRP were associated with an increased risk of AKI(25). According to the study conducted in Indonesia showed that a high APACHE score at admission were independent predictors of AKI(27).The study conducted at two of Johannesburg, South Africa's largest hospitals showed that Patients having hypoalbuminemia were identified to be independent risk factors for AKI(30). According

to a retrospective study conducted at a tertiary teaching hospital in Zambia the presence of oliguria were a positive predictor of ICU-AKI(31). A prospective study conducted in Democratic Republic of the Congo(DRC) revealed that higher SOFA scores and CRP were the risk factors for AKI(32).

According to the study conducted in North west Ethiopia thrombocytopenia were found to be significant predictors of AKI among patients admitted to ICU(14). According to the study conducted at Jimma university medical centre revealed that, AKI was strongly linked with cases at baseline with haemoglobin levels ≤ 10.9 mg/dl, and creatinine levels > 1.36 mg/dl(36).

Conceptual framework of the AKI among ICU admitted patients.

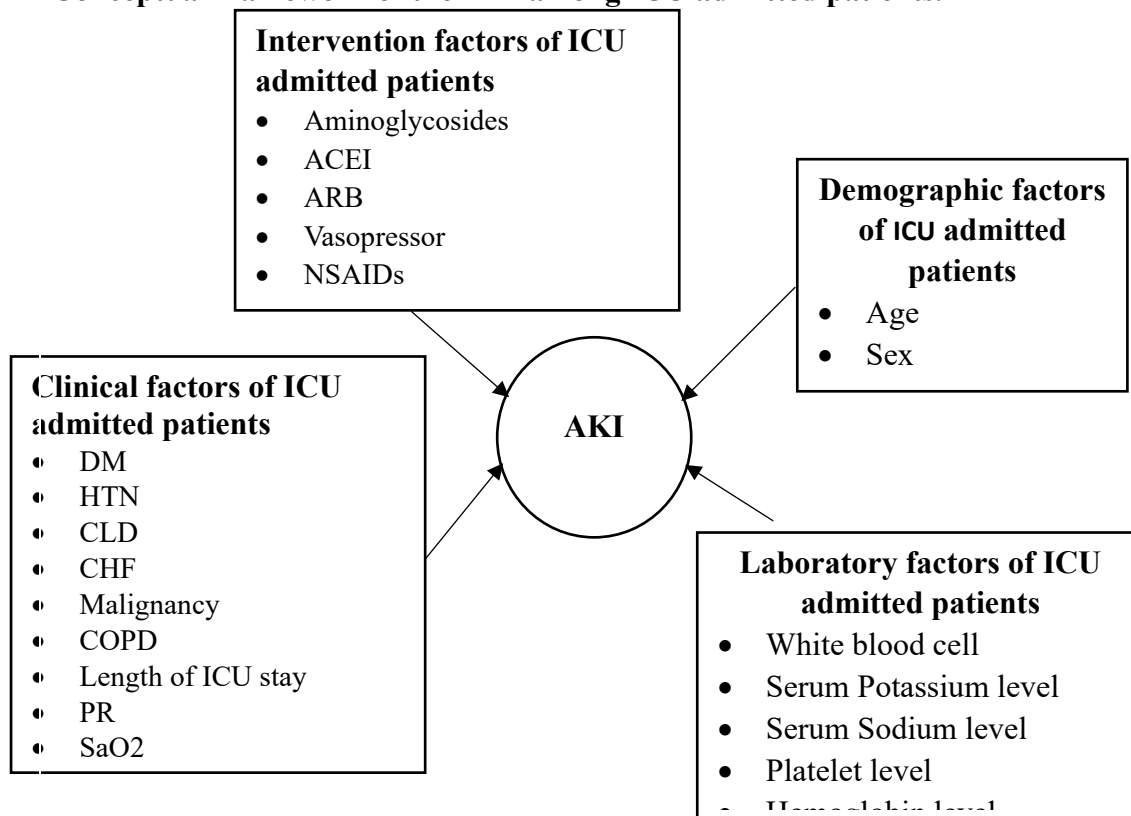


Figure 1: Conceptual framework of AKI risk factors among ICU admitted patients in public hospitals of Addis Ababa, Ethiopia(12, 14, 37, 39)

3. Objectives

3.1. General Objective

- To Assess the Magnitude and associated factors of acute kidney injury (AKI) among patients admitted to the adult intensive care unit (ICU) in public hospitals of Addis Ababa, Ethiopia from 1st January 2022 to 31st December 2023.

3.2. Specific Objectives

- To determine the Magnitude of AKI among adult patients admitted to ICU in public hospitals of Addis Ababa, Ethiopia from 1st January 2022 to 31st December 2023.
- To identify factors associated with AKI among patients admitted to adult ICU in public hospitals of Addis Ababa, Ethiopia from 1st January 2022 to 31st December 2023.

4. Methods and Materials

4.1. Study setting

Addis Ababa is Ethiopia's capital and seat of the African Union. It has a total of 53 hospitals, with 15 of them being state-run and more than 40 privately operated. 12 public Hospitals, provides ICU services for public that lives in the city and whole country. The study was conducted at four selected public hospitals of Addis Ababa Ethiopia, namely Ras Desta Memorial Hospital, Menilik II Referral Hospital, Zewditu Memorial Hospital, and St. Paul Hospital Millennium Medical College. These Hospitals were selected by simple random sampling (lottery method).

Ras Desta Memorial Hospital: Ras Desta Memorial General Hospital is one of the state-owned public hospitals in the capital of Ethiopia, Addis Ababa, located in Arada Sub City Arbegnoch Street which is the road from Arada Giorgis church to Asko just 500 meters from Yohannes Church. It is run under the health bureau of the city administration of Addis, providing comprehensive medical service for the people. Besides, the hospital incorporates 550 staffs consisting of 246 medical staffs and social workers, 98 technical staffs and 206 administrative staffs. The hospital provides general medical service and specialty service of eye. The hospital has 168 beds in five inpatient wards (37 in gynaecological and obstetric, 39 in surgical, 33 in medical and 19 beds in paediatric and 6 beds at the facility provide ICU services(40).

Menilik II Referral Hospital: is one of the referral hospitals, situated in Addis Abeba's Arada Sub-city. Menelik II Auxiliary Health Workers Training School (now Menelik-II Health Science College) was founded in 1941 E.C. (1949 G.C.), according to the history of nursing in Ethiopia, and was the country's first health training institution. The College has been moving forward on a progressive historical trajectory since 1949. It is run under the health bureau of the city administration of Addis, providing comprehensive medical service for the people. In addition to other services, the hospital currently provides six ICU beds for patients(41).

St. Paul Hospital Millennium Medical College: is a referral hospital in Addis Ababa under the Ethiopian Federal Ministry of Health (FMOH). It is the second largest public hospital in the nation, built by the Emperor Haile Selassie in 1961 with the help of the German Evangelical Church. The hospital was established to serve the economically under privileged population, providing services free of charge to about 75% of its patients. In 2007 it became a medical college and its core services include the provision of medical care, teaching and research.²⁷⁵

medical students attend the college, and its new and integrated curriculum stands out in comparison to the country's other medical schools. It has 800 clinical and non-clinical staff members that provide medical specialty services to an estimated 110,000 people annually who are referred from all over the country. The hospital gives ICU service by 14 beds in addition to other inpatient and outpatient services(42).

