ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCES

SCHOOL OF PUBLIC HEALTH

Incidence and Predictors of Inpatient Mortality among Road Traffic Accident Patients Admitted to Trauma Centers of Hospitals in Addis Ababa, Ethiopia (2020-2024): A Retrospective Cohort Study

By

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Thesis Submitted to the School of Graduate Studies of Addis Ababa University in Partial Fulfilment of the Requirements for the Degree of Master of Public Health (MPH) in Epidemiology and Biostatistics.

June, 2025

Addis Ababa, Ethiopia

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APPROVAL SHEET

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The Incidence and Predictors of Inpatient Mortality among Road Traffic Accident Patients Admitted to Trauma Centers of Hospitals in Addis Ababa, Ethiopia (2020-2024): A Retrospective Cohort Study.

I undersigned agree to accept all responsibilities for the scientific and ethical conduct of this research project and declare that this thesis is my original work in partial fulfilment of the requirement for the Master of Public Health in Epidemiology and Biostatistics.

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APPROVAL BY EXAMINATION BOARD

This thesis by Deressa Bayisa is accepted in its present form by the board of examiners as satisfying thesis requirements for the review for the degree of Masters of Public Health in Epidemiology and Biostatistics.

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Abbreviations and acronyms

AaBET	Addis Ababa Burn Emergency and Trauma
AIDS:	Acquired Immune Deficiency Syndrome
AHR	Adjusted Hazard Ratio
ALERT	African Leprosy, Tuberculosis, Rehabilitation and Training
AOR	Adjusted Odds Ratio
CI	Confidence Interval
ED	Emergency Department
EMR	Electronic Medical Record
ETB	Ethiopian Birr
GCS	Glasgow Coma Scale
HIV:	Human Immunodeficiency Virus
HMIS	Health Management Information System
ICU	Intensive Care Unit
IDR	Incidence Density Rate
IMR	Incidence of Mortality Rate
KTS	Kampala Trauma Score
LMIC:	Low and Middle-Income Countries
LOC:	Loss of Consciousness
LTFU	Lost to Follow Up
MRN	Medical Record Number
NGO	Non-governmental Organization
ODK	Open Data Kit
PHO	Person Hours Observations

QR	Quick Response
RTA	Road Traffic Accident
RTI	Road Traffic Injury
SBP	Systolic Blood Pressure
SD	Standard Deviation
SNNPR	Southern Nations, Nationalities and Peoples Region
SSA	Sub-Saharan Africa
TASH	Tikur Anbessa Specialized Hospital
WHO	World Health Organization

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Abstract

Introduction: Road traffic accidents (RTAs) result in the deaths, injuries, and disabilities of millions of people each year globally. Despite having fewer vehicles, low and middle-income countries (LMICs) account for a disproportionately higher share of road traffic fatalities and injuries. In Ethiopia, although the country experiences high mortality rates due to RTA, there is a lack of comprehensive data on the incidence and predictors of mortality among RTA patients admitted to hospitals.

Objective: To determine the incidence and predictors of inpatient mortality among road traffic accident patients admitted to trauma centers of hospitals in Addis Ababa, Ethiopia.

Methods: Institution-based retrospective cohort study was conducted among 482 RTA patients. A simple random sampling technique was used to select study participants. Data were collected using a pre-tested and structured data abstraction form through Open Data Kit (ODK). Descriptive statistics were used to summarize data. Kaplan-Meier survival analysis and the log-rank test were applied to assess the presence of differences in mortality incidence among different categories of predictor variables. Cox proportional hazards regression was employed to identify predictors. The model's fitness was evaluated using the Cox-Snell residual. Variables with a p-value of < 0.25 in the bivariate analysis were included in multivariable analysis. Statistical significance was determined using a 95% confidence interval (CI) for the adjusted hazard ratio (AHR) and a p-value of < 0.05.

Results: The cumulative incidence of mortality among RTA patients was 10.8% (95% CI: 12.00%, 18.03%), and the incidence density rate was 7.2/10,000 person-hours of observation. The mean survival time was 6.24 days. Factors significantly associated with mortality include Glasgow coma scale (GCS) ≤ 8 (AHR 3.41; 95% CI: 1.09,10.71), developing complications (AHR 2.89; 95% CI: 1.22,6.85), systolic blood pressure (SBP) < 90mmHg (AHR 5.98; 95% CI: 2.30,15.51), a history of loss of consciousness (AHR 2.46; 95% CI: 1.12,5.40), and admission to the intensive care unit (ICU) (AHR 2.34; 95% CI: 1.18, 4.63).

Conclusion: The Incidence of mortality among RTA patients was high. RTA patients with GCS ≤ 8, developing complications, experiencing loss of consciousness, admission to the ICU, and SBP < 90 mmHg at admission were at high risk of mortality compared to their counterparts.

Keywords: Incidence, mortality, road traffic accidents, Retrospective study, Ethiopia.

1. Introduction

1.1 Background

Road traffic accidents (RTA) is defined as an injury occurring on a street or public road involving at least one moving vehicle, leading to the deaths or injuries of one or more persons (1, 2). Although the term RTA often evokes images of modern automobiles, it is important to recognize that such incidents have existed long before the advent of automobiles (3).

In 2000, RTAs were the tenth leading cause of death globally. This ranking increased to the eighth in 2016 and is projected to rise to the seventh by 2030, according to the World Health Organization (WHO) (4). The 2023 Global Road Safety Status Report indicates that RTAs resulted in approximately 1.19 million deaths and between 20 and 50 million injuries globally in 2021 (5). On average, around 3,700 people are killed each day in RTAs globally (6).

RTAs have become a significant global public health issue, particularly affecting low and middle-income countries (LMICs). The majority of RTAs and related fatalities occur in less motorized and developing nations, suggesting that the burden of road traffic injuries is not proportional to motorization levels (6). Sub-Saharan African (SSA) countries are among the top twenty countries most affected by road traffic injuries and fatalities (7). LMICs account for approximately 92% of global road traffic deaths (5).

Despite having a lower vehicle population in the region, Ethiopia experiences thousands of deaths annually due to road traffic crashes (8). It ranks second among the East African countries in terms of RTA fatalities (6). According to the WHO, RTAs constitute a major public health concern in Ethiopia, resulting in nearly 2,000 deaths each year (9).

RTAs are the leading cause of death among young adults (5). Beyond mortality, RTAs can cause long-term consequences, including physical disabilities, reduced quality of life, and psychological difficulties (10, 11). The key risk factors influencing road traffic fatalities include demographic profiles, pre-accident conditions, the nature of the incident, and post-accident responses(12).

Males are more frequently involved in traffic accidents than females, accounting for approximately 73% of traffic-related deaths. Despite national and international efforts to improve post-crash care, developing countries continue to face inadequate emergency response systems, resulting in higher rates of death and disability from RTAs (5).

1.2 Statement of the problem

RTAs constitute a significant public health challenge globally, representing a major cause of injury and mortality (13-15). They are now recognized as a major epidemic of non-communicable diseases (NCDs), often resulting in permanent disabilities such as amputation, traumatic brain injuries, and spinal cord injuries (16).

LMICs experience disproportionately higher mortality rates from RTAs. The African region has the highest global fatality rate from road traffic accidents, increasing from 24.1 per 100,000 people in 2013 to 26.6 in 2018 (7, 17). Despite having a relatively low level of motorization, the sub-Saharan region has witnessed the rising frequency of RTAs and deaths. The burden of RTAs varies across the sub-Saharan countries, with case fatality rates ranging from 0.3% to 41% (18).

The prevalence of RTA deaths was different from country to country. A follow-up study done in the Democratic Republic of Congo discovered that 19.2% of RTA patients died throughout the research period (19).

Despite having a low motorization rate, RTA cause a significant loss of life and property every year in Ethiopia (20). Road traffic accidents account for 24% of all trauma-related deaths in the country (21). A systematic review and meta-analysis reported a pooled prevalence of road traffic injuries at 29% and deaths at 18%, respectively (22). Economically, RTAs result in an estimated annual loss of 400 to 500 million Ethiopian Birr (ETB) (9).

The Global Plan for the Decade of Action for Road Safety 2021-2030 aims to reduce road traffic deaths and injuries by at least 50% (23). In alignment with the global initiative, the Federal Democratic Republic of Ethiopia (FDRE) Ministry of Transport and Logistics, alongside other stakeholders and partners, developed a national strategy to reduce road traffic fatalities and injuries. This strategy is informed by an understanding of the local context and global best practices (8).

Many studies have been conducted in Ethiopia focusing on RTA injuries and fatalities, with an emphasis on the magnitude of these events. However, limited evidence exists regarding the mortality incidence among RTA patients admitted to hospitals in the country. Therefore, this study aimed to assess the incidence and identify the predictors of death among road traffic accident patients admitted to trauma hospitals in Addis Ababa.

1.3 Rationale of the study

The findings of this study contribute to the enhancement and refinement of the existing strategies and programs aimed at reducing mortality among RTA patients. Furthermore, it can inform planning, funding, staffing, and training initiatives with the goal of improving patient outcomes. In addition, it also enhances the understanding of the public health burden posed by RTAs among patients admitted to healthcare facilities. Moreover, it contributes to the development of effective pre-crash precautions and strong post-crash response strategies, which are critical for preventing and reducing RTA-related fatalities (5).

Similarly, the results of this study may be used to identify important predictors of mortality that are relevant for both public health and clinical perspectives. Additionally, the study provides insights into the survival time, which can inform timely interventions aimed at preventing RTA-related fatalities. Overall, this research will advance knowledge within the field of public health and contribute to the ongoing efforts to reduce RTA-related fatalities.

Despite the significance of the problem, existing researches primarily emphasize the magnitude of mortality, resulting in limited data on the incidence and predictors of mortality among RTA patients admitted to healthcare facilities (24). Therefore, this study seeks to quantify the incidence and identify predictors of mortality among RTA patients.

1.4 Significance of the Study

This study provides valuable insights that can serve as a source of information for future researchers in the domain. It also serves as an information resource for policymakers in designing targeted policies, strategies, and interventions to mitigate mortality associated with RTAs.

For healthcare professionals, this study offers insights into the factors contributing to mortality, thereby aiding in the development of targeted interventions.

2. Literature review

2.1 Introduction

After extensive reviewing of different sources related to the problem under study, the literature review was classified into three parts (themes) such as the burden of RTAs, determinants of mortality among RTA patients, and the conceptual framework. Databases including Google Scholar, PubMed, Web of Science, journals, and papers published up to 2025 were searched using the title and keywords to identify all relevant publications.

2.2 Burden of road traffic accidents

Death from RTAs continues to be a serious public health issue, affecting over 1.3 million people globally each year, and as many as 50 million others are injured (25). According to the World Health Organization, the global mortality rate from RTAs is approximately 18.2 per 100,000 population, with low-income countries facing disproportionately higher rates(5). According to the Statistical Yearbook 2021, 244,674 road traffic accidents occurred in China in 2020, resulting in 61,703 deaths and 250,723 injurie(15). China's traffic accident fatality rate was 19.75%, which was much higher than fatality rate of industrialized countries over the same time (26).

African Countries also experienced the highest mortality rate from RTAs, resulting in minor injuries, serious injuries, loss of life, and property damage. The prevalence of RTA deaths was different from country to country. A follow-up study done in the Democratic Republic of Congo discovered that 19.2% of RTA patients died throughout the research period (19).

Numerous studies have highlighted the alarming prevalence of RTAs in Ethiopia, indicating significant and rising public health concerns. Cross-sectional studies conducted in the southern part of Ethiopia (16), the East Shewa zone of Oromia (27), and Addis Ababa (28) indicated that the magnitude of RTA-related deaths was 9.5%, 12.9%, and 17.4%, respectively. Another follow-up study conducted at Jima University Medical Center and the southern part of Ethiopia found that death prevalence among admitted RTA patients was 12.6% (29). However, a facility-based descriptive study conducted on pre-hospital care and 24-hour crash injury mortality among RTA patients revealed that 4.9% of RTA victims died within 24 hours of crash occurrence (30).

A research done in Iran found that the death rate among RTA patients was 4.51/10,000 pho. (31). Similar to this, studies conducted in the Amhara region of Ethiopia (24) and Addis Ababa

(32) found that the overall mortality incidence was 2.9 and 1 per 10,000 pho, respectively. However, studies conducted in the northwest (33) and southern (34) parts of Ethiopia found that the death rate among RTA patients was 15.34 and 7.34/10,000 pho, respectively

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RTA injuries and disabilities affect tens of millions of people every year(35). By 2030, RTAs are anticipated to be the sixth cause of disability-adjusted life years lost globally (36). In addition to immediate fatality, there is an increased chance of subsequent death, persistent physical impairment, psychological issues, and poor overall health-related quality of life following RTAs (10).

A study done in Brazil found that 15.1% of RTA causes sequelae and/or impairment (37). However, a study conducted in China estimated an incidence of 1.12 people per 1,000 population with sequelae arising from RTA(38). Another study done in Yemen discovered that about 40% of patients experienced sequelae and/or impairment (39). Less developed countries are responsible for an estimated 90% of annual disability-adjusted life years (DALYs). In Ethiopia, one in every seven people has a disability (40). According to a 2011 World Bank and World Health Organization report on disability, 17.6% of Ethiopia's population is disabled (41).

2.3 Predictors of mortality among RTA victims

2.3.1 Demographic profiles of study participants

According to several studies, socio-demographic factors like age, gender, occupation, and place of residence play a significant role in road traffic accident-related mortality. Being a male, rural inhabitant, and in a young age group is strongly associated to mortality and injury due to RTAs (24, 27, 34). According to researches done in Kenya, Thailand, and Romania, males die at a greater rate than women(42-44). A follow up in southern Ethiopia indicated that the male population was the most commonly afflicted by RTAs, with a male-female ratio of 5:1(34). In contrast, another study conducted in northwest Ethiopia found that the ratio of male to female was 2.6:1 (24).

The previous studies reported that the productive age group were the affected group by RTA (24, 27). A study from the East Shewa zone of Oromia, Ethiopia, found that young adults aged 25 – 44 years were 4.5 times more likely to die from RTAs compared to those under 15 years (27). However, a prospective observational study conducted in India over one year found that mortality was not significantly associated with age and sex (45) (Figure 1).

Regarding occupational status, a retrospective study conducted in northwest Ethiopia revealed that several RTA patients were farmers, followed by students (24). However, another study conducted in the East Shewa zone of Oromia found that several RTA patients were employed workers, followed by merchants (27). Rural road traffic mortality rates were generally higher than in urban areas (15). A study conducted in the northwest of Ethiopia discovered that 58% of RTA patients were from urban areas. However, the hazard of death from RTAs among rural residents was 1.98 times higher compared to urban residents (24). Another study found that the odds of death among rural RTA patients were 2.26 times higher among rural compared to urban patients (27). A Study conducted in Addis Ababa revealed that RTA patients who reside in Addis Ababa had a low mortality rate compared to those who reside outside Addis Ababa (46) (Figure 1).

