



MAGNETIC RESONANCE IMAGING BRAIN FINDINGS AMONG PATIENTS WITH SEIZURE DISORDER IN PORT HARCOURT METROPOLIS

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ABSTRACT

OBJECTIVE: Seizure disorder is one of the most common chronic neurological disorders, affecting approximately 50 million worldwide. About 100,000 new cases are reported in Nigeria each year. To comprehend the prevalence of Magnetic Resonance Imaging (MRI) abnormalities and their correlation with seizures, local data is essential.

METHOD: A retrospective study design was adopted to review clinical data and MRI reports of 122 patients at a tertiary medical imaging facility in Port Harcourt, Rivers State between January 2015 and January 2023. Demography, image findings, and the relationship between the MRI findings, age, and sex were data obtained and analysed using descriptive and inferential statistics with the degree of significance set at $p < 0.05$.

RESULTS: This study involved 64 females and 58 males, aged 0 to 89 years. About 69 (57%) patients had normal brain MRI findings, while 53 (43%) were abnormal. The most common pathologies noted were cerebrovascular disorder 14 (11.48%), followed by white matter disease 13 (10.66%), and brain tumour 10 (8.20%). Age group 0-17 years had the highest number of pathological findings (20/53; 37%), followed by age group 36-53 years (11/53; 21%), and the age group 54-57 years (9/53; 17%). Age group spanning from 73 to 86 years, had the least of abnormal findings (4/53; 0.1%). No significant association existed between sex and MRI findings.

CONCLUSION: Brain MRI findings were normal in majority of seizure patients; the most common findings were cerebrovascular abnormalities, white matter disease, and brain tumours respectively, which were more common in younger patients. The study emphasizes the significance of early MRI scans in identifying seizure-related brain pathologies, particularly in children and adolescents in their diagnostic workup of seizure disorder.

KEYWORDS: Epilepsy; Magnetic Resonance Imaging; Neuroimaging; Neurological disorders; Seizure disorder

INTRODUCTION

Seizure disorder is a chronic neurological disorder marked by recurring seizures; brief bursts of involuntary bodily movements frequently used interchangeably with epilepsy (Reddy *et al.*, 2021). It is the most common neurological condition worldwide, affecting approximately 50 million people across all age groups, although, it is more common in children and adolescents (Reddy *et al.*, 2021).

About 3.4 million people in the United States suffer from epilepsy, while around 6 million people are affected in Europe. The Centre for Disease Control and Prevention (CDC) estimates that about 5 million cases worldwide are diagnosed annually; in high-income nations, the number of cases is 49 per 100,000 people; in middle- and low-income countries, the number is tripled to 139 per 100,000.

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This high number in lower-income countries can be attributed to inadequate and inaccessible preventative health measures, common risk factors such as traumatic brain injuries from road traffic accidents, birth-related trauma, and endemic diseases like neurocysticercosis and malaria (Reddy *et al.*, 2021). In Nigeria, approximately 100,000 new cases of epilepsy are recorded each year, with between 15 and 37 cases reported for every 1000 persons. However, as many people with this condition are reluctant to acknowledge their condition and seek treatment, these figures may only represent the tip of the iceberg (Owolabi *et al.*, 2019).

Epilepsy accounts for more than 0.5% of the global disease burden, with socio-economic implications and challenges for patients and the economy (Reddy *et al.*, 2021). Societal pressure to avoid marriage or find partners, limited educational opportunities, exclusion from schools, fear of participating in social gatherings due to potential seizure episodes, and difficulty finding and keeping a job due to fear or prejudice are some of these social challenges (Owolabi *et al.*, 2019; Tanaka *et al.*, 2018). Most African communities have associated epilepsy with witchcraft, and pervasive superstitions about epilepsy being communicable, incurable, or the outcome of morally reprehensible character. This has kept patients in isolation and deterred them from seeking treatment (Ekeh and Ekrikpo, 2015). This isolation and stigma can exacerbate anxiety, despair, and low self-esteem, thus, resulting in low productivity and low quality of life. Moreover, the financial implications of accessing healthcare have put many families in debt and poverty, especially in Nigeria where access to healthcare is limited. Private organizations like the Nigeria Epilepsy Care Advancement Programme (NECAP) have made progress in raising awareness, enhancing care, and expanding treatment options for Nigerians with epilepsy, but significant challenges remain despite these commendable efforts (Adum *et al.*, 2016).

