

SAINT PAUL HOSPITAL MILLINIUM MEDICAL COLLEGE



GRADUATE STUDY PROGRAM

Title: Assessment of Hospital Mortality and Predictors of Traumatic Acute Subdural Hematoma in Addis Ababa, Ethiopia, 2025.

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ADDIS ABABA, ETHIOPIA

November, 2025



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**ASSESSMENT OF IN HOSPITAL MORTALITY AND Its PREDICTORS OF
TRAUMATIC ACUTE SUBDURAL HEMATOMA AMONG PATIENTS
ADMITTED TO ADDIS ABABA BURN, EMERGENCY AND TRAUMA
HOSPITAL AND ALL AFRICAN LEPROSY REHABILITATION AND
TRAINING CENTER, ADDIS ABABA, ETHIOPIA.**

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A research Thesis submitted to the department of emergency and critical care medicine in partial fulfillments for the requirements of specialty degree in emergency and critical care medicine, St. Paul Hospital Millennium Medical College.

Addis Ababa, Ethiopia

November, 2025.

Saint Paul Hospital Millennium Medical College Graduate Study Program.

Project template

Name of investigator	Dr. Aklilu Berhanu, ECCM RIII	
Title	Assessment of in hospital mortality and its predictors of traumatic acute subdural hematoma among patients admitted to Addis Ababa Burn, Emergency and Trauma hospital and All African Leprosy Rehabilitation and Training center, Addis Ababa, Ethiopia	
Duration of the study	January 2023 to December 2025	
Study area	Addis Ababa Burn, Emergency and Trauma hospital and All African Leprosy Rehabilitation and Training center, Addis Ababa, Ethiopia.	
Total cost of the project	25000 ETB	
Source of funding	SPHMMC	
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Acknowledgments

I would like to express my heartfelt gratitude to St. Paul's Hospital Millennium Medical College (SPHMMC) for granting me the opportunity to conduct this research and for providing the necessary funding to make it possible.

My deepest thanks go to Dr. Rakeb Mulugeta and Dr. Etsegenet Aklog for their invaluable support, constructive feedback, and guidance throughout the preparation of my research proposal. Their expertise and encouragement were instrumental in shaping this work.

Lastly, I extend my appreciation to everyone who contributed to the success of this research, directly or indirectly. Your support has been greatly appreciated.

Abbreviations and acronyms

AaBET	Addis Ababa Burn, Emergency and Trauma center
AEDH	Acute epidural hematoma
ALERT	All African Leprosy Rehabilitation and Training Center
DM	Diabetes mellitus
FDA	Falling down accident
GCS	Glasgow coma scale
HMIS	Health management information system
HTN	Hypertension
ICH	Intracerebral hematoma
ICP	Intracranial pressure
LMIC	Low- and middle-income countries
MRN	Medical record number
RTA	Road traffic accident
SPHMMC	St. Paul hospital millennium medical college
TASDH	Traumatic acute subdural hematoma
TBI	Traumatic brain injury
TIS	Time from injury to surgery.

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Abstract

Background: Traumatic Acute Subdural Hematoma (TASDH) is among the most lethal forms of traumatic brain injury, with a high global mortality rate. In low- and middle-income countries like Ethiopia, the burden of TASDH is significant, yet local data on mortality and its predictors remain scarce. This study aimed to determine the in-hospital mortality rate and identify key predictors of death among TASDH patients in Addis Ababa.

Methods: A hospital based cross sectional study was conducted on 272 patients with TASDH admitted to Addis Ababa Burn, Emergency and Trauma (AaBET) Hospital and the All-Africa Leprosy Rehabilitation and Training Center (ALERT) from January 2023 to September 2025. Data on sociodemographic, clinical presentation, radiological findings, and treatment outcomes were extracted from medical records. A binary logistic regression model was used to identify independent predictors of in-hospital mortality.

Results: The in-hospital mortality rate was 22.79%. Multivariate analysis revealed that a lower Glasgow Coma Scale (GCS) score at admission was the principal predictor of mortality. Compared to patients with a GCS of 3-8, those with a GCS of 9-13 had 90% lower odds of death (AOR=0.10, 95% CI: 0.016–0.70), and those with a GCS of 14-15 had 99% lower odds (AOR=0.011, 95% CI: 0.007–0.172). The presence of bilateral non-reactive pupils significantly increased the odds of mortality (AOR=20.64, 95% CI: 2.23–190.87). Radiologically, a hematoma thickness greater than 10 mm was a strong independent predictor of death (AOR=7.51, 95% CI: 1.80–31.29).

Conclusion: The mortality rate from TASDH in this setting is high. The initial GCS, pupillary reactivity, and hematoma thickness are strong independent predictors of in-hospital mortality. These findings emphasize the critical need for rapid neurological assessment, timely neuroimaging and urgent intervention to improve outcomes for patients with TASDH.

Keywords: Traumatic Brain Injury, Acute Subdural Hematoma, In-Hospital Mortality, Prognostic Factors, Ethiopia.

1. Introduction

1.1. Background

Traumatic brain injury (TBI) is an injury to head with external mechanical force and it is the leading cause of death and disability in young adults worldwide. It occurs three times higher in low and middle income countries with higher mortality rate and disabilities than high income countries(1). TBI was linked to over 2.5 million ED visits, hospitalizations, or deaths in the United States in 2010, either individually or in tandem with other illnesses, and it led to the deaths of over 50,000 individuals (2, 3). Globally, TBI is projected to be the third leading cause of death and injury by the World Health Organization in 2020. Based on severity of the injury, TBI can be classified according to GCS score as mild , moderate and sever with GCS of 3-8,9-12 and 13-15 respectively (2, 4, 5).

The diagnosis of traumatic brain injury is typically made using computed tomography (CT) scans, which are considered the gold standard for evaluating the extent and nature of brain injury. Common findings on CT scans include epidural hematoma (EDH), subdural hematoma (SDH), intracerebral hematoma (ICH), cerebral contusions, diffuse axonal injury (DAI), cerebral edema, and skull fractures (2, 4-6).

Clinically, patients with TBI can present with a wide range of signs and symptoms, depending on the severity of the injury. These symptoms may range from mild manifestations such as headache, dizziness, and confusion to more severe symptoms including seizures, abnormal pupillary reactions (indicative of increased intracranial pressure), hypoxia, hypotension, and loss of consciousness or coma. Early recognition and timely management of these symptoms are crucial in reducing morbidity and mortality associated with TBI (6-8).

Despite the lack of comprehensive national studies on traumatic brain injury in the Ethiopian context, some research conducted in tertiary hospitals in Addis Ababa has highlighted significant trends. These studies indicate that road traffic accidents and interpersonal violence (assault) are the leading causes of TBI-related deaths. The data also reveal that young males, particularly those aged between 15 and 45 years, are disproportionately affected. Contributing factors include

the rapid increase in motor vehicle usage, poor road safety measures, and a high prevalence of violence, especially in urban areas. Early intervention and improved trauma care are essential to address the burden of TBI in Ethiopia (6-8).

Acute subdural hematoma (ASDH) is considered one of the most severe and lethal types of traumatic brain injury (TBI). It involves the accumulation of blood between the dura mater (the outermost layer covering the brain) and the arachnoid mater (the middle protective layer). This collection of blood clots results from the tearing of bridging veins or arteries due to rapid acceleration or deceleration forces, often associated with head trauma from road traffic accidents, falls, or assaults.

Traumatic ASDH is a common neurosurgical emergency, frequently requiring urgent surgical intervention, such as a craniotomy or decompressive craniectomy, to evacuate the hematoma and relieve increased intracranial pressure. Delayed diagnosis and treatment can lead to devastating outcomes, including severe neurological deficits, coma, or death. Early identification and prompt surgical management are critical in improving patient prognosis and reducing mortality rates associated with acute subdural hematomas (5, 9).

It is found in one-third of all severe head injuries with higher mortality, the fatality rate rises as high as 60 % (5, 10). However, mild to moderate traumatic brain injury accounts for up to 86 % of all ASDH that require hospitalization (5). In the majority of cases, they are related with high-energy traumas, especially road accidents (RTA), motor vehicle accidents (MVA), falls and assaults (11). Rarely, they may occur spontaneously or after a minor trauma in patients receiving anticoagulant or antiplatelet therapy or after aneurysmatic rupture, mainly posterior communicant artery (4).

1.2. Statement of the problem:

Trauma is the most common cause of death for those under the age of 45 among which TBI accounts approximately for half of the deaths secondary to trauma. Among the types of TBI, traumatic ASDH is the most lethal one and previously the mortality was as high as 68% (9, 12). The reported incidence of ASDH is as high as 5% in patients with head trauma. Among patients

with severe head injury, it occurs in 12% to 30% and reported mortality rates range from 36% to 79% for patients who underwent surgery which showed to increase with age (12).

It mostly affects men more than women, especially aged <50 years. The causes of head trauma resulting ASDH include motor vehicle accidents, falls, assaults and others (11, 12). Age, preoperative Glasgow Coma Score, brain herniation and the time from trauma to decompression are independent predictors of death (12). In elder age groups falls account for the majority of causes of ASDH than RTA, assaults or blunt head trauma(11). The risk factors for increasing the incidence of ASDH in elders are: normal cerebral atrophy related to aging, stretching the bridging veins from the dura, anticoagulant, or antiplatelet intake due to cardiovascular risk factors or primary/secondary prevention and increased risk of minor trauma (4). The treatment outcomes of ASDH in elders is generally worse and the initial GCS, pupillary abnormality, time elapsed until treatment and the presence of midline shift > 5mm, hematoma thickness >1cm on CT scan are the most significant predictors of outcome (10).

Even though improvements in emergency care, neuro-intensive monitoring and surgical techniques have been made in the past decades, recently reported mortality rates for ASDH in the general population still range from 14% in mild traumatic brain injury to 100% in patients with low Glasgow Coma Scale (GCS) scores , leaving ASDH as one of the unsolved problems in neuro-traumatology (9, 10).

In Ethiopia, even though there was scarcity of research published on head injury in the country's context, the prevalence of head injury causing ASDH is a common health problem that causes morbidity and mortality in the productive age group of the population. Therefore, this study aimed to assess the mortality rate and factors associated to mortality of patients with traumatic ASDH in AaBET & ALERT hospitals.

2. Literature Review

2.1. Magnitude of mortality of TASH

TASH develops in approximately one third of brain injuries due to severe head trauma. Although the mortality rate of TASH was reported to be around 60% until the 1990s, the rate was reduced to the level of 20% around 2000 and as low as 14% within the last decade due to improvements in emergency care and neurosurgical techniques (13).

A study done in 17 Austrian centers between February 2002 and April 2010 among patients with severe TASH had found the mortality rate of 47%(15), which is significantly higher than similar studies done in Washington(MR=14%), Shanghai(MR=21.75%), Portugal(MR=26%) and Turkey(MR=30%) (4, 13, 14).

