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Original Article

Visual impairment among Children with epilepsy at a Tertiary Hospital in Nigeria.

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ABSTRACT

Background: Visual impairment (VI) may be one of the least reported neurologic comorbidities among children with epilepsy (CWE). However, its impact on the child's development and quality of life makes it of public health importance. This study describes the prevalence of VI and the clinical and schooling factors associated with VI among CWE being managed at the Jos University Teaching Hospital (JUTH). **Methods**: This was a cross-sectional comparative study of CWE and their age and sex matched controls. CWE were consecutively recruited from the paediatric neurology clinic, while the controls were from neighbouring schools and the community. Vision was assessed using the American Academy of Paediatrics guideline for visual systems assessment in infants, children and young adults by paediatricians and categorised using the International Classification of Diseases version 11 (ICD-11) guidelines. **Results:** One hundred CWE and 100 controls aged 1-18 years with a male-to-female ratio of 1.2:1 were recruited for the study. The prevalence of VI among CWE (5.0%) was significantly higher than among the controls (2.0%) ($p < 0.001$). Vision loss in both groups was in the moderate VI category. No association was found between patients' clinical parameters and VI. Although the CWE had a significantly poorer schooling history ($p < 0.001$), it had no statistically significant relationship with VI ($p = 0.363$) or school performance ($p = 0.130$). **Conclusion:** VI is more common among CWE than among the controls, but it has no significant association with clinical parameters, schooling history, or school performance of CWE.

Keywords: Visual impairment, children, epilepsy, school

INTRODUCTION

Epilepsy is one of the most common neurological diseases affecting children globally, and may be accompanied by various neurologic and non-neurologic complications.[1,2] Aaberg et al[3] demonstrated that nearly 80% of children with epilepsy have at least one or more comorbid disorders of which neurologic disorder account for 41% of them. In Nigeria, neurologic complications have been reported to occur in 43.1%-68.3% of children with epilepsy (CWE).[4,5]

Although visual impairment (VI) is considered one of the least common neurologic comorbidities associated with childhood epilepsy, it remains a significant public health problem as it may interferes with the child's quality of life.[4-6] Moreover, epilepsy has been reported as the commonest neurological disorder associated with VI due to cortical blindness.[7] The pathophysiology of VI in CWE can be multifactorial, involving several potential pathways including recurrent seizure activities, structural brain abnormalities such as cortical dysplasias and malformations, anti-seizure medication (ASM), neuroinflammation, metabolic and mitochondrial disorders and the presence of other co-morbidities.[1,8]

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Some ASMs like vigabatrin have been associated with visual field defects due to retinal toxicity and have been reported in up to 46% of CWE.[9,10] Some forms of epilepsy are associated with metabolic or mitochondrial disorders, which can also affect the retina, optic nerve, or other parts of the visual system.[1] Often CWE have comorbid conditions such as cerebral palsy or genetic syndromes that can independently affect visual function.[1]

VI in epilepsy can be acute or chronic at presentation and may take a transient or permanent course depending on the aetiology.[1,8] Acute blindness can occur following epileptic seizures, however, it is rarely reported and is usually brief, resolving with ASM. [9,11-13]

A few authors from Western Nigeria have reported neurological morbidities among CWE including VI.[4,5] There is paucity of published data regarding VI from the North-central region. This study was conducted to determine the prevalence and pattern of VI among CWE and identify the clinical and schooling factors associated with VI among CWE to create awareness of its importance among health care practitioners, hence improving the quality of life of CWE.

MATERIALS AND METHODS

This cross-sectional comparative study was conducted between 2017 and 2018 among CWE and their age and sex matched controls. CWE aged one month to 18 years with a confirmed diagnosis of epilepsy according to the International League Against Epilepsy[14] were consecutively recruited from the paediatric neurology clinic of JUTH. Children were included in the control group if they were apparently healthy without a history of epilepsy and were recruited from schools or the communities where CWE live and were age and sex matched. Those with chronic disorders such as cardiac, renal or sickle cell disease, those acutely ill and those in whom consent of the caregiver was denied were excluded from the study.

Approval for the study was obtained from the ethics and review board of the JUTH and the Ministry of Education of Plateau State. Additional permission was obtained from the relevant school authorities. Caregiver consent was obtained for the CWE and controls at enrolment or through the school. At all times, the tenets of the Declaration of Helsinki for research on human subjects were upheld.

