

Spectrum of Cranial Computed Tomography Findings and Clinical Correlates in Paediatric Head Injury at a Nigerian Tertiary Hospital

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Abstract

Background: Traumatic brain injury (TBI) is a major cause of morbidity and mortality in children. Computed tomography (CT) is essential for early detection of intracranial injuries, but patterns and determinants of CT findings vary across settings. This study evaluated CT findings in paediatric TBI and their relationship with injury severity and mechanism. **Methods:** This retrospective study included 218 paediatric patients with TBI who underwent cranial CT at Ekiti State University Teaching Hospital. Data on demographics, mechanism of injury, injury severity, and CT findings were analyzed. Injury severity was classified as mild, moderate, or severe. Associations were assessed using appropriate statistical tests. **Results:** The mean age was 8.3 years, with 61.5% males. Road traffic accidents were the leading cause (71.5%). Mild, moderate, and severe TBI accounted for 48.2%, 22.0%, and 29.8% of cases. Abnormal CT findings occurred in 84.4% of patients, most commonly cerebral contusion (22.5%), subdural haematoma (14.2%), and epidural haematoma (8.7%). CT abnormalities increased significantly with injury severity ($p < 0.001$), but not with mechanism of injury. **Conclusion:** Abnormal CT findings are common in paediatric TBI and strongly associated with injury severity. Early CT imaging remains essential for effective evaluation and management.

Keywords: Traumatic brain injury, Paediatric head injury, Computed tomography, Intracranial lesions.

Introduction

Traumatic brain injury (TBI) remains a major cause of morbidity and mortality among children worldwide and continues to challenge healthcare systems. Paediatric head injuries account for a substantial proportion of trauma-related hospital visits and are associated with significant long-term neurological disability in survivors [1]. The burden is particularly high in low- and middle-income countries, where rapid urbanization, increasing motorization, and limited injury-prevention strategies contribute to rising rates of trauma [2].

Evaluation of head injury in children can be difficult, as younger patients may be unable to clearly describe symptoms and clinical findings may not accurately reflect the severity of underlying intracranial injury [3]. Consequently, neuroimaging has become an essential component of assessment, enabling early detection of significant pathology and guiding clinical management.

Computed tomography (CT) remains the most widely used imaging modality in the acute evaluation of paediatric head trauma. Its speed, availability, and ability to rapidly identify life-threatening intracranial lesions make it indispensable in emergency settings [4]. CT can detect conditions such as epidural haematoma, subdural haematoma, cerebral contusions, and diffuse cerebral swelling, many of which require urgent intervention [5]. Early identification

of these abnormalities is critical in preventing secondary brain injury and improving outcomes [6].

Despite its clinical value, the increasing use of CT in children raises concerns about exposure to ionizing radiation and the associated long-term risk of malignancy [7]. This has led to the development of clinical decision rules to guide appropriate imaging. Guidelines such as the Pediatric Emergency Care Applied Research Network (PECARN), the Canadian Assessment of Tomography for Childhood Head Injury (CATCH), and the Children's Head Injury Algorithm for the Prediction of Important Clinical Events (CHALICE) help identify children at low risk of clinically significant brain injury and reduce unnecessary CT use [8-10].

Nevertheless, CT remains indispensable in moderate and severe TBI and in selected cases of mild head injury with concerning clinical features [11]. Studies have consistently shown that CT abnormalities correlate with injury severity and provide important prognostic information [12].

A wide range of intracranial lesions may be identified on CT following paediatric head trauma, including cerebral contusions, epidural and subdural haematomas, intracerebral haemorrhage, diffuse cerebral oedema, and skull fractures [13]. The frequency and pattern of these lesions often reflect the mechanism of injury and characteristics of the population studied.

In many developing countries, road traffic accidents are the leading cause of paediatric TBI, followed by falls and other injuries [14]. Poor road safety practices, limited enforcement of traffic regulations, and inadequate prevention strategies contribute to this trend [15]. Despite existing studies, detailed data on the spectrum of CT findings in paediatric TBI remain limited in many developing settings [16]. Such information is essential for understanding local injury patterns and improving clinical decision-making in resource-constrained environments. This study therefore aimed to evaluate the spectrum of cranial CT findings in paediatric TBI at Ekiti State University Teaching hospital and to examine their relationship with injury severity and mechanism of injury.

Methodology

This study was a retrospective hospital-based descriptive study carried out at Ekiti State University Teaching Hospital. The medical records of paediatric patients who presented with traumatic brain injury and underwent cranial computed tomography (CT) scanning between January 2025 and December 2025 were reviewed. A total of 218 eligible patients were identified from hospital records and radiology databases and included in the analysis. Patients with incomplete records and those without CT scan were excluded from the study.