A study conducted at a tertiary center in Abuja, Nigeria, found a mortality rate of 44.1% among patients with traumatic acute subdural hematoma (TASH) who underwent surgical management (15).

In Ethiopia, a study conducted in tertiary hospitals in Addis Ababa investigated the clinical characteristics and functional outcomes of surgically treated adult head trauma patients with acute subdural hematoma, reporting an in-hospital mortality rate of 17.4% (5).

2.2. Factors related to mortality of TASH

2.2.1. Sociodemographic factors

Elderly patients are particularly vulnerable to traumatic acute subdural hematoma (TASH) following brain injury, primarily due to age-related cerebral atrophy. Additionally, factors such as increasing frailty, the prevalence of comorbidities, and the widespread use of antithrombotic drugs further heighten their risk. At the same time, the growing desire for mobility and autonomy among the aging population has led to an increase in the incidence of subdural hematomas in this demographic. This combination of factors contributes to a significantly high mortality rate of TASH in elders, reported to be as high as 90% (4, 10, 16). According to a study conducted in the USA, Mortality of TASH was 35% in those < 80 years old and 53% for those over 80 years old (16) while in Germany, it was 11% and 33% respectively (10).

Almost all studies have shown that males are predominantly at a higher risk of developing traumatic acute subdural hematoma (ASDH) in all age groups. This increased risk is attributed to their greater exposure to trauma, as men typically spend more time outside the home and are more frequently engaged in high-risk occupations. These jobs often include working at heights, such as on construction sites or high-voltage transmission lines, and operating vehicles, all of which inherently carry a higher likelihood of accidents compared to the activities commonly undertaken by women (5, 13, 14, 16).

A retrospective cohort study on TASH in Washington has reported falls(57%) are most common causes of head injury followed by motor vehicle accidents(28%)(16). similar result was found in Korea where falls were the commonest causes of injury(39.8%), followed by traffic accidents(34.8%) (9).A retrospective analysis conducted in USA on surgical outcome for TASH in the elderly reported that falls from standing was the most common mechanism of injury (80%). Other mechanisms included motor vehicle collisions (10%), automobile versus pedestrian (6%), and other types of falls like roof tops and ladders (4%) (16). Another study conducted in Medical college of Virginia(dec 1972-feb 1980)has found that MVA was the leading cause of head injury accounting for 55% with higher mortality (17).

In Ethiopia, however, assaults were found to be the most common cause of head injuries resulting in acute subdural hematoma (ASDH), accounting for 35.7% of cases, followed by road traffic accidents (RTAs), which accounted for 20.9% and falling down injury accounted for 20.9% (5). Another cross-sectional hospital based study conducted on Pattern and Outcome of Traumatic Brain Injury at AaBET hospital has reported that RTA was the commonest cause of TBI in general accounting for 45.4% followed by interpersonal violence (17.8%) (6).

2.2.2. Clinical factors related to mortality in patients with TASH

The most important predictors of outcome in patients with ASDH were GCS score and pupillary light reflex. According to a study conducted on Clinical characteristics and functional outcome of surgically treated adult head trauma patients with acute subdural hematoma in Ethiopia, 57.1 % of patients with initial GCS 5 and below end up with hospital mortality and those with dilated and fixed pupil never had a favorable outcome (5). Other similar studies have also revealed that lower GCS (≤ 8) and abnormal pupillary response on admission are predictors of poor outcome in patients with TASH (1, 9, 12, 15, 18, 19).

Platelet count, the presence of complications during hospitalization, ICU admission, intubation status, and whether the patient received any form of prehospital first aid all showed meaningful links with the clinical course of traumatic acute subdural hematoma (20). Patients with lower platelet levels or those who developed complications tended to have poorer outcomes, while the need for ICU care or mechanical ventilation often reflected more severe injury (21). Similarly, receiving timely first aid before reaching the hospital appeared to influence survival and recovery. Together, these factors emerged as important contributors to outcome differences among patients with TASDH (22-24).

2.2.3. Radiographic findings related to mortality

TASDH patients' treatment outcome also determined by radiologic findings. The presence of significant midline shift(>5mm) is significantly associated with poor treatment outcome than those who have less than 5mm and no shift at all (12).

Hematoma thickness exceeding 1 cm and a hematoma volume greater than 50 ml on CT imaging are consistently recognized as key indicators of unfavorable outcomes in patients with traumatic acute subdural hematoma, as they reflect a more severe degree of mass effect and underlying brain injury (12, 25, 26).

Hematoma location plays a significant role in determining prognosis for patients with traumatic acute subdural hematoma: for example, studies have shown that subdural clots over fronto-parietal or temporo-parietal convexities carry a higher risk of poor functional outcome or death than hematomas in less extensive or more localized regions (27). In particular, a clinical series found mortality around 26.7% when the hematoma was in the temporal fossa, versus only 13.3% when located in the frontal lobe (28).

The time from injury to surgery (TIS) is crucial for the functional recovery of TASDH patients who underwent surgery. According to a study conducted on The impact of time from injury to surgery in functional recovery of traumatic acute subdural hematoma in Taiwan, the threshold time for functional recovery of comatose and surgically treated TASDH patients was 2 h and 57.5 min and the probability of functional recovery in a comatose TASDH patient who undergoes surgery within less than 2 h and 57.5 min was 51.5% and that of a patient who

undergoes surgery after the threshold time was 8.1% (100% – 91.9%), p value = 0.002 (29). Haselsberger et al. found that the mortality rate of TASDH increased from 47% to 80% when the TIS exceeds 2 hours (30). A similar result was reported by Seelig et al. which stated that patients who underwent surgery within 4 hours of injury has a mortality rate of 30% and the mortality increased to 90% when TIS delayed beyond 4 hours (17). Another retrospective study conducted in Shanghai sixth's hospital in China reported that the length of time between the injury and operative decompression significantly influenced the final outcome. Patients who were operated on for less than 6 hours after the injury had a lower mortality (14.29%) than the other patients (12).

On the contrary, a study conducted in Massachusetts General Hospital and Harvard Medical School, Boston, USA, on time interval to surgery and outcomes following the surgical treatment of acute traumatic subdural hematoma reported that increasing time to surgery was not associated with mortality, and in fact had a significant effect in decreasing mortality (OR 0.984; 95%CI 0.971–0.997; p = 0.018) and faster time to surgery was significantly associated with greater mortality (p = 0.010) (31). Park et al. and Tien et al. also reported that early decompressive surgery for TASDH within 4 hours has no better outcomes than late surgery (32, 33).

To date, there is scarcity of published studies conducted in Ethiopia to specifically examine the impact of time from injury to surgery (TIS) on the in-hospital mortality of patients with traumatic acute subdural hematoma (TASDH). Understanding this relationship is crucial, as timely surgical intervention is a key factor in improving outcomes. This research aims to address this gap by evaluating how delays in surgical management affect patient survival, ultimately contributing to improved clinical practices and outcomes in the Ethiopian healthcare context.

2.3 Conceptual frame work

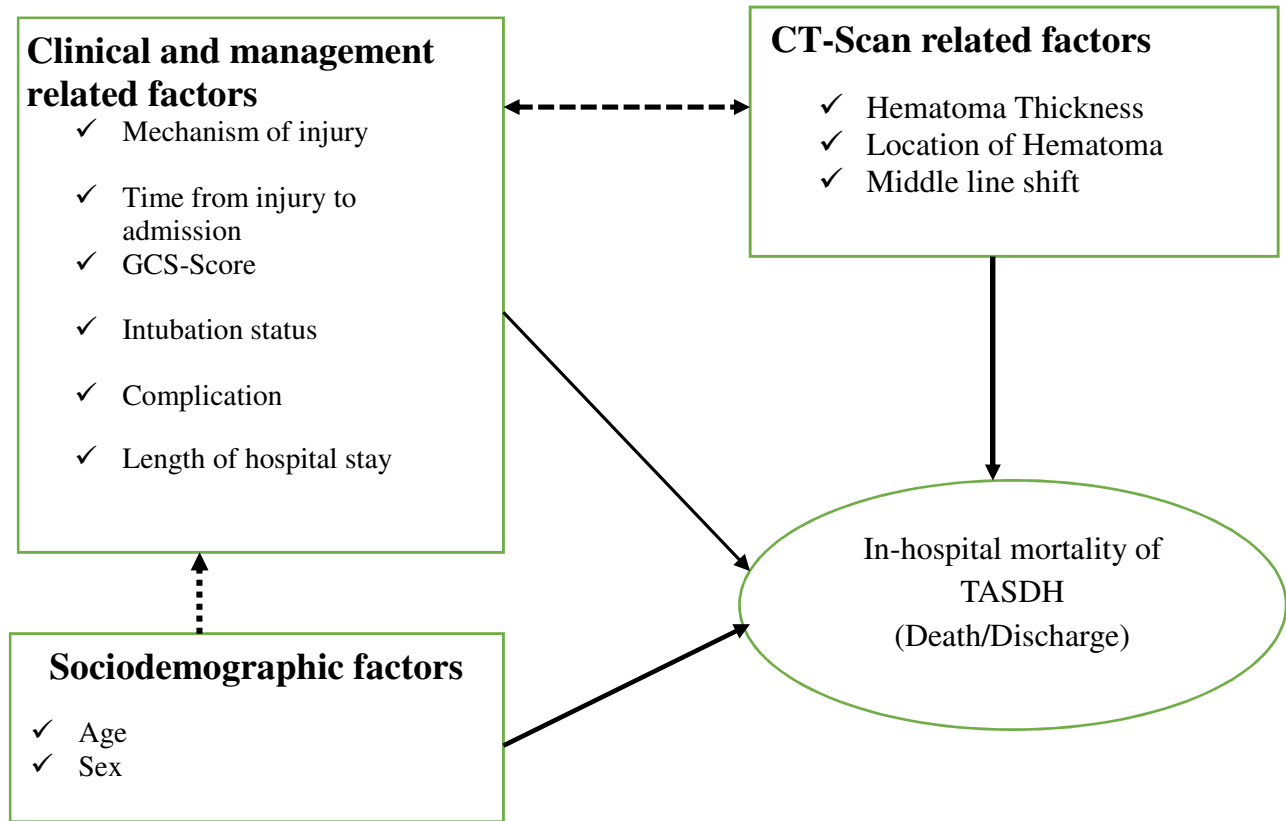


Figure 1: Conceptual framework of In-hospital mortality of TASDH developed from literatures.

2.4 Significance of the Study

This study aims to assess the mortality rate and its predictors among patients with traumatic acute subdural hematoma (TASDH) admitted to AaBET and ALERT hospitals in Addis Ababa, Ethiopia. The findings will provide critical baseline information for local policymakers in the health sector, enabling them to develop evidence-based strategies and optimize the utilization of medical and surgical therapies to improve treatment outcomes.