Individuals with seizure disorder have a threefold increased chance of dying young compared to the general population. Nonetheless, if diagnosed early and given the right medication and care, up to 70% of epileptics might enjoy seizure-free lives. Electroencephalography (EEG), which measures abnormalities in brain waves and evaluates electrical activity in the brain to assess whether anti-seizure drugs may be helpful, is one of the early procedures for diagnosing seizures. Video monitoring is also used with EEG to assess the nature of a person's seizures and to rule out other disorders that may present like seizure disorder. More recently, magnetic signals generated by neurons in a procedure known as a magnetoencephalogram (MEG) have also been used to identify anomalous brain activity. This enables surgeons to plan interventional procedures to remove seizure-causing focal regions while minimizing damage to healthy brain tissue and disruption of

normal brain function. Advances in neuroimaging have seen the development of Positron Emission Tomography (PET), which allows for the imaging of the brain by identifying areas with normal and abnormal chemical activity. Areas of abnormal chemical activity are indicative of brain regions with lower-than-normal metabolism and can be used to pinpoint the location of seizures even after the episode. Single photon emission computed tomography (SPECT) makes use of an intravascular blood flow tracer. Images captured during a seizure are compared to images captured during intervals between seizures to determine cerebral blood flow during that period. On the scan image, the site of the seizure onset displays a high blood flow (Jayalakshmi *et al.*, 2011; Goodman and Amurao, 2012).

Magnetic Resonance Imaging (MRI) has become an invaluable tool in imaging brain lesions for diagnosis of seizure disorders especially because of its relatively lower cost and easier availability when compared to PET and SPECT. It has also revolutionized clinical decision-making and patient care, with its high soft tissue characterization capacity, and multi-parametric and multiplanar capabilities to guide appropriate therapy, particularly for patients who do not respond to anti-epilepsy medications. Moreover, research has shown that MRI can detect up to 80% of these epileptogenic lesions using a dedicated MRI protocol (Goodman and Amurao, 2012).

A recent study has shown that the prevalence of epilepsy in the Port Harcourt metropolis is 8 out of 1000 people, with the male population aged 21 and 30 years making up the highest percentage. This translates to a significant population of affected persons and families, thus, emphasizing the need for early diagnosis, all-encompassing care, support, and public awareness initiatives. The prevalence and symptoms of epilepsy might differ depending on genetics, infectious diseases, and access to healthcare. To comprehend the prevalence of MRI abnormalities and their correlation with seizures, local data is essential. However, there are limited data that particularly examine MRI findings in individuals with seizure disorders in the Port Harcourt metropolis. Hence, the need for this study.

MATERIALS AND METHOD

This employed a retrospective descriptive study design that utilized MRI reports of patients who underwent conventional brain MRI investigations with a 1.5 Tesla machine at a tertiary medical imaging facility in Port Harcourt, Rivers State between January 2015 and January 2023. Ethical approval was obtained from the Ethics Committee of the Department of Radiography and Radiological Science, University of Calabar (Approval Number: UC/ECRA/21/012) to access a total of 122 brain MRI reports which were carefully selected from the hospital's electronic archive (MedPlus), and reviewed to meet the inclusion criteria set for the study.

All patient data used for this study were treated with high level of confidentiality.

Inclusion and exclusion criteria

The study included reports of patients formally diagnosed with seizures while those with history of brain trauma and surgery were excluded.

Data collection

The patient's age, sex, clinical indications, and radiological findings were data documented for the study.

