

# Outcome of traumatic brain injury and its associated factors among pediatrics patients treated in Amhara national regional state comprehensive specialized hospitals, Ethiopia 2022

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## Thesis Article

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## Abstract

**Background:** Traumatic brain injury in pediatrics is one of the commonest causes of morbidity, disability and mortality worldwide. In low- and middle-income countries Study showed that death of pediatrics from traumatic brain injury was 7.3%. However, there is limited data towards the outcome of traumatic brain injury and its associated factors in Ethiopia.

**Objective:** To assess the outcome of traumatic brain injury and associated factors among pediatrics patients in Amhara National Regional State Comprehensive Specialized Hospitals, Ethiopia.

**Methods:** An institution based retrospective cross-sectional study was conducted among 423 pediatrics patients from January 1, 2019 to December 30, 2021, and data extraction period was from May 16 to June 15, 2022. Systematic random sampling technique was employed to select the study participants. Data were collected from patient charts and registry books by using a data extraction tool. Data were entered into the Epi-info version 7 and analysis was done by SPSS Version 25. Both Bi-variable and multi-variable analyses were employed to identify factors associated with outcome of traumatic brain injury.

**Result:** From 423 sampled study participant charts 404 of them had complete information with response rate of 95.5% and included in the final analysis. The overall unfavorable outcome of traumatic brain injury at discharge was found that 12.13% (95% CI: 9.1% - 15.7 %). Sever traumatic brain injury [AOR: 5.11(CI :1.8 -14.48)], moderate traumatic brain injury [AOR:2.44(CI:1.07-5.58)], Hyperglycemia [AOR: 3.01 (CI:1.1-8.04)], sign of increased intracranial pressure [AOR:7.4(CI:3.5-15.26)], and medical comorbidity [AOR: 2.65(CI:1.19-5.91)] were predicted of unfavorable outcome of traumatic brain injury pediatrics patient.

**Conclusion and recommendations:** twelve present of traumatic brain injury results unfavorable outcome. Sever and moderate form of traumatic brain injury,

hyperglycemia, signs of increased intracranial pressure, and medical comorbidity were factors associated with unfavorable outcome of traumatic brain injury in children. Therefore, it is preferable to improve accesses to acute and post-acute care services to lower the unfavorable outcome of traumatic brain injury in children.

### Introduction

Traumatic brain injury is physical insult that happen once the brain is exposed to an excessive external force and the common clinical presentation after trauma is confusion, loss of consciousness, coma and seizure[1].

Traumatic brain injury is more common in children. There are a variety of contributing factors that make children more vulnerable to TBI, including the size of their of head is larger than their body weight and other physiologic aspects [2]. Fall from a height, road traffic accidents, and direct head trauma are the most prevalent causes of traumatic brain injury in children[3].

Previous study showed that worldwide prevalence and incidence of Traumatic brain injury in children is continuing to be a serious community health concern, with 47 to 280 traumatic brain injury cases per hundred thousand children [4].

In USA, study showed that yearly 99,796 of children were die due to traumatic brain injury [5]. As well as Study conducted in resource limited Low- and Middle-Income countries reveled that mortality among traumatic brain injury of children was 7.3% [6].

Previous study in African study found that high burden of deaths due to trauma-related brain injury among children. According to those study, traumatic brain injury caused 41.8 %, 18.75 %, and 8% of deaths in Egypt, South Africa, and Sub-Saharan Africa, respectively.[3,7,8].

In Ethiopia study suggest that trauma is one of major public health challenge and the most prevalent contributing reasons include RTAs, falls, and animal-related injuries, however there is scarcity of data towards outcome of TBI and associated factors in children [9,10].

Different study shows that unfavorable outcome of traumatic brain injury in children is still higher and one of the major community heath challenges in worldwide. Such as, study conducted in Europe 10 % , Netherlands 5%, Germany 27.6% and in Singapore 30% [11–14].

A study conducted in India found that 10.6% of children who suffer traumatic brain injuries have unfavorable outcomes [15]. And other similar study done in China 12.6% death among all TBI and in Pakistan among decompressive craniotomy of severe TBI 36 % of children results unfavorable outcome of traumatic brain injury of children [16,17].

Study conducted in Qatar National Trauma Center showed that 13% and Saudi Arabia 14.8% children was reported that unfavorable outcome from TBI [18,19].

In resource limited setting of low- and middle-income country different study revealed that death of children's from TBI are still high such as study done in south Africa 18.75% , in Togo at Sylvanus Olympio University Hospital 31.9 % , in Uganda 35% and in Egypt at Cairo University Hospitals 41.7% of TBI in children [3,7,20,21].

Study conducted in Sub-Saharan Africa showed that the overall mortality from traumatic brain injury of children was report that 8% and other cross-sectional study done in age of under 14 children in south Ethiopia Hawassa University Compressive Specialized Hospital revealed that 15.8% of TBI children results unfavorable outcome [8,10].

According to WHO and other similar worldwide study revealed that age of less than four and male children was associated with unfavorable outcome pediatric TBI in children [4,22]. Other study conducted by Centers for Disease Control and Prevention showed that rural residence is significantly higher in hospitalization and death among TBI children [23].

Study done in France revealed that educational level of children and parental education level significantly associated with outcome of TBI [24]. However, study done on under age of 14 in Ethiopia Hawassa University Hospital showed parental education level were not associated with outcome of TBI of children [10].

Different Study revealed that RTA the most common Mechanism of traumatic brain injury of pediatrics traumatic brain injury such as, study in German, Sub-Saharan Africa and Ethiopia [8,10,25,26]. However, study conducted in USA, in Netherland, Hong Kong and India shows that fall down accident was the major cause of TBI among children [14,27–29]. Other study conducted in China revealed that assaults was the most common mechanism of traumatic brain injury in children [30]. Study done in India revealed that TBI of children who had additional injury with chest and spinal cord significantly associated with unfavorable outcome [15]. And other similar study in and chain showed that TBI children who had chest injury significantly associated with unfavorable outcome [16].

