

Computed Tomographic Patterns of Traumatic Head Injury in Warri, Southern Nigeria.

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Abstract

Background: Traumatic brain injury (TBI) is a primary health challenge in Nigeria and globally, with road traffic accidents (RTA) being the major cause. Computed tomography (CT) is the preferred imaging modality for the diagnosis and management of head injury.

Objective: This study evaluated the radiologic patterns of cranial CT findings among patients who presented with head injury at a private radiology facility in Warri, Delta State, Southern Nigeria.

Methods: This cross-sectional retrospective study reviewed 474 completed cranial CT reports of patients with head injury between January 1st, 2021 and December 31st, 2025. Data on age, gender, clinical features, cause of injury, and cranial CT findings were recorded for each subject.

Results: The study population comprised 309 males (65.2%) and 165 females (34.8%), with a mean age of 37.26 ± 19.8 years. The most predominant age group was the 21–30 years age bracket.

Road traffic accidents (RTA) accounted for 70.9% of head injuries. Scalp injury was the most common presenting feature, followed by headaches and loss of consciousness. Majority of the Cranial CT scans were abnormal, with skull fractures (27.2%), intracranial haematomas (21.7%) and cerebral contusions (20.7%) being the predominant findings. Multiple craniofacial fractures were common, predominantly affecting the right side. A significant association was observed between the presence of skull fractures and all types of intracranial haematomas ($p < 0.001$).

Conclusion: The study concluded that head injury predominantly affected young adult males in Warri, Delta State, with RTA being the primary cause.

Keywords: Head injury, road traffic accidents, intracranial haematoma, computed tomography (CT), traumatic brain injury (TBI).

Introduction

Traumatic brain injury (TBI) is a major public health concern in Nigeria and globally. It is defined as trauma to the brain and or its coverings resulting from an externally applied mechanical force.¹ According to the Centers for Disease Control and Prevention (CDC), TBI represents a disruption of normal brain function caused by impact, shock, concussion, or penetrating injury.² Broadly, TBIs can be classified into two types; closed and open head injuries. In closed head injuries, the dura remains intact, whereas in open injuries, the dura is torn.³

The severity of symptoms may range from mild to severe depending on the extent of brain damage.³ Patients may present with altered consciousness, localized neurological abnormalities, or modest cognitive impairments.^{4,5} Intracranial complications, including haemorrhages, cerebral contusions, widespread cerebral oedema, and skull fractures, frequently occur and significantly influence outcomes.^{3,6}

Globally, TBI contributes significantly to the disease burden, with an estimated 13.8 million individuals requiring neurosurgical care annually.⁷ In sub-Saharan Africa, road traffic accidents (RTAs), falls, gunshot wounds, and assaults due to increasing violence and insurgency have altered the epidemiological pattern of head injuries.⁸

The primary objective in the management of patients with craniocerebral trauma is to preserve life and enhance brain function. Early and accurate diagnosis, often through neuroimaging, plays a crucial role in achieving this goal.⁹ Computed tomography (CT), introduced by Godfrey Hounsfield in 1972, revolutionized the evaluation of head injuries and has since become the imaging modality of choice due to its speed, accuracy, and accessibility.^{3,9-11} Computed tomography findings are vital for determining prognosis and guiding appropriate management. Although plain skull

radiographs remain in use due to their low cost and wider availability, they are of very limited diagnostic value in head trauma.^{10,12}

In Nigeria, the incidence of TBI continues to rise, driven by poor road infrastructure, the widespread use of motorcycles for transportation, increasing urbanization and industrial activity.¹² Ogolo and Ibe¹ identified RTA as the leading cause of head injuries (55.3%), while Adoguet *al.*¹³ reported that traders (25.9%) and commercial motorcyclists (24.1%) are the occupational groups most affected. Despite the increasing burden, the absence of comprehensive local data on TBI limits the development and evaluation of evidence-based prevention and management strategies.¹⁴

With the rising incidence of RTA and other forms of trauma in Nigeria, head injuries have become a crucial public health concern.^{1,15} There is therefore a need to understand the CT patterns which would be crucial in accurate diagnosis, appropriate clinical management and development of effective preventive methods against the common etiological factors.^{6,11}

This study thus aims to evaluate the pattern of cranial CT findings among adult patients presenting with head injury at a private radiology facility, in Warri, Delta State, Nigeria, which will contribute to local data on the pattern of head injury in the study population and further provide evidence that can inform clinical practice and policy formation.

