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Frequency of Temporal Lobe Lesions in People with Epilepsy. A Single Center Study

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ABSTRACT

Background: Temporal lobe epilepsy is characterized by seizures originating from the temporal lobe, common causes which include mesial temporal lobe sclerosis and tumors. In a community with high rates of brain injury and risk factors for epilepsy, it is expected that the rate of mesial temporal lobe sclerosis will be high. The aim of this study is to describe the pattern of brain MRI temporal lobe lesions in people living with epilepsy in Enugu Nigeria.

Methods: This was a retrospective descriptive study carried out at Memfys Hospital Enugu. MRI reports included in the study were between December 2019 and June 2022.

Results: Out of the 875 brain MRIs of people living with epilepsy, 120 (13.7%) had lesions localized on the temporal lobe. There was no significant difference in the age distribution of the patients. Mesial temporal sclerosis was diagnosed in 33 (27.5%) out of the 120 with temporal lobe lesions. Other common structural findings were atrophy 21(17.5%) and tumors 14 (11.7%). Mesial temporal lobe sclerosis and atrophy decreased with age. Other parts of the brain involved were parietal lobe (18.3%) and frontal lobe (15.8%).

Conclusion: Temporal lobe lesions were found in 13.7% of people with epilepsy in Enugu. Mesial temporal lobe sclerosis was found in 27.5% of epilepsy patients with temporal lobe lesions. The frequency of temporal lobe lesions decreased with age. Other brain MRI findings were temporal lobe atrophy 17.5% and tumors 11.7%. Routine use of brain MRI is useful in elucidating the burden of temporal lobe epilepsy in the community.

Introduction

Temporal lobe epilepsy is characterized by seizures originating from the temporal lobe. They are often divided into mesio-basal and lateral neocortical temporal lobe seizures[1]. Clinically, however, symptoms overlap. The prevalence of temporal lobe epilepsy varied widely from published studies. In community-based studies, about 60–70% of focal seizures originate in the temporal lobe[2]. Hauser and Kurland reported a prevalence of 10.4 per 100 000 in Rochester Minnesota from 1935-1967[3] Semah et al.[4] reported 24% of all cases of epilepsy originated from the temporal lobe and about 66% of focal epilepsies were temporal lobe epilepsy. Manford et al.[5] in a study of 594 (21%) of cases with epilepsy, 41% had focal epilepsy out of which 21% had temporal lobe epilepsy. The overall proportion of temporal lobe epilepsy was 9%. Surgical series reported higher rates of temporal lobe epilepsy based on brain resections. Wass et al.[6] reported 73%, Rougier et al.[7] reported 76%, Daniel and Chandy[8] reported 73%. Others reported slightly lower rates[9,10].

Causes of temporal lobe epilepsy vary with age with structural lesion more likely to be seen in older individuals[1,2,11–13]. Reported MRI findings are brain tumors, brain trauma, cerebrovascular diseases and central nervous system infections[1,2,12–14]. Other pathologies seen are malformations of cortical development, or gliosis as a result of encephalitis or meningitis[1,7,8,12,14].

Mesial temporal lobe sclerosis is a common cause of temporal lobe epilepsy. It is the second commonest cause of temporal lobe epilepsy in children and a primary indication for surgical intervention in patients with epilepsy[1-3]. The commonest pathology underlying mesial temporal lobe seizures is hippocampal sclerosis[1,15,15] which is characterized by significant loss of neurons in the hilus of the dentate gyrus and pyramidal neurons in the Ammon's horn of the hippocampus, particularly in the CA1 and CA3 regions[16,17]. Pathologically cell loss and astrocytosis is unrelated to Alzheimer's disease pathology[18].

The mesial temporal lobe may be idiopathic or secondary[17]. Secondary mesial temporal lobe sclerosis is associated with repetitive seizures such as in status epilepticus or in febrile seizures, brain injury, infections or surgery[2,15–18].

No study in Nigeria has described MRI brain reports in people living with epilepsy. The relative frequency of temporal lobe abnormalities is also not known as well as the frequency of mesial temporal lobe sclerosis/hippocampal sclerosis. In a community with high rates of complex febrile seizures, poor seizure control and brain injury, it is expected that the rate of mesial temporal lobe sclerosis to be high. The aim of this study therefore is to describe the pattern of brain MRI temporal lobe lesions in people living with epilepsy in Enugu Nigeria.