A predesigned proforma was used to obtain sociodemographic data, schooling history, and academic performance from the caregivers for both CWE and controls. Details of ASM were also obtained. Vision was assessed by observing fixation and following of a pen torch for children less than three years of age and those with intellectual impairment. Lea symbols chart was used for those aged three to four years, and the Snellen's chart or illiterate 'E' chart for children five years and older, based on the American Academy of Paediatrics (AAP) guidelines for visual systems assessment for infants, children and young persons by paediatricians.[15] Vision assessment was conducted in a brightly illuminated room at the paediatric outpatient department for CWE, a dedicated classroom or a shady environment outdoor in the community for the controls. For each participant, one eye was tested at a time while the other was covered with an occluder. In all instances, the VA in the better eye was taken as the vision for the child.

Vision was categorized for children 3 years and older based on ICD11 guidelines as normal (VA of 6/12 or better), mild (VA < 6/12 to 6/18, moderate (<6/18 to 6/60), severe visual impairment (<6/60 to 3/60) and blindness (<3/60 to no perception of light) [16] Vision was taken as normal in children less than three years of age and among older children with intellectual disability if fixation and following of light was central, steady and maintained; adopted from similar studies.[8,17] Severe seizures were defined as having at least one seizure in a month, [14]

This is part of a larger study evaluating four neurological disorders among CWE, including visual, auditory, intellectual impairments and attention deficit/hyperactivity disorder, details of which have been published in other publications associated with this study.[18-20]

Data was entered into Microsoft Excel spreadsheets and exported to STATA IC 14.2 by Stata Corp LLC, Texas, USA, for Macintosh Operating Systems for data analysis. Continuous variables are expressed as median and interquartile range, while categorical variables are presented as frequencies and proportions. The association between VI with clinical parameters, schooling history and academic performance of CWE were tested using the Chi-square test. Fisher's Exact test was used where the variables were less than five in a cell. For every variable of interest, significance level was set at $p < 0.05$.

RESULTS

A total of 200 children, comprising 100 children with epilepsy (CWE) and 100 controls aged between 12 months and 18 years, were recruited. The median (interquartile range) age of the CWE was 8 (4-13) years, while that of the control group was 9 (5-13) years. Most of the children were of school age; 73% among CWE and 74% in the control group. The male-to-female ratio was 1.2:1. The age and gender differences between the cases and controls were not statistically significant, as seen in Table 1.

Of the 73 CWE of school age, more than half (61.6%) were enrolled in mainstream schools and were in the appropriate class for their age. Fourteen (19.2%) had repeated a class at least once, two (2.7%) had dropped out of school, one (1.4%) was in a special school, and 10 (13.7%) had never been enrolled in

school. In comparison, 60 (81.1%) of the school-aged

Table I**:** Sociodemographic characteristics of the study population.

Characteristics	**CWE**	**Controls**		
	Frequency (%)	**Frequency (%)**	**Total (%)**	**Fisher's Exact P value**
Age (years)				
1-5	31 (31.0)	29 (29.0)	60(30.0)	0.937
>5-10	31 (31.0)	33 (33.0)	64(32.0)	
>10	38 (38.0)	38 (38.0)	76 (38.0)	
Total	100(100)	100 (100)	200 (100)	
Sex				
Male	45(45.0)	45(45.0)	90(45.0)	
Female	55(55.0)	55(55.0)	110(55.0)	1.000
Total	100(100)	100(100)	200(100)	
Schooling history (children ≥ 5yrs)				
Appropriate for age	45 (61.6)	60 (81.1)	105(71.4)	
Repeated class at least once	14 (19.2)	3 (4.1)	17 (11.5)	<0.001*
Dropout of school	2 (2.7)	0 (0.0)	2 (1.4)	
In and out of school	1(1.4)	0 (0.0)	1 (0.7)	
Started late not for health reason	0 (0.0)	11(14.8)	11(7.5)	
In Special school	1 (1.4)	0 (0.0)	1(0.7)	
Not enrolled in school	10 (13.7)	0 (0.0)	10 (6.8)	
Total	73 (100)	74 (100)	147(100)	