Early availability of TBI patient in hospital for neurotrauma management is very crucial for early privation of ongoing pathological brain injury [31]. study in Uganda and Pakistan revealed that let to hospital presentation more than four hours is associated with unfavorable outcome [17,32]. And other study in United States revealed that short (< 1day) in hospital length of stay associated with unfavorable outcomes of traumatic brain injury [33].

Pathophysiology of TBI classified as Primary brain injury which occurs during at time of trauma includes soft tissue injury, bleeding in to extra axial (epidural, sub Dural, subarachnoid space and intraventricular), skull fracture and intracranial lesions (DAI, cortical contusion and vascular injury) and were as secondary brain injury occurs after trauma due to hypotension, hypoxia and increased ICP which is significantly associated with unfavorable outcome [29,34,35].

A systematic study conducted in Europe, as well as other studies in, Hong Kong, Germany and Pakistan, showed that having a skull fracture on a CT scan finding were significantly associated with a unfavorable outcome of traumatic brain injury in children [17,25–27].

Immediate management of TBI needs multidisciplinary approach such as resuscitation, management airway, intubation when GCS < 8 TBI, monitoring ICP, prevention of secondary TBI and neurosurgical management [36,37].

Study conducted in USA, Singapore, and Ethiopia revealed that Presence of ICP were significantly associated with unfavorable outcome of traumatic brain injury [10,11,38].

In Germany Study conducted in short term outcome of severe TBI showed that decompressive craniotomy significantly associated with unfavorable outcome of TBI [12]. other similar study done in India shows that sever TBI and Fixed bilateral dilated pupil significantly associated with unfavorable outcome of TBI in children [15].

Study conducted in Singapore showed that clinical presentation of vomiting, severity of TBI, hypotension, use of inotropic and comorbid with anemia significantly associated with unfavorable outcome [11]. And other similar Study in chain shows that SAH significantly associated with unfavorable outcome [16]. Study in Togo was reported that presence hypotension, comorbidity with

anemia, hyperthermia and GCS of  $< 6$  associated with unfavorable outcome of TBI [21]. Other similar study conducted in, Singapore, Ankara Turkey and Hawassa Ethiopia showed that hyperglycemia were significantly associated with unfavorable outcome of TBI [10,39,40].

## Methods and materials

### *Study design and Period*

Institutional-based cross-sectional study was conducted from May 16 to June 15, 2022 G.C.

### *Study area*

This study was carried out in Comprehensive Specialized Hospitals of the Amhara National Regional State in Ethiopia. Amhara National regional state is one federal republics of Ethiopia with an approximate land area of 170000 square kilometers.[41]. The territory is divided into 12 administrative zones, three city administrations, and 83 districts. The Amhara National Regional Health Bureau's Annual Performance Report shows the region has 81 Hospitals, 858 Health centers, and 3560 Health posts. Among Hospitals eight of them are Comprehensive Specialized Hospital these are University of Gondar, Dessie, Felege-Hiwot, Tibebe-Ghion, Debre-Markos, Waldiy, Debre Tabor, and Debebirhan Comprehensive Specialized Hospital which are serve for population within the region [42] . These Hospitals provide surgical, medical, pediatric, maternal, and other types of care to their patients. These hospitals have specialty units for cardiology, respiratory, neurology, dermatology, and sexually transmitted diseases, as well as gastroenterology, infectious diseases, orthopedics, gynecology and obstetrics, hematology, and intensive care units. Five Comprehensive Specialized Hospitals was chosen by simple random lottery methods from a total of eight Comprehensive Specialized Hospitals those are University of Gondar, Felege-Hiwot, Tibebe-Ghion, Debre-Markos, and Debre-Berhan Compressive Specialized Hospitals.

## Objectives

### *General objective*

To assess the outcome of traumatic brain injury and its associated factors among pediatrics patients treated in Amhara National Regional State Comprehensive Specialized Hospitals, Ethiopia 2022.

### *Specific objectives*

- To determine the outcome of traumatic brain injury among pediatrics patients treated in Amhara National Regional State Comprehensive Specialized Hospitals, Ethiopia 2022.
- To identify the factors associated with outcome of traumatic brain injury among pediatrics patients treated in Amhara National Regional State Comprehensive Specialized Hospitals, Ethiopia 2022.

### *Population*

#### *Source population*

All pediatric patients with traumatic brain injuries were treated in Amahera National Regional State Comprehensive Specialized Hospitals.

#### *Study population*

Study population was all selected traumatic brain injury pediatrics patients age of 1 month to 18 years who were treated at Amhara National Regional State Comprehensive Specialized Hospitals from January 1, 2019 and December 30, 2021.

### *Eligibility Criteria*

This study includes traumatic brain injury pediatrics patients age of one month to 18 years who was treated in Amhara National Regional State Comprehensive Specialized Hospitals. However, TBI pediatrics patients who were died on arrival, referred to another institution and refused treatment after medical advice to their families was excluded from this study.

### *Sample Size Determination*

The required sample size was calculated for the dependent variable by using the single population proportion formula. The anticipated proportion of outcome (P= 50%) was taken because no previous study was done in under 18 years of children in Ethiopia. By considering CI= 95% and the margin of error (D) = 5% in order to increase the precision of the study. Hence, the required sample size was:

$$\text{sample size was: } n = \frac{(Z_{\alpha/2})^2 \times P(1-P)}{D^2} = \frac{(1.96)^2 \times 0.5(1-0.5)}{(0.05)^2} = 384$$

n = the minimum sample size required

P= estimated proportion (50%) = 0.5

Z = the standard value of confidence level of  $\alpha=95\%$

D = the margin of error between the sample and the population (0.05).