Relevant clinical and demographic information was obtained from patients' case notes, emergency department records, and radiology reports. Data collected included age, sex, mechanism of injury, severity of head injury at presentation, and CT scan findings. The severity of traumatic brain injury was assessed using the Glasgow Coma Scale (GCS) and categorized as mild (GCS 13-15), moderate (GCS 9-12), or severe (GCS \leq 8).

The mechanisms of injury were grouped into road traffic accidents, falls, and other causes of trauma. CT findings were extracted from the official radiology reports prepared by consultant radiologists. Imaging results were classified as normal or abnormal, and specific intracranial lesions such as cerebral contusion, epidural haematoma, and subdural haematoma were documented where present.

Data were entered and analyzed using the Statistical Package for the Social Sciences (SPSS) version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize patient characteristics and CT findings. Associations between injury severity, mechanism of injury, and CT abnormalities were assessed using appropriate statistical tests, with p-values less than 0.05 considered statistically significant.

Ethical approval for the study was obtained from the Institution's Research Ethics Committee.

Results

A total of 218 paediatric patients with traumatic brain injury who underwent cranial computed tomography were included in the analysis.

Demographic Characteristics, Mechanism of Injury, and Injury Severity

The demographic characteristics and injury patterns of the study population are presented in Table 1. The mean age of the patients was 8.3 years, and males constituted 61.5% of the cohort, indicating a male predominance.

Road traffic accidents were the most common mechanism of injury, accounting for 71.5% of cases. Other mechanisms included

falls and other less frequent causes.

Based on clinical assessment, mild traumatic brain injury accounted for 48.2% of cases, while 22.0% had moderate injury and 29.8% presented with severe injury.

Distribution of CT scans Findings

The overall distribution of CT scan findings among the study population is summarized in Table 2. Abnormal CT findings were observed in 84.4% of patients, while 15.6% had normal CT scans.

Among the abnormal findings, cerebral contusion was the most frequently identified lesion (22.5%), followed by subdural haematoma (14.2%) and epidural haematoma (8.7%). Other intracranial abnormalities included additional traumatic lesions identified on CT imaging.

Relationship between Injury Severity and Presence of CT Abnormalities

The relationship between injury severity and the presence of abnormal CT findings is presented in Table 3. The proportion of abnormal CT scans increased progressively with the severity of traumatic brain injury. Abnormal CT findings were detected in 71.4% of patients with mild injury, 91.7% of those with moderate injury, and 100% of patients with severe injury.

Statistical analysis demonstrated a significant association between injury severity and the presence of abnormal CT findings ($p < 0.001$).

Distribution of Specific CT Lesions According to Injury Severity

The distribution of individual CT lesions across different injury severity categories is shown in Table 4. Cerebral contusions were observed across all severity categories but were more frequently identified among patients with moderate and severe injuries. Subdural and epidural haematomas were also more commonly seen in patients with more severe traumatic brain injury.

Overall, the frequency and complexity of intracranial lesions increased with increasing injury severity.

Distribution of CT Lesions According to Mechanism of Injury

The relationship between mechanism of injury and specific CT scan findings is presented in Table 5. Road traffic accidents accounted for the majority of CT abnormalities observed in the study population. Cerebral contusions, subdural haematomas, and epidural haematomas were most frequently associated with road traffic-related injuries. Other mechanisms of injury contributed smaller proportions of the identified CT abnormalities.

Association between Mechanism of Injury and Presence of CT Abnormalities

The association between mechanism of injury and the presence of abnormal CT findings is shown in Table 6. Although abnormal CT findings were most frequently observed among patients injured in road traffic accidents, statistical analysis revealed no significant association between the mechanism of injury and the presence of CT abnormalities ($p > 0.05$).

Summary of Key Findings

Overall, abnormal CT findings were highly prevalent among children presenting with traumatic brain injury. Cerebral contusion was the most common lesion identified. The likelihood of detecting intracranial pathology increased significantly with the severity of injury, whereas the mechanism of injury did not demonstrate a statistically significant relationship with the presence of CT abnormalities.

