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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

Ayenew Genet Kebede[1], Abebu Tegenaw[2*], Yeshimebet Tamir[2], Sahileslassie Afewerk[2], Asnake Gashaw Belayneh[3], Sosina Tamre[3], Ousman Adal[3], Abraham Dessie Gessesse[4], Bekalu Mekonen Belay[5], Lalem Tilahun[6] and Haileyesus Gedamu[2]

Abstract

Introduction Road traffic accident is the most common cause of death in adults worldwide. Road traffic accident-related deaths increased from time to time in low- and middle-income countries including Ethiopia; however, there is limited evidence about Survival status and its predictors among adult victims of road traffic accidents admitted to Hospitals in Ethiopia specifically in the study area. Thus, this study aimed to assess Survival status and its predictors among adult victims of road traffic accident admitted to Hospitals.

Methods An institutional-based retrospective follow-up study was conducted from July 01/2019 to June 30/2022. A total of 402 samples were chosen using simple random sampling. Data was collected by a prepared checklist from the victims' chart and entered into Epi-Data version 4.6 software and then exported to STATA version 14.1 for analysis. Kaplan-Meier failure function and log-rank test were computed. The assumption was checked by Schoenfeld residual test. All variables in bivariable analysis, p-value < 0.25 were entered into multivariable cox-regression model. Adjusted Hazard Ratio with 95% Confidence Interval was reported to declare the strength of association and statistical significance p-value of < 0.05. Model fitness was checked by using Cox-Snell residual. Data was presented by text, table, and graph.

Result The median survival time was 504 h. From all, 63(15.6%) deaths, 57% of deaths occurred between 24 and 168 h of follow-up with an overall incidence of 15.34deaths per10, 000 victims-hours observation. According to the Kaplan-Meier failure curve together with the log-rank test, the incidence density rate of death among victims who had a complication during admission was71.86per10,000victims-hour observation (95%, CI:53.66–96.25), which is different from those who did not have complication 5.17per10,000person-hour observation (95%, CI:3.26–8.21). The incidence density rate of death among victims who had low level of arterial oxygen saturation (SPO2 < 95%) during admission was 82.87per10, 000 victims-hour observation (95%, CI: 63.15-108.75), which is different from those

*Correspondence:
Abebu Tegenaw
abebutegenaw@gmail.com
Full list of author information is available at the end of the article

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who had arterial oxygen saturation ≥ 95% 3.16per10, 000victims -hour observation (95%, CI: 1.75–5.71) Develop complication (AHR = 3.1,95% CI:1.44–6.70), systolic blood pressure measurement value ≤ 89 mmHg (AHR = 2.4,95% CI:1.10–5.19), not admitted intensive care unit (AHR = 0.46,95% CI:0.022–0.97), Glasgow Coma Scale score ≤ 8 (AHR = 2.9,95% CI:1.07–7.75), Glasgow Coma Scale score 9–12(AHR = 3.8,95% CI:1.61–8.97) and, level of arterial oxygen saturation ≤ 95% (AHR = 6.5,95% CI:2.38–17.64) were predictors of outcome variable.

Conclusion and recommendations The median survival time was short. Complication, low systolic blood pressure measurement value, low Glasgow Coma Scale score, not admit to intensive care unit and low level of arterial oxygen saturation were significant predictors of the outcome variable. So that healthcare providers better give special attention and care to those victims admitted to Hospitals. A further prospective study is recommended.

Keywords Predictors, Road traffic accident, Survival status, Hospital, Bahir dar city

Background

A road traffic accident (RTA) is a medical emergency and a common reason for visiting emergency room and hospitalization. RTA(Road Traffic Accident) related death is the occurrence of death immediately or within 30 days after injuries [1].

Globally, RTA-related deaths are a major public health concern, especially in developing countries including Ethiopia. Annually, over 1.35 million people die related to RTA worldwide. It is the 8th cause of death worldwide [2]. Of all road fatalities in the globe,90% take place in developing countries [3].

Regional road fatality rates in Southeast Asia and Africa were the highest with 20.7 and 26.6 deaths per 100,000 people, respectively [4]. Sub-Saharan Africa (SSA) countries are ranked among the top 20 countries with the highest vulnerability to RTAs in terms of injuries and fatalities. Ethiopia ranks second in terms of deaths of RTAs from East African countries [5].

A road traffic accident (RTA) is the first cause of death in Adults [2]. Different risk factors increase victims' death related to RTA. As some studies showed that, having comorbidity, being hypotensive, pre-hospital delaying, delaying to intensive care unit (ICU) admission, shortage of ICU care setup, having head injuries, multiple trauma/multi-regional injuries, and organ injuries were common risk factors among admitted RTA victims to die but a time when they died, was not well identified [6–11].

Death due to RTA results many consequences. According to the WHO report indicated that among all global RTA-related deaths, more than 50% were adults resulting in a shrinking labor force and a weaker countries' economy and cost of the global economy of $1.85 trillion each year [12–14]. According to the WHO, the cost of road traffic crashes in most countries is estimated to be around 3% of their GDP [15]. In India, 73.5% of the victims were adults among all RTA deaths which leads to a serious economic loss to their families and community as well [16]. Road traffic-related death is increasing from time to time in the world and its burden is becoming three times higher in developing countries including Ethiopia [17]. The classic trimodal mortality pattern among trauma victims is currently shifting to bimodal due to advances in trauma care systems in most industrialized countries. However, studies reported that the trimodal distribution of mortality in developing countries, including Ethiopia, is still a problem [18].

In Ethiopia, RTA-related death has been a key public health and developmental challenge of the country and adversely affects the livelihood of the community, individuals and their families, and the economy of the country as well including the study area [19].

Currently, the international community is adopting Sustainable Development Goal (SDG) 3.6 to reduce RTA-related deaths by half by 2030 [20]. Ethiopia developed some initiatives to reduce the risk of RTA-related death such as ambulance procurement, distribution and utilization, establishment of an emergency command post, providing basic and advanced life support training, and the strengthening of specialty care like intensive care units and trauma care services. In addition, 43 health sector transformation plans with different guidelines, Guidelines for the management of ambulances, guidelines for first aid, guidelines for setting up intensive care units, and manuals for liaison services, but deaths related to RTA is still high [21].

A retrospective case study conducted in Iran revealed that road traffic fatality rate was 45.1 per 100,000 people, and of these, 72.1, 16.2, 45.7, and 42.2 per 100,000 people were male, female, urban and rural respectively [22]. The retrospective follow up study conducted in South Ethiopia at Hawassa also indicated that the death rate of RTA victims admitted to Hospital was 7.34/10,000 person-hours observation [23]. Another institution-based prospective follow-up study conducted in Ethiopia at Addis Abeba also showed that 10 deaths per 100,000 person-hours observations were due to RTAs [24].

A study conducted in Iran indicated that among RTA related deaths nearly half of deaths (42%) occurred in the first 24 h [25].