By considering 10% incomplete data rate the final sample size was 423.

### *Sampling Technique and Procedure*

From January 1, 2019 to December 30, 2021 G.C, the total estimated number of TBI pediatric patients who visited at selected Amhara National Regional State Comprehensive Specialized Hospitals, Ethiopia was 3,384. Our study participants were chosen by using a systematic random sampling technique after proportional allocation for each selected hospital at every k interval:  $K=N/n= 3,384/423$ ,  $K=8$ . The first MRN of study participants was identified from each hospital's registry books to select sampled study participants during the study period, and then every k patient chart was selected until reached to the desired sample size and the first participant was chosen by lottery methods. As a result, the diagram below depicts how study participants were chosen, with proportional allocation from each hospital (See Figure 1).

### *Operational definitions*

Pediatrics age patients: age of younger than 18 years old [22,43,44].

Glasgow coma scale: It is Generated Clinical Standards that objectively measure a patient's neurological status based on their Motor Response graded out of 6, Eye Opening graded out of 4, Verbal Response graded out of 5, and total out of 15 [45].

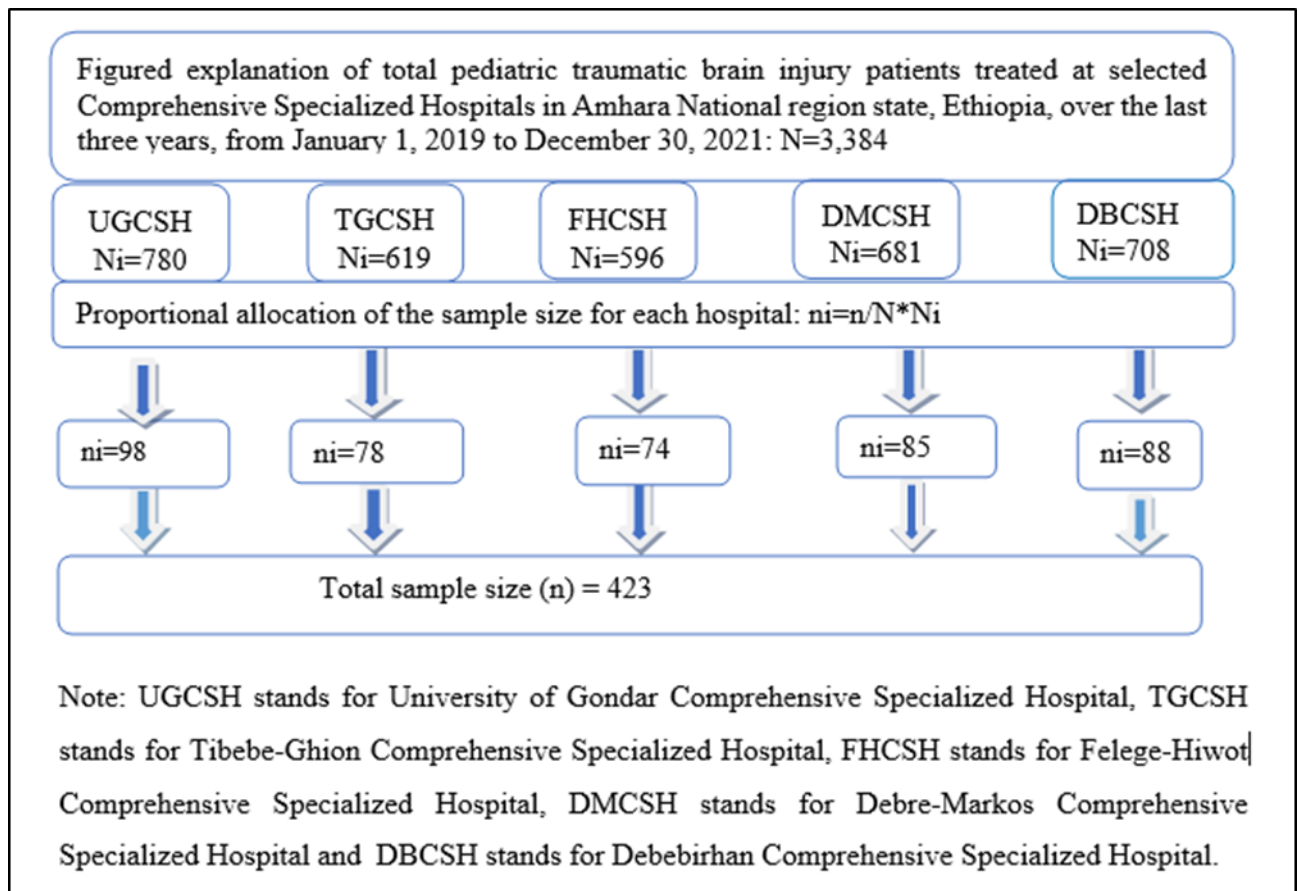
Severity of traumatic brain injury: Mild, moderate, and severe traumatic brain injuries are classified as GCS 13-15, 9-12, and 3-8, respectively [11].

Glasgow outcome scale: is a global scale for measuring functional outcome in patients with traumatic brain injury that rates patient status on a five-point : Dead, vegetative state, severe disability, moderate disability, and good recovery [47,48].

Outcome of TBI : Based on the Glasco outcome scale at the time of discharge, which is unfavorable outcome (GOS 1 - 3) and favorable outcome (GOS 4 and 5) [18,43,44] .

Additional injury: when there is more than one body system involved in the injury [49].