Ethical approval

Ethical approval was obtained by the Ethics

Committee of the Department of Radiography and Radiological Science, University of Calabar (Approval Number: UC/ECRA/21/012).

Data Analysis

The data collected were processed using Microsoft Excel 2013. The Statistical Package for Social Science (SPSS) Inc., Chicago, IL, USA, version 25.0 was used for the analysis. The patient's descriptive data were provided in frequencies, mean, and standard deviation (SD). Pearson chi-square was used to examine the effect of age and gender on the MRI findings. The level of significance was set at $p < 0.05$.

RESULTS

Table 1: illustrates a significant ($p < 0.05$) association between age group and the MRI findings

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.910 ^a	4	.000
Likelihood Ratio	32.192	4	.000
N of Valid Cases	122		

Table 2: Association between gender and the MRI findings ($p < 0.05$)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.460 ^a	1	.117
Likelihood Ratio	2.466	1	.116
N of Valid Cases	122		

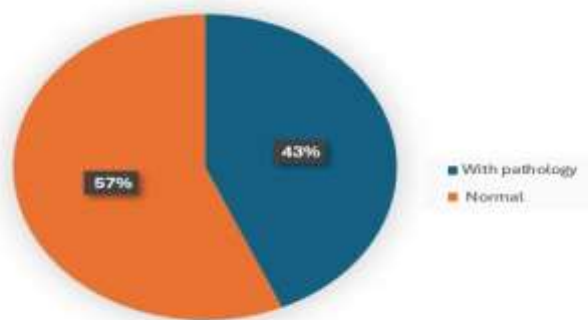


Figure 1: Distribution of brain MRI findings among seizure patients

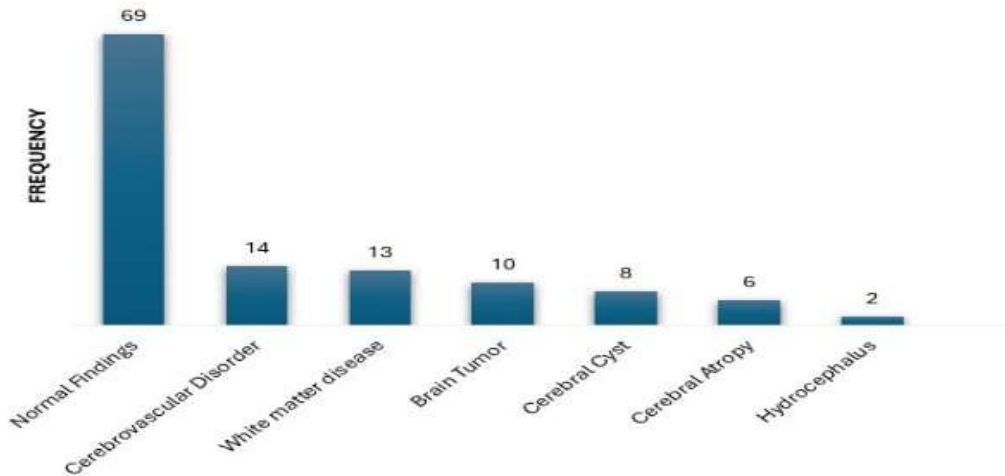


Figure 2: Prevalence of specific pathologies among seizure patients

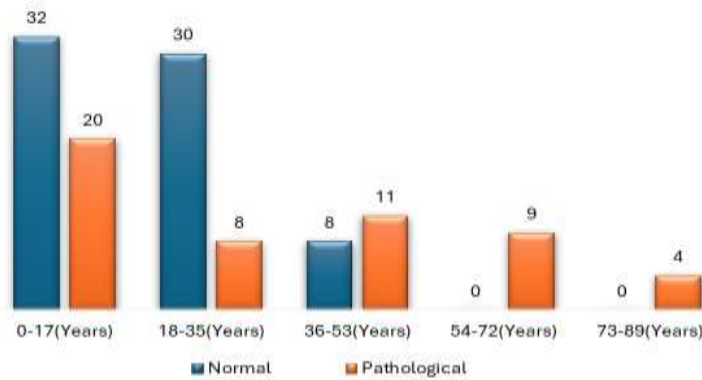


Figure 3: Distribution of MRI findings (normal and pathological) across different age groups