A study conducted in Guinea found that 90% deaths occurred within 24 h of being admitted to the hospital among death due to RTA [26]. Studies conducted in Democratic Republic of Congo and Kenya revealed that 19.6% and 7.7% died from all road traffic accident victims [8, 9] with 18.6 days survival time between admission and discharge [9]. A study conducted in Hawassa revealed that more than 50% of deaths occurred within 72 h of admission [9] and a study conducted in Gondar showed that among 80deaths, about22.5% of deaths were occurred between 4 and 24 h [7].

In Ethiopia, studies were conducted about the burden and determinants of RTA. However, limited evidence is available about the time of death during hospital admission due to RTA. Even, the previously published literatures did not include important predictors like, level of arterial oxygen saturation and injury severity score.

Overall, there is a dearth of evidence regarding time death and its predictors among adult victims of RTA admitted to Hospital. This study aimed to determine, Survival status and its predictors among adult victims of RTA admitted to Bahir Dar City Comprehensive Specialized Public Hospitals, in Amhara Regional State, Northwest Ethiopia 2023.

Methods

Study area and period

A facility-based retrospective follow-up study was conducted among 2,864 victims admitted to Felege Hiwot and Tibebe Ghion Comprehensive Specialized Hospitals in Bahir Dar City between January 2019 and June 30, 2022. Data collection for this study took place from March 19 to April 18, 2023.

Felege Hiwot Comprehensive Specialized Hospital (FHCSH), established in 1963, is the first referral hospital in Bahir Dar City. It currently has over 410 beds and serves more than 5 million people. The hospital is organized into various wards, including medical, surgical, gynecology and obstetrics, orthopedics, oncology, pediatrics, and an intensive care unit (ICU). It also has adult and pediatric emergency departments and multiple outpatient departments. Available imaging services include conventional radiology, ultrasonography, and computed tomography. FHCSH provides emergency healthcare services 24/7 (Source: Hospital report, December 2022).

Tibebe Ghion Comprehensive Specialized Hospital (TGSH), a teaching hospital affiliated with Bahir Dar University, began operations in February 2019, Located about 10 km south of the city center and 23 km from the Blue Nile Falls, TGSH serves a population of around 5 million. It functions as a research and teaching hospital and is organized into various wards, including medical, surgical, gynecology and obstetrics, orthopedics, oncology, pediatrics, ICU, NICU, and adult and pediatric emergency departments. The hospital has 423 regular beds and more than 126 medical service rooms. Imaging services include conventional radiology, ultrasonography, and computed tomography. TGSH provides emergency healthcare services 24/7 (Source: Hospital report, December 2022).

Source population

All road traffic accident (RTA) adult victims aged 18 years and older who were admitted to Felege Hiwot Comprehensive Specialized Hospital (FHCSH) and Tibebe Ghion Comprehensive Specialized Hospital (TGCSH).

Study population

All road traffic accident (RTA) adult victims aged 18 years and older who were admitted to Felege Hiwot Comprehensive Specialized Hospital (FHCSH) and Tibebe Ghion Comprehensive Specialized Hospital (TGCSH).from July 01/2019 to June 30 /2022.

Study unit

Each randomly selected adult patient aged ≥ 18 years(chart) who were admitted to FHCSH and TGCSH with a diagnosis of RTA from July 01, 2019, to June 30, 2022, and met the inclusion criteria was included in the study.

Eligibility criteria

Inclusion criteria

All medical charts of adult RTA victims (aged ≥ 18 years) who were admitted to FHCSH and TGCSH in the study period.

Exclusion criteria

Incomplete victim's medical charts (charts without date of hospitalization, no date on which outcome occurred, charts without outcome (death or censored), and repeat victims with RTA during the study times.

Sample size determination

The sample size was calculated using a sample size calculation formula for survival analysis by Stata software version 14.1 by considering the assumption, α of 5%, 95% level of confidence, power of 80%, the proportion of withdrawal of 10%, by using predictors from a previous study conducted in Gondar [7] and, having a probability of event = 0.176. (Table 1).

Based on the sample size calculation result the largest sample size was 387, by considering 10 losses to follow up the final sample size was 425.

Table 1 Sample size calculation of survival status and its predictors among adult victims of RTA, admitted to comprehensive specialized public hospitals of Bahir Dar City

Predictors	AHR	Probability of event	Sample size
Being driver	2.26	0.176	272
SBP	4.41	0.176	82
GCS ≤ 8 at admission	5.86	0.176	58
Hospital arrival time	0.41	0.176	277
Rural Residence	1.98	0.176	387

Sampling technique and procedures

First, RTA adult victims were listed based on their medical record number (MRN) from adult registration books among those who were admitted to Felege Hiwot and Tibebe Gion Comprehensive Specialize Hospital from July 01/2019 to June 30 /2022. The sampling frame was prepared by using their MRN. Study participants were selected by a simple random sampling technique using a computer-generated method. Then, using the medical record number victims' chart was retrieved from the medical record office (Patients' record catalog). Finally, the data was extracted from selected victims' medical charts.

Study variables

Dependent variables

Probability of death.

Independent variables

Socio-demographic related variables

Sex, age, marital status, and Occupation.

Previous health and pre-hospital status of the victim's related variables

Vehicle type used, road user category (victim's role), mechanism of injury, history of chronic disease, means of transportation to health facility, delay to transfer, time of accident occurred, vehicles used, and source of referral.

Health status of victims' condition in the hospital

Hospital arrival time, level of GCS, level of arterial oxygen saturation, victim's vital signs status at the time of admission, time /date of admission to a health facility, site of body region injured, acquire a new infection during hospitalization, injury severity score, develop a complication, management given, ICU admission, organ injury and length of Hospital stay).

Operational and term definitions

Event

The event of interest in this study is the occurrence of death due to RTA during follow-up time in the Hospital [23].

Censored

This is when a victim is transferred after the study started, discharged against medical advice, study time completed, or alive at the time of discharge [23].

Time to death

Is the time interval from the first hour of hospitalization to the time when the death of the victims is confirmed.

Comorbidities

The "coexistence of non-communicable and co-infectious diseases in addition to a primary disease of interest (cancer disease) like diabetes mellitus, hypertension, heart failure, HIV/AIDS.

Method of data collection and analysis

Data collection tools and procedures

Data was collected using a structured checklist developed in English which was adopted from the current Ethiopian Federal Minister of Health emergency registration log book and related literatures [6, 7, 9, 23]. The tool included; socio-demographic-related factors, pre-hospital victim status-related factors, in-hospital victims' condition-related factors, and outcome variables. The RTAs adult victim medical registration numbers (MRN) were obtained from adult registration log book and a sampling frame was prepared. After that, the required numbers of medical charts were selected by using computer generation method by simple random sampling technique, and then selected medical cards were retrieved from the medical record office. Two data collectors (BScN.) and two supervisors (MSc Nurses) participated throughout the data collection period. Finally, relevant data was extracted from the victim's medical charts.