Figure 1. Sampling procedure for the outcome of TBI among pediatrics TBI who vested in Amhara National Regional State CSHs from January 1,2019 to December 30,2021.



Hypothermia and Hyperthermia: by axillary measurement hypothermia < 36.5°C and hyperthermic >37.5°C [50].

Hypoxia: is defined as inadequate oxygen in tissues for normal cell and organ function. It can happen even when circulation is normal not or occurs when SapO2 < 90 %[51].

Hypertension and Hypotension: considered as based on with respective age and sex of pediatrics population ≥95th percentile and below the 5th percentile respectively [52].

Hyperglycemia and Hypoglycemia: consideration of random blood glucose on admission >200mg/dl and <70 mg/dl respectively [40].

*Data collection procedures and Tools*

The outcome and other explanatory data of traumatic brain injury in children were collected by using data extraction tools that were developed after a deep review of different literature [13,16,17,23,28,50,51]. Data were collected from patient charts and medical records of sampled study participants after obtaining MRN from the hospital registration logbooks. Five BSC nurses and two MSC nurse supervisors with prior data collection experience participated in data collection procedures. Five parts of the data extraction check list were used to assess all important variables. These are sociodemographic variables, pattern of injury related variables, clinical and management related variables, time-related variables, and traumatic brain injury outcome variables. Outcome of traumatic brain injury was assessed by Glasgow outcome scale [47,48,57].

#### *Data quality assurance*

To maintain the quality of data, pretest was done on 5% of samples at University of Gondar Comprehensive Specialized Hospital. The pre-test of data extraction tools Cronbach alpha result was 0.75. After the pretest was done ambiguous words and concepts were corrected accordingly. Training was given to data collectors and supervisors regarding to the data collection methods, checklist content, instruction, and includes practical demonstration. During data collection close supervision, and fast feedback was given by both principal investigator and supervisors. Necessary adjustments were done consistently on daily based and before starting data entry the collected data were checked for Inconsistencies, coding errors, completeness, correctness, clarity, missing values thoroughly and data entry was done.

#### *Data processing and analysis*

After the data was collected from patient charts by using a data extraction tools and data quality assurance was assured the data were cleaned, coded and enter to Epi-info version 7 then transfer data to SPSS version of 25, for descriptive and analytic Statistical analysis. Then after the data cleaning, coding and recoding was done and cross-tabulation to assess the distribution of unfavorable and favorable outcomes of TBI in pediatrics and the data was processed by carrying out simple descriptive statistics. For categorical variable frequency with percentage distribution were employed. Box plot graphs were used to check outliers for continuous data, and the variance inflation factor (VIF) was used to determine whether there were any multi-collinear. Association of TBI related variables and demographic characteristics with the outcome of TBI in pediatrics patient at discharge were analyzed by Chi square and Binary logistic regression analysis. model goodness-of-fit was checked by using the Hosmer-Lemeshow tests ( $P= 0.514$ ). Those variables with a  $p$ -value  $< 0.25$  in bi-variable analysis were entered into multi-variable analysis with back ward stepwise method. Then, in multivariable analysis, variables of  $P$ -value  $\leq 0.05$  were declared as significantly associated factors with the outcome of traumatic brain injury in pediatrics. The odds ratio was used to determine the strength of association between dependent and independent variables.

#### *Ethical clearances*

The study was approved by the University of Gondar, College of Medicine and Health Sciences, School of Nursing Ethical and Research Review Committee on behalf of the Institutional Review Board (IRB) with an ethical clearance number S/N/237/2014 was given to the principal investigator to preceding the study implementation. since the study was done by retrospectively chart review without contacting patients the official letters were sent for each respective comprehensive specialized hospitals of Amhara national regional state in which the study was conducted. After supportive letter was obtained from each respective Hospital Medical Director's office data was retrieved from the patient's chart and records. Confidentially of all information were kept and no individual identifiers were collected.

### **Results**

There were 3,384 TBI in pediatrics visited in Amhara National Regional State Comprehensive Specialized Hospitals during the past three years, from January 1, 2019 G.C to December 30, 2021G.C. Data were gathered by using data extraction tools, and 404 charts had complete documentation from 423 randomly selected charts, with a response rate of 95.5 %.

#### *Socio-demographic characteristics of respondent*

The Mean age of study participant was  $9.2 \pm 5.4$  years and the majority of victims were age range of

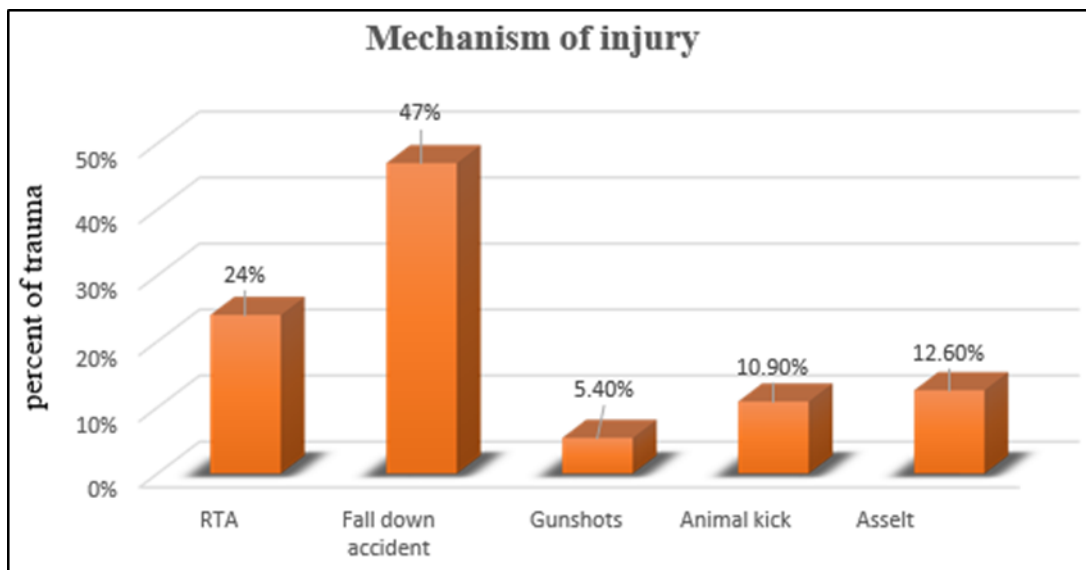


Figure 2. mechanism of injury among pediatrics TBI who visited in Amhara regional state CSHs from January 1,2019 to December 30,2021 GC.

