

# Role of Computed Tomography in the Evaluation of Brain Findings of Children with Seizure Disorders in North Western Nigeria

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## ABSTRACT

**Background:** Seizures are relatively common but often poorly investigated in the developing world, with resultant inadequate management of the affected patients. This is worse with the paediatric age group. Imaging is key to the proper management of patients with seizures, including the paediatric age group. This paper intends to assess the imaging pattern of intracranial structural abnormal findings seen in children in our environment. **Aim:** The aim of this article is to evaluate the pattern of brain computed tomography (CT) findings among children presenting with seizure disorders in Kaduna and its environs. **Methods:** A retrospective study of 114 paediatric patients referred to the Radiology Department of the National Ear Care Centre (NECC) with history of seizure disorders was done. The request forms, images and findings were reviewed by two independent consultant radiologists. **Results:** 114 children were seen within the study period, with a male predominance of 63% (male to female ratio of 1.7: 1). The most frequently affected group are those in the 11th and 12th years of age while those within the 7th to 10th age groups were the least affected. In addition to the seizure as a presenting symptom, 25% of these children also presented with complaints of headache. There was a history of head trauma in 17 % of these children. 21.3 % of the CT findings were normal while 19.7% had dilated lateral ventricles, followed by hypodense cerebri. **Conclusion:** Seizures are common in the pediatric age group in our environment and yet are often poorly investigated. The non-availability and high cost of MRI scans necessitated the use of the more available and affordable modality of imaging. The high yield of diversity of CT scan findings in this study justified the appropriate use of CT scan in the diagnosis of suspected brain pathologies in our area.

**Keywords:** Paediatrics, Seizure diagnosis, Computed tomography.



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## INTRODUCTION

Seizures are common in the pediatric age group,<sup>1, 2</sup> and are normally frightening to both the caretakers and caregivers.<sup>3</sup> This occurrence is more in the developing world<sup>4</sup> and reflects persistently high risks at birth, and the adverse neurological sequelae of viral, bacterial, malarial and other parasitic infections during and beyond childhood.<sup>3</sup> There is lack of regional information on this important condition,<sup>5</sup> and even when seizures are diagnosed and treatment sought, there is a treatment gap that is exacerbated by the sparsity of trained health personnel, the cost and difficulty of access to technical investigation and poorly sustained drug treatment.<sup>6</sup> On the other hand, modern imaging facilities are also not easily available in these countries, including Nigeria.<sup>7</sup> The objective of this retrospective study is to determine and analyse the diagnostic utility of CT in the pattern of intracranial pathologies and their possible aetiologies among children who presented with seizures in our environment.

## METHODOLOGY

A retrospective study was conducted on one hundred and fourteen (114) paediatric patients made up of 72 males and 42 females who were referred to the Radiology Department of National Ear Care Centre (NECC) Kaduna for cranial CT following seizure disorders between January 2017 and December 2018 (a period of 24 months), where a Toshiba Alexion 32-slice multidetector CT scanner was used. A multi-slice protocol with 38 mm (5 mm) cuts from the base to the vertex was used and images were acquired in the axial plane with multiplanar reformatted sagittal and coronal images. It was undertaken to evaluate the role of routine CT scan of the brain in children presenting with seizure disorders in Kaduna and its environs. Majority of these children with seizure disorders were referred to this centre for cranial CT investigation, from where they were recruited. The inclusion criteria was all patients of both sexes

who are 16 years and below who presented with episode (s) of seizure, while those above that age group were excluded. Prior ethical clearance was obtained from the Institution's Research and Ethics Committee.

A retrospective analysis of their request forms, duplicate copy of radiology reports, and soft copy of CT images of the patients were reviewed independently by two consultant radiologists. A proforma was used to document the obtained information about the patients. The imaging findings were documented in the proforma. All data was entered, tabulated and analysed using the Statistical Package for Social Sciences (SPSS 23, Armonk, NY: IBM Corp). Frequency distributions (proportions), graphs, charts and tables were drawn to present the data appropriately.

