NIGERIAN JOURNAL OF PAEDIATRICS

VOLUME 53 | NUMBER 3 | JULY - SEPTEMBER 2026

https://www.njpaediatrics.com

PRINT: ISSN 0302-4660

ONLINE: ISSN 2814-2985

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ORIGINAL RESEARCH



Nigerian Journal of Paediatrics 2026 (September); Volume 53(3):330-338.
https://dx.doi.org/10.63270/njp.v53i3.2000073.

A Comparative Study of Socio-demographic Characteristics, School Enrolment and Risk Factors of Epilepsy Between Children with and Co-existing Cerebral Palsy in Sokoto, Northwestern Nigeria

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Abstract

Background: Epilepsy and cerebral palsy have been reported as the two most common neurologic disorders in children's outpatient clinics in Nigeria. Studies in Nigeria reported high epilepsy prevalence among children with CP.

Objectives: To compare the socio-demographic characteristics and risk factors of epilepsy between children with epilepsy and co-existing cerebral palsy and those without co-existing cerebral palsy.

Methods: The study was a comparative cross-sectional study conducted from March 2022 to February 2023. One hundred and twenty-one (121) children with epilepsy and co-existing cerebral palsy (Group 1), and one hundred and twenty-four (124) children with epilepsy but without co-existing cerebral palsy (Group 2) were recruited into the study.

Results: In both groups, the age ranged from 6 months to 15 years. Children in Group 2 had significantly higher socio-economic status (35; 28.2%) than in Group 1 (18; 14.9%) ($p = 0.03$). Children in Group 2 had significantly higher school enrolment than those in Group 1. Eighty-six children in Group 2 were of school age, of whom 73 (84.9%) were enrolled in school, whereas in Group 1, out of 38 of school-age children, only 11 (28.9%) were enrolled in school ($p < 0.001$). All the children in Group 1 had identifiable risk factors for epilepsy, compared to 69.4% in Group 2.

Conclusion: Children with epilepsy without associated cerebral palsy have better socio-demographics and unknown risk factors for epilepsy.

Keywords: Birth asphyxia, Electroencephalography, Motor deficits, School enrolment, Seizure disorders.

Introduction

Epilepsy is a significant global health issue, [1] with disproportionate burden in low- and middle-income countries.[2] Millions are newly diagnosed each year, [1] and its impact varies greatly across different regions, including Nigeria.[1] A recent community-based study in Nigeria reported an incidence of 103 per 100,000 population.[3] This burden is linked to infections, adverse perinatal events, and poor healthcare access.[1,4,5] About

80% of people with epilepsy live in LMICs, where poverty, cultural beliefs, and weak health systems worsen challenges such as isolation, discrimination, educational deprivation and the epilepsy treatment gap. [1] The treatment gap - people with active epilepsy not receiving care - ranges from 96–100%. [4–7] However, WHO's Mental Health Gap Action Programme (mhGAP) has reduced this gap in Ghana and Mozambique.[1]

Children with cerebral palsy (CP) show particularly high epilepsy prevalence elsewhere, [8–10] and in Nigeria. [11,12] Children with both CP and epilepsy utilise significantly more healthcare resources than those who do not have co-existing CP. [8–10,13] This dual burden imposes additional economic and psychological stress on affected children and their families due to the concurrent need for antiepileptic medications and specialised services such as physiotherapy, speech therapy, visual and hearing aids, and special education. [11–14] The costs of care are substantial: ₦107,600 (US$717) in Ibadan (2005), [15] ₦113,000 (US$1,065.14) in Kano, [16] and the annual CP care in Kano in 2019 averaged ₦444,313 (US$1,234.20). [17]

Although there are four government-owned special schools in the region - across Sokoto, Kebbi, and Zamfara States - three of these are located in state capitals, making them accessible only to children residing in those urban centres. Therefore, this study aimed to address the scarcity of data on epilepsy and cerebral palsy co-morbidity in the study area. This should facilitate a better understanding of local socio-demographic characteristics, risk factors of seizure disorders and cerebral palsy as well as the available educational services patterns. This should inform region-specific interventions, which include improving access to educational services and optimised health care delivery, ultimately enhancing the quality of life of affected children.

Methods

Study design

The study was a descriptive, cross-sectional, and comparative study conducted over 12 months, from March 2022 to February 2023.

Study population

Inclusion criteria for Group 1: age range of 6 months to 15years, co-existence of cerebral palsy and epilepsy, with or without other deficits, complete EEG recordings (awake and sleep) for each subject and parental consent, and assent for children aged 7 years and above.