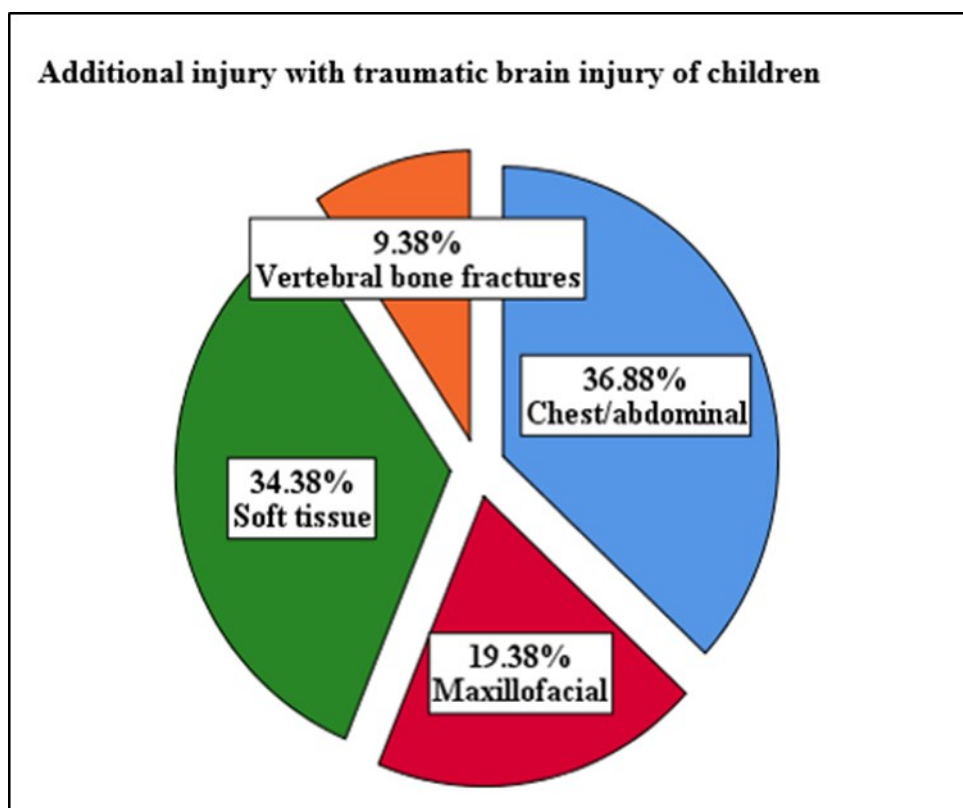


Figure 3. Additional injury among pediatrics TBI patients treated in Amhara National Regional State CSHs from January 1,2019 to December 30,2021.



Table 1. Socio-demographic characteristics of TBI among pediatrics patients in CSHs of Amhara regional state, Ethiopia from January 1,2019 to December 30, 2021G.C(N=404).

Variables	Category	Outcome of TBI in children		Total N (%)
		unfavorable	Favorable	
Age in years	<5	15	112	127(31.4%)
	5-12	18	132	150(37.1%)
	13-18	16	111	127(31.4%)
sex	Male	28	236	264(65.3%)
	Female	21	119	140(34.7%)
Resident	Rural	35	216	251(62.1%)
	Urban	14	139	153(37.9%)
Origin of referral	From health center	15	109	124(30.7%)
	From hospital	16	63	79(19.6%)
	From the scene	17	156	173(42.8%)
	Others	1	27	28(6.9%)
Mode of arrival	Ambulance	30	88	118(29.2%)
	Bajaj	0	102	102(25.2%)
	Taxi	4	107	111(27.5%)
	Other *	15	58	73(18.1%)

Note: Other\* Means mode of arrival by on foot, horse, holding by people

Table 2. Clinical characteristics of TBI among pediatrics traumatic brain injury who vested in Amhara national regional state CSHs from January 1,2019 to December 30, 2021G.C(N=404).

