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Original Article

Pattern, Management, and Outcomes of Head Injury Patients in Northwestern Nigeria, Sokoto: A 1-Year Retrospective Hospital-Based Study

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ABSTRACT

Background: Traumatic brain injury (TBI) remains a leading cause of death and disability globally, with the greatest burden occurring in low- and middle-income countries. Evidence from northwestern Nigeria remains limited. This study evaluated the epidemiological profile, management patterns, clinical outcomes, and predictors of poor outcomes among patients with traumatic head injury treated at a tertiary neurosurgical center.

Methods: A retrospective review was conducted among patients admitted with traumatic head injury between January and December 2023 at the Regional Centre for Neurosurgery, Usmanu Danfodiyo University Teaching Hospital, Sokoto. Demographic, clinical, radiological, treatment, and outcome data were extracted from medical records. Outcomes were assessed using the Glasgow Outcome Scale (GOS) at discharge and categorized as favorable (GOS, 4–5) or poor (GOS, 1–3). Logistic regression was used to identify independent predictors of poor outcomes.

Results: A total of 120 patients were included. Males represented 81.7% of cases, and individuals aged 21 to 39 years accounted for 38.3%. Road traffic accidents were the leading mechanism of injury (60.0%). Moderate TBI was the most common presentation (43.3%), while 28.3% of patients underwent surgery. Overall, 61.7% achieved favorable outcomes, whereas 38.3% experienced poor outcomes, including 15.0% mortality. Independent predictors of poor outcome included severe Glasgow Coma Scale at admission, age ≥60 years, seizure occurrence, abnormal computed tomography findings, and surgical intervention.

Conclusions: Traumatic head injury predominantly affects young adult males and is largely attributable to road traffic accidents. Injury severity at presentation remains the strongest predictor of poor outcome. Strengthening injury prevention strategies, improving prehospital care, and expanding neurosurgical and rehabilitation services may improve outcomes in this setting.

Key words: Traumatic brain injury, head injury, Glasgow Coma Scale, Glasgow Outcome Scale, road traffic accidents, Nigeria

INTRODUCTION

Head injury, or traumatic brain injury (TBI), is one of the leading causes of disability and death worldwide, particularly among young people. [1] TBI remains a major yet under-recognized global health challenge, affecting an estimated 69 million people each year, with low- and middle-income countries bearing a disproportionate share of the burden. [2] Most cases result from road traffic accidents, which predominantly affect young males, [3] likely because they are more exposed to driving, occupational hazards, and other high-risk activities. A male-to-female ratio of 3.3:1 has been reported. [4,5] Consequently, head injury not only affects individual patients but also creates substantial social and economic consequences, as many victims are in their most productive years.

The severity of head injury is commonly assessed using the Glasgow Coma Scale (GCS), which classifies injuries as mild, [6,7] moderate, [8–12] or severe [3–5,13–15] according to the patient's level of consciousness. [13] Another important assessment tool is the Glasgow Outcome Scale (GOS), which evaluates recovery after injury, ranging from death to complete recovery. Studies have consistently shown that low GCS scores, advanced age, seizures, and abnormal brain imaging findings are associated with poorer outcomes. [8,9,14,15]

In contrast, another study reported that sex was not an independent predictor of poor outcome following severe TBI. [10] Despite the usefulness of these assessment tools, predicting outcomes remains challenging, particularly in resource-limited settings where access to specialist care and advanced treatment options may be limited.

The main problem is that although head injury is very common in emergency and neurosurgical units, there is still insufficient local evidence in our region to clearly understand how patients present and which factors truly influence their recovery. Most available studies are from high-income countries, and their findings may not fully reflect what occurs in resource-limited settings, where treatment delays, limited imaging, and fewer neurosurgical interventions are common. In addition, the role of factors such as post-traumatic seizures, type of treatment (surgical or non-surgical), and CT scan findings may vary depending on local healthcare systems and patient populations. This makes it difficult for clinicians to rely solely on international data when making decisions in everyday practice.