Data quality assurance technique

Data quality was assured by providing training for data collectors and supervisors for one day, about how and what information should be collected from the exact data sources. Data extraction forms were checked for their completeness and any missing information before data collection. During data collection supervisors and investigators checked the completeness daily and gave prompt feedback. Pretest was done on 5% [22] of the study

samples at TGCSH before actual data collection and modification had been done based on the pre-test result. The data was not added to the main analysis. Pre-hospital care, level of education, and distance were excluded from the study variable list since no data was available. The principal investigator entered the data carefully and cleaned it thoroughly before analysis.

Data management process and analysis

The data were coded, entered, and cleaned using Epidata version 4.6, then exported to STATA version 14.1 for analysis. A life table was created to estimate the cumulative probability of survival. Kaplan-Meier curves with log-rank tests were employed to compare survival times between different predictor categories. Multicollinearity was assessed before conducting multivariable Cox proportional hazard regression analysis, using the Variance Inflation Factor (VIF), with a mean VIF value of 1.68. The Cox proportional hazard assumption was graphically checked using Kaplan-Meier (Log-Log) curves and via global and detailed Schoenfeld tests for all covariates. Based on these tests, the model was fitted with a p-value > 0.05 and a global test result of 0.1274 (see Annex- V). Cox regression models were utilized, and their assumptions were validated through Log-Log survival time plotted against the log of analysis time; the resulting graphs showed parallel and straight lines. The Cox proportional hazard model was employed to determine the association between independent variables and the outcome variable. Variable selection preceded model diagnostics, with all variables in the bi-variable analysis having a P-value less than 0.25 included in the multivariable Cox proportional hazard regression model. The likelihood ratio test was used to diagnose the model, which yielded a significant likelihood ratio (p-value < 0.05), indicating model adequacy (p-value 0.0001). Variables with a P-value less than 0.05 and a 95% confidence interval were considered significant predictors of time to death, with the adjusted hazard ratio used to demonstrate the strength of association between each predictor variable and the outcome variable. The incidence density rate was computed for the entire study period. Finally, the study results were presented using text, tables, charts, and graphs.

Results

Socio-demographic characteristics of the study participants

The study was conducted on 402 RTA-admitted adult victims' records. The response rate was 94.6%. Twenty-three victims' charts were excluded due to incomplete information. Among the study participants, 74.88% were male which resulted in male to female ratio of 3:1. Most 336 (83.58%) study participants were 18-40years of age and more than three fourth (75%) of death occurred in this age group and median age was 30years (IQR 21.5, 43.5). Around two-thirds 243(60.45%) of the participants were urban residents (Tables 2 and 3).

Pre- hospital circumstances, hospital arrival time and means of transportation

Most (90%) of the victims were sustained injury during the day time and around half (48.87%) of the victims had used minibuses followed by motorcycles 111(27.61%). 40% of death occurred among victims who had used minibuses which means the accident happened while victims used minibuses for transportation. Among road user categories three three-fourths (77.3%) were passengers (Tables 2 and 3).

Injury pattern and characteristics

Extremities and Head were the most commonly injured body parts accounted 181(45%) and 128(32%) respectively. About one-sixth 64(16%) of admitted victims had experienced polytrauma among these more than half died. More than two-fifths of 170(42.2%) of the admitted victims had bleeding at the time of arrival to these Hospitals. Around two-fifths of 167(41.42%) of victims had encountered bone fracture of which 70(17%) accounted for extremities followed by Skull fracture of 65(16.2%).

Table 2 Socio-demographic characteristics of RTA adult victims

Variables	Categories	Status of victim		
		Censored (339) no. (%)	Death (63) no. (%)	Total (402) no. (%)
Sex	Male	243(71.7)	58(92)	301(74.8)
	Female	96(28.3)	5(8)	101(25.2)
Age	18-40yrs	287(84.7)	49 (77.8)	336(83.6)
	41-60yrs	48 (14.2)	12(19)	60(14.9)
	> 60yrs	4 (1.2)	2 (3.2)	6(1.5)
Residence	Urban	206(51.2)	37(58.7)	243(60.5)
	Rural	133(48.8)	26(41.9)	159(39.6)
Marital status	Married	272 (80.2)	49(77.8)	321(79.9)
	Single	65(19.2)	11(17.5)	76(18.9)
	Windowed	2(0.6)	3(4.7)	5(1.2)
Occupation	Farmer	98 (28.9)	19 (30.2)	117(29.1)
	G. employee	63 (18.6)	5(7.9)	68(16.9)
	Merchant	84(224.8)	11(17.5)	95(23.6)
	Student	29(8.5)	4(6.4)	33(8.2)
	self-employee	33 (9.7)	7(11.1)	40(10.0)
	Driver	17(5.0)	14(22.2)	31(7.7)
	Housewife	15(4.4)	3(4.8)	18(4.5)

Table 3 Pre-hospital conditions of RTA adult victims

Variables	Categories	Status of victims		
		Censored (339) no.(%)	Death (63) no. (%)	Total (402) no. (%)
Time of accident occurred	Day	318 (93.8)	44(69.8)	362(90)
	Night	21(6.2)	19(4.73)	40(10)
Vehicle used	Public Bus	26(7.7)	4(6.3)	30(7.5)
	Minibus	171(50.4)	26(41.3)	196(48.8)
	heavy trucker	5 (1.8)	14(22.22)	19(4.73)
	Motorcycle	98(29)	13(20.6)	111(27.6)
	Others[a]	39(15.5)	6(9.52)	45(11.2)
Road user category (role of victims)	Pedestrian	47(14)	9(14.3)	56(14)
	Passenger	271(78)	40(63.5)	311(77.3)
	Driver	21(8)	14(22.2)	35(8.7)
Mechanism of RTA	pedestrian direct hit	47(13.8)	8(12.7)	55(13.7)
	Rollover	18(5.3)	6(9.5)	24(6.0)
	Collision	184(54.3)	33(52.4)	217(54.0)
	strike with roadside	90(26.5)	16(25.4)	106(26.3)
Arrival time to hospital	within 1 h	63(15.67)	8(1.99)	71(17.7)
	1–4 h	229 (67.55)	40(63.49)	270(67.2)
	4–24 h	47(13.9)	14(22.22)	61(15.1)
Source of arrival	Referred from HF	169(49.86)	31(49.2)	200(49.8)
	Self	131(38.64)	15(23.8)	145(36.1)
	Direct from scene	39(11.5)	17(27)	56(14.1)
Presence of comorbidity	Yes	10 (3)	24(38.1)	34(8.5)
	No	329(97)	39(61.9)	368(91.5)

[a] Others; (Bajaj, taxi &Isuzu)

Among victims, those who had skull fracture 50% were died. The injury severity score was computed using a revised trauma score; therefore, the revised trauma median score was 7.68 ± 0.97(IQR 6, 8). In this study, the injury severity score ranges from 3.2 to 7.84. In this study, the injury severity score less than five were 21(5.2%), and as the injury severity score decreased indicated that the risk of death also increased (Table 4).