Methods

This cross-sectional observational study was retrospectively conducted at a private radiology facility, in Warri, Delta State, Southern Nigeria between January 1st, 2021 and December 31st, 2025. Ethical approval was obtained before the commencement of the study from the Health Research and Ethics committee (HREC), Delta

State University Teaching Hospital, Oghara (HREC/PAN/2025/113/0799).

All head injury patients that presented during the study period and who had complete records of finalized cranial CT reports and images were included in this study. Cranial CT images used in this study were accessed in the Picture Archiving Communications Systems (PACS) software. These images were captured using a 32-slice CT scanner (Siemens Somatomgo Now, Germany). Non-contrast 1.5mm axial slices of the cranial computed tomogram were taken from the vertex to the skull base, using the acquisition parameters set at 120kv and 300mA. Thereafter, reformatted sagittal and coronal images as well as three-dimensional (3D) volume rendered images were also acquired. Bone algorithms with wide window settings were studied to visualize any fractures of the skull. All images were reviewed by two Consultant Radiologists.

Sociodemographic, clinical features, cause of head injury, and abnormal cranial CT findings were noted and recorded for each participant in a structured proforma. The abnormal cranial CT findings seen include amongst others are cerebral contusions, skull fractures, intracranial haematomas, cerebral edema, lacunar infarcts and paranasal sinus abnormalities. Using the brain window setting, the CT scan appearance of acute cerebral contusions or intracerebral haematoma are homogeneously well-defined hyperdense areas with surrounding hypodensity (oedema), commonly occurring in the frontal and temporal lobes, while acute extradural haematomas are usually seen as biconvex hyperdense lesions, as depicted in Figures 4a and 4b. Acute subdural haematoma is seen typically as a crescent-shaped hyperdense collection with a convex outer border and concave inner border (concavo-convex) overlying the cerebral convexity and do not cross suture lines, as shown in Figures 4b and 4d; and it can be extensive overlying an entire cerebral hemisphere. CT features of brain edema include

compression or reduction in size of the ventricles; effacement of the basal cisterns and the sulci and the reduction in density of the brain parenchyma surrounding the area of the intracranial haematoma or contusion. The bone window setting of the CT scanner has a higher resolution in demonstrating skull fractures better than conventional skull radiographs. Skull fractures are seen as discontinuity or breach of the calvarium, as shown in Figure 4e and 4f. In addition, swelling of the scalp with hyperdensities in-situ are features of scalp haematoma (Figure 4e).

Other findings include paranasal sinus abnormalities (maxillary sinus wall fractures with resultant hyperdense collections within it) and lacunar infarcts (seen as small sized/subcentimeter rounded hypodensities within both cerebral hemispheres).

Data analysis was performed using the IBM Statistical package for Social Sciences (SPSS) version 27 (IBM SPSS Armonk, NY). For quantitative variables, means and standard deviations were used to compare data, while the frequencies of cranial CT findings were summarized in tables and figures. Chi-square test was used to evaluate the relationship between skull fracture and intracranial haematoma and *p* was considered significant at <0.05.

Results

The study reviewed Cranial CT reports of 474 patients, comprising 309 (65.2%) males and 165 (34.8%) females. The subjects age ranged from 0-95 years with a mean age of 37.26 ± 19.8 years. Males had a mean age of 37.27 ± 19.39 years while females had a mean age of 37.23 ± 20.61 years. Majority of the participants (96, 20.3%) fell within the 21-30 years age bracket. The >70 years age had the least frequency in the study (24, 5.1%). The distribution of subjects based on age and gender are illustrated in Figure 1.

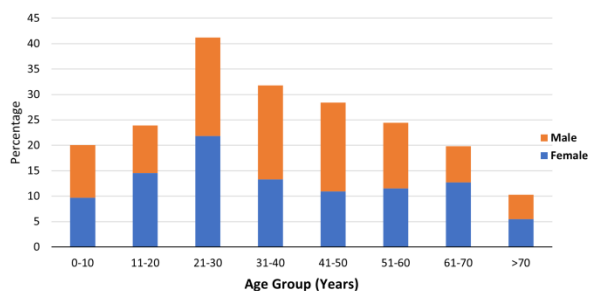


Figure 1: Distribution of patients based on age and gender

Road traffic accidents (RTA) were the most dominant reason for head injury in this study (336, 70.9%). Some of the reports did not state the cause for head injury (82, 17.3%). The causes for head injury in this study are demonstrated in Figure 2 below.