This study is therefore vital because it helps describe what actually happens in a real clinical setting and identifies the factors most strongly associated with poor outcomes. By examining variables such as GCS, age, seizures, CT findings, and type of intervention, the study aims to improve understanding of which patients are at higher risk and may require more urgent or intensive care. This kind of information is especially useful in busy or resource-limited hospitals where rapid decisions are necessary. Alongside improvements in primary and secondary healthcare facilities, there is also a growing need to focus on the rehabilitation of neurotrauma patients in low- and middle-income countries. A lack of transportation, cultural stigma, and inadequate funding often hinders access to rehabilitation. [11]

MATERIALS AND METHODS

Study Design, Setting, and Population

This retrospective study was conducted at the Regional Centre for Neurosurgery of Usmanu Danfodiyo University Teaching Hospital. All consecutive patients admitted and managed for traumatic head injury at the Regional Centre for Neurosurgery, Usmanu Danfodiyo University Teaching Hospital, between January and December 2023, who met the inclusion criteria, were enrolled in the study.

Inclusion Criteria

Only patients admitted to the neurosurgical unit were included in this study. Assessment of outcomes using the GOS was based on the patient's condition at discharge, as long-term follow-up data were not consistently available.

Exclusion Criteria

Patients with incomplete or missing clinical records were excluded. In addition, patients assessed in the emergency department and discharged without admission were excluded from the study.

Sample Size Calculation, Sampling Technique, and Data Collection

All patients admitted and treated for traumatic head injury during the study period were included in the study, achieving total enumeration, thereby enhancing statistical power and reducing selection bias. A purposive sampling method was employed. Information was collected from surgical theatre records and patient case files using a standardized data extraction form. Information collected included:

- Demographic characteristics: age at presentation, sex, and place of residence.
- Mechanism of injury: cause of injury was recorded, with road traffic accidents (RTAs) further disaggregated into motorcycle-related injuries, four-wheeled vehicle collisions, and pedestrian strikes. Other mechanisms included falls, assaults, and gunshot injuries.
- Clinical characteristics: the post-resuscitation GCS—assessed after initial airway, breathing, and circulation stabilization in the emergency department—was recorded and stratified into mild (13–15), moderate (9–12), and severe (3–8). Pupillary reactivity (presence of unilateral or bilateral fixed, dilated pupils) was recorded where documented. Seizure occurrence was categorized as early post-traumatic seizures (occurring within 7 days of injury) or late post-traumatic seizures (occurring after 7 days of injury).
- Brain CT findings: findings were recorded by a consultant neurosurgeon and categorized into specific pathologies (e.g., skull fracture, epidural hematoma, acute subdural hematoma, contusions, diffuse axonal injury). For prognostic modeling, findings were dichotomized into "Normal CT" (no acute intracranial abnormality) and "Abnormal CT" (presence of any fracture, hematoma, hemorrhage, or mass effect).
- Treatment modality: management was classified as non-surgical (conservative) or surgical. Surgical interventions were further sub-categorized into craniotomy/craniectomy for hematoma evacuation, decompressive craniectomy for refractory intracranial hypertension, and external ventricular drain (EVD) placement.

- Outcome measure: the GOS at discharge was used to classify outcomes as: Good Recovery (5), Moderate Disability (4), Severe Disability (3), Vegetative State (2), or Dead (1). For the primary analysis, outcomes were dichotomized into favorable (GOS, 4–5) and poor (GOS, 1–3).

Statistical Analysis

Data analysis was performed using IBM SPSS Statistics, version 25.0 (IBM Corp., Armonk, NY). Descriptive statistics were summarized using frequencies, percentages, means, and standard deviations where appropriate. Associations between categorical variables and outcomes were assessed using the Chi-square test or Fisher's exact test when necessary. Variables with *P*-values less than 0.10 on bivariate analysis, together with clinically relevant covariates, were entered into a binary logistic regression model to determine independent predictors of poor outcome, defined as GOS scores of 1 to 3. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were reported, and statistical significance was set at $P < 0.05$.

Ethical Approval

Ethical approval for this study was obtained from the Health Research Ethics Committee of Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria (Approval No: UDUTH/HREC/2026/1755).