2.3.2 Pre-injury characteristics: Several studies revealed that pedestrians were more likely to die compared to passengers (27, 47). A study in the northwest of the country showed that pedestrians were the most frequently affected road user category compared to passengers and drivers. However, the death hazard among drivers and passengers was 2.61 and 1.97 times higher than pedestrians, respectively (24). RTA victims injured at night had a greater mortality rate than those injured during the day.(48-50). A research done in the Amhara region of Ethiopia discovered that the hazard of mortality among trauma patients who were injured during the overnight was 2.29 times greater compared to those injured during the daytime (51).

RTA patients arrived to hospital before 24 hours were less likely to die compared to those who after 24 hours (52). In contrast, another study found that early arrivals to the hospital (<1 hour) had a greater death rate (34). A study conducted in Addis Ababa found that patients who arrived at the health facility by ambulance and sustained head injuries had an increased odds of death (46). Being obese and underweight was associated with a greater risk of mortality (55) (Figure 1).

2.3.3 Mechanism of injury: Several studies discovered that the mechanism of injury plays a significant role in determining the outcome of RTA patients. Studies highlighted that rollover (53, 54) and collisions with a fixed object exacerbate the risk of mortality (53). Vehicle to vehicle crash also associated with mortality (55). Furthermore, the odds of death among head-on collisions were 2.28 times higher compared to crashes with a fixed object (56) (Figure 1).

2.3.4 Nature of injury: Fractures are the most common nature of injury, accounting for 34.1%, followed by superficial injuries (26.1%). The majority of motorcycle crashes resulted in head

injuries (54.3%), fractures (52.9%), and multiple injuries (51.2%) (13). Studies discovered that traumatic brain damage was significantly associated with death following all types of traffic incidents (57, 58). Thoracic, abdominal, lower limb, and multiple injuries are associated with in-hospital mortality (59-62). Pelvic injuries are also major risk factors for mortality across all collision types, except for those involving bicycles(61, 63). RTA patients with poly-trauma had a higher (13.4/10,000 person-hours) mortality rate as compared to RTA patients with mono-trauma (34) (Figure 1).

2.3.5 Post-crash responses to RTA patients

Pre-hospital care: Pre-hospital care is crucial in deciding the results of therapies, which considerably minimize mortality and morbidity among RTA patients (64). Lack of pre-hospital emergency care was associated with a higher fatality rate (P = 0.000) (45). According to a study conducted in Tanzania, only 2% of the victims received some form of management at the crash site (13). The risk of death among trauma patients who did not get pre-hospital care was 2 times (AHR = 2.00, 95% CI 1.13, 3.53) higher than those who got pre-hospital care services (65). However, a similar study conducted in Brazil revealed that RTA patients who didn't receive pre-hospital care were less likely to have prolonged hospitalization, disability, or death (37). The death rate among self-referred RTA patients was greater than those who were referred from other health institutions (34) (Figure 1).

Admission and management of outcome: A study conducted in Tanzania showed that hospital management of RTA patients was more non-operative (79.9% (13). Several studies have indicated that RTA patients admitted to the ICU are more likely to die than their counterparts. (34, 64). The odds of death among RTA patients admitted to the ICU were 30 times higher compared to those who did not (66). Low SBP at admission was found to be a significant predictor of mortality among RTA patients (32, 67, 68). Studies discovered that acquiring complications during hospitalization was a predictor of death among RTA patients, which suggested that the risk of death rose for those who had complications as opposed to those who did not(34, 69). Trauma patients who had complications were 3.7 times (AHR = 3.71, 95% CI 1.29, 10.64) higher risk of mortality than their counterparts (65). The death hazard among trauma patients who received blood transfusion was 2 times greater (AHR = 2.01, 95% CI: 1.08, 3.74) than those who did not receive it (51) (Figure 1).

2.3.6 Severity of injury: The Glasgow Coma Scale (GCS) measures a patient's level of consciousness. Low GCS score increases the risk of in-hospital mortality (32, 54). A similar study reported that RTA patients with a GCS score of less than 8 had a greater risk of death

than those with GCS scores of 9-12 (moderate category) and GCS scores of 13-15 (60, 64, 70, 71). Additionally, the death hazard among trauma patients with a GCS score < 9 at admission was 3.9 times higher than those with a GCS score of 13–15 (65). Furthermore, a study conducted in the Democratic Republic of Congo showed that RTA patients with a low GCS were at risk of dying during their hospital stays (66).

In many studies, having a history of loss of consciousness was related to a higher risk of mortality compared to those who did not (34, 64). According to a study conducted in the Democratic Republic of Congo, the odds of death among RTA patients with a Kampala trauma score less than 6 were 13 times higher compared to patients with scores greater than 6 (66). A study in North-western Tanzania found that RTA patients with a Kampala trauma score of less than 6 have a higher chance of mortality compared to those who have greater than 6 (64, 68)(Figure 1).

2.4 Conceptual framework.

The conceptual framework below represents the relationships between dependent and independent variables. It was developed by reviewing different literatures (24, 32, 56, 72, 73). The solid straight lines indicate the hypothesized pathway, while the broken lines indicate pathways not originally hypothesized and show there might be relations among independent variables, but not for all variables inside the box. There are six groups of variables (demographic profiles, pre-injury characteristics, injury severity, injury mechanism, nature of injury, and post-crash response) associated with an outcome variable.

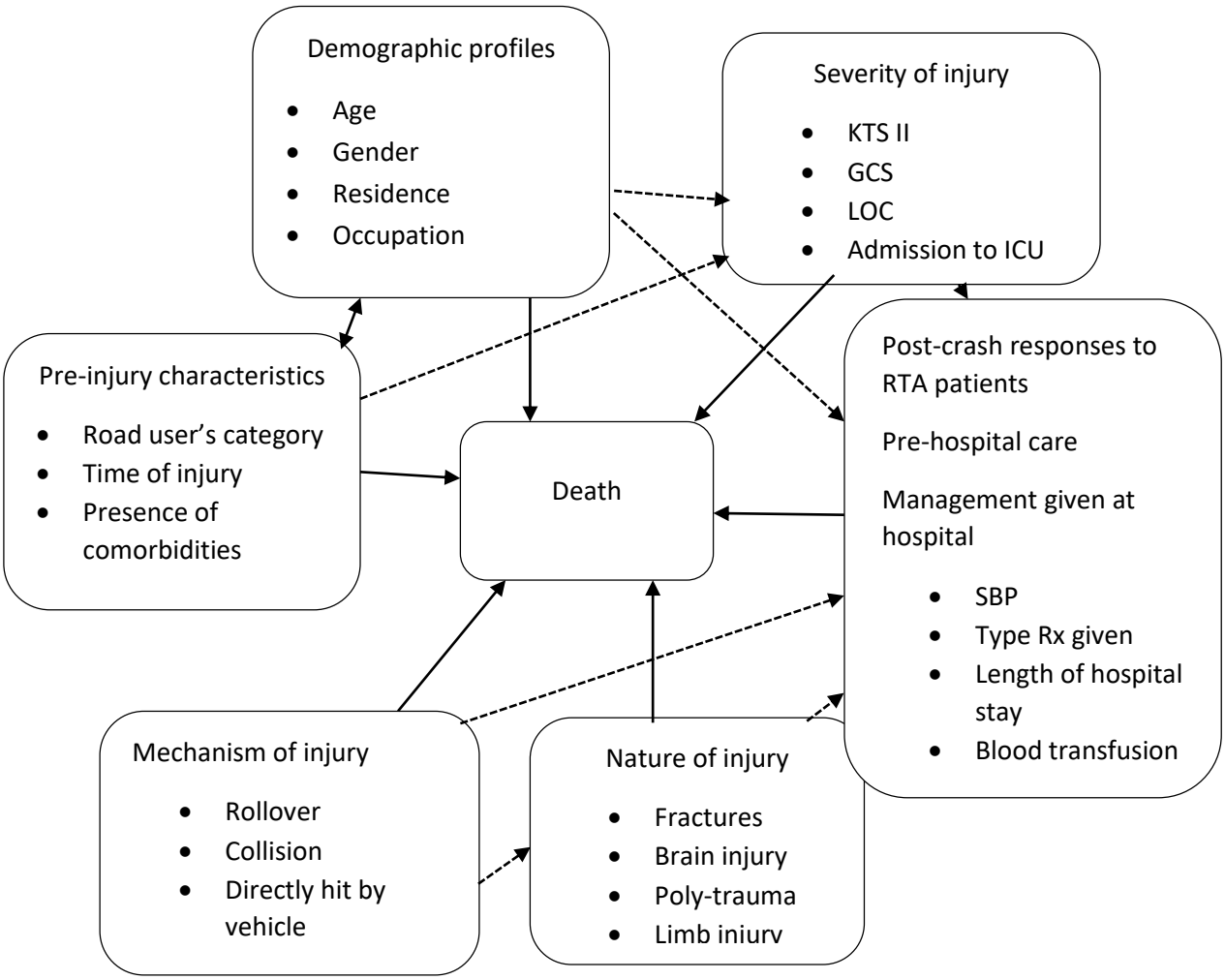


Figure 1: Conceptual framework for assessing the incidence and predictors of mortality among road traffic accident patients admitted to trauma Hospitals in Addis Ababa, Ethiopia, 2024/25.

Foote note: LOC: Loss of consciousness, Rx: Treatment

2.5 Research questions

1. What is the incidence of inpatient mortality among road traffic accident patients admitted to trauma hospitals in Addis Ababa, Ethiopia?

2. What is the estimated time to death among road traffic accident patients admitted to trauma hospitals in Addis Ababa, Ethiopia?

3. What are the predictors of mortality among road traffic accident patients admitted to trauma hospitals in Addis Ababa, Ethiopia?

3. Objectives

3.1 General objective

To determine the incidence and predictors of inpatient mortality among road traffic accident patients admitted to trauma centers of hospitals in Addis Ababa, Ethiopia, from 2020 to 2024.

3.2 Specific objectives

1. To determine the incidence of inpatient mortality among road traffic accident patients admitted to trauma centers of hospitals in Addis Ababa, Ethiopia, from 2020 to 2024.
2. To estimate time to death among road traffic accident patients admitted to trauma centers of hospitals in Addis Ababa, Ethiopia, from 2020 to 2024.
3. To investigate predictors of inpatient mortality among road traffic accident patients admitted to trauma centers of hospitals in Addis Ababa, Ethiopia, from 2020 to 2024.

4. Methods and materials

4.1 Study setting

The study was conducted at two selected government trauma hospitals in Addis Ababa. Addis Ababa is the capital of Ethiopia, covering approximately 527 square kilometres (km^2). Current data indicate that Addis Ababa has a total of 38 hospitals, comprising 2 NGO hospitals, 13 government hospitals, and 23 private hospitals. Additionally, there are 29 health centers, 116 private non-profit clinics, and 357 private for-profit clinics. Among the thirteen government hospitals, AaBET, TASH, and ALERT are designated as trauma centers (74). This study was conducted at ALERT Comprehensive Specialized hospital and AaBET hospital.

AaBET hospital is a branch of St. Paul's Hospital established in 2015 near Gojam Berenda. It provides 24-hour emergency services and is staffed with senior surgeons and medical doctors, as well as BSc nurses. The emergency department alone employs a total of 75 nurses out of the 257 nurses working at the hospital (74).

ALERT Hospital is a tertiary hospital serving an estimated population of approximately 3.5 million residents in Addis Ababa. It has 20 emergency department beds, 38 inpatient trauma ward beds, and 10 critical care beds. The hospital is equipped with 10 operating rooms, three of which are dedicated exclusively to trauma care. In 2016, the hospital initiated a basic trauma registry, recording data for all patients presenting to the trauma emergency department (46).

The present study was conducted from January,2025 – March, 2025.

4.2 Study design

An institution-based retrospective cohort study was conducted by reviewing medical records of RTA patients admitted to trauma centers of hospitals in Addis Ababa.

4.3 Populations

4.3.1 Source population

All RTA patients admitted to trauma hospitals in Addis Ababa, Ethiopia.

4.3.2 Study population

All RTA patients admitted to ALERT and AaBET hospitals.

4.4 Eligibility criteria

4.4.1 Inclusion criteria

All RTA patients admitted to ALERT and AaBET hospitals.

4.4.2 Exclusion criteria

RTA patients admitted to ALERT and AaBET hospitals from January, 1,2020 to December 31, 2024 and had incomplete or missing data, particularly on outcome variables (reason for discharge, admission and discharge time), and admitted for less than 24 hours were excluded.

4.5 Sample size determination and sampling procedure

4.5.1 Sample size determination: The parameters from prior researches conducted in Ethiopia were used to calculate sample size. The studies were chosen because they were the most recent and had a larger sample size than others (24, 34, 51).

For specific objective one (1)

The single proportion formula was used to calculate the required sample size.

$$\mathbf{N=}\frac{(za/2)^2pq}{d^2}$$

- Where N is the sample size required for the study
- Z a/2 - is the critical value of the standard normal distribution variable at 95%.
- d - is the margin of error (0.05)
- p - the proportion of individuals who developed the event
- q - the proportion of individuals who did not develop the event, or 1-p

Previous study (24) (N) = $\frac{(1.96)^2(0.176)(0.824)}{(0.05)^2}$ = 223, by adding 10% for incomplete data = **246**

Previous study (34) (N) = $\frac{(1.96)^2(0.126)(0.874)}{(0.05)^2}$ = 169, by adding 10% LTFU = **186**

For specific objective two (2)

STATA software version 17 and manual sample size calculation methods were employed to calculate sample size through power analysis for the Cox proportional hazard model, taking into account covariates significantly associated with mortality (34, 36).

1. The sample size was calculated by inserting the following parameters into STATA software version 17.

- N - total required sample size
- Z a/2 - is the critical value of the standard normal distribution variable at 95%
- Zβ - is the critical value of the standard normal distribution variable at 20% β, and 10% lost to follow-up
- HR is the hazard ratio for selected covariates.
- p(e) - is the probability of death among RTA patients

2. For manual calculation, the following parameter was added to the above parameters, and the minimum required sample size was calculated as follows.

- "e" is the expected number of events

$$e = \frac{4\left(Za/_2 + ZB\right)^2}{(Ln(HR))^2}$$

$$N = \frac{e}{p(e)}$$

The sample sizes calculated by both methods were equal, except for minor discrepancies inherited from manual calculations.

Table 1: The summary of the minimum sample size calculated for time to death.

Assumptions	Previous study	Significant Variables	Hazard ratio	Expected event	Probability of an event	Sample size (N)
Type I error = 0.05, Power = 80 Lost to follow-up = 0.1	(24)	Residence	1.98	68	0.176	425
		Road user category	1.97	69	0.176	432
		GCS	7.89	8	0.176	47
	(34)	SBP	4.41	15	0.126	126
		Admission to the ICU	3.89	18	0.126	151
		GCS	3.27	23	0.126	198

For specific objective three (3)

The sample size was calculated by employing STATA software version 17 and manually, by applying the double proportion formula. Covariates significantly associated with mortality were taken from previous studies (36, 53).

First, the sample size was calculated by inserting the following parameters into STATA software version 17.

- "Z a/2" is the critical value of the standard normal distribution variable at 95%.
- "Zβ" is the critical value of the standard normal distribution variable at 20% β;

- "P1" is the proportion of the outcome among the unexposed
- "p2" the proportion of outcome among exposed and 10% lost to follow-up

Second, to calculate sample size manually, the following two parameters were added to the above parameters, and the minimum required sample size was calculated as follows.

- "r" the ratio of unexposed to exposed
- "q" = $(p2+mp1)/ (1+m)$

$$N = \frac{\left(Za\sqrt{(1+\frac{1}{r})\,pq} + ZB\sqrt{\frac{p1q1}{r} + p2q2}\right)^2}{(p1-p2)^2}$$

The sample sizes calculated by both methods were equal, except for minor discrepancies inherited from manual calculations.

Table 2: The summary of the minimum calculated sample size for predictors of mortality due to RTAs

Assumption	Previous study	Significant Variables	P1%, p2% ,r%	Sample size (N)
Type I error = 0.05 Power = 80 Lost to follow-up = 0.1	(51)	Blood transfusion	4.5, 15.4, 1	297
	(24)	SBP	10.9, 67.9, 1	31
		Organ injured	5.3, 31.4, 1	91

As indicated, among the sample sizes calculated for the three specific objectives, 432 was identified as a maximum. But, to enhance statistical power, improve precision, and strengthen the generalizability of the study findings, we decided to review **482** medical cards of RTA patients.

4.5.2 Sampling technique and procedures.

ALERT and AaBET hospitals were randomly selected from the three hospitals which have trauma center. The list of all RTA patients admitted both hospital during the study period was made from the HMIS log book and trauma registry book using the Medical Record Number (MRN).

Table 3: The summary of RTA patients admitted to ALERT and AaBET hospitals from 2020 to 2024.

Year of admission Institution	2020	2021	2022	2023	2024	Total
ALERT hospital	93	135	154	142	130	654

AaBET hospital	128	177	168	152	183	808
Total	221	312	322	294	313	1462

After the sampling frame was prepared for both hospitals, the final sample size (482) was proportionally allocated to each hospital as follows.

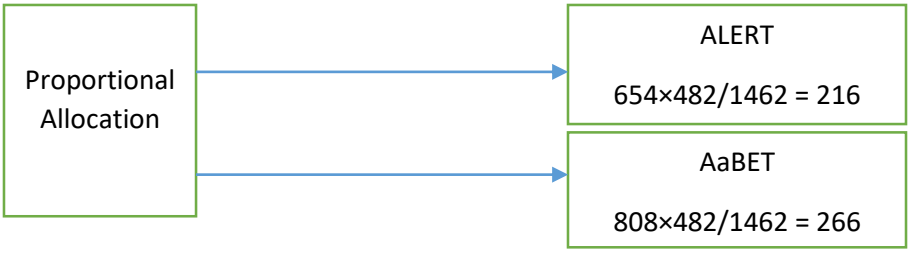


Figure 2: Proportional allocation of samples to ALERT and AaBET hospitals based on year of enrolment.

To ensure representativeness within years of enrolment, the study population was stratified by the year of enrolment. Then, the sample size allocated to both hospitals was reallocated to each year of enrolment proportionally.

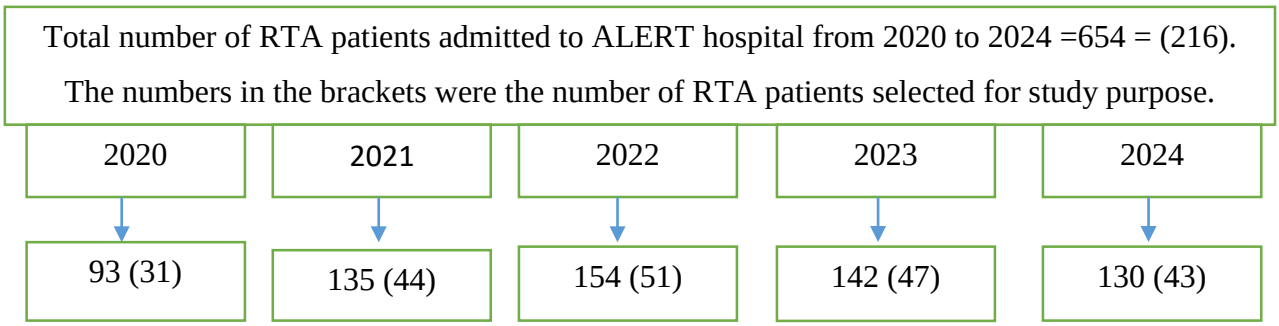


Figure 3: Allocation based on enrolment year (2020-2024) to the ALERT comprehensive specialized hospital.

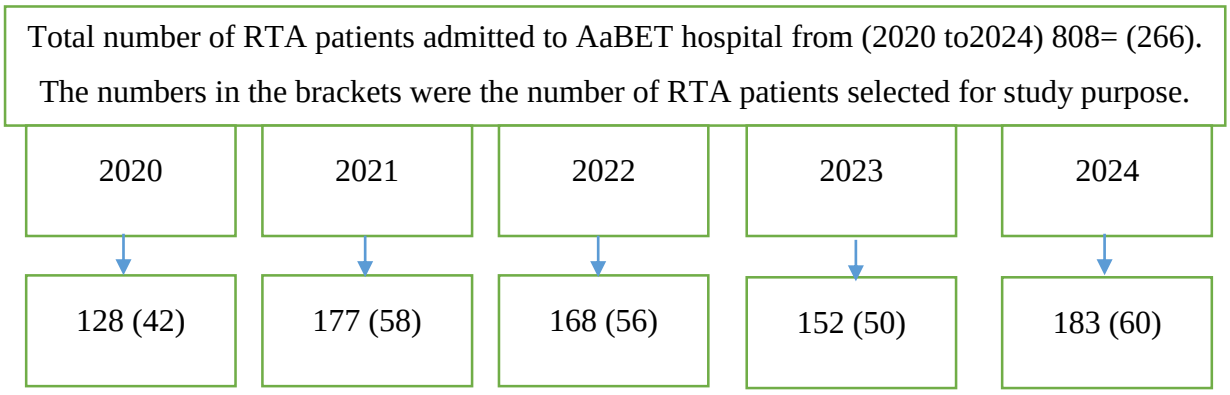


Figure 4: Allocation based on enrolment year (2020-2024) to AaBET hospital.

After proportional allocation was performed based on year of enrolment for both hospitals, patient cards were randomly selected from each year of enrolment using computer-generated simple random sampling technique.

4.6 Study variables

4.6.1 Dependent variables

Death and time to death

4.6.2 Independent variables

Demographic factors: sex, age, occupation, and residence.

Pre-hospital conditions: pre-hospital care, referral source, referral status, referral form, road user's category, time event occurred, and comorbidities.

Nature of injury: presence or absence of organ injury, poly-trauma, bleeding, and fracture.

Admission and management at hospital: admission to ICU, vital statistics at admission, length of Hospital stay, type of surgery, and history of blood transfusion.

Severity of injury: loss of consciousness, level of GCS, and KTS II

Mechanism of injury: rollover, direct hit by a vehicle, and collision.

4.7 Data collection tool and procedures

The data abstraction form was developed based on an extensive reviewing of the literatures (24, 27, 34, 75, 76). The form comprised sections on demographic profiles, pre-hospital conditions, pre-injury characteristics, injury severity, management, and outcomes. Data collection was conducted electronically using Android smartphones. To facilitate electronic data collection, the paper-based form was digitized by inserting the form into Microsoft Excel and converting it into an XLS format compatible with Open Data Kit (ODK). After verifying the readability and functionality of the form, the form was uploaded to Kobo Toolbox (kobotoolbox.org). The form was then deployed from the central server, allowing data collectors to access it remotely using a Quick Response (QR) code or a direct link. Before the actual onset of data collection, patient cards selected by a simple random sampling technique were separated and registered two times to avoid possible duplication of the data. After that cards with incomplete and missing data were replaced by cards of same year until the required sample size achieved. Then, data collection was conducted by two male graduates under the supervision of a designated supervisor.

4.8 Operational definitions and measurements.

Admitted RTA patients: Refers to patients who have been admitted to an inpatient facility. It excludes those who arrived at the ED and were discharged the same day or were directed elsewhere without being admitted to inpatient care, or died before admission.

Censored (0): This was when the outcome (death) was not observed during the study period, such as when a patient was discharged alive, transferred to another facility, left against medical advice, or was alive at the end of follow-up.

Comorbidities: The "coexistence of non-communicable diseases like hypertension, heart failure, diabetes mellitus, and HIV/AIDS.

Event (1): The event of interest is the occurrence of death due to RTA during follow-up time.

Follow-up time: Follow-up time was defined as the duration from the date and time of hospital admission to the occurrence of death (for events) or to the time of discharge, transfer, or leaving against medical advice (for censored cases). Patients were followed only during their hospital stay, with no post-discharge follow-up. The study subjects were followed for 30 days (720 hours).

Glasgow coma scale: is the measure of person's level of consciousness and classified as mild (GCS 13–15)), moderate (GCS 9–12), and severe (GCS 3–8 (64).

Kampala trauma score II: is classified as severe injury $\leq$ 6, moderate injury 7–8, and mild injury 9–10 (77).

Time event occurred - Daytime is from sunrise (6 am) to sunset (6 pm), while nighttime is the opposite of this.

Time to death is defined as the time interval from the first hour of admission to the time death occurred.

4.9 Data management

Data were entered directly into the ODK app during data collection, and the daily collected data were sent to the central server every working night. The principal investigator monitored the daily collected data to ensure that data collectors submitted it or not. After data collection was completed, the data were exported to STATA software version 17 for cleaning, sorting, and analysis. Additionally, data were and will not be shared with anyone unless explicitly

requested by advisors or an authorized institutional repository. All data is stored securely on an encrypted computer with password protection.

4.10 Data processing and analysis

We used STATA software version 17 to process and analyse data. Descriptive statistics were used to summarize data. Incidence density rate (IDR) was estimated for the overall study period by dividing incidence within the study period by the total person-hours of follow-up and reported in per person-hours and patient status declared as event or censored. The Kaplan-Meier survival curve and log-rank test were used to determine the median time to death and test for the presence of differences in the mortality incidence among different categories of explanatory variables. The Cox proportional hazards regression analysis was used to determine the relationship between predictors and response variables (mortality).

The Schoenfeld residual and graphical assumption checking were used to assess the hazards proportionality assumption over time for each covariate, and the linearity assumption was tested by martingale residuals. Cox-Snell residuals were used to test the overall model fitness. Variables with a p-value < 0.25 in bivariate analysis and that fulfilled proportionality assumptions were included in multivariable analysis. Statistical significance was determined using a 95% CI for the AHR and a p-value of ≤ 0.05. Lastly, the results were presented in the form of texts, graphs, and tables.

4.11 Data quality control

Before the onset of actual data collection, the data abstraction form was pretested on 5% of the patient charts outside the study area to check the consistency of understanding, adequacy, and completeness of the instrument to improve the data quality. Based on the results of the test, necessary modifications were made. To avoid incompleteness of data due to overlooking during data collection, we made all fields mandatory. So, it was impossible to jump to the next question before filling in the first one. The two-day training session was given for data collectors (two graduate students) and a supervisor before the commencement of actual data collection. The first day of training was on the theoretical aspects of the study, and the second day was on the practical aspects of the data abstraction form (checklist) and how to use the ODK Collect app. The same data collectors collected the data from both facilities under the supervision of the supervisor.

4.12 Ethical considerations

Ethical clearance was obtained from the research and ethical review committee of the School of Public Health, College of Health Science, Addis Ababa University, on 22/01/2025, with

reference number SPH/452/2025. The formal letter of permission from the University was submitted to the hospital's administrative authorities to obtain approval for data collection. The health information technologists and data clerks of the hospitals were adequately informed about the purpose and feature benefits of the study. Any personal identifiers except ID were not incorporated into the data abstraction form to ensure confidentiality. As long as this study used secondary data, informed consent was not applicable, but waiver consent was sought throughout data collection. There was and will be no risk to patients whose records were reviewed. There was no incentive or direct benefit to patients whose charts were involved in the study.

4.13 Dissemination of the results

The results of this study will be submitted to Addis Ababa University, College of Health Science, and the School of Public Health. Also, the results will be submitted to the study hospitals. Further efforts will be made to present it at a workshop and conference and publish it in a peer-reviewed journal.

5. Results

5.1 Study subjects flow diagram

From randomly selected patient medical cards, those not fulfilled the inclusion criteria were excluded and replaced with other cards from the same year until a total of 482 samples were reached.

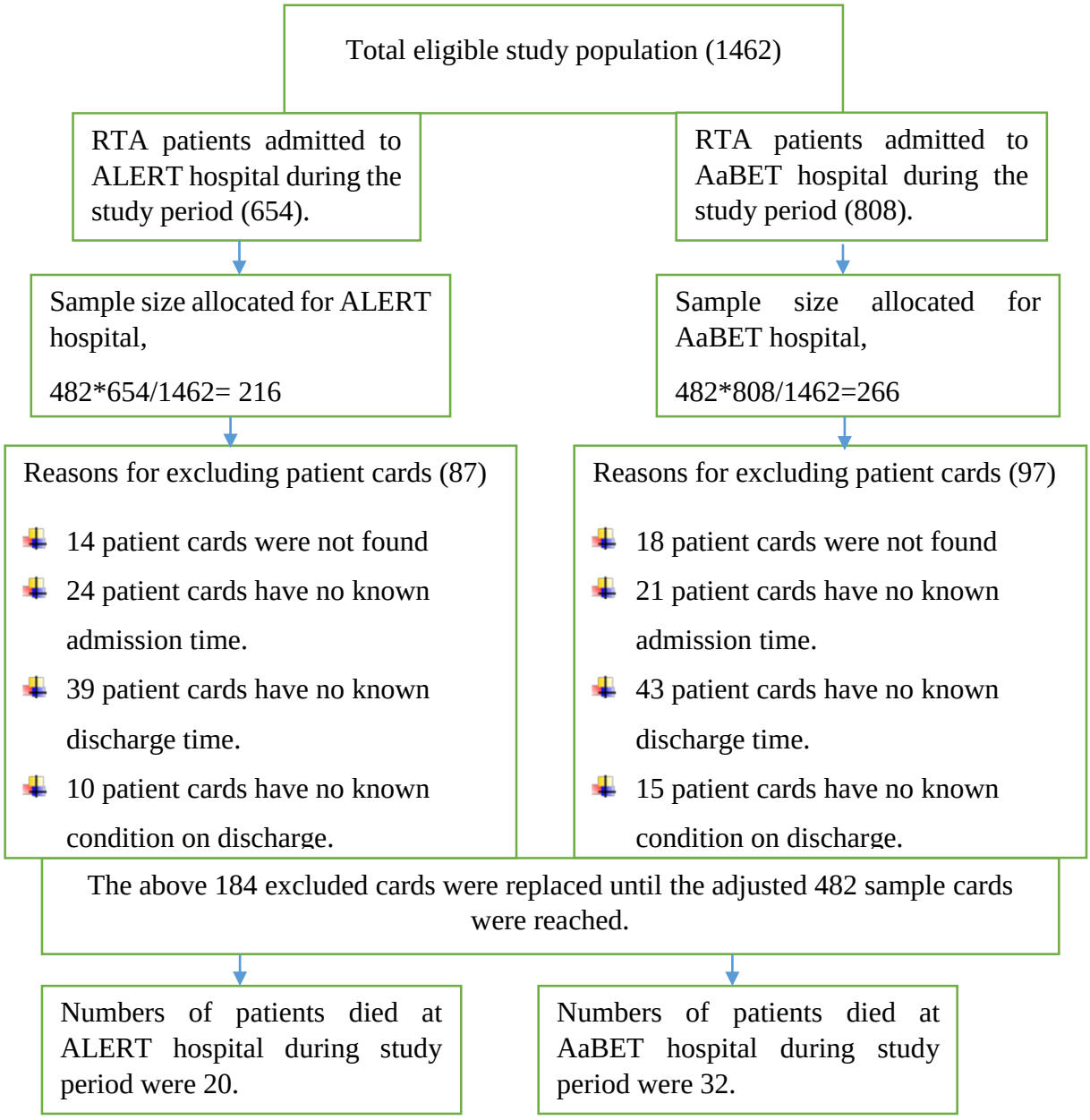


Figure 5: Flow diagram of RTA patients admitted to ALERT and AaBET hospitals, Addis Ababa, Ethiopia; Jan, 2020 to Dec, 2024; (n = 482).

5.2 Socio-demographic characteristics and pre-hospital conditions of RTA patients

Among the 482 patients, 362 (75%) were male population. The mean age of study participants was 33 ± 16 SD. Approximately 216 (44.8%) of RTA patients were aged between 16 and 30 years. Additionally, individuals aged between 16 and 45 accounted for 330(68.46%) of deaths

due to RTAs. The majority of the RTA patients reside in Addis Ababa 253 (52.5 %), followed by Oromia 178 (36.9%).

Table 4: Socio-demographic and pre-hospital conditions of RTA patients admitted to AaBET and ALERT hospitals, Addis Ababa, Ethiopia; Jan, 2020 to Dec, 2024; (n = 482).

Variables	Category	Frequency	Percentage
Sex	Female	120	24.9
	Male	362	75.1
Age	<15 years	55	11.4
	16-30 years	216	44.8
	31-45 years	114	23.7
	46-60 years	67	13.9
	>60 years	30	6.2
Residence	Addis Ababa	253	52.5
	Oromia	178	36.9
	Others	51	10.6
RTA patients' role at the time of injury.	Pedestrian	298	61.8
	Passenger	130	27.0
	Driver	54	11.2
Mechanism of the accident	The pedestrian was directly hit by a vehicle	294	61.0
	Rollover	53	11.0
	Collision	117	24.3
	Unknown	18	3.7
Type of vehicle involved	Two wheeled	14	2.9
	Three wheeled	32	6.6
	Four wheeled	394	81.8
	Unknown	42	8.7
Mode of arrival at the hospital	Ambulance	236	49.0
	Taxi	156	32.4
	Private vehicle	62	12.8
	Police car	16	3.3
	Other	12	2.5
Referral status of the victims	Referred	326	67.6
	Self-referral	156	32.4
Having referral form(n = 326)	Yes	285	87.4
	No	41	12.6
Sources of referral(n = 326)	Directly from the scene	53	15.0
	Health center	120	37.1
	Hospital	139	43.4
	Private clinic	14	4.5
Presence of comorbidities	No	433	89.8

	Yes	49	10.2
Time of injury	Day	406	84.2
	Night	76	15.8
Injury pattern by year	2020	73	15.1
	2021	102	21.2
	2022	107	22.2
	2023	97	20.1
	2024	103	21.4
Study setting	ALERT hospital	216	44.8
	AaBET hospital	266	55.2

Footnote: Other mode of arrival to hospital includes: Walk in, inter facility referral

5.3 Injury characteristics of RTA patients

Approximately 45% of RTA patients encountered poly-trauma, and over one-third (39.42%) of them experienced injury to their extremities. About 12% of RTA patients suffered from visceral organ injury. More than half of the RTA patients (59.54%) had fractures, with nearly half of those fractures located in the extremities.

Table 5: Injury characteristics of RTA patients admitted to trauma hospitals in Addis Ababa; Jan, January 2020 to Dec 2024 (n = 482).

Variables	Category	frequency	Percentage
Poly-trauma (n=482)	No	276	57.3
	Yes	206	42.7
Injured body part (n=482)	Extremities	190	39.4
	Head	79	16.4
	Multiple	158	32.8
	Others	55	11.4
Visceral organ injury (n=482)	No	425	88.2
	Yes	57	11.8
Presence of bleeding (n=482)	No	82	17.0
	Yes	400	83.0
Presence of fracture (n=482)	No	195	40.5
	Yes	287	59.5
	Extremity	151	52.6

Particular fractured bone (n= 287)	Face	17	5.9
	Skull	27	9.4
	Multiple	77	26.8
	Others	15	5.3
Presence of open wound (n= 482)	No	297	61.6
	Yes	185	38.4

5.4 Management given for RTA patients

More than three-quarters of RTA patients were admitted for surgical treatment. Approximately 9.3% of study participants acquired the disease, with pneumonia being the most frequently observed. The most common procedure performed was fixation, and about 17.4% of RTA patients developed complications.

Table 6: Management given for RTA patients admitted to AaBET and ALERT hospitals, Addis Ababa, Ethiopia; Jan, 2020 to Dec, 2024; (n = 482).

Variables	Category	Frequency	Percentage
Reason for admission	Requires surgery or Resuscitation	360	74.7
	Requires close Observation	122	25.3
Procedure done	Wound repair	102	21.2
	Plaster of Paris	31	6.4
	Craniotomy	20	4.2
	Chest tube	37	7.7
	Ventilation	17	3.5
	Medication	45	9.3
	Fixation	174	36.1
	Multiple	56	11.6
Hospital Acquired diseases	No	437	90.7
	Yes	45	9.3
Particular disease acquired (n = 45)	Pneumonia	30	66.7
	Others	15	33.3
Complication developed	No	398	82.6
	Yes	84	17.4

Disability (n =430)	No	413	96.0
	Yes	17	4.0

5.5 Admission characteristics of RTA patients

More than two-thirds of RTA patients in this study had a Kampala trauma score II between 9 and 10, and the majority (63.7%) of them had a GCS score between 13 and 15.

Table 7: Admission characteristics of RTA patients admitted to AaBET and ALERT hospitals, Addis Ababa, Ethiopia; Jan, 2020 to Dec, 2024; (n = 482).

Variables	Category	Frequency	Percentage
Kampala trauma score II	9-10	323	67.0
	7-8	109	22.6
	≤6	50	10.4
Glasgow coma score	13-15	307	63.7
	9-12	104	21.6
	≤8	71	14.7
SBP	>89	424	88.0
	≤ 89	58	12.0
History of LOC	No	372	77.2
	Yes	110	22.8
Admission to ICU	No	398	82.6
	Yes	84	17.4
RTA patients disposition	Improved and discharged alive	411	85.3
	Referred to another facility	13	2.7
	Left against medical advice	6	1.2
	Died in the hospital	52	10.8

5.6 Incidence of mortality among RTA patients

A total of 482 individuals were tracked for a duration ranging from 24 to 720 hours, with a median follow-up time of 96 hours (4 days). During the follow-up time, 85.3% (411) of RTA patients improved and were discharged alive, 10.8% (52) died, and 3.9% (18) had left against medical advice or referred. The total follow-up time for 482 RTA patients was 72,393 person-hours. The overall mortality incidence was 7.2 per 10,000 person-hours of observations (95% CI: 5.47, 9.42 per 10,000 pho). The mortality incidence among RTA patients from outside of

Addis Ababa was higher (9.6/10,000; 95%CI: 6.98, 13.19/10,000 person-hours observations) compared to patients from Addis Ababa. The mortality incidence among RTA patients referred to the study facilities from other health institutions was higher than self-referred (9.04/10,000; 95% CI: 5.54, 14.76/10,000 person-hours observation). RTA patients who did not have referral forms had a higher mortality incidence (8.51/10,000; 95%CI: 3.54, 20.4/10,000 pho) as compared to their counterparts **(Table 8**).

The mortality incidence was higher among RTA patients whose hospital arrival time was between 4 and 24 hours (10.6/10,000; 95% CI: 7.37, 15.26/10,000 person-hours observation). The mortality incidence among RTA patients with poly-trauma was higher (10.9/10,000; 95%CI: 7.93, 14.98/10,000) as compared to those who had mono-trauma. RTA patients who had visceral organ injury had a higher mortality incidence (17.99/10,000; 95% CI: 10.84, 29.85/10.000) **(Table 8).**

Table 8: Incidence of mortality among RTA patients admitted to AaBET and ALERT hospitals, Addis Ababa, Ethiopia; Jan, 2020 to Dec, 2024; (n = 482).

Variables	Category	IMR/10,000	95%CI(10,000)
Residence	Addis Ababa	4.2	2.5,7.5
	Outside Addis Ababa	9.6	6.9,13.1
Referral status of the victims	Referred	6.5	4.7,9.1
	Self-referral	9.04	5.5,14.7
Having referral form	Yes	6.3	4.4,9.0
	No	8.5	3.5, 20.4
Hospital arrival time	<4hours	5.6	3.6, 8.7
	4-24 hours	10.6	7,3, 15.2
	>24 hours	3.1	1.1, 9.7
Poly-trauma	No	3.7	2.2, 6.2
	Yes	10.9	7.9, 14.9

5.7 The overall Kaplan-Meier survival curve estimate

The overall Kaplan–Meier survival curve indicated that the probability of death among RTA patients increased over time. The median survival time was not calculated since 71% of study subjects survived beyond the study period; instead, we determined mean and cumulative survival times. The mean survival time was 150 hours (6.24 days) ±148 hours (6.2 days) SD.

The cumulative survival probability of RTA patients was 95.13% (95% CI: 92.70%, 96.77%), 93.40% (95% CI: 90.63%, 95.37%), 91.91%(95% CI: 88.83%, 94.17%), 88.30%(95% CI: 84.22%, 91.38%), and 71.08% (95% CI: 54.04%, 82.75%) at the end of 24 hours, 48 hours, 72 hours, 168 hours, and 720 hours of admission to the hospitals respectively (**Figure 6**).

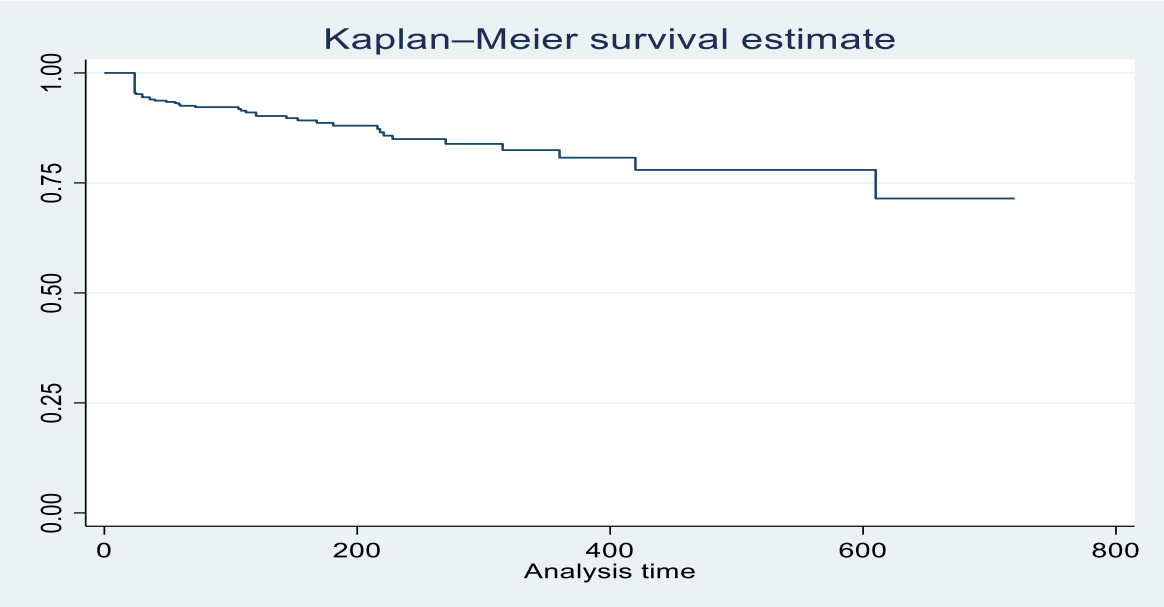


Figure 6: Overall Kaplan Meier survival estimation among RTA patients admitted to AaBET and ALERT hospitals, Addis Ababa, Ethiopia; Jan, 2020 to Dec, 2024; (n = 482).

Mortality rate differed significantly between RTA patients with poly-trauma and mono-trauma. The mortality incidence was higher among RTA patients who had poly-trauma compared to mono-trauma. Additionally, the mortality rate differed significantly between RTA patients admitted to the ICU and non-ICU patients. RTA patients admitted to the ICU had a greater risk of death compared to non-ICU patients. Furthermore, mortality rate differed significantly between RTA patients with SBP at admission greater than 89 mmHg and those with a measurement of 89 mmHg or lower. The mortality rate was significantly higher among RTA patients with SBP less than or equal to 89 mmHg compared to their counterparts (log-rank test, $\chi^2 = 276.73$**) (Table 9)**.

Kaplan-Meier survival curves and log-rank test were used to assess the occurrence of death among different categories of explanatory variables. Patients with GCS scores ≤ 8 (log-rank test, $\chi^2 = 136.37$), a history of loss of consciousness (log-rank test, $\chi^2 = 88.20$), and a history of complications (log-rank test, $\chi^2 = 137.56$) had a higher incidence of mortality **(Table 9)**.

Table 9:Table: Comparison of mortality among categories of predictor factors by using log-rank test of RTA patients admitted AaBET and ALERT hospitals, Addis Ababa, Ethiopia; Jan, 2020 to Dec, 2024; (n = 482).

Variables	Category	Event	Censored	IMR/10,000 pho	Log-rank ($\chi 2$)	p-value
Place of residence	Addis Ababa	14	239	4.2		
	Outside Addis Ababa	38	191	9.6	9.83	0.0017
Poly-trauma	No	14	262	3.7		
	Yes	38	168	10.9	15.39	0.0001
Admission to the ICU	No	37	361	6		
	Yes	15	69	13.2	6.23	0.0125
Hospital-acquired diseases	No	40	397	6.4		
	Yes	12	33	11.1	5.13	0.0235
Visceral organ injury	No	37	388	5.7		
	Yes	15	42	17.9	16.19	0.0001
Time of injury	Day	28	378	4.5		
	Night	24	52	23.3	42.89	<0.0001
Kampala trauma score II	9-10	13	310	2.8		
	7-8	15	94	7.3		
	<6	24	26	36.4	86.01	< 0.0001
SBP	>89	10	414	15.5		
	≤ 89	42	16	61.2	276.73	< 0.0001
LOC	No	10	362	1.8		
	Yes	42	68	21.9	88.20	<0.0001
Complication	No	9	389	1.5		
	Yes	43	41	29	137.56	<0.0001
GCS	13-15	7	300	1.5		
	9-12	11	93	5.4		
	<8	34	37	41	136.37	<0.0001
Pre-hospital Care	Yes	8	225	2.6		
	No	44	205	10.4	17.97	<0.0001

Footnote: Pre-hospital care: Care given for RTA patients before admitted to health facility

5. 8 Kaplan-Meier survival graphs for selected predictors

RTA patients who reside in Addis Ababa had a better survival probability compared to those who reside outside Addis Ababa **(Figure 7)**.

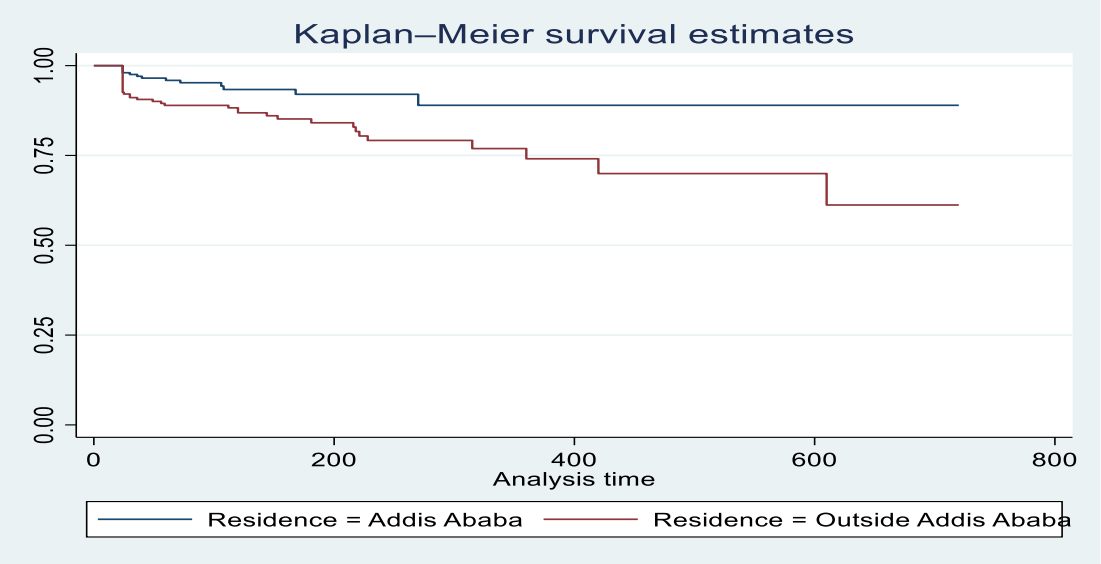


Figure 7: Kaplan-Meier survival curve estimate for RTA patients admitted to trauma hospitals of Addis Ababa city, categorized by residence.

RTA patients with a history of poly-trauma had a low survival probability compared to patients with mono-trauma **(Figure 8)**.

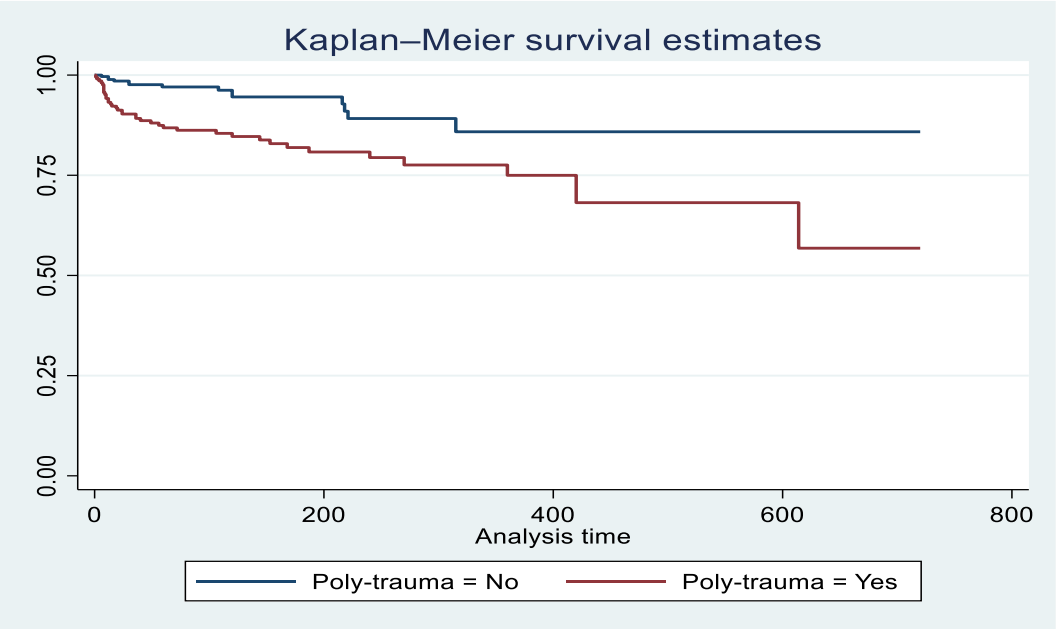


Figure 8: Kaplan-Meier survival curve estimate for RTA patients admitted to trauma hospitals of Addis Ababa, categorized by poly-trauma.

RTA patients who had visceral organ injury had a low survival probability compared to their counterparts **(Figure 9)**.

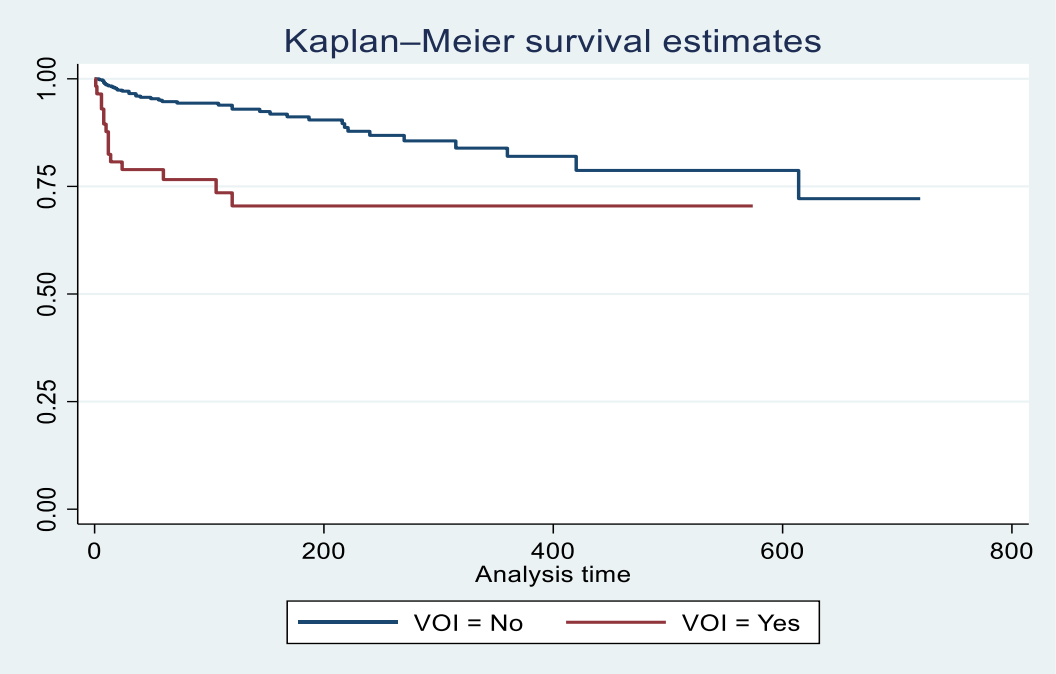


Figure 9: Kaplan-Meier survival curve estimate for RTA patients admitted to trauma hospitals of Addis Ababa city, categorized by visceral organ injury.

Footnote: VOI- Visceral Organ Injury

5.9 Predictors of mortality among RTA patients

Bivariate analysis

The relationships between mortality and the independent variables were analyzed using the Cox proportional hazards regression analysis. In bivariate Cox proportional hazards regression analysis: sex, age, residence, mode of arrival, the role of the RTA patients at the time of injury, pre-hospital care, time at which event occurred, presence or absence of comorbidities, mechanism of injury, presence or absence of poly-trauma, injured body part, presence or absence of visceral organ injury, history of the presence of bleeding, fracture, particular fractured bone, presence of an open wound, referral status, presence or absence of referral form, referral source, GCS, SBP, KTS II, loss of consciousness, the reason for admission, presence or absence of complication, hospital-acquired disease and admission to ICU were paired with mortality to see the association. However, in bivariate analysis, variables like place of residence, history of bleeding, GCS, KTS II, poly-trauma, visceral organ injury, admission to ICU, SBP, complications developed, presence of an open wound, time event occurred, hospital-acquired disease, pre-hospital care, and having a history of loss of consciousness became candidates for multivariable Cox regression analysis **(Table 10)**.

Table 10: Bivariate Cox proportional hazards regression analysis for independent predictors of death among RTA patients admitted to AaBET and ALERT hospitals, Addis Ababa, Ethiopia; Jan, 2020 to Dec, 2024; (n = 482).

Variables	Category	Patient status		CHR (95%CI)	P-value
		Event	Censored		
Sex	Female	12	108	**1**	
	Male	40	322	1.13(0.59, 2.17)	0.695
Residence	Addis Ababa	14	239	**1**	
	Outside Addis Ababa	38	191	1.31(.90,1.91**)**	0.147
Presence of comorbidity	No	46	387	**1**	
	Yes	6	43	1.19(0.50, 2.79)	0.682
Bleeding	No	3	79	**1**	
	Yes	49	351	2.59 (.80, 8.36)	0.109
Glasgow Coma Scale	13-15	7	300	**1**	
	9-12	11	93	3.83 (1.47, 9.94)	0.006
	<8	34	37	25.08(10.92,57.59)	<0.0001
Poly-trauma	No	14	262	**1**	
	Yes	38	168	3.17 (1.71, 5.87)	<0.0001
Complication (n=482)	No	9	389	**1**	
	Yes	43	41	20.5 (9.97, 42.14)	<0.0001
SBP	>89	10	414	**1**	
	≤ 89	42	16	36 (18.06, 71.93)	<0.0001
Kampala Trauma Score II	9-10	13	310	**1**	
	7-8	15	94	2.92 (1.37, 6.20)	0.005
	<6	24	26	12.73 (6.40, 25.31)	<0.0001
History of loss of consciousness	No	10	362	**1**	
	Yes	42	68	12.8 (6.41, 25.55)	<0.0001
Hospital acquired diseases	No	40	397	**1**	
	Yes	12	33	2.08 (1.08, 3.99)	0.028
Admission to ICU	No	37	361	**1**	
	Yes	15	69	2.09 (1.15, 3.82)	0.016
Pre-hospital care	No	8	225	**1**	
	Yes	44	205	4.40 (2.06, 9.37)	<0.0001
Visceral organ injury	No	37	388	1	
	Yes	15	42	3.19 (1.74, 5.83)	<0.0001
Time of injury	Day	28	378	1	
	Night	24	52	5.13 (2.96, 8.92)	<0.0001

Multivariable Cox proportional hazards regression analysis

Variables with p < 0.25 in bivariate analysis and that met the proportionality test assumption were included in multivariable analysis. Therefore, bleeding, residence, GCS, KTS II, visceral organ injury, admission to ICU, complications, presence of an open wound, time event occurred, hospital-acquired disease, pre-hospital care, poly-trauma, SBP, and loss of consciousness were included in multivariable Cox proportional hazards regression analysis. Among them, GCS, having a history of loss of consciousness, having a history of complication, SBP, and admission to ICU became significant predictors of death among RTA patients, adjusting for bleeding, poly-trauma, visceral organ injury, time event occurred, hospital-acquired disease, pre-hospital care, KTS II, presence of open wound, and residence at p-value < 0.05.

The hazard of death among RTA patients who had a GCS ≤ 8 was about 3.41 times higher than those with a GCS score between 13 and 15 (AHR 3.41, 95% CI (1.09, 10.71)). The hazard of death among RTA patients who had complications was 2.89 times higher than those who didn't have complications (AHR 2.89, 95% CI (1.22, 6.85)). The hazard of death among RTA patients with SBP ≤ 89 was 5.98 times higher compared to those with SBP > 89 (AHR 5.98, 95% CI (2.30, 15.51)). The hazard of death among RTA patients who had a history of loss of consciousness was 2.46 times higher compared to those who didn't have loss of consciousness (AHR 2.46, 95% CI (1.12, 5.40))**.** The risk of death among RTA patients admitted to the ICU was 2.34 times higher compared to those who were not admitted to the ICU (AHR 2.8, 95% CI (1.18, 4.63)).

Table 11: Multivariable Cox proportional hazards regression analysis for independent predictors of death among RTA patients admitted to AaBET and ALERT hospitals, Addis Ababa, Ethiopia; Jan, 2020 to Dec, 2024; (n = 482).

Variables	Category	Patient status		AHR (95%CI)	P-value
		Event	Censored		
Residence	Addis Ababa	14	239	**1**	
	Outside Addis Ababa	38	191	1.25 (0.62,2.49)	0.526
Bleeding	No	3	79	**1**	
	Yes	49	351	0.73 (0.20, 2.63)	0.635
Glasgow Coma Score	13-15	7	300	**1**	
	9-12	11	93	0.92 (0.30, 2.77)	0.883
	≤ 8	34	37	3.41 (1.09, 10.71)	**0.035**
Poly-trauma	No	14	262	**1**	
	Yes	38	168	0.84 (0.40, 1.75)	0.652

Complications	No	9	389	**1**	
	Yes	43	41	2.89 (1.22, 6.85)	**0.016**
Presence of open wound	No	14	283	1	
	Yes	38	147	1.47 (0.70, 3.09)	0.301
SBP	>89	10	414	**1**	
	≤ 89	42	16	5.98 (2.30, 15.51)	**<0.0001**
Kampala trauma score II	9-10	9	389	**1**	
	7-8	13	310	1.66 (0.69, 3.98)	0.252
	<6	15	94	1.22 (0.47, 3.17)	0.679
History of loss of consciousness	No	24	26	**1**	
	Yes	10	362	2.46 (1.12, 5.40)	**0.024**
Hospital acquired diseases	No	42	68	**1**	
	Yes	40	397	1.34 (0.58, 3.12)	0.484
Admission to ICU	No	37	361	**1**	
	Yes	15	69	2.34 (1.18, 4.63)	**0.014**
Pre-hospital care	No	8	225	**1**	
	Yes	44	205	2.00 (0.81, 4.94)	0.130
Visceral organ injury	No	37	388	**1**	
	Yes	15	42	1.52 (0.56, 4.13)	0.406
Time of injury	Day	28	378	**1**	
	Night	24	52	1.65 (0 .66, 4.16)	0.282

5.10 Cox proportional hazards assumptions checking

The Schoenfeld residual test showed that the overall model satisfied the proportionality assumption (X^2 10.43, P < 0.8435). Graphical assessment of the proportional hazards assumption was performed by plotting the -ln(-ln(survival)) against –ln (analysis time) for covariates significantly associated with mortality. The curves appeared roughly parallel, with no crossing observed, indicating that the proportional hazards assumption is reasonably satisfied **(Figure 10)**.