## RESULTS

Of the brain CT of children done within the twenty-four months period, 114 referred to the radiology department for imaging satisfied the inclusion criteria. There were 72 (63%) males and 42 (37%) females, giving a ratio of 1.7:1. The pattern of male predominance was observed in every age group except for those between 13 years and above. The most frequently affected age groups are those in the 11<sup>th</sup> and 12<sup>th</sup> years of age while those within the 9<sup>th</sup> to 12<sup>th</sup> years of age were the least affected (figs. 1 and 2). In addition to the seizure as a presenting symptom, 28 (25%) of these children also presented with other complaints of headache while 19 (17%) had a history of head trauma. Twelve percent (12%) of patients had a past history of low birth weight while neonatal jaundice contributed only 8% to the clinical information (fig. 3).

Out of the total number of patients, 26 (21.3 %) of them had normal CT findings while 19.7% had dilated lateral ventricles, followed by dilated 3<sup>rd</sup>/4<sup>th</sup> ventricles and hypodense cerebri which were seen in 12.3% each. Intracranial masses contributed only 2.4% of the total (fig 4)

Fig. 1 showing the age and sex distribution of the scanned patients.

Age (years)	Male	Female	Total	Percentage
<1	10	5	15	13.2
1-2	7	5	12	10.5
3-4	13	5	18	15.8
5-6	12	6	18	15.8
7-8	3	-	3	2.6
9-10	3	-	3	2.6
11-12	22	8	30	26.3
13-14	2	7	9	8.0
15-16	-	6	6	5.2
<b>Total</b>	<b>72</b>	<b>42</b>	<b>114</b>	<b>100</b>

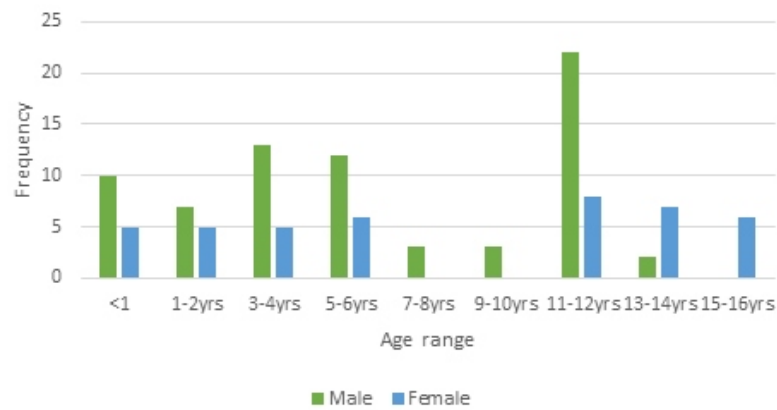


Fig2 shows the graphic demonstration of the scanned patients

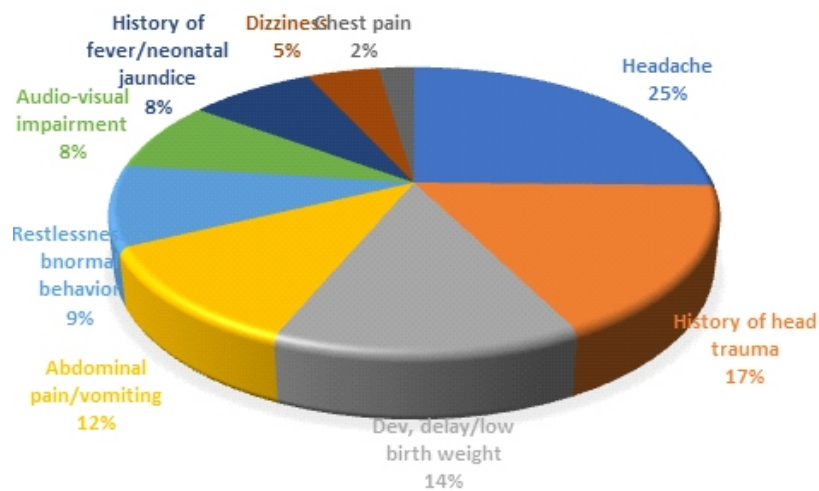


Fig. 3 shows the pie chart of additional presenting complaints in addition to the presenting complaints of seizures.