Additionally, the study will assist in designing effective programs to identify risk factors and predictors of adverse treatment outcomes, thereby enhancing preventive and therapeutic interventions. The results will offer significant benefits to patients by potentially improving survival rates and overall care quality.

Healthcare professionals, including clinicians directly involved in patient management, will benefit from insights into mortality predictors, allowing for more informed clinical decision-making. Public health personnel and health institutions, particularly AaBET and ALERT hospitals, will gain valuable data to refine service delivery and resource allocation. Moreover, the study findings will serve as a foundation for future research in this field, promoting further investigations into TASDH and its management within the Ethiopian context and beyond.

3. Objectives

3.1. General objective

- To assess the mortality rate and predictors of mortality among patients with TASDH admitted to AaBET and ALERT hospitals, Addis Ababa, Ethiopia, from January 2023 to Sept 2025.

3.2. Specific objectives

- To assess the in-hospital mortality (number of patients who died during their hospital stay) among patients with TASDH admitted To AaBET and ALERT hospitals from January 2023 to Sept 2025.
- To identify factors associated with in-hospital mortality of TASDH among patients admitted AaBET and ALERT hospitals from January 2023 to Sept 2025.

4. Methodology

4.1. Study area and study population

The study was conducted at Addis Ababa Burn, Emergency and Trauma (AaBET) Hospital and All African Leprosy Rehabilitation and Training Center (ALERT), from Jan 2023 to Sept 2025, Addis Ababa, Ethiopia.

AaBET is one of the largest trauma and burn centers located in Addis Ababa, the capital city of Ethiopia. It is established in 2015 as part of St. Paul hospital Millennium Medical College, currently providing health care services in several specialties, namely: orthopedics and traumatology, general surgery, neurosurgery, plastic, reconstructive and hand surgery, and emergency and critical care medicine. The hospital has approximately 20,000–30,000 total visits yearly to the hospital and provides a variety of emergency and outpatient services by different departments with elective and emergency surgeries of the respective departments. The hospital has two ICUs with a 13-bed capacity providing services for patients living in the city as well receiving referrals from different regions (34).

ALERT hospital is one of the leading specialized hospitals in dermatology and venereology, ophthalmology, 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 (8).

4.2. Study Design

Hospital based, cross-sectional study was conducted.

4.3. Population

4.3.1. Source population

All TBI patients admitted to AaBET and ALERT hospitals during the study period.

4.3.2. Study population

All patients diagnosed with TASDH admitted to AaBET and ALERT hospitals during the study period.

4.4. Inclusion and Exclusion Criteria

4.4.1. Inclusion criteria

All TBI with TASDH patients with complete records of information on outcome variables and associated factors was included to the study.

4.4.2. Exclusion criteria

1. Those patients who were discharged against medical advice and transferred to other hospitals other than AaBET/ALERT
2. Those who had incomplete medical records

3, Non traumatic (spontaneous) subdural hematoma (Chronic subdural hematoma, anticoagulant related spontaneous bleeding, aneurysmal rupture)

4, penetrating brain injuries

5, Sever life threatening extracranial injuries.

4.5. Sample Size Determination

The sample size was determined using a single population proportion formula, taking the proportion of in-hospital mortality of surgically treated TASDH from a study done in tertiary Hospitals found in Addis Ababa (17.4%%)(5), as proportion of TASDH is not known and there is no similar study done previously in this study area, using $\alpha=0.05$, 95% CI, $p= 0.174$ and margin of error $d= 5\%$, the sample size can be determined as follows

$$n = \frac{Z_{\alpha/2}^2 P(1 - P)}{d^2}$$

$Z_{\alpha/2}$ = Critical value=1.96(normal Standard deviation usually set at 1.96 which corresponds to the 95% confidence interval)

Sample size (n) = 220 and adding 10% for non-response rate, the final sample size will be = **242**.

While collecting the data i got only 30 cases of TASDH from ALERT hospital and 242 cases from AaBET hospital, and then all cases (272) were included in this study.

4.6. Sampling Procedure and Technique

The patient registry log book of patients admitted in AaBET and ALERT hospitals was used; then all the medical record number (MRN) of patients with any TASDH documented was taken & the chart retrieved. Those with confirmed TASDH based on CT scan diagnosis obtained.

4.7. Data Collection Methods

The HMIS registration book was used to get the card numbers of TASDH patients who were admitted during the study period. After getting the card numbers, patient charts were retrieved from the record and documentation office.

4.7.1. Data collection instrument/tool

A retrospective chart review (RCR) was conducted. A structured checklist was prepared by the principal investigator based on a literature review and pre-tested to obtain critical demographic data, clinical presentation, Ct scan imaging findings, treatment given and final outcome of the patient by the data collection team.

4.7.2. Data collectors

Data collection was performed by five medical interns (final year medical students) who are off duty during data collection time. All the data collectors were trained about the objective of the study; methods of data collection including data extraction from patient's chart as well as the inclusion and exclusion criteria and the principal investigator supervised the data collectors.

4.7.3. Data collection procedure

A structured checklist was used to extract data from patient charts. The supervisor checked selected charts and assess the abstracted data. Data collection was performed by five medical interns who were trained about the objective of the study; methods of data collection including data extraction from patient's chart as well as the inclusion and exclusion criteria and the principal investigator supervised the data collectors. Finally the collected data exported to SPSS for further analysis and interpretation.

4.8 Operational defination

- ❖ **Sever life threatening extracranial injuries:** injuries which are the primary cause of death by themselves and the death cannot be attributed to the TASDH. E.g. Injuries like exsanguinating thoraco-abdominal injury (35).
- ❖ **Penetrating brain injury (PBI):** traumatic brain injury caused by an external projectile (Eg. Knife, gunshot) that breaches the scalp, skull, **external protective layers of the brain, and entering the brain parenchyma**, resulting in **direct laceration, disruption, or destruction of brain tissue**.
- ❖ **Traumatic acute subdural hematoma (TASDH):** Presence of acute blood collection between the dura and arachnoid mater following head trauma, confirmed by CT scan showing hyperdense crescent-shaped collection consistent with acute subdural hematoma (5, 9).

- ❖ **In-hospital mortality:** Death of a patient with TASDH occurring after hospital admission and before discharge, regardless of the cause, during the same hospitalization period (2, 3).
- ❖ **Mechanism of injury:** The cause of the traumatic event leading to TASDH, categorized as road traffic accident (motor vehicle or motor cycle accident), fall down accident (FDA), assault, **or** other (e.g., object strike) (16, 17).
- ❖ **Time from injury to hospital admission:** Duration between the time of injury and arrival at the hospital, recorded in **hours**, and categorized as < 4 hrs, 4-12 hrs, 12 -24 hrs, or >24 hrs (26).
- ❖ **Glasgow coma scale (GCS);** Level of consciousness at admission measured using the GCS, recorded as: Severe (3–8), Moderate (9–13) and Mild (14–15) (18).
- ❖ **Pupillary light reflex:** Response of each pupil to light at admission, recorded as normal, sluggish, or fixed/dilated (either unilaterally or bilaterally) (36).
- ❖ **Intubation status:** Whether the patient was intubated and supported with mechanical ventilator or not on arrival or during hospital stay, as indicated in the medical record (37).
- ❖ **Comorbidity:** Presence of at least one chronic medical condition (e.g., hypertension, diabetes mellitus, cardiac illness, seizure disorder) based on patient history.
- ❖ **Per hospital care:** Any medical or first-aid intervention provided before arrival at the study hospitals, categorized as **yes** (if provided) or **no** (if none).
- ❖ **Mid line shift:** The lateral displacement of the brain's midline structures on CT scan measured in millimeters (mm); categorized as ≤ 5 mm or > 5 mm(significant)(17).
- ❖ **Hematoma thickness:** The maximum thickness of the subdural hematoma measured on CT scan in millimeters (mm); categorized as ≤ 10 mm or > 10 mm (38).
- ❖ **Type of management:** The treatment modality given for TASDH, classified as **surgical** (e.g., decompressive craniotomy/craniectomy) or **conservative** (non-operative management).
- ❖ **Length of hospital stay:** Total number of days from admission to discharge or death, recorded in days.

4.8. Study Variables

4.8.1. Dependent variables

- ✓ In-hospital mortality of TASDH (yes/no)

4.8.2. Independent variables

- ✓ Sociodemographic factors (age, sex)
- ✓ Clinical factors (GCS, pupillary reflex, underlining comorbidities, Systolic blood pressure)
- ✓ Radiologic factors (midline shift, hematoma volume)
- ✓ Type of intervention (for surgical or conservative management)
- ✓ Time from injury to admission
- ✓ Intubation status
- ✓ Length of hospital stay

4.9. Data Quality Control

To assure the quality of data, the following measures were undertaken. The appropriately designed data collection instrument was used. The checklist or format pre-tested and Clarity of language, of checklists were checked. The investigator supervised the data collection process so that the data collectors can forward any issue during the data collection time.

4.10. Methods of Data Analysis

Data entered using EpiData version 3.1 and analyzed using Stata 17. Descriptive analysis was used to describe the Sociodemographic data and the pattern of each independent variable. Confidence interval with 95% accuracy and P-value used as test of the significance of the study. Logistic regression used to determine crude and adjusted odds ratio. Bivariate Logistic regression analysis carried out to assess the association between the dependent and independent variables and to identify candidate for multivariate analysis. Then, multivariate analysis was performed on the variables which have P-value < 0.25 to determine the independent predictors of in-hospital mortality. Statistical significance was measured by p-values < 0.05 and adjusted odds ratio (AOR) with 95% confidence interval (95% CI).

4.11. Ethical Considerations

Ethical clearance was obtained from the SPHMMC Institutional Health Research Ethics Review Committee (IHRERC) prior to data collection. Informed voluntary written and signed consent obtained from heads of the hospitals and the letter was submitted to all responsible bodies to ensure smooth and effective data collection. Information gained from medical records held anonymous and confidential.

4.12. Expected Outcome

The expected outcomes of this study are reliable findings regarding the in-hospital mortality of TASDH and its predictors in order to improve the management practices of TASDH, and prevention risk factors associated with poor treatment outcomes.

4.13. Plan for Dissemination of the Findings

The study's findings will be submitted to the department of Emergency and Critical Care Medicine, School of Medicine, and College of Health and Medical Sciences SPHMMC in partial fulfillment of the requirements for the specialty of Emergency and Critical Care medicine. A copy of the research will be given to the hospital as well. The finding will also be presented for different workshops and seminars and published in a peer-reviewed journal.

4.0 Result

4.1 Descriptive Analysis

4.2 Socio-demographic characteristics and mortality of Study population

Among 5074 head injury patients a total of 272 patients with traumatic acute subdural hematoma (TASDH) were included in this study. The incidence of TASDH in this study was found to be 5.36%. The majority were male, accounting for 82% (n = 223) of the study population, while females represented 18% (n = 49).

