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Original Research

A Comparative Study of Clinical and Electroencephalographic Findings of the Children with Epilepsy with or without Cerebral palsy in a Tertiary Health Facility in Nigeria

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Abstract

Background: Epilepsy, whether occurring alone or with cerebral palsy (CP), is among the most common neurological disorders seen in paediatric neurology clinics in Nigeria. Management requires accurate diagnosis and classification, which becomes more challenging when epilepsy coexists with CP. Electroencephalography (EEG) is a valuable tool for confirming and characterising epileptic activity. This study aimed to compare the clinical and EEG characteristics of children with CP and epilepsy (Group 1) and those with epilepsy without CP (Group 2) in a Nigerian tertiary institution.

Methodology: This prospective, cross-sectional, comparative study was conducted from March 2022 to February 2023. A total of 121 children with epilepsy and CP (Group 1) and 124 with epilepsy only (Group 2), aged 6 months to 15 years, were consecutively recruited. Clinical profiles and EEG findings were compared. Data were analysed with SPSS version 25.0, with $p < 0.05$ considered significant.

Results: The median age at epilepsy onset was 12 months (IQR: 9.5) in Group 1 and 49 months (IQR: 58.7) in Group 2, showing a significant difference ($p < 0.001$). Uncontrolled epilepsy was more common in Group 1, occurring in 50 of 72 (69.4%) on antiepileptic drugs, compared to 12 of 69 (17.4%) in Group 2 ($p < 0.001$). Generalized-onset epilepsy was most frequent in both groups (59.5% vs. 54.8%, $p = 0.844$). West and Lennox–Gastaut syndromes appeared only in Group 1, while Doose syndrome occurred only in Group 2.

Conclusion: A disparity was observed between clinical and electroencephalographic (EEG) classifications, particularly among children with epilepsy and cerebral palsy. EEG evaluation is therefore recommended as an essential component of epilepsy management in this population.

Keywords: Children; Epilepsy; Cerebral Palsy; Electroencephalography.

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Introduction

Epilepsy is a leading cause of childhood neurological morbidity worldwide and is associated with substantial medical, psychosocial, and economic consequences, particularly in low- and middle-income countries (LMICs).[1–3] Cerebral palsy (CP) is the most common cause of chronic motor disability in childhood,[4]and together, epilepsy and CP constitute the two most frequent neurological disorders seen in African paediatric neurology clinics.[1–3,5]The coexistence of epilepsy and CP is well documented, with prevalence ranging from 15–90% globally[6–9] and 36.9–60% in Nigeria[10,11]. Despite this high burden, most studies describing epilepsy in children with CP have been retrospective[7,8] and non-comparative, limiting the understanding of how clinical and electroencephalographic (EEG) features differ between children with epilepsy and CP and those with epilepsy alone.[2,3,10–13]

EEG provides objective evidence of abnormal cortical electrical activity, enabling confirmation of epileptic seizures and differentiation from seizure mimics such as dystonic posturing, paroxysmal dyskinesias, startle responses, and other non-epileptic events common in CP.[14,15] This distinction is particularly important in resource-limited settings where diagnosis often relies solely on clinical observation. EEG also improves seizure classification; for example, it may reveal focal discharges in children initially diagnosed with generalized seizures based on clinical presentation, thereby influencing both treatment selection and prognosis.[16]

Clinically, children with epilepsy and CP often have an earlier age of seizure onset, higher seizure frequency, greater drug refractoriness, and more frequent episodes of status epilepticus compared to those with epilepsy alone. They frequently require polytherapy and present with more complex co-morbidities, including intellectual disability, sensory impairments, and significant motor deficits.[6–9,17] In contrast, children with epilepsy without CP often have more isolated seizure disorders, fewer co-morbidities, and better seizure control.[1,3,7–9]

Evidence on the distribution of seizure types and epilepsy syndromes across these groups is inconsistent: while some studies report a predominance of focal-onset seizures in children with epilepsy and CP[7,9], others find generalized seizures to be more common in both groups.[6]There are also discrepancies in the reported occurrence of specific epilepsy syndromes, such as absence seizures and myoclonic–atonic epilepsy, between the two populations.[6,7,9,17]Many of these studies lack EEG evaluation or employ non-standardised diagnostic approaches. In Northern Nigeria, this problem is compounded by limited access to EEG services in the study area, for example, only three hospitals, all located in the state capital, have functional EEG machines, with non available in the neighbouring states. Such scarcity increases the risk of seizure misclassification, especially in children with CP whose involuntary movements may mimic seizures and perpetuates the substantial epilepsy treatment gap.