*CWE: Children with epilepsy, *statistically significant*

Table II: Clinical characteristics of 100 children with epilepsy

Characteristics	**Frequency (%)**
Age at first epileptic seizure (years)	
<1	21 (21.0)
1-5	45 (45.0)
>5-10	27 (27.0)
>10	7 (7.0)
Age at first presentation (years	
<	10 (10.0)
1-5	47 (47.0)
>5-10	27 (27.0)
>10	16 (16.0)
Type of seizure	
Generalized seizure	70 (70.0)
Focal seizure	30 (30.0)
Severity of seizure	
*Severe	64 (64.0)
Not severe	36 (36.0)

*Severe (at least 1 seizure per month)

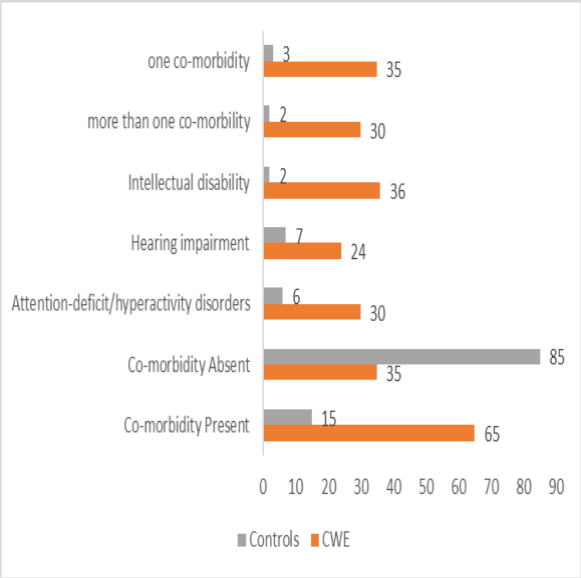

Figure 1: Distribution of co-morbidities among Children with epilepsy (CWE) and controls

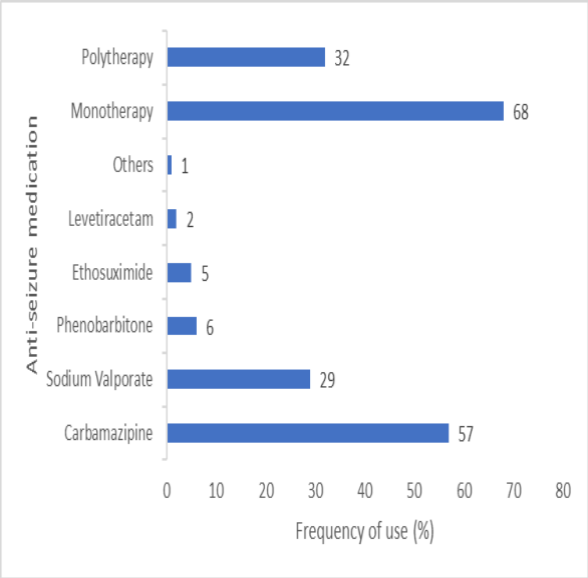

Figure 2: pattern of anti-seizure medication uses among CWE

schools, had a schooling history appropriate for their age and only three (4.1%) had repeated a class at least once. The CWE had a significantly poorer schooling history than the control group (p <0.001).

About 45% of the CWE had their first seizure within the first 5 years of life, with a median age of 3 years and an interquartile range of 1-7 years. Table II shows the age distribution at first seizure and first presentation, including types of epilepsy in the cohort.

A total of 65 CWE and 15 controls had other co-morbidities, including hearing impairment, intellectual disability and attention deficit/hyperactivity disorder (ADHD). Some of the children had more than one co-morbidity, particularly among the CWE. The details of the co-morbidities among CWE and controls are shown in Figure 1.

Figure 2 is a bar chart showing the pattern of ASM usage among the CWE. Carbamazepine was the most frequently (57%) utilized medication, while levetiracetam was the least (2%). The majority (68%) of the CWE were on monotherapy, with a mean duration of treatment of 2.6 ±0.5 months.

The prevalence of VI was significantly higher among CWE (5.0%) than among the controls (2.0%) (p <0.0001). See Table II. VI was in the moderate category in both groups. A total of 36 (18%) CWE and controls were tested for light fixation only, of whom 20 (55.6%) were 3 years and below, and the remaining 16 (44.4%) were older but had intellectual impairment. These patients were considered to have normal vision but were not included in the ICD11 classification for visual impairment as shown in Table III.

There was no significant association between the presence of VI and age at onset of seizure, seizure type, severity of seizure and type of AED used. Of the visually impaired CWE, two (40%) also had ADHD, one (20%) had mild intellectual impairment, and two (40%) had moderate hearing impