Original Article

Incidence of mortality and its predictors among patients with head injury admitted to adult intensive care unit at AaBET and ALERT hospitals, Addis Ababa, Ethiopia

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Abstract

Background: Traumatic head injury, referred to as the "silent epidemic", remains a growing public health concern and the leading cause of mortality in young adults, with a disproportionate burden of disability and death occurring in low-income and middle-income countries, including Ethiopia. However, estimates of the traumatic brain injury burden from low and middle-income countries are scarce. The aim of this study was to assess outcome and its associated factors among patients with head injury admitted to the Adult Intensive care unit at AaBET and ALERT hospitals, Addis Ababa, Ethiopia. **Methods:** Institution-based retrospective cohort study was conducted at AaBET and ALERT hospitals from February 01, 2019 to January 30, 2020. All head injury patients' records were reviewed. A structured checklist was used to collect data. Binary logistic regression analysis was used to identify factors associated with death among head injury patients. **Result:** Out of 205 patients, 178 (86.8%) improved, while 27 (13.2%) died. Road traffic accident was the most common cause of head injury (Adjusted odds ratio (AOR) = 46.3%). Patients with pulse rate admission (AOR = 1.49), NA + level (3.48), type of head injury (AOR = 3.67), mechanical ventilation (AOR = 4.70) were significant predictors of death among patients with head injuries. **Conclusion:** The incidence of death among head injury patients was 13.2% (27). Road traffic accident was the leading cause of head injury. Pulse rate, plasma sodium level, penetrating head injury, being on a mechanical ventilator were predictors of death among traumatic head injury (THI) patients treated for head injuries. Prevention of road traffic accidents and continuous awareness creation about the consequences of a road traffic accident is recommended.

Keywords: Head injury, intensive care unit, mortality

Introduction

A head injury is defined as a morbid condition caused by mechanical forces that cause substantial or subtle structural changes in the scalp, skull, and/or skull contents. Depending on whether or not the dura mater was ruptured, the head injury might be classified as open or closed. A head injury is described as a morbid state caused by mechanical forces that cause extensive or subtle structural changes in the scalp, skull, and/or the contents of the skull. Depending upon whether the dura mater was torn or not, the head injury may be termed as an open or closed type.[1] Traumatic brain injury is another term for head injuries (TBI).[2]

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Road traffic injuries (RTI), falls, and violence are the primary causes of traumatic brain injuries worldwide.[3] Falls are the leading cause of TBI hospitalization in Europe and the United States of America. However, throughout the rest of the world, particularly in poorer countries, road traffic accidents continue to be the major cause of injuries, including TBI.[4]

TBI is a serious public health issue that affects people all around the world.[5] Motor Vehicle Crashes will become the third leading cause of death and disability in the general population by 2030 due to urbanization and increased number of motor vehicles on the roads, and the resulting increase in Motor Vehicles.[6] Thus, most of the victims of TBI are within the productive age group who contribute to the country's much-needed economic growth.[7]

Every year, more than 50 million people are affected by TBI worldwide. Low and middle-income countries (LAMIC), which account for 85% of the global population, bear the heaviest burden of head injury.[8] Traumatic brain injuries are a leading cause of death and disability, with major repercussions for patients and their families as well as the potential for massive financial costs.[9] In people under 40, TBI is severely disabling 150–200 people per million annually.[10] The burden of disability and death is disproportionately high in low-income and middle-income countries.[11] The World Health Organization (WHO) ranked head injuries among the top ten leading causes of death, with an estimated 5 million deaths annually, and African men have the highest injury-related mortality rates in the world. Among African nations, the rate of head injury-related mortality was the highest in Nigeria, and South Africa and Ethiopia were second and third, respectively.[12] One-third of all head injury patients in Africa have poor outcomes, and those with severe head injuries have nearly double the risk of dying as those in high-income nations.[13]

Because society is mostly unaware of the severity of the problem, it is regarded as one of the most silent epidemics.[14] The epidemiological trends of TBI are changing, and the demand for study in this area is increasing.[11]