RESULTS

Demographic Characteristics

A total of 120 patients with traumatic head injury were included in the study. The majority were male (98, 81.7%), yielding a male-to-female ratio of approximately 4.5:1. Patients aged 21 to 39 years constituted the largest age group (38.3%), followed by those younger than 20 years (35.8%). Patients aged 40 to 59 years represented 17.5%, while only 8.4% were aged 60 years or older. **Table 1** summarizes the demographic characteristics of the participants.

Mechanism (Cause) of Head Injury

RTAs were the predominant mechanism of injury, accounting for 72 patients (60.0%). Assaults contributed 16.7%, while falls accounted for 11.7%. Gunshot injuries were relatively uncommon (3.3%), and miscellaneous causes represented 8.3% of cases (**Table 2**).

Table 1: Demographic characteristics of patients (N = 120).

Variable	Frequency (n)	Percentage (%)
Age group (years)		
<20	43	35.8
21–39	46	38.3
40–59	21	17.5
≥60	10	8.4
Sex		
Male	98	81.7
Female	22	18.3

Clinical Characteristics

Table 3 describes the clinical characteristics of patients included in this study. Based on admission GCS scores, 52 patients (43.3%) had moderate TBI, 48 (40.0%) had mild injury, and 20 (16.7%) presented with severe injury.

Seizures occurred in 35 patients (29.2%), comprising 23 (19.2%) with early post-traumatic seizures and 12 (10.0%) with late seizures.

Brain CT imaging demonstrated a broad spectrum of injuries. Skull fractures were the most common abnormality (18.3%), followed by cerebral contusions (15.0%), traumatic subarachnoid hemorrhage (11.7%), mixed intracranial lesions (10.0%), epidural hematoma (8.3%), diffuse axonal injury (8.3%), acute subdural hematoma (6.7%), and chronic subdural hematoma (5.0%). Normal CT findings were observed in 16.7% of patients.

Most patients (86, 71.7%) received conservative management, while 34 (28.3%) underwent surgical intervention.

Table 2: Mechanism of injury.

Mechanism of injury	Frequency (n)	Percentage (%)
Road traffic accident	72	60.0
Fall	14	11.7
Assault	20	16.7
Gunshot injury	4	3.3
Others	10	8.3

Table 3: Clinical characteristics of patients.

Clinical characteristics	Frequency (n)	Percentage (%)
GCS category		
Mild	48	40.0
Moderate	52	43.3
Severe	20	16.7
Seizure status		
None	85	70.8
Early seizure	23	19.2
Late seizure	12	10.0
CT finding		
Skull fracture	22	18.3
Cerebral contusion	18	15.0
Traumatic subarachnoid hemorrhage	14	11.7
Mixed intracranial lesions	12	10.0
Epidural hematoma	10	8.3
Diffuse axonal injury	10	8.3
Acute subdural hematoma	8	6.7
Chronic subdural hematoma	6	5.0
Normal CT findings	20	16.7
Treatment modality		
Conservative	86	71.7
Surgical	34	28.3

Clinical Outcomes

Clinical outcomes at discharge were assessed using the GOS. Good recovery was achieved in 46 patients (38.3%), while 28 (23.3%) experienced moderate disability. Severe disability occurred in 22 patients (18.3%), 6 patients (5.0%) remained in a vegetative state, and 18 patients (15.0%) died.

Overall, 74 patients (61.7%) achieved favorable outcomes (GOS scores, 4–5), whereas 46 patients (38.3%) had unfavorable outcomes (GOS scores, 1–3; **Table 4**).

Factors Associated With Clinical Outcome

Bivariate analysis demonstrated that admission GCS category was significantly associated with clinical outcome ($P < 0.001$). Patients presenting with severe head injury were significantly more likely to experience an unfavorable outcome than those with mild or moderate injuries.

Age was also significantly associated with outcome ($P = 0.02$), with patients aged 60 years or older showing a higher frequency of poor outcomes.

Similarly, seizure occurrence was significantly associated with an unfavorable outcome ($P = 0.01$). Because of the relatively small number of patients with early and late seizures, seizure status was entered into the multivariable analysis as a binary variable (presence versus absence of seizures).

Multivariable Logistic Regression Analysis (Predictors of Poor Outcome)

Variables meeting the predefined selection criteria were entered into a multivariable logistic regression model to identify independent predictors of poor outcome (GOS, 1–3). After adjusting for age, sex, GCS severity, seizure occurrence, CT abnormalities, and treatment modality, several factors remained independently associated with poor outcomes (**Table 5**).

A severe GCS score was the strongest predictor of unfavorable outcome (AOR, 7.5 [95% CI, 3.42–16.45]; $P < 0.001$). Advanced age (≥60 years) was also independently associated with poor outcome (AOR, 3.2 [95% CI, 1.21–6.48]; $P = 0.016$). Patients who experienced any seizure (early or late) had more than twice the likelihood of poor outcomes compared with those without seizures (AOR, 2.4 [95% CI, 1.31–4.39]; $P = 0.004$).

Table 4: Glasgow Outcome Scale at hospital discharge.

Outcome	Frequency (n)	Percentage (%)
Good recovery	46	38.3
Moderate disability	28	23.3
Severe disability	22	18.3
Vegetative state	6	5.0
Death	18	15.0

Table 5: Multivariable logistic regression analysis of predictors of poor outcome (GOS 1–3).

Variable	Odds ratio (OR)	95% CI	*P* value
Severe GCS	7.5	3.42–16.45	<0.001
Age ≥60 years	3.2	1.21–6.48	0.016
Seizures	2.4	1.31–4.39	0.004
CT abnormality	2.1	1.12–3.94	0.021
Surgical intervention	3.8	1.08–4.08	<0.001

Abnormal CT findings were another important predictor of poor prognosis (AOR, 2.1 [95% CI, 1.12–3.94]; $P = 0.021$). Surgical intervention was significantly associated with poor outcome (AOR, 3.8 [95% CI, 1.08–4.08]; $P < 0.001$); however, as detailed in the discussion, this finding is attributed to confounding by indication, as surgical patients inherently presented with more severe intracranial pathology.

Monthly Distribution of Cases

The monthly distribution of traumatic head injury admissions demonstrated a clear seasonal pattern (**Figure 1**). The highest number of admissions occurred in July, accounting

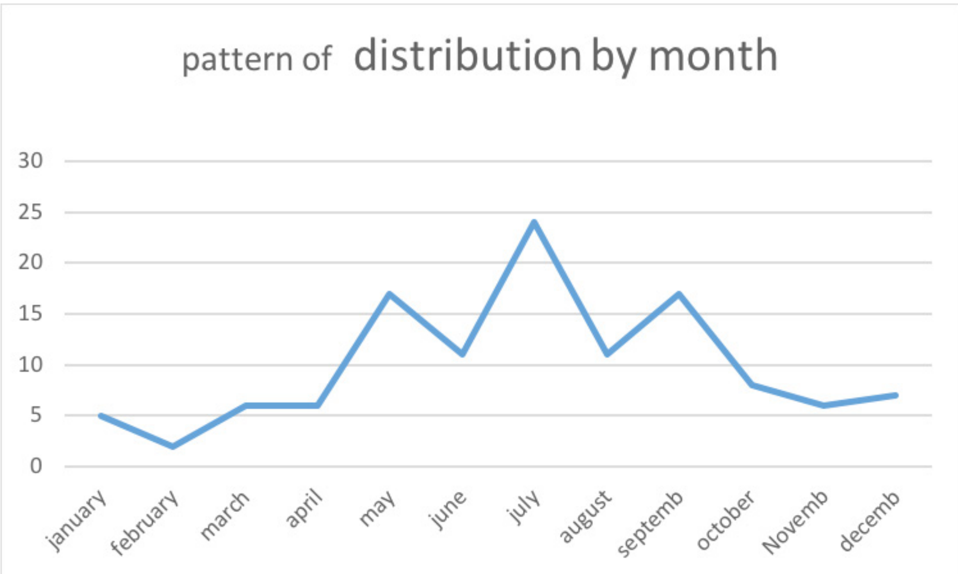

Figure 1: Monthly distribution of traumatic head injury cases managed at Usmanu Danfodiyo University Teaching Hospital, from January to December 2023, showing increased incidence during the rainy season (May–September).

for approximately 20% of all cases. Overall, the period from May to September contributed approximately 67% of annual admissions, whereas the lowest number of cases was recorded in February (1.7%). The number of admissions increased progressively from May, peaked in July, and gradually declined toward the end of the year. These findings are presented descriptively, as no formal time-series or seasonal trend analysis was performed (**Figure 1**). Monthly distribution of traumatic head injury admissions from January to December 2023.