In view of these limitations, the present study was designed to prospectively compare the clinical and EEG findings in children with epilepsy with and without CP in a resource-limited setting. By generating locally relevant evidence, this study will contribute to improving diagnostic accuracy, reduce inappropriate antiepileptic drug use, and facilitate tailored management strategies. The findings will also provide context-specific evidence to guide future research and inform health policy, particularly regarding the need for improved EEG access and integrated care pathways for children with neurological disorders in LMICs.

Methodology:

This was a prospective, cross-sectional, comparative, hospital-based study conducted in a Nigerian Tertiary Institution, from March 2022 to February 2023. A total of 121 subjects with epilepsy associated with cerebral palsy (Group 1) and 124 subjects with epilepsy not associated with cerebral palsy (Group 2) were recruited consecutively as they presented to the Paediatric Neurology Clinic, for follow up, or as

new cases. The age range in both groups was 6 months to 15 years. Consent for participation in the study was obtained from the caregivers or parents of all subjects. Where applicable, assent was also obtained from children aged seven years and above. Caregivers who provided consent were required to sign a consent form.

Ethical approval

Ethical approval with Number: NHREC/30/012/2019 was obtained from the research and ethics committee of the Usman Dan Fodio University Teaching hospital Sokoto, Nigeria.

The inclusion criteria for both groups were as follows, with the exception of criterion 2, where absence of cerebral palsy was required for inclusion in Group 2, with or without other co-morbidities

1. Age between six months and 15 years.
2. Presence of both cerebral palsy and epilepsy for Group 1; absence of cerebral palsy for Group 2.
3. Complete electroencephalographic (EEG) recordings, including awake and sleep states, for each subject.
4. Provision of parental consent and, where applicable, assent from children aged seven years and above.

Exclusion criteria for both groups were:

1. Incomplete or unreliable information, including the absence of a primary caregiver or lack of an eyewitness account of the seizure.
2. Acute illness at the time of data collection.
3. Current use of antipsychotic medications by the child.

Epilepsy Diagnosis and Classification

Epilepsy was diagnosed in children with a history of two or more unprovoked seizures, occurring more than 24 hours apart and outside the neonatal period. Seizures had to be either witnessed by a reliable adult or documented by video recording. In cases where verbal descriptions were unclear, parents or guardians were asked to demonstrate the observed seizure semiology to aid in classification.

Seizure types and epilepsy syndromes were classified according to the International League against Epilepsy (ILAE 2017) criteria.[18]

Sample size determination:

The sample size for the study was determined using the formula described below: [19]

The minimum sample size (n) per group was calculated by:

$$n = \frac{\left(Z_{1-\alpha/2} + Z_{\beta}\right)^2 \times (p_1 q_1 + p_2 q_2)}{(p_1 - p_2)^2}$$

$Z_{1-\alpha/2}$ = percentage point of the normal distribution corresponding to the required (two-sided) significance level (α) of 0.05 = 1.96.

Z_{β} = one sided percentage point of the normal distribution corresponding to 100%-the power, i.e. power = 80% (100% - power) = 20% (i.e. p value of 0.2) = 0.84

p_1 = prevalence of epilepsy in children with cerebral palsy from a previous study

q_1= complementary probability of p_1= 1- p_1

p_2= prevalence of epilepsy in children without CP from a previous study

q_2= complimentary probability of $p_2 = 1 - p_2$

To account for a 10% non-response rate and adjust the sample size for a finite population of fewer than 10,000 individuals, the following formula was applied:

$$n_f = \frac{n}{n + \frac{n}{N}}$$

Where:

n_f= adjusted sample size when the study population is less than 10, 000

n= sample size:

N= estimate of the finite population

The calculated sample size is 104 in each group,

Sampling Technique:
Subjects were recruited into the study using a non-probability sampling technique, specifically the purposive sampling method. Participants were enrolled consecutively as they presented to the Paediatric Neurology Clinic in a tertiary health facility in Nigeria, either for follow-up or as new cases, provided they met the inclusion criteria. Recruitment continued until the required sample size was achieved. Each subject was assigned a unique identification number to prevent duplication and ensure confidentiality.

Definition of seizure freedom
Epilepsy was considered controlled when the patient remained seizure-free for a period equivalent to three times the baseline seizure frequency. For example, a child who initially experienced seizures once per month was considered to have good seizure control if no seizures occurred for three consecutive months following the initiation of antiepileptic drug therapy (adapted from Berg et al.)[20]

Conversely, epilepsy was considered uncontrolled if a seizure occurred within a period less than three times the baseline frequency. For instance, a child with a baseline frequency of one seizure per month was classified as having uncontrolled epilepsy if a seizure occurred within three months of initiating antiepileptic treatment (adapted from Berg et al.)[20]

Epilepsy in remission:

Epilepsy was considered to be present but in remission when the individual remained seizure-free for 10 years, with at least 5 of those years without antiepileptic medication (adapted from Fisher et al.)[21]