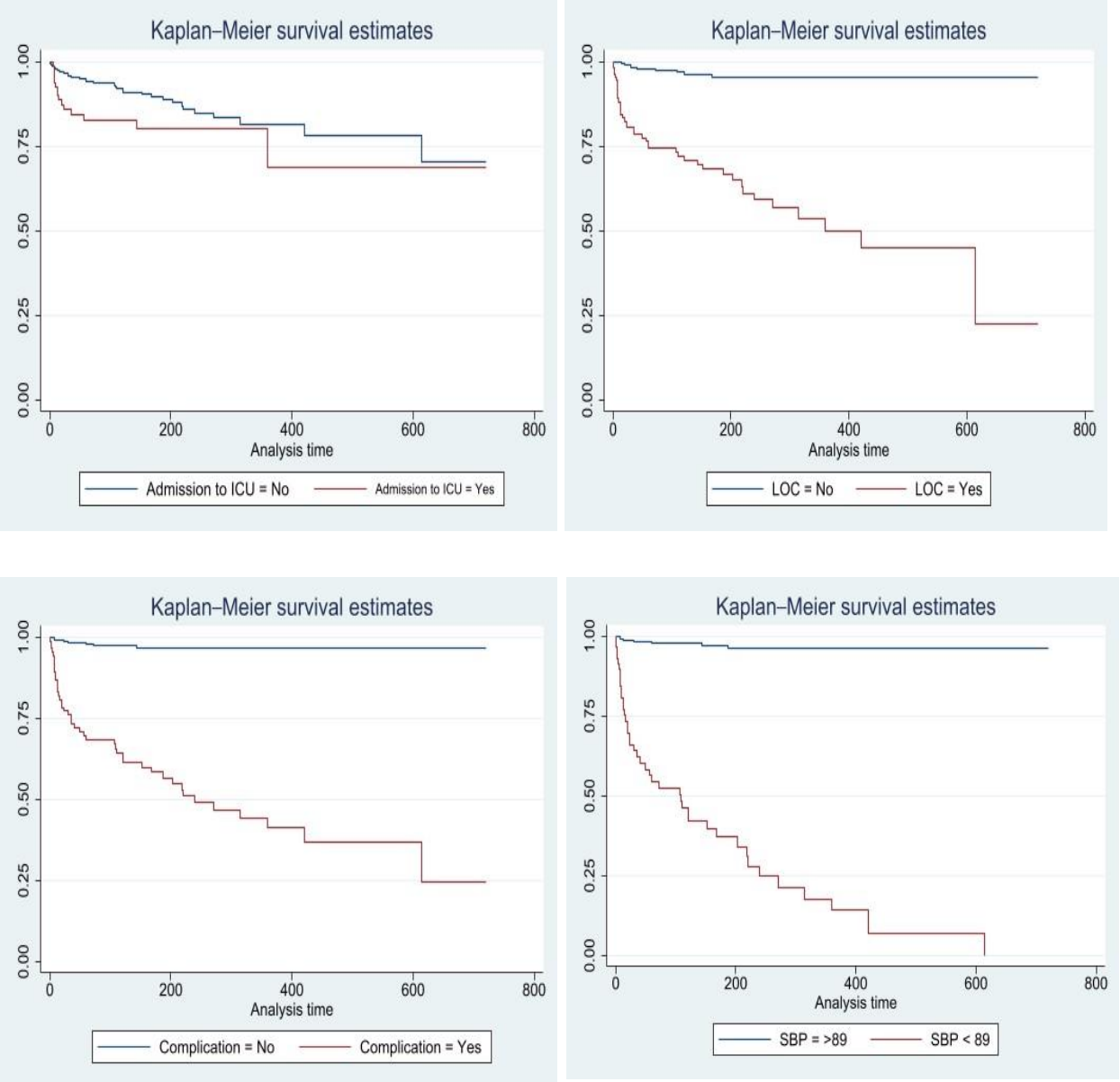


Figure 10: Graphical assumption checking for statistically significant independent variables

Footnote: LOC= Loss of consciousness, SBP= Systolic blood pressure, and ICU Intensive care unit.

The Martingale residual plot was used to assess the linearity assumption. The plot indicated that the relationship between the covariates and the log hazard was linear. Additionally, the residuals show no systematic pattern or trend across the range of covariates, supporting the validity of the linearity assumption.

The model's fitness was evaluated using the Cox-Snell residual. Residuals from the fitted model follow an exponential unit distribution along the 45-degree slope (baseline). The graph shown below indicates that the assumption was satisfied **(Figure 11)**. Hence, applying multivariable Cox proportional hazards regression analysis is appropriate for these data.

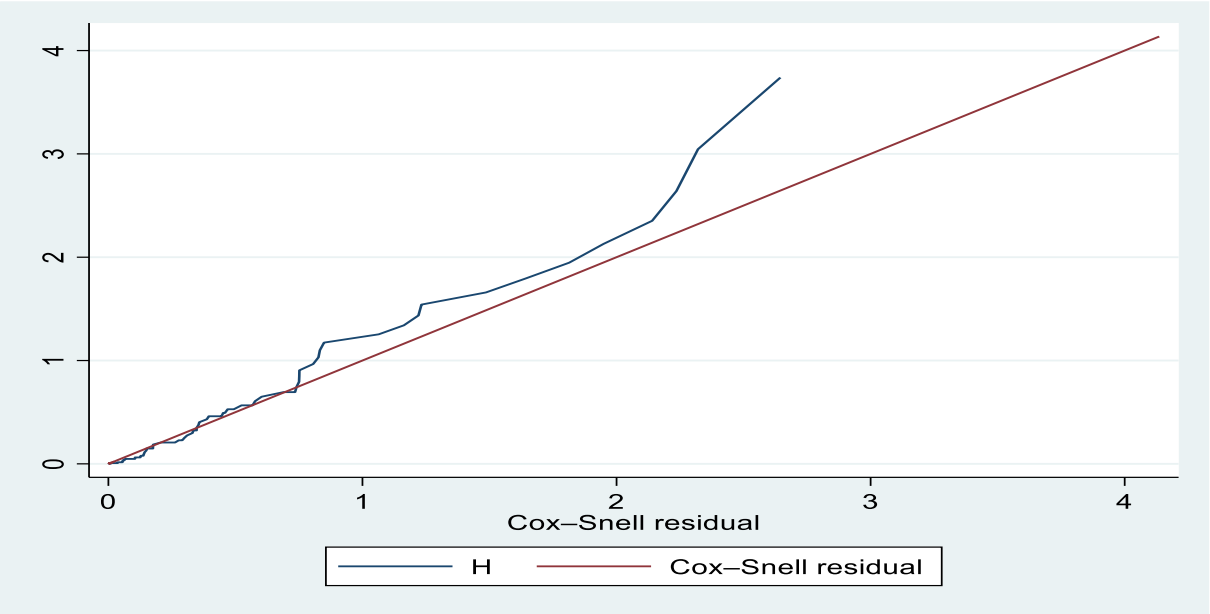


Figure 11: Nelson-Aalen cumulative hazard graph against Cox-Snell residual on RTA patients admitted to AaBET and ALERT hospitals, Addis Ababa, Ethiopia; Jan, 2020 to Dec, 2024; (n = 482).

6. Discussion

This study discovered that the mortality incidence among admitted RTA patients was 7.2 per 10,000 person-hours, highlighting the burden of RTA-related deaths. GCS scale $\leq$ 8, developing complications, admission to ICU, SBP $\leq$ 89 mmHg at admission, and experiencing loss of consciousness during or after accidents were the key predictors of mortality. Additionally, the mean survival time was 6.24 $\pm$ 6.2 SD, emphasizing the critical period during which clinical interventions may influence outcomes.

The present study found that 10.8% of RTA patients died during the follow-up time. This finding is higher than a study conducted at Wolaita Sodo, southern Ethiopia, which reported a mortality rate of 9.5% (16), but lower than the mortality rate reported in another study from East Shewa zone Oromia, Ethiopia, 12.9% (27). However, it is higher than the finding of a study from Kenya (7.7%) (43). In contrast, it is lower than the rates observed in studies from the Democratic Republic of Congo (19.6%) (19) and Tanzania (17.5%) (64). The possible explanations for this discrepancy may be the patient's characteristics, healthcare quality, and methodological factors.

The mortality incidence among RTA patients in this study was 7.2/10,000 person-hours of observations, which aligns with a study in the Sidama region of Ethiopia (34) but higher than rates reported in Northwest of Ethiopia and Addis Ababa, which reported rates of 2.9/10,000 and 1.0/ 10,000 person-hours respectively (24, 32). Furthermore, it is higher than the rate reported in a study from Iran, which reported 4.51/10,000 person-hours (31). The possible reasons for these discrepancies may be that our study included only cases admitted to the hospitals, which likely involved more severe injuries. Furthermore, differences in hospitals' critical care setups and emergency management protocols across institutions may also contribute to these variations.

The present study revealed that RTAs mostly affected the male population, with a male-to-female ratio of 3:1, which is similar to findings from a study in the northwest of Ethiopia (2.6:1) (24), but smaller than a study in Ethiopia's Sidama region (34). However, it is higher than the ratio reported in studies from the Democratic Republic of Congo (1.13), but smaller than ratio reported in study from Kenya (4:1) (19, 43). The possible explanations for this discrepancy may be attributed to sample size and gender role, which may limit the female's role to indoor activities.

The present study found that pedestrians were the most frequently affected group by RTAs compared to passengers and drivers, which is similar to studies in Ethiopia (24, 27). Additionally, it aligns with a study from Japan (47). In our study, the mortality incidence among the male population was higher (7.4/10,000 pho) compared to the female population. This finding is consistent with a study in the Sidama region of Ethiopia (34). Furthermore, it is similar to the mortality rate reported in a study from Iran (31). The possible reason for this difference may be that females are more likely to be involved in an indoor activity than males.

The present study found that the mortality incidence among RTA patients under the age of 50 was higher compared to patients above the age of 50, which is consistent with a study from Ethiopia (22). Furthermore, it is similar to rates reported in the studies from the Democratic Republic of Congo and Tanzania, which reported that the mortality incidence was higher among those under 50 years (19, 64). Additionally, it is consistent with a study from Yemen (39). This disparity may be because younger populations are more prone to engaging in risky behaviors that lead to severe injury, thereby reducing their likelihood of responding to treatment.

The mortality incidence among RTA patients who reside outside Addis Ababa was higher (9.83 per 10,000) than those who reside in Addis Ababa, which aligns with a study from Addis Ababa, Ethiopia (46). The possible reasons for this discrepancy may be disparities in health care access, socioeconomic status, infrastructure like roads, and health awareness.

RTA patients who didn't receive pre-hospital care experienced a higher (10.4 per 10,000) rate of mortality compared to those who did, which is consistent with a mortality rate reported in a study from Ethiopia (65). Additionally, it is similar to a rate in a study from Tanzania (64). In contrast to studies in Ethiopia and Tanzania, a study in Brazil reported that the mortality rate among RTA patients who received pre-hospital care was higher (37). The possible explanations for this difference may be differences in healthcare infrastructures, injury characteristics, response times, and socio-demographic factors.

The current study showed that RTA patients with poly-trauma experienced a higher incidence of mortality (10.9 per 10,000) than RTA patients with mono-trauma, which agrees with the finding of a study in the Sidama region of Ethiopia (34). Also, it is consistent with studies from Tanzania and Iran (31, 64). The possible reasons for this variation may be that poly-trauma leads to multiple organ injuries. These injuries can affect vital organs like the brain, lungs, and heart, making it harder for the body to recover.

The incidence of mortality was higher (11.1 per 10,000) among RTA patients who acquired diseases during the hospitalization period compared to patients who didn't acquire such diseases ($p < 0.0235$). This finding agrees with a study conducted in the Sidama region of Ethiopia (34).

Regarding the time of injury, the incidence of mortality was higher among patients injured during nighttime compared to those who were injured during the daytime, similar to a study in the Amhara region of Ethiopia (51). Furthermore, it is consistent with a study in Japan (50). The possible reasons for this discrepancy may be that injuries during nighttime are more severe due to reduced visibility, which can delay recognition of deterioration.

Our study found that RTA patients with a low GCS score were associated with an increased risk of in-hospital death. RTA patients with a GCS score ≤ 8 had a hazard of death 3.41 times higher than those with a GCS score between 13 and 15, which is in agreement with studies in Ethiopia (32, 65). Additionally, similar results have been reported in studies referenced as (54, 66). The possible explanations for this discrepancy may be that RTA patients with low GCS had severe neurological impairment and systemic instability, which elevates the risk of death due to primary brain injury and secondary complications.

The occurrence of complications during hospitalization was a predictor of mortality. Patients who developed complications during the hospitalization period had a hazard of death 2.89 times higher than those who didn't, which aligns with studies in the Sidama region and Northwest Ethiopia (34, 65). Additionally, it is similar to a finding reported in a study in Germany (69). The possible reasons for this disparity may be that complications can affect various bodily systems, impair vital functions, and contribute to fatalities among RTA patients.

RTA patients with SBP less than or equal to 89 mmHg were at significantly higher risk of mortality than those with SBP above 89 mmHg. The hazard of death for patients with SBP $\leq$ 89 mmHg was 5.98 times higher compared to their counterparts, which supports studies undertaken in Ethiopia (32, 34, 65, 67). Furthermore, it is similar to a result reported in a study from Tanzania (68). The possible reason for the disparity might be that low blood pressure leads to poor blood perfusion to vital organs, which leads to multiple organ failure and increased mortality among RTA patients.

In our study, RTA patients who have experienced loss of consciousness were significantly affected by mortality than those who have not experienced loss of consciousness. Moreover, this study showed that the hazard of death among patients who experienced loss of

consciousness was 2.46 times higher than those who had not experienced loss of consciousness. This result was supported by a study conducted in Ethiopia and Tanzania (34, 64). The possible reasons for this discrepancy may be because loss of consciousness signifies severe injury, particularly to the brain, which is associated with a higher likelihood of complications and death.

RTA patients who have been admitted to the ICU had a higher risk of mortality than those who have not been admitted to the ICU. RTA patients admitted to the ICU had a hazard of death 2.34 times higher than those who were not admitted to the ICU, consistent with a study from Ethiopia (34). This finding is similar to studies conducted in the Tanzania and Democratic Republic of Congo (64, 66). In contrast, a study from Kenya indicates that admission to the ICU is protective (43). The discrepancy may be because most of RTA patients admitted to the ICU were severely injured and experienced delays in reaching definitive care, as many patients were referred after spending critical time elsewhere.

7. Strengths and limitations of the study

7.1 Strengths

Despite the nature of the study being retrospective, it possesses several strengths, including incorporating more than one study setting. Additionally, the use of electronic data collection using ODK minimized data quality issues associated with paper-based methods, such as incomplete records and manual data entry errors.

7.2 Limitations

Despite its notable strengths, the study has several limitations that should be acknowledged. First, the retrospective designs may have introduced biases related to data collection, potentially affecting the accuracy and completeness of the information gathered. Second, the absence of behavioural variables like drinking habit in the analysis may lead to unmeasured variable bias, limiting the comprehensiveness of the findings. Third, selection bias may be present since the study only included patients admitted to trauma hospitals, which may not be representative of all RTA patients. Additionally, the relatively low number of events and high proportion of censorship observed in this study may have reduced the statistical power.

8. Conclusion and Recommendations

8. 1 Conclusion

Road traffic accidents pose significant public health challenges. This study found that 10.8% of RTA patients admitted to trauma hospitals in Addis Ababa died during the follow-up period, with a mean survival time of 6.24 days. The independent predictors of mortality among these patients were a GCS score equal to 8 or less, SBP equal to 89 mmHg or lower, admission to the ICU, a history of complications during hospitalization, and loss of consciousness.These findings have important clinical implications. The results can guide public health strategies aimed at improving trauma care and post-crash response in the study area.

