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Research Article

# Outcomes and Associated Factors of Traumatic Brain Injury Among Adult Patients Treated in Buea Health District (BHD), Cameroon

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## Abstract

Traumatic brain injury (TBI) represents a significant public health challenge in sub-Saharan Africa, with limited data on outcomes in Cameroon. This prospective observational study evaluated outcomes and associated factors of TBI among adult patients treated in Buea Health District (BHD), Cameroon, from January 2020 to December 2025. A total of adult patients diagnosed with TBI were included. Data on socio-demographic characteristics, clinical severity (Glasgow Coma Scale scores), injury mechanisms, treatment pathways, and outcomes were collected using structured questionnaires and medical records. The primary outcome was functional status at discharge assessed using the Glasgow Outcome Scale (GOS), dichotomised into favourable (GOS 4–5) and unfavourable (GOS 1–3) outcomes. Statistical analysis included descriptive statistics, chi-square tests, and bivariable and multivariable logistic regression to identify independent predictors. Results showed that 74% of patients achieved favourable outcomes, with road traffic injuries (60%) being the leading cause, followed by falls (23%) and assaults (10%). Most patients were young adult males (78%), consistent with global patterns. Clinical severity indicators were strongly predictive of outcomes: patients with GCS scores 13–15 had overwhelmingly favourable outcomes (79%), while those with GCS < 8 had predominantly unfavourable outcomes ($\chi^2 = 93.605$, $p < 0.001$). Duration of unconsciousness >24 hours and post-traumatic amnesia were significant negative predictors ($p < 0.001$). Socio-demographic variables showed no significant associations with outcomes. Quality of life assessments revealed 76.5% were discharged successfully, though 23.5% experienced residual complaints, including seizures (10.5%), memory loss (4.5%), and paralysis (2%). These findings highlight that TBI in BHD predominantly affects young adult males through preventable

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mechanisms. Clinical severity remains the most critical outcome predictor, underscoring the need for improved pre-hospital care, timely presentation, and neurosurgical capacity to reduce the burden of TBI in Cameroon.

## Keywords

Traumatic Brain Injury, Glasgow Outcome Scale, Affected Factors, Outcome Predictors, Cameroon

## 1. Introduction

Traumatic brain injury (TBI) represents one of the most significant global public health challenges, affecting an estimated 69 million people annually and serving as the leading cause of trauma-related morbidity and mortality worldwide [1]. TBI accounts for approximately one-third of all trauma-related deaths and is often referred to as the "silent epidemic" due to its substantial contribution to global disability [1]. In 2021, there were 20.8 million new TBI cases globally, with an age-standardized incidence rate of 259 cases per 100,000 population [2]. Despite a notable decrease in age-standardized rates from 1990-2021, the absolute burden continues to increase due to population growth and aging [2].

The epidemiology of TBI varies substantially across geographic and socioeconomic contexts. In sub-Saharan Africa (SSA), the burden is particularly severe, with an estimated 3.2 million people sustaining TBI annually—a number projected to rise dramatically to 14 million by 2050 [3]. This alarming trajectory reflects rapid urbanization, inadequate road safety infrastructure, limited access to healthcare, and increasing rates of interpersonal violence across the region [4]. In SSA, TBI accounts for 30–40% of all trauma cases, with prevalence rates significantly higher than those reported in high-income countries (HICs) [5]. A scoping review of 107 studies from SSA reported that TBI affects all age groups but is most common among young males aged 20–40 years [4].

The demographic profile of TBI patients in Africa consistently shows a predominance of young adult males. In Cameroon, 78% of TBI patients are aged 15–45 years, with males comprising 90% of cases [3]. This gender disparity reflects higher engagement of males in high-risk activities, including road traffic participation, hazardous occupations, and interpersonal violence [4]. In Ethiopia, the male-to-female ratio was approximately 3.5: 1, with 77.9% of patients being male and an average age of 27.5 years [6]. The impact on economically productive populations is substantial, affecting workforce participation and economic development [1].

Road traffic incidents (RTIs) remain the predominant cause of TBI in SSA, accounting for a median of 71 patients per study [4]. In Cameroon, RTIs were responsible for 85% of TBI cases, with motorcyclists representing 27% of patients—a particularly vulnerable occupational group [3]. This contrasts with developed countries where falls are the primary cause of TBI, particularly among older adults [7]. The disparity reflects differences in infrastructure, road safety enforcement, and demographic profiles. In Ethiopia, RTIs represented 35% of TBI cases, while assaults accounted for 36% and falls 21% [6]. The elevated assault rates in Ethiopia reflect socioeconomic inequalities, urbanization, poverty, and inadequate law enforcement resources [4].

TBI severity is typically classified using the Glasgow Coma Scale (GCS), with scores of 3–8 indicating severe TBI, 9–12 moderate TBI, and 13–15 mild TBI [8]. In Ethiopia, mild TBI comprised 57% of cases, moderate TBI 25%, and severe TBI 18% [6]. However, GCS classification can be influenced by factors such as intoxication, sedation, or systemic conditions, necessitating careful interpretation [6]. The distribution in Cameroon was similar, with most patients presenting with mild to moderate severity [3]. A comprehensive systematic review of 80 studies encompassing over 2.3 million patients confirmed that GCS is a cornerstone in initial TBI assessment, with significant correlations between GCS scores and Glasgow Outcome Scale (GOS) outcomes [9, 10].