Epilepsy not in remission

Epilepsy was considered not in remission if the subject experienced a seizure attack within the 10 years preceding recruitment (Fisher et al.)[21]

Diagnosis of cerebral palsy

Cerebral palsy was diagnosed clinically, based on a history of abnormal motor development attributable to a non-progressive brain insult to the developing brain.[4]

Classification of cerebral palsy:

Cerebral palsy was classified according to physiological characteristics into spastic, dyskinetic (dystonic), hypotonic (atonic), ataxic, and mixed subtypes. Spastic cerebral palsy was further sub-classified based on the affected limb(s) (adapted from Balf et al.)[22]

A structured study proforma was administered to each caregiver and/or child in the study groups (i.e., participants who met the inclusion criteria). A comprehensive medical history was obtained, and physical examinations—including a detailed neurological assessment—were performed on all eligible participants. Anthropometric measurements were also recorded for each enrolled subject.

Electroencephalography protocol

All electroencephalograms (EEGs) were performed in the departmental EEG room at the study institution by a senior resident doctor, assisted by the EEG technician in charge of the department and under the supervision of consulting neurologists. The two supervising consultants, who are also co-authors of this study, are paediatric neurologists certified in paediatric EEG interpretation in South Africa. Conventional inter-ictal EEG recordings were obtained using a Satellite P200-132 EEG machine (Toshiba Europe GMBH, DC 19V, 3.4A). Electrodes used were uniform in size, consisting of 5 mm diameter silver chloride cups.

Instrumental control setting:

It was ensured that the EEG machine displayed all instrumental settings, including sensitivity, filter, and paper speed, at the beginning of each recording. The machine was configured to a standard sensitivity of 7 μV/mm, a high-frequency filter of 70 Hz, and a paper speed of 30 mm per second.

Subject preparation

Parents were instructed to avoid using hair conditioner, shampoo, or lotion on the subject's scalp prior to the EEG procedure. The scalp was cleaned with NUPREP gel to reduce impedance caused by sweat and debris. Parents were also encouraged to ensure that the child was fed before the procedure.

Electrodes were placed on the scalp using conductive Ten 20 paste, following the international 10/20 system of electrode placement[23] with recordings obtained from 16 channels. Additionally, electrocardiogram (ECG) electrodes were applied to record cardiac activity concurrently with the EEG. Adhesive paper tape, approximately twice the size of the electrode cup, was applied over each electrode to minimize detachment during the procedure. Electrode cups were thoroughly cleaned prior to placement on each subject.

Sleep deprivation

Each child underwent partial sleep deprivation following a protocol adapted from a previous study.[24] Parents were instructed to allow the child to fall asleep between 8:00 and 9:00 p.m., then to rouse the child by 4:00 a.m. Subsequently, parents were encouraged to keep the child awake by actively engaging him or her throughout the morning until the EEG recording was performed. They were also advised to avoid giving the child any stimulants, such as caffeine, during the sleep deprivation period.[24] Adequate provisions were made to ensure the comfort of both children and caregivers in the EEG waiting room. Each subject underwent conventional inter-ictal EEG recording during sleep and while awake using a standard longitudinal bipolar montage. Additional montages, including transverse, referential, and

average, were also reviewed prior to final interpretation. Each recording session lasted between 30 and 40 minutes.

Melatonin administration

In subjects where natural sleep could not be achieved, sleep was induced using oral melatonin (5-methoxy-N-acetyltryptamine).[25]

Where indicated, the paediatric nurse administered oral melatonin at a dose of 3 mg (one tablet) for children weighing less than 15 kg, and 6 mg (two tablets) for children weighing 15 kg or more.[25]

For subjects who failed to fall asleep within one hour of melatonin administration, a second dose was given.[25] Any child who did not achieve sleep following sleep deprivation and after both doses of melatonin was withdrawn from the study.

Data analysis

Continuous variables such as age and sleep onset latency were summarized using the median and interquartile range. Median values were compared between the two groups using the Mann–Whitney U test. Frequencies and percentages were used to summarize categorical variables. Differences in proportions between the two groups were analysed using the Chi-square test or Fisher's exact test, as appropriate. SPSS version 25.0 was used; Statistical significance was set at p-values less than 0.05.

Results

Comparison of the age at onset of epilepsy between children with epilepsy and CP those with epilepsy not associated with CP

The median age, inter-quartile range (IQR) of onset of epilepsy in subjects in groups 1 and 2 were 12 (9.5) months and 49(58.7) months respectively, and the difference in the median age of onset of the two groups was statistically significant (Mann–Whitney U = 3885.0, p = 0.001)

On categorisation of the age of onset of epilepsy into <5 years and 5 years and above

One hundred and twenty (99.2%) subjects in group 1 had age at onset of epilepsy before the fifth year of life, compared to 69 (55.6%) subjects in group 2. Only one subject in group 1 had the onset of epileptic seizure beyond the fifth year of life, as shown in Table 1.

