Predictive Factors for Fatality After Traumatic Brain Injury Among Road Traffic Crash Victims in Addis Ababa City, Ethiopia

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Research Article

Abstract

Background

Traumatic brain injury (TBI) is one of the common preventable causes of mortality and disability among road traffic victims worldwide, most especially in low- and middle-income countries, including Ethiopia.

Objective

to determine risk factors of mortality after traumatic brain injury due to road traffic crash.

Methods

This study aimed to examine the predictive factors of short-term mortality after severe brain injury due to a road traffic crash. The study was done on a prospective cohort of 242 severely brain-injured patients selected using cluster sampling in Addis Ababa City hospitals. The study was conducted from February 2018 to November 2019. Data were collected from brain-injured patients using a questionnaire and recorded findings within the first 24 hours of admission, Survival Analysis was used for statistical analysis. Ethical clearance was obtained from the Addis Ababa University, College of Health Sciences Institutional Review Board (IRB). Confidentiality of information about injured patients was maintained.

Results

In this study, the death rate was 73(30.2%). The majority of TBI patients accounting for, 186(81%) were men. The median age of TBI patients was 29 years. The hazard for those patients with subnormal body temperature was 1.64 times that of normal temperature (AHR: 1.64; CI: 2.14-10.29). The estimated fatality hazard ratio for patients who experienced Glasgow Coma Scale (GCS)below six was 5.61 times higher compared to GCS six to eight (CI:3.1-10.24).

Conclusion

In conclusion, there was high early mortality of patients (30.2%) in Ethiopia. Being men, young and lower GCS were associated with higher mortality hazards. Hence, optimum advanced neuro-surgical pre-hospital care programs are urgently needed.

Background

Traumatic brain injury (TBI) constitutes a considerable portion of the global injury burden caused primarily by road injuries and leads to high levels of disability and mortality. Traumatic Brain Injury [TBI]

is defined as an alteration in brain function or anatomic structure induced by mechanical force such as a motor vehicle crash that caused temporary or permanent neurological dysfunction [1]. TBI is also defined by both the initial primary injury and subsequent secondary injuries. Primary damage occurs when TBI happens due to initial impact, while secondary brain damage ensues the development of mass lesions which frequently exacerbates by systemic insults as a consequence of intrinsic pathophysiologic mechanisms [2]. TBI can be diagnosed and estimated by clinical examinations of the level of consciousness using scoring systems such as the Glasgow Coma Scale(GCS), Computed Tomography (CT) imaging, and the assessment of other vital parameters such as intracranial pressure[2, 3].

The pathophysiology of severe TBI can be viewed as a two-step process [1, 2]. The first step is primary injury, in which there is a wide range of TBI pathologies, such as focal contusions, and space-occupying intra-extradural hematomas, and diffuse axonal injury[4]. Diffuse axonal injury (DAI), also known as shear injury or traumatic axonal injury, refers to intracranial injury caused by rapid and sustained deceleration or acceleration of the brain [4, 5]. The second step is the secondary injury that occurs as a consequence of the primary injury [2–4]. It is especially because most of its consequences, especially cognitive impairments are not obvious [4]. It is also estimated that the majority of patients with severe TBI have other body site traumatic injuries [2]. A study showed that TBI plus one additional injury was the most common injury [3]. Studies revealed that an increased mortality rate following TBI[5–8]. Several factors contributed to TBI mortality. Studies revealed that being young and male is an important risk factor for TBI[6, 8–10]. Glasgow coma scale score and presence of hematoma on CT as independently significant predictors of survival. The studies also showed factors related to a poor outcome such as age > 38 years, Glasgow Coma Scale score < 8, subdural hematoma, and development of secondary systemic insults (respiratory, circulatory, and metabolic) [5, 8].

It was stated that the brain depends on the mean arterial pressure for perfusion, making maintenance of cerebral perfusion and oxygenation crucial in the setting of TBI as the brain is so vulnerable to ischemic injury [7]. A study in Scandinavia revealed that arterial hypotension and hypothermia were pre-hospital risk factors for mortality [11]. Significant morbidity and mortality occur when a patient experiences both hypoxia and hypotension, even when it is merely a brief instance of each [2, 12]. Patients with hypotension that is not corrected in the field had a worse outcome than those whose hypotension was corrected in the field (during scene and transport time) and at the emergency department [13, 14]. Hypothermia is related to uncontrolled bleeding in the prehospital and emergency settings [14]. TBI patient mortality increases with the magnitude of hemodynamic instability, and mainly the extent of the injury with bleeding [15] Thus, neurological monitoring of these patients is essential to limit episodes of decreased cerebral perfusion pressure [16].

Detecting traumatic brain injury (TBI) patients with a high risk of mortality is important to maximize the resource for trauma care[17]. Studies show that when the effective post-crash response was practiced, secondary injury is potentially preventable and represents endpoints for goal-directed resuscitation using evidence-based research input [2, 18]. Once a crash has happened there should be fast, easy, and adequate medical care to increase the chance of survival and to limit the physical consequences [5].

Glasgow Coma Scale (GCS) measure is a significant and reliable indicator of the severity of TBI, and it can help to identify improvement or deterioration in neurological status through repeated measurements during emergency management [6]. Prediction of the patient outcome can be useful as an aid to clinical decision making, to explore possible biological mechanisms, and as part of the clinical audit process [5].

In Ethiopia, the study regarding the extent of early mortality after severe traumatic brain injury due to road traffic crashes is limited. Therefore, the purpose of this study was to determine predictive factors of fatality after traumatic brain injury due to road traffic crashes and identify the extent of early mortality.

Methods

Study design, period and settings

We conducted institutional base prospective cohort study, with follow-up of severe TBI patients from the time 24 hours after crash brain injury admission up to 30 days or earlier death. The research work was accomplished from February 2018 to November 2019 in randomly selected Addis Ababa City Tertiary hospitals, including Tikur Anbessa Specialized Hospital, AaBET Hospital, and Minilic II Hospital emergency departments.The research work was accomplished from February 2018 to November 2019 in randomly selected Addis Ababa City Tertiary hospitals: Tikur Anbessa Specialized Hospital, AaBET Hospital, and Minilic II Hospital emergency departments. Addis Ababa City Administration is the Capital City of Ethiopia. Addis Ababa City is the seat of the African Union (AU) and the United Nations Economic Commission for Africa (UNECA). Addis Ababa was founded by Emperor Minilik II and Empress Taitu in 1887. The history of the City 's road development also began from the inception of the City. Emperor Minilik II is also believed to be the first in importing two cars in Addis Ababa and introduced car technology in the City for the first time in 1907[20]. In Addis Ababa, there were 28,361 crashes of which 4,433 of them harming humans during 2019 [20]. This study predicts the risk of mortality after severe Traumatic Brain injury among vehicle crash victims in Addis Ababa City.

Source population
The source population was all charts of severe traumatic brain injured patents due to vehicle crash victims
that visited the tertiary trauma care hospitals in Addis Ababa City.
Study population
Victims of road traffic crashes who were diagnosed with severe traumatic brain injury based on Computed Tomography scan finding recorded by examining medical doctors were the study population. The study included every individual TBI patient with an age of greater or equal to 18 years old, having severe Traumatic Brain Injury (TBI) due to road traffic crash with a measured intracranial lesion Abbreviated Injury Score (AIS) ≥ 4 on the base of the Computer Tomography (CT) scan findings recorded within the first 24 hours of admission [18]. TBI patients with un-recordable vital signs, like pulse, blood pressure that indicates pre-hospital physiological status, died during the pre-hospital time, had no signs of brain trauma, and were referred or transferred to other hospitals were excluded.

Sample size determination and Sampling procedure

The study initiated when individual diagnosed for severe TBI and admitted in the tertiary hospitals but have not experienced the death event at the time of ascertainment, and prospectively followed to observe the death event. The participants were ether experience the mortality event or censored at the 30th day of follow up to exit the study.