Inclusion criteria for Group 2: age range of 6 months to 15 years, absence of cerebral palsy, with or without other neurological deficits, complete EEG recordings (awake and sleep) for each subject and parental consent and assent for children aged 7 years and above.

Exclusion criteria for both groups: incomplete information, by virtue of the informant not being reliable, the non-availability of the primary caregiver, and an eye-witness account of seizures. Others include the presence of acute illness at the time of data collection, child taking any anti-psychotic agent therapy.

Sample size determination

The sample size for the study was determined using the formula [18] shown below:

$$n = \frac{(Z_{1-\alpha/2} + Z_{\beta})^2 \times (p_1q_1 + p_2q_2)}{(p_1 - p_2)^2}$$

$Z_{1-\alpha/2}$ = 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= complimentary probability of $p_1 = 1 - p_1$

p_2 = prevalence of epilepsy in children without cerebral palsy in the control group from the previous study
q_2= complimentary probability of $p_2 = 1 - p_2$
The calculated sample size was adjusted for a finite population of fewer than 10,000 individuals. The final calculated size in each arm of the study was 104.

Sampling technique
Subjects were recruited using a non-probability sampling technique (convenience sampling) for easy access to the participants. Eligible participants were enrolled consecutively as they presented to the Paediatric Neurology Clinic of a Tertiary Health Facility in Nigeria, either for follow-up or as new cases, provided they met the inclusion criteria, until the required sample size was achieved.

Ethical considerations
The study was approved by the Health Research and Ethics Committee of a Tertiary Health Facility with the approval number NHREC/30/012/2019. Informed consent was obtained from the parents or caregivers, and assent was obtained from children aged 7 years and above, where applicable.

Data collection
The questions in the proforma were assessed using a four-point Likert scale, as described by Likert, [19] with the following response options:
1 – Not relevant
2 – Somewhat relevant
3 – Quite relevant
4 – Highly relevant
Ratings of 3 and 4 were considered acceptable, while ratings of 1 and 2 were deemed unacceptable. A question was considered valid and retained if more than 75% of the assessors rated it as either 3 or 4.
The investigator administered the study proforma to the caregiver and/or child participants who met the inclusion criteria. The socio-economic status of each child was determined using the Revised Scoring Scheme for the Classification of Socio-economic Status in Nigeria. [20]
For school-aged children, a history of school enrolment was obtained and further classified as attendance at either conventional or special schools. Additionally, anthropometric measurements were recorded for all participants, according to standard protocol.

Operational definitions
Epilepsy - diagnosed based on a history of two or more unprovoked seizures, occurring greater than 24 hours apart, witnessed by a responsible adult or by video recording of the events. [21] Where there was doubt with verbal description, parents or guardians were requested to mimic what they observed during the attacks, and seizure types were documented
Cerebral palsy - diagnosed clinically, based on a history of abnormal motor development ascribable to non-progressive brain insult, coupled with the presence of abnormal neurological signs that localised the lesion to the developing brain.[22]

Classification of cerebral palsy
Cerebral palsy was physiologically classified into spastic, dystonic, atonic, ataxic, and mixed types. Spastic cerebral palsy was further categorised according to the limbs affected, based on the classification adapted from Balf *et al.* [23]

Gross Motor Function Classification System – Expanded and Revised (GMFCS -ER).
Children with epilepsy and cerebral palsy were also classified according to the Gross Motor Function Classification System – Expanded and Revised (GMFCS-ER), based on their age-appropriate level. Classification was determined by the child's current gross motor abilities, limitations in gross motor function, and the need

for assistive technology or wheeled mobility, as adapted from Palisano *et al.* [24]

Data analysis

The SPSS version 25.0 software was used for data management. Continuous variables were summarised as median and inter-quartile range, and categorical variables as frequencies and percentages. Median values were compared between the two groups using the Mann-Whitney U test, while frequencies and percentages were used to summarise categorical variables. Differences between proportions and percentages of categorical variables between the two groups were compared using the Chi-Square or Fisher's Exact test as appropriate. Statistical significance was defined as p-values <0.05.

Results

Socio-demographic profile of the subjects

Age of the children in both study groups

The age of children in Group 1 ranged from 6 months to 15 years, with a median age (inter-quartile range, IQR) of 36 (50) months while it was 75.5 (61.7) months in the comparison group (p<0.001).