Variable	Category	Outcome of TBI in children		Total N (%)
		unfavorable	Favorable	
GCS score	Mild (13-15)	12	209	221(54.7%)
	Moderate (9-12)	22	125	147(36.4%)
	Sever (3-8)	15	21	36(8.9%)
Blood pressure	Hypertension	9	15	24(5.9%)
	Hypotension	16	13	29(7.2%)
	Normal	12	111	123(30.4%)
	Not investigated	12	216	228(56.4%)
Blood glucose level	<70 mg/dl	10	50	60(14.9%)
	>200 mg/dl	15	47	62(15.3%)
	70-200 mg/dl	17	125	142(35.7%)
	Not investigated	7	133	140(34.7%)
Body To on admission	Hyperthermic	13	69	82(20.3%)
	Hypothermic	15	103	118(29.2%)
	Normothermic	21	183	204(50.5%)
O2 saturation on admission	Hypoxia	24	88	112(27.7%)
	Normal	25	267	292(72.3%)
History of Loss of	Yes	45	140	185(45.8%)
	No	4	215	219(54.2%)
Convulsion at	Yes	7	33	40(9.9%)
	No	42	322	364(90.1%)
Battle sign	Yes	16	13	29(7.2%)
	No	33	342	375(92.8%)
Cerebrospinal fluid leakage	CSF Otorrhea	7	13	20(5%)
	CSF rhinorrhea	3	9	12(3%)
	No CSF leakage	39	333	372(92.1%)
Increased ICP sign	Yes	34	62	96(23.8%)
	No	15	293	308(76.2%)
Types of increased ICP sign	Decreased mentation	22	49	71(74%)
	Hypertension	8	4	12(12.5%)
	Vomiting	3	10	13(13.5%)
Pupillary sign	Bilateral fixed	18	15	33(8.2%)
	Bilaterally dilated	9	7	16(4%)
	Unilaterally fixed	3	15	18(4.5%)
	Midsized and reactive	18	319	337(83.4%)
Comorbidity	Yes	20	53	73(18.1%)
	No	29	302	331(81.9%)
Types of comorbidities	Diabetes mellitus	1	7	8(11%)
	Epilepsy	2	5	7(9.6%)
	Anemia	15	22	37(50.7%)
	Others*	2	19	21(28.8%)

Notes: \*Other means include Seizures, Head ach, and heart diseases

Table 3. Management related characteristics of pediatrics TBI who vested in Amhara National Regional State CSHs from January 1,2019 to December 30, 2021G.C (N=404).

Variables	Category	Outcome of TBI		Total N (%)
		unfavorable	Favorable	
Prehospital care	Yes	15	118	133(32.9%)
	No	34	237	271(67.1%)
Type of Prehospital care	Basic First aid	4	85	89(66.9%)
	Medication	7	24	31(23.3%)
	Resuscitation	4	9	13(9.8%)
Head CT Done	Yes	24	154	178(44.1%)
	No	25	201	226(55.9%)
Ct-scan finding	Contusion/DAI	5	9	14(7.8%)
	Depressed skull #with contusion, DAI+, ICH	7	29	36(20%)
	Intracranial bleeding	7	14	21(11.7%)
	Skull fracture	6	47	53(29.4%)
	Normal finding	1	55	56(31.1%)
Skull X-ray done	Yes	21	182	203(51%)
	No	24	171	195(49%)
Skull X-ray finding	Depressed skull #	9	22	31(15.2%)
	Linear skull fracture	0	42	42(20.6%)
	Normal finding	13	117	130(64.2%)
Use of Inotropic medication	Yes	4	13	17(4.2%)
	No	45	342	387(95.8%)
Management type in hospital	Conservative*	26	316	342(84.7%)
	Surgical	8	25	33(8.2%)
	Both	15	14	29(7.2%)
Surgical intervention	Burr hole	4	3	7(11.3%)
	Craniotomy/evacuation	2	4	6(9.7%)
	Elevation of depressed skull #	10	29	39(62.9%)
	Irrigation &debridement	6	4	10(16.1%)

\*Conservative management includes mannitol, anti-seizure and other medications and # fractures

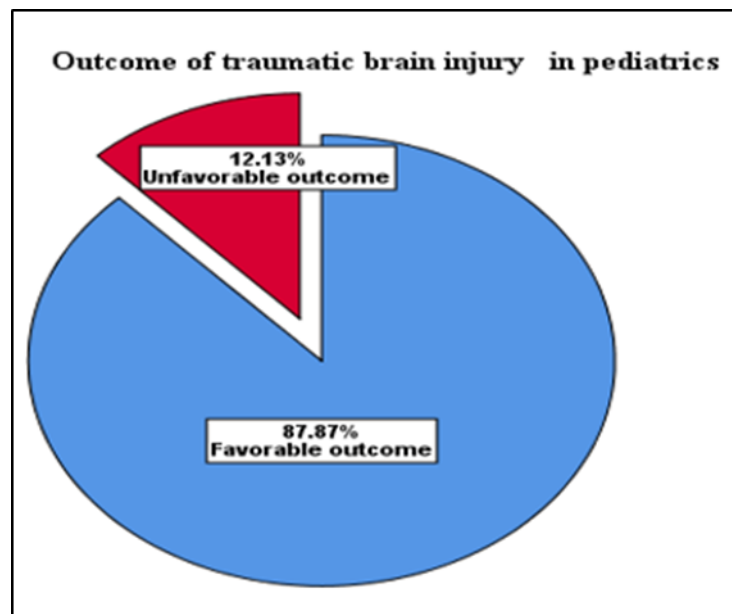


Figure 4. Outcome of TBI among pediatrics patients treated in Compressive Specialized Hospitals of Amhara National Regional State from January 1,2019 to December 30,2021G.C.

5-12 years, 150(37.1%). Male accounts higher proportion of TBI, 264(65.3%) with male to female ratio of 2:1. More than half of TBI cases were come from rural 251(62.1%). The majority of traumatic brain injury case children comes from the scene 173(42.8%) and the commonest way of transportation was ambulance 173 (42.8%). (See Table 1).

#### *Pattern of injury related characteristics of respondent*

In this study, fall down accident was the commonest mechanism of traumatic brain injury in children 190(47%), followed by road traffic accident 97(24%). (See Figure 2)

#### *Additional injury with traumatic brain injury of children*

At the time of admission, 160 (39.5 %) of the total study participants had additional injuries. The most common additional injuries in children with traumatic brain injury were chest/abdominal injuries 59 (36.8%) followed by soft tissue injuries 55(34.38%), maxillofacial injuries 31(19.38%) and vertebral bone fractures 15(9.38%). (See Figure 3)

#### *Clinical characteristics respondent*

From the total study subjects 221(54.7%),147(36.4%) and 36(8.9%) mild, moderate and sever traumatic brain injury respectively. concerning vital sign on admission Body temperature half of the study subjects had normal body temperature 204(50.5%) and more than one-fourth of study subjects had hypoxia on addition ,112(27.7%), nearly half of case 185(45.8%) had history of Loss of consciousness and 40(9.9%) study participant had Convulsion at presentation. (See Table 2).