Participants in this mixed cohort were recruited based on brain injury severity status in which all those fulfilled severe TBI diagnostic criteria and admitted for it included. We ascertain risk factors such as age, sex, GCS, type of brain injury and TB severity status at the time of enrollment, and then prospectively followed the individuals with the severe TBI to observe the death events of interest.

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All tertiary care hospitals in Addis Ababa that provide trauma care service were identified. All hospitals with functional computed Tomography scan were listed. The randomly selected three hospitals (Minilic II Hospital, Tikur Anbessa Hospital and AbaT Hospital) that provide service to severe brain injury patients were recruited. The study subjects were recruited based on eligible criteria during the study period from the selected hospitals emergency departments when the injured patient admitted within 24 hours crash injury event.

Data collection instrument and techniques

Variables

Dependent variable

Mortality at 30 days or earlier

The response in this research was the "survival time/time for death". It was defined as the number of days from the date of crash injury for which the patient arrived at the Emergency Department of Hospitals assessed and followed up for 30 days for survival or death outcome. The survival data studied here were "right-censored".

Independent variable

Socio-demographic characteristics; age, sex, religion, marital status,

Clinical factors: traumatic brain injury type on the first day of crash occurrence, GCS, hypoxia, hypotension, and hypothermia.

Operational definitions

Initial neuro-physiological variables

Glasgow Coma Scale (GCS);is a neurological scale aimigto provide a reliable, objective way of recording the conscious state of a person. unconscious patients were defined as presenting a GCS <9.

Prehospital arterial hypotension was defined as systolic blood pressure <90 mmHg measured at time point within 24 hours of hospital admission including hospital arrival value.

Prehospital hypoxia was defined as body oxygenation with a pulse oximeter oxygen saturation <90% measured at any time point within 24 hours of hospital admission, including hospital arrival value.

Prehospital hypothermia was defined as body temperature with a thermometer measurement ≤ 35.0°C measured at any time point within 24 hours of hospital admission including hospital arrival value.

Fatality

is defined as a severe traumatic injury patient's death during 30 days or earlier after the crash.

The data collection tool included a structured questionnaire responded to by severely injured patients or relatives. Besides, patient record data with measured traumatic brain injury severity and the vital sign was collected by using a checklist adapted from another study [5, 6, 21]. The Survival data for this study were obtained from selected brain-injured patients collected by emergency medical doctors and emergency MSc nurses at emergency departments. The data collectors and supervisors with the principal investigator have followed up the injured patients from the first day of crash injury assessment to 30 days for the patient's survival or death.

Data Quality Assurance

The training was given to data collectors and supervisors about the objectives of the study and how to collect data in detail.

The questionnaire was developed from previous studies[5, 6, 10–12], translated from English to Amharic and again to English by language experts to ensure consistency. To ensure the quality of data, a pre-test of the data collection tool was done in Zewditu Hospital. The supervisors and investigator facilitated the data collection process. The principal investigator worked with data collectors to assure the trustworthiness of the data and to minimize inter-observer bias. Every day, the collected data were checked for completeness of data including vital signs, level of consciousness, Computed Tomography scan finding, missing value, and consistency using the checklist. Double data entry was done to ensure accuracy.

Data processing and analysis

Data were coded and entered into the computer using STATA 14 statistical software package. Outliers were cleaned and validated data were prepared for analyses. In this study, Survival Analysis was employed. Descriptive analysis of survival data utilized nonparametric methods to compare the survival function of two or more groups. The Kaplan-Meier estimate (product-limit-estimate) of the survival function was employed. The Log-rank test was utilized to test whether observed differences in survival experience between/among groups were significant or not. The multivariable model used a semi-parametric regression model known as the Proportional Hazard Regression (PHR) model to estimate the hazard of death.