Admission, management outcome of victims

The SBP measurement median value of the participants during admission was 108.25mmHg (IQR 85,128) and the mean value of DBP and pulse rate of the participants were 71 mmHg SD ± 12.18 and 85.3bt/min SD ± 18.49 respectively. Around one-sixth 63(16%) of victims had less than 95% arterial oxygen saturation (SPO2) at room air at the time of admission The most commonly performed procedure for admitted RTA adult victims was wound repair 150(37.31%) and 45(11.2%) Plaster Paris followed by ventilation 22(5.5%). The most frequently performed major surgical procedure was craniotomy 14(5%) followed by laparotomy 8(2%). The median hospital stay was 2 days (IQR, 1, 13) ranging from 1 day to 30 days.

Time to death among admitted adult victims of RTA

Four hundred two participants were followed for a total of 41,055 victim-hours observation. The total follow-up time of this study was 720 h (30 days). The minimum and maximum follow-up time was 1 h and 720 h respectively. The median survival time was 504 h (95%, CI: 366.3-631.6). Among adult victims of RTA 63(15.7%) were died. Of 63 deaths,36(57.1%) occurred between 24 and 168 h of admission (Fig. 1**).** The median time to death of admitted RTA victims across different categorical variables was different.

Failure estimator of time to death

The probability of failure during, follow-up time, from the time of admission due to RTA to death occurred, was also presented by the failure curve. When the graph went up sharply increasing indicated that high probability of victims' death whereas when the graph became straight the likelihood of victims' death remained stable with virtually no deaths occurring (Figure. 2).

Table 4 Injury pattern and characteristics of RTA adult victims

Variables	Categories	Survival status		
		Censored (339) no. (%)	Death (63) no. (%)	Total (402) no. (%)
Polytrauma[a]	Yes	30(8.9)	34(54)	64(16)
	No	309(91.1)	29(46)	338(84)
Injured body parts	Extremity	173(51)	8(13)	181(45)
	Abdomen	18(5.3)	7(11.1)	25(6)
	Chest	15(4.4)	13(21)	28(7)
	Head	96(28.3)	32(51)	128(32)
	Others	36(11)	2(3.2)	38(10)
Visceral organ injury	Yes	4 (1.2)	15(24)	19(4.7)
	No	335(98.8)	48(76)	383(95.3)
presence of bleeding	Yes	144(42.5)	26(41.3)	170(42.3)
	No	195(57.5)	37(58.7)	232(57.7)
Bone fracture	Yes	115(33.9)	52(82.5)	167(41.5)
	No	223(59.1)	11(17.5)	234(58.5)
Identified fractured bone	Extremity	70(60.3)	2(3.8)	72(42.7)
	Rib	2(1.8)	13(25)	15(8.7)
	Skull	33 (28.4)	31(59.7)	64(38.3)
	Multiple	11 (9.5)	6(11.5)	17(10.0)
Injury severity Score	< 5	2(0.7)	19(30.2)	21(5.2)
	5–7	7(2.0)	22(34.9)	29(7.2)
	≥ 7	330(97.3)	22(34.9)	352(87.6)

NB, **Multiple** means more than two bones fracture or more than two body part injuries, [a]**Polytrauma** means trauma experienced on more than two body parts (organs)**, Others**, (face, pelvic, back, shoulder)

Predictors of time to death among adult victims admitted due to RTA

Log-rank test was used to estimate failure probability between categories of different predictor variables revealed that the failure pattern among adult victims admitted due to RTA was significantly different as there is highly significant difference among failure curves. Kaplan- Meier together with the log-rank test showed the relationship between each predictor on admitted adult victims of RTA (Tables 5 and 6).

According to the Kaplan-Meier failure curve together with the log-rank test, the incidence density rate of death among victims who had a complication during admission was71.86per10,000victims-hour observation (95%, CI:53.66–96.25), which is different from those who did not have complication 5.17per10,000person-hour observation (95%, CI:3.26–8.21) (Figure. 3).

The incidence density rate of death among victims who had low level of arterial oxygen saturation (SPO2 < 95%) during admission was 82.87per10, 000 victims-hour observation (95%, CI: 63.15-108.75), which is different from those who had arterial oxygen saturation ≥ 95% 3.16per10, 000victims -hour observation (95%, CI: 1.75–5.71) (Fig. 4).

Cox-proportional hazard assumption test

For each explanatory variable, Cox-proportional hazard assumption was performed separately and simultaneously by using the overall Schoenfeld global test. The test showed that the *P*-value of each predictor and the whole predictors simultaneously were greater than 0.05 which indicated that there were no time-varying variables in the model and the proportional hazard assumption was fitted ($p = 0.1274$) (Annex- V). The model's fitness test was checked using the goodness-of-fit test by Cox-Snell residuals and the hazard function follows 45^0 close to the base line hazard line which indicated the model was well fitted (Fig. 5).

Bivariate and multivariate proportional hazard regression model for different predictors

In bi-variable Cox proportional hazard regression analysis, twelve variables (sex, time of accident occurred, the role of victim(road user category), polytrauma, ICU admission, presence of comorbidity, complication developed, low systolic blood pressure, pulse rate, respiratory rate ≥ 25br/minute, SPO2 < 95%, and low Glasgow Coma Scale score) were candidate variables for multivariable analysis with a *p*-value of ≤ 0.25. In multi-variable

Table 5 Log-rank test for equality of different categorical predictors among adult victims