The mortality rate associated with TBI in SSA is alarmingly high, ranging from 10% to 24% [4]. In Cameroon, mortality was 14% overall and disproportionately high (46%) among patients with severe TBI [3]. This contrasts significantly with earlier estimates from Ethiopia showing 12% overall mortality [4]. The higher death rates in low- and middle-income countries (LMICs) are attributed to limited pre-hospital care, financial constraints, delays in accessing neurotrauma care, and lack of intracranial pressure monitoring [3, 4]. In Cameroon, only 9% of patients were transported by medical means, with 91% using non-medical transportation (taxi, moto taxi, private vehicle) [3]. This contrasts sharply with HICs where emergency medical services are standard.

GCS scores are strongly predictive of TBI outcomes. Lower GCS scores, particularly below 8, correlate with worse outcomes and increased mortality, while higher scores indicate better recovery chances [10]. Lower GCS scores and higher pupillary inequality were associated with increased mortality, whereas improved motor responses and reactive pupils were associated with favourable outcomes [10]. Duration of post-traumatic amnesia (PTA) is the most powerful predictor of function, independent living, and productive activity after TBI [11]. PTA duration independently predicts neuropsychological and global outcome, reinforcing the importance of careful

measurement [12]. Similarly, duration of unconsciousness >24 hours predict poorer outcomes compared to recovery within 24 hours [3].

Associated intracranial injuries significantly contribute to TBI outcomes. In Cameroon, cerebral contusion (54%) and extradural hemorrhage (49%) were the most common types, with skull fractures seen in 30% of cases [3]. In Ethiopia, skull fractures were reported at 29%, followed by epidural hematoma (EDH) at 18% and brain contusion at 16% [6]. Death during hospitalisation was more frequent in patients with subdural hematoma (45%) compared to EDH (10.71%), highlighting the prognostic significance of hematoma type [13]. In SSA, 31% of patients required surgical intervention, with significant regional variation reflecting disparities in access to surgical care [4].

Outcomes after TBI are typically assessed using the Glasgow Outcome Scale (GOS) or Glasgow Outcome Scale-Extended (GOSE). In Cameroon, 75% of surviving patients had favourable outcomes (GOSE 5–8) at 6 months, while 25% had unfavourable outcomes (GOSE 1–4) [3]. Another study found that 72% of long-term TBI survivors had favourable functional outcomes at 15 years, with 79% achieving GOS 5 (good recovery) and 18% GOS 4 (moderate disability) [14]. However, binary outcome prediction models limit the possibility of detecting subtle yet significant improvements [15]. Younger age was consistently associated with favourable outcomes across multiple studies [4].

Quality of life after TBI is strongly linked to functional outcome. In Cameroon, the median quality of life score was assessed using the Quality of Life after Brain Injury (QoLIBRI) questionnaire, with 28% of patients impaired at 6 months and 36% achieving above-average scores [3]. A prospective, longitudinal 15-year study reported a median quality of life score of 0.88 (on a scale from negative numbers to maximum 1) among long-term survivors [14]. Discharged against medical advice (DAMA) patients had a significantly poorer quality of life (39% impaired vs. 22% for regularly discharged; $p = 0.019$) [3]. In Cameroon, 33% of patients were discharged DAMA due to financial constraints—a rate much higher than the 1.8–2.8% reported in HICs [3]. Only 3% of patients received post-injury physical therapy services, highlighting the lack of rehabilitation infrastructure [3].

Financial constraints represent a major barrier to TBI care in LMICs. In Cameroon, 93% of patients who did not receive CT scans cited financial constraints, with costs at 75,000 FCFA ($122 USD) being prohibitive [3]. This contrasts starkly with HICs where advanced imaging is readily available. An analysis of emergency care delays in Tanzania found that 31.9% of patients experienced delays of 1.1–4.0 hours from injury to hospital arrival, with delays significantly associated with poor in-hospital outcomes [16]. Delays beyond 4 hours are associated with worsening neurological outcomes and increased mortality [17].

Complications after TBI occur in approximately 17% of cases in SSA, including post-traumatic seizures, aspiration pneumonia, and wound infections [6]. This rate is consistent with findings from other LMICs (15–20%) but higher than HICs (10–15%), attributed to limited access to intensive monitoring and specialised medical care [4]. Neuropsychological rehabilitation can facilitate gains in independent functioning, yet access to rehabilitation is severely limited in many LMICs [11].

Despite the significant burden, comprehensive data on TBI in SSA, including Cameroon, remain scarce, hindering evidence-based interventions and policies [4]. Previous Cameroonian studies were retrospective, making outcome evaluations inappropriate for patient characteristics and medium-term outcomes [3]. This study aims to address these gaps by evaluating outcomes and associated factors of TBI among adult patients treated in Buea Health District, Cameroon, providing crucial data for targeted prevention strategies and healthcare improvements.

## 2. Material and Methods

### 2.1. Study Design and Setting

This prospective observational study was conducted in Buea Health District (BHD), South West Region, Cameroon, from January 2020 to December 2025. BHD serves an estimated population of 500,000 people and includes multiple district hospitals, regional hospitals, private healthcare facilities, and integrated health centres. The study followed STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for observational research.