Age Distribution and Mortality

The study included 272 patients with a mean age of 38.6 ± 17.4 years (range: 3–90 years). When categorized, the majority of patients were between 18 and 45 years, accounting for 66.2% (n = 180) of the sample. Patients aged 46–65 years comprised 18.4% (n = 50), those under 18 years represented 6.2% (n = 17), and individuals older than 65 years made up 9.2% (n = 25).

Mortality increased with advancing age. Among patients younger than 18 years, 11.8% (n = 2) died. In the 18–45 years group, mortality was 19.4% (n = 35). The 46–65 years category showed a higher mortality of 30% (n = 15), while the >65 years group experienced the highest mortality rate at 40% (n = 10).

Sex Distribution and Mortality

In terms of Sex the majorities were males 223 (82%) and the rest are females (18%). Among females, 20.4% (n = 10) died, compared to 23.3% (n = 52) of males. Despite the higher proportion of male patients overall, mortality patterns were relatively comparable between sexes.

Regional Distribution and Mortality

Patients were primarily from Oromia (54.8%, n = 149) and Addis Ababa (37.1%, n = 101). Smaller proportions were from Amhara (n = 10), SNNR (n = 2), and other regions (n = 10).

Mortality varied by region. In Addis Ababa, 27.7% (n = 28) of patients died, while Oromia recorded a mortality rate of 19.5% (n = 29). Higher mortality rates were observed in Amhara

(40%, n = 4) and SNNR (50%, n = 1), although these groups had smaller sample sizes. No deaths were reported in the other regions category.

Table 1: Socio-demographic characteristics and mortality of Study population.

Variable	Category	Discharged n (%)	Died n (%)	Total
Age	<18 years	15 (88.2%)	2 (11.8%)	17
	18–45 years	145 (80.6%)	35 (19.4%)	180
	46–65 years	35 (70.0%)	15 (30.0%)	50
	>65 years	15 (60.0%)	10 (40.0%)	25
Sex	Female	39 (79.6%)	10 (20.4%)	49
	Male	171 (76.7%)	52 (23.3%)	223
Region	Addis Ababa	73 (72.3)	28 (27.7)	101
	Oromia	120 (80.5)	29 (19.5)	149
	Amhara	6 (60)	4 (40)	10
	SNNR	1(50)	1 (50)	2
	Other	10 (100)	0 (0)	10

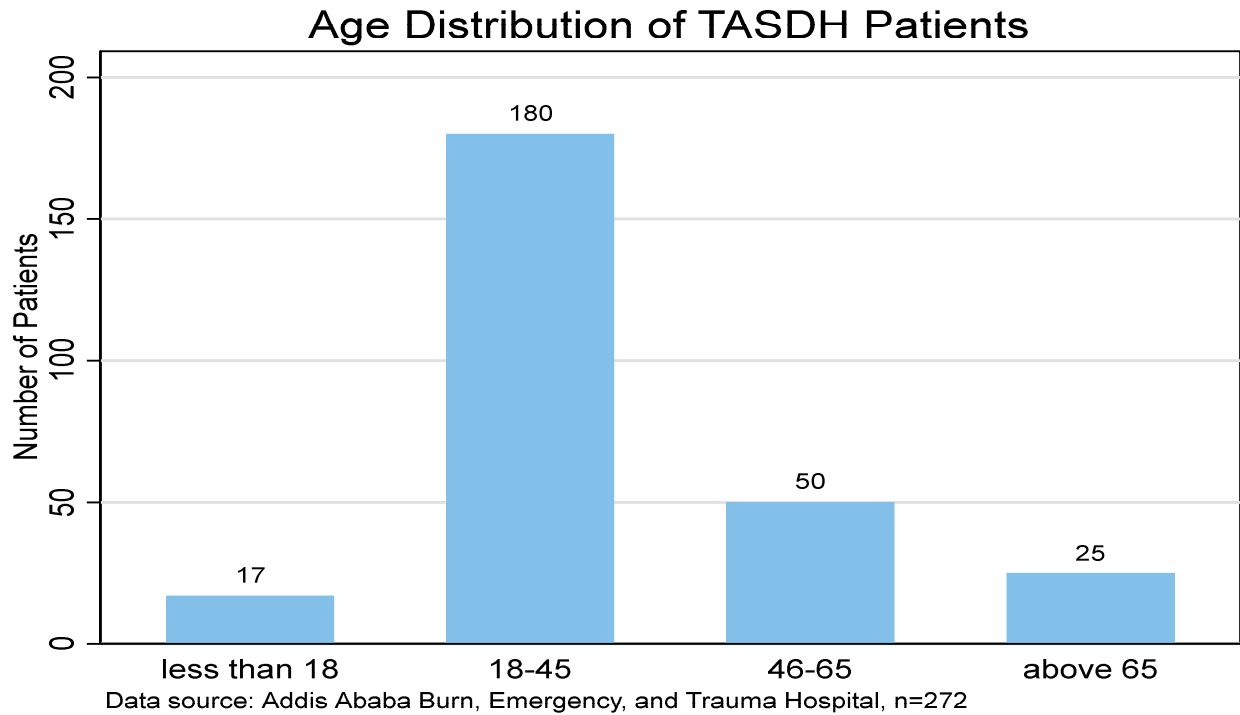


Figure 2: Age distribution of study participants in Addis Ababa, 2025.

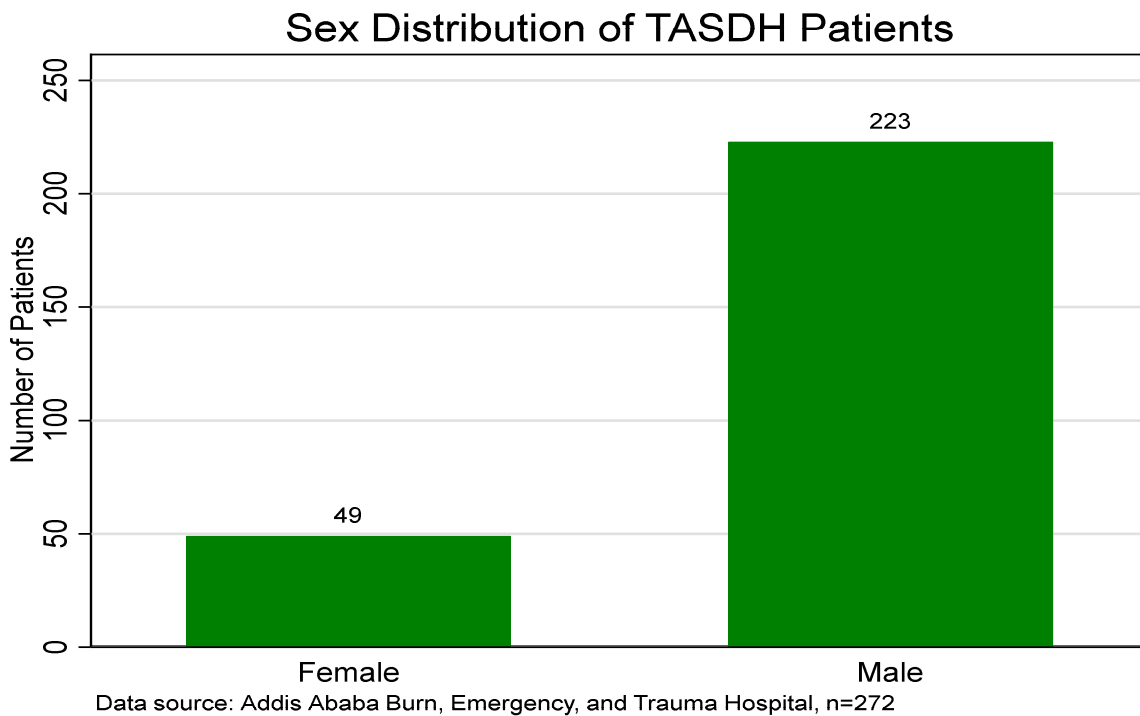


Figure 3: Sex distribution of TASDH patients in Addis Ababa, 2025.

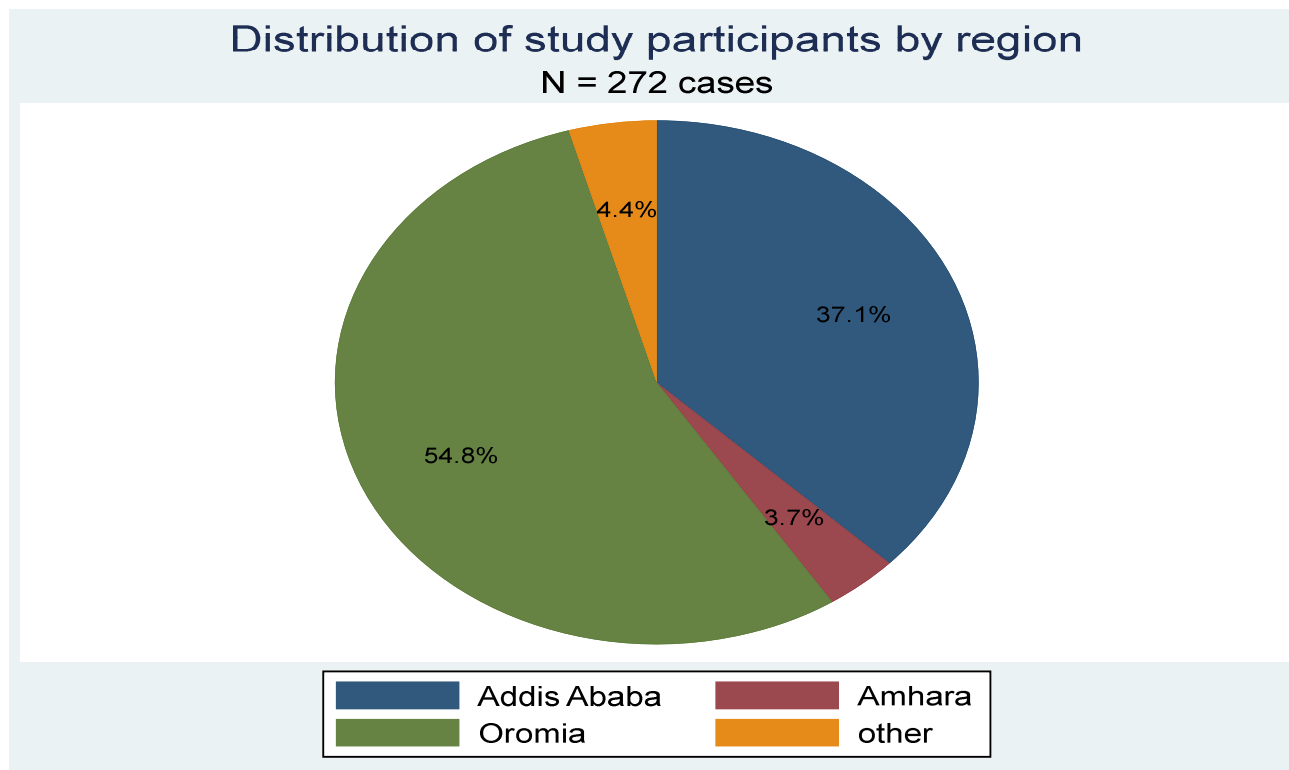


Figure 4: Pie chart of the distribution of the study participants by region.