Variable	Category	Event	Incidence/10,000(95% CI)	X^2	*p*-value	Degree of freedom
Sex	Male	58	18.31(14.16-23.69)	6.8	0.0034	1
	Female	5	5.33(2.22-12.81)			
Marital status	Married	49	15.48(11.70-20.48)	11.21	0.0107	2
	Single	11	13.43(7.44-24.25)			
	Windowed	3	22.55(33.64-68.70)			
Occupation	Farmer	16	19.26(11.80-31.44)	14.3	0.0264	6
	G. employee	5	9.12(3.79-21.91)			
	Merchant	11	12.77(7.07-23.06)			
	Student	5	17.75(7.39-42.64)			
	self- employee	7	11.55(5.51-24.23)			
	Driver	14	31.76(18.81-53.63)			
	Housewife	5	9.31(3.88-22.38)			
The time of injury occurred	Day	44	11.65(8.67-15.65)	39.44	0.0000	1
	Night	19	57.84(36.89-90.68)			
Vehicle used	Public Bus	4	26.39(9.90-70.30)	46.74	0.0000	4
	Minibus	26	12.59(8.57-18.49)			
	Heavy tracker	14	76.05(45.04-128.40)			
	Motorcycle	13	9.94(5.77-17.12)			
	Others	6	15.14(6.80-33.69)			
Road user category	Pedestrian	9	17.81(92.69-34.24)	8.67	0.0341	2
	Passenger	40	13.39(98.24-18.26)			
	Driver	14	22.82(13.51-38.52)			
Source of referral	Referred	31	12.07(8.49-17.19)	31.84	0.0000	2
	Self	15	12.06(7.27-20.01)			
	Direct from Scene	17	57.69(35.86-92.79)			
Injured body part	Extremity	8	3.57(1.79-7.14)	63.3	0.0000	4
	Abdomen	7	14.11(6.73-29.60)			
	Chest	13	53.98(31.35-92.98)			
	Head	32	34.30(24.26-48.51)			
	Others	2	11.15(2.79-44.60)			
Polytrauma	Yes	34	30.99(22.14-43.36)	30.8	0.0000	1
	No	29	9.64(6.70-13.87)			
Visceral organ injury	Yes	15	52.10(31.41-86.42)	28.79	0.0000	1
	No	48	12.57(9.48-16.68)			
Bone fracture	Yes	52	18.95(14.01-24.13)	11.21	0.0008	1
	No	11	8.62(4.78-15.57)			
Comorbidity	Yes	24	50.47(33.83-75.30)	45.38	0.0000	1
	No	39	10.74(7.85-14.71)			

analysis only five variables (ICU admission, complication developed, low systolic blood pressure, SPO2 < 95%, and low Glasgow Coma Scale score) were significant predictors of death, with *P*-value of < 0.05at 95% CI (Table 7).

The hazard of death among RTA adult victims increased by 2.4-fold [AHR 2.38;95% CI: (1.10–5.19)] for those RTA victims whose systolic blood pressure measurement value ≤ 89mmHg at time of admission as compared to those with systolic blood pressure measurement value > 89mmHg at the time of admission. The hazard of death among RTA adult victims was increased by 2.9 times [AHR 2.88;95% CI: (1.07–7.75)] for those RTA victims whose GCS score of ≤ 8 as compared to those who had a GCS score of 13–15. Similarly, the hazard of early death among admitted RTA adult victims, increased 3.8 times [AHR = 3.80; 95% CI: 1.61–8.97)] for victims

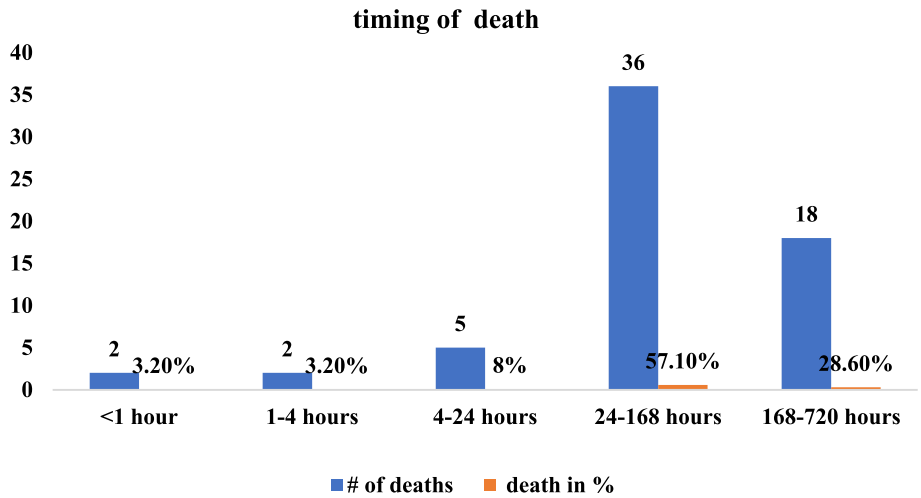

Fig. 1 Timing distribution of death following RTA adult victims admitted to comprehensive specialized Public Hospitals of Bahir Dar City, from July 01/2019 to June 2022

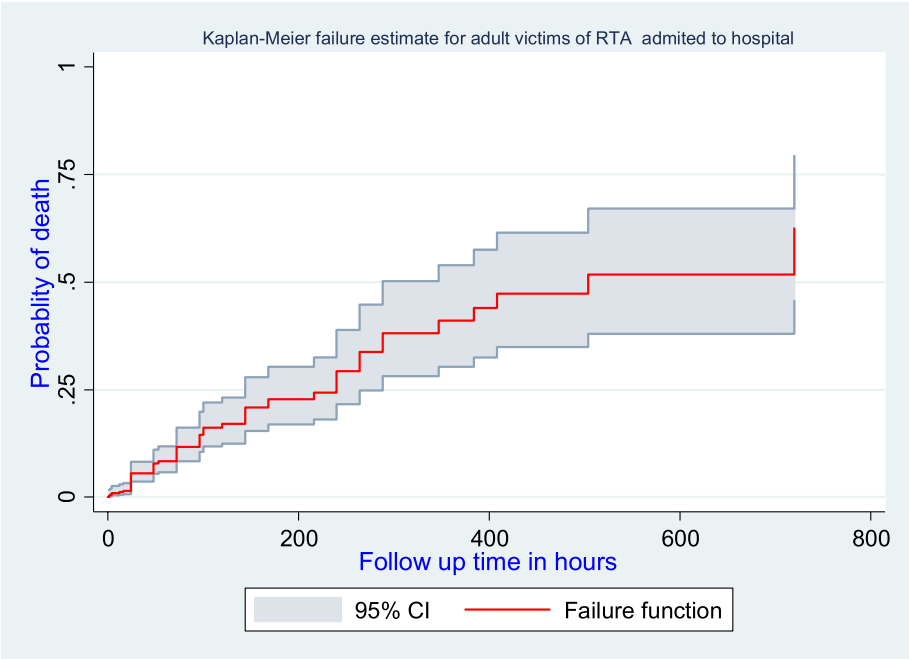

Fig. 2 Summary of Kaplan-Meir failure estimate curve for RTA adult victims admitted to Comprehensive Specialized Public Hospitals of Bahir Dar City, July 01/2019 to June 2022(402), 2023

who had a GCS score of 9–12 as compared to those who had a GCS score of 13–15. Road traffic accident admitted victims who had developed complications were 2.87 times high-risk of death [AHR = 2.87; 95% CI: 1.44–6.78)] as compared to those who did not develop complications.

In this study, the risk of death is decreased by 54% (AHR = 0.46; 95%CI: 0.22–0.97) for those who were admitted to the ICU as compared to those who were not admitted to the ICU. The hazard of death among RTA adult victims who had a low level of arterial oxygen saturation at the time of admission was increased by 6.5 (AHR = 6.48; 95% CI: 2.38–17.64) as compared to RTA victims who had normal levels of arterial oxygen saturation (SPO2 ≥ 95%).