Table 1: Comparison of age at onset of epilepsy between children with epilepsy associated with CP and those with epilepsy without associated CP

Age in months	Grouping		Statistical Test	p-value
	Group 1	Group 2		
	121(%)	124(%)		
<60months	120(99.2)	69(55.6)	Fisher's exact probability test	P < 0.001
≥60months	1(0.8)	55(44.4)		
Total	121(100)	124(100)		

Fisher's exact probability test, P < 0.001

On comparison of anti-seizure medications given

Sodium valproate and phenobarbitone were the most commonly prescribed antiepileptic drugs in both groups in this study, as shown in Table 2.

Table 2: Distribution of antiepileptic therapy given among subject in group 1 and 2

Types of AEDs	Grouping		Statistical Test	p-value
	Group 1 121(%)	Group 2 124(%)		
Sodium Valproate	47(38.8)	62(50.0)	χ^2=3.37	p=0.337
Phenobarbitone	33(27.3)	27(21.8)		
Carbamazepine	27(22.3)	21(16.9)		
Not on any AEDs*	14(11.6)	14(11.3)		
Total	121	124		

χ^2=3.37, p=0.337 Key: AEDs = Antiepileptic drugs

Comparison of antiepileptic drug polytherapy between group 1 and group 2

Of the 107subjects in group 1 that were already commenced on AEDs, 26 were on two or more drugs compared to 9 subjects out of 110 in group 2. The difference was statistically significant. χ^2= 10.41: df=1 then p-value =0.001.

Past history of status epilepticus

A history of status epilepticus was observed in 25 (20.7%) subjects in group 1, compared to 5 (4.0%) subjects in group 2. This difference was statistically significant (Fisher's exact test, p = 0.001).

Pattern of epileptic seizure

Generalised tonic-clonic seizures were the predominant seizure type in both subjects with epilepsy and cerebral palsy (Group 1) and those with epilepsy without cerebral palsy (Group 2), as shown in Table 3. Notably, epileptic spasms and atonic seizures were observed more frequently in Group 1 compared to Group 2, occurring in 9 (7.4%) versus 0 (0%) and 4 (3.3%) versus 1 (0.8%) of cases, respectively.

Table 3: Patterns of Epileptic Seizures in Children with Epilepsy Associated with Cerebral Palsy Compared to Those without Cerebral Palsy

Variable	Grouping	
Pattern of epilepsy	Epilepsy and CP 121(%)	Epilepsy only 124(%)
Focal tonic epilepsy	11(9.1)	9(7.3)
Focal clonic epilepsy	12(9.9)	18(14.5)
FBTCE	10(8.3)	9(7.3)
Focal myoclonic	4(3.3)	8(6.4)
Focal atonic epilepsy	0(0.0)	1(0.8)

Generalised atonic	4(3.3)	0(0.0)
Generalised tonic epilepsy	2(1.7)	0(0.0)
GCE	1(0.8)	0(0.0)
GTCE	65(53.7)	68(54.8)
MTCE	3(2.5)	0(0.0)
MAE	0(0.0)	9(7.3)
Epileptic spasm	9(7.4)	0(0.0)
Absence epilepsy	0(0.0)	2(1.6)

Key FBTC= focal to bilateral tonic-clonic, GCE=generalised clonic epilepsy, GTCE= generalised tonic clonic epilepsy, MTCE =myoclonic tonic clonic epilepsy, MAE=Myoclonic atonic epilepsy

Observed disparity between clinical and EEG classification of epilepsy

In Group 1, four children with epileptic spasms and two children with a mixed (myoclonic-tonic-clonic) seizure pattern were clinically considered to have focal epilepsy based on history. However, EEG recordings demonstrated hypsarrhythmia in those with epileptic spasms, leading to their classification among patients with West syndrome. The two cases with mixed seizure patterns exhibited generalized spike activity on EEG and were classified as Lennox-Gastaut syndrome. Additionally, one child in Group 1 was clinically diagnosed with generalized tonic seizures, but EEG revealed focal epileptiform discharges.

Epilepsy types based on mode of onset and epilepsy syndromes

Generalized epilepsy with motor onset was the predominant epilepsy type in both subjects with epilepsy and cerebral palsy (Group 1) and those with epilepsy without cerebral palsy (Group 2). Nine cases of West syndrome and three cases of Lennox-Gastaut syndrome were observed exclusively in Group 1, whereas two cases of absence seizure and nine cases of Doose syndrome were identified only in Group 2, as shown in Table 4.