4.2 CT variables related to Mortality due to Traumatic Acute Subdural Hematoma

The analysis of CT variables revealed a strong association between hematoma characteristics and patient outcomes. Hematoma thickness was a critical predictor of mortality. Among patients with a hematoma thickness of ≤ 10 mm, the vast majority, 93.4% (n = 142), survived, while only 6.6% (n = 10) died. In contrast, patients with a hematoma thickness of >10 mm had significantly higher mortality, with 43.3% (n = 52) dying and only 56.7% (n = 68) surviving. This indicates that larger hematomas pose a substantial risk for mortality.

The location of the hematoma also influenced patient outcomes. Bilateral hematomas had the best survival rate, with 83.3% (n = 20) of patients surviving, while 16.7% (n = 4) died. The highest mortality rate was observed in patients with a left-sided hematoma, where 26.7% (n = 31) died, and 73.3% (n = 85) survived. For right-sided hematomas, the mortality rate was somewhat lower, with 20.5% (n = 27) dying, and 79.5% (n = 105) discharged alive. This

suggests that the location of the hematoma, particularly on the left side, is associated with poorer outcomes.

Midline shift, a key radiological finding, further predicted mortality. In patients with no midline shift, 99% (n = 64) survived, with only 1% (n = 1) dying, demonstrating the relatively better prognosis in these cases. In patients with a midline shift <5 mm, 11.8% (n = 10) died, while 88.2% (n = 75) survived, highlighting the increased risk of mortality even with a small shift. The most severe outcomes were seen in patients with a midline shift ≥ 5 mm, where 41.8% (n = 51) died, and only 60.2% (n = 71) were discharged alive. This clearly indicates that a significant midline shift is strongly associated with a higher risk of death.

In conclusion, hematoma thickness, location, and midline shift are all important factors influencing mortality in patients with traumatic acute subdural hematoma. Larger hematomas, particularly those with a significant midline shift, are associated with a dramatically increased risk of death, emphasizing the importance of rapid identification and surgical intervention in these patients.

Table 2: CT variables related to Mortality due to Traumatic Acute Subdural Hematoma.

Variable	Category	Discharged n (%)	Died n (%)	Total
Hematoma thickness	≤ 10 mm	142 (93.4%)	10 (6.6%)	152
	>10 mm	68 (56.7%)	52 (43.3%)	120
Location of hematoma	Bilateral	20 (83.3%)	4 (16.7%)	24
	Left side	85 (73.3%)	31 (26.7%)	116
	Right side	105 (79.5%)	27 (20.5%)	132
Midline shift	No	64 (99)	1	65
	< 5mm	75 (88.2)	10 (11.8)	85
	≥ 5 mm	71 (60.2)	51(41.8)	122

4.3 Association between Clinical and Management Factors and Treatment Outcome of Traumatic Acute Subdural Hematoma Patients.

The analysis of clinical and management factors associated with the treatment outcomes of Acute Subdural Hematoma (ASDH) patients revealed several key trends and risk factors. Among the mechanisms of injury, patients who sustained injuries from assault and fall down accidents showed higher survival rates, with 87.7% (n = 71) and 91.0% (n = 71) being discharged, respectively, compared to road traffic accidents (RTA), where only 61.1% (n = 58) survived, and 38.9% (n = 37) died. Patients with other injuries had the highest mortality rate, with 44.4% (n = 8) dying.

In terms of the time from injury to admission, patients admitted within 24 hours had worse survival outcomes. On the other hand 98.3% (n = 58) of patients admitted above 24 hours survived, with only 1.7% (n = 1) dying. Patients admitted within 4 hours (69.1%, n = 67) and 4–12 hours (73.3%, n = 66) had lower survival rates, suggesting that patients who presented to the hospital earlier likely had severe brain injury with rapid decompensation causing higher mortality. Furthermore, surgical management had significantly improved survival, with 88.8% (n = 95) of surgical patients discharged, compared to only 69.7% (n = 115) of patients who received conservative management.

The Glasgow Coma Scale score was a strong predictor of patient outcome. Those with a GCS of 3–8 had a much higher mortality rate, with 74.3% (n = 55) dying, while patients with GCS 9–13 had a much better prognosis, with 91.5% (n = 65) discharged alive. Patients with a GCS 14–15 had the best outcome, with 99.2% (n = 126) surviving. Regarding pupillary light reflex, patients with normal reflexes had a significantly higher discharge rate of 97.5% (n = 191), while those with bilateral non-reactive pupils had an overwhelming mortality rate of 87.5% (n = 35), and those with unilateral dilated/non-reactive pupils had a 61.1% mortality rate.

Patients who did not require intubation had a better survival rate, with 82.1% (n = 184) being discharged compared to 54.2% (n = 26) in the intubated group. The presence of comorbidities appeared to have a minor protective effect, with patients without comorbidities showing a mortality rate of 24.1% (n = 55), compared to 15.9% (n = 7) in those with comorbid conditions. Regarding prehospital first aid, those who received first aid had a slightly higher discharge rate

(75.3%, n = 113) compared to those who did not (79.5%, n = 97), but this difference was not statistically significant.

When considering complications, patients who experienced pneumonia had a higher mortality rate, with 34.5% (n = 10) dying, compared to those who did not experience complications (20.4%, n = 46). Post-op/traumatic meningitis and traumatic seizure also had higher mortality rates, with 14.3% (n = 1) and 35.7% (n = 5) dying, respectively. Platelet count also appeared to influence outcomes, with patients having $\geq 100,000$ platelets showing a survival rate of 77.8% (n = 207), while those with $< 100,000$ platelets had a 50% mortality rate.

Finally, the length of hospital stay varied widely among patients, with the mean stay being 7.26 days (SD = 10.43), indicating substantial variation in patient recovery times. These findings emphasize the significant role of timely admission, GCS scores, pupillary reflexes, type of management, complications, and platelet count in determining survival outcomes for ASDH patients.

Table 3: Association between Clinical and Management Factors and Treatment Outcome of Acute Subdural Hematoma (ASDH) Patients (n = 272).

Variables	Categories	Discharged (n, %)	Died (n, %)	Total (n)
Mechanism of Injury	Assault	71 (87.7%)	10 (12.3%)	81
	Fall down accident	71 (91.0%)	7 (9.0%)	78
	Road traffic accident	58 (61.1%)	37 (38.9%)	95
	Other(found unconscious, injury by falling object, motor cycle accident)	10 (55.6%)	8 (44.4%)	18
Time from Injury to ED Admission	Within 4 hours	67 (69.1%)	30 (30.9%)	97
	4–12 hours	66 (73.3%)	24 (26.7%)	90
	13–24 hours	19 (73.1%)	7	26

			(26.9%)	
	Above 24 hours	58 (98.3%)	1 (1.7%)	59
GCS Score	3–8	19 (25.7%)	55 (74.3%)	74
	9–13	65 (91.5%)	6 (8.5%)	71
	14–15	126 (99.2%)	1 (0.8%)	127
Pupillary Reflex	Normal	191 (97.5%)	5 (2.5%)	196
	Bilateral non-reactive	5 (12.5%)	35 (87.5%)	40
	Unilateral dilated/non-reactive	14 (38.9%)	22 (61.1%)	36
Intubation Status	No	184 (82.1%)	40 (17.9%)	224
	Yes	26 (54.2%)	22 (45.8%)	48
Comorbidity	No	173 (75.9%)	55 (24.1%)	228
	Yes	37 (84.1%)	7 (15.9%)	44
Prehospital First Aid	No	97 (79.5%)	25 (20.5%)	122
	Yes	113 (75.3%)	37 (24.7%)	150
Type of Management	Surgical (Craniotomy/craiectomy)	95 (88.8%)	12 (11.2%)	107
	Conservative	115 (69.7%)	50 (30.3%)	165
Complications	None	176 (79.6%)	46 (20.4%)	222

	Pneumonia	19 (65.5%)	10 (34.5%)	29
	Post-op/ traumatic meningitis/ abscess	6 (85.7%)	1 (14.3%)	7
	Post traumatic seizure	9 (64.3%)	5 (35.7%)	14
Platelet Count	$\geq 100,000$	207 (77.8%)	59 (22.2%)	266
	$< 100,000$	3 (50.0%)	3 (50.0%)	6
Length of Hospital Stay (days)	Mean $\pm$ SD	—	—	7.26 $\pm$ 10.43 (1– 76)

4.4 Correlation Analysis of Factors Affecting Subdural Hematoma Outcome

A correlation matrix was generated to examine the relationships between patient demographic, clinical, and radiological factors and subdural hematoma outcomes. The analysis included 272 patients and assessed variables such as age, platelet count, length of hospital stay, GCS score, pupillary reflex, intubation status, comorbidities, midline shift, hematoma thickness, and complications.

The results show that most variables had weak to moderate correlations, with correlation coefficients ranging from -0.7435 to 0.6314 . For example, GCS score was negatively correlated with pupillary reflex ($r = -0.675$), and intubation status was strongly negatively correlated with GCS score ($r = -0.7435$) and positively correlated with pupillary reflex ($r = 0.6314$). Other variables, including age, platelet count, and hematoma thickness, exhibited low correlations with the outcome and with each other.

To avoid multicollinearity in the final regression analysis, variables with correlation coefficients greater than 0.7 were excluded. This ensured that highly correlated predictors did not distort the estimated effects on subdural hematoma outcomes, allowing for a more reliable multivariable analysis.

4.5 Inferential Analysis of Clinical and Management Factors Influencing In-Hospital Mortality in Traumatic Acute Subdural Hematoma Patients.

4.5.1 Evaluation of Predictive Performance and Model Fit for In-Hospital Mortality in Traumatic Acute Subdural Hematoma Using Logistic Regression.