Fig. 4 shows the distribution of the CT findings of the scanned patients.

Radiological findings	Male	Female	Total	Percentage
Dilated lateral ventricle	12	12	24	19.7
Hypodense/oedematous cerebral area	9	6	15	12.3
Dilated 3 <sup>rd</sup> /4 <sup>th</sup> ventricle	5	10	15	12.3
Prominent sulci/basal sulci	6	3	9	7.4
Effaced sulci	3	3	6	5.0
Intracerebral/intraventricular calcification		- 6	6	5.0
Opaque mastoid/middle ear	4	2	6	5.0
Effaced lateral ventricle		- 3	3	2.4
Intracerebral mass	1	2	3	2.4
Compressed 4 <sup>th</sup> ventricle	3	-	3	2.4
Thinned cerebral mantle		- 3	3	2.4
Cranial vault overlap	1	2	3	2.4
Normal findings	19	7	26	21.3
<b>Total</b>	<b>63</b>	<b>59</b>	<b>122</b>	<b>100</b>

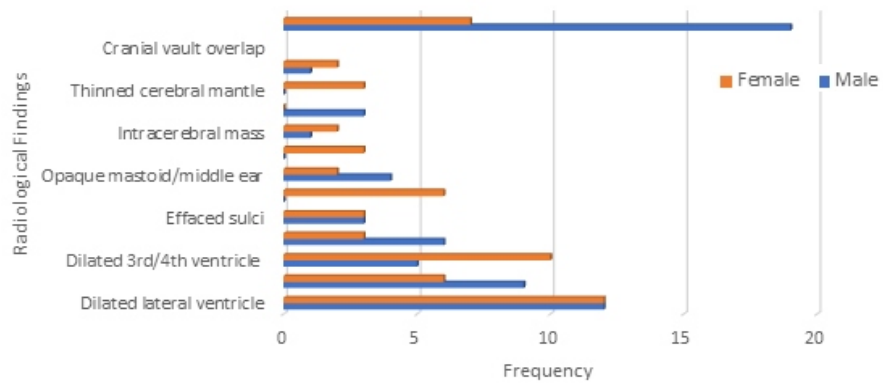


Fig. 5 shows the graphical presentation of the CT findings

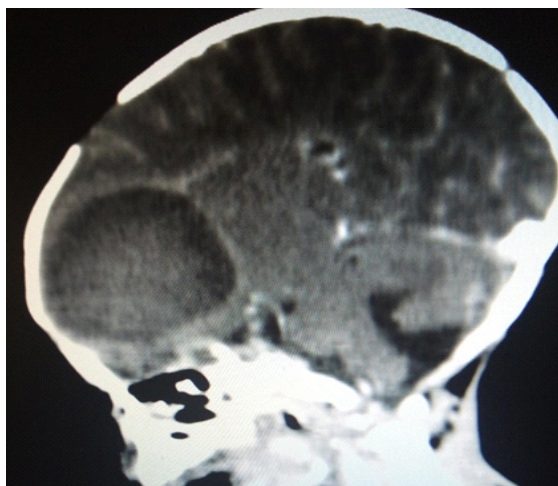


Fig. 6 showing multiple cerebral abscesses in the brain of a child that presented with fever and seizures