#### *Management-related factor with outcome of traumatic brain injury*

In this study, out of 404 patients, 133 (32.9%) had pre-hospital care. Of those patients 89(66.9%) received basic first aid after injury were happening, followed by Medication like tetanus anti -toxoid, antipain 31(23.3%). (See Table 3)

#### *Time-related characteristics of traumatic brain injury pediatrics*

The median duration of Prehospital length of stay were 5 hours (IQ, R 2-14). most of case, 156(38.6%)

Table 4. Time-related variables for outcomes of TBI pediatrics who vested in Amhara national regional state CSH from January 1,2019 to December 30, 2021G.C(N=404).

Variables	Category	Outcome of TBI in children		Total N (%)
		Unfavorable	Favorable	
Prehospital length of stay	≤1hours	7	87	94(23.3%)
	2-4hours	15	101	116(28.7%)
	5-24hours	21	135	156(38.6%)
	≥24hours	6	32	38(9.4%)
In hospital length of stay	≤ 1 days	3	118	121(30%)
	2-7 days	32	213	245(60.6%)
	>7 days	14	24	38(9.4%)

Table 5. Bivariable and multivariable logistic regression analysis of factors associated with outcome of TBI pediatrics patients who visited in Amhara national regional state CSHs from January 1, 2019 to December 30, 2021G.C.

Variable	Category	Outcome of TBI		COR (95% CI)	AOR (95%CI)	P-value	
		Unfavorable	Favorable				
Sex	Male	28	236	0.67 (0.36-1.2)	0.81(0.38-1.70)	0.58	
	Female	21	119	1	1		
Residency	Rural	35	216	1.6(0.84-3.09)	1.24(0.57-2.72)	0.589	
	Urban	14	139	1	1		
GCS category	3-8	15	21	12.4(5.1-30.04)	5.11(1.8-14.48)	0.002*	
	9-12	22	125	3.0(1.46-6.40)	2.44(1.07-5.58)	0.033*	
	13-15	12	209	1	1		
Blood glucose Level	<70mg/dl	10	50	1.4(0.63-3.43)	1.94(0.71-5.30)	0.193	
	>200mg/dl	15	47	2.34(1.08-5.07)	3.01(1.12-8.04)		0.028*
	Not.Ix	7	133	0.38(0.15-0.96)	0.58(0.21- 1.5)		0.289
Body temperatures	70-200mg/dl	17	125	1	1	0.43	
	Hyperthermic	13	69	1.64(0.98-4.71)	1.44(0.57-3.64)		0.13
	Hypothermic	15	103	1.26(0.62-2.56)	1.89(0.81-4.38)		
O2 saturation	Normothermic	21	183	1	1	0.99	
	Hypoxia	24	88	2.91(1.58-5.35)	0.99(0.44-2.26)		
	Normal	25	267	1	1		
Sign of ICP	Yes	34	62	10.7(5.5-20.8)	7.4(3.5-15.26)	0.000*	
	No	15	293	1	1		
Medical Comorbidity	Yes	20	53	3.13(0.1.8-5.2)	2.65(1.19-5.91)	0.017*	
	No	29	302	1	1		
Prehospital length of stay	≤1 Hours	7	87	1	1	0.96	
	2-4 Hours	15	101	1.84(.72-4.73)	0.96(0.23-3.96)		
	5-24 Hours	21	135	1.93(0.78-4.74)	1.03(0.29-3.6)		
	>24 Hours	6	32	2.3(0.72-7.45)	1.60(0.47-5.41)		

Abbreviations: COR= crude odds ratio; CI= confidence interval; AOR= adjusted odds ratio; Not.Ix=not investigated and \* shows p value of significantly associated variables.

seek health care service within 5-24 hours, 116(28.7%) of case seek health care within 2-4 hours, 94 (23.3%) case seek health care with in  $\leq 1$  hours and 38(9.4%) of case were come to hospital for health care service with  $\geq 24$  hours. The median in hospital length of stay were 3 days (IQ, R 1-7). majority of the traumatic brain injury pediatrics patients in-hospital length stay were from 2 – 7 days 245(60.6%),  $\leq 1$  days 121(30%) and 38(9.4%) of case stay more than 7 days. (See Table 4).

#### *Outcomes of traumatic brain injury at time of discharge from hospital*

The overall prevalence of unfavorable outcomes of traumatic brain injury among pediatrics patient treated in Amahera National Regional State Compressive Specialized Hospitals were found that 12.13% (95% CI: 9.1% - 15.7 %) as indicated in figure five. Based on the Glasgow Outcome Score, nearly three-four of pediatric patients with traumatic brain injuries had good recovery at the time of discharge 292 (72.3%), followed by moderate disability 63 (19.6%), severe disability 19 (4.7%), persistent vegetative state 6 (1.5%), and death 24(5.9 %) of cases (Figure 4).

#### *Factors associated with outcomes of traumatic brain injury in pediatrics*

In binary logistic regression analysis, the sex of respondent, Residency, severity of traumatic brain injury, Blood glucose Level, Body temperatures, O<sub>2</sub> saturation, Sign of increased ICP, medical Comorbidity and Prehospital length of stay were significantly associated with unfavorable outcome of traumatic brain injury. However, in multivariable logistic regression analysis only Severity TBI, blood glucose level, Sign of increased ICP and medical Comorbidity were significantly associated with outcome of traumatic brain injury patient.