Injuries are a major source of health problems in Ethiopia, ranking among the main causes of morbidity and mortality.[15]

TBI fatality rates, as well as data on the economic burden of TBI, are frequently insufficient and vary among nations and continents.[11] Efforts to collect solid epidemiological data on TBI disability and mortality in resource-limited areas are still required.[14] Even though the Ethiopian government has implemented initiatives to reduce road traffic accidents, the morbidity and mortality linked to severe head injuries as a result of road traffic accidents (RTAs) remain extremely high.[16] The outcome of a head injury is highly tied to quick management, which includes secondary brain injury prevention and intensive care unit (ICU) management.[17]

Despite the severity of the problem, dependable statistics on brain injury are lacking, particularly in LAMICs such as Ethiopia.[18] There was an insufficient study on head injuries in Ethiopia. There are no published studies in the study area, to the best of our knowledge. Therefore, this study assessed the outcome of head injury and associated factors among patients with head injuries at AaBET and ALERT hospitals in Addis Ababa.

Identifying the predictors of death from a head injury may help the primary care physicians to refer the patients promptly to the advanced care centers so that they get quality care.

It may help the primary care physicians to allocate scarce resources and pay special attention to high-risk group patients on admission and during hospital stay, and may eventually add an input in the struggle to reduce head injury-related deaths.

The findings of this study will be useful in order to identify future areas of improvement regarding in-hospital Intensive care services delivered to safe, invaluable, and irreplaceable human life following head injury.

It would also be helpful for health monitoring groups, for policymakers, and for other researchers as a baseline and for the respective hospitals.

Methods and Materials

Study area and period

The study was conducted at Addis Ababa Burn, Emergency and Trauma (AaBET) Hospital and All African Leprosy Rehabilitation and Training Center (ALERT), from Oct 1 to 31, 2020, Addis Ababa, Ethiopia.

AaBET is one of the trauma and burn centers located in Addis Ababa, the capital city of Ethiopia. AaBET currently provides health care services in several specialties, namely: orthopedics, neurosurgery, plastic and reconstructive surgery, and emergency and critical care. The hospital has approximately 20,000–30,000 total visits to the hospital and provides a variety of outpatient services, including emergency services, and provides elective and emergency surgeries of the respective departments. The hospital has two ICUs with an 18-bed capacity.[19]

ALERT hospital is one of the leading specialized hospitals in dermatology, opthalmology, plastic and reconstructive surgery along with other health care facilities and a center of excellence providing blended comprehensive leprosy and TB/HIV training in the nation. ALERT trauma center has three ICU departments with 40 well-equipped beds and trained nurses. Thus they are providing Trauma services not only for Addis Ababa dwellers but also for the whole country by receiving referral cases from respective regions and city administrations.

Study design

Institution-based retrospective cohort study was conducted.

Source population

All trauma patients admitted to the Adult intensive care unit (AICU) at AaBET and ALERT hospitals were the source population.

Study population

All patients with head injury were admitted to AICU at AaBET and ALERT hospitals from Feb 01, 2019 to Jan 30, 2020.

Sample size determination and sampling technique

Initially, Addis Ababa Burn, Emergency and Trauma (AaBET) Hospital and All African Leprosy Rehabilitation and Training center were selected purposely.

All adult head injury patients admitted to AICU from Feb 01, 2019 to Jan 30, 2020 were included in the study. Between Feb 01, 2019 to Jan 30, 2020, 219 head injury cases were admitted. Of these, six cases were lost, and eight were referral cases. Finally, charts of 205 head injury patients were reviewed consecutively.

Data collection tool and procedure

A data abstraction tool (checklist) was developed using the selected variables from the components of the chart of the federal ministry of health and literature. The data were collected by 4 BSc nurses.

Data quality management

To assure the data quality, training was given to the data collectors and supervisors.

Respective supervisors conducted close onsite supervision to clarify any ambiguity and misunderstanding regarding data collection procedures and have provided sound explanations with the principal investigator, accordingly. All collected data were manually checked and cleaned before importing to the computer for analysis.