Zewditu memorial hospital: is one of the 6 hospitals administered by the Addis Ababa Health Bureau, providing comprehensive medical service for the people. It is located in the central part of the Ababa, Kirkos sub-city, Ethiopia. It was built, owned and operated by the Seventh-day Adventist Church, but was nationalized during the Derg regime in about 1976. Zewditu Hospital is Ethiopia's leading hospital in the treatment of ART patients and currently treats over 6,000 each month. Zewditu became the largest HIV clinic in Ethiopia, with 14,000 patients in its care. Since, ART programs have been initiated in other hospitals around the country, relieving pressure on the hospital. The hospital also deals with palliative care, HIV counselling and testing, STI services and Post-exposure prophylaxis (PEP) services. It has a total of 885 staff, 580 of them are health professionals. The hospital also gives ICU service by 10 beds in addition to other inpatient and outpatient services(43).

4.2. Study Period

The study was conducted from May 15 to June 15, 2024.

4.3. Study design

A multicentre institution-based Cross-sectional study was conducted.

4.4. Source and Study population

4.4.1 Source population

- All charts of adult ICU admitted patients in public hospitals of Addis Ababa, Ethiopia.

4.4.2 Study population

- All charts of adult ICU admitted patients in selected public hospitals of Addis Ababa, Ethiopia, 1st January 2022 to 31st December 2023.

4.4.3 Sampling unit

- Randomly Selected Adult ICU admitted patient chart in selected public hospitals of Addis Ababa, Ethiopia, 1st January 2022 to 31st December 2023.

4.4.4 Inclusion criteria

- All charts of adult ICU admitted patients in selected public hospitals of Addis Ababa, Ethiopia, 1st January 2022 to 31st December 2023.

4.4.5 Exclusion criteria

- Patients chart Admitted to ICU diagnosed with known chronic kidney disease (CKD).
- Incomplete, missed, or misplaced Patient charts from the Record room was not included in the study.

4.5. Sample Size determination

The sample size was determined by using single population proportion formula with the following assumptions; prevalence of AKI was 21.4%, among Adult ICU admitted patients, which was done at two trauma centres in Addis Ababa, Ethiopia(37), 95% confidence level and 5% a tolerable margin of error n= the minimum sample size required.

$$n = \frac{(z\alpha/2)^2 p(1-p)}{d^2}$$

Where: n=sample size,

Z=critical value of 95% CI=1.96,

P=prevalence of AKI among ICU patients=21.4%,

d=margin of error=0.05.

$$q = (1-p) = (1-0.214) = 0.786$$

$$d = \text{was assumed to be } 5\% = 0.05$$

Therefore, based on using the above single population proportion formula the sample size calculated as:

$$n = \frac{z^2 p(q)}{d^2} = \frac{(1.96)^2 \cdot 0.214 \cdot 0.786}{0.05^2} = 258.46 \approx \underline{\underline{259}}$$

After taking a 10 % for incomplete charts, the final sample size was 285.

- To determine the required sample size for second objective by calculating on open EPI-Info version 7.2.6, software. Software using factors associated with the magnitude and associated factors of acute kidney injury among ICU admitted patients with the following assumption, 95% confidence level, 5% margin of error and power of 80% by taking study finding form (table 1).

Table 1:sample size determination with the different variables

Variables	CI %	Power by %	OR/RR	Ratio	% of exposed	% of unexposed	p-value	sample size	Reference
1.Platelet level	95	80	RR	1:1	89.21	10.79	0.011	157	(14)
2.Sepsis	95	80	RR	1:1	90.26	9.74	0.034	64	(14)
3.CHF	95	80	RR	1:1	88.7	11.3	0.001	130	(14)

The required sample size for this study is decided by taking the maximum sample size by comparing the sample size for first and second Objective. Therefore, the required sample size is **285** and is taken from the first objective.

Finally, the required sample size for this particular study is decided by taking **285** was included in the study.

4.6. Sampling Procedures

Among Addis Ababa public hospitals provide intensive care unit service four hospitals were selected by using lottery method. A simple random sampling technique was used, and the sampling frame was prepared by using the patients admitted to intensive care unit using the patient registration book. Then, from the prepared sampling frame, the required number of samples was drawn using simple random method (computer number generator). Following the proportional allocation of the sample size for each selected hospitals been chosen based on the number of patients admitted to ICU from January 1st 2022 to December 31th 2023.

By using formula for proportional allocation:

$ni = (Ni/N) * n$ where, ni =sample size for stratum i

Ni =population size of stratum i

N =total population size (2260)

n =total sample size (285)