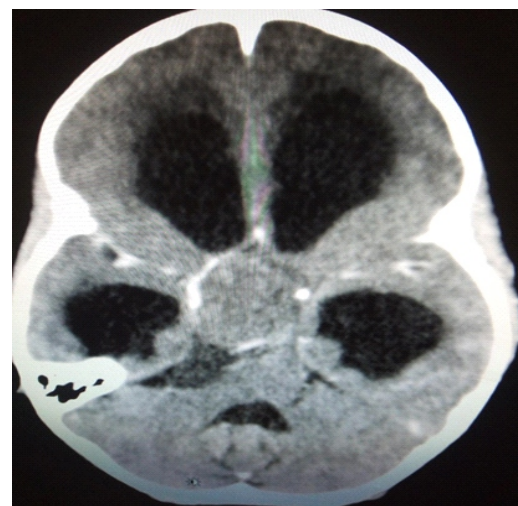
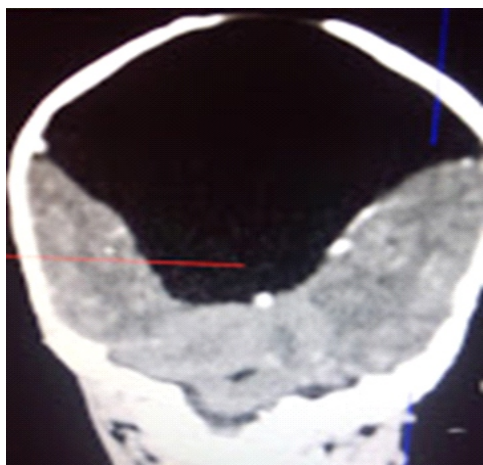


Fig. 7 showing a ring enhancing mid-line tumour with resultant marked lateral ventricular dilatation



**Fig. 8 shows a porencephalic brain in a child with seizure disorders.**

## DISCUSSION

Seizures are quite common worldwide and are as old as man,<sup>2</sup> with very frightening consequences to both the caregivers and caretakers.<sup>3</sup> They affect children of all age groups with a decreasing frequency in the older age group.<sup>8</sup> At least 4-10% of children experience a minimum of one seizure within the first 16 years of life.<sup>8</sup> It is also known by many studies that seizures generally have a higher incidence among children, with the highest occurrence among those of the developing world.<sup>4</sup> Before the advent of CT, the management of seizures was difficult because the cause was only suspected from clinical information and findings.<sup>9</sup> However, CT is a frontline and formidable imaging modality for the diagnoses of seizure disorders in the developing world.<sup>10</sup> This is because of its availability and affordability when compared to Magnetic Resonance Imaging (MRI).<sup>11,12</sup>

Of the 114 patients under review, there were 72 (63%) males and 42 (37%) females, giving a ratio of 1.7:1. The studies of Obajimi et al and Ndubuisi et al got ratios of 1.8:1 and 1.2:1 respectively when compared to our finding. This male preponderance may be explained by the fact that the average

African parent favours the male child more than the female, and can therefore easily spend his/her fortune on the former.<sup>2,10</sup> Majority of these children were younger, where 55.3 % were 6 years and below, with a higher pattern of male prevalence observed in every age group except for those that are 13 years and above. This agrees with the findings of Mwipopo et al who also observed that most children were younger than 5 years and males were the predominant sex.<sup>3</sup> However, Adhikari et al noted a higher prevalence of female in their study in Nepal.<sup>8</sup> Majority (91%) of seizures below this age of 5 years has febrile illness as its aetiology, and who's prevalence is higher and poorer in tropical countries than the western countries.<sup>10,13</sup> Outside of seizures from febrile illness of malaria origin, the commonly implicated risk factors in Sub-Sahara Africa are birth trauma, CNS infections, and traumatic brain injury.<sup>14</sup> Neurocysticercosis has also been implicated in South India.<sup>15</sup> Other important but less significant causes of seizures are asphyxia, sepsis and neonatal hypoglycemia.<sup>6</sup>

The age group with the highest frequency of occurrence are those within the 11th and 12th years of age (26.3%) while those within the 9th to 12th years of age had the least frequency of 2.6%. This agrees with the findings of Idro et al and Saravanan.<sup>15,16</sup> Twelve percent (12%) of patients had a past history of low birth weight while neonatal jaundice contributed only 8% to the clinical information. In many African countries, the most commonly implicated risk factors are hypoxia birth trauma, CNS infections, and traumatic brain injury,<sup>14,17</sup> while in some Asian countries, neurocysticercosis has been mentioned as a major cause of seizures.<sup>15</sup> In addition to the seizure as a presenting symptom, 28 (25%) of these children also presented with other complaints of headache while 19 (17%) had a history of head trauma.