Study variables

Dependent variables

Outcome of the head injury (discharged with improvement or died).

Independent variable

- Age
- Sex
- Mechanism of head injury
- Duration of ICU admission
- Patient status at admission
- Types of head injury
- Severity of head injury
- Associated injury
- Patient status at admission
- CT-Scan finding/Diagnosis
- Comorbid illness
- Length of ICU stay
- Complications
- Types of interventionsgiven.

Data analysis

Data were checked, coded, and entered to EpiData 3.1 and exported to statistical package for social sciences [SPSS] version 20 for analysis. Percentages, frequencies, tables, charts, and graphs were used to present the results. Binary logistic regression was used to identify factors associated with the outcome of TBI. The variables having *P* value less than 0.25 entered into the multivariate logistic regression model to identify the independent effects of variables on the outcome variables. Adjusted odds ratio with 95% CI was estimated and interpreted. A *P* value of less than 0.05 was considered to declare as statistically significant in the final model.

Operational definitions and definition of terms

Intensive care unit: A special department of a hospital or health care facility that provides intensive treatment for critically ill patients.

Outcome status- Clinical outcomes of head injury, that is, either patients are discharged with improvement or die at the end of their hospital ICU stay.

Traumatic brain injury (TBI) - Alteration in brain function, which manifests as confusion, altered level of consciousness, coma, seizure, etc.

Results

Socio- demographic characteristics of patients with head injury

A total of 205 patients with head injuries admitted to the adult intensive care unit were included in this study. Of which 172 (83.9%) were males, with a male to female ratio of 5.2:1. The mean (± SD) age of patients was 36.02 ± 15.74 years. More than two-thirds (68.8%) of the patients were in the age category of 18–40 years [Table 1].

Sign and symptoms of head injury patients

Regarding the signs and symptoms of patients with head injury at admission to the adult ICU, 44 (21.5%) were admitted with seizures, and 25 (12.2%) were admitted with increased ICP [Figure 1].

Mechanism of head injury

Regarding the mechanism of injury, 95 (46.3%) sustained head injuries from road traffic accidents [Figure 2].

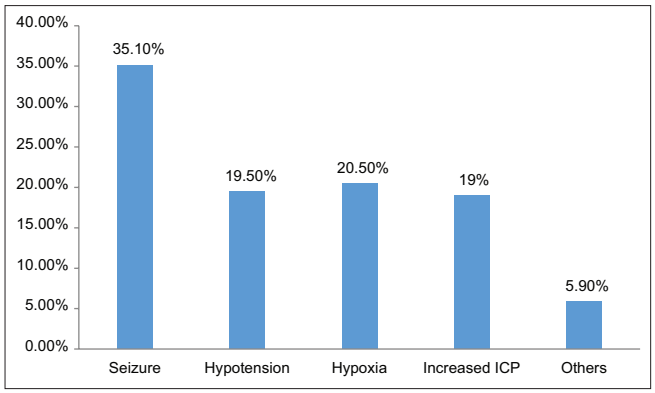

Figure 1: Signs and symptoms of patients with head injury at admission to adult ICU of AaBET and Alert hospital, Addis Ababa, Ethiopia, from Feb 01, 2019 to Jan 30, 2020 (*n* = 205). Others*, indicates Vomiting, Nausea, and confusion during admission

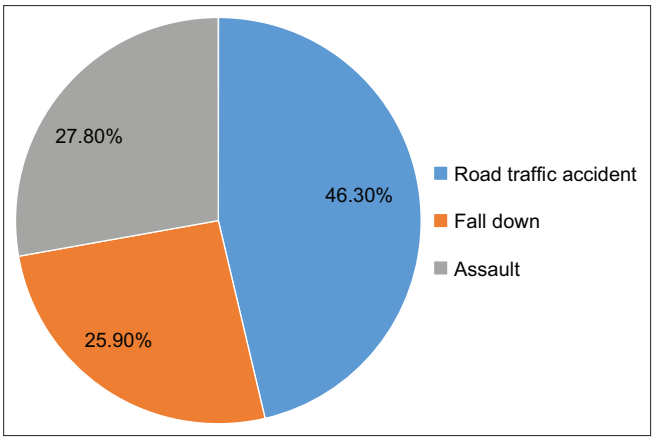

Figure 2: Mechanism of head injury among patients admitted to adult ICU at AaBET and Alert hospitals Addis Ababa, Ethiopia from Feb 01, 2019 to Jan 30, 2020 (*n* = 205)