This study shows having sever TBI (GCS 3-8) [AOR: 5.11(CI :1.8-14.48)] and moderate TBI (GCS9-12) [AOR:2.44(CI:1.07-5.58)] were significantly associated with unfavorable outcome. The severity of traumatic brain injury among sever traumatic brain injury were 5.11 times and among moderate TBI 2.44 times higher odds of developing unfavorable outcome as compared to those who had mild traumatic brain injury.

Being Hyperglycemic was 5.84 times more likely to develop unfavorable outcome of TBI than those blood glucoses levels were with in normal range [AOR: 3.01 (CI:1.1-8.04)]. And The odds of unfavorable outcome among those who had sign of increased ICP were 7.4 times higher than those had no sign of increased ICP [AOR:7.4(CI:3.5-15.26)].

The finding of these study shows that the odds of having unfavorable outcome from traumatic brain injury were 2.65 times higher in those having medical comorbidity at presentation than those not having medical comorbidity [AOR: 2.65(CI:1.19-5.91)]. (See Table 5)

### **Discussion**

The aim of this study was to evaluate the outcome of traumatic brain injury and associated factors in pediatric patients seen at Amhara National Regional State Comprehensive Specialized Hospitals in Ethiopia. The overall prevalence of unfavorable outcome of traumatic brain injury among pediatrics patients was found that 12.13 % (95 % CI: 9.1 % - 15.7 % ).This study finding was consistent with study conducted in India 10.7 % (15) and study conducted in Saudi Arabia 14.8% (19) . In contrast, it was higher than study conducted in Netherlands 5% (12) . This difference could be due to variability in socio demographic states, study design and availability of advance equipment like CT-scan and MRI. On the other hand , the current study result was lower than study conducted in Mulago National Referral Hospital in Uganda 21.25% (20). The possible discrepancy may be due to difference in study setting, study design and study period it was conducted in community based and long term follow up

study.

The findings of this study indicated that pediatrics with severe TBI 5.11 times and moderate TBI 2.44 higher risk of unfavorable outcomes than those who had mild traumatic brain injury. This finding were consistent with in study conducted in Germany, Singapore and Togo[11,12,21]. The similarities may be due to increased risk for secondary brain injury in severe and moderate TBI cases , like hypoxia, and elevated intracranial pressures [29,34,35].

This study also revealed that Hyperglycemia in traumatic brain injury pediatrics patients were 3.01 times more likely to develop unfavorable outcome than those with normal range of blood glaucous level , This study finding in line with study conducted in Singapore , Ankara Turkey and Hawassa Ethiopia [10,39,40]. Possibility explanation could be impaired cerebral mitochondrial dysfunction following TBI and acute stress response causes hyperglycemia, which worsens impairments of microcirculatory blood flow, increases blood-brain barrier permeability, promotes inflammation, triggers osmotic diuresis, hypovolemia, and immunosuppression [27,40,58].

The odds of unfavorable outcome among those TBI pediatrics patients who had sign of increased intracranial pressures 7.4 times higher than those who had not increased intracranial pressures signs , This finding is supported by a study done united states of America, Singapore and Hawassa Ethiopia (10,11,38). This may due to the fact that brain tissue itself is swelling from injury that the fluid under pressure tends to deform the brain and pushes tissue results Diffuse cerebral ischemia of the brain (60,61).

This study finding showed that the odds of having unfavorable outcome from TBI pediatrics patients were 2.65 times higher in those having medical comorbidity than those had no medical comorbidity. This finding in line with study conducted in Togo and Singapore [11,21]. The possible explanation of similarity may be due to having comorbid medical illness like anemia, epilepsy and heart failures compromise adequate oxygenated blood supply to the brain [62,63].

#### **Limitation of study**

One of the study's limitations was dealing with insufficient data from the patients' charts. However, data collators received training, and incomplete chart was treated as a non-response and lack of local data for comparison and conclusion.

#### **Conclusion and recommendation**

According to this study, about twelve present of traumatic brain injury of pediatrics patient results unfavorable outcome and the most common predictive factors associated with unfavorable outcome of traumatic brain injury were severity of traumatic brain injury, signs of increased ICP, hyperglycemia and medical comorbidity. This study indicates that need for precaution and appropriate management for moderate and sever form of traumatic brain injury, sign of increased intracranial pressures, hyperglycemia and medical comorbidity. To address possible risk factors including children's educational backgrounds, families, and other variables that are not properly captured from patient charts, it is preferable to conduct prospective studies.

#### **List of Abbreviation/Acronym**

AOR - Adjusted Odds Ratio

CI - Confidence Interval

COD - Crud Odds Ratio

CSH - Comprehensive Specialized Hospital

CSF - Cerebrospinal Fluid

DAI -Diffuse Axonal Injury

GCS - Glasgow Coma Scale

GOS -Glasgow Outcome Scale

ICH -Intracranial hemorrhage

ICP - Intracranial pressure

ICU - Intensive Care Unit

RTA - Road Traffic Accident

TBI -Traumatic brain injury

WHO - World Health Organization

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### **Declarations**

#### **Confidentiality**

To reassure confidentiality, the data on the chart was collected without the names of the patients, and the information which is collected from this research project were keep confidential. In addition, it was not be revealed to anyone except the investigator.

#### **Consent for publication**

Not applicable

#### **Availability of data and material**

The datasets used and/or analyzed during the current study is available upon request from the corresponding author and Co- authors.

#### **Competing interests**

The authors declare that they have no competing interests.

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#### **Author's contribution**

Aytenew Getabalew conceived, designed the study, analyzed the data and prepared the manuscript. Abebaw Alemayehu, Kennean Mekonnen, Bikis Liyew and Belete Melesegn assisted with the design conception, advising and reviewing the manuscript.

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