Methods

This was a retrospective, descriptive study carried out at Memfys Hospital Enugu which is a private tertiary Hospital and a referral neurology /neurosurgery center. The study included only individuals who had brain imaging using 1.5T MRI machine and were aged 50 years and above. All images were obtained in sagittal T1, T2, GRE Stir, axial and coronal T1, T2 sequences. Only patients with a diagnosis of epilepsy were included in the study. We retrieved previous brain MRI reports of patients done in the hospital. MRIs in Memfys hospital are reported by consultant radiologists, however in cases of doubt or ambiguity the images are reviewed by two or more radiologists and sometimes with the physician/surgeon involved in managing the patient to ascertain the accurate diagnosis. MRI reports included in the study were between December 2019 and June 2022. As at the time of the study, a total of 875 brain MRIs were carried out in patients with epilepsy. All patients were coded using existing hospital numbers. Patients' names were not included in the current study. Information such age, sex and clinical/ referral diagnoses were retrieved from the hospital records. Data was collected using a structured questionnaire.

ETHICAL CONSIDERATIONS: This was a retrospective study and did not pose any risk for the participants. Ethical approval was gotten from the ethic committee of Memfys hospital. To ensure the privacy of participants, all data collected was anonymized and any personal identifiers removed from research-related information.

Statistical methods

For database management and statistical analyses, we used the SPSS version 26 (IBM Corporation, New York, NY, USA). Data were presented on

tables and figures. For continuous variables, mean values and standard deviation were calculated. Prevalence of white matter hyperintensities was expressed as percentages. Other statistical methods also included Student's T-test for unpaired observations to compare means. In all, P value < 0.05 was regarded as statistically significant. Conclusions were drawn at the level of significance. The confidence level was kept at 95%.

Results

Out of the 875 brain MRIs done on people living with epilepsy, 120 (13.7%) had lesions localized on the temporal lobe and about 60% of them were males. Most of the patients were less than 20 years, although there was no significant difference in the age distribution of the patients. About 7.4% of the patients presented with severe headaches as well.

Table 1. General characteristics of participants

N	Male	Female	Total	P-value
Age, range				
Mean age, years	31.6(20.9)	29.6(22.5)	30.8(21.5)	0.63
Median age (range), years	30.5(1-74)	23.5 (0-84)	26 (0-84)	
Age group, years				
≤19	24(33.3)	19(39.6)	43(35.8)	
20-39	25(34.7)	15(33.3)	40(33.3)	
≥40	23(31.9)	14(30.8)	37(30.8)	0.78
Present complaints				
Epilepsy	69(95.8)	47(97.7)	116(80.4)	
Epilepsy/Headache	3(4.2)	1(2.1)	4(7.4)	
Total	72(60)	48(40)	120(100)	**<0.01**

P-values are for sex differences.

Mesial temporal sclerosis was diagnosed with 28 (23.3%) out of the 120 with temporal lobe lesions. Another 5 individuals had hyperintensities seen on MRI raising the possibility of mesial temporal lobe sclerosis to 33 (27.5%). Other structural findings were atrophy 21(17.5%) and tumors 14 (11.7). Other findings are shown in Table 2, Figures 1 and 2.

Figure 1. Findings on Brain MRI.