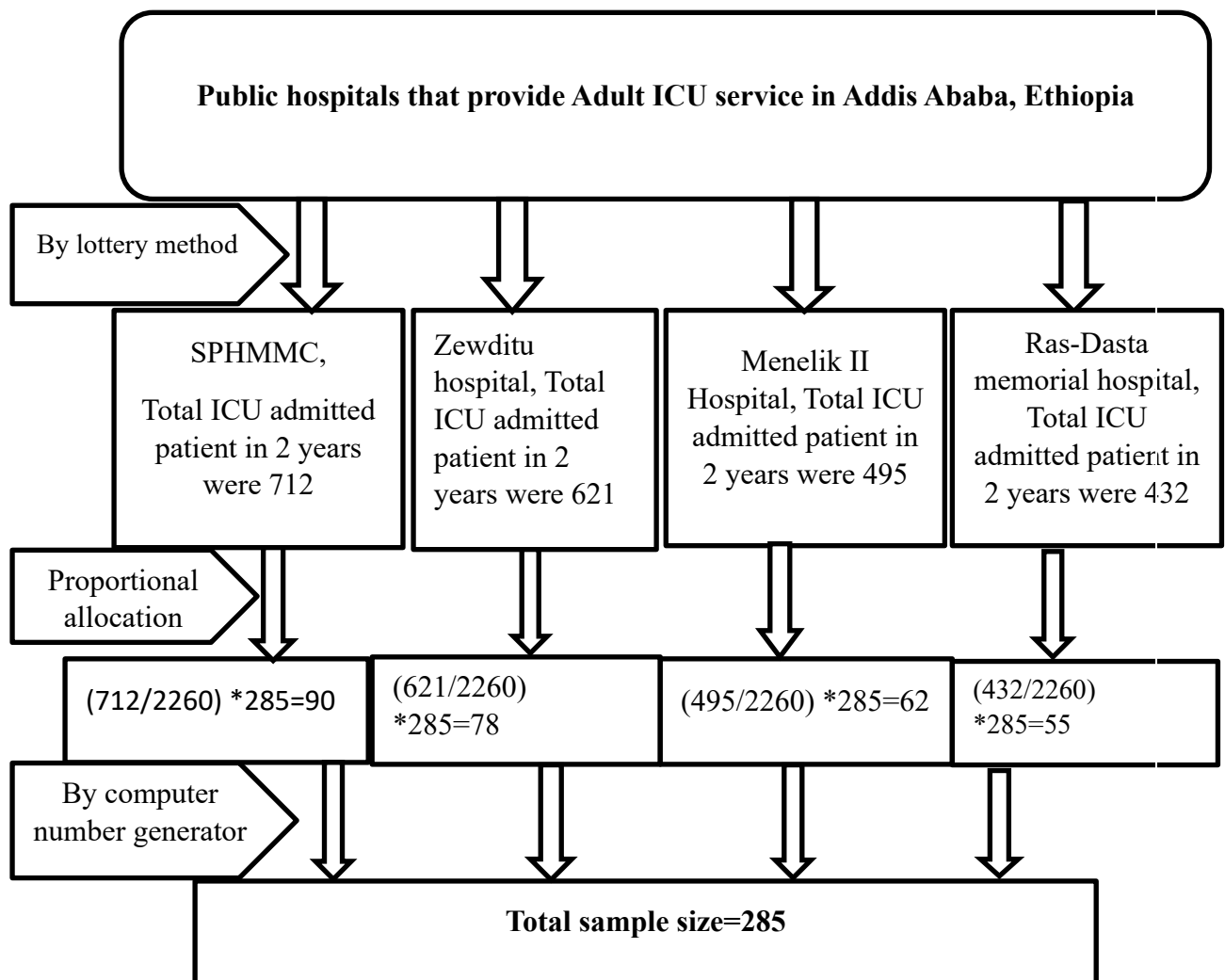


Figure 2: Schematic presentation of sampling procedure on Acute kidney injury and its associated factors among ICU admitted patients in selected public hospitals of Addis Ababa, Ethiopia, 2024.

4.7. Measurements

4.7.1. Study Variables

Dependent variable: Acute kidney injury (AKI).

Independent variable:

Sociodemographic variables:

- Age and
- Sex.

laboratory related variables:

- Platelet level

- Haemoglobin level
- Serum potassium level
- White blood cells
- Serum sodium level

Clinical related variables:

- Diabetes Mellitus
- Hypertension
- Chronic Liver Disease
- Chronic Obstructive Pulmonary (COPD)
- Congestive Heart Failure and
- Malignancy
- Length of ICU stay
- Pulse rate and
- Oxygen Saturation (Sao2)

Intervention related variables:

- Non-steroidal anti-inflammatory drugs (NSAIDs)
- Angiotensin converting enzyme inhibitors (ACEI)
- Vasopressors
- Aminoglycosides
- Angiotensin receptor blocker (ARB)and
- Contrast dye usage.

4.8. Operational Definitions

Acute kidney injury: A written diagnosis of acute kidney injury based on the clinical decision of the physician on the patient card after admission to the Adult ICU.

Incomplete chart: considered when 5% of the independent variable's indicator are not recorded(14).

Adult: The patient who admitted to ICU and his/her age is ≥ 18 (16).

4.9. Data Collection tools and Procedures

Data was extracted through a data extraction tool from patients' registration book and selected medical records of all ICU admitted patients. Then the charts of the selected patients were reviewed in detail. The English version of the data extraction tool was adapted from

previously studied literature(12, 14, 37, 39).It contains socio-demographic characteristics, clinical related factors, laboratory related factors and interventional related factors.

First, the letter of permission was distributed to ICU of each hospital and the principal investigator was communicated with hospital administrator and briefly describe the aim of the study in order to obtain permission to conduct the study. The data was collected by 4 trained BSc Nurses with 1 MSc nurse supervisor using kobo toolbox data collection software from patient chart. Eligible patients were identified by data collectors. All data was gathered retrospectively from the patient chart.

4.10. Data Quality Control and Management

The quality of data was maintained by designing the proper data collection material and through continuous supervision and training, prior to data collection on developed data extraction tool, to collect needed information from each source of the hospitals. One-day training was given for the data collectors, by the principal investigator on content of the data extraction tool, process of data collection, how to collect data, and the collected data was how to check for completeness and accuracy on the same day, before commencement of data gathering. A pretest was employed on 15 ICU patient chart admitted at SPHMMC and based on the pretest findings, there were some modifications of data extraction tool. The reliability of the tool was checked using Cronbach alpha.

4.11. Data processing and analysis

Data were filled by the data collectors using kobo toolbox collect software and was imported from excel format to Statistical package for social science (SPSS) version 27 for further processing and analysis. Depending on the type of data, graphs, frequencies, percentages and means with standard deviations, was used to describe the descriptive statistics. Over the course of the study, the magnitude of AKI was determined. Multi-Co linearity was checked by variance inflation factor (VIF) and model of fitness was checked by Hosmer-Lemeshow test ($\chi^2=6.43$, p-value=0.599). In the bivariate analysis Variables with a p-value of less than 0.25 was included to multivariate analysis to identify any possible association among them. Ultimately, a p-value of less than 0.05 was determined to indicate statistical significance, An adjusted odd ratio (AOR) with corresponding 95% confidence intervals was used to describe the strength of associations.

4.12. Ethical Consideration

The ethical clearance and approval to conduct the research was obtained from College's ethical review committee with the approval of the SPHMMC ethical review board and Addis Ababa public health and Emergency Management Directorate, **Reference no pm23/1157, AA/H/17072/227** respectively. The support letter was also received from each selected hospital. All information collected during the data collection were kept fully confidential, and neither the identity of the study participant nor any other identifying information was recorded. The collected data was only be applied to research projects.

4.13. Dissemination of Results

The study result will be submitted to St. Paul's Hospital Millenium Medical college (SPHMMC), school of Nursing. It will be disseminated to the Addis Ababa public health and Emergency Management Directorate and to each study hospitals. The findings will be published in peer-reviewed journals and presented at relevant seminars, conferences, and workshops.

5. Results

This study assessed the magnitude and associated factors of acute kidney injury (AKI) in adult patients who were admitted to the Intensive Care Unit (ICU) in public hospitals of Addis, Ababa, Ethiopia. The study assessed sociodemographic information, clinical factors, laboratory data, and interventions related to the outcome of the study.

5.1. Distribution of demographic characteristics among adult ICU admitted patients in selected public hospitals of Addis Ababa, Ethiopia,2024(n=266).

In this study, 266 patient charts from adult ICU admissions in selected public hospitals of Addis Ababa were included, resulting in a 93% response rate out of a total sample size of 285. Among the participants, 152 (57.1%) were male and 114 (42.9%) were female. The majority of participants 140(52.6%) were below the average age of 37.97 years, with ages ranging from 18 to 75 years. The mean age of the participants was 37.97 years with a standard deviation of 12.578. The average ICU stay for the participants was 13.06 days with a standard deviation of 8.002, ranging from 2 to 90 days.

5.2. Clinical related profiles among adult ICU admitted patients in public hospitals of Addis, Ababa, Ethiopia,2024(n=266).

