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

Gezehagn Aregago¹, Teshome Gishu², Ermias Getaneh², Lire Lemma Tirore³, Desta Erkalo Abame³, Simeon Meskele⁴

¹Intensive Care Unit, Nigist Elleni Mohammed Memorial Comprehensive Specialized Hospital, Wachemo University, Hossana, Ethiopia, ²Department of Nursing, St. Paul Hospital Millennium Medical College, Addis Ababa, Ethiopia, ³Department of Public Health, College of Medicine and Health Sciences, Wachemo University, Hossana, Ethiopia, ⁴Department of Anatomy, College of Medicine and Health Sciences, Arbaminch University, Arbaminch, Ethiopia

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), plasma sodium 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
Road traffic injuries (RTI), falls, and violence are the primary causes of traumatic brain injuries worldwide.[6] 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.[6]

TBI is a serious public health issue that affects people all around the world.[6] 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.[1]

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.[6] 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.[6] In people under 40, TBI is severely disabling 150–200 people per million annually.[6] The burden of disability and death is disproportionately high in low-income and middle-income countries.[1] 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.[1] 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.[6]

Because society is mostly unaware of the severity of the problem, it is regarded as one of the most silent epidemics.[1] The epidemiological trends of TBI are changing, and the demand for study in this area is increasing.[1]

Injuries are a major source of health problems in Ethiopia, ranking among the main causes of morbidity and mortality.[5] TBI fatality rates, as well as data on the economic burden of TBI, are frequently insufficient and vary among nations and continents.[1] Efforts to collect solid epidemiological data on TBI disability and mortality in resource-limited areas are still required.[6] 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.[6] The outcome of a head injury is highly tied to quick management, which includes secondary brain injury prevention and intensive care unit (ICU) management.[1]

Despite the severity of the problem, dependable statistics on brain injury are lacking, particularly in LAMICs such as Ethiopia.[6] 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.[1]

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
- CT-Scan finding/Diagnosis
- Comorbid illness
- Length of ICU stay
- Complications
- Types of interventions given.

### 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 ($\pm$ SD) age of patients was 36.02 $\pm$ 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].
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, 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 Table 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.

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].
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 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%). Nigeria (10.1%). Similarly, this finding is in line with a study conducted in Uganda on 194 head injury patients, where 23 (12.1%) died. The mortality rate in this study is lower than that of Felegehiwot Comprehensive Specialized Hospital (30.45%), Tongji Hospital (26.4%), and Benin City (52.2%). 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. In a study done in Uganda, road traffic accidents (RTA) contributed to 108 (56.8%) of all cases. Furthermore, a study conducted in Gedeko Zone, Southern Ethiopia, has shown that road traffic accident was the main cause of severe head injury (44.1%).

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     | Yes             | 88 24          |
| ventilation               | No              | 90 3           |
| Comorbid illness          | Yes             | 12 5           |
|                           | No              | 166 22         |
| Complications             | Yes             | 87 21          |
|                           | No              | 91 6           |

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.[20] Similarly, it has been observed that mechanical ventilation in severe brain injury is associated with a threefold risk of death.[21] 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.[22] 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.
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%.²⁴ 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.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

**References**

1. Pate RS, Hire RC, Rojekar MV. Pattern of head injury in central India population. Int J Res Med Sci 2017;5:3515-9.
2. Ariaka H, Kiryabwire J, Hussein S, Ogwal A, Nkonge E, Oyania F. A comparison of the predictive value of the Glasgow Coma scale and the Kampala Trauma Score for mortality and length of hospital stay in head injury patients at a tertiary Hospital in Uganda: A diagnostic prospective study. Surg Res Pract 2020;2020:1362741. doi: 10.1155/2020/1362741.
3. Zia N, Mehmood A, Namaganda RA, Ssenyonjo H, Kobusingye O, Hyder AA. Causes and outcomes of traumatic brain injuries in Uganda: Analysis from a pilot hospital registry. Trauma Surg Acute Care Open 2019;4:e000259.
4. Adam A, Alhassan A, Yabasin I. Incidence of traumatic brain injury in a Ghanaian tertiary hospital. J Med Biomed Sci 2016;5:5-12.
5. Hospital TA, Ababa A, Scale GC, Hospital TA. ISSN 2073-9990 East Cent. Afr J Surg 2020;21:81-8.
6. Mydor NM, Ragaee MA, Hanna RT. Role of some biochemical and genetic markers in predicting the severity of brain injury. Mansoura J Forensic Med Clin Toxicol 2019;27:49-65.
7. Mwala K, Muthuali JC, Chikoya L. Factors associated with outcome in patients admitted with traumatic brain injury at the university teaching hospital, Lusaka, Zambia. Med J Zambia 2015;42:68-73.
8. Kool B, Raj N, Wainigolo I, Kafoa B, McIgail E, Ameratunga S. Hospitalised and fatal head injuries in Viti Levu, Fiji: Findings from an island-wide trauma registry (TRIP 4). Neuroepidemiology 2012;38:131-85.
9. Yamagami K, Kurogi R, Kurogi A, Nishimura K, Onozuka D, Ren N, et al. The influence of age on the outcomes of traumatic brain injury: Findings from a Japanese Nationwide survey (J-ASPECT study-traumatic brain injury). World Neurosurg 2019;130:e26-46. doi: 10.1016/j.wneu.2019.05.140.
10. Agrawal D, Ahmed S, Khan S, Gupta D, Sinha S, Satyarthee G. Outcome in 2068 patients of head injury: Experience at a level 1 trauma centre in India. Asian J Neurosurg 2016;11:143-5.
11. Care C, Maas AI R, Menon DK, Adelson PD, Andelic N, Bell MJ, et al. Traumatic brain injury: Integrated approaches to improve prevention, clinical care, and research. Lancet Neurol 2017;16:987-1048.
12. Ikubor JE. Pattern of head injury in the emergency
Aregago, et al.: Incidence of mortality and its predictors among patients with head injury