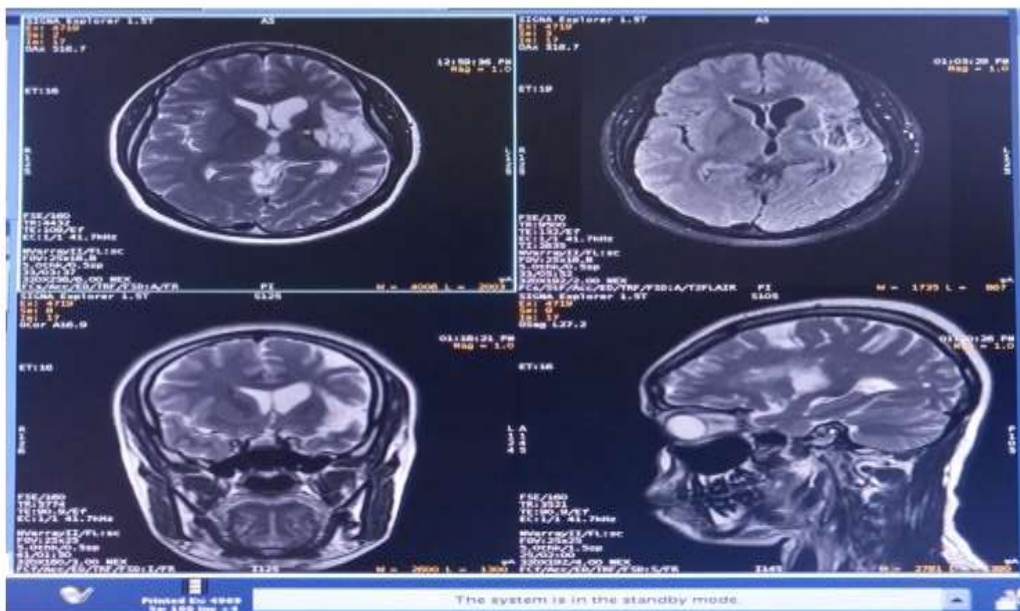


Figure 4: Axial T2-Axial FLAIR- Coronal T2-Sagittal T2 (From left to right) images of a 27-year-old Female seizure patient with left parietal lobe ischemic stroke

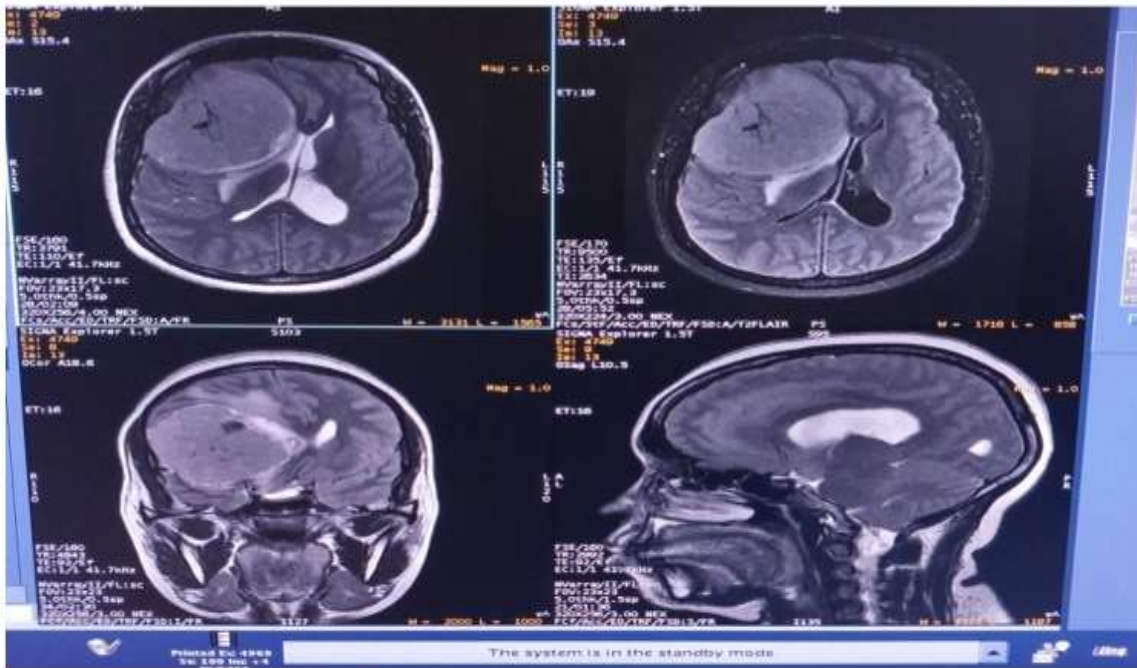


Figure 5: Axial T2-Axial FLAIR- Coronal T2-Sagittal T2 (From left to right) images of a 33-year-old Female seizure patient with right frontal lobe mass

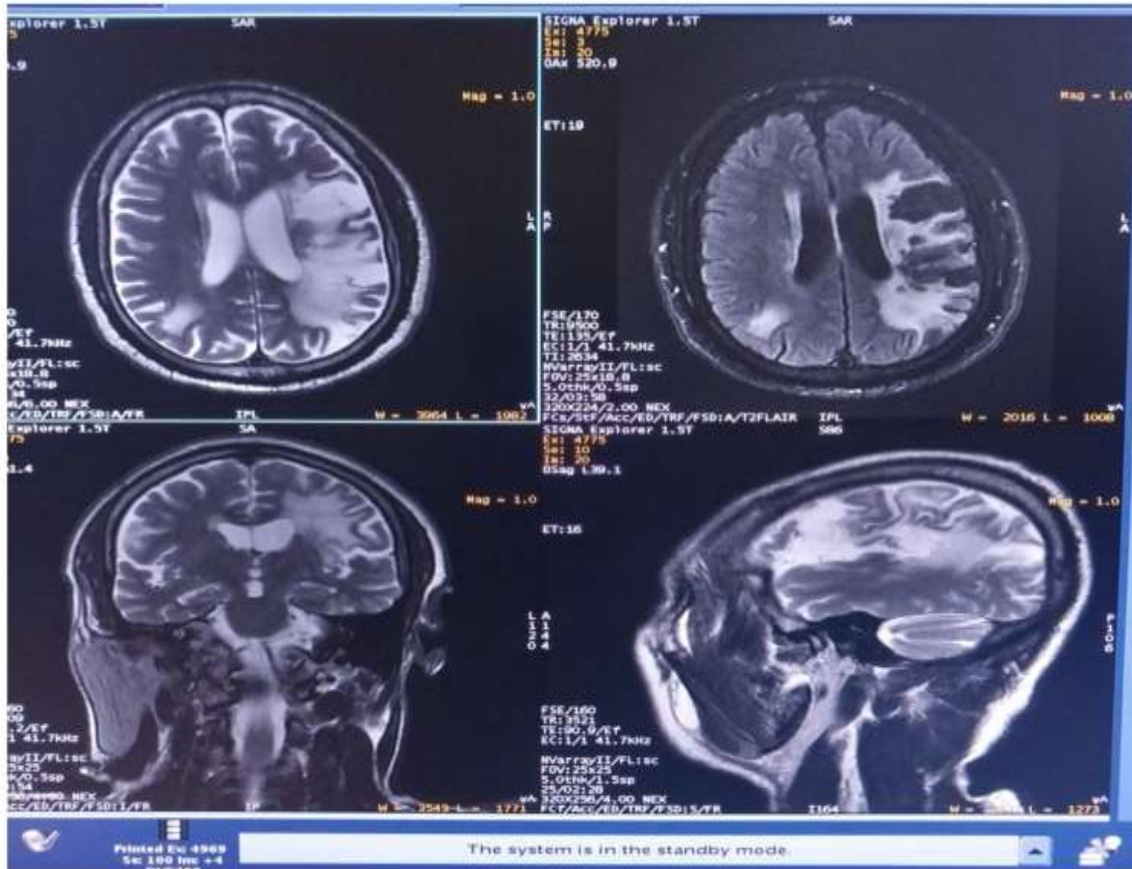


Figure 6: Axial T2-Axial FLAIR- Coronal T2-Sagittal T2 (From left to right) images of a 66-year-old Male seizure patient with left parietal intracerebral infarcts with hemorrhagic transformations.

The present study evaluated MRI brain findings of 122 subjects (64 females and 58 males) aged 0 to 89 years. Result showed that 69 (57%) of the patients with suspected cases of seizure, had normal brain MRI findings while 53 (43%) had abnormal finding (Figure 1). Figure 2 illustrates that the most predominant pathology was cerebrovascular disorder 14 (11.48%) followed by white matter disease 13 (10.66%), and brain tumour 10 (8.20%). Figure 3 demonstrates the distribution of MRI findings (normal and abnormal) across the different age groups. Table 1 illustrates a significant ($p < 0.05$) association between age group and the MRI findings. The most pathological findings (20/53; 37%) were seen in the age group 0-17 years, followed by the age group 36-53 years (11/53; 21%), then 54-57years (9/53; 17%) the oldest age group 73-86 years recorded the least (4/53; 0.1%). At a $p < 0.05$ significant association noted between age and the MRI findings (normal and pathological), no significant association noted between gender and the MRI findings (Table 2). At $p < 0.05$ No significant association was noted between gender and the MRI findings (normal and pathological).

DISCUSSION

Seizure disorder has become a widespread public health concern affecting people of all ages. The MRI has developed useful diagnostic tool that guides surgical procedures and therapy plans, improving the prognosis of patients with seizures (Cendes *et al.*, 2016; Sarmast *et al.*, 2020).

The present study examined brain MRI results of a heterogeneous cohort of 122 patients with queried/suspected cases of seizure. Remarkably, 43% of the patients had at least one abnormal structural finding on the MRI scans, but majority of the patients (57%) had normal brain findings (Figure 1). This aligns with studies that reported more than two-third of patients with normal brain MRI findings and another in Keyna that reported significantly higher (77%) percentage of normal brain MRI findings in childhood epilepsy (Akinmoladun *et al.*, 2020; Samia *et al.*, 2021). However, similar works in Kampala-Uganda contradicts a reported higher (74.15%) prevalence of structural abnormalities in an epileptic paediatric population where the author acknowledged that selection bias may have played a role in this high yield, as the study was conducted in specialized paediatric neurology clinics within selected tertiary facilities (Apolot *et al.*, 2022). The aetiology of seizure disorder in patients with normal brain MRI findings has been linked to genetic and metabolic disorders, particularly in paediatric patients whose effects are covert on conventional MRI scans (Almannai *et al.*, 2021; Zimmerman, 2011; Yu and Pear, 2013). This calls for further specialized imaging techniques such as functional MRI (fMRI) and magnetic resonance spectroscopy (MRS), which assess brain function and evaluate brain chemical activity respectively with more