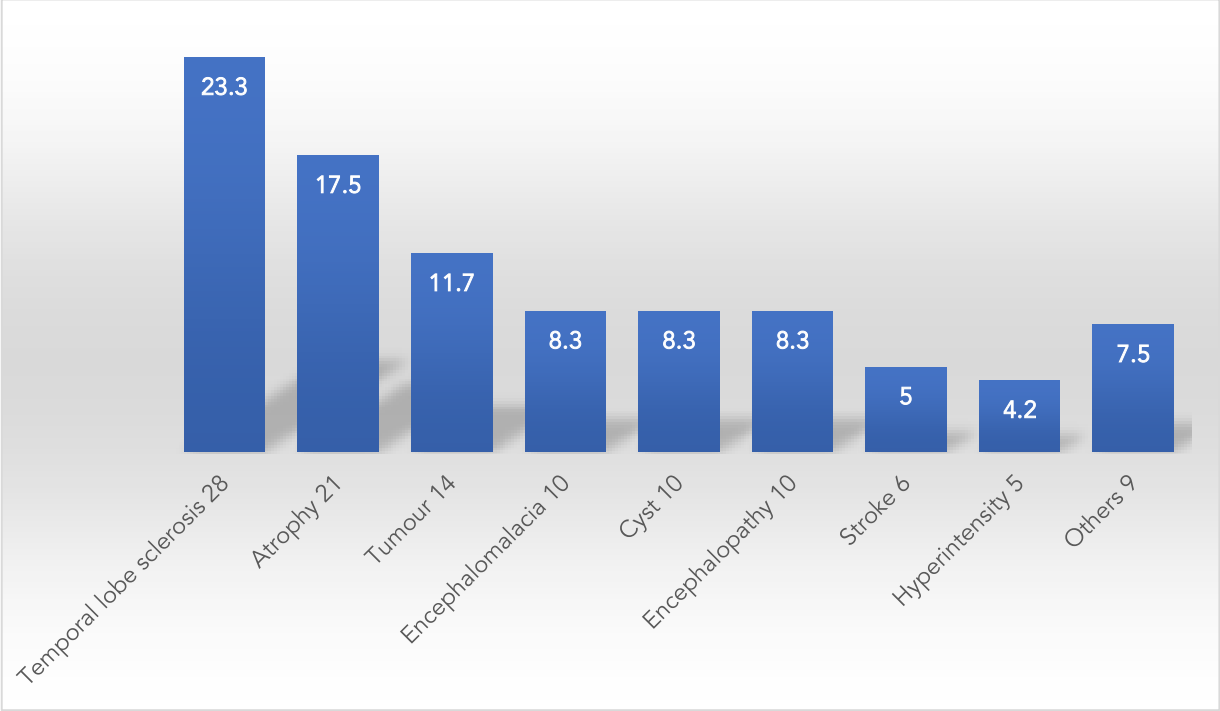
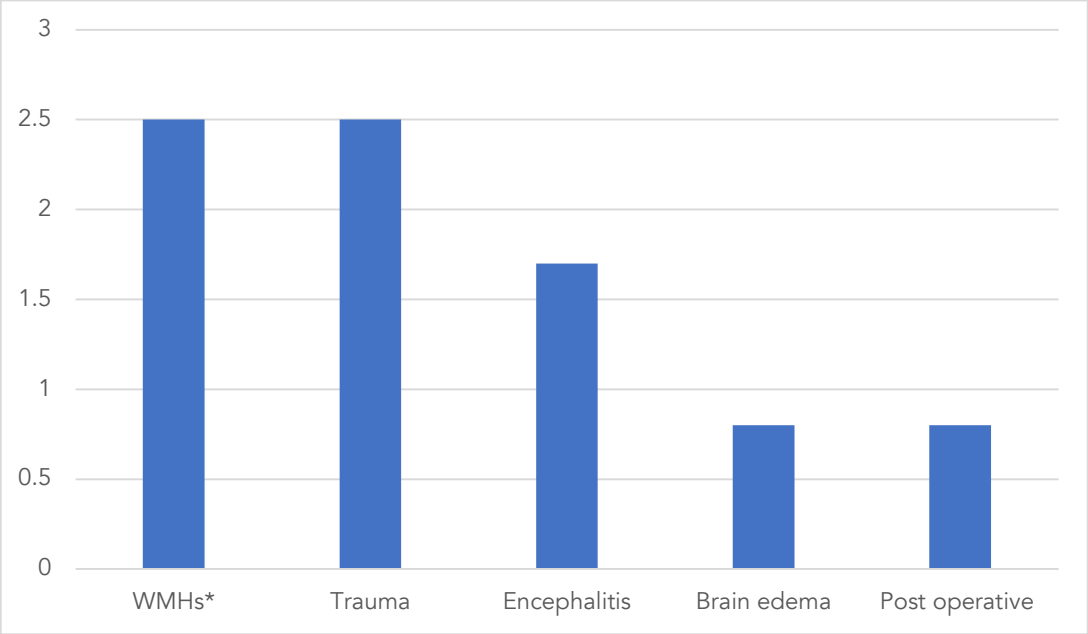


Figure 2. Other brain MRI findings on the temporal lobe.



*WMHs white matter hyperintensities.

Brain MRI findings did not show any sex differences. Mesial temporal lobe sclerosis and atrophy decreased with age. Brain tumors and encephalomalacia increased with age. Other findings did not show age difference with age. Table 2.