Severity of head injury

More than half (51.7%) had a severe head injury, 83 (40.5%) had a moderate head injury, and 16 (7.8%) had a mild head injury.

Diagnosis or CT-scan finding at admission

Regarding diagnosis at admission, from the total cases, 59 (28.8%) had a diagnosis with acute epidural hematoma, of which 35 (33.01%) were severe head injury patients, 57 (27.8%) with acute subdural hematoma followed by basal skull fracture which accounts for 41 (20%) patients. Among severe head injury patients, 77 (72.6%) underwent an operative procedure, and the remaining 29 (27.4%) were managed conservatively, as shown [Table 2].

Associated injury

Out of the 205 head injury patients, 124 (60.5%%) had a skull fracture, 55 (26.8% had soft tissue injury, 23 (11.2%) had a neck injury, 19 (9.3%) had Abdominal injury, 16 (7.8%) had a Chest injury, and the remaining 13 (6.3%) had a pelvic injury as shown [Figure 3].

Management done in ICU

Among patients admitted to adult ICU, 63.4% were operated on, while 36.6% were managed conservatively. Sixty-seven percent of the patients with Traumatic head injuries had intracranial hematomas. Craniotomy and burr hole evacuation for intracranial hematoma were done for 76 (37.1%) and 22 (10.7%) patients, respectively [Table 3].

Regarding complications, 137 (66.8%) patients developed complications; from this, pneumonia and seizure were the most common ones, as shown in T*able* 4.

Length of ICU stay

The median hospital ICU stay was 11 days. About 70 (34.1%) patients stayed less than seven days, 47 (22.9%) patients stayed between seven to 14 days, while 88 (42.9%) patients stayed greater than 14 days in ICU. Average hospital ICU stay of mild, moderate, and severe head injury was 7.8, 40.7, and 51.5 days, respectively.

Table 1: Distributions of socio-demographic characteristics of Patients with Head injury Admitted to Intensive care unit at AaBET and Alert hospitals, Addis Ababa, Ethiopia, from Feb 01, 2019 to Jan 30, 2020 (*n*=205)

Variables	Categories	Frequency	Percent (%)
Sex	Male	172	83.9
	Female	33	16.1
Age	18-40	141	68.8
	41-60	44	21.5
	>60	20	9.8
Residence	Urban	133	64.9
	Rural	72	35.1
Place of accident	Addis Ababa	84	41
	Oromia	86	42
	SNNPR	22	10.6
	Others	13	6.3
Source of referral	Public health center	56	27.3
	Self-referral	28	13.7
	Public hospital	93	45.4
	Private facility	28	13.7

Management outcome of head injury patients

Overall, 178 (86.8%) improved and 27 (13.2%) died. Mortality of cases was more predominant in the 18–40 age group, which accounts for 17 (67%), and males comprised of 22 (81.5%). There was more death in urban inhabitants; 16 (59.3%) compared to the one who lives in rural 11 (40.7%) [Table 5].

Road Traffic Accident was the commonest cause of death 12 (44.4%) followed by fall down 8 (29.6%) and assault 7 (26%). Severe head injury accounts for the majority of death 16 (59.2%), moderate accounts for 8 (29.6%), and mild head injury accounts for 3 (11.1%) [Table 6].