Of all patients participated in this study (N=266), Most 54(20.3%) have Diabetes mellitus (DM), 47(17.7%) have hypertension (HTN), and 35(13.2%) of them have Congestive heart failure (CHF), while 21(7.9%) have chronic liver disease CLD. From the total study participants 195(73.3%) were tachycardia PR >100, and among this participant most of their oxygen saturation 246 (92.5%) were ≥ 90 (table 2).

Table 2: Distribution of clinical related profiles among adult ICU admitted patients in selected public hospitals of Addis Ababa, Ethiopia,2024(n=266).

Variable	Category	Frequency (%)
DM	No	212(79.7)
	Yes	54(20.3)
HTN	No	219(82.3)
	Yes	47(17.7)
CHF	No	231(86.8)
	Yes	35(13.2)

CLD	No	245(92.1)
	Yes	21(7.9)
SPo2	≥ 90	246(92.5)
	< 90	20(7.5)
Pulse Rate	< 60	3(1.1)
	60 -100	68(25.6)
	> 100	195(73.3)
Length of ICU	≤13 day	154(57.1)
	>13 day	112(42.1)
Malignancy	No	254(95.49)
	Yes	12(4.51)
COPD	No	257(96.61)
	Yes	9(3.39)

5.3. Laboratory related profiles among adult ICU admitted patients in public hospitals of Addis, Ababa, Ethiopia,2024(n=266).

Laboratory-related factors, including potassium, sodium, creatinine, and BUN, WBC, platelet, and baseline haemoglobin values, of participants included in this study. Among 266 study participants, nearly half 130 (48.9%) had low potassium results (<3.5mg/dl), Out of the participants, 90 (which accounts for 33.8%) had low haemoglobin levels (<12g/dl). 104 participants had high total leukocyte count (>12x10⁹). One hundred fifty-nine of the study participants (59.8%) had low sodium (<135mEq/L), and 50(18.8%) participants had low Platelet count <150x10⁹/L) (Table 3).

Table 3: Distribution of laboratory related profiles among adult ICU admitted patients in public hospitals of Addis, Ababa, Ethiopia.2024(n=266).

variables	Category	Frequency (%)
potassium	<3.5	130(48.9)
	3.5 -5.1	121(47)
	>5.1	11(4.1)
WBC	≤12	162(60.9)
	>12	104(39.1)

Sodium	135 -145	159(59.8)
	<135	81(30.5)
	>145	26(9.8)
Platelet	<150	50(18.8)
	150 -400	206(77.4)
	>400	10(3.8)
Haemoglobin	<12	90(33.8)
	≥12	176(66.2)

5.4. Intervention related profiles among adult ICU admitted patients in public hospitals of Addis, Ababa, Ethiopia,2024(n=266).

Out of 266 patients whose charts were reviewed, the study found that 188 (70.7%) received vasopressors, 49(18.4) received contrast dye during their ICU stay, 29 (10.9) were treated with NSAIDs, 22 (8.3) were treated with ACE inhibitors, 10 (3.8) received Aminoglycoside medication, and 7 were treated with ARB drug (Table 4).

Table 4: Distribution of Interventional related profiles among adult ICU admitted patients in public hospitals of Addis, Ababa, Ethiopia.,2024(n=266).

Variables	Category	Frequency (%)
Aminoglycosides usage	No	256(96.2)
	Yes	10(3.8)
ACEI usage	No	244(91.7)
	Yes	22(8.3)
ARB usage	No	259(97.4)
	Yes	7(2.6)
Vasopressor usage	No	78(29.3)
	Yes	188(70.7)
NSAIDs usage	No	237(89.1)
	Yes	29(10.9)
Contrast usage	No	217(81.6)
	Yes	49(18.4)

5.5. magnitude of Acute Kidney Injury (AKI) among adult ICU admitted patients in public hospitals of Addis, Ababa, Ethiopia.,2024(n=266).

Out of 266 patients admitted to the adult intensive care unit of the study hospital, 27.1% (95% CI: 21.8, 32.8) of patients were diagnosed acute kidney injury. Of the study participants who had acute kidney injury, 36 (13.5%) had stage III AKI, 20 (7.5%) had stage II AKI, and 16 (6.0%) had stage I AKI. Among the AKI-diagnosed patients, 28 (38.9%) died, and 42 (58.3%) received renal replacement therapy (figure 3 and 4).

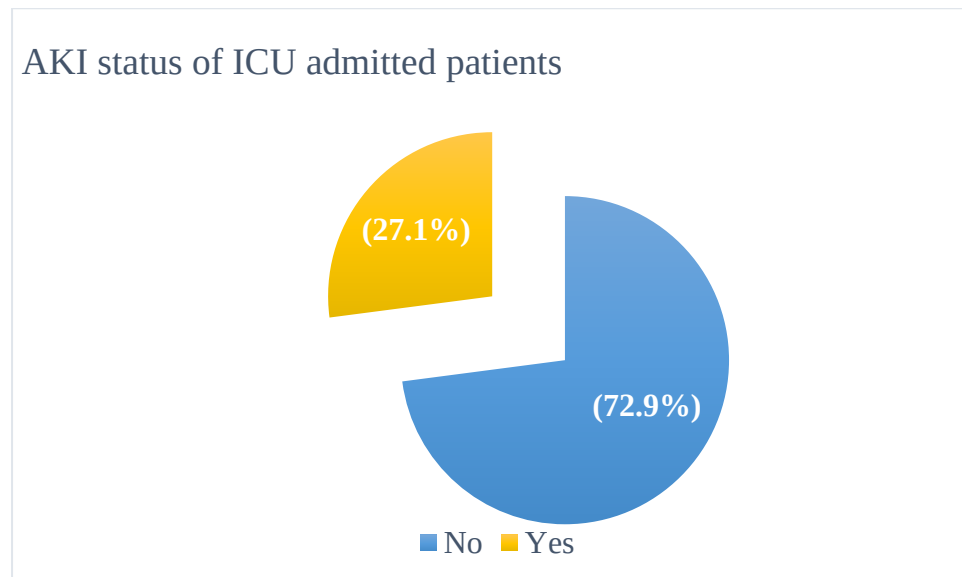


Figure 3:*Magnitude of AKI among ICU admitted patients in selected public hospitals of Addis Ababa, Ethiopia,2024(n=266).*