Table 4: Comparison of Epilepsy Types and Syndromes between Children with Epilepsy Associated with Cerebral Palsy and Those without Associated Cerebral Palsy

Epilepsy type	**Grouping**		**Statistical Test**	**p-value**
	Group 1	**Group 2**		
	121(%)	**124(%)**		
Focal aware	9(7.4)	12(9.7)	χ^2=1.4	p= 0.844
FWIAE	18(14.9)	24(19.4)		
FBTC	10(8.3)	9(7.3)		
Generalised motor	72(59.5)	68(54.8)		
Others *	12(9.9)	11(8.8)		
Total	121(100)	124(100)		

χ^2=1.4; df = 4, p= 0.844 Key: FWIAE = Focal with impaired awareness epilepsy, FBTC = Focal to bilateral tonic-clonic. Others* include West syndrome nine (9), Lennox-Gastaut syndrome three (3), Absence seizures two (2) and Doose syndrome nine (9)

Distribution of cerebral palsy types and corresponding epilepsy among subjects in group 1

Spastic quadriplegic cerebral palsy was observed in 61.1% of subjects with cerebral palsy, with 47% exhibiting generalised epilepsy of motor onset, as shown in Table 5.

Table 5: **Types of Cerebral Palsy among Children with Epilepsy Associated with CP and Corresponding Epilepsy Types by Mode of Onset**

CP TYPE	CP FREQUENCY 121(%)	EPILEPSY TYPES					
		FA	FWIAE	FBTC	GM	O‡	TOTAL
S* quadriplegic	74 (61.1)	0	8	9	47	10	74
S* hemiplegic	21(17.4)	9	10	1	1	0	21
S* diplegic	5(4.1)	0	0	0	5	0	5
Dystonic	9(7.4)	0	0	0	9	0	9
Hypotonic	2(1.7)	0	0	0	2	0	2
Mixed**	10(8.3)	0	0	0	8	2	10
Ataxic	0(0)	0	0	0	0	0	0
TOTAL	121(100%)	9	18	10	72	12	121

* =Spastic, **= mixed is the combination of spastic and dystonic CP, CP = cerebral palsy: FA= focal aware epilepsy, FWIAE = Focal with impaired awareness epilepsy, FBTC = Focal to bilateral tonic-clonic.GM= generalised motor, **O‡ =** others which include West syndrome nine (9), Lennox-Gastaut syndrome three (3)

Comparison of Background EEG Activity on Awake Recording between the Two Groups

Eighty-nine (71.8%) subjects in Group 2 demonstrated normal background EEG activity, compared to only 13 (10.7%) subjects in Group 1. The difference in background EEG abnormalities between the two groups was statistically significant ($p < 0.001$).

Comparison of epileptiform activity on awake recording between the two groups

Sixty-four (52.9%) of the 121 subjects in Group 1 had demonstrable epileptiform activity on their EEGs, while 63 (50.8%) of the 124 subjects in Group 2 exhibited various forms of epileptiform activity. The difference in epileptiform activity on awake EEG recordings between the two groups was not statistically significant ($p = 0.799$).

Comparison of epileptiform activity on sleep recording between the two groups

Eighty-two (67.8%) of the 121 subjects in Group 1 demonstrated epileptiform activity on EEG, compared to 85 (68.5%) of the 124 subjects in Group 2. There was no significant difference in the frequency of epileptiform discharges between the two groups ($p = 1.000$). Overall, normal EEG findings were observed in less than one-fifth of the subjects across both groups, consistent with the results of previous studies.

Epilepsy control between the two groups

Among the subjects who met the criteria for epilepsy control assessment, 72 were in Group 1, of whom 50 (69.4%) had uncontrolled epilepsy. In contrast, only 12 out of 69 subjects (17.4%) in Group 2 exhibited uncontrolled epilepsy. This difference between the two groups was statistically significant (p = 0.001). Notably, no subjects in either group achieved remission during the study period.