department of the delta state university teaching hospital, Oghara, Nigeria. J Adv Med Med Res 2016;15:1-6.
13. Landes M, Venugopal R, Berman S, Heffernan S, Maskalyk J, Azazh A. Epidemiology, clinical characteristics and outcomes of head injured patients in an Ethiopian emergency centre. Afr J Emerg Med 2017;7:130-4.
14. Dewan MC, Rattani A, Gupta S, Baticulon RE, Hung YC, Punchak M, et al. Estimating the global incidence of traumatic brain injury. J Neurosurg 2019;130:1080-97.
15. Bulto LN, Dessie Y, Geda B. Magnitude, causes and characteristics of trauma victims visiting emergency and surgical units of Dilchora Hospital, Eastern Ethiopia. Pan Afr Med J 2018;30:177.
16. Eshete A, Taye F. Magnitude of severe head injury and its associated factors among head injury patients in a geozone, southern Ethiopia: A two-year retrospective study. Ethiop J Heal Sci 2018;28:323-30.
17. Ptroze RT, Byringiro JC, Jayaraman S, Dominique S, Tarek R, et al. A systematic review of impact of focused trauma education in low resource settings. East & Central African Journal of Surgery. 2014;19:6-8.
18. Laeke T, Tirsit A, Debebe F, Girma B, Gere D, Park KB, et al. Profile of head injuries: Prehospital care, diagnosis, and severity in an Ethiopian tertiary hospital. World Neurosurg 2019;127:e186-92.
19. Ayalew Z. Assessment of Trauma Care in Tertiary Center, Addis Ababa Ethiopia: An Observational Study. EC Emergency Medicine and Critical Care 2020;2:1-8.
20. Assele DD, Lendado TA, Awato MA, Workie SB, Faltamo WF. Incidence and predictors of mortality among patients with head injury admitted to Hawassa University Comprehensive Specialized Hospital, Southern Ethiopia: A retrospective follow-up study. PLoS One 2021;16:e0254245.
21. Amare AT, Tesfaye TD, Ali AS, Woelile TA, Birlie TA, Kebede WM, et al. Survival status and predictors of mortality among traumatic brain injury patients in an Ethiopian hospital: A retrospective cohort study. African J Emerg Med 2021;11:396-403.
22. Liu C, Xie J, Xiao X, Li T, Li H, Bai X, et al. Clinical predictors of prognosis in patients with traumatic brain injury combined with extracranial trauma. Int J Med Sci 2021;18:1639-47.
23. Tobi KU, Azeez AL, Agbedia SO. Outcome of traumatic brain injury in the intensive care unit: A five-year review. S Afr J Anaesth Analg 2016;22:135-9.
24. Hyder AA, Wunderlich CA, Puvanachandra P, Gururaj G, Kobusingye OC. The impact of traumatic brain injuries: A global perspective. NeuroRehabilitation 2007;22:341-53.
25. Holland MC, Mackersie RC, Morabito D, Campbell AR, Kivett VA, Patel R, et al. The development of acute lung injury is associated with worse neurologic outcome in patients with severe traumatic brain injury. J Trauma 2003;55:106-11.
26. Ziaeirad M, Alimohammadi N, Irajpour A, Aminmansour B. Association between outcome of severe traumatic brain injury and demographic, clinical, injury-related variables of patients. Iran J Nurs Midwifery Res 2018;23:211-6.
27. Santiago LA, Oh BC, Dash PK, Holcomb JB, Wade CE. A clinical comparison of penetrating and blunt traumatic brain injuries. Brain Inj 2012;26:107-25.