### 2.2. Study Population

The study included all adult patients (≥18 years) diagnosed with traumatic brain injury who presented to healthcare facilities within BHD within 24 hours of injury. TBI was defined as trauma-induced alteration in brain function or pathology, confirmed by clinical assessment and/or neuroimaging. Exclusion criteria included: (1) patients with pre-existing neuropsychiatric disorders that could confound outcome assessment; (2) individuals who arrived at healthcare facilities >24 hours post-injury; (3) patients who could not be contacted for follow-up evaluation; and (4) those who refused informed consent or whose family members declined participation on their behalf.

### 2.3. Data Collection

Data were collected using a structured questionnaire based on the NIH-NINDS Common Data Elements for TBI. Trained research nurses and medical officers collected data at admission and during hospitalization. Baseline data included sociodemographic characteristics (age, sex, education level, marital status, profession, residence), clinical details (GCS score, pu-

pil reactivity, vital signs, loss of consciousness duration), injury characteristics (mechanism of injury, time from injury to presentation, first responder type), pre-hospital factors (transport method, first aid/CPR received, immobilization during transfer), neuroimaging findings (CT scan results if available), associated injuries (brain swelling/contusion, hematoma type, skull fractures), and treatment details (level of first contact facility, surgical intervention).

GCS was classified as severe (3–8), moderate (9–12), and mild (13–15) based on admission scores. Time to treatment was categorized as ≤1 hour, 1–4 hours, 4–8 hours, and >8 hours. Post-traumatic amnesia was recorded as present or absent. Duration of unconsciousness was categorized as <24 hours or ≥24 hours.

### 2.4. Outcome Measures

The primary outcome was functional status at discharge assessed using the Glasgow Outcome Scale (GOS), as described by G/Michael *et al.* [9]. The GOS is a multidimensional tool for assessing patient outcomes following neurological events, as described by G/Michael *et al.* [9]. It categorizes recovery into five levels, from death to good recovery, which can be further grouped into unfavourable (GOS 1–3) and favourable (GOS 4–5) outcomes. Table 1 presents the operational definitions of these categories for clarity in this study.

### 2.5. Data Processing and Analysis

Data were exported to Minitab version 22 for analysis. Cross-tabulation assessed the distribution of favourable and unfavourable outcomes. Simple descriptive statistics and chi-square ($\chi^2$) tests were performed. Frequencies with percentages summarized categorical variables. Variables independently associated with traumatic brain injury (TBI) outcomes were identified using adjusted odds ratios (AORs), with 95% confidence intervals (CIs); statistical significance was set at $p < 0.05$. Results are presented in text, tables, and charts.

***Table 1.*** *GOS Categories [9].*

| GOS Category | Outcome | Description |
|---|---|---|
| 1: Death | Unfavourable | Patients were certified for death. |
| 2: Coma | Unfavourable | The patient exhibited no obvious cortical function. |
| 3: Severe disability | Unfavourable | Patients were conscious but disabled; they could not perform any activity independently. |
| 4: Moderate disability | Favourable | Patients were disabled but independent in daily life; disabilities included varying degrees of dysphasia and hemiparesis. |
| 5: Good recovery | Favourable | Resumption of normal activities, even though there may be minor neurological or psychological deficits. |

## 3. Results

### 3.1. Socio-demographic Characteristics of Outcomes Among Adult Patients Treated for TBI in BHD, Cameroon

Favourable outcomes were more common across all age groups, with the highest proportion among those aged 18–24 years (29.5%); unfavourable outcomes were evenly distributed and showed no significant association ($\chi^2 = 2.957$, $p = 0.565$; Table 2). Males comprised the majority of favourable outcomes (70.5%), but sex differences were not significant ($\chi^2 = 2.475$, $p = 0.116$). Patients with secondary education had the largest share of favourable outcomes (39%), followed by primary (28.5%) and tertiary (21%) education, without significant differences ($\chi^2 = 1.372$, $p = 0.504$). Single patients had slightly more favourable outcomes (49.5%) than married patients (39%), but this was not significant ($\chi^2 = 0.54$, $p = 0.462$; Table 2).

***Table 2.*** *Socio-demographic characteristics of favourable and unfavourable outcomes among adult patients with traumatic brain injury treated in Buea Health District, Cameroon (n=200).*

| Variables | Category | Favourable N (%) | Unfavourable N (%) | Total N (%) | $\chi^2$ | p-value |
|---|---|---|---|---|---|---|
| Age | 18-24 | 59 (29.50) | 8 (4.00) | 67 (33.50) | 2.957 | 0.565 |

| Variables | Category | Favourable N (%) | Unfavourable N (%) | Total N (%) | $\chi^2$ | p-value |
|---|---|---|---|---|---|---|
| | 25-34 | 41 (20.50) | 3 (1.50) | 44 (22.00) | | |
| | 35-44 | 26 (13.00) | 2 (1.00) | 28 (14.00) | | |
| | 45-54 | 24 (12.00) | 5 (2.50) | 29 (14.50) | | |
| | >55 | 27 (13.50) | 5 (2.50) | 32 (16.00) | | |
| Sex | Male | 141 (70.5) | 15 (7.5) | 156 (78.00) | 2.475 | 0.116 |
| | Female | 36 (18.00) | 8 (4.00) | 44 (22.00) | | |
| | Primary | 57 (28.5) | 8 (4.00) | 65 (32.50) | | |
| Educational level | Secondary | 78 (39.00) | 12 (6.00) | 90 (45.00) | 1.372 | 0.504 |
| | Tertiary | 42 (21.00) | 3 (1.50) | 45 (22.50) | | |
| Marital Status | Married | 78 (39.00) | 12 (6.00) | 90 (45.00) | 0.54 | 0.462 |
| | Single | 99 (49.50) | 11 (5.50) | 110 (55.00) | | |

## 3.2. Patient Condition on Admission and Treatment-Related Factors on Outcomes Among Adult Patients with TBI in BHD

Road traffic injuries (RTIs) were the leading trauma cause (60%), followed by falls (23%) and assaults (10%; Table 3). Although RTIs contributed to both outcome types, the association between mechanism of injury and prognosis was marginally non-significant ($\chi^2 = 7.653$, $p = 0.054$). First responders were mostly pedestrians (49.5%) and family members (27.5%), but this did not significantly influence outcomes. Similarly, first aid or CPR (6%) and immobilization during transfer (7.5%) were rare and showed no significant effect on recovery, indicating limited pre-hospital interventions (Table 3).