Results

Result of the descriptive analysis

Socio-demographic characteristics

In this study 242 severe Traumatic Brain Injured (TBI) patients were observed. There were 73(30.2%) deaths. Of those, 65(89%) of deaths occurred among patients with subnormal body temperature and 8(11%) among normal temperature. Ninety-four percent of TBI patients with normal body temperature and 50% of TBI patients with subnormal temperature survived for 20 days. The hazard of death during the first 10 days for TBI patients with subnormal temperature and normal body temperature was 40% and 12% respectively. Overall Survival and hazard functions are shown in figure 1.

Table 1 indicates that seventy percent of TBI patients were right-censored and the remaining uncensored. TBI patients lived for an average of 24 days (95% CI: 22.69-25.40 days). The incident rate was 0.365 per person-30 days. The majority of TBI patients accounting for, 186(81%) were men. The incidence of death for age groups above fifty years old were 16(52%). The incidence of death for married and unmarried were 47(30.1%) and 26(30.2%) respectively. The incidence of death for Muslims and Orthodox were 16(28.1%) and 44(31.0%) respectively.

Table 1
Socio-demographic characteristics of TBI Victims, Addis Ababa, Ethiopia, 2019
(n=242)

Covariate	Category	Outcome			
		Died	Censored	Total	Present (%) censored
Sex	Female	14	34	48	71
	Male	59	135	194	70
Age	18 – 29	34	89	123	72
	30 -39	15	45	60	75
	40- 49	8	20	28	71
	>=50	16	15	31	52
Marital status	Married	47	109	156	70
	Unmarried	26	60	86	70
Religion	Muslim	16	41	57	72
	Orthodox	44	98	142	69
	Protestant	13	28	41	68
	Catholic	0	2	2	100

Clinical Characteristics

Among 14 traumatic subarachnoid hemorrhage cases, there were 8 deaths (57%) followed by 50 hemorrhagic cerebral contusion cases in which there were 19 deaths (38%). Regarding skull fracture, among 46 basal skull fracture cases, there were 22 deaths ((47.8%)) followed by 31 multiple skull

fracture cases with 12 deaths (38.7%). Among 71 comatose patients, there were 54 deaths (76.1%). Out of 66 hypovolemic cases, there were 34 deaths (51. 5%). Among 89 deoxygenated cases there were 46 deaths (51.7%). Out of 102 traumatic brain injuries plus other traumatic injury cases, there were 40 deaths (39.2%). A summary of the data for each level of variables is provided in Table 2.

Table 2
Clinical characteristics of TBI victims, *Addis Ababa, Ethiopia, 2019 (n=242)*.

Covariate	Category	Outcome			
		Died	Censored	Total	Present (%) censored
Type of injury	Subdural hematoma	6	55	61	90
	Subarachnoid hemorrhage	8	6	14	43
	Intraventricular Hemorrhage	20	33	53	62
	Diffuse axonal injury	17	30	47	64
	Hemorrhagic cerebral contusion	19	31	50	62
	Epi-Dural hematoma	3	14	17	82
Skull fracture	Single lobe fracture	6	18	24	75
	Basal skull fracture	22	24	46	52
	Multiple fractures	12	19	31	61
	No fracture	33	108	341	77
Body temperature	Normal	8	113	121	93
	Subnormal	65	56	121	46
GCS	Comatose	54	17	71	24
	Semi-conscious	19	152	171	89
Systolic B/P	Systolic B/P >= 100	39	137	176	78
	Systolic B/P < 100	34	32	66	49
Oxygen saturation	Oxygen saturation >= 90	27	126	153	82
	Oxygen saturation < 90	46	43	89	48
TBI Injury	Isolated TBI Injury	33	107	140	76
	Isolated TBI Injury +other injuries	40	62	102	61
Pre – hospital care	Care given	19	47	66	71
	No care given	54	122	176	69

Table 3 Shows results based on the log-rank test. The p-values show differences in survival experience between two or more levels of predictors. The predictors that manifested differences in levels of survival function are indicated as follows.