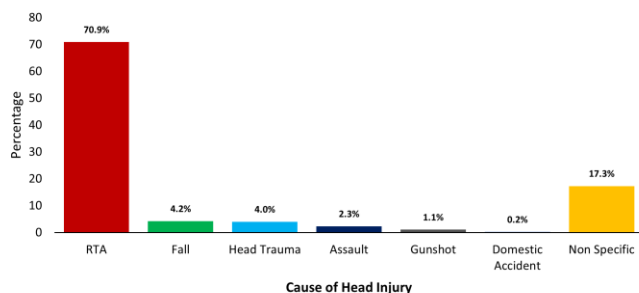


Figure 2: Mechanisms of head injury in the study population.

The patients evaluated in this study presented with different clinical features with scalp injury being the most prevalent (203, 42.8%) as seen in Table 1.

Table 1: Clinical features of patients presenting for head CT

Clinical Features	Frequency	%
Scalp injury	203	42.8
Headache	29	6.1
Loss of consciousness	21	4.4
Suspected skull fracture	14	3.0
Post traumatic seizure	11	2.3
Deficit in short term memory	7	1.5
Vomiting	2	0.4

Percentages are based on n =474.

Most of the Cranial CT images reviewed in this study were abnormal (372, 78.5%) while only one hundred and two patients had normal cranial CT images (102, 21.5%) as seen in Figure 3.

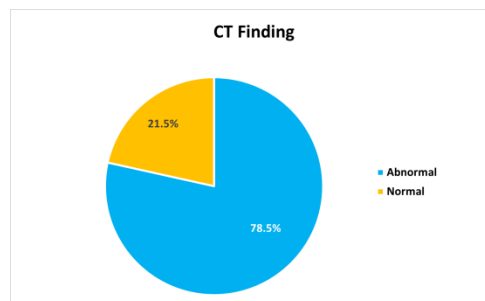


Figure 3: Normal and Abnormal Cranial CT findings among patients in the study population.

The most common cranial CT finding were skull fractures (129, 27.2), intracranial haematomas (103, 21.7%), closely followed by cerebral contusions (98, 20.7%) as depicted in Table 2. Other intracranial findings included periorbital oedema (38, 8%), intraorbital emphysema (34, 7.2%) and raised intracranial pressure (32, 6.8%). Subarachnoid haemorrhage, followed by extradural and subdural haematomas were seen in this study.

Table 2: Abnormal findings in Cranial CT images of study participants.

CT Findings * (n = 474)	Frequency	%
Cerebral contusions	98	20.7
Skull Fracture	129	27.2
Intracranial haematoma	103	21.7
Extradural	52	11.0
Subdural	45	9.5
Subarachnoid	61	12.9
Periorbital oedema	38	8.0
Cerebral Oedema	10	2.1
Raised Intracranial Pressure	32	6.8
Scalp haematoma	79	16.7
Midline Shift	48	10.1
Pneumocephalus	9	1.9
Foreign Body	17	3.6
Cephalohaematoma	1	0.2
Intraorbital emphysema	34	7.2
Lacunar infarcts	134	28.3
Paranasal Sinus Abnormality	131	27.6

*Multiple CT findings (frequency > 474)

One hundred and twenty-nine skull fractures were reported in this study with most of them being multiple fractures (71, 15.0%). The side of the skull most affected by fractures was the right side (79, 16.7%). Facial bones were mostly fractured in this study (58, 12.2%) while the least fractured skull bone was the occipital bone (23, 4.9%).

Comminuted fractures were seen in 44 patients (9.3%) and basal skull fracture in 15% of cases. The characteristics of skull fractures seen within the study are displayed in Table 3.

Table 3: Characteristics of skull fractures in the study population.

	Categories	Frequency (%)
Number of Fractures	Single	58 (12.2)
	Multiple	71 (15.0)
Side of Skull Affected	Right	79 (16.7)
	Left	77 (16.2)
	Bilateral	26 (5.5)
Bone Affected	Frontal	41 (8.6)
	Parietal	38 (8.0)
	Occipital	23 (4.9)
	Temporal	41 (8.6)
	Facial	58 (12.2)
	Others	55 (11.6)
Fracture Line	Depressed	21 (4.4)
	Comminuted	44 (9.3)
	Displaced	13 (2.7)
	Linear	46 (9.7)
Basal Skull Fracture		71 (15.0)

Basal skull fractures in this study involved majorly the right hemicranium (64.8%) and the middle skull base (63.4%), while posterior basal skull fractures were least common among study subjects. The distribution of basal skull fractures based on laterality and anatomic location are illustrated in Figures 5 and 6 respectively.