8.2 Recommendations

Clinicians should prioritize and give more attention to RTA patients with lower GCS, low SBP, admitted to the ICU, developed complications, and those with a history of loss of consciousness to identify high-risk RTA patients.

Researchers in the discipline are advised to undertake a prospective study in order to completely discover predictive factors. So that clinicians can use the result to prioritize patients throughout treatment.

Study settings are advised to include detailed clinical variables in patient charts for ongoing monitoring and research. Build and improve an electronic data management system.

References

1. Honelgn A, Wuletaw T. Road traffic accident and associated factors among traumatized patients at the emergency department of University of Gondar Comprehensive Teaching and Referral Hospital. PAMJ-Clinical Medicine. 2020;4(9 %@ 2707-2797).
2. Peden MM. World report on road traffic injury prevention: World Health Organization; 2004.
3. OPTALERT. The evolution of road safety 2017 [cited 2024 August 16]. Available from: https://www.optalert.com/the-evolution-of-road-safety/.
4. Benhamed A, Ndiaye A, Emond M, Lieutaud T, Boucher V, Gossiome A, et al. Road traffic accident-related thoracic trauma: Epidemiology, injury pattern, outcome, and impact on mortality-A multicenter observational study. PLoS One. 2022;17(5):e0268202.
5. Organization. WH. Global status report on road safety. Geneva: World Health Organization; 2023 [cited 2024 August 14/2024]. Available from: https://www.who.int/publications/i/item/9789240086517.
6. Who V. Global status report on road safety 2018. World Health Organization. 2018.
7. World Health O. Global status report on road safety 2018: World Health Organization; 2019.
8. Federal Democratic Republic of Ethiopia motal. National road safety strategy. 2022.
9. Fasika Amdeslasie MD, Mizan Kidanu MD, Wondwosen Lerebo MD, Dagim Ali DA. PATTERNS OF TRAUMA IN PATIENT SEEN AT THE EMERGENCY CLINICS OF PUBLIC HOSPITALS IN MEKELLE, NORTHERN ETHIOPIA. 2016.
10. Alharbi R, Mosley I, Miller C, Hillel S, Lewis V. Factors associated with physical, psychological and functional outcomes in adult trauma patients following Road Traffic Crash: A scoping literature review. Transportation Research Interdisciplinary Perspectives. 2019;3:100061.
11. Mayou R, Bryant B. Consequences of road traffic accidents for different types of road user. Injury. 2003;34(3):197-202. doi: 10.1016/s0020-1383(02)00285-1.
12.(WHO). WHO. Road Traffic Injuries 2022. Available from: https://www.who.int/srilanka/news/detail/17-05-2022-holistic-approach-to-prevent-deaths-from-road-traffic-crashes-underscored-during-un-road-safety.
13. Boniface R, Museru L, Kiloloma O, Munthali V. Factors associated with road traffic injuries in Tanzania. Pan Afr Med J. 2016;23:46.(doi):10.11604/pamj.2016.23.46.7487. eCollection 2016.
14. Boyko V, Dubrovina N, Gerrard R, Zamiatin P, Gurov O, Tovkach Y, et al. Study of Severe Trauma Mechanism of Victims and Prediction of Outcomes of Patients in Road Transport and Other Accidents: Forensic and Clinic Issues. 2020.
15. Ren K, Miao L, Lyu J. The temporal trend of road traffic mortality in China from 2004 to 2020. SSM-Population Health. 2023;24:101527 %@ 2352-8273.
16. Hizkel A, Gebru T, Yisihak E, Markos D. Outcome and associated factors among road traffic accident victims at wolaita soddo christian hospital, wolaita soddo, south ethiopia 2020, institution-based cross-sectional study. medRxiv. 2021:2021.09. 16.21262878.
17. World Health O. Global status report on road safety 2013: supporting a decade of action: summary. World Health Organization; 2013.
18. Vissoci JRN, Shogilev DJ, Krebs E, Andrade Ld, Vieira IF, Toomey N, et al. Road traffic injury in sub-Saharan African countries: A systematic review and summary of observational studies. Traffic injury prevention. 2017;18(7):767-73 %@ 1538-9588.
19. Ndongila JM, Natuhoyila AN, Nkumu ML, Batane LMB, Kulimba DM, Nsambi G, et al. Survival and Predictors of Patient Mortality during Road Traffic Accidents in the Democratic Republic of Congo: Historical Cohort Study. Open Access Library Journal. 2021;8(11):1-11.
20. RTA. Traffic Safety activity in Ethiopia report fiscal year 2016/2017. 2017.

21. Ali S, Destaw Z, Misganaw A, Worku A, Negash L, Bekele A, et al. The burden of injuries in Ethiopia from 1990-2017: evidence from the global burden of disease study. Injury epidemiology. 2020;7:1-11.
22. Denu ZA, Osman MY, Bisetegn TA, Biks GA, Gelaye KA. Prevalence and risk factors for road traffic injuries and mortalities in Ethiopia: systematic review and meta-analysis. Injury prevention. 2021;27(4):384-94 %@ 1353-8047.
23. Assembly WhoUG. Decade of action for road safety 2021-2030 2020. Available from: https://www.who.int/teams/social-determinants-of-health/safety-and-mobility/decade-of-action-for-road-safety-2021-2030.
24. Denu ZA, Yassin MO, Azale T, Biks GA, Gelaye KA. Do deaths from road traffic injuries follow a classical trimodal pattern in North West Ethiopia? A hospital-based prospective cohort study. BMJ open. 2021;11(12):e051017 %@ 2044-6055.
25. World Health O. Road safety: The Global Health Observatory; 2016 [cited 2024 August 19]. Available from: https://www.who.int/data/gho/data/themes/road-safety.
26. Wang D, Liu Q, Ma L, Zhang Y, Cong H. Road traffic accident severity analysis: A census-based study in China. Journal of safety research. 2019;70:135-47 %@ 0022-4375.
27. Demisse A, Shore H, Ayana GM, Negash B, Raru TB, Merga BT, et al. Magnitude of death and associated factors among road traffic injury victims admitted to emergency outpatient departments of public and private hospitals at Adama Town, East Shewa Zone, Ethiopia. SAGE Open Medicine. 2021;9:20503121211060203.
28. Jofiro G, Teklu B, Kumie M. Magnitude of Road Traffic Accidental (RTA) Death and Its associated factors among Adult Emergency Visit Patients at ALERT Hospital, A 2 Year Retrospective Review Study. Pan African Journal of Emergency Medicine and Critical Care. 2023;1(2 %@ 2958-9584).
29. Mamo DE, Abebe A, Beyene T, Alemu F, Bereka B. Road traffic accident clinical pattern and management outcomes at JUMC Emergency Department; Ethiopia. African journal of emergency medicine. 2023;13(1):1-5 %@ 2211-419X.
30. Mengistu Z, Ali A, Abegaz T. The pattern of orthopedic fractures and visceral injury in road traffic crash victims, Addis Ababa, Ethiopia. PLoS One. 2021;16(9):e0253690.
31. Mirzaei M, Mirzadeh M, Shogaei Far H, Mirzaei M. Trends in Road Traffic Deaths in Yazd, Iran, 2004 - 2010. Archives of Trauma Research. 2016;5(2):- %! Trends in Road Traffic Deaths in Yazd, Iran, 2004 - 10.
32. Seid M, Azazh A, Enquselassie F, Yisma E. Injury characteristics and outcome of road traffic accident among victims at Adult Emergency Department of Tikur Anbessa specialized hospital, Addis Ababa, Ethiopia: a prospective hospital based study. BMC emergency medicine. 2015;15:1-9.
33. Kebede AG, Tegenaw A, Tamir Y, Afewerk S, Belayneh AG, Tamre S, et al. Survival status and its predictors among adult victims of road traffic accident admitted to public hospitals of Bahir Bar City, Amhara regional state, Northwest, Ethiopia, 2023: multi center retrospective follow-up study. BMC emergency medicine. 2024;24(1):177.
34. Afacho AA, Belayneh T, Markos T, Geleta D. Incidence and predictors of mortality among road traffic accident victims admitted to hospitals at Hawassa city, Ethiopia. PLoS one. 2024;19(5):e0296946 %@ 1932-6203.
35. World Health O. Global status report on road safety 2015: World Health Organization; 2015.
36. World Health O. Global status report on alcohol and health 2018: World Health Organization; 2018.
37. Tobias GC, Mandacaru PMP, Guimaraes RA, Morais Neto OL. Use of prehospital, hospitalization and presence of sequelae and/or disability in road traffic injury victims in Brazil. PLoS One. 2021;16(4):e0249895.

38. Lin T, Li N, Du W, Song X, Zheng X. Road traffic disability in China: prevalence and socio-demographic disparities. Journal of public health. 2013;35(4):541-7 %@ 1741-3850.
39. Eshrak A, Ali A, Yousef K. Pattern of road traffic injuries in Yemen: A hospital-based study. The Pan African Medical Journal. 2018;29 %@ 1937-8688.
40. Jima D, Zewdie R. Disabilities and road traffic incident in ethiopia. 2021.
41. Ursula Miller ECS-, " Light for the World International, 2016.
42. Sae-Tae N, Lim A, Kakchapati S, Ueranantasun A. Hospital reported factors associated with mortality among road traffic accident victims in southern Thailand. Southeast Asian Journal of Tropical Medicine and Public Health. 2018;49(4):717-26 %@ 0125-1562.
43. Saidi H, Mutiso BK, Ogengo J. Mortality after road traffic crashes in a system with limited trauma data capability. Journal of trauma management & outcomes. 2014;8:1-6.
44. Rus Ma D, Peek-Asa C, Baragan EA, Chereches RM, Mocean F. Epidemiology of Road Traffic Injuries Treated in a Large Romanian Emergency Department in Tîrgu-Mureş Between 2009 and 2010. Traffic Inj Prev. 2015;16(8):835-41. doi: 10.1080/15389588.2015.1030501. Epub 2015 Apr 1.
45. Chandrasekharan A, Nanavati AJ, Prabhakar S, Prabhakar S. Factors Impacting Mortality in the Pre-Hospital Period After Road Traffic Accidents in Urban India. Trauma monthly. 2016;21(3):e22456.
46. Starr N, Ayehu M, Zhuang A, Minalu HT, Alemu GK, Fisseha S, et al. Review of a large trauma registry in Addis Ababa, Ethiopia: insights into prehospital care and provider training for trauma quality improvement. East and Central African Journal of Surgery. 2023;28(2 %@ 2073-9990).
47. Katayama Y, Kitamura T, Kiyohara K, Sado J, Hirose T, Matsuyama T, et al. Prehospital factors associated with death on hospital arrival after traffic crash in Japan: a national observational study. BMJ open. 2019;9(1):e025350.
48. Okada N MT, Takebe K, Kitamura T, Sado J, Ohta B. . Rear seating position is associated with a higher risk of mortality in motor vehicle crashes: analysis of Japanese Trauma Data Bank. Acute Med Surg 2020;7(1):e444.
49. Molina-Soberanes D M-RV, Lardelli-Claret P, Pulido-Manzanero J, Martín-delosReyes LM, Moreno-Roldán E, et al. . Individual and environmental factors associated with death of cyclists involved in road crashes in Spain: a cohort study BMJ Open 2019;9(8):e028039.
50. Katayama Y, Kitamura T, Kiyohara K, Iwami T, Kawamura T, Hayashida S, et al. Factors associated with prehospital death among traffic accident patients in Osaka City, Japan: a population-based study. Traffic injury prevention. 2018;19(1):49-53 %@ 1538-9588.
51. Endeshaw AS, Dejen ET, Zewdie BW, Addisu BT, Molla MT, Kumie FT. Perioperative mortality among trauma patients in Northwest Ethiopia: a prospective cohort study. Scientific reports. 2023;13(1):22859.
52. Abafita BJ, Abate SM, Kasim HM, Basu B. Pattern and Outcomes of Injuries among Trauma Patients in Gedeo Zone, Dilla, South Ethiopia: A 5 Years Retrospective Analysis. Ethiop J Health Sci. 2020;30(5):745-54.
53. Culhane J, Silverglate B, Freeman C. Alcohol is a predictor of mortality in motor vehicle collisions. Journal of safety research. 2019;71:201-5 %@ 0022-4375.
54. Travis LL CD, Haskins AE, Kilch JA. Mortality in rural locations after severe injuries from motor vehicle crashes. J Safety Res 2012;43(5-6):375–80.
55. Homayoun SB, Milad JD, Mina G, Parvin S. Predictors of pre-hospital vs. hospital mortality due to road traffic injuries in an Iranian population: results from Tabriz integrated road traffic injury registry. BMC emergency medicine. 2022;22(1):37.
56. Alharbi RJ, Lewis V, Miller C. A state-of-the-art review of factors that predict mortality among traumatic injury patients following a road traffic crash. Australas Emerg Care. 2022;25(1):13-22.

57. Hamidun R RA, Sarani R. . Exploring factors for pedestrian fatalities at junctions in Malaysia. . Pertanika J Soc Sci Humanity 2017;25:1833–40.

58. Olds K BR, Langlois NE. . Injury patterns and features of cycling fatalities in South Australia. . J Forensic Leg Med 2015;34:99–103.

59. Saidi H MB, Ogengo J. . Mortality after road traffic crashes in a system with limited trauma data capability. J Trauma Manag Outcomes 2014;8(1):4.

60. Talving P TP, Barmparas G, DuBose J, Preston C, Inaba K, et al. Motorcycle-related injuries: effect of age on type and severity of injuries and mortality. J Trauma Acute Care Surg 2010;68(2):441–6.

61. Leung C LC, Tsui K. . Predictors of outcomes of pedestrian casualties in motor vehicle injuries managed in emergency department. Hong Kong J Emerg Med 2013;20(2):82–9.

62. Senserrick T BS, De Rome L, Ivers R, Stevenson M. . Detailed analysis of pedestrian casualty collisions in Victoria, australia. Traffic Inj Prev 2014;15(sup1):S197–205.

63. Tilahun L, Zeleke M, Desu B, Dagnew K, Nega A, Birrie E, et al. Time to recovery and its predictors following traumatic injuries among injured victims in Dessie Comprehensive Specialized Hospital, North East of Ethiopia, 2022: a retrospective follow-up study. BMC emergency medicine. 2024;24(1):44.

64. Chalya PL, Dass RM, McHembe MD, Mbelenge N, Ngayomela IH, Chandika AB, et al. Citywide trauma experience in Mwanza, Tanzania: a need for urgent intervention. J Trauma Manag Outcomes. 2013;7(1):9. doi: 10.1186/752-2897-7-9.

65. Messelu MA, Tilahun AD, Beko ZW, Endris H, Belayneh AG, Tesema GA. Incidence and predictors of mortality among adult trauma patients admitted to the intensive care units of comprehensive specialized hospitals in Northwest Ethiopia. Eur J Med Res. 2023;28(1):113.