Out of the total number of patients, 26 (21.3 %) of them had normal CT findings. When compared to other studies, the percentage of the normal scan were varied in different place. While Inah et al<sup>18</sup> had 17% normal CT findings, Obajimi et al<sup>10</sup> had 46.6% and Maytal et al<sup>19</sup> had the highest value of 78.8%.



Of the abnormal CT scan cases, 19.7% had dilated lateral ventricles, followed by dilated 3rd/4th ventricles and hypodense cerebri which were seen in 12.3% each. Intracranial masses contributed only 2.4% of the total findings. In a similar study by Inah et al, cerebral atrophy constituted 55.3% while infarction followed with a distant 6.4%.<sup>18</sup> Anas et al. also reported obstructive hydrocephalus as the most common finding in their centre<sup>20</sup> This was attributed to the high prevalence of meningitis in the northern part of the Nigeria.

Seizures are common neurological disorders with diverse etiologies.<sup>11</sup> However, the introduction of computerized tomography (CT) in the 1970s transformed the practice of radiology, thereby changing the practice of clinical neurology and neurosurgery.<sup>21</sup> Its use in the clinical circle is to demonstrate cause and explore etiology, which is a form of triage,<sup>19</sup> in order to give patients and their relatives an accurate prognosis.<sup>11</sup> Although CT scan is an important diagnostic tool in the manage of paediatric seizures, it constitutes a source of great concern due to radiation exposure to the relatively young brain<sup>2</sup> and should be used with great caution as stipulated by the “as low as reasonably achievable” (ALARA) principle to reduce radiation dose to the patient.<sup>22,23</sup>

CT scan has a number of advantages over MRI such as availability, lower cost and fast production of images<sup>22</sup> but having access to this modality of investigation and affordability are still problems encountered by patients in the developing countries, Nigeria inclusive.<sup>2, 7</sup> At the time this study was conducted, there was no functional MRI machine in the whole state, thereby necessitating the use of CT as an alternative. The use of the more affordable and accessible ultrasound scans for investigating the brain for structural lesions in much younger children would have sufficed because of their radiosensitive brains, but it is limited only to infants with patent fontanelles.<sup>24</sup> <sup>25</sup>MRI is superior to CT as it gives a better soft tissue resolution, able to diagnose very small lesions and vascular malformations (higher

sensitivity), and at the same time does not expose patients to the risk of radiation, hence it is very useful in the pediatric age groups.<sup>2, 23</sup> Early imaging investigation is expected to increase diagnostic certainty, reduces progressive brain damage, especially from lesions that would potentially benefit from surgery as well as reduce cost on the long run, as a result of wrong decision or need for medication.<sup>10</sup>

## CONCLUSION

Seizures are common in the pediatric age group and yet are often poorly investigated and managed in developing countries. Sociocultural misconceptions, financial difficulties, and lack of facilities are often blamed. The non-availability and high cost of MRI scans in a large part of our country necessitated the use of the more available and affordable modality of imaging. The high yield of diversity of CT scan findings in this study justified the appropriate use of CT scan in the diagnosis of suspected brain pathologies in our area where magnetic resonance imaging scan is unavailable. Also, this study strengthened the argument for the imaging of patients presenting with seizures in this environment irrespective of age or sex of the patient; considering that, most patients do not present to the expert care until seizure has occurred more than once. It is recommended that early imaging investigation will increase diagnostic certainty and prevent progressive brain damage, especially from lesions that would potentially benefit from interventions as well as reduce cost on the long run.

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