Table 3
Long-rank test p-values based on socio-demographic and clinical
characteristics of TBI Victims, *Addis Ababa City, Ethiopia, 2019 (n=242)*

Covariate	Df	Chi-sq	Long-rank p-values
Sex of TBI patient	1	0.01	0.91
Ages of TBI patient	3	9.43	0.24
Marital status of TBI patient	1	0.02	0.88
Religion of TBI patient	3	1.00	0.79
Type of brain injury	5	21.87	<0.0006
Isolated TBI injury + other site injuries	1	7.20	0.007
Systolic blood pressure measure	1	22.08	< 0.0001
Oxygen saturation status	1	36.78	< 0.0001
Body temperature	1	66.04	< 0.0001
GCS	1	127.27	< 0.0001
Pre – hospital care	1	10.30	0.58
Skull fracture involvement	3	12.70	0.005

Patients who had subdural hematoma injury lived for an average of ten days longer than those subarachnoid hemorrhage injured patients. Patients, who experienced single lobe fractures lived for an average of six days longer survival time than those exposed to a basal skull fracture. Patients with GCS measures range from three to five lived an average of 13 days' lower survival time than those patients with GCS measures range from six to eight. Normotensive patients lived for seven days longer survival time on average than hypotensive patients. Hypoxemia patients lived for eight days longer survival time on average than oxygen saturation patients. Isolated TBI lived for an average of four days longer survival time than patients with TBI Injury plus other traumatic injuries.

Results of Multivariate analysis

The cox model procedure that includes model selection, tests, diagnosis, and fit confirmed showed no problems concerning the interaction of main effects and cofounding. Therefore, the results in Table 4 are based on the bi-variable and multi-variable analyses. It should be pointed out that variables with p-values below 0.05 were considered statistically significant. Based on bi-variable cox regression, the estimated HRs for those age groups greater or equal to 50 are associated with a poorer prognosis compared to the 19 to 29 age group (CHR: 2. 18; CI: 2.21-3.96), the multi-variate model is not statistically significant. The result of the multivariate analysis revealed that the hazard of death for those patients with subnormal body temperature is 1.64 times that of normal temperature (AHR: 1.64; CI: 2.14-10.29).

Table 4

Estimated parameters of the bi-variable and multivariable cox regression analysis among TBI Victims, Addis Ababa, Ethiopia, 2019 (n=242)

Variables	Bi-variate analysis			Multi-variate analysis		
	Parameter estimate	CHR(95%CI)	P-value	Parameter estimate	AHR(95%CI)	P-value
Age: 18 -29	0.15	0.86(0.47-1.58)	0.62	-0.199	0.19(0.44-1.02)	0.53
30 − 39	0.03	1.03(0.48-2.23)	0.94	0.22	1.24(0.56-2.74)	0.59
40 − 49	0/78	2.18(2.21-3.96)	0.01	0.19	1.21(0.65-2.24)	0.55
>= 50						
Temperature Normal Subnormal	2.4	11.0(5.67-22.97)	0.001	1.55	1.64(2.14-10.29)	0.001
Systolic BP Normal subnormal	1.04	2.83(1.78-4.48)	0.001	0.50	1.64(1.00-2.69)	0.05
Injury status Isolated BI TBI+ other	0.61	1.84(1.16-2.92)	0.009	0.64	1.89(1.17-3.05)	0.009
Oxygenation Normal Subnormal	1.34	3.62(2.37-6.16)	0.001	0.34	1.4(0.83-2.40)	0.2
GCS Comatose Semi-conscious	2.42	11.2(6.59-19.03)	0.001	1.73	5.61(3.1-10.24)	0.001

Table 5
Goodness-of-fit test assessing proportional hazards Assumption among TBI Victims, Addis Ababa, Ethiopia, 2019 (n=242).