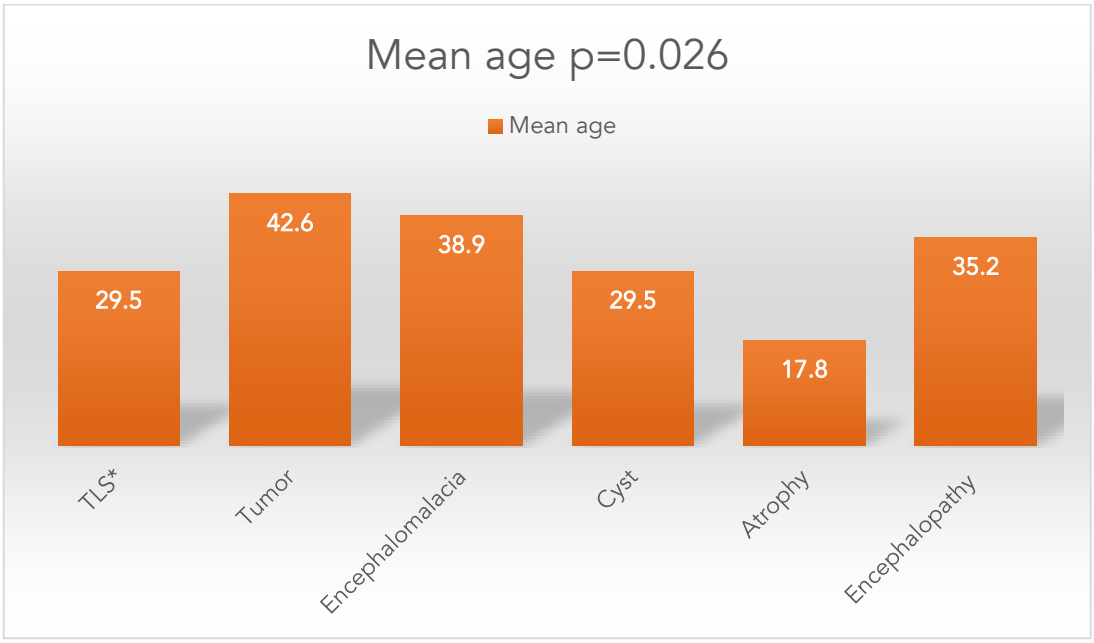
Twelve (57.1%) out of the 21 cases of brain atrophy were unilateral (right 6 and left 6) Most cases of mesial temporal lobe sclerosis were bilateral. Table 2.

Table 2. Pattern of temporal lobe lesion in people with epilepsy.

	TLS*	Atrophy	Tumour	Encephalomalacia	Encephalopathy	Cyst	Other lesions	Total
Sex								
Male	14(50	12(57.1)	9(64.3)	9(90)	6(60)	6(60)	16(59.3)	72(60)
Female	14(50)	9(17.5)	5(35.7)	1(10)	4(40)	4(40)	11(40.7)	48(40)
Age group (years)								
0-19	12(42.9)	14(66.7)	3(21.4)	1(10)	2(20)	4(40)	7(25.9)	43(35.8)
20-39	9(32.1)	4(19)	3(21.4)	5(50)	4(40)	3(30)	12(44.4)	40(33.3)
≥ 40	7(25)	3(14.3)	8(57.1)	4(40)	4(40)	3(30)	8(29.6)	37(30.8)
Side								
Right	3(10.7)	6(28.6)	7(50)	4(40)	-	4(40)	7(25.9)	31(25.8)
Left	-	6(28.6)	7(50)	6(60)	5(50)	5(50)	9(33.3)	38(31.7)
Bilateral	20(71.4)	7(33.3)	-	-	4(40)	1(10)	9(33.3)	41(34.2)
Diffuse	-	2(9.5)	-	-	-	-	-	2(1.7)
Not specified	5(17.9)	-	-	-	1(10)	-	2(7.4)	8(6.7)
Total	28(23.3)	21(17.5)	14(11.7)	10(8.3)	10(8.3)	10(8.3)	27(22.5)	120(100)