Most patients first contacted regional hospitals (43.5%) or private hospitals (32.5%), with fewer at district hospitals (20%) or integrated health centres (4%; Table 2). However, first contact level was not significantly associated with outcomes ($\chi^2 = 5.707$, $p = 0.734$). Over half (55%) received treatment at first contact, but this had no significant effect ($\chi^2 = 0.54$, $p = 0.462$). Time from injury to treatment was often delayed (58.5% after 8 hours vs. 41.5% within 1 hour), yet not statistically significant ($\chi^2 = 1.311$, $p = 0.252$; Table 3).

Neurological indicators strongly predicted outcomes. Patients with Glasgow Coma Scale (GCS) scores of 13–15 had predominantly favourable outcomes (79%), whereas those with GCS <8 had mostly unfavourable outcomes ($\chi^2 = 93.605$, $p < 0.001$; Table 3). Duration of unconsciousness >24 hours was linked to poorer outcomes ($\chi^2 = 55.046$, $p < 0.001$), as was post-traumatic amnesia (47% unfavourable; $\chi^2 = 23.082$, $p < 0.001$). Common associated injuries included brain swelling/contusion (37.5%), subdural hematoma (32.5%), and extradural hematoma (16.3%), which contributed to poor outcomes despite lacking statistical significance (Table 3).

***Table 3.*** *Patient's condition on the admission and treatment-related factors of favourable and unfavourable outcomes among adult patients with traumatic brain injury treated in Buea Health District, Cameroon 2020 - 2025 (n=200).*

| Variables | Category | Favourable outcome N (%) | Unfavourable outcome N (%) | Total N (%) | $\chi^2$ | p-value |
|---|---|---|---|---|---|---|
| | Assaults | 19 (9.50) | 1 (0.50) | 20 (10.00) | | |
| | Fall | 36 (18.00) | 10 (5.00) | 46 (23.00) | | |
| Mechanism of injury | RTI | 108 (54.00) | 12 (6.00) | 120 (60.00) | 7.653 | 0.054 |
| | Others | 14 (7.00) | 0 (0.00) | 14 (7.00) | | |
| | Community people | 13 (6.50) | 3 (1.50) | 16 (8.00) | | |
| First responder | Family | 49 (24.50) | 6 (3.00) | 55 (27.50) | 1.571 | 0.666 |
| | Friends/ Colleagues | 28 (14.00) | 2 (1.00) | 30 (15.00) | | |

| Variables | Category | Favourable outcome N (%) | Unfavourable outcome N (%) | Total N (%) | $\chi^2$ | p-value |
|---|---|---|---|---|---|---|
| Received first aid or CPR | Pedestrians | 87 (43.50) | 12 (6.00) | 99 (49.5) | 0.126 | 0.723 |
| | No | 166 (83.00) | 22 (11.00) | 188 (94.00) | | |
| | Yes | 11 (5.500) | 1 (0.50) | 12 (6.00) | | |
| Immobilized/ transfer | No | 164 (82.00) | 21 (10.50) | 185 (92.50) | 0.054 | 0.817 |
| | Yes | 13 (6.50) | 2 (1.00) | 15 (7.50) | | |
| First level of contact for txt | DH | 34 (17.00) | 6 (3.00) | 40 (20.00) | 5.707 | 0.734 |
| | IHC | 6 (3.00) | 2 (1.00) | 8 (4.00) | | |
| | PH | 55 (27.50) | 10 (5.00) | 65 (32.50) | | |
| | RH | 82 (41.00) | 5 (2.50) | 87 (43.50) | | |
| Received txt/ 1 level | No | 78 (39.00) | 12 (6.00) | 90 (45.00) | 0.54 | 0.462 |
| | Yes | 99 (49.50) | 11 (5.50) | 110 (55.00) | | |
| Time/injury-txt | <1 hour | 76 (38.00) | 7 (3.50) | 83 (41.50) | 1.311 | 0.252 |
| | >8 hours | 101 (50.50) | 16 (8.00) | 117 (58.50) | | |
| GCS | <8 | 5 (2.50) | 14 (7.00) | 19 (9.50) | 93.605 | 0.000 |
| | 13-15 | 158 (79.00) | 3 (1.50) | 161 (80.50) | | |
| | 9-12 | 14 (7.00) | 6 (3.00) | 20 (10.00) | | |
| Duration consciousness (h) | <24 | 19 (9.50) | 17 (8.50) | 36 (18.00) | 55.046 | 0.000 |
| | >24 | 158 (79.00) | 6 (3.00) | 164 (82.00) | | |
| PT-amnesia | No | 168 (84.00) | 15 (7.50) | 183 (91.50) | 23.082 | 0.000 |
| | Yes | 9 (4.50) | 8 (4.00) | 17 (8.50) | | |
| Associated injury | Brain swollen/ contusion | 4 (2.00) | 71 (35.50) | 75 (37.50) | 6.45 | 0.168 |
| | BSF | 2 (1.00) | 13 (6.50) | 15 (7.50) | | |
| | EDH | 3 (1.50) | 30 (15.00) | 33 (16.30) | | |
| | Other skull fracture | 2 (1.00) | 10 (5.00) | 12 (6.00) | | |
| | SDH | 12 (6.00) | 53 (26.50) | 65 (32.50) | | |

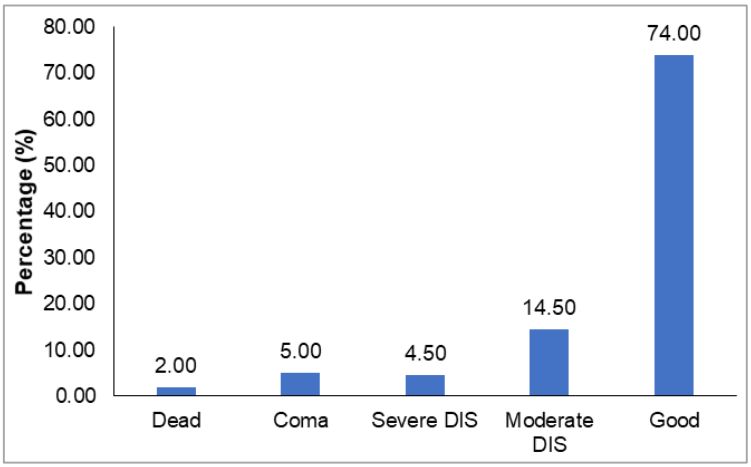


***Figure 1.*** *Outcome of Traumatic brain injury among patients treated in Buea district hospitals 2020-2025.*

Between 2020 and 2025, traumatic brain injury outcomes among patients treated in Buea district hospitals showed that most recovered well, with 74% achieving a "good" outcome (i.e., functional independence or minimal disability; Figure 1). However, 14.5% experienced moderate disability and 4.5% severe disability, highlighting the need for stronger rehabilitation and support systems (Figure 1). Less frequent but critical outcomes included coma (5%) and death (2%; Figure 1).

### 3.3. Bivariable and Multivariable Regression Results for Significant Variables Among Adult Patients Treated for TBI in BDH

Most sociodemographic variables (age, sex, education, marital status) showed no statistically significant associations with outcomes ($p > 0.05$; 95% CIs crossed 1; Table 4). Among mechanisms of injury, falls were the sole exception, significantly increasing the odds of unfavourable outcomes (AOR = 0.2174, 95% CI: 0.0271–0.4076, $p = 0.025$). Factors such as first responder type, first aid/CPR, immobilization, and time to treatment also lacked independent predictive effects.

Clinical severity indicators were strongly predictive. Higher Glasgow Coma Scale (GCS) scores (13–15 and 9–12) were associated with significantly better outcomes than GCS <8 ($p < 0.001$). Shorter unconsciousness duration (<24 hours) predicted favourable outcomes, whereas prolonged unconsciousness (>24 hours) predicted worse outcomes ($p < 0.001$). Post-traumatic amnesia was a significant negative predictor (AOR = 0.3886, 95% CI: 0.2378–0.5394, $p < 0.001$). Associated injuries (brain swelling, skull fractures, epidural hematoma [EDH], subdural hematoma [SDH]) did not reach significance (Table 4).

***Table 4.*** *Bivariable and multivariable logistic regression analysis result for significant variables among adult patients treated for traumatic brain injury attending Buea health district, Cameroon 2020 -2025 (n = 200).*

| Variables | Category | Outcome | | p-value |
|---|---|---|---|---|
| | | AOR | 95% CI | |
| Age | 18-24 | 0.0368 | (-0.0991, 0.1728) | 0.593 |
| | 25-34 | 0.0881 | (-0.0589, 0.2350) | 0.239 |
| | 35-44 | 0.0848 | (-0.0788, 0.2485) | 0.308 |
| | 45-54 | -0.0162 | (-0.1783, 0.1460) | 0.844 |
| | >55 | Ref | | Ref |
| Sex | Female | Ref | | Ref |
| | Male | 0.0857 | (-0.0216, 0.1929) | 0.117 |
| Educational level | Primary | | | |
| | Secondary | -0.0103 | (-0.1131, 0.0926) | 0.844 |
| | Tertiary | 0.0564 | (-0.0661, 0.1789) | 0.365 |
| Status | Married | Ref | | Ref |
| | Single | 0.0333 | (-0.0564, 0.1231) | 0.465 |
| Mechanism of injury | Others | Ref | | Ref |
| | Assaults | -0.05 | (-0.267, 0.167) | 0.65 |
| | Fall | -0.2174 | (-0.4076, -0.0271) | 0.025 |
| | RTI | -0.1 | (-0.2760, 0.0760) | 0.264 |
| First responder | Community people | Ref | | Ref |
| | Family | 0.0784 | (-0.1014, 0.2582) | 0.391 |
| | Friends/ Colleagues | 0.1208 | (-0.0751, 0.3168) | 0.225 |
| | Pedestrians | 0.0663 | (-0.1043, 0.2369) | 0.444 |
| Received first aid or CPR | No | Ref | | Ref |

| Variables | Category | Outcome | | p-value |
|---|---|---|---|---|
| | | AOR | 95% CI | |
| Immobilized/Transfer | Yes | 0.0337 | (-0.1545, 0.2219) | 0.724 |
| | No | Ref | | Ref |
| First Level of Contact for TXT | Yes | -0.0198 | (-0.1895, 0.1499) | 0.818 |
| | DH | Ref | | |
| | IHC | -0.1 | (-0.343, 0.143) | 0.417 |
| | PH | -0.0038 | (-0.1297, 0.1220) | 0.952 |
| | RH | 0.0925 | (-0.0271, 0.2122) | 0.129 |
| Received TXT/1 Level | No | Ref | | Ref |
| | Yes | 0.0333 | (-0.0564, 0.1231) | 0.465 |
| Time/Injury-TXT | <1 hour | Ref | | Ref |
| | >8 hours | -0.0524 | (-0.1429, 0.0380) | 0.254 |
| GCS | <8 | | | |
| | 13-15 | 0.7182 | (0.6061, 0.8304) | 0.000 |
| | 9-12 | 0.4368 | (0.2887, 0.5850) | 0.000 |
| Duration/Consciousness/ Hrs | <24 hours | Ref | | Ref |
| | >24 hours | 0.4356 | (0.3366, 0.5347) | 0.000 |
| PT-Amnesia | No | Ref | | Ref |
| | Yes | -0.3886 | (-0.5394, -0.2378) | 0.000 |
| Associated injury | Other skull fracture | Ref | | Ref |
| | Brain swollen/ contusion | 0.1133 | -0.0816, 0.3082 | 0.253 |
| | BSF | 0.033 | -0.209, 0.276 | 0.787 |
| | EDH | 0.076 | -0.136, 0.287 | 0.48 |
| | SDH | -0.0179 | -0.2149, 0.1790 | 0.858 |

DH = District hospital, IHC =Integrated Health Center, PH = Private Hospital, RH = Regional Hospital, EDH= Epidural hematoma, SDH = Subdural hematoma

### 3.4. Quality of Life After Management for Traumatic Brain Injury Among Adult Patients Treated in Buea District Hospitals

Between 2020 and 2025, quality of life after surgery for traumatic brain injury patients in Buea district hospitals showed encouraging recovery (Figure 2). Most reported no problems in mobility (72.5%), self-care (71.5%), and usual activities (70.5%), reflecting strong functional independence. However, 16–19% experienced some limitations, and 10–11.5% faced extreme difficulties, indicating persistent impairments. Pain outcomes were largely positive: 78% were pain-free, and only 3% reported extreme pain. Anxiety was well managed, with 85% unaffected and 6.5% severely affected.

Residual complaints after discharge occurred in 23.5% of patients, though 76.5% were discharged successfully (Figure 3). The most common lingering issues were seizure or agitation (10.5%), followed by memory loss or persistent headaches (4.5%). Less frequent but serious complications included urinary incontinence or paralysis (2%) and mortality (6.5%).

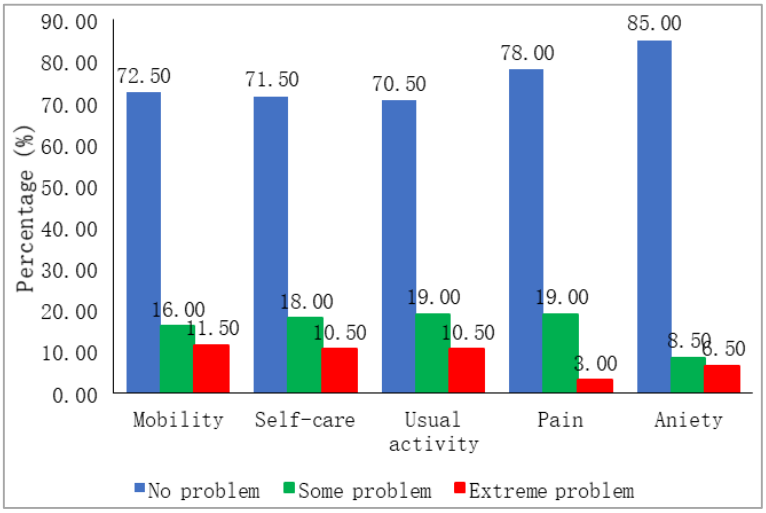


***Figure 2.*** *Quality of live after management of Traumatic brain injury among adult patients treated in Buea district hospitals 2020-2025.*

Between 2020 and 2025, patients treated for traumatic brain injury in Buea district hospitals experienced various residual complaints after surgery, though most were discharged successfully (76.5%; Figure 3). The most common lingering issue was seizure or agitation (10.5%), followed by memory loss or persistent headaches (4.5%). Less frequent but notable complications included urinary incontinence or paralysis (2%) and mortality (6.5%; Figure 3).