Table 6 Log-rank tests for equality of different categorical predictors among adult victims

Variable	Category	Event	Incidence/10,000(95% CI)	X^2	*p*-value	Degree of freedom
Sex	Male	58	18.31(14.16–23.69)	6.8	0.0034	1
	Female	5	5.33(2.22–12.81)			
Marital status	Married	49	15.48(11.70-20.48)	11.21	0.0107	2
	Single	11	13.43(7.44–24.25)			
	Windowed	3	22.55(33.64–68.70)			
Occupation	Farmer	16	19.26(11.80-31.44)	14.3	0.0264	6
	G. employee	5	9.12(3.79–21.91)			
	Merchant	11	12.77(7.07–23.06)			
	Student	5	17.75(7.39–42.64)			
	self- employee	7	11.55(5.51–24.23)			
	Driver	14	31.76(18.81–53.63)			
	Housewife	5	9.31(3.88–22.38)			
The time of injury occurred	Day	44	11.65(8.67–15.65)	39.44	0.0000	1
	Night	19	57.84(36.89–90.68)			
Vehicle used	Public Bus	4	26.39(9.90–70.30)	46.74	0.0000	4
	Minibus	26	12.59(8.57–18.49)			
	Heavy tracker	14	76.05(45.04–128.40)			
	Motorcycle	13	9.94(5.77–17.12)			
	Others	6	15.14(6.80-33.69)			
Road user category	Pedestrian	9	17.81(92.69–34.24)	8.67	0.0341	2
	Passenger	40	13.39(98.24–18.26)			
	Driver	14	22.82(13.51–38.52)			
Source of referral	Referred	31	12.07(8.49–17.19)	31.84	0.0000	2
	Self	15	12.06(7.27–20.01)			
	Direct from Scene	17	57.69(35.86–92.79)			
Injured body part	Extremity	8	3.57(1.79–7.14)	63.3	0.0000	4
	Abdomen	7	14.11(6.73–29.60)			
	Chest	13	53.98(31.35–92.98)			
	Head	32	34.30(24.26–48.51)			
	Others	2	11.15(2.79–44.60)			
Polytrauma	Yes	34	30.99(22.14–43.36)	30.8	0.0000	1
	No	29	9.64(6.70-13.87)			
Visceral organ injury	Yes	15	52.10(31.41–86.42)	28.79	0.0000	1
	No	48	12.57(9.48–16.68)			
Bone fracture	Yes	52	18.95(14.01–24.13)	11.21	0.0008	1
	No	11	8.62(4.78–15.57)			
Comorbidity	Yes	24	50.47(33.83–75.30)	45.38	0.0000	1
	No	39	10.74(7.85–14.71)			

SBP Systolic blood pressure, *DBP* Diastolic blood pressure *GCS* Glasgow Coma Scale, *ICU* Intensive care Unit, *RR* Respiratory rate, *PR* Pulse rate

Discussion

A road traffic accident (RTA) is a medical emergency and a common reason for visiting emergency room and hospitalization. TRA(road traffic accident) related death is the occurrence of death immediately or within 30 days after injuries [1].

This study assessed the time to death and its predictors among adult victims of RTA admitted to Comprehensive Specialized Public Hospitals of Bahir Dar City, from July 01/2019 to June 2022. The study also assessed the incidence rate of death among adult victims of RTA admitted to Hospitals.

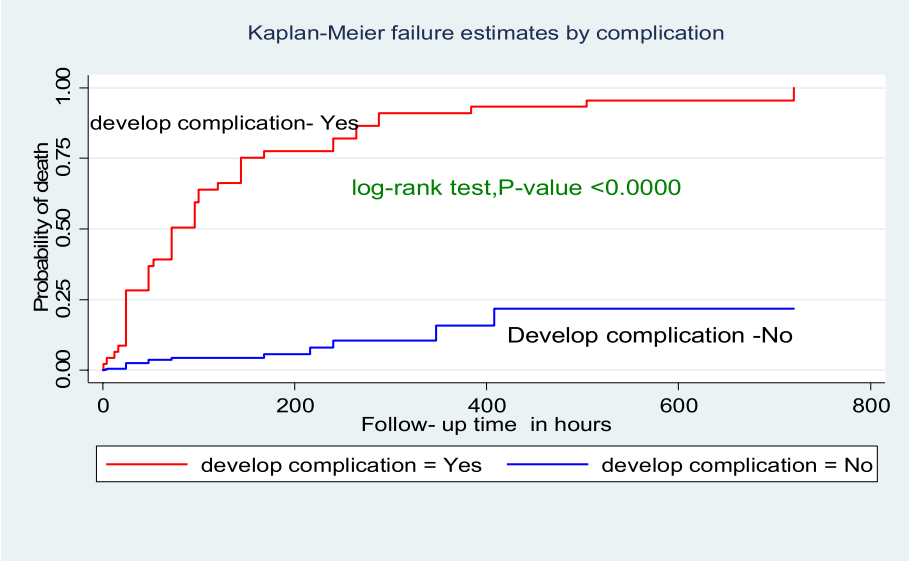

Fig. 3 Kaplan-Meir failure estimate curve by complication developed during admission for road traffic accident adult victims admitted to Public comprehensive specialized Hospitals of Bahir Dar City, July 2019 to June 2022($n=402$),2023

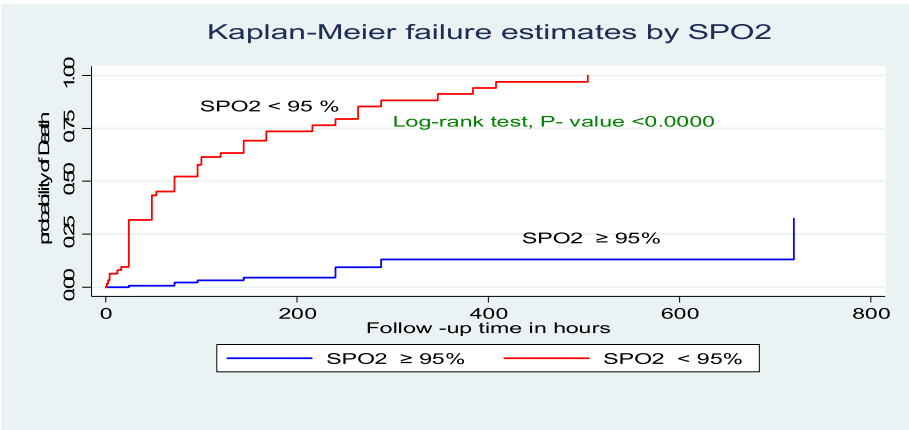

Fig. 4 Kaplan-Meir failure estimate curve by arterial oxygen saturation for road traffic accident adult victims admitted to Public comprehensive specialized Hospitals of Bahir Dar City, July 2019 to June 2022(402), 2023