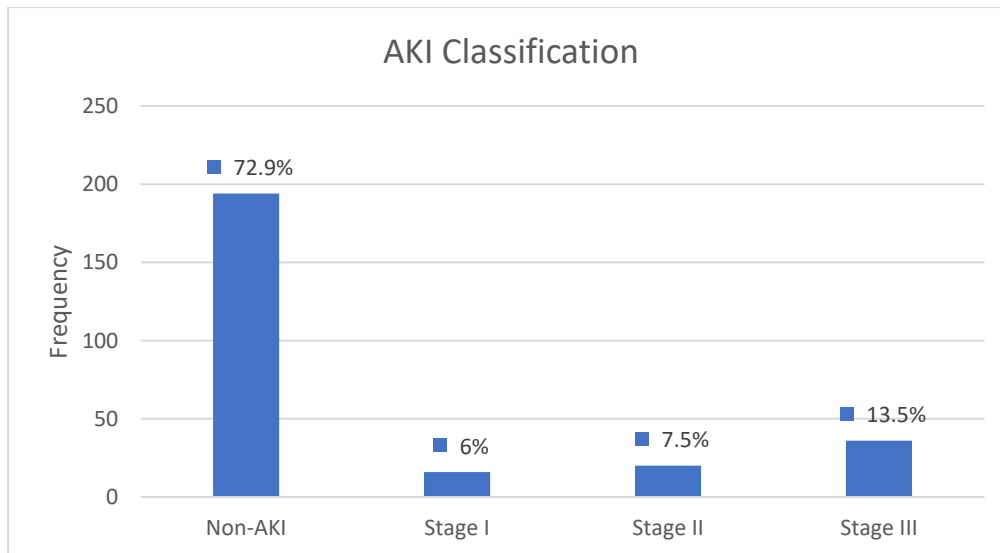


Figure 4:AKI classification of ICU admitted patients in selected public hospitals of Addis Ababa, Ethiopia,2024(n=266).

5.6. Factors Associated with Acute kidney injury (AKI) among adult ICU admitted patients in public hospitals of Addis, Ababa, Ethiopia.,2023(n=266).

Eight variables emerged as candidates for the multivariate logistic regression in the bivariable logistic regression analysis. These variables are the length of ICU stay, Contrast, Vasopressor, angiotensin-converting enzyme inhibitor (ACEI), Hypertension (HTN), Diabetes mellitus (DM), high Serum K⁺ level, and high WBC. This variable is associated with the AKI, with a significance level of $p < 0.25$ (Table 6).

In the multivariable logistic regression analysis, the variable associated with the outcome in binary logistic regression was included. After conducting the multivariable analysis, six variables were found to be significantly associated with AKI: hypertension, usage of contrast, diabetes mellitus, vasopressor usage, $WBC \geq 12 \times 10^9$ and length of ICU stay. These variables showed a significant association with the acute kidney injury using multiple binary logistic regression at a significance level of $p < 0.05$ (Table 5).

Table 5: Bivariable and multivariable binary logistic regression analysis for factors associated with acute kidney injury among ICU admitted patients in selected public hospitals of Addis Ababa, Ethiopia, 2024 (n=266).

Variables	Category	AKI status		COR (95% C. I)	AOR (95% C. I)	P-Value
		No	yes			
vasopressor usage	No	68	10	1	1	
	yes	126	62	3.34(1.61,6.94)	14.99(4.32,52)	<0.001*
DM	No	159	39	1	1	
	Yes	35	33	3.84(2.13,6.4)	3.08(1.52,6.25)	0.002*
HTN	No	167	52	1	1	
	Yes	27	20	2.37(1.23,4.58)	6.02(1.9,19.14)	0.002*
ICU stay	≤13.06 day	121	33	1	1	
	≥13.06	73	39	1.95(1.13,3.38)	2.01(1.04,,3.9)	0.037*
ACEI usage	No	181	63	1	1	
	Yes	13	9	1.98(0.81,4.87)	1.03(0.23,4.5)	0.973
Contrast Usage	No	173	44	1	1	
	Yes	21	28	5.24(2.72,10.09)	5.1(2.34,11.15)	<0.001*
WBC Count	≤12x10 ⁹	129	33	1	1	
	>12x10 ⁹	65	39	2.34(1.35,4.07)	2.46(1.27,4.77)	0.008*
Serum K+ Count	<3.5mEq/L	107	23	1	1	
	3.5-5.1mEq/L	84	41	2.27(1.26,4.07)	1.45(.74,2.85)	0.285
	>5.1mEq/L	3	8	12.4(3.05,50.4)	3.68(0.62,21.8)	0.151

NB: CI= Confident Interval, AOR=Adjusted Odd Ratio, COR= Crude Odd Ratio, * =significant at p value <0.05, 1=Reference.

Accordingly, patients with Diabetes Mellitus (DM) were 3.08 times more likely to develop AKI than patients without DM (AOR = 3.08; 95% CI [1.52, 6.25]). For the patients who were received contrast dye, the Odds of developing acute kidney injury were 5.1 times higher than the patients who didn't receive contrast (AOR = 5.1; 95% CI [2.34,11.15]). patients who received vasopressor were 14.99 times more likely to develop AKI than those who did not (AOR = 14.99; 95% CI [4.32,52]). Patients with Hypertension were 6.02 times more likely to

develop AKI than patients without (AOR =6.02; 95% CI [1.9,19.14]). For the patients whose length of ICU stay more than average were 2.01 times to develop AKI when compared with the patients whose length of ICU stay less than average (AOR =2.01; 95% CI [1.04,3.9]). The Odds of developing AKI patients whose WBC is $>12 \times 10^9$ were 2.46 times higher than the patients whose WBC is $\leq 12 \times 10^9$ (AOR=2.46,95%CI [1.27,4.77]).

6. Discussion

This retrospective chart review study was assessed the magnitude and associated factors of Acute Kidney Injury among Adult ICU admitted patients. Accordingly, one in four patients developed AKI 72(27.1%) and 47(17.7%) received renal replacement therapy from the total study participants. In addition to this, the finding of this study revealed that associated factors for Acute kidney injury (AKI) were Hypertension, Usage of contrast, Diabetes Mellitus, vasopressor usage and length of ICU stay.

In this study, AKI occurred in 27.1% (95% CI: 21.8, 32.8) of ICU admitted patients. The result of this study was consistent to the study done in Democratic-republic of Congo (29%)(32), Sudan (28.9%)(12), Jimma, Ethiopia (23.32%)(36) and Addis Ababa, Ethiopia (21.4%)(37).

However, the magnitude of this study was higher compared to the studies done among the 6727 ICU patients in 32 ICUs in Australia and New Zealand (11%)(21) This variation might be in quality care given for ICU, healthcare settings, socio-demographic characteristics, and contextual differences among the countries may account for the differences and the magnitude of this study was higher compared to another retrospective observational analysis studies, conducted at Gadjah Mada University, Yogyakarta, Indonesia (14.3%)(27), this might be the difference in study design and economic status of the country. A multicentre institution-based retrospective follow-up study conducted at West Amhara comprehensive specialized Hospitals, Northwest Ethiopia (13.4%)(14). The difference might be the study design, this study doesn't include the patient who were admitted with Acute kidney disease. Another reason for the variability in the reported magnitude was the time at which AKI was diagnosed, increased length of stay and inadequate infrastructure.