Covariate	Rho	Chi^2	Df	p-value
Temperature	-0.045	0.10	1	0.67
Systolic BP	0.072	0.41	1	0.52
Injury status	0.018	0.03	1	0.87
Oxygenation	-0.19	3.27	1	0.07
GCS	0.15	2.08	1	0.15
Age:	0.16	0.79	1	0.18
18 -29	0.047	0.16	1	0.68
30 − 39	0.085	0.56	1	0.45
40 − 49				
>= 50				
Global test		5.78	8	0.67

Based on multivariate cox regression, the estimated HRs of death for those who were hypotensive were 1.6 times higher than normotensive patients (AHR:1.6; CI: (1.00-2.69)), the multi-variate model was not statistically significant. Those patients who had traumatic brain injury plus other site injury were 1.89 times more likely to die compared to those who had isolated traumatic brain injury (AHR 1.89; CI: 1.17-3.05).

Based on bi-variable cox regression, the estimated hazard of death for those patients who had deoxygenated were 3.62 times higher than those of oxygenated (CHR: 3.62; CI: 2.37-6.16), the multi-variate model was not statistically significant. The estimated fatality hazard for patients who experienced deep comma was 5.61 times higher than patients in coma state (AHR: 5.61; CI:3.1-10.24) (Table:4).

Test of proportional-hazards assumption

Testing the proportional hazard assumption is vital for the interpretation and use of fitted proportional hazard models. In this study, goodness-of-fit (GOF) particularly the Schoenfeld residuals proportional hazard assumption test for the individual covariates and global tests was used. The findings indicated that all variables included in the model satisfied the PH assumptions (p-value>0.05). For each predictor, there was no significant evidence of a poor fit. The global test does not have statistically significant evidence of poor fit (p-value: 0.67). Therefore; we do not reject the assumption of proportional hazards (See Table:5).

Discussion

This study finds out that patients with severe traumatic brain injury have a high mortality rate (30.2%), especially, the men and the younger were the victims. The rate of mortality reported in our study was higher than the study conducted in New York and Tunisia, which were 25%, and 26.9% respectively [2, 8], and lower than the studies conducted in Uganda [6], South Africa [8]. But our study involved only short-term mortality. Our study revealed that female Traumatic Brain Injury (TBI) patients had on average similar survival times to those of men. The majority of severely brain-injured patients, accounting for 80% were men which is similar to other studies conducted in Paris [1], USA [5], Tunisia [8], and Uganda [6, 9]. The possible explanation might be since men's vehicle users are younger and energetic to exert forceful driving that could lead to a crash. Our study showed that the mean age of severe traumatic brain injury was 36 years which is lower than the study conducted in the USA [5] and higher than the study conducted in Uganda [6] and similar to studies conducted in Uganda and Paris [1, 9]. This difference might be explained by the fact that in our setting, younger victims were mostly exposed to crashes which are dangerous to lead to severe brain injury.

A previous study showed that primary injury has a wide range of TBI pathologies, such as diffuse axonal injury, focal contusions, and space-occupying intra- and extradural hematomas [2]. That study was similar to our finding which revealed that 38%deaths were due to hemorrhagic cerebral contusion. That might be due to not wearing protective devices.

This study finds out that the most fatal skull fracture was basal skull fracture and multiple skull fracture. Moreover, patients with TBI have often committed other body site traumatic injuries. In this study, the traumatic brain injury patient who undergoes deep comma had the least survival. The estimated hazard ratio for those patients who experienced deep comma was more likely to die compared to comma patients. This is in agreement with other studies that indicate lower on-scene GCS associated with higher mortality [7, 14, 15]. This might be probably due to worsening of primary impact as a result of lack of advanced life support care for damaged brain tissue as well as lack of anesthetist who secures airway of victims in the prehospital setting. In the current study, hypotension resulted in a major fatality, accounting for 51.5% of deaths. Based on bi-variable cox regression, the estimated HRs for those who were hypotensive was 2.83(CI:1.78-4.48). This finding was similar to another study [2]. The majority of deoxygenated severe traumatic patients (51.7%) died. Those patients having deoxygenated had lived eight days' shorter survival time on average than those having oxygenated. Based on bi-variable cox regression, the estimated hazard ratio for those who were deoxygenated were 3.6 times more likely to die compared to oxygenated (CI: 2.37-6.16). This finding was in agreement with previous findings that stated hypoxemia as a prehospital risk factor for the early fatality of severely brain-injured patients [14, 15]. This might suggest that pre-hospital care lacks immediate airway management with an anesthetist to prevent deoxygenation.