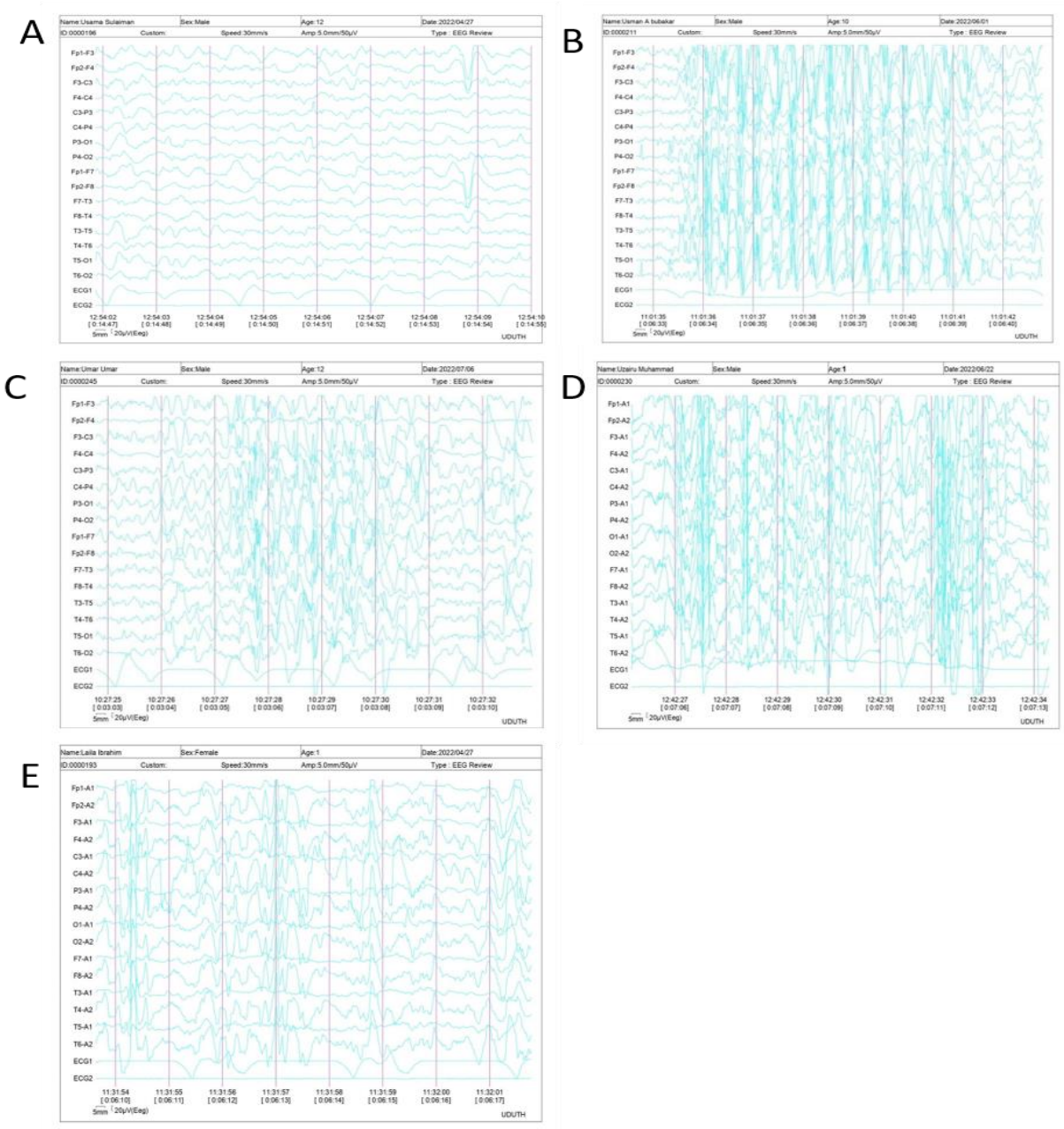

Figure 1A-E: Illustrative example of EEG tracing of subject from the index study

A. Awake EGG tracing of a 12-year-old with hemiplegic CP and GTC showing marked generalised slowing on awake EEG recording.
B. Awake EGG tracing of a 10-year-old with quadriplegic CP and generalised tonic clonic showing generalised spikes discharges on awake EEG recording.
C. Awake EGG tracing of a 12-year-old with quadriplegic CP and generalised tonic clonic showing generalised spikes discharges on awake EEG recording.
D. Awake EGG tracing of a year old with epilepsy and spastic quadriplegic CP showing Hypsarrhythmia.
E. Sleep EEG tracing of a year-old girl with tonic epilepsy and spastic quadriplegic CP showing intermittent focal epileptiform discharges in the right electrodes.