On the other hand, the magnitude of this result was found to be lower as compared to a study in Brazil's single intensive care unit (53.2%)(20), The study conducted Trondheim University Hospital in Central Norway (53.5%)(10), study at Sheba Medical Centre in Israel (51%)(22), a study conducted at Sultan Qaboos University Hospital, Oman, (55.2%)(26), The study conducted in India (74%)(28), In a study conducted at Shifa International Hospital in Islamabad, Pakistan (68.55%)(29), study conducted in South Africa (51%)(30), study conducted in Zambia (52.9%)(31), study conducted in Northern Tanzania (55.3%)(33), The study conducted in the intensive care unit of Fedail Hospital in Khartoum, Sudan (39%)(34), and A study conducted at Southern Ethiopia (40.4%)(16). This discrepancy might be attributed to

variations in study areas except a study done In Ethiopia, the study time difference, the difference in the sample size, the difference in study design, socioeconomic status of the countries with the exception of the study done in Ethiopia, and the use of different diagnostic criteria and definitions across the studies and most of the studies done during Covid -19 pandemic period which increase the risk of AKI.

This study revealed that the patients with Diabetes Mellitus (DM) were almost 3 times more likely to develop AKI compared to patients without DM (AOR = 3.08; 95% CI [1.52, 6.25]). This study was similar with the study conducted in Central Norway, Jordan, Tanzania and Sudan; the participant with Diabetes Mellitus (DM) were slightly more develop Aute kidney injury (AKI) than participant who didn't have DM(10, 25, 33, 34);This may be due to the reason high blood sugar levels can damage the small blood vessels in the kidney's.

For the patients who were received contrast dye, the Odds of developing acute kidney injury were almost 5 times higher than the patients who didn't receive contrast (AOR =5.1; 95% CI [2.34,11.15]). The finding supports a study conducted in USA; which showed that participants who received contrast for diagnostic imaging were associated with a higher possibility of being develop AKI(18).The reason for this may be, the effect of Contrast on the constriction of the blood vessels in the kidneys.

Patients who received vasopressor were almost 15 times more likely to develop AKI than those who did not (AOR = 14.99; 95% CI [4.32,52]). This is similar to the findings in Jordan University Hospital (JUH),(23), South Africa(30), in Northern Tanzania (33),Northwest Ethiopia(14) and study conducted in Southern Ethiopia(16); which showed that the patients who was treated with the vasopressor were associated highly with the Acute Kidney Injury.

Patients with Hypertension were almost 6 times more likely to develop AKI than patients without (AOR =6.02; 95% CI [1.9,19.14]). This is confirmed by the study conducted in Central Norway(10), study conducted at Sheba Medical Centre in Israel (22);The study conducted in the intensive care unit of Fedail Hospital in Khartoum, Sudan(34), A study in Jimma Ethiopia, (35) and A study conducted at Southern Ethiopia from 2018 to 2022(16); which showed that the patients who have the comorbid hypertension were associated more with the Acute Kidney Injury when compared with patient who didn't have. This may be due to the reason hypertension can reduce blood flow to the kidneys and increase the risk of ischemic injury.

For the patients whose length of ICU stay more than average were almost 2 times to develop AKI when compared with the patients whose length of ICU stay less than average (AOR =2.01;

95% CI [1.04,3.9]). This finding is supported by the study conducted in Jimma, Ethiopia showed that increased length of hospital stay, was independently associated with Acute kidney injury(35). The finding may be due to, as they stay long in the intensive care unit they exposed more to nephrotoxic drugs and the ICU also the stress-full environment which may also another risk factor of Acute kidney injury.

The Odds of developing AKI patients whose WBC is $>12 \times 10^9$ were 2 times higher than the patients whose WBC is $\leq 12 \times 10^9$ (AOR=2.46,95%CI [1.27,4.77]). This finding is supported by the study conducted among trauma patients admitted to the intensive care unit (ICU) indicated that elevated APACHE II score were risk factors for AKI, raised WBC is one component of APACHEII score(38). It also supported by the study conducted in Tikur Ambessa Specialised Hospital (TASH), Addis Ababa, Ethiopia, sepsis accounted for 43.2% of the AKI(39). This might be due to local and systemic inflammation plays a significant part in the initiation and extension phases of AKI, in the multi-organ failure associated with AKI and also in the progression to chronic kidney disease which can result if these immune mechanisms persist(44).

6.1. Strength and limitations of the study

6.1.1. Strength

- The study also identified independent factors contributing to the AKI among ICU admitted patients, which should be areas to be studied and more focused in clinical practice.
- The study was done in multicentre making it possible to generalize the finding.

6.1.2. Limitations

- Due to unavailability of measurements of some parameters, the study could not include well established scores like APACHE II and SOFA.
- The cross-sectional nature of the study does not establish definitive cause and effect relationships between the outcome and explanatory variables.

7. Conclusion

This study has assessed magnitude and associated factors of AKI among patients admitted to adult intensive care unit at public hospitals of Addis Ababa, Ethiopia. Accordingly, the magnitude of Acute Kidney Injury (AKI) among Adult Intensive Care Unit (AICU) admitted patients was 27.1% and the mortality related to AKI was 28(38.9%). It was found that patients with Hypertension, Contrast Usage, Diabetes Mellitus, vasopressor usage, increased WBC count and increased length of ICU stay were significantly associated with the acute kidney injury.

8. Recommendation

On the basis of this study, the following recommendations are forwarded.

➤ **To Ministry of Health and Addis Ababa Health Bureau**

- It is better to start clinical early screening programs for AKI among patients with diabetes mellitus, Hypertension, vasopressor usage, contrast usage increased WBC and increased length of ICU stay throughout the ICU follow-up.
- It is recommended to strengthen close monitoring and supportive supervisions for ICU.

➤ **To Health care institutions**

- It is better to strengthen ICUs and monitor the quality of service in the ICU to decrease the incidence of AKI in ICU patients.
- Special consideration should be given to preventing ICU patients from developing AKI by integrating different case teams.

➤ **To Health care providers**

- Health care providers shall give special emphasis and close follow-up for intensive care unit patients admitted with hypertension, diabetes Mellitus, increased WBC count and increased length of ICU stay to reduce the risk of AKI.
- Additionally, clinicians shall give more emphasis to treatment strategies, specifically those for vasopressors and contrast usage.

➤ **To public community:**

- Those who have DM and HTN should take care of them themselves and start regular checkups based on kidney function tests.

➤ **To Researchers**

- Researchers shall conduct a prospective cohort study to overcome the limitation of this study.