Table 1: Demographic characteristics, mechanism, and severity of head injury (n = 218)

Variable	Frequency	Percentage
Age Groups (years)		
0-5	72	33.0
6-10	64	29.4
11-15	54	24.8
16-18	28	12.8
Total	218	100.0
Sex		
Male	134	61.5
Female	84	38.5
Total	218	100.0
Mechanism of Injury		
Road traffic accident	156	71.5
Fall	53	24.3
Assault	9	4.2
Total	218	100.0
Severity of Head Injury (GCS)		
Mild (13-15)	105	48.2
Moderate (9-12)	48	22.0
Severe (≤8)	65	29.8
Total	218	100.0

Table 2: Overall Distribution of Cranial CT Scan Findings

CT Scan Findings	Frequency (n)	Percentage (%)
Normal CT	34	15.6
Skull fracture only	19	8.7
Cerebral contusion	49	22.5
Epidural hematoma	19	8.7
Subdural hematoma	31	14.2
Subarachnoid hemorrhage	12	5.5
Intracerebral hemorrhage	10	4.6
Intraventricular hemorrhage	5	2.3
Diffuse axonal injury	12	5.5
Brain edema	17	7.8
Mixed lesions	10	4.6
Total	218	100.0

Table 3: Cranial CT Scan Result by Severity of Head Injury

Severity of head injury	Normal CT scan	Abnormal CT scan	Total
Mild (GCS 13-15)	30	75	105
Moderate (GCS 9-12)	4	44	48
Severe (GCS ≤8)	0	65	65
Total	34	184	218

$\chi^2 = 27.36, df = 2, p < 0.001$

Table 4: Cranial CT Scan Findings by Severity of Head Injury

CT finding	Mild	Mode rate	Severe	Total
Normal CT	30	4	0	34
Skull fracture only	12	4	3	19
Cerebral contusion	29	13	7	49
Epidural hematoma	10	3	6	19
Subdural hematoma	8	9	14	31
Subarachnoid hemorrhage	4	4	4	12
Intracerebral hemorrhage	3	2	5	10
Intraventricular hemorrhage	3	1	1	5
Diffuse axonal injury	2	4	6	12
Brain edema	1	4	12	17

Mixed lesions	3	0	7	10
Total	105	48	65	218

$\chi^2 = 107.74, df = 20, p < 0.001$

Table 5: Cranial CT scan Findings by Aetiology of Injury

CT finding	RTA	Fall	Assault	Total
Normal CT	24	9	1	34
Abnormal CT	132	44	8	184
Total	156	53	9	218

Table 6: Cranial CT Scan Result (Normal vs Abnormal) by Aetiology of Injury

Aetiology	Normal CT	Abnormal CT	Total
Road traffic accident	24	132	156
Fall	9	44	53
Assault	1	8	9
Total	34	184	218

$\chi^2 = 0.55, df = 2, p = 0.759$

Discussion

This study demonstrates a high prevalence of abnormal cranial CT findings among children presenting with head injury in our environment. The proportion of patients with radiological abnormalities observed in this study is comparable to the findings reported by other researchers in this field. In a study conducted by Itanyi et al. in 2017 in Northern Nigeria, it was reported that 85.6% of paediatric head injury had abnormal cranial CT scan findings [13]. This is similar to the findings in present study where as many as 84.4% of patients studied had abnormal Cranial CT scan findings. Such observations highlight the substantial burden of intracranial injury among children presenting with head trauma and underscore the continuing importance of timely neuroimaging in the evaluation of these patients.

The demographic pattern observed in the present study revealed that younger children and males were disproportionately affected, with males constituting 61.5% of the study population with a male: female ratio of 1.6:1. This is comparable to the findings of Ogbeide et al. where boys constituted as many as 53.4% of paediatric head injuries [11]. The higher vulnerability among males has been attributed to greater participation in outdoor activities and increased exposure to risk-prone environments. In addition, road traffic accidents emerged as the predominant mechanism of injury in the present study (71.5% of cases). This finding mirrors reports from several studies conducted in low- and middle-income countries, including the study conducted by Itanyi et al. where road traffic accidents were responsible for 79.6% cases of paediatric head injuries [13]. The persistence of this pattern highlights ongoing challenges related to road safety, inadequate enforcement of traffic regulations, and limited preventive interventions.

The pattern of intracranial lesions observed on cranial CT in this study highlighted cerebral contusion as the most frequently identified abnormality, accounting for 22.5% of cases, followed by subdural haematoma (14.2%) and epidural haematoma (8.7%). The predominance of cerebral contusions is consistent with the pathophysiological response of the paediatric brain to blunt head trauma, where acceleration-deceleration forces commonly result in parenchymal injury, particularly in regions adjacent to bony prominences [17,18]. Similar findings were reported by a study conducted by Itanyi et al. who reported hemorrhagic contusion (26.9%) as the most commonly observed intracranial lesion affecting across all the age groups of children with head injuries

[13]. Similarly, Udoh et al. reported that the most frequent computed tomography findings in paediatric head injury were intracerebral haemorrhages [19].