66. Numbe BCW, Gulimwentuga FC, Mukamba FM, Matabaro BS, Wani AB, Mudekereza PS, et al. Factors Associated With In-Hospital Mortality After Road Traffic Accidents in Bukavu. 2024.

67. Denu ZA, Yassin MO, Azale T, Biks GA, Gelaye KA. Timing, Distribution and Predictors of Mortality Following a Road Traffic Injury in Northwest Ethiopia: A Hospital-Based Prospective Follow up Study. 2021.

68. Chalya PL, Mabula JB, Dass RM, Mbelenge N, Ngayomela IH, Chandika AB, et al. Injury characteristics and outcome of road traffic crash victims at Bugando Medical Centre in Northwestern Tanzania. J Trauma Manag Outcomes. 2012;6(1):1. doi: 10.1186/752-2897-6-1.

69. Qiao Z, Wang W, Yin L, Luo P, Greven J, Horst K, et al. Using IL-6 concentrations in the first 24 h following trauma to predict immunological complications and mortality in trauma patients: a meta-analysis. European journal of trauma and emergency surgery : official publication of the European Trauma Society. 2018;44(5):679-87.

70. Hailemichael Y, Kassahun T. Prognostic factors for time-to-death from traumatic brain injury following road traffic accident. 2023.

71. NLBd Oliveira RS. Factors associated with the death of motorcyclists in traffic accidents. Revista da Escola de Enfermagem da USP 2012;46(6):1379–86.

72. Endalamaw A, Birhanu Y, Alebel A, Demsie A, Habtewold TD. The burden of road traffic injury among trauma patients in Ethiopia: a systematic review and meta-analysis. African journal of emergency medicine. 2019;9:S3-S8 %@ 2211-419X.

73. M. D. Risk factors associated with serious and fatal road traffic accidents in Manzini City, Swaziland. BMC EmergMed 2017; 15(1): 1.

74. SL. M. Knowledge and skill of triaging with associated factors among nurses working in adult emergency departments of selected Addis Ababa Public Hospitals, 2017 GC. [Educational Research]. [Addis Ababa, Ethiopia]: Addis Ababa University; 2017. .
75. Mengistu Z, Ali A, Abegaz T. Prehospital care and 24-hour crash injury mortality among road traffic crash victims in Addis Ababa, Ethiopia. Science. 2021;9(1):23-9.
76. Holder Y. Injury surveillance guidelines: World Health Organization. Geneva; 2001.
77. Mutooro SM, Mutakooha E, Kyamanywa P. A comparison of Kampala trauma score II with the new injury severity score in Mbarara University Teaching Hospital in Uganda. East and Central African Journal of Surgery. 2010;15(1):62-71 %@ 2073-9990.

Annex I: Information sheet (English version)

Research Title: The Incidence and Predictors of Inpatient Mortality Among Road Traffic Accident Patients Admitted to Trauma Hospitals in Addis Ababa, Ethiopia, Retrospective Follow-Up Study.

Name of principal investigator: Deressa Bayisa (BSc)

Name of the sponsoring organization: Addis Ababa University

Introduction: This information sheet is prepared for AaBET and ALERT specialized Hospitals. The form aims to make the institution clear about the purpose of the research, data collection procedures, and finally, to get permission to conduct the research.

Purpose of the research project: Primarily, the results of this study will be submitted to Addis Ababa University School of Public Health for the requirements to obtain a Master of Public Health in Epidemiology and Biostatistics. Additionally, there are few studies done so far in the area of road traffic accidents due to the fact in Ethiopia. The international and national road safety program had mentioned improving research capacity on road traffic crashes as one strategy to reduce death, injury, and disability. Thus, the findings of this study will contribute their part in filling the information gap related to road traffic accidents. Therefore, it will contribute to policies that focus on road traffic accident prevention, control, and treatment.

Procedure: All patients' cards and database information of road traffic accidents who were admitted to AaBET and ALERT hospitals from January 1, 2020, to December 31, 2024, will be selected, and a review of the required information from the records will be made using the extraction tool. Two male graduate students will be trained and review the charts using ODK.

Risk: There were and will be no risk at all for patients whose records will be reviewed.

Benefits: There will be no incentive or direct benefit to patients whose charts are involved in the study. Indeed, they will benefit indirectly from the research when the result of the study is used for program planning. Therefore, this research will have a paramount direct benefit for health care planners and managers working on road traffic accident prevention and control.

Confidentiality: The rights of all victims were highly respected. The victim’s name will not be used; instead, number codes will be used for every patient. The victim’s information will be kept confidential so that no other parties can obtain it except the principal investigator, and it will be locked with a password on a computer.

Person to contact: This research proposal will be reviewed and approved by the Institutional Review Board of the Public Health College of Health Sciences, Addis Ababa University. In case you want to know more about the research and its undertakings, you can contact the committee through the following address.

Addis Ababa University College of Medicine and Health Science Research Review Committee
Deressa Bayisa (MPH Candidate): Tel: +251912405443

Permission letter

Therefore, you are kindly requested to permit and forward your permission to the concerned body in your organization so that the researcher can get cooperation from data clerks and other responsible bodies.

With regards!

To be filled by medical directors:

I have properly examined the objective of the study, understood that patient rights are respected as well as patient confidentiality is assured, and there will be no risks to patients related to the study. Therefore, I gave formal permission for the study to begin on behalf _____hospital.

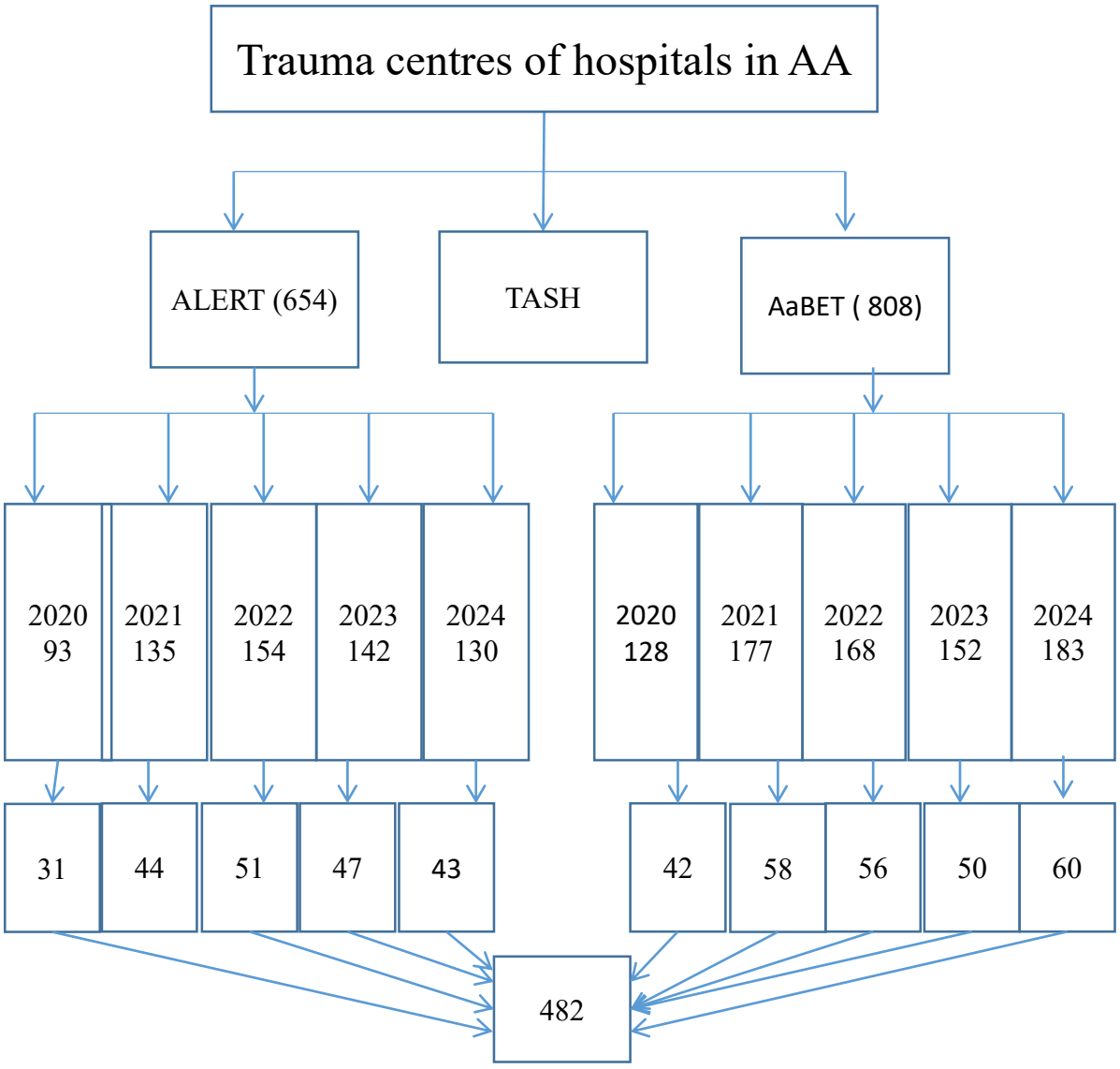
Medical Director Name: _____

Signature: _____

Date: _____

Annex II: Data abstraction form and sampling procedure

A. Sampling Procedure



B. Data abstraction form

S/N	Demographic profiles		Remarks
	Variables	Category	
01	Sex of study participant?	Male	
		Female	
02	Age of study participant?	0-15	
		16-30	
		31-45	
		46-60	
		>60	
03	Residence	Addis Ababa	
		Outside Addis Ababa	
04	Occupation	Employed	
		Merchant	
		Farmer	
		Student	
		House wife	
		Taxi driver	
		Others	
05	Hospital arrival time in hours		
06	Mode of arrival at the hospital	Ambulance	
		Taxi	
		Self-presentation(walk up)	
		Inter-facility referral	
		Private vehicle	
		Police	
		Other	
07	Road user category	Pedestrian	
		Passenger	
		Driver	
08	Prehospital care	No	
		Yes	
09	Mechanism of the accident	Pedestrian directly hit by a vehicle	
		Rollover	
		Collision	
10	The type of vehicle that causes injury	Three wheeled	
		Four wheeled	
		Two wheeled	
		Not complete data	
11	What was the referral status of the victims?	Self-referral	
		Referred	
12	Having a referral form	Yes	
		No	
13	Sources of referral settings	Directly from the scene	
		Health center	
		Hospital	

14	Presence of comorbidity	No	
		Yes	
	Injury pattern and characteristics		
15	Presence of poly-trauma	No	
		Yes	
16	Injured body part	Extremities	
		Head	
		Multiple	
		Others	
17	Visceral organ injury	No	
		Yes	
18	Presence of bleeding	No	
		Yes	
19	Any bone fracture	No	
		Yes	
20	A particular fractured bone	Extremities	
		Face	
		Skull	
		Multiple	
		Others	
21	Presence of an open wound	No	
		Yes	
22	Presence of disability upon discharge	No	
		Yes	
	If yes to q24	Temporary	
		Permanent	
	Admission and management of the victim		
23	Respiratory rate at admission(breath/min)		
24	Pulse rate at admission (beats/min)		
25	Temperature at admission		
26	SBP at admission	>89 mmHg	
		≤89 mmHg	
27	GCS at admission	< 8 GCS value	
		9-12 GCS value	
		13-15 GCS value	
28	Kampala trauma score II	<6	
		7-8	
		9-10	
29	History of loss of consciousness	No	
		Yes	
30	Reason for admission	Surgery and resuscitation	
		Close observation	
31	Admission to the ICU	No	
		Yes	
Management and diseases among victims			
32	Common procedures done	Wound repair	

		Plaster of Paris	
		Craniotomy	
		Chest tube	
		Ventilation	
		Fixation	
		Medication	
		Other	
33	Was there Hospital hospital-acquired disease?	No	
		Yes	
34	If yes to q23, what was the particular disease acquired?	Pneumonia	
		Others	
35	Did complications develop?	No	
		Yes	
36	What was the type of management given?	Conservative	
		Surgical & conservative	
37	Blood transfusion	Yes	
		No	
Please read the history note, discharge summary, or death summary before filling out this general summary of the discharge status of the road traffic accident victims.			
38	Follow-up time (hrs)		
39	Reason for discharge	Improved	
		Referred to another facility	
		Left against medical advice	
		Died	
40	Injury pattern by years	2020	
		2021	
		2022	
		2023	
		2024	
41	Name of study setting	AaBET	
		ALERT	

Annex III. Training guide on the data abstraction form

First of all, the potentially challenging areas during data collection were identified, and this data guide was developed to overcome the challenges. Therefore, this guide will be used for the training of data collectors and supervisors as a reference when data collectors abstract data from the medical records of road traffic accident victims in AaBET and ALERT hospitals. This guide will explain the sources of data for every variable, the most frequently used abbreviations by physicians in the hospitals, protocols, and steps for data collection from records. Therefore, data collectors will easily perform their tasks with this reference.

Objective of the study: To determine the incidence and predictors of inpatient mortality among road traffic accident patients in AaBET and ALERT hospitals.

Inclusion criteria: All RTA Patients admitted to AaBET and ALERT hospitals in Addis Ababa due to RTAs as of January 1, 2020, and December 31, 2024

Exclusion criteria: Admitted RTA patients with incomplete or missing data, particularly on outcome variables, and admitted for less than 24 hours.

Sources of data: Electronic medical records, logbooks, and trauma registry books.

Criteria for data collectors and Supervisors: Data collectors and supervisors should have a smartphone.

Part I: Data collection from medical records.

Time required: a maximum of 25 minutes for every patient chart.

How will each variable be extracted?

1. **Socio-demographic variables**

Sex, age, and place of residence: These can be fully or partially available on the cover page of the patient chart.

Admission and management of outcome

GCS- This information is documented in patients' medical charts, particularly in the neurologic assessment section. Look for any notes or assessments made by the health care provider.

KTS II - This was rated out of 10 by data collectors based on the following parameters:

S/N	Parameters	category	score
A	Age	5-55	1
		<5 or >55	0
B	SBP on admission	>89 mmHg	2
		Between 50 and 89 mmHg	1
		Equal to or <49	0
C	Respiratory rate on admission	10-29/min	2
		30+/min	1
		Less than or equal to 9/min	0
D	Neurological status	Alert	3
		Respond to verbal stimuli	2
		Respond to painful stimuli	1
		Unresponsive	0

E	Score for serious injury	None	2
		One	1
		Multiple	0
Total		A+B+C+D+E	___/10

Follow-up time will be calculated in hours by subtracting the time of admission from the time of discharge. Time of admission is obtained from the admission sheet, vital statistics, and flow sheet. Time of discharge and death will be obtained from the discharge summary and death summary or death certificate, respectively.

3. **Comorbidities:** This variable is going to be filled from the discharge diagnosis of the patients. **Commonly used Abbreviations on patients' chart:** dx (diagnosis), Ass (assessment), RTA (Road traffic accident), MVA (Motor vehicle accident), RTI (Road traffic injury), RTC (Road traffic crash)

The rest of the information will be obtained from the patient's medical histories that were written during admission.

Operational definitions of some terminology

Rollover: When a vehicle flips onto its side or roof during an accident.

Collision: refers to an event when two or more vehicles or a vehicle and an object (such as a wall, pole, or barrier) come into contact with each other, resulting in damage.