Table I: Comparison of socio-demographic characteristics of children in both study groups

Sociodemographic characteristics	Grouping		Statistics	p-value
	Group 1 n = 121 (%)	Group 2 n = 124 (%)		
Gender				
Male	77 (64.0)	74 (60.0)	$\chi^2 = 0.4$	0.599
Female	44 (36.4)	50 (40.0)		
Social Class				
Upper	18 (14.9)	35 (28.2)	$\chi^2 = 11.3$	0.003
Middle	48 (39.6)	56 (45.2)		
Lower	55 (45.5)	33 (26.6)		
Place of abode				
Rural	82 (68.0)	50 (40.3)	$\chi^2 = 18.56$	< 0.001
Urban	39 (32.0)	74 (59.7)		

School enrolment in both study groups

There were 38 children of school age in Group 1, of whom 11 (28.9%) were enrolled in school whereas 73 (84.9%) of the 86 school-aged children in Group 2 were enrolled in school (p< 0.001).

Based on clinical evaluation, all subjects in Group 1 (121; 100%) had identifiable risk factors for their epilepsy. In contrast, 38 subjects (30.6%) in Group 2 had no identifiable risk factors. Some subjects presented with multiple risk factors, as detailed in Table IV.

Discussion

The present study demonstrated a significant difference in age at presentation between the two groups. More than half (68%) of the subjects with epilepsy and cerebral palsy (Group 1) were clustered within the age range of six months to five years, compared to only one-third (30.6%) of subjects with epilepsy without associated cerebral palsy (Group 2). This finding aligns with previous studies in Nigeria [14, 15, 25] and elsewhere.[26, 27]

Table II: Types of cerebral palsy and the degree of functional disability among children in Group 1

Cerebral palsy Type	Frequency n (%)	GMFCS E&R				
		I	II	III	IV	V
Spastic quadriplegia	74 (61.1)	0	0	0	5	69
Spastic hemiplegia	21 (17.4)	12	9	0	0	0
Spastic diplegia	5 (4.1)	0	0	5	0	0
Dystonia	9 (7.4)	0	0	0	0	9
Hypotonia	2 (1.7)	0	0	0	0	2
Mixed type*	10 (8.3)	0	0	0	0	10
Ataxic	0 (0)	0	0	0	0	0
Total	121 (100.0)	12	9	5	5	90

***Mixed is the combination of spastic and dystonic cerebral palsy.**
Figures in parentheses are percentages of the total

Associated co-morbidities

Table III: Comparison of the associated co-morbidities between the study groups

Co-morbidity	Grouping		Statistics	p-value
	Group 1 n (%)	Group 2 n (%)		
Co-morbidity	103(85.1)	11(8.9)	$\chi^2 = 145.12$	< 0.001
No co-morbidity	18(14.9)	113(91.1)		
Total	121(100)	124(100)		

Table IV: Identifiable risk factors for epilepsy between the two study groups

Risk factors	Grouping	
	Group 1 n = 121 (%)	**Group 2 n = 124 (%)**
Home delivery	102 (84.3)	65 (52.4)
DCBF	87 (71.9)	52 (41.9)
Birth asphyxia	85 (70.2)	17 (13.7)
Infection*	37 (30.6)	14 (11.3)
Neonatal seizure	33 (27.3)	6 (4.8)
SIFY	72 (59.5)	15 (12.0)
Neonatal jaundice	31 (25.6)	10 (8.1)
Family history	16 (13.2)	29 (23.4)
Multiple pregnancy	3 (2.4)	1 (0.8)
EBT	1 (0.8)	1 (0.8)
Head trauma	0 (0.0)	3 (2.4)
Not identified	0 (0.0)	38 (30.6)

In some subjects, some children had more than one risk factor.
DCBF - Delayed commencement of breastfeeding; SIFY - Seizure in the first year of life; EBT - Exchange Blood Transfusion. *Pyogenic meningitis 34 cases, Tuberculous meningitis 2 cases, Cerebral malaria 1 case.

However, the younger age at presentation observed in children with epilepsy and cerebral palsy in this study contrasts with findings by Eyong *et al.* [28] and Wilson *et al.* [29] where children were reported to present at relatively older ages. The earlier presentation in the current study may be attributed to the higher prevalence of co-morbidities among subjects with epilepsy and associated cerebral palsy (85%) compared to 43.8% [28] and 37.4% [29] reported in the aforementioned studies. It is well documented that children with epilepsy accompanied by other neurological deficits tend to present at a younger age than those with epilepsy alone. [30]

Additionally, this study showed a male predominance in both groups, consistent with many studies from the African region examining epilepsy with or without cerebral palsy. [6, 28-31] The male predominance observed in both groups in the present study may be attributed to the use of a convenience sampling technique. This contrasts with some comparative studies that reported an equal gender distribution among children with epilepsy and cerebral palsy and those with epilepsy without cerebral palsy. [8,9]