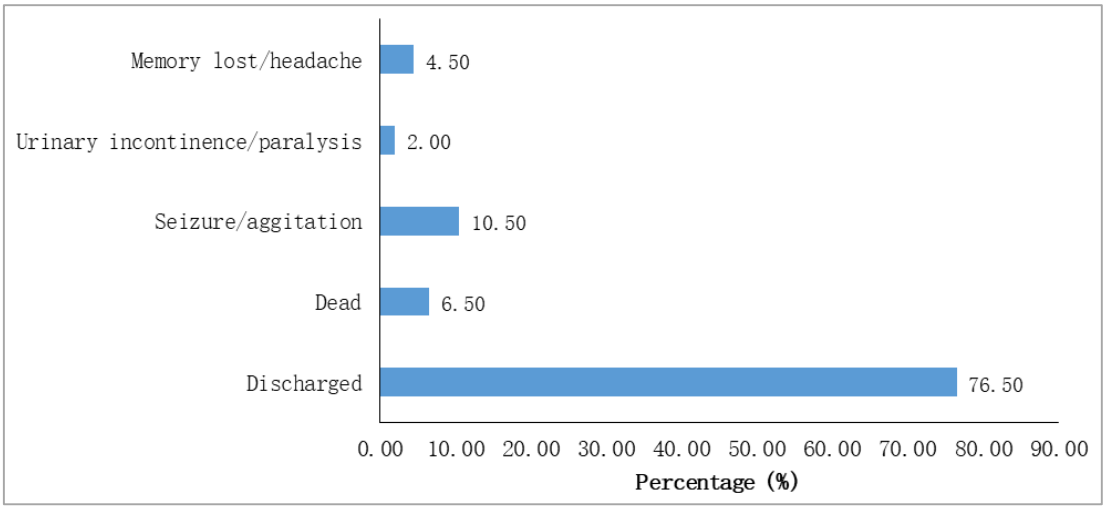


***Figure 3.*** *Other residual complains after management of Traumatic brain injury among adult patients treated in Buea district hospitals 2020-2025.*

## 4. Discussion

The lack of significant associations between socio-demographic variables and patient outcomes in Buea Health District reflects patterns observed in trauma research across Cameroon, where clinical severity and injury mechanism outweigh demographic influences. This aligns with the findings of Buh *et al.* [18] who carried out a multi-center study on traumatic brain injury in Cameroon found that while young adults (median age 30) and males (80%) were disproportionately affected, outcomes were primarily determined by injury severity and access to care, not demographic status. The relatively high proportion of favourable outcomes among younger patients (18–24 years, 29.5%) may be explained by better physiological resilience and recovery capacity in younger age groups, as younger adults demonstrate stronger neuroplasticity, faster tissue repair, and more robust immune responses compared to older populations. This aligns with the findings of Arora *et al.* [19] who studies on transitional-aged youth confirm that resilience, both intrinsic and extrinsic, is a measurable quality that enhances recovery following trauma. Similarly, Singh &

Mukherjee [20] showed that emerging adults possess resilience mechanisms that buffer the effects of trauma and improve mental health outcomes, underscoring the biological and psychosocial advantages of youth in recovery. Male predominance in favourable outcomes (70.5%) likely reflects greater exposure to trauma among men, especially road traffic injuries (RTIs), rather than inherent biological differences, as outcome disparities were not statistically significant. This pattern is consistent with Cameroonian trauma studies showing that men are disproportionately represented in RTI cases due to occupational exposure, mobility, and risk-taking behaviours. Ngu *et al.* [21] reported that 69.6% of RTI patients in Fako Division hospitals were male, with the highest burden among those aged 26–35 years, emphasizing exposure rather than sex-based recovery differences. Similarly, Buh *et al.* [18] found that 80% of traumatic brain injury cases across multiple Cameroonian hospitals involved men, but outcomes were primarily determined by injury severity and access to care, not sex.

RTIs accounted for the majority of trauma cases (60%), consistent with national data showing that RTIs represent nearly 70% of injuries in Cameroon's trauma registry [22]. However, the marginal non-significance of their association with prognosis suggests that while RTIs are frequent, outcomes depend more on injury severity than mechanism alone. This was also similar with the findings of G/Michael *et al.* [9] who reported that road traffic accidents emerged as the leading cause of traumatic brain injury among adults, accounting for 181 cases (37.5%), followed by assaults with 117 cases (24.2%) in Amhara regional state comprehensive specialized hospitals Ethiopia. The limited impact of first responders and prehospital interventions is explained by the near absence of structured emergency systems. This was also reported in Cameroon Trauma Registry analysis by Ngekeng *et al.* [22] who reported that only 4.9% of patients received any form of scene care, despite global evidence that basic first aid significantly reduces mortality. Similar findings have been reported in broader African trauma research: Kobusingye *et al.* [23] emphasized the absence of organized emergency medical services in low-income countries, noting that community-based first responder training could substantially reduce preventable deaths. Likewise, Mock *et al.* [24] demonstrated that simple interventions like haemorrhage control and airway management are among the most cost-effective strategies for improving trauma outcomes in resource-limited settings.

Neurological indicators were decisive: patients with Glasgow Coma Scale (GCS) had 79% favourable outcomes, while those with GCS <8 had overwhelmingly poor prognosis. This finding is consistent with that of Chou *et al.* [25] who confirms that GCS 13–15 defines mild traumatic brain injury with good recovery, whereas GCS <8 indicates severe injury with high mortality and disability. Prolonged unconsciousness (>24 hours) and post-traumatic amnesia are consistently identified as strong predictors of poor outcomes in traumatic brain injury (TBI), emphasizing the prognostic importance of cognitive and consciousness markers. Maas *et al.* [26] reported that duration of unconsciousness and amnesia are among the most reliable indicators of long-term disability. Secondary injuries such as cerebral edema, subdural hematomas, and extradural hematomas are widely recognized in neurotrauma research as factors that worsen prognosis, primarily because they raise intracranial pressure and heighten the likelihood of additional brain damage [27]. Buh *et al.* [18] show non-significant associations due to sample size limitations, the broader neurotrauma literature affirms their clinical relevance.