Table 2: Diagnosis of patients with head injury admitted to adult intensive care unit at AaBET and Alert hospitals, Addis Ababa, Ethiopia, from Feb 01, 2019 to Jan 30, 2020 (*n*=205)

Diagnosis	Frequency	Percent (%)
Basal skull fracture	41	20
ASDH	57	27.8
DSF	12	5.9
CSDH	6	2.9
AEDH	59	28.8
SAD	13	6.3
CEDH	2	1.0
Liner skull vault fracture	5	2.4
Basal contusion	12	5.9
Diffused axonal injury	30	14.6

ASDH=indicates acute subdural hematoma, DSF=depressed skull fracture, AEDH=acute epidural hematoma, SAD=subdural hematoma, and CEDH=chronic epidural hematoma

Table 3: Management of patients with head injury admitted to adult ICU at AaBET and Alert Hospitals, Addis Ababa, Ethiopia from Feb 01, 2019 to Jan 30, 2020 (*n*=205)

Procedures done	frequency	Percent (%)
Craniotomy and evacuation of hematoma	76	37.1
Elevation of depression of skull fracture	9	4.4
Burr hole and evacuation of hematoma	22	10.7
Decompressive craniotomy	12	5.9
Other surgical treatment	11	5.4
Total	130	63.4
Conservative treatment	75	36.6

Table 4: Complications of head-injured patients admitted to Adult ICU at AaBET and Alert hospital Addis Ababa, from Feb 01, 2019 to Jan 30, 2020 (*n*=137)

Complication	Frequency	Percent
Neurological deficit	25	18.2
Wound sepsis	5	3.6
Pneumonia	68	49.6
Seizure development	39	28.5

Predictors of mortality among admitted head injury patients

Variables with *P* value < 0.25 in bivariate analysis such as diastolic blood pressure, pulse rate, level of consciousness, types of head injury, NA+, pupillary size, mechanical ventilation, comorbid illness, and complication were considered for multivariate analysis.

In multivariable analysis, pulse rate, NA+, type of head injury, mechanical ventilation, and diastolic blood pressure (DBP) were significantly associated with mortality among head injury patients. Patients with a pulse rate <60 on admission were 1.49 times more likely to die than those having >100 (AOR: 1.49; 95% CI: 0.20, 11.10). Those who had NA+ greater than one hundred forty were 3.48 times more likely to die than those with NA+ between

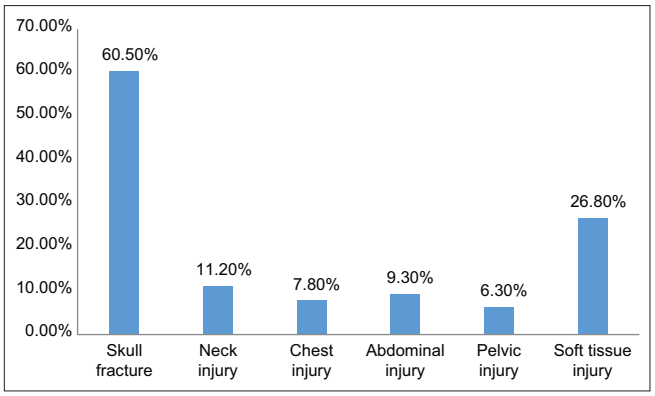

Figure 3: Associated injury of head injury patients admitted to adult ICU at AaBET and Alert hospitals Addis Ababa, Ethiopia from Feb 01, 2019 to Jan 30, 2020 (*n* = 205)

120–140 (AOR = 3.48,95% CI: 1.22–9.88). Those who had penetrating head injury were 3.67 times more likely to die than those who had a blunt head injury (AOR = 3.67, 95% CI: 1.17–11.55). Those who were put on mechanical ventilation were 4.70 times more likely to die than those who were not put on mechanical ventilation (AOR = 4.70, 95% CI: 1.01–21.93) [Table 7].

Discussion

This study aimed to determine the incidence and predictors of mortality among patients with head injury admitted to adult ICU at AaBET and Alert hospitals, Addis Ababa, Ethiopia, from Feb 01, 2019 to Jan 30, 2020. Out of 205 head injury patients, 27 (13.2%) died. This finding is nearly consistent with the study conducted at Hawassa University Comprehensive Specialized Hospital Ethiopia (12.7%),[20] Nigeria (10.1%).[17] Similarly, this finding is in line with a study conducted in Uganda on 194 head injury patients, where 23 (12.1%) died.[2] The mortality rate in this study is lower than that of Felegehiwot Comprehensive Specialized Hospital (30.45%),[21] Tongji Hospital (26.4%),[22] and Benin City (52.2%).[23] The difference in mortality rate among the studies could be due to differences in the quality of care, the severity of the head injury, and the background of the patients.