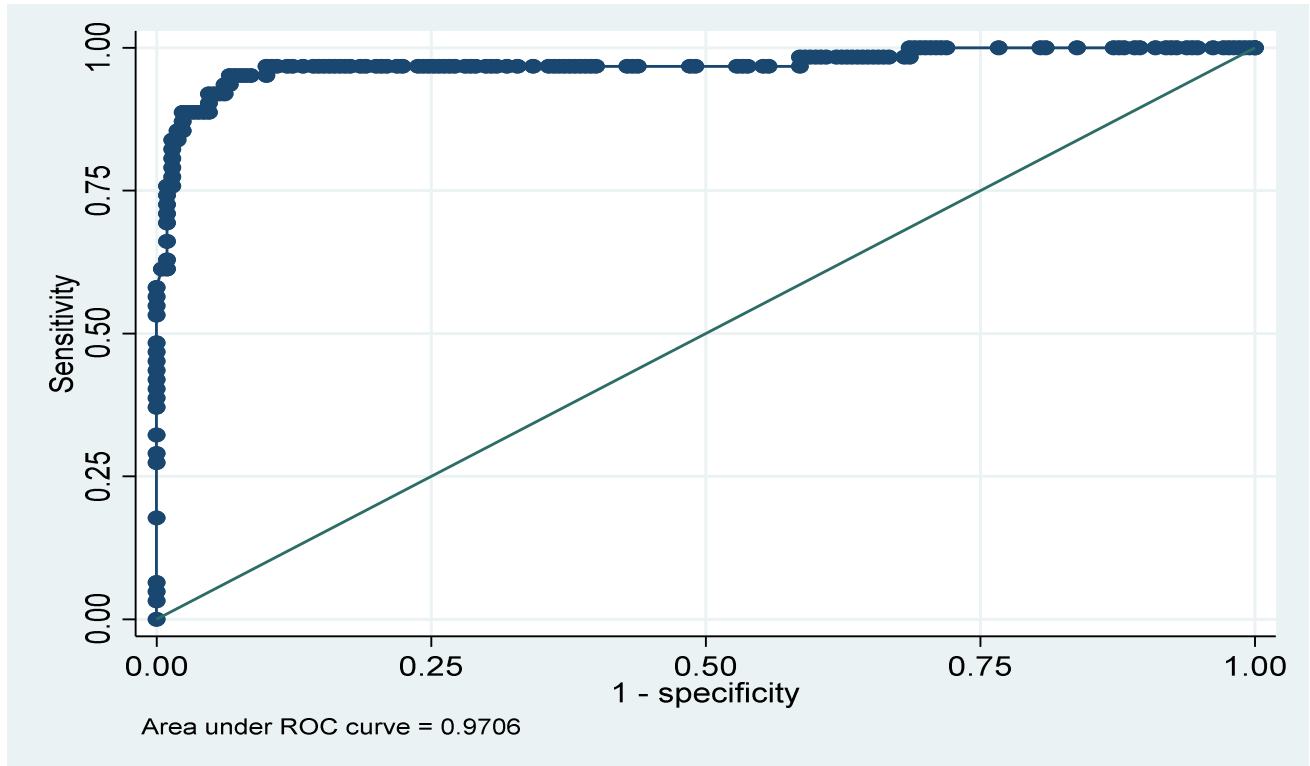


Figure 5: ROC Curve Analysis of the Mortality Prediction Model.

The logistic regression model demonstrated excellent discriminatory ability and overall fit. The area under the receiver operating characteristic curve (LROC/AUC = 0.9706) indicates that the model discriminates extremely well between patients who died and those who survived, with an AUC greater than 0.9 considered outstanding. The likelihood ratio test ($LR \chi^2(11) = 209.75, p < 0.001$) shows that the predictors collectively contribute significantly to explaining variation in hospital mortality. The log-likelihood value of -41.13 suggests a good model fit, and the pseudo- R^2 of 0.7183 indicates that approximately 72% of the variability in the outcome is accounted for by the included predictors, reflecting a very strong explanatory power. Overall, these statistics confirm that the model provides a robust and reliable framework for predicting hospital mortality in patients with traumatic acute subdural hematoma.

In model building the final multivariable model, contain only factors showing sufficient statistical significance in the initial analysis, those with a p-value below 0.025 were retained for inclusion.

4.5.2 Clinical and Radiological Predictors of Hospital Mortality in Patients with TASDH

Hospital mortality among patients with traumatic acute subdural hematoma was significantly associated with both clinical and radiological factors. Patients presenting with higher Glasgow Coma Scale scores had markedly lower odds of death compared to those with a GCS of 3–8; specifically, a GCS of 9–13 was associated with an adjusted odds ratio (AOR) of 0.10 (95% CI: 0.016–0.70, $p = 0.001$), and a GCS of 14–15 had an AOR of 0.011 (95% CI: 0.007–0.172, $p = 0.008$).

Pupillary reflex was another strong predictor, with patients exhibiting bilateral non-reactive pupils having substantially increased odds of mortality (AOR = 20.64; 95% CI: 2.23–190.87, $p = 0.008$), while unilateral dilated and non-reactive pupils showed elevated but non-significant odds (AOR = 3.68; 95% CI: 0.61–22.12, $p = 0.154$). Radiologically, hematoma thickness greater than 10 mm significantly increased the likelihood of death (AOR = 7.51; 95% CI: 1.80–31.29, $p = 0.006$) compared to hematomas ≤ 10 mm.

Duration of hospital stay was inversely associated with mortality, with each additional day reducing the odds of death (AOR = 0.86; 95% CI: 0.78–0.94, $p = 0.001$). Although midline shift ≥ 5 mm or < 5 mm was associated with higher crude odds of death, these associations were not statistically significant after adjustment. In summary, lower GCS scores, bilateral non-reactive pupils, greater hematoma thickness, and shorter hospital stays were independently associated with increased hospital mortality in TASDH patients.

Table 4: Clinical and Radiological Predictors of Hospital Mortality in Patients with Traumatic Acute Subdural Hematoma.

Variable	Hospital mortality of TASDH		OR	AOR (95%CI)	p-value
	Died	Alive discharge			

GCS 9–13	3-8(Ref)	55	19	1	1	---
	9-13	6	65	0.032	0.10(0.016 – 0.70)	0.001
	14-15	1	126	.002	0.011(0.007–0.172)	0.008
Midline shift	No(ref)	1	64	1	1	---
	>= 5mm	51	71	45.97	3.21(0.0921 - 112.2077	0.519
	< 5mm	10	75	8.53	9.60(0.233 - 395.01)	0.233
Pupillary Light Reflex	No (ref)	191	5	1	1	---
	Bilateral non-reactive to light	35	5	267.4	20.64 (2.232 - 190.87)	0.008
	Unilateral dilated and unreactive	22	14	60.02857	3.68 (0.614 - 22.12)	0.154
Hematoma thickness >10mm	<= 10mm(ref)	10	142	1.00	1.00	...
	>10mm	52	68	10.85	7.51 (1.80–31.29)	0.006
Total hospital stays(day)		Continues		0.934	0.86 (0.78–0.94)	0.001

4.5.3 Prevalence of Death among TASDH of patients in Addis Ababa, 2025.

There were 5074 total head injuries in the two hospitals in our study period. Out of these head injuries there were 272 patients with acute subdural hematoma and the incidence of TASDH becomes 5.36% which is comparable with the studies reviewed in the literature. Among those who have TASDH 22.8 (95%CI; 18.2% - 28.2%) died, implies that approximately 23 out of 100 TASDH patients have risk of death.

Discussion

This study aimed to assess hospital mortality and identify clinical and radiological factors among patients with traumatic acute subdural hematoma in Addis Ababa, 2025. TASDH is a severe form of traumatic brain injury associated with high morbidity and mortality worldwide, and timely recognition of its associated factors is critical for guiding clinical management and improving outcomes (1, 16).

The study found that a hospital mortality rate of 22.8% (95%CI; 18.2% - 28.2%) among patients with traumatic acute subdural hematoma, which is consistent with intermediate mortality rates reported in similar settings (39, 40). Several older and surgical-only series reported substantially higher mortality rates for acute subdural hematoma. For instance, a study reported that mortality rates of 50–90% for ASDH overall and up to 88% among patients older than 80 years (41). Similarly, reported an overall mortality of 55% in a series of ASDH patients (42). These higher rates likely reflect cohorts with more severe injuries, population difference, limited neurosurgical management, resources limitation, lack of neuro-critical units and delays in surgical intervention (43).

Conversely, more recent and broader cohort studies show lower mortalities. For example, Chen et al. (2014) a study in USA reported an in-hospital mortality of 14% among 1,427 adult patients with acute traumatic subdural hematoma in a U.S. trauma registry. Similarly, an Ethiopian tertiary-hospital study reported an in-hospital mortality of 17.4% among surgically treated adult patients with ASDH (44). Compared to these studies, our mortality estimate of 22.8% is slightly higher but remains much lower than older high-mortality reports (17). Possible explanations for this intermediate result include differences in case-mix, with our cohort potentially including more moderate-to-severe injuries, resource and system limitations in the local context including ICU beds and ventilators, delayed surgical intervention, variations in inclusion/ exclusion criteria, poor referral system, lack of pre-hospital emergency services and demographic factors such as age and comorbidities. These findings suggest that while outcomes have improved over time, further optimization of neurocritical care, pre-hospital care, urgent referral for neurosurgically equipped centers and early neurosurgical intervention could potentially reduce mortality in TASDH patients in Addis Ababa (41, 45-47)

Glasgow Coma Scale (GCS)

In this study, lower GCS scores at admission were strongly associated with higher hospital mortality. Patients with a GCS of 9–13 had significantly lower odds of death compared to those with a GCS of 3–8, with an AOR of 0.10, indicating a much lower likelihood of mortality. Those with a GCS of 14–15 had even lower odds of death, with an AOR of 0.011, demonstrating a dramatically reduced risk of mortality. This finding highlights the critical role of initial neurological status in predicting outcomes after traumatic acute subdural hematoma (48, 49). Lower GCS scores reflect greater severity of brain injury, increased ICP with reduced cerebral perfusion, and increased risk of secondary complications, all of which will contribute to higher mortality (45, 50). Similar studies have consistently shown that GCS is one of the most reliable prognostic indicators in traumatic brain injury, with higher scores associated with improved survival and functional outcomes (51).

Pupillary Reflex

Bilateral non-reactive pupils were strongly associated with increased mortality, with an AOR of 20.64, indicating that patients with this condition had significantly higher odds of dying compared to those with reactive pupils. In contrast, unilateral dilated and non-reactive pupils were not statistically significant in predicting mortality. The absence of pupillary light reflex suggests severe brainstem dysfunction or elevated intracranial pressure, both of which are powerful predictors of poor outcomes in traumatic brain injury (52). Previous studies have indicated that patients with bilateral non-reactive pupils often experience mortality rates exceeding 70%, and this sign is commonly used in early triage and surgical decision-making (53, 54). Our findings further emphasize the critical role of pupillary assessment as a rapid, non-invasive prognostic tool in the acute management of traumatic acute subdural hematoma.

Hematoma Thickness

Hematoma thickness greater than 10 mm was independently associated with higher hospital mortality, with an AOR of 7.51, indicating that patients with larger hematomas had significantly higher odds of dying compared to those with smaller hematomas. Larger hematomas contribute to increased intracranial pressure, midline shift, and secondary ischemic injury, which collectively worsen patient prognosis (54). These findings align with previous studies by (17, 25)

who reported that thicker subdural hematomas are correlated with higher mortality and poorer functional outcomes. Timely surgical evacuation of large hematomas has been shown to reduce mortality, emphasizing the need for early imaging and intervention in these cases (55).