The outcomes of traumatic brain injury (TBI) among patients treated in Buea district hospitals, achieved good recovery. Aligns with the findings of Nkouonlack *et al.* [28] who observed that in Buea and Limbe hospitals, 69% of patients had mild TBI, with advanced age and prolonged loss of consciousness strongly predicting poor outcomes, while the case fatality rate was 3.3%. Similarly, Buh *et al.* [18] reported that across multiple Cameroonian trauma centers, mortality reached 10.3% overall, disproportionately affecting severe TBI patients (55%), underscoring disparities in care provision due to financial and infrastructural constraints.

The findings indicate that sociodemographic factors such as age, sex, education, and marital status were not significantly associated with outcomes. This is consistent the findings of Buh *et al.* [18] who reported that demographic variables often play a limited role in predicting recovery after traumatic brain injury (TBI). Falls emerged as the only mechanism of injury significantly linked to poorer outcomes. The significant association of falls with poorer outcomes may reflect the higher risk of diffuse brain injury and comorbidities in older populations. This is consistent with findings of Majdan *et al.* [29] who reported that fall-related TBIs often result in worse recovery trajectories compared to road traffic injuries. Similarly, Rafiee *et al.* [30] reported that falls are linked to worse functional recovery compared to road traffic accidents, particularly in older adults. By contrast, clinical severity markers were strongly predictive: higher Glasgow Coma Scale (GCS) scores, shorter duration of unconsciousness, and absence of post-traumatic amnesia were robustly associated with favorable outcomes. This is algins with the findings of Rafiee *et al.* [30] found that GCS score at admission was the most reliable predictor of outcome, with higher scores strongly linked to favorable recovery. Buh *et al.* [3] emphasize neurological status as the most reliable prognostic indicator in TBI. Similarly, Eghzawi *et al.* [31] emphasized that mortality and disability in mild-to-moderate TBI are best explained by neurological status (GCS, pupillary reactivity, intracranial haemorrhage) rather than sociodemographic background. Regarding prehospital factors (first responder type, CPR, immobilization, time to treatment), the absence of significant effects in this dataset may reflect systemic gaps in emergency response capacity. In low-resource settings, prehospital interventions are often inconsistent or delayed, limiting their measurable impact on outcomes. Nkouonlack *et al.* [28] reported a retrospective data from Buea and Limbe hospitals that highlighted the limited

impact of prehospital interventions in contexts with weak emergency systems. similar context was highlighted by Rafiee *et al.* [30] who reported that prehospital care quality is crucial but often underdeveloped, which explains the lack of statistical significance despite theoretical importance. The associated injuries (brain swelling, skull fractures, EDH, SDH) did not reach statistical significance. This may be due to sample size limitations or overlapping effects with primary severity indicators. However, Schüller *et al.* [32] reported that injuries complicate management, they are not always independent predictors once GCS and PTA are considered.

Between 2020 and 2025, the encouraging recovery trends among traumatic brain injury (TBI) patients in Buea district hospitals—such as high independence in mobility, self-care, and daily activities—likely reflect improvements in surgical care, early intervention, and structured rehabilitation, consistent with global evidence that timely neurosurgical management and multidisciplinary follow-up reduce disability rates [33, 34]. However, the persistence of residual complaints like seizures, agitation, and memory loss indicates the limitations of relying solely on functional independence scores, as subtle neurocognitive deficits and post-traumatic epilepsy remain common sequelae [35, 36]. The relatively low rates of extreme pain and anxiety suggest effective perioperative pain control and psychosocial support, yet the 6.5% mortality and 2% paralysis highlight systemic gaps in prehospital triage and long-term rehabilitation access, which are reported by Rickels [37] and Schüller *et al.* [32]. The Glasgow Coma Scale (GCS) remains a cornerstone for outcome prediction, its limitations—such as misclassification of "talk and die" patients—necessitate complementary assessments like pupillary reactivity and motor response to better anticipate complications and guide care pathways [38, 39].

## 5. Conclusions

Pre-hospital factors and mechanisms of injury were not strong predictors of recovery, whereas clinical severity markers proved decisive. Indicators such as Glasgow Coma Scale scores, length of unconsciousness, and post-traumatic amnesia consistently determined patient prognosis, with intracranial complications contributing to poorer outcomes even without statistical significance. Overall, most patients regained independence and functional recovery, though a meaningful proportion continued to face disability, residual symptoms, or death. These findings highlight the need to reinforce rehabilitation services and emphasize early neurological evaluation as central to improving traumatic brain injury outcomes in the Buea Health District.

## Abbreviations

| | |
|---|---|
| GOS | Glasgow Outcome Scale |
| LMICs | Low- and Middle-income Countries |
| SSA | Sub-Saharan Africa |
| TBI | Traumatic Brain Injury |
| HICs | High-income Countries |
| RTIs | Road Traffic Incidents |
| PTA | Post-traumatic Amnesia |
| EDH | Epidural Hematoma |
| GOSE | Glasgow Outcome Scale-Extended |
| QoLIBRI | Quality of Life After Brain Injury |
| BHD | Buea Health District |
| STROBE | Strengthening the Reporting of Observational Studies in Epidemiology |
| DAMA | Discharged Against Medical Advice |

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## Conflicts of Interest

The authors declare no conflicts of interest.

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