The leading cause of traumatic head injury was road traffic accidents, which comprised 95 (46.3%), followed by assault accounts 57 (27.8%) and fall down comprising 53 (25.9%). This finding is almost similar to the study conducted in Latin America and sub-Saharan Africa and especially where road traffic accidents and assault were the commonest causes of TBI.[23,24] In a study done in Uganda, road traffic accidents (RTA) contributed to 108 (56.8%) of all cases.[2]

Furthermore, a study conducted in Gedeo Zone, Southern Ethiopia, has shown that road traffic accident was the main cause of severe head injury (44.1%).[16]

The median hospital ICU stay was 11 days. This finding is inconsistent with a study conducted at Tikur Anbessa hospital,

Table 5: Distribution of outcomes of head injury among Socio-demographic characteristics of patients admitted to AaBET and Alert hospitals, Addis Ababa, Ethiopia from Feb 01, 2019 to Jan 30, 2020 (*n*=205)

Variables	Category	Outcome status	
		Improved	Died
Sex	Male	150	22
	Female	28	5
Age	18-40	124	17
	41-60	39	5
	>60	15	5
Place of Residence	Urban	117	16
	Rural	61	11
Place accident occurred	Addis Ababa	72	12
	Oromia	73	13
	SNNPR	21	1
	Others	12	1
Source of referral	Public Health center	51	5
	Self-Referral	24	4
	Public Hospital	76	10
	Private Health facility	27	8

Table 6: Distributions of outcomes of head injury among patient status on admission to ICU at AaBET and Alert hospital, Addis Ababa, Ethiopia from Feb 01, 2019 to Jan 30, 2020 (n=205)

Variables	Category	Outcome status	
		Improved	Died
Mechanism of head injury	Road Traffic Injury	83	12
	Fall down injury	45	8
	Assault	50	7
Type of head injury	Blunt	144	16
	Penetrating	34	11
Severity of head injury	Sever	89	16
	Moderate	75	8
	Mild	13	3
Types of intervention	conservative	63	12
	Surgery	115	15
Patient on Mechanical ventilation	Yes	88	24
	No	90	3
Comorbid illness	yes	12	5
	No	166	22
Complications	yes	87	21
	No	91	6

Ethiopia (13 days),[5] at Hawassa University Comprehensive Specialized Hospital Ethiopia (3 days),[20] and Felegehiwot Comprehensive Specialized Hospital (44 days).[21] This difference could be due to the difference in the severity of the injury, the need for prolonged mechanical ventilation such as in acute respiratory distress syndrome (ARDS), complications arising from ICU stay, and difference in service quality.

Patients with a pulse rate <60 were more likely to die than those with a pulse rate >100. This finding is in line with the study done in the tertiary hospital, Nigeria, where the presence of bradycardia at presentation was associated with higher odds of death.[17] However, pulse rate was not associated with the hazard of death in a study done in Felegehiwot Comprehensive Specialized Hospital (44 days).[21]

Patients who were put on mechanical ventilation were more likely to die than those who were not put on mechanical ventilation. This finding is consistent with the study done in southern African Benin city, Nigeria, where traumatic brain injury patients who received ventilator support had higher odds of mortality compared with those who did not.[23] Similarly, it has been observed that mechanical ventilation in severe brain injury is associated with a threefold risk of death.[25] Furthermore, this finding was similar to a study conducted in Nigeria that showed patients who were mechanically ventilated had higher mortality than those who were not ventilated.[17] The need for ventilator support in severe TBI is often an independent risk factor for mortality irrespective of the duration and mode of ventilation.[23] This observation of increased mortality in mechanically ventilated patients may be a reflection of the severity of head injury or other injuries in patients requiring mechanical ventilation in our setting.