Subdural haematomas, the second most common finding in this study, are often associated with more severe injury mechanisms and are typically due to tearing of bridging veins, while epidural haematomas, although less frequent, remain clinically significant because of their potential for rapid neurological deterioration if not promptly identified and managed [20,21].

A key finding of the present study was the strong association between injury severity and the presence of intracranial pathology on CT imaging. All children presenting with severe head injury demonstrated abnormal CT findings, and the frequency of abnormalities increased progressively with worsening clinical severity. This observation is consistent with reports of de Oliveira et al. which demonstrated a clear relationship between lower Glasgow Coma Scale scores and a higher likelihood of radiologically detectable brain injury [22]. These findings reinforce the central role of neurological assessment in determining the need for urgent imaging and clinical monitoring.

In contrast, the mechanism of injury did not demonstrate a significant association with the presence of CT abnormalities in this study. This observation supports the growing emphasis in current clinical guidelines on neurological status rather than injury mechanism as the primary determinant for imaging decisions [7-9]. This is also supported by the findings of Haydel et al. who observed in a study of a cohort of head injured-patients, only about 6% had positive cranial CT scan findings which correlated with presence of neurological findings [23]. Clinical decision rules developed for paediatric head trauma similarly prioritize clinical indicators such as altered consciousness, neurological deficits, or signs of skull fracture when determining the need for CT scanning.

Modern neurotrauma management strategies increasingly emphasize risk stratification based on injury severity, prompt identification of high-risk patients, and judicious use of imaging to reduce unnecessary radiation exposure in children [24-28]. While advanced imaging modalities such as magnetic resonance imaging may provide greater sensitivity for detecting subtle injuries such as diffuse axonal damage, their availability in acute trauma settings is often limited [26,27]. In many emergency contexts, CT therefore remains the most practical and reliable imaging modality for the rapid assessment of intracranial pathology.

Taken together, the findings of the present study are consistent with current international recommendations advocating selective CT imaging guided primarily by clinical severity and neurological findings. Such an approach is particularly relevant in resource-constrained healthcare environments where access to advanced neuroimaging may be limited and careful prioritization of imaging resources is required [28-30].

Limitations

The hospital-based design limits generalizability. Long-term neurocognitive outcomes were not assessed. Some CT diagnostic categories had small sample sizes, and the lack of routine magnetic resonance imaging may have resulted in under-detection of subtle non-hemorrhagic injuries [21,22].

Conclusion

This study demonstrates that abnormal cranial CT findings are highly prevalent among children presenting with traumatic brain injury in our setting. Intracranial lesions were identified in the

majority of patients, with cerebral contusion, subdural haematoma, and epidural haematoma representing the most common radiological abnormalities. The likelihood of detecting intracranial pathology increased significantly with the severity of injury, highlighting the strong relationship between clinical neurological status and radiological findings.

In contrast, the mechanism of injury did not show a statistically significant association with the presence of CT abnormalities, suggesting that clinical severity remains a more reliable indicator for imaging decisions than injury mechanism alone. These findings reinforce the importance of careful neurological assessment in guiding the use of CT imaging in paediatric head trauma.

Overall, cranial CT continues to play a critical role in the early evaluation of paediatric traumatic brain injury, particularly in patients with moderate to severe injury or concerning clinical features. The high burden of road traffic-related injuries observed in this study further underscores the need for strengthened injury prevention strategies and improved road safety measures aimed at reducing the incidence of paediatric head trauma.

Future studies incorporating multicentre data and long-term outcome assessment may provide additional insight into the prognostic significance of CT findings and help refine imaging guidelines for children with traumatic brain injury.

Declarations

Author Contributions

The author was solely responsible for the conception and design of the study and drafting of the manuscript. The author conducted data collection, data analysis and interpretation. The author critically revised the work for important intellectual content and approved the final version of the manuscript.

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Ethical Approval Statement

Ethical approval was obtained from the Hospital Research and Ethics Committee prior to commencement of the study. The study was carried out in accordance with the ethical standards of the institutional research committee and the principles of the Declaration of Helsinki.

Conflict of Interest Statement

The author declares that there are no conflicts of interest regarding the publication of this article.

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Data Availability Statement

The datasets generated and analyzed during the study are available from the corresponding author upon reasonable request.

United Nations Declaration of Human Rights

The author confirms that he accepts and agrees with the UN's Declaration of Human Rights.

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