The high proportion of subjects from low socioeconomic backgrounds, particularly among those with epilepsy associated with cerebral palsy, is consistent with previous reports from Nigeria, [11, 12, 14, 25] and other regions. [27] This socioeconomic disadvantage may further hinder the care and management of children affected by these dual pathologies. [13, 15–17] This finding underscores the urgent need for commitment from all stakeholders to establish an expanded and robust national health insurance program aimed at improving the quality of life for affected children and their families, as recommended in the previous report. [15] The present study demonstrated that the majority of subjects in Group 1 were from rural areas and of lower socio-economic status, which concurs with reports of Adeniran. [32] This finding, coupled with the higher rates of home deliveries, delayed initiation of breastfeeding, and perinatal asphyxia observed among Group 1 compared to Group 2, may indicate ineffective maternal and child healthcare services or an inverse healthcare delivery system in the study area. These results further emphasise the urgent need for stakeholders' commitment to identify and address these gaps in order to alleviate the burden of these preventable conditions on the affected population.

In the present study, more than two-thirds of school-aged children in Group 2 were enrolled in school, compared to only one-third of those in Group 1. This finding is consistent with previous reports on children with cerebral palsy, with or without epilepsy, by Banksota *et al.*, [27] Abdelmalek *et al.*, [33] and Lagunju *et al.* [34] The low school enrolment among children with coexisting epilepsy and cerebral palsy observed in this study may be attributed to the high proportion of children with severe functional limitations, the lower socioeconomic status of their caregivers, and high percentage of co-morbidities, all of which can further restrict access to education. These factors are similar to those reported by Abdelmalek *et al.* [33] and Lagunju *et al.* [34] Additionally, high levels of stigmatisation associated with cerebral palsy, compounded by epilepsy, have been identified as significant barriers to school enrolment, as documented by Lagunju *et al.* [34] and Wallace.[35] The centralised location of special schools within state capitals in Nigeria, coupled with their day-school structure in the study region, may contribute to the difficulties in school enrolment among children with epilepsy and cerebral palsy. Although this study did not investigate the reasons for the lack of school enrolment, the establishment of additional special schools, adequately staffed with trained special education personnel, and the decentralisation of existing facilities could

potentially improve enrolment rates for this population.

All the children with coexisting epilepsy and cerebral palsy had identifiable probable risk factors aligning with the findings in previous studies by Abdelmalek *et al.* [33] and Lagunju *et al.* [11] which reported similar rates of 100% and 95%, respectively. It is important to note that all children in this study had epilepsy, and some causes of epilepsy are also independent risk factors for cerebral palsy. [35] Conversely, the absence of probable risk factors in approximately one-third of subjects in Group 2 is consistent with reports from other parts of Nigeria and elsewhere. [28, 36] The proportion of children with central nervous system infections (CNSI) in Group 1, although lower than that reported by Lagunju *et al.*[11] was still higher than the one-fifth observed in children with epilepsy without CP. The occurrence of neonatal seizures among subjects with epilepsy associated with CP in this study is comparable to findings from other studies elsewhere [8, 33] and in Nigeria. [12] Similarly, the higher proportion of seizures occurring within the first year of life among subjects with epilepsy associated with CP, compared to their counterparts without CP, aligns with previous reports from Nigeria. [11, 12]

The present study did not demonstrate prematurity as a leading cause in any child across both groups. This is notable, given the significant prevalence of prematurity reported in the study area a decade ago. [37] This finding suggests that, although prematurity is a recognised risk factor for cerebral palsy, it may not be a significant risk factor for epilepsy.

Limitation

This study was limited by the use of a convenience sampling technique and its hospital-based design. Further studies on the research theme in multi-centre or community-based settings are, therefore, recommended.

Conclusion

Epilepsy occurs at a younger age in children with cerebral palsy (CP), particularly among those from low socio-economic backgrounds, who also demonstrated significantly lower rates of school enrolment. Concerted effort should be made by the Government and all stakeholders to address the preventable causes and risk factors for epilepsy and cerebral palsy in the region, as well as the provision of a comprehensive management approach for children with cerebral palsy and epilepsy, due to their increased needs for subspecialties care for the associated comorbidities. This will help improve their quality of life.

Authors' Contributions: MAJ conceived and designed the study and did the literature review. AH, AMM and YA participated in literature review, data curation, analysis and interpretation. WU, SI and ISM drafted the manuscript. Revision of manuscript for sound intellectual content was carried out by JFB, AHK and IFA. All the authors approved the final version of the manuscript.

Conflict of Interest: None declared.

Financial support: The authors did not receive any financial support towards the research or the preparation of the manuscript.

Accepted for publication: 29th May 2026.

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