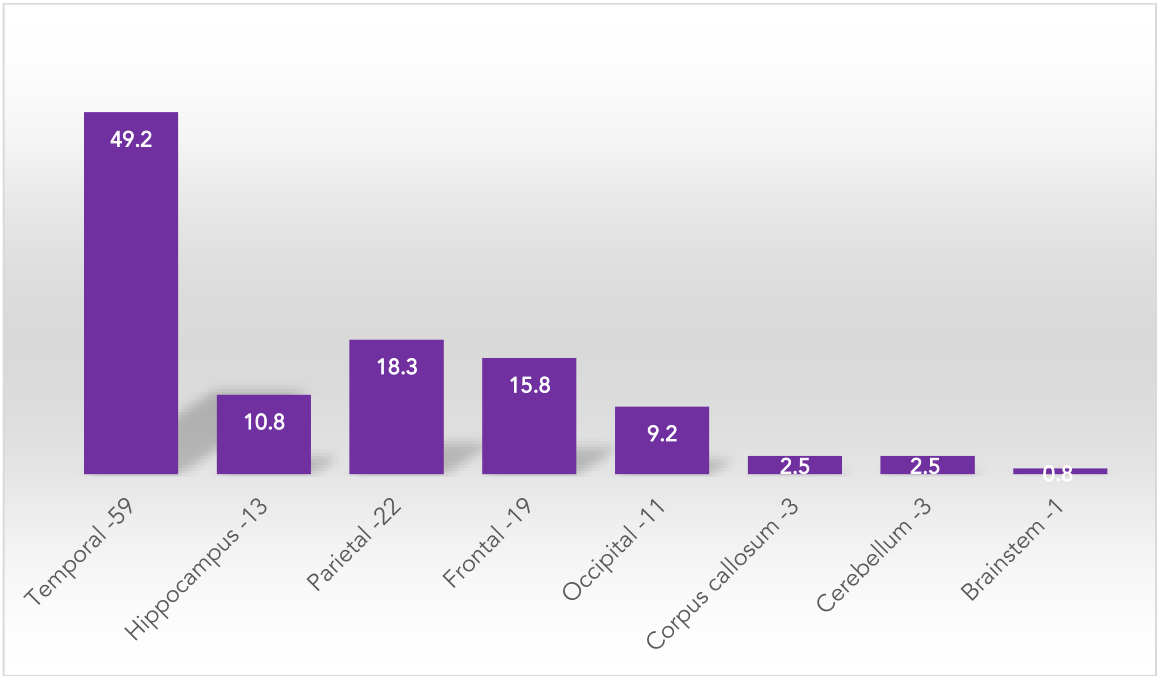
The mean age of patients with different lesions is shown in Figure 3. Patients with temporal lobe atrophy were the youngest followed by those with mesial temporal lobe sclerosis and brain cysts. Patients with brain tumors and encephalomalacia were the oldest.

Figure 3. Mean age of occurrence of different lesions.



The study shows that apart from the temporal lobe/hippocampus (60% of the lesions), other parts of the brain were also involved. Parietal lobe (18.3%) and frontal lobe (15.8%) were the commonest part of the brain involved. Figure 4.

Figure 4. Part of the brain with pathologies in people with temporal seizures.



Discussion.

The temporal lobe is a common seizure focus with an estimated 60-70% of focal seizures originating from there[2]. Commonly the diagnosis of temporal lobe seizures is suspected on clinical basis however, however brain MRI is a useful diagnostic tool in confirming the diagnosis[19]. Reports show that most patients with temporal lobe epilepsy will have structural lesion on MRI[1,11,13,19,20] and the frequency and pattern of these lesions vary with age and possibly geographical location because risk factors for epilepsy vary with age and location[14].

Our index study evaluated lesions found on the temporal lobe of people evaluated for epilepsy/seizures. Mesial temporal sclerosis was the most frequent finding reported in 23.3% of the participants. Other structural findings were atrophy 17.5% and tumors 11.7%. Overall, structural brain MRI findings in the patients did not show sex predilection, however mesial temporal lobe

sclerosis and atrophy decreased with age. Brain tumors and encephalomalacia increased with age.

Most of the patients in this study were males. Temporal lobe epilepsy does not show any gender predilection however they may be associated with hormonal fluctuations in females thus increased rate of diagnosis in females[13]. In this study, the diagnosis 'mesial temporal lobe sclerosis' together with 'temporal lobe hyperintensity' were the most frequent lesion reported which is similar to previously reported cases[13]. The hippocampus is strongly associated with epileptic seizures and is particularly vulnerable to secondary damage resulting from recurrent seizures or other brain insults. These factors lead to gliosis, neuronal loss, and subsequently to reorganization of neurons making it strongly epileptogenic[16,17]. Temporal lobe sclerosis is a common cause of focal seizures especially in children[2,20]. The frequency of mesial temporal lobe sclerosis in the in-index study is within the ranges of 23-29% reported in previous studies[4–6,9,10]. These studies, also reported relatively high frequency of tumors. Temporal lobe tumors may account for up to 40% of lesions seen in temporal lobe in people with temporal lobe epilepsy[21,22] which is much higher than 4% reported in our study.