Total Hospital Stay

Longer hospital stay was inversely associated with mortality (AOR = 0.86), suggesting that patients who survive the earliest, critical phase of TASDH are more likely to continue their recovery. This finding aligns with previous reports indicating that early mortality in traumatic brain injury is often concentrated within the first few days of admission, and survivors beyond this period generally experience better outcomes (56). Shorter hospital stays may reflect rapid deterioration and early death even before resuscitation and surgical intervention, while prolonged hospitalization often allows for stabilization, rehabilitation, and management of complications, all of which improve the outcome (57).

Conclusion

In conclusion, hospital mortality among patients with traumatic acute subdural hematoma in Addis Ababa was substantial, with an observed rate of 22.79%. Lower Glasgow Coma Scale scores, bilateral non-reactive pupils, and hematoma thickness greater than 10 mm were identified as independent predictors of mortality, while longer hospital stays were associated with improved survival. The logistic regression model demonstrated excellent fit and discriminatory power, indicating that these factors reliably predict patient outcomes. These findings underscore the importance of rapid neurological assessment, timely imaging, and prompt intervention in high-risk patients, and provide evidence to guide clinical decision-making, resource allocation, and strategies to improve survival in TASDH patients.

Strengths and Limitations

This study has several strengths. It provides updated, context-specific evidence on hospital mortality and predictors of traumatic acute subdural hematoma in Addis Ababa, using a well-defined cohort with detailed clinical and radiological data. The inclusion of multiple significant predictors and the use of a robust logistic regression model with excellent discriminatory power (AUC = 0.9706) enhance the reliability and applicability of the findings. Additionally, the study

highlights modifiable factors that can inform early intervention and resource allocation in neurosurgical care.

However, the study also has limitations. Its retrospective design may be prone to missing or incomplete data, which could introduce information bias. The single-center setting limits the generalizability of the findings to other hospitals or regions with different patient populations and healthcare resources. Moreover, some potentially important predictors, such as pre-existing comorbidities, time from injury to intervention, and long-term functional outcomes, were not included in the analysis. Despite these limitations, the study provides valuable insight into key determinants of mortality in TASDH patients and can guide clinical practice and future research.

Recommendations

Based on the finding it is recommended that,

- **Clinicians and Neurosurgeons:**

- ✓ Prioritize early and thorough neurological assessment, including Glasgow Coma Scale scoring and pupillary reflex evaluation.
- ✓ Ensure rapid imaging and timely surgical intervention, particularly for patients with large hematomas or severe neurological impairment.

- **Hospital and Critical Care Units:**

- ✓ Strengthen critical care resources to provide intensive monitoring and supportive management during the early hospital stay.
- ✓ Implement standardized protocols for triage, early intervention, and postoperative care to improve patient outcomes.

- **Health Policy Makers and Administrators:**

- ✓ Facilitate resource allocation to enhance neurosurgical and critical care capacity in hospitals managing traumatic brain injuries.
- ✓ Support multicenter research initiatives to evaluate additional risk factors, long-term outcomes, and context-specific interventions.

Reference

1. Simegnew N, Abafita M, Worku AT, Baye MF. A prospective study on patterns and management outcomes of intracranial Hematoma at Jimma University Medical Center. 2022.
2. Biluts H, Abebe M. SHORT-TERM OUTCOME OF OPERATED TRAUMATIC BRAIN INJURY PATIENTS FOR INTRACRANIAL HEMORRHAGE AT TIKUR ANBESSA SPECIALIZED TEACHING HOSPITAL (TASTH), ADDIS ABABA, ETHIOPIA. Ethiopian Medical Journal. 2017;55(1):63-8.
3. Dinsmore J. Traumatic brain injury: an evidence-based review of management. Continuing Education in Anaesthesia, Critical Care & Pain. 2013;13(6):189-95.

4. Lavrador J, Teixeira J, Oliveira E, Simão D, Santos M, Simas N. Acute subdural hematoma evacuation: predictive factors of outcome. *Asian Journal of Neurosurgery*. 2018;13(03):565-71.
5. Teshita G, Wondafrash M, Getachew B, Bergene E. Clinical characteristics and functional outcome of surgically treated adult head trauma patients with acute subdural hematoma: Ethiopian tertiary hospitals experience. *World Neurosurgery*: X. 2024;21:100264.
6. Hagos A, Tedla F, Tadele A, Zewdie A. Pattern and outcome of traumatic brain injury, Addis Ababa, Ethiopia: a cross-sectional hospital-based study. *Ethiopian journal of health sciences*. 2022;32(2).
7. Suga Y, Shimelis W, Yesuf A, Dendena F, Teklewold B. Assessment of magnitude and factors affecting outcomes of head injury at Addis Ababa burn emergency and trauma hospital, Ethiopia. *Int J*. 2021;7(1):28.
8. Aregago G, Gishu T, Getaneh E, Tiore LL, Abame DE, Meskele S. 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. *Journal of Family Medicine and Primary Care*. 2022;11(9):5277-84.
9. Kim K-H. Predictors for functional recovery and mortality of surgically treated traumatic acute subdural hematomas in 256 patients. *Journal of Korean Neurosurgical Society*. 2009;45(3):143.
10. Younsi A, Fischer J, Habel C, Riemann L, Scherer M, Unterberg A, Zweckberger K. Mortality and functional outcome after surgical evacuation of traumatic acute subdural hematomas in octa-and nonagenarians. *European Journal of Trauma and Emergency Surgery*. 2021;47(5):1499-510.
11. Aromatario M, Torsello A, D'Errico S, Bertozzi G, Sessa F, Cipolloni L, Baldari B. Traumatic epidural and subdural hematoma: epidemiology, outcome, and dating. *Medicina*. 2021;57(2):125.
12. Tao X, Jin H, Bo-ying R, Gan W, Wen-wei G, Hao C. Risk factors related to hospital mortality in patients with isolated traumatic acute subdural haematoma: analysis of 308 patients undergone surgery. *Chinese medical journal*. 2008;121(12):1080-4.
13. Alagoz F, Yildirim A, Sahinoglu M, Korkmaz M, Secer M, Celik H, et al. Traumatic acute subdural hematomas: analysis of outcomes and predictive factors at a single center. *Turkish neurosurgery*. 2017;27(2).
14. Ryan CG, Thompson RE, Temkin NR, Crane PK, Ellenbogen RG, Elmore JG. Acute traumatic subdural hematoma: current mortality and functional outcomes in adult patients at a Level I trauma center. *Journal of Trauma and Acute Care Surgery*. 2012;73(5):1348-54.
15. Igbokwe KK, Ayogu OM, Onobun DE, Essiet EA, Ugwuanyi UC, Igbokwe K, et al. The outcomes of traumatic acute subdural hematoma in a tertiary center in Abuja, Nigeria. *Cureus*. 2021;13(11).
16. Monsivais D, Choi HA, Kitagawa R, Franch M, Cai C. A retrospective analysis of surgical outcomes for acute subdural hematoma in an elderly cohort. *Interdisciplinary Neurosurgery*. 2018;14:130-4.
17. Seelig JM, Becker DP, Miller JD, Greenberg RP, Ward JD, Choi SC. Traumatic acute subdural hematoma: major mortality reduction in comatose patients treated within four hours. *New England Journal of Medicine*. 1981;304(25):1511-8.

18. Fountain DM, Kolias AG, Lecky FE, Bouamra O, Lawrence T, Adams H, et al. Survival trends after surgery for acute subdural hematoma in adults over a 20-year period. *Annals of surgery*. 2017;265(3):590-6.
19. Leitgeb J, Mauritz W, Brazinova A, Janciak I, Majdan M, Wilbacher I, Rusnak M. Outcome after severe brain trauma due to acute subdural hematoma. *Journal of neurosurgery*. 2012;117(2):324-33.
20. Thakkar R, Chotai S, Guidry BS, Yengo-Kahn A, Thomas HC, Sermarini AJ, et al. Impact of Thrombocytopenia on Preoperative Hematoma Expansion for Acute Traumatic Subdural Hematoma. *World Neurosurg*. 2022;167:e19-e26.
21. Lillemäe K, Luostarinen T, Reinikainen M, Bendel S, Laitio R, Hoppu S, et al. Early thrombocytopenia is associated with an increased risk of mortality in patients with traumatic brain injury treated in the intensive care unit: a Finnish Intensive Care Consortium study. *Acta neurochirurgica*. 2022;164(10):2731-40.
22. Wu E, Marthi S, Asaad WF. Predictors of Mortality in Traumatic Intracranial Hemorrhage: A National Trauma Data Bank Study. *Front Neurol*. 2020;11:587587.
23. Rubenson Wahlin R, Nelson DW, Bellander BM, Svensson M, Helmy A, Thelin EP. Prehospital Intubation and Outcome in Traumatic Brain Injury-Assessing Intervention Efficacy in a Modern Trauma Cohort. *Front Neurol*. 2018;9:194.
24. Spaite DW, Bobrow BJ, Keim SM, Barnhart B, Chikani V, Gaither JB, et al. Association of Statewide Implementation of the Prehospital Traumatic Brain Injury Treatment Guidelines With Patient Survival Following Traumatic Brain Injury: The Excellence in Prehospital Injury Care (EPIC) Study. *JAMA Surg*. 2019;154(7):e191152.
25. Mendelson KG, Fallat ME. Pediatric injuries: prevention to resolution. *Surgical Clinics*. 2007;87(1):207-28.
26. Trevisi G, Sturiale CL, Scerrati A, Rustemi O, Ricciardi L, Raneri F, et al. Acute subdural hematoma in the elderly: outcome analysis in a retrospective multicentric series of 213 patients. *Neurosurgical Focus*. 2020;49(4):E21.
27. Hoffman H, Jalal MS, Bunch KM, Chin LS. Management of chronic subdural hematoma with the subdural evacuating port system: systematic review and meta-analysis. *Journal of Clinical Neuroscience*. 2021;86:154-63.
28. Wilberger JE, Jr., Harris M, Diamond DL. Acute subdural hematoma: morbidity, mortality, and operative timing. *J Neurosurg*. 1991;74(2):212-8.
29. Chen S-H, Sun J-M, Fang W-K. The impact of time from injury to surgery in functional recovery of traumatic acute subdural hematoma. *BMC neurology*. 2020;20(1):226.
30. Haselsberger K, Pucher R, Auer L. Prognosis after acute subdural or epidural haemorrhage. *Acta neurochirurgica*. 1988;90(3):111-6.
31. Walcott BP, Khanna A, Kwon C-S, Phillips HW, Nahed BV, Coumans J-V. Time interval to surgery and outcomes following the surgical treatment of acute traumatic subdural hematoma. *Journal of Clinical Neuroscience*. 2014;21(12):2107-11.
32. Park J-H, Park J-E, Kim S-H, Lim Y-C, You N-K, Ahn Y-H, et al. Outcomes of ultra-early decompressive craniectomy after severe traumatic brain injury-treatment outcomes after severe TBI. *Korean journal of neurotrauma*. 2014;10(2):112-8.
33. Tien HC, Jung V, Pinto R, Mainprize T, Scales DC, Rizoli SB. Reducing time-to-treatment decreases mortality of trauma patients with acute subdural hematoma. *Annals of surgery*. 2011;253(6):1178-83.