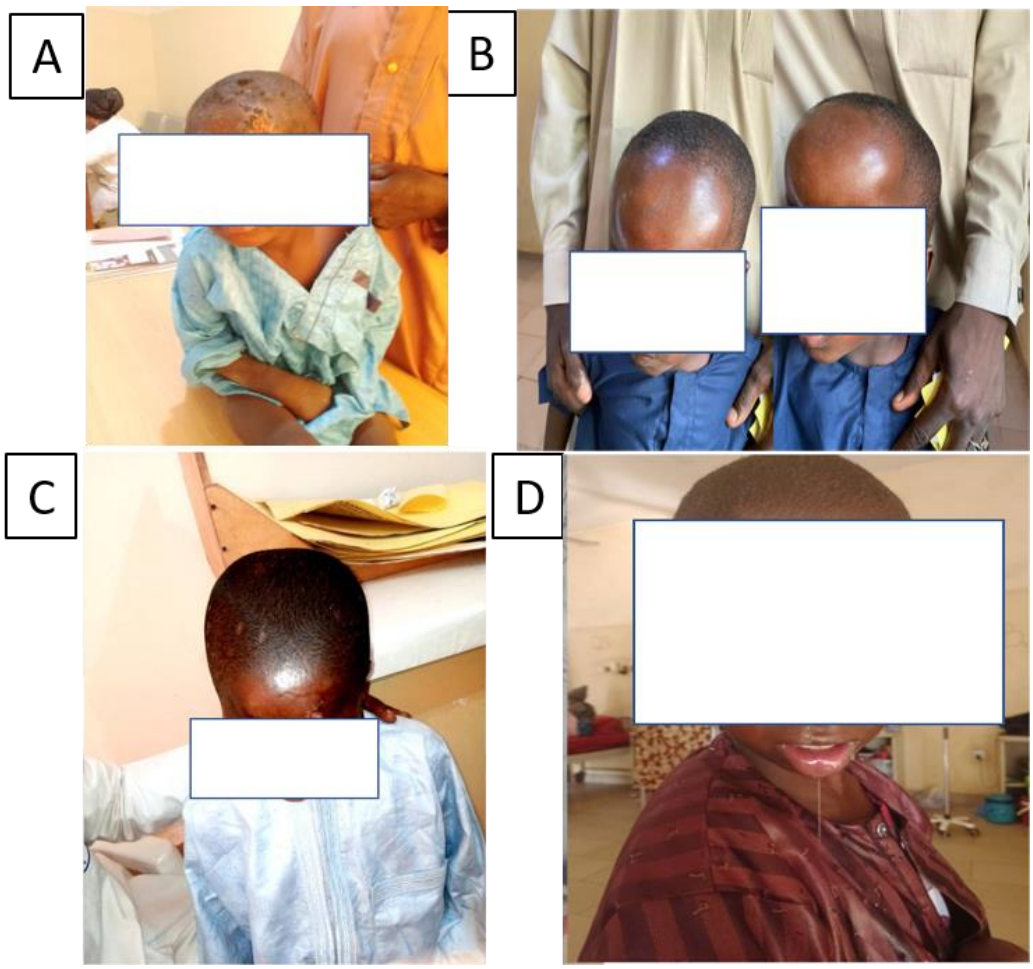

***Figure 2*A, B and C are clinical photos of subjects with myoclonic atonic epilepsy seen in the present study with head injuries sustained during attacks.**
D. A clinical photo of subject with Lennox-Gastaut syndrome

Discussion

The earlier onset of epilepsy among subjects with epilepsy and cerebral palsy (CP) in the present study is consistent with findings from other comparative studies conducted elsewhere,[6–9,17] as well as studies on epilepsy associated with CP in Nigeria[10,11] This earlier age of epilepsy onset may be attributed to the presence of identifiable risk factors originating in the perinatal period, which aligns with the reported association between early epilepsy onset and the timing of brain injury, as noted by Singhi et al.[26] Additionally, the high proportion of spastic quadriplegic CP in this study—which is characterized by widespread brain damage—may also contribute to the early manifestation of epilepsy.[6,26,27]

Sodium valproate and phenobarbitone were the most commonly prescribed anti-seizure medications in both groups in this study, consistent with findings from previous studies.[6,13]The high frequency of sodium valproate use in the index study may be attributed to the predominance of generalized epilepsy, a pattern similarly reported in another research.[6,13]

The elevated proportion of subjects requiring polytherapy among children with epilepsy and cerebral palsy (CP) in the present study aligns with earlier reports.[6–9] This need for multiple antiepileptic drugs may be due to the high prevalence of spastic quadriplegic CP and associated co-morbidities, all indicative of widespread brain damage, which complicates epilepsy control.[6,8,17,26,27]

The higher occurrence of status epilepticus among children with epilepsy and cerebral palsy (CP) observed in the present study is consistent with findings from previous reports.[6,7,9] This increased frequency may be attributed to the greater proportion of younger children in the epilepsy with CP group compared to those with epilepsy without CP, alongside the susceptibility of the immature brain to status epilepticus, as noted by Gross-Tsor et al.[28] Additionally, the high prevalence of quadriplegic CP—characterized by widespread brain damage—may further contribute to the increased risk of status epilepticus in this population.[6,7,26]

The predominance of generalized onset epilepsy of the motor type in both groups observed in this study aligns with findings from several non-comparative studies on epilepsy associated with cerebral palsy (CP) in Nigeria [10,11] and elsewhere,[26,27]as well as studies focused on epilepsy alone.[1,12,13]

However, this finding contrasts with previously reported comparative studies from Asia[7][7] and Europe,[8,9,17]where focal onset epilepsy was shown to be the predominant type among subjects with CP and epilepsy. In these Asian[7]and European studies,[6,9]generalized onset epilepsy was the predominant type among subjects with epilepsy without CP.