Studies have shown that temporal lobe sclerosis may be primary or secondary. Secondary temporal lobe sclerosis has been associated with prolonged febrile seizures[1,11,14,19]. The FEBSTAT study[23] demonstrated evidence of acute hippocampal injury following febrile seizures in Sommer's sector and impaired hippocampal growth in affected patients. Studies have also demonstrated the role of inflammation and autoimmune encephalitis in the pathogenesis of temporal lobe sclerosis and epileptogenesis[24,25]. The nature of initial precipitating factors has also been implicated in the development of mesial temporal lobe sclerosis. These initial precipitating lesions are generally defined as significant clinical events that occur prior to the onset of TLE[27]. Mesial temporal lobe sclerosis has also been reported in dementia and stroke[14,26,26,27]. In communities with multiple infectious risk factors for epilepsy, brain injury, stroke and febrile seizures, the frequency of temporal lobe sclerosis is expected to be high.

Genetic factors have also been implicated in mesial temporal lobe sclerosis. It is possible that febrile seizures and mesial temporal lobe sclerosis share the same risk factors[1,2]. Our study showed a predominance of temporal lobe sclerosis in younger individuals. Mesial temporal lobe sclerosis in common in the younger age group, however it has been reported as a cause of first onset seizures in the elderly[21]. The mean (median) age of mesial temporal lobe sclerosis in the index study is similar to what has been reported in the literature[1,11].

Temporal lobe atrophy is another important finding in this study. The frequency of temporal lobe atrophy decreased with age suggesting possible congenital or early life brain insult as the possible causes. Birth related injuries are reported to be the commonest preventable risk factor for epilepsy in Nigeria. These injuries may lead to focal brain atrophy, gliosis and encephalomalacia.

The mean ages of patients with different lesions are shown in Figure 4. People with temporal lobe tumors, encephalomalacia and encephalopathy were the oldest. Temporal lobe sclerosis, cysts and brain atrophy were the youngest which may support a congenital or early onset.

Mesial temporal lobe sclerosis may be unilateral or bilateral[12,13]. It has been reported that up to 80% of temporal lobe sclerosis may be bilateral.[19] This is similar to the index study where 71% had bilateral involvement, 10.7% had unilateral while the rest were not specified.

The existence of dual pathology where mesial temporal lobe sclerosis may exist with other temporal lobe lesions are said to be common. The incidence of dual lesions in literature ranges from 8-22% and in our index study the frequency of dual lesions is 22.5%. Lesions that may co-exists with mesial temporal lobe sclerosis include tumors, focal cortical dysplasia, stroke among others.[19] In children, the incidence of dual pathology is reported to be higher than adults[11,14].

Furthermore, in the index study we found comorbid lesions in other parts of the brain. Temporal lobe lesions only were seen in 60% of the cases (72/120) while other parts of the brain were affected in other cases. Frontal and parietal lobes were the most frequent parts of the brain that were affected. The coexistence of lesions in other parts of the brain may be related to initial precipitating factors such as injury and infections.

The utility of high resonance MRI in the evaluation of epilepsy and especially in temporal lobe epilepsy have long been reported. In people with temporal lobe epilepsy, coronal images are very valuable and very informative. All patients with epilepsy who met the criteria for brain MRI evaluation should get at least a 1.5-Tesla MRI. This will not only improve diagnostic yield but also detect possible comorbidities in the other parts of the brain. It also provides a clue to patients who may likely benefit from epilepsy surgery.

Limitations. This study is the first to explore temporal lobe abnormalities in people living with epilepsy in our Nigeria, however it has some limitations. We looked at MRI results and did not correlate with clinical findings. Brian MRI should be interpreted in context of clinical and electroclinical findings because false positives may exist, and MRI evidence of mesial temporal lobe sclerosis may occur in normal individuals[1,16,19,21]. Objective quantitative methods such as volumetry also improve the diagnosis of mesial temporal lobe sclerosis[28–30]. The second limitation of this study is related to the first. Some of the patients with temporal have seizures originating from other parts of the brain. These limitations, notwithstanding, we have been able to document a high rate of mesial temporal lobe sclerosis and other temporal lobe lesions in people living with epilepsy.

Conclusions.

Temporal lobe lesions were found in 13.7% of people with epilepsy in Enugu. Mesial temporal lobe sclerosis was found in 27.5% of epilepsy patients with temporal lobe lesions. The frequency of temporal lobe lesions decreased with age. Other brain MRI findings were temporal lobe atrophy 17.5% and tumors 11.7%. Routine use of brain MRI is useful in elucidating the burden of temporal lobe epilepsy in the community.

Conflict of Interest Statement:

None.

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