DISCUSSION

This study examined the demographic patterns, clinical features, and outcomes of patients with head injuries. The results show that head injuries occur predominantly among young males, with the highest incidence seen in individuals aged 21 to 39 years. These findings were consistent with both global and regional observations, where young men are more likely to engage in high-risk activities, particularly those involving road use. [12] Interestingly, while the peak incidence in this study falls within early adulthood, studies from the United States report a peak in the 15 to 19-year age group. This difference may be explained by earlier access to car driving among American teenagers, whereas Nigerian youths are more likely to begin motorcycle use at that age. [6]

Road traffic crashes appeared as the leading cause of injury, accounting for 60% of cases, followed by falls and assaults. This pattern is consistent with findings from many developing countries, where rapid motorization, poor road conditions, and weak enforcement of safety regulations contribute heavily to trauma incidence. In contrast, a study by Alexious et al. reported falls as the most common cause of injury, followed by motor vehicle accidents. [7] The notable frequency of falls from trees, especially among children, highlights an important public health concern. It suggests the need for targeted educational campaigns to raise awareness about the risks of tree climbing and to encourage closer adult supervision. [16]

Overall, the predominance of road traffic crashes reflects broader systemic issues such as inadequate road safety enforcement, poor infrastructure, and low compliance with protective measures like helmet and seatbelt use. Assault-related injuries, which made up 16.7% of cases, also indicate a significant burden of interpersonal violence and call for distinct preventive strategies.

Most patients in this study presented moderate TBI, while severe injuries accounted for a smaller proportion of cases. This pattern differs from findings reported in a study conducted in Nnewi, although similar observations have been documented in some other settings. [17–19] Importantly, the GCS at presentation emerged as the strongest predictor of patient outcome. Patients with severe GCS scores were approximately seven times more likely to experience death or severe disability compared with those presenting with milder injuries. This finding is consistent with previous studies and further emphasizes the critical role of early neurological assessment in the management and prognostication of TBI. [13, 20–22]

Age emerged as an important determinant of outcome in this study. Patients aged 60 years and above were significantly more likely to experience poor outcomes compared with younger patients. This may be due to reduced physiological reserve, a higher prevalence of comorbidities, and a generally limited capacity for neurological recovery in older adults. [23–26]

Seizure occurrence, particularly early post-traumatic seizures, was also associated with worse outcomes. This likely reflects more severe underlying brain injury and may further worsen prognosis through secondary neuronal injury and neurological deterioration. [27]

CT scan findings showed a clear association with outcome. Patients with intracranial abnormalities such as hematomas, contusions, and skull fractures had poorer outcomes than those with normal imaging results. [28] This highlights the crucial role of neuroimaging in evaluating injury severity, guiding clinical management, and supporting prognostication.

Although surgical intervention was associated with poorer outcomes, this is most likely explained by selection bias. Patients who require surgery generally present with more severe injuries and significant intracranial pathology; therefore, their outcomes reflect injury severity rather than the effect of surgery itself.

A clear seasonal pattern in head injury incidence was observed in this study, with cases rising sharply between May and September and peaking in July. This suggests a sustained period of increased risk, likely driven by higher levels of outdoor activity, occupational exposure, and travel during these months. This period also coincides with the rainy season in northern Nigeria, when wet and slippery roads, reduced visibility, and occasional flooding increase the likelihood of road traffic accidents and falls. These environmental challenges are often more pronounced in areas with heavier rainfall, further elevating injury risk.

The seasonal rise in cases highlights the need for targeted preventive measures during high-risk months. These may include intensified road safety campaigns, stricter enforcement of traffic regulations such as helmet and seatbelt use, improved road maintenance, and stronger emergency preparedness in trauma centers. Strengthening education on safe driving in adverse weather conditions is also essential.