9. References

1. Gameiro J, Agapito Fonseca J, Jorge S, Lopes JA. Acute Kidney Injury Definition and Diagnosis: A Narrative Review. *J Clin Med*. 2018;7(10).
2. Bellomo R, Kellum JA, Ronco C. Acute kidney injury. *Lancet*. 2012;380(9843):756-66.
3. Inc NKF. Acute Kidney Injury (AKI): The National Kidney Foundation; 2024 [Available from: <https://www.kidney.org/atoz/content/AcuteKidneyInjury>].
4. Parikh CR, Mansour SG. Perspective on Clinical Application of Biomarkers in AKI. *J Am Soc Nephrol*. 2017;28(6):1677-85.
5. Lameire NH, Bagga A, Cruz D, De Maeseneer J, Endre Z, Kellum JA, et al. Acute kidney injury: an increasing global concern. *Lancet*. 2013;382(9887):170-9.
6. Khwaja A. KDIGO clinical practice guidelines for acute kidney injury. *Nephron Clin Pract*. 2012;120(4):c179-84.
7. Silvester W. Outcome studies of continuous renal replacement therapy in the intensive care unit. *Kidney Int Suppl*. 1998;66:S138-41.
8. Neveu H, Kleinknecht D, Brivet F, Loirat P, Landais P. Prognostic factors in acute renal failure due to sepsis. Results of a prospective multicentre study. The French Study Group on Acute Renal Failure. *Nephrol Dial Transplant*. 1996;11(2):293-9.
9. Case J, Khan S, Khalid R, Khan A. Epidemiology of Acute Kidney Injury in the Intensive Care Unit. *Critical Care Research and Practice*. 2013;2013:479730.
10. Mo S, Bjelland TW, Nilsen T, Klepstad P. Acute kidney injury in intensive care patients: Incidence, time course, and risk factors. *Acta Anaesthesiologica Scandinavica*. 2022;66.
11. Abd ElHafeez S, Tripepi G, Quinn R, Naga Y, Abdelmonem S, AbdelHady M, et al. Risk, Predictors, and Outcomes of Acute Kidney Injury in Patients Admitted to Intensive Care Units in Egypt. *Sci Rep*. 2017;7(1):17163.
12. Sidahmed AM, Ahmed S, Hassan N, Eltahir M. Incidence and Risk Factors of Acute Kidney Injury in ICU Patients of Omdurman Teaching Hospital. *Open Journal of Nephrology*. 2021;11:43-57.
13. Minja N, Akrabi H, Yeates K, Kilonzo K. Acute Kidney Injury and Associated Factors in Intensive Care Units at a Tertiary Hospital in Northern Tanzania. *Canadian Journal of Kidney Health and Disease*. 2021;8:205435812110279.

14. Beyene M, Azagew A, Abetew K, Alemu G, Aynalem Z, Guadie B. Incidence and Predictors of Acute Kidney Injury among Patients Admitted to Adult Intensive Care Unit at West Amhara Comprehensive Specialized Hospitals, Northwest Ethiopia: A multicenter retrospective follow-up study 2023.
15. 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. *Scientific Reports*. 2022;11.
16. Ashine TM, Mekonnen MS, Heliso AZ, Wolde YD, Babore GO, Bushen ZD, et al. Incidence and predictors of acute kidney injury among adults admitted to the medical intensive care unit of a Comprehensive Specialized Hospital in Central Ethiopia. *PLoS One*. 2024;19(6):e0304006.
17. Thomas ME, Blaine C, Dawnay A, Devonald MA, Ftouh S, Laing C, et al. The definition of acute kidney injury and its use in practice. *Kidney Int*. 2015;87(1):62-73.
18. Malhotra R, Kashani KB, Macedo E, Kim J, Bouchard J, Wynn S, et al. A risk prediction score for acute kidney injury in the intensive care unit. *Nephrology Dialysis Transplantation*. 2017;32(5):814-22.
19. Ru SC, Lv SB, Li ZJ. Incidence, mortality, and predictors of acute kidney injury in patients with heart failure: a systematic review. *ESC Heart Fail*. 2023;10(6):3237-49.
20. Peres LA, Wandeur V, Matsuo T. Predictors of acute kidney injury and mortality in an Intensive Care Unit. *J Bras Nefrol*. 2015;37(1):38-46.
21. Feng Y, Li Q, Finfer S, Myburgh J, Bellomo R, Perkovic V, et al. A Novel Risk Prediction Model for Severe Acute Kidney Injury in Intensive Care Unit Patients Receiving Fluid Resuscitation. *Frontiers in Cardiovascular Medicine*. 2022;9.
22. Hod T, Oberman B, Scott N, Levy L, Shlomai G, Beckerman P, et al. Predictors and Adverse Outcomes of Acute Kidney Injury in Hospitalized Renal Transplant Recipients. *Transplant International*. 2023;36.
23. Bani Hani A, Abu Abeeleh M, Al-Najjar S, Alzibdeh A, Mansour S, Bsisu I, et al. Incidence, risk factors and outcomes of acute kidney injury in surgical intensive care unit octogenarians at the Jordan University Hospital. *BMC Geriatrics*. 2023;23(1):266.
24. Farah RI, Alfukah OA, Younes AR, Mahmoud HA, Al-Jboor AM, Karajeh MM, et al. Prevalence and Mortality Rates of Acute Kidney Injury among Critically Ill Patients: A Retrospective Study. *Critical Care Research and Practice*. 2023;2023:9966760.

25. Oweis AO, Alshelleh SA, Hawasly L, Alsabbagh G, Alzoubi KH. Acute Kidney Injury among Hospital-Admitted COVID-19 Patients: A Study from Jordan. *Int J Gen Med.* 2022;15:4475-82.
26. Al Abri SY, Burad J, Al Wahaibi MM. The Incidence of Acute Kidney Injury (AKI) in Critically Ill COVID-19 Patients: A Single-Center Retrospective Cohort Study at a Tertiary Level Hospital in Oman. *Cureus.* 2023;15(6):e40340.
27. Jauhari H, Bagaswoto H, Setianto B. Predictors of Acute Kidney Injury in Critically Ill Patient at Intensive Cardiac Care Unit. *Indonesian Journal of Cardiology.* 2023;43:144-9.
28. Rao IR, Thanekar S, Nagaraju SP, Prabhu RA. Incidence And Predictors Of Major Adverse Kidney Events In Icu Patients With Sepsis: A Prospective Cohort Study From A Developing Country. *Nephrology Dialysis Transplantation.* 2023;38(Supplement_1).
29. Hussain SW, Qadeer A, Munawar K, Qureshi MSS, Khan MT, Abdullah A, et al. Determining the Incidence of Acute Kidney Injury Using the RIFLE Criteria in the Medical Intensive Care Unit in a Tertiary Care Hospital Setting in Pakistan. *Cureus.* 2019;11(2):e4071.
30. Mweene MD, Richards GA, Paget G, Banda J, Dickens C. Risk factors and outcomes of sepsis-associated acute kidney injury in intensive care units in Johannesburg, South Africa. *S Afr Med J.* 2022;112(12):919-23.
31. Banda J, Chenga N, Nambaya S, Bulaya T, Siziya S. Predictors of Acute Kidney Injury and Mortality in Intensive Care Unit at a Teaching Tertiary Hospital_ID. *Indian J Crit Care Med.* 2020;24(2):116-21.
32. Nlandu Mayamba Y, Rissassi Makulo Jr, Essig M, Mompango Engole Y, Ingole Mboliasa Mf, Momeme Mokoli V, Et Al. Wcn23-1160 Incidence, Risk Factors And Outcome Of Acute Kidney Injury (Aki) In Covid-19 Patients In A Sub-Saharan African Intensive Care Unit: A Prospective Cohort Study. *Kidney Int Rep.* 2023;8(3):S443.
33. Minja NW, Akrabi H, Yeates K, Kilonzo KG. Acute Kidney Injury and Associated Factors in Intensive Care Units at a Tertiary Hospital in Northern Tanzania. *Can J Kidney Health Dis.* 2021;8:20543581211027971.
34. Magboul SM, Osman B, Elnour AA. The incidence, risk factors, and outcomes of acute kidney injury in the intensive care unit in Sudan. *International Journal of Clinical Pharmacy.* 2020;42(6):1447-55.