The finding of this study indicated that from the total of 63 deaths, more than half (57%) of the deaths occurred between 24 h and 168 h of admission. The finding of this study is higher than the study conducted in Gondar (40%) [7]. The possible justification might be the differences in the study population in which the study conducted in Gondar included all RTA victims who visited the Hospital of all ages whereas our study included only adult admitted victims. In addition, it might be due to, around two-fifths (38%) of victims experienced skull fracture which increased the risk of death but in the study conducted in Gondar only around one seventh (14.8%) of victims sustained skull fracture. On the other hand, about 8% of deaths occurred within 24 h of admission. This finding is lower as compared to the study conducted in Guinea which reported that 90% of RTA-related deaths occurred within 24 h of admission [27]. The possible justification might be attributed to differences in scope. This study conducted in guinea included road traffic accident (RTA) victims from 20 hospitals and eight police stations within the same district, which is considerably larger than our study [27]. It is also lower than the study conducted in Iran indicated that nearly half of the deaths (42%) occurred in the first 24 h [25]. The discrepancy might be due to study population variation in which the study conducted in Iran included all trauma-related

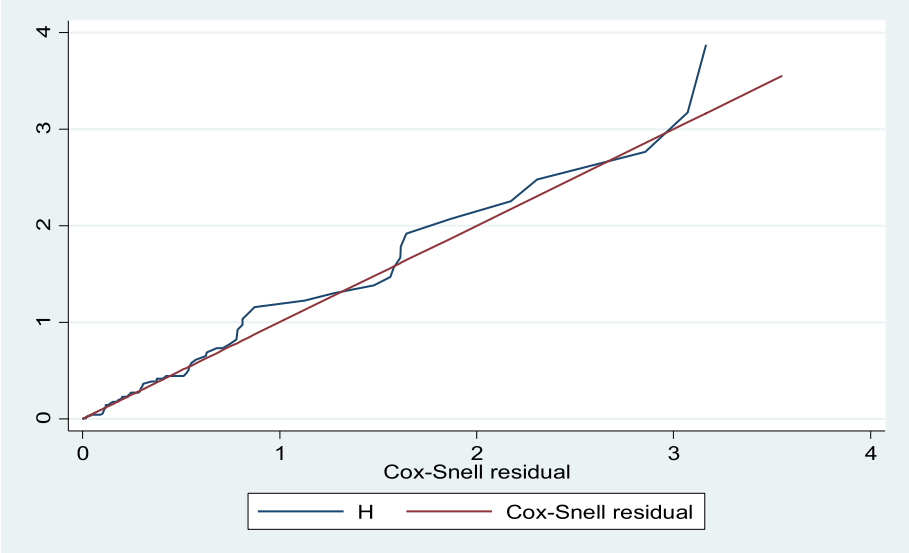

Fig. 5 Nelson-Aalen cumulative hazard graph against Cox-Snell residual on road traffic accident victims admitted to Public comprehensive specialized Hospitals of Bahir Dar City, July 2019 to June 2022(*n* = 402),2023

victims admitted to hospital, whereas our study included only RTA victims. In addition, the discrepancy might be due to the large sample size and number of study settings (3 Hospitals) for a study conducted in Iran.

In this study, the median survival time was 504 h (21 days) which is found to be comparable to the study done in the Democratic Republic of Congo which was 18.6 days. The possible reason might be due to the similarity of the study design and study setting which is both studies used retrospective follow-up studies at two Hospitals [9].

The overall incidence rate of death was 15.345 deaths per 10,000 victim-hours observation. This finding was higher than the studies done in Gondar and Hawassa 2.9& 7.4 per10, 000victims-hour observation respectively. The variation could be the differences in, the study design and study population, which a study was done in Gondar, all RTA victims of all age groups attending the Hospital both outpatients and in patients were study populations prospectively [7], whereas this study included only adult victims aged ≥ 18years admitted to Hospital, retrospectively. In addition, the variation from a study done in Hawassa could be explained by the difference in the study population, period, and study setting, in which the study done in Hawassa included a private Hospital and victims of all ages were the study population, whereas this study assessed only adult victim age greater than or equal to 18years [23]. The finding of this study was also higher than a study conducted in Kenya(7.7%) [28]. The discrepancy might be due to delayed presentation to health institutions after injury, differences in the study population, period, design, and sampling procedure variation in which the sampling technique used in Kenya was convenience sampling whereas in our study simple random sampling was used. On the other hand, the finding of this study is in line with a study conducted in the Republic of Congo (17.6%) [9], this might be due to the similarity of study design and the study setting which are both studies used retrospective follow-up study at two Hospitals. In addition, most victims who experienced death had polytrauma in both studies.

In this study, a low GCS score was a significant predictor of death. For victims with a GCS score of ≤ 8 the risk of death was higher compared to those who had a GCS score of 13–15. Similarly, the hazard of death of RTA victims with a GCS score of 9–12 was higher compared to those who had a GCS score of 13–15. This finding was supported by studies conducted in Gondar, Dilla, Hawassa, Kenya, and Japan [7, 8, 23, 29–31]. The possible justification might be those victims who had lower GCS scores were unable to protect their airways, had a high risk of aspiration, compromised ventilator effort, and risk of developing intracranial hypertension which reduces cerebral perfusion and leads to secondary cerebral attacks and finally leads to death [32].

Victims with low systolic blood pressure measurement value (SBP ≤ 89mmHg) on admission were more likely to experience death than victims who had SBP > 89mmHg. The finding of this study is supported by studies conducted in Gondar, Hawassa, and Tanzania [7, 23, 24]. This can be explained by the fact that acute blood loss is very likely in trauma patients who had brought a drop in

Table 7 Bivariate and multivariate cox regression analysis for independent predictors of death among RTA adult victims

Variables	Categories	Censored no (%)	Death no (%)	CHR (95%) CI	AHR (95%) CI
Sex	Male	243(71.7)	58(92)	3.5(1.4–8.75)	1.13(0.34–3.5)
	Female	96(28.3)	5(8)	1	1
SBP at admission	<=89mmhg	5(1.5)	20(31.7)	9.52(4.95–14.67)	2.38(1.09–5.19) *
	> 89mmhg	334(98.5)	43(68.3)	1	1
GCS score at admission	<=8	1(0.3)	15(23.8)	21.91(11.18–42.94)	2.88(1.07–7.75) *
	9–12	3(0.9)	22(34.9)	16.05(8.68-29-67)	3.80(1.61–8.97) *
	13–15	335(98.8)	26(41.3)	1	1
Complication developed	Yes	1(0.3)	45(71.4)	15(8.66–26.16)	2.87(1.44–6.78) *
	No	329 (99.7)	18(28.6)	1	1
Polytrauma	Yes	30(8.8)	34(53)	3.9(2.32–6.45)	0.89(0.46–1.71)
	No	309(91.2)	29(47)	1	1
SPO2	>=95%	328(96.8)	11(17.5))	1	1
	< 95%	11(3.2)	52(82.5)	29.7(14.62–6.50)	6.48(2.38–17.64) **
Role of victims	Pedestrian	47(14)	9(14.3)	1	1
	Passenger	271(78)	40(63.5)	0.13(0.2–0.97)	1.14(0.44–2.9)
	Driver	21(8)	14(22.2)	0.25(0.03–1.9)	0.27(0.07–1.03)
Comorbidity	Yes	10(3)	24(38)	4.7(2.8–7.86)	0.47(0.22-1.00)
	No	329(97)	39(62)	1	1
Admitted to ICU	Yes	6(1.8)	19(30.2)	0.20(0.11–0.35)	0.46(0.22–0.97) *
	No	333(98.2)	44(69.8)	1	1
Respiratory rate	>=25	54(16)	49(77.7)	2.5(0.59–10.36)	2(0.33-14.0)
	< 12	10(3)	3(4.8)	0.16(0.04–0.14)	0.46(0.18–1.13)
	12–24	275(81)	11(17.5)	1	1
Pulse Rate	< 60	15(4.4)	35(55.6)	9(4.6-17.63)	1.3(0.57–2.77)
	> 100	251(74)	16(25.4)	0.6(0.29–1.29)	0.99(0.41–2.41)
	60–100	73(21.2)	12(19)	1	1
Time of accident	Day	318(93.8)	44(70)	1	1
	Night	21(6.2)	19(30)	4.7(2.8–8.44)	2.3(0.89–5.57)