comprehensive multidisciplinary approach to patient diagnosis and treatment involving neurology, psychiatry, geneticists, and endocrinologists. Moreover, studies have shown that fMRI has become a noninvasive intraoperative alternative for intraoperative cortical stimulation and the Wada test for eloquent cortex mapping and language lateralization in seizure cases, respectively (Kesavadas and Thomas, 2008). Additionally, MRS has shown high sensitivity in determining the side of involvement and temporal lobe epilepsy (TLE) in patients with TLE, even in patients with normal findings on conventional MRI studies (Fung *et al.*, 2020). The most common abnormality found in the patients is shown in Figure 2. Cerebrovascular disease (11.48%) was the most frequent pathology (Figure 4), followed by brain tumour, 10.20% (Figure 5) and white matter disease (10.66%). This result is in tandem with a study that ranked cerebrovascular lesions and brain tumours as the first and second most frequently detected potentially epileptogenic lesions in adults with a new onset of seizure (King *et al.*, 1998). Similarly, a recent study in Ibadan- Nigeria also reported cerebral tumours and ischemic infarcts (Figure 6) as the most common MRI finding in epileptic children. Ischemic and haemorrhagic strokes have also been noted to cause decreased blood flow, neuroinflammation, and gliosis resulting in excitotoxicity and altered ion channel function thereby eliciting epilepsy (Phan *et al.*, 2022). Additionally, the scarring (sclerosis) left behind after a stroke can also serve as a focal seizure site. The epileptogenic effect of tumours is seen in their ability to cause hyper-excitability. Edematous tumours also, cause blood vessel permeability to increase, this affects neuronal excitability and lowers the seizure threshold (Friedman and Heinemann, 2012). Demyelination caused by white matter diseases such as leukodystrophies and multiple sclerosis, reported in the present study, can change neuronal firing patterns and ultimately cause a seizure.

Most pathological findings (20/53; 37%) were seen in the age group 0-17 years, followed by the age group 36-53 years (11/53; 21%), then 54-57years (9/53; 17%). The oldest age group (73-86 years) recorded the least (4/53; 0.1%). The prevalence of pathological findings in the paediatric population points to their vulnerability, which could be probably from birth complications, genetic predispositions, early exposure to chemicals, and developmental factors. Therefore, it is imperative to seek early and accurate diagnosis as well as to focus research towards understanding aetiology and risk factors specific to the paediatric population. The decreased life expectancy in the study area could have impact on the study's reduced number of elderly patients (Atchessi *et al.*, 2018). According to WHO, the average life expectancy in Nigeria is 62.2 years, which is lower than the highest age group in the study locale. This may have affected the study's demographic representation, resulting in

fewer people in the oldest age group. Another reason could be the poor healthcare-seeking behaviour of the elderly in the study population (Atchessi *et al.*, 2018). A study utilizing information from the Nigerian General Household Survey revealed that the elderly had a lower-than-average tendency to seek medical attention, a behaviour that is linked to low income and inadequate education (Atchessi *et al.*, 2018). While the present study did not look at the specific seizure type concerning sex, a study on sex and hormonal influences on seizure and epilepsy reported that clinical and experimental evidence shows that during early childhood idiopathic generalized epilepsy, Aicardi syndrome, and Rett syndrome are more common in females while febrile seizures, generalized myoclonic epilepsies and infantile spasms are commoner in males (Atchessi *et al.*, 2018). However, the present study reported no significant association between MRI findings and sex in the study population which is at variance with another study that reported more abnormal findings in male adolescents using low-field (0.36T) MRI (Akinmoladun *et al.*, 2020). This variation may be attributed to MRI field strength, protocol differences, and variations in lifestyle and local disease patterns between the two study populations.

CONCLUSION

The study reported that the majority of seizure patients had normal brain MRI findings. Cerebrovascular disorders, white matter disease, and brain tumour which were the most common pathological findings that predominate the younger population (0-17 years). Consequently, early MRI scans for all patients with seizure disorders could prove beneficial. The study highlights the importance of early MRI scans for seizure patients; early screening may help identify underlying cerebrovascular disorders. Additionally, the prevalence of brain disorders in the younger patients emphasizes the need for clinicians to prioritize early MRI scans in children and adolescents in their diagnostic workup of seizure disorder.

CONFLICTS OF INTEREST: None declared

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