35. Abebe A, Kebede B, Wobie Y. Clinical Profile and Short-Term Outcomes of Acute Kidney Injury in Patients Admitted to a Teaching Hospital in Ethiopia: A Prospective Study. *Int J Nephrol Renovasc Dis.* 2021;14:201-9.
36. Desalagn W, Maekel B, Fassikaw K. Magnitude and Factors Associated with Acute Kidney Injury Among Patients Admitted in Jimma University Medical Centre South West Ethiopia 2020. *Science Journal of Clinical Medicine.* 2022;11(1):33-9.
37. MT Tiruneh, MK Tufa, EN Gamshe, YW Eshetie, Mengistie A. Prevalence, outcome and associated factors of acute kidney injury among trauma patients admitted to adult intensive care unit at trauma centers of Addis Ababa Ethiopia. *MJH* 2022;2.
38. Søvik S, Isachsen MS, Nordhuus KM, Tveiten CK, Eken T, Sunde K, et al. Acute kidney injury in trauma patients admitted to the ICU: a systematic review and meta-analysis. *Intensive Care Med.* 2019;45(4):407-19.
39. Gebrezgabiher Selemon , Kefyalew Merahi, Admasu Tesfaye Nigussie , Kiros Solomon Gebregiworgis , Mossie KA. Clinical Profile and Outcome of Acute Kidney Injury in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia. *Journal of Nephrology & Therapeutics.* 2022;12(6).
40. Belachew B. Factors Influencing Patients' Service Delivery In Public Hospitals: A Case In Ras Desta Memorial General Hospital, Addis Ababa. *Indira Gandhi National Open University School Of Social Work.* 2017.
41. Kasu Tola HA, Yemane Gebremariam, and Birhanu Jikamo. Improving Completeness of Inpatient Medical Records in Menelik II Referral Hospital, Addis Ababa, Ethiopia. *hindawi.* 2017.
42. Mohammed DL. Implementing a Balanced Scorecard at St. Paul's Hospital Addis Ababa, Ethiopia. ministerial leadership initiative ASPEN Global Health and Development 2011.
43. Filmawit Aynalem Tesfay FBA, Girum Sebsibie Teshome. Determinants of neural tube defect among children at zewditu memorial hospital, addis ababa, ethiopia a case control study. *international journal of africa nursing sciences.* 2021;15.
44. Radi ZA. Immunopathogenesis of Acute Kidney Injury. *Toxicol Pathol.* 2018;46(8):930-43.

Appendix

Data extraction tool

1. Socio demographic information

Age in years_____

Sex

Male

Female

2. Questions that are used to assess laboratory related factors

White blood cell___x10⁹/L

Serum Potassium level___mEq/L

Serum Sodium level___mEq/L

Platelet level_____ x10⁹/L

Hemoglobin level_____g/dL

3. Questions that are used to assess clinical related factors

I. Vital signs

Pulse rate__beat per minute

Oxygen saturation__%

Blood pressure___/___mmHg

II. Presence of Comorbid diseases

A. Yes

B. No

If the answer is yes for above questions which one among the following?

A. Diabetes Mellitus (DM)

a) Yes

b) No

B. Hypertension(HTN)

a) Yes

b) No

C. Congestive heart failure(CHF)

a) Yes

b) No

D. Chronic liver diseases(CLD)

a) Yes

b) No

E. Malignancy

a) Yes

b) No

F. COPD

a) Yes

b) No

A. What is the patient ICU admission diagnosis_____

B. For how long the patient stay in ICU_____day

4. Questions that are used to assess interventional related factors

A. Did the patient received Aminoglycoside drugs.

a) Yes

b) No

B. Did the patient received Angiotensin Converting Enzyme Inhibitor (ACEI)

a) Yes

b) No

C. Did the patient received Angiotensin Receptor blocker (ARB)

a) Yes

b) No

D. Did the patient received Vasopressor

a) Yes

b) No

E. Did the patient received Nonsteroidal anti-inflammatory drugs (NSAIDs)

a) Yes

b) No

F. Did the patient received contrast dyes

a) Yes

b) No

5. Does the patient diagnosed with AKI?

A. Yes

B. No

III. If the above question answer is yes, what is the stage of AKI According to KDIGO?

A. Stage I

B. Stage II

C. Stage III

IV. Did the patient received Renal replacement therapy

A. Yes

B. No

6. Out come related question

V. What is the patient Status?

A. Improved/transferred to other wards.

B. Died

Information Sheet

Research project: Acute Kidney Injury and its associated factors among patients admitted to Adult Intensive Care Unit in Public Hospitals of Addis Ababa, Ethiopia, 2024.

Purpose of the study: The information obtained from this study may be used by Ministry of health, researchers, hospitals and partners for promotion of Magnitude and Associated Factors of Acute Kidney Injury Among patients admitted to Adult Intensive Care Unit in Public Hospitals of Addis Ababa, Ethiopia, 2024.

Procedure: The hospital is selected by chance among the public hospitals of Addis Ababa. The information we extract is very helpful in assessing the Magnitude and associated Factors of Acute Kidney Injury Among patients admitted to Adult Intensive Care Unit.

Risks and Benefits: participation in this study has no risks and it was not causing any harm to the participant.

Confidentiality: The information that we take from patient chart was kept strictly confidential. There was no information that identified patient in particular. No reference was made in oral or written reports that could link participants to the research. No one outside the research team have accessed to your responses.

Contact details for further information: if you have any questions, you can contact the principal investigator in the following address:

Name: Leta Adugna Malasa

Tel: 251-912053466

Email: letaadugnamelese@gmail.com

Contact details for complaint: if you have any complaint please contact Saint Paul's Hospital Millennium Medical College, Nursing school.

Tel: +251 112 75 01 25

Email: info@sphmmc.edu.et

Declaration

I declare that this Research thesis entitled “Acute kidney injury and its associated factors among patients admitted to Intensive care in public hospitals of Addis Ababa, Ethiopia, 2024” is my own work that have not been addressed in the study area as far as my knowledge touched and all the sources I used has been indicated and acknowledged as complete reference.

Name of investigator

Signature

Date

1. Lata Adugna Malasa

Name of Adviser/s

1. Hirut Megersa (Assistant professor, PhD fellow).

2. Kokeb Gezahegn (BSc, MSc).

Name of Invigilators

1. Getahun Fetensa (Assistant professor, MSc in Adult Health Nursing, MPH in Epidemiology, MBA in Project Management Fellow, JBI Fellow).

2. Fatuma Arage (BSc, MSc).