34. Zewdie A. Assessment of trauma care in tertiary center, Addis Ababa Ethiopia: an observational study. *EC Emerg Med Crit Care*. 2020;4:01-8.
35. Geeraedts LM, Jr., Kaasjager HA, van Vugt AB, Frölke JP. Exsanguination in trauma: A review of diagnostics and treatment options. *Injury*. 2009;40(1):11-20.
36. Foundation BT. Early indicators of prognosis in severe traumatic brain injury. *J Neurotrauma*. 2000;17(6-7):555-627.
37. Gravesteyn BY, Sewalt CA, Nieboer D, Menon DK, Maas A, Lecky F, et al. Tracheal intubation in traumatic brain injury: a multicentre prospective observational study. *British journal of anaesthesia*. 2020;125(4):505-17.
38. AbdelFatah MAR. Prognosis of acute subdural hematoma greater than 10 mm in thickness in head injury patients with an extension or no motor response to pain after resuscitation. *Egyptian Journal of Neurosurgery*. 2019;34(1):9.
39. Dias L, Nogueira P, Oliveira JP, Cabral J. Acute Traumatic Subdural Hematomas-When (and why) do we stop? The atSDH-stop survey. *Journal of Neurological Surgery Part A: Central European Neurosurgery*. 2025.
40. Mohan A, Malnik S, Grady C, Lucke-Wold B, Kubilis P, Hoh BL. Inversed probability case-control analysis of operative burr hole evacuation versus subdural evacuating port system for chronic subdural hematomas: clinical and economic outcomes. *Clinical Neurology and Neurosurgery*. 2022;220:107356.
41. Stone JL, Rifai MH, Sugar O, Lang RG, Oldershaw JB, Moody RA. Subdural hematomas: I. Acute subdural hematoma: progress in definition, clinical pathology, and therapy. *Surgical neurology*. 1983;19(3):216-31.
42. Juković M, Till V. Chronic subdural hematoma-diagnosis, treatment and perspectives. *Medicinski pregljed*. 2020;73(9-10):295-300.
43. Phuenpathom N, Choomuang M, Ratanaalert S. Outcome and outcome prediction in acute subdural hematoma. *Surgical neurology*. 1993;40(1):22-5.
44. Kebede BM, Getachew K, Bezu MT, Abebe M, Laeke T. Clinical Outcome and Prognostic Factors of Surgically Treated Acute Epidural Hematoma, A 32-Month Prospective Observational Study. *WFNS Journal*. 2025;2(01):e52-e62.
45. Seelig JM, Greenberg RP, Becker DP, Miller JD, Choi SC. Reversible brain-stem dysfunction following acute traumatic subdural hematoma: a clinical and electrophysiological study. *Journal of neurosurgery*. 1981;55(4):516-23.
46. Wilberger JE, Harris M, Diamond DL. Acute subdural hematoma: morbidity, mortality, and operative timing. *Journal of neurosurgery*. 1991;74(2):212-8.
47. Miller JD, Nader R. Acute subdural hematoma from bridging vein rupture: a potential mechanism for growth. *Journal of neurosurgery*. 2014;120(6):1378-84.
48. Lee JJ, Segar DJ, Morrison JF, Mangham WM, Lee S, Asaad WF. Subdural hematoma as a major determinant of short-term outcomes in traumatic brain injury. *Journal of neurosurgery*. 2017;128(1):236-49.
49. Bocca LF, Lima JVF, Suriano IC, Cavalheiro S, Rodrigues TP. Traumatic acute subdural hematoma and coma: retrospective cohort of surgically treated patients. *Surgical Neurology International*. 2021;12:424.
50. Asakawa MG, Mackillop E, Olby NJ, Robertson ID, Cullen JM. Imaging diagnosis—neuronal ceroid lipofuscinosis with a chronic subdural hematoma. *Veterinary Radiology & Ultrasound*. 2010;51(2):155-8.

51. HATASHITA S, KOGA N, HOSAKA Y, TAKAGI S. Acute subdural hematoma: severity of injury, surgical intervention, and mortality. *Neurologia medico-chirurgica*. 1993;33(1):13-8.
52. Yokobori S, Nakae R, Yokota H, Spurlock MS, Mondello S, Gajavelli S, Bullock RM. Subdural hematoma decompression model: a model of traumatic brain injury with ischemic-reperfusional pathophysiology: a review of the literature. *Behavioural brain research*. 2018;340:23-8.
53. Stocchetti N, Paterno R, Citerio G, Beretta L, Colombo A. Traumatic brain injury in an aging population. *Journal of neurotrauma*. 2012;29(6):1119-25.
54. Ortega-Perez S, Shoyombo I, Aiyagari V, Atem F, Hill M, Stutzman SE, Olson DM. Pupillary light reflex variability as a predictor of clinical outcomes in subarachnoid hemorrhage. *Journal of Neuroscience Nursing*. 2019;51(4):171-5.
55. Choudhary AK, Bradford RK, Dias MS, Moore GJ, Boal DK. Spinal subdural hemorrhage in abusive head trauma: a retrospective study. *Radiology*. 2012;262(1):216-23.
56. van Essen TA, Lingsma HF, Pisică D, Singh RD, Volovici V, den Boogert HF, et al. Surgery versus conservative treatment for traumatic acute subdural haematoma: a prospective, multicentre, observational, comparative effectiveness study. *The lancet neurology*. 2022;21(7):620-31.
57. Lega BC, Danish SF, Malhotra NR, Sonnad SS, Stein SC. Choosing the best operation for chronic subdural hematoma: a decision analysis. *Journal of neurosurgery*. 2010;113(3):615-21.

ANNEXES

Information Sheet and Informed Voluntary Consent Form

My name is Dr. Aklilu Berhanu; I am collecting data for my study being conducted in this hospital. Currently I am studying emergency and critical care medicine Specialty Certificate program at SPHMMC. I kindly request you to lend me your attention to explain you about the study and your institution being selected as the study setting.

1. The study title:

“Assessment of in-hospital mortality and its predictors of patients with TASDH admitted to AaBET and ALERT hospitals, Addis Ababa, Ethiopia”

2. Purpose/aim of study

The study will assess the in-hospital mortality and associated factors of the problem in the area, so that all the stakeholders give due attention to combat the problem.

Policy makers will use the data to scale-up the preventive measures and management practices in collaboration with organizations working in Addis Ababa.

SPHMMC will use the data to strengthen and improve preventive measures, standard diagnostic modalities and therapeutic measures.

It will also open the door for other researchers to further investigate the problem, including actual prevalence and burden of TASDH and treatment outcomes other than death at country level.

Lastly, the aim of this study is to write a thesis as a partial requirement for the fulfillment of Emergency and critical care medicine certificate program for the principal investigator.

3. Procedure and duration

I reviewed the patient charts retrospectively using checklists to provide me with pertinent data that is helpful for the study. There are structured checklists to be filled from the charts of the patients. The review of each chart will take 20 minutes.

4. Risks and benefits

The risk of taking secondary data from the patients file in this study is negligible, but the findings from this research may reveal important information for the local health planners.

5. Confidentiality

All the information will be kept confidential. There will be no information that will identify the participants in particular. The findings of the study will be general for the study community and will not reflect anything particular of individual persons. The questionnaire will be coded to exclude showing names. No reference will be made in oral or written reports that could link participants to the research.

6. Rights

Review of charts for this study is fully voluntary. The Public hospitals administrators (Chief executive officer & medical director) have the right to have full information about the research to

be conducted, the process and the final outcome on behalf the patients. They have the right to stop the study from being conducted if any misdeeds and unethical procedures are observed during the data collection process in the hospitals' premises.

7. Contact address

If there is any question or inquiry at any time about the study or the procedures, please contact: +251-938281598 at mobile phone or Email (aklilub44@gmail.com).

8. Declaration of informed voluntary consent

I have read the participant information sheet. I have clearly understood the purpose of the research, the procedures, the risks and benefits, issues of confidentiality, rights of participants and the contact address for any queries. I have been given the opportunity to ask questions for things that may have been unclear. I am also informed that the hospital has the right to stop this study from being conducted if any misdeeds and unethical procedures are observed during data collection process in the hospital's premises. Therefore, I declare my voluntary consent to behalf of _____ hospital management to allow this study to be conducted in this Hospital with my initials (signature).

Name and signature of Head of the Hospital: _____ Date _____

Name and signature of PI: Aklilu Berhanu (MD) Date: 20th Nov/ 2025

Thank You.

A structured checklist

1. Patient's detail and admission information

1.1. Medical record number: _____

1.2. Age: _____

1.3. Sex: male ☐, female ☐

1.4. Residency: urban ☐, rural ☐

1.5. Date of admission: _____

- 1.6. Date of discharge/death: _____
- 1.7. Time of death after admission: _____
- 1.8. Time between injury and hospital admission: _____
- 1.9. Time from injury to surgery.....
- A) <6 hours
 - B) 6—12 hours
 - C) 12—24 hours
 - D) >24 hours
- 1.10. Any pre-hospital care given? A)yes B)No
- 1.11. Length of hospital stay: _____
- 1.11. Mechanism of injury:
- RTA ☐ FDA ☐
- Assault/personal violence ☐ others specify _____
- 1.12. clinical symptoms after the injury
- LOC.....A)yes B)no
- Seizure..... A)yes B)no
- Vomiting..... A)yes B)no
- 1.13. Prior medical illness
- DM _____
- HTN _____
- Known cardiac illness _____
- Seizure disorder/epilepsy _____
- Other, specify _____
- 1.14. Prior use of anticoagulant A)Yes B)No
- If yes, specify the drug _____
- 1.15. P/E on admission:
- Intubation status _____
- BP: _____
- HR: _____

RR: _____

Spo2_____

GCS_____

Pupillary reflex: A) right _____ B) left_____

2. Pertinent investigation results

2.1.Brain CT scan finding

A) Location of hematoma_____

B) Hematoma thickness in mm_____

C) Midline shift in mm_____

D) Other concomitant CT findings_____

2.2. Hemoglobin_____ platelet_____

3. Management and outcome:

3.1. Conservative _____

Outcome A) Death B) Discharged alive

3.2. Surgical

Outcome A) Death B) Discharged alive