Community engagement is equally important. Awareness programs involving farmers, commercial motorcyclists, school-aged children, and community and religious leaders may help reduce transport-related injuries. In settings where cultural practices contribute to risk—such as falls from trees—working with trusted local leaders can improve acceptance of preventive messages, particularly among children and adolescents.

In contrast, the lower incidence between January and April, especially in February, may reflect reduced exposure to environmental and behavioral risk factors. Drier weather and fewer outdoor or travel-related activities likely contribute to this decline. These findings align with previous studies reporting seasonal variation in trauma linked to weather and human activity. [29–31] Similar patterns have been described elsewhere, including higher trauma rates during warmer months associated with increased travel and outdoor engagement, and reduced motorcycle crashes during colder periods with a relative rise in falls. [32] However, not all settings show a direct relationship between adverse weather and increased injuries; for example, findings from Aseer indicated no corresponding rise in road traffic injuries during foggy winter conditions. [33]

In Nigeria, studies from Nnewi and Abuja have also reported seasonal variation in head injury incidence, with peaks during festive and wet seasons, respectively. [17, 34] However, as no formal time-series analysis was conducted in this study, these variations should be interpreted descriptively.

Overall, these patterns reinforce the importance of prevention-focused strategies in resource-limited settings. Strengthening road safety enforcement, promoting protective measures, and improving prehospital care systems are likely to be more cost-effective than managing severe TBI and its long-term consequences.

Limitations

First, as a retrospective study, it relied on previously recorded data, which may be subject to incomplete or inaccurate documentation. Missing data and recording errors could have affected the accuracy of the findings.

Second, the study was conducted in a single Centre, which may limit the generalizability of the results to other settings or populations with different demographic and healthcare characteristics.

Third, the dataset lacked detailed information on certain important variables such as comorbidities, pre-hospital care, time to presentation, and long-term follow-up, which may influence outcomes in head injury patients.

Fourth, outcome assessment was based on GOS scores at discharge only; therefore, late neurological recovery and long-term functional outcomes could not be evaluated.

CONCLUSIONS

Head injury in this study primarily affected young, economically active males, with road traffic accidents identified as the leading cause. Although a majority of patients achieved favorable outcomes, the proportion of severe disability and mortality remains considerable. The severity of injury at presentation, as reflected by the GCS, emerged as the most important predictor of outcome. Other factors, such as advanced age, presence of seizures, abnormal CT findings, and the need for surgical intervention, were also associated with poorer prognosis. The observed seasonal variation, with increased cases during the mid-year months, suggests that environmental and behavioral factors contribute significantly to injury risk. Overall, these findings highlight the need for improved road safety enforcement, public health education, and timely clinical assessment. Targeted interventions, especially during peak periods, could play a key role in reducing the incidence and improving outcomes of head injury in this setting. Future multicenter prospective studies with larger sample sizes and long-term follow-up are needed to validate these findings, evaluate functional outcomes beyond hospital discharge, and identify additional prognostic factors that can guide clinical decision-making and inform national neurotrauma policies in Nigeria and other low-resource settings.

Recommendations

1. Strengthening road safety measures, including stricter enforcement of helmet use, seatbelts, and speed limits, is essential to reducing head injuries caused by road traffic accidents.
2. Public education on injury prevention, safer driving, and child supervision should also be improved. Early assessment, prompt neuroimaging, and better emergency and neurosurgical care can enhance patient outcomes.
3. Preventive efforts should be intensified during high-risk rainy seasons, while further multicenter prospective studies are needed to provide broader data on head injury patterns and outcomes in Nigeria.
4. Improving pre-hospital care systems and strengthening referral pathways may help reduce delays in definitive neurotrauma management and improve outcomes.
5. Routine seizure prophylaxis protocols for high-risk TBI patients should also be considered to reduce secondary neurological injury.

AUTHORS' CONTRIBUTION

Each author has made a substantial contribution to the present work in one or more areas, including conception, study design, conduct, data collection, analysis, and interpretation. All authors have given final approval of the version to be published, agreed on the journal to which the article has been submitted, and agree to be accountable for all aspects of the work.

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None.

CONFLICT OF INTEREST

None.

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