Our study found out that those patients who had traumatic brain injury plus other site injuries were twofold more likely to die compared to those who had isolated traumatic brain injury. That might be

probably due to the limitation of pre-hospital neurosurgical care integrated with other body injury care on scene and during transportation.

The combination of hypotension and hypoxia occurring before arrival at the pre-hospital time is associated with a significant increase in death compared with either physiologic insult alone. This study was inconsistent with another study [12[. This might be due to a lack of immediate advanced neurosurgical care at the scene and transportation time to manage the primary impact of the brain tissue.

Limitation of the study

This study may have some limitations: First, the data were collected where the crash injury victims have been in physical and psychological stress situations that can limit recalling the exact measure of scene and transport time values. Second, the study mainly focused on pre-hospital care of TBI, but prehospital data were not originally documented on the scene and during transportation for this study, but the data were verified by the supervisor and facilitator to reduce biases. Third, the study did not consider the previous status of the patient's physiological status like hypovolemia and pathological status like comorbidity. Fourth, collecting data at the time of hospital arrival may not be inclusive to collect the overall situation of scene time and transport time characteristics of crash injured victims. Lastly, this study did not consider long-term mortality after 30 days of TBI and neurological deficit as a consequence of TBI, especially cognitive impairments that are not obvious during the study period.

Conclusion

In conclusion, there was high early mortality of TBI patients (30.2%) in Ethiopia. The lower GCS was associated with a higher mortality hazard, which may lead to a higher proportion of TBI patients with poor outcomes. Post-injury events, such as hypoxemia, hypotension, and intracranial hypertension may also initiate the pathophysiological mechanisms of secondary brain injury. This demonstrates the need for early correction of the alarming situation in the pre-hospital setting to lower the risk of secondary brain injury. Trauma patient mortality increases with the magnitude of hemodynamic instability that require appropriate skilled practice programs on pre-hospital TBI management are urgently needed. Further study long-term outcome TBI that includes long-term mortality and disability to large extent should be considered.

Abbreviations

CT: Computed Tomography, GCS: Glasgow coma scale, IRB: Institutional Review Board, TBI: Traumatic Brain injury

Declarations

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of the Addis Ababa University, College of Health Science, Institutional Review Board (IRB) with Protocol number: 036/17/SpH before conducting the study.

Permission was obtained from selected Addis Ababa City Tertiary hospitals: Tikur Anbessa Specialized Hospital, AaBET   Hospital, and Minilic II Hospital. Since some patients cannot read and write a crash victim and/or surrogate offered oral informed consent for free study participation according to IRB-approved consent procedure. When patients were neurologically capable of giving informed consent, they were asked directly. If the patients were not neurologically capable of giving informed consent themselves, their relatives were contacted and asked for consent. In the case of withdrawal, further, follow-up was discontinued. Complying with a patient's request, the collected data would be removed from the database and destroyed. The confidentiality of information regarding patients involved in this study was maintained by keeping all patients records within the study site and avoiding of identifying study participants by name on any documentation, report or publication resulting from data collected in this study.

All methods were performed in accordance with the relevant guidelines and regulations.

Consent for publication

Not applicable

Availability of Data and Materials

The data is presented along with the manuscript. All the data included in the manuscript can be accessed from the corresponding author Zuriyash Mengistu Assen upon request through an email address of zuriyashaau@yahoo.com..

Competing interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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Authors' Contribution

 ZM originated the idea, design and develop proposal participated in data collection, data organizing, statistical analysis, and report writing.

 AA participated in reviewing and editing -   supervising. TA participated in reviewing and editing - supervising. All authors read and approved the final manuscript before submission.

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Figures
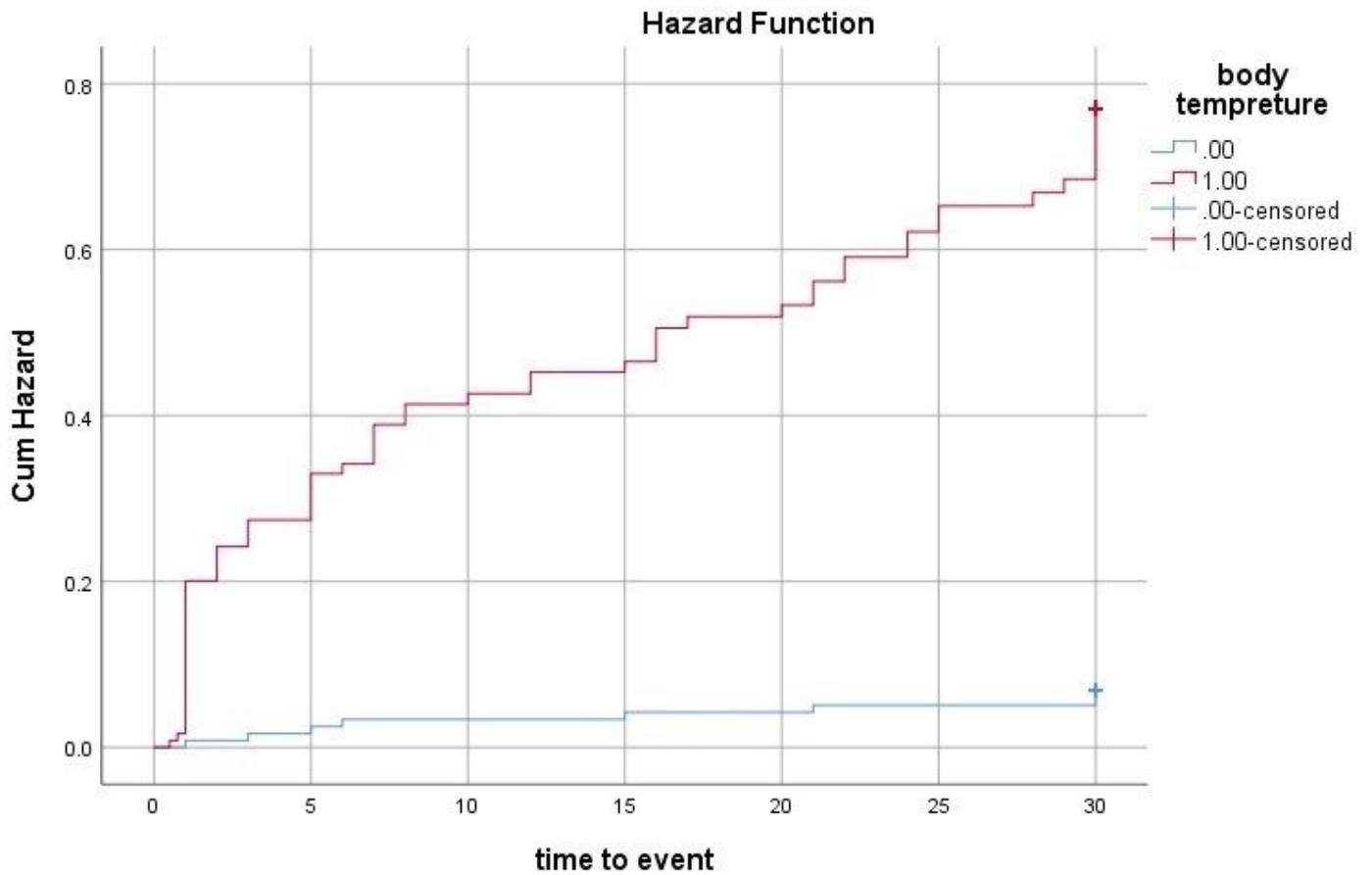
Figure 1

Overall survival and hazard function (in days) of severe TBI patients in Addis Ababa City, Ethiopia, 2019(n = 242)