NB.SBP Systolic blood pressure, *GCS* Glasgow Coma Scale, *ICU* Intensive care Unit

**P*-value, Significant at<0.05 and ***P* <0.001

systolic blood pressure [33]. Low systolic blood pressure could increase the risk of death due to poor organ perfusion and finally lead to organ failure. Hemorrhagic shock victims also have a high likelihood of developing complications such as nosocomial infections or sepsis [34, 35].

The finding of this study revealed that developing complications during admission was a significant predictor of death among RTA victims; which means the hazard of death was higher among victims who had developed complications as compared to those who didn't develop complications related to RTA. This finding is supported by studies conducted in South Ethiopia, America, Germany, and Romania [18, 23, 36, 37]. The possible reason could be, complications that cause multi-organ dysfunctions and cellular injury which in turn leads to death [37]. For instance, victims with shock usually have hypotension which leads to inadequate tissue perfusion and leads to multi-organ failure [38].

Victims who were admitted to ICU had a lower risk of death compared to those who were not admitted to ICU. The finding of this study is supported by a study conducted in Kenya [8], where admission to ICU has been reported to be protective. On the contrary, the result of this study is different from the result of a study conducted in south Ethiopia at Hawassa [23]. This discrepancy might be due to; the previous study verified that delayed admission to ICU, variation in arrival status to the Hospital to get definitive management, and the severity of injury. Another might be the differences between Hospitals in their emergency and intensive care services setup.

The finding of this study revealed that victims with low levels of arterial oxygen saturation (SPO2 < 95%) had a high hazard of death compared to those who had a normal levels of arterial oxygen saturation (SPO2 ≥ 95%). This finding is supported by the studies conducted in Brazil and Korea [39, 40]. It is also supported by

clinical evidence when the level of arterial oxygen is low, it causes hypoxemia, and hypoxia finally leads to hypoxic ischemic-encephalopathy which in turn leads to death if not treated promptly [38].

Limitations of the study.

Since the study was institution-based, it was unable to assess deaths occurring outside the hospital. Additionally, victims who were discharged against medical advice or referred to another institution after admission were at a higher risk of death, potentially leading to an underestimation of mortality rates.

Furthermore, due to incomplete data in victims' charts, important predictors such as distance from the hospital, prehospital care, and the level of education of the victim were not assessed. Additionally, reliance on secondary data as the data source may introduce bias in the reliability of vital signs measurements, such as pulse rate and blood pressure.

Conclusion

The median survival time was five hundred-four hours (twenty-one days) which is short. Complication developed during admission, low systolic blood pressure measurement value at the time of admission, low Glasgow Coma Scale score, victims did not admit to ICU and low level of arterial oxygen were the independent predictors of time to death among adult victims of road traffic accidents admitted to hospital which can be prevented. So it is recommended to assess complication during admission, measure blood pressure and oxygen saturation, immediate assessment of Glasgow Coma Scale score and if it is possible admission of RTA victims to ICU to decrease mortality.

Abbreviations

AHR	Adjusted Hazard Ratio
AOR	Adjusted Odds Ratio
DBP	Diastolic Blood Pressure
DRC	Democratic Republic of Congo
FHCSH	Felege Hiwot Comprehensive Specialized Hospital
GCS	Glasgow Coma Scale
ICU	Intensive Care Unit
IRB	Internal Review Board
ISS	Injury Severity Sore
MICs	Middle- Income Countries
MRN	Medical Record Number
POP	Plaster of Paris
RTA	Road Traffic Accident
RTIs	Road Traffic Injury
SBP	Systolic Blood Pressure
SSA	Sub Saharan Africa
TGCSH	Tibebe Gion Comprehensive Specialized Hospital
WHO	World Health Organization

Supplementary Information

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Supplementary Material 1.

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Authors' contributions

AG was involved in the design of the study, data analysis, and interpretation of the findings, report writing, and paper preparation. HG and AT were involved in the analysis and interpretation of data and review of the report. YT, SA, ST, AG, OS, AD, BM and LT were participated during paper preparation, data analysis, interpretation of the findings and report writing. All authors read and approved the final paper.

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Availability of data and materials

All data generated or analyzed during this study are included in this manuscript.

Declarations

Ethics approval and consent to participate

Ethical clearance was obtained from the Institutional Review Board of Bahir Dar University College of Medicine and Health Science with protocol No. of CMHS/IRB765/2023.Since we used secondary data analysis, the need for consent to participate was waived by an Institutional Review Board of Bahir Dar University College of Medicine and Health Science. The letter of permission was written by College of Medicine and Health Sciences academic and research director and Amhara public health institution director. A formal written letter was provided to selected specialized hospitals. Permission to review charts was taken from hospitals' medical directors. To keep confidentiality the name of the victim was not recorded and their information was not disclosed to third body for other purpose. While data collection the victims' charts were not taken to anywhere out of the card room.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

[1]Amhara regional health Bureau, Northwest, Ethiopia. [2]Department of Adult Health Nursing, School of Health Sciences College of Medicine and Health Sciences, Bahir Dar University, Bahir Dar, Ethiopia. [3]Department of Emergency and Critical Care Nursing, School of Health Sciences College of Medicine and Health Sciences, Bahir Dar University, Bahir Dar, Ethiopia. [4]Department of pediatrics and child Health Nursing College of Medicine and Health Sciences, Woldia University, Woldia, Ethiopia. [5]Department of Adult Health Nursing College of Medicine and Health Sciences, Debre Tabor University, Debre Tabor, Ethiopia. [6]Amhara regional health Bureau, Northwest, Ethiopia.

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