The observed differences may be attributed primarily to the predominance of spastic quadriplegic CP in the present study, as opposed to spastic hemiplegic CP in other series. Additionally, the Asian study[7] and one European study[17] were limited by small sample sizes. Differences in study design and the epilepsy classification systems used by Kwong et al.[7] and Aksu et al.[17] may also have contributed to the disparity. The discrepancy observed between clinical and EEG classification of epilepsy in subjects with epilepsy and CP in this study further highlights the importance of EEG evaluation. The absence of epilepsy cases classified as unknown onset or unclassified in this study is likely due to its prospective design.

The increased yield of epileptiform activity on sleep EEG recordings compared to awake recordings in both groups is consistent with findings reported in another study.[29] The predominance of generalized epileptiform discharges observed in both awake and sleep EEG recordings in the present study aligns with previous reports from Nigeria and other African countries.[3,12,13]In contrast, Kwong et al.[7] and Zarfeirious et al.[9] found that focal epileptiform activity was more predominant among subjects with epilepsy and cerebral palsy (CP). This discrepancy may be explained by the higher proportion of hemiplegic CP in their studies, whereas quadriplegic CP was predominant in the present study. Supporting this, Carlson[30] reported that 100% of subjects with hemiplegic CP exhibited focal onset epilepsy.

This study found hypsarrhythmia exclusively among subjects with epilepsy and cerebral palsy (CP), corresponding with the exclusive presence of West syndrome in this group. This indicates that all children with West syndrome and Lennox-Gastaut syndrome in the present study had underlying brain pathology. The finding of myoclonic atonic epilepsy (MAE) exclusively in Group 2 aligns with the report by Aksu et al.[17]Overall, normal EEGs were demonstrated in less than one-fifth of subjects in both groups, consistent with findings by Zarfeirious et al.[9]

The high proportion of poor epilepsy control observed in Group 1 concurs with the findings of Urio et al[1] and Ogunlesi et al.[3]who reported poor epilepsy control among subjects with epilepsy associated with other neurological deficits. Similar observations were made in a study conducted in Asia.[7]However, equal rates of one-year epilepsy control in both groups were reported by Hadjipanayis et al.[6]and Zarfeirious et al.,[9] possibly due to the lack of significant differences in socioeconomic status between the groups.

The better epilepsy control reported in Europe[6,9] in both groups may be attributed to the existence of the Surveillance of Cerebral Palsy in Europe (SCPE) commission, which aims to standardize care for children with cerebral palsy.[31] If similar initiatives were implemented in Nigeria and other African countries, they could potentially improve epilepsy control among children with epilepsy and CP, bringing their outcomes closer to those of children with epilepsy without CP.

Although significantly better epilepsy control is generally achieved among subjects with epilepsy without CP compared to those with epilepsy associated with CP, the present study found no cases of remission in either group, as defined by Fisher et al.[21] (seizure-free for ten years). This lack of remission has also been reported in other studies.[6,9]

Even when applying the traditional five-year seizure-free definition of remission, as suggested by Naligan et al.,[32]none of the subjects in the present study had attained remission. This may be due to the local practice of scheduling long follow-up intervals for children weaned off anti-seizure medication (ASM) therapy—usually initiated after two years of seizure freedom combined with normal EEG findings—particularly extended in patients with additional neurological deficits. Parental attitudes, including the perception that epilepsy has resolved leading to missed follow-up visits, may also contribute to the lack of documented remission.[5] Additionally, the transition of care from the Paediatrics Department to the Internal Medicine Department as patient's age may result in loss to follow-up and thus underreporting of remission cases.

In contrast, European studies such as Zarfeirous et al.,[9] have reported good epilepsy control defined by five-year seizure freedom among subjects with cerebral palsy, although with a high rate of relapse within the first year following ASM discontinuation.

The demonstration of multiple head injuries among subjects with myoclonic atonic epilepsy (MAE), as shown in Figure 2 A–C, underscores the importance of using head protective devices in children with MAE until epilepsy is adequately controlled.

Conclusion

Epilepsy was found to occur at a younger age in children with cerebral palsy (CP). Generalized epilepsy was the predominant type in both children with epilepsy associated with CP and those without CP, as demonstrated by clinical and EEG findings. A notable disparity was observed between clinical and EEG classifications of epilepsy, particularly among children with epilepsy and CP. The combined use of awake and sleep EEG recordings improved the detection of epileptiform activity. Early diagnosis and appropriate treatment of both epilepsy and CP are recommended to optimize epilepsy control and prevent complications.

Limitation

This study was limited by financial constraints and the unavailability of additional investigations such as brain magnetic resonance imaging (MRI), computed tomography (CT), genetic, and immunologic studies, which are essential for comprehensive etiologic classification of epilepsy according to the full-scale ILAE 2017 epilepsy classification.

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