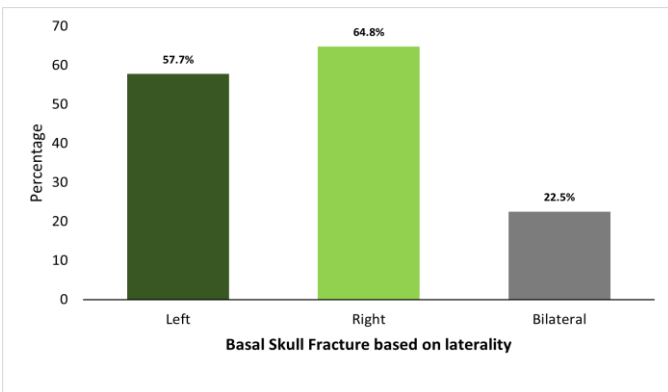


Figure 5: Basal Skull Fractures based on laterality

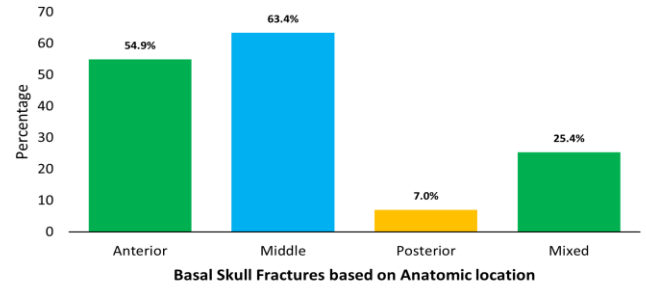


Figure 6: Basal skull fractures based on based on anatomic location.

A statistically significant association was observed between the presence of skull fractures and intracranial haematomas, across all haematoma subtypes. Extradural haematoma showed a strong association with fracture ($\chi^2 = 52.05$, $p < 0.001$), same also with subdural haematoma ($\chi^2 = 20.16$, $p < 0.001$) and subarachnoid haematoma ($\chi^2 = 35.74$, $p < 0.001$) as depicted in Table 4.

Table 4: Relationship between Intracranial haematoma and presence of skull fracture.

Intracranial Haematoma		N (% with skull fracture)		χ^2	P value
		Absent	Skull Fracture Present		
Extradural	No	329 (95.4)	93 (72.1)	52.05	<0.001
	Yes	16 (4.6)	36 (27.9)		
Subdural	No	325 (94.2)	104 (80.6)	20.16	<0.001
	Yes	20 (5.8)	25 (19.4)		
Subarachnoid	No	320 (92.8)	93 (72.1)	35.74	<0.001
	Yes	25 (7.2)	36 (27.9)		

Discussion

The findings of the present study regarding sociodemographic distribution reveals a marked male predominance (65.2%) and a peak incidence of participants in the third decade of life (21–30 years). This pattern is congruent with several regional and international reports.^{3,4,16–18}Ikuboret *al.*⁶ and Obieje *et al.*¹² observed similar male-to-female ratios of 3:1 and 3.5:1, respectively, in Nigerian cohorts. Tamunokuro and Amadi,¹⁹ Ismail and Azeez,³ and Nnaemeka *et al.*¹⁶ also reported a higher representation of individuals within this same age range (20-30 years). This consistent demographic trend has been largely attributed to the increased involvement of young, productive-age

males in high-risk physical activities, rigorous occupations, and social behaviours such as the consumption of illicit substances or the disregard for traffic regulations.^{14,17}

Road traffic accidents were the predominant mechanism of injury in this study accounting for 70.9% of cases. This aligns with the high incidence reports in Oghara (61.0%),⁶ Enugu (56.0%)¹, Lagos (67.2%),¹⁴ and Iraq (39.4%).³ The high frequency of RTAs in Nigerian urban centres is frequently linked to factors such as increasing urbanization, poor road infrastructure, inadequate vehicle maintenance, and the lack of strict enforcement for safety regulations like use of helmet or adhering to speed limits laws.^{6,15,16,19} There is a necessity for individuals, the Government, and organizations to confront the perilous conditions of the Nigerian roadways, which pose daily hazards to life.⁶ Legislation and enforcement of speed limits in high-risk regions have significantly reduced the burden of TBI in many large cities, particularly in the Western world, largely due to the availability of pre- and post-intervention epidemiological data.¹⁴ In contrast, a study in Ethiopia,¹⁸ reported higher contributions from assaults and penetrating injuries, reflecting localized geographic and socioeconomic stressors. This socioeconomic disparity may account for the variations observed in studies conducted on diverse population groups.¹⁸

In terms of clinical presentation, this study found scalp injury to be the most common feature (42.8%), followed by headache and loss of consciousness (LOC). This contrasts with the findings of Shita *et al.*¹⁸ who reported LOC as the leading indication for cranial CT in their study, and Ugwuanyi *et al.*¹⁷ who found headaches as the most common clinical indication for cranial CT, accounting for 17.7% of cases. The high prevalence of scalp injuries in the present study may be reflective of the private health facility setting of the study center, which might receive a broader range of trauma severities

compared to tertiary referral centers that often manage more critical cases presenting with profound neurological deficits.¹⁴

The abnormality rate of cranial CT scans in the present study was 78.5%. Similarly, studies conducted in Nnewi, Nigeria¹² and Baghdad, Iraq³ also reported high prevalence of abnormal cranial CT scans. Conversely, these findings differ from studies in Enugu¹⁷ and Ghana,⁴ which reported high rates of normal cranial CT findings. Plausible explanations for these discrepancies in the findings between studies may be linked to the difference in sample size and nature of the studies.¹⁷ Ugwuanyi *et al.*¹⁷ had high prevalence of non-trauma indications as opposed to our study which reports high rate of trauma related indications. The high diagnostic yield supports the acceptance of CT as the first-line imaging modality in emergency settings for the preliminary assessment of head trauma, enabling swift detection of addressable primary intracranial lesions.^{6,11,18} Conversely, a normal CT scan may not exclude brain damage from diffuse axonal injury which is best assessed using magnetic resonance imaging (MRI) due to its excellent soft tissue resolution. Thus, MRI should be considered for patients with normal CT whose symptoms persist or deteriorate.⁶

The abnormal cranial CT findings in this study were dominated by skull fractures (27.2%), followed by intracranial haematoma (21.7%) and cerebral contusions (20.7%). In contrast, Ikubor *et al.*⁶ and Ugwuanyi *et al.*¹⁷ reported brain contusions and intracerebral haemorrhages as their most prevalent CT finding. These differences can be ascribed to geographical differences affecting the severity of head trauma in these locations.¹⁶ Among intracranial haemorrhages, subarachnoid haemorrhage was the most frequent (12.9%), which corroborates with the findings in Nnewi¹² but differs from the Oghara study,⁶ where brain contusions were the most common focal lesion.

Most patients in this study had multiple skull fractures, predominantly occurring on the right side of the skull which aligns with the reports of Ikubor *et al.*⁶ Similar to the report in Nnewi,¹² craniofacial fractures occurred more frequently than basal skull fractures, but contrasts with the findings by Connor and Flis²¹ in London where basal skull fractures comprised a low proportion of cranial CT evaluated. The high incidence of craniofacial fractures in these studies may be because the cranial convexities are more susceptible to traumatic impact during head injuries, and the face, being the most exposed region of the head, lacks protective structures, resulting in heightened fragility of the facial bones.¹² The disparity in prevalence rate values among industrialized countries may stem from a more advantageous transportation demographic, characterized by better road infrastructure, adherence of road users to safety rules, and the availability of diverse transportation modalities.¹²

This study also observed a statistically significant association between skull fractures and all types of intracranial haematoma ($p < 0.001$) which is comparable with the findings of Ikubor *et al.*,⁶ who noted that the presence of a fracture significantly increases the probability of an underlying haematoma.

This study also found a high incidence of cerebral infarcts which is similar to the report in Bauchi¹⁶ may be indicative of secondary brain injury resulting from delayed presentation or vascular dysregulation following the trauma.²⁰

The clinical and public health outcomes of these findings reinforce the pressing necessity for preventative measures and enhanced healthcare infrastructure.²² Numerous interventions have to be implemented to mitigate the alarming increase in head injuries in Nigeria, including traffic laws and regulations, as well as the prohibition of commercial

motorcycles as a mode of transportation in some metropolitan areas.¹²

Conclusion

Road traffic accidents is a major cause of head injury in Warri, Delta State, and occurs mostly among young male adults. There was a high incidence of abnormal cranial CT findings with skull fractures and intracranial haematomas occurring more frequently. These findings highlight the important role of cranial CT in the diagnosis and management of head injury.

Limitations of the study

This was a single-center study which may reduce the generalize ability of the findings to a broader population. Additionally, this study adopted a retrospective design, with the data obtained solely from the request forms, CT images and reports, which restricted access to comprehensive clinical information and evaluation of patient's outcomes.

Recommendations

This study recommends prioritizing early cranial CT evaluation in patients with head injury, particularly those resulting from RTA, to enable early detection of intracranial abnormalities, which may affect patient's outcomes. There is need for stricter traffic safety enforcement, improved public health education and the increase in the availability of medical resources targeted towards improving access to CT imaging. In addition, multicenter studies and follow-up of patient's outcomes should be evaluated in future studies.

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