Patients who had plasma NA+ level greater than one hundred forty were more likely to die than those with normal plasma sodium level. This finding is in line with the study done in Nigeria that revealed Abnormal levels of plasma sodium at admission were associated with higher odds of death.[17] Similarly, a study conducted at Isfahan University of Medical Sciences, Iran, found that plasma sodium level >145 mmol/L was the predictor of death.[26]

Patients who had penetrating head injury, were more likely to die than those with a blunt head injury. This finding is in line with a study done in the USA, where the mortality of patients with a penetrating TBI was four times greater than that of patients with closed traumatic brain injury.[27]

Key points

- The median length of ICU stay was 11.
- The incidence of death was 13.2%.
- Road traffic accident was the most common cause of head injury
- Patients pulse rate admission, type of head injury, mechanical ventilation were significant predictors of death among patients with head injury.

Strength of the study

The inclusion of the participants from two broad care centers could make the result of the study representative.

Limitations of the study

The study was conducted in a short period of time, and there was shortage of time in writing this research thesis and with this COVID-19 pandemic.

Table 7: Factors associated with death among admitted head injury patients at AaBET and Alert hospitals, Addis Ababa, Ethiopia from Feb 01, 2019 to Jan 30, 2020 (*n*=205)

Variable	Category	COR,95%CI	AOR,95% (CI)	*P*
DBP	<60	2.04 (1.44-8.89)*	2.58 (0.79-8.35)	0.11
	>=60	1	1	
PR	<60	0.75 (0.85-4.93)	1.49 (0.20-11.10)	0.03
	60-100	0.16 (0.06-0.39)	0.22 (0.07-0.71)**	
	>100	1	1	
Level of conscious	Conscious	1	1	0.30
	Unconscious	2.99 (1.15-7.76)*	1.90 (0.57-6.35)	
NA+	120-140	1	1	0.02
	>140	2.44 (1.07-5.57)*	3.48 (1.22-9.88)**	
Pupillary size	Unilateral Fixed	0.23 (0.03-1.81)	0.08 (0.01-0.80)	0.12
	Bilateral Fixed	4.05 (1.66-9.89) *	1.31 (0.37-4.60)	
	Symmetric Fixed	0.64 (0.08-5.39)	0.75 (0.07-8.30)	
	Mid-size and reactive	1	1	
Type of head injury	Blunt	2.91 (1.24-6.84)*	3.67 (1.20-11.55)**	0.03
	Penetrating	1	1	
Mechanical ventilation	Yes	8.18 (2.37-28.1)*	4.70 (1.01-21.91)**	0.04
	No	1	1	
Comorbid illness	Yes	3.14 (1.01-9.77)	3.73 (0.80-18.05)	0.10
	NO	1	1	
Complication	Yes	3.66 (1.41-9.50)*	2.02 (0.56-7.21)	0.28
	No	1	1	

As the data was taken from a secondary source, some of the factors such as smoking and alcohol consumption, which could possibly affect the management outcome of THI, were not included. In this study, the condition of patients after the discharge was not known. Therefore, the magnitude of unfavorable outcomes could have been underestimated.

Conclusion

The incidence of death among head injury patients was 13.2%.[26] Road traffic accident was the leading cause of head injury.

Pulse rate, plasma sodium level, penetrating head injury, being on a mechanical ventilator were predictors of death among THI patients treated for head injuries.

Authors contribution

GA: conceived the study. GA, TG, EG, LLT, DEA, and SM prepared the design, did literature search, data acquisition, data analysis, statistical analysis, manuscript preparation, manuscript editing, and manuscript review.

Ethical consideration

Ethical clearance was obtained from the Institutional Review Board (IRB) of St. Paul millennium medical college. A formal letter of permission was obtained from AaBET and ALERT hospitals. As the study used a review of records, no consent was needed from the mothers or caregivers of the study subjects. The information collected for this study was kept confidential without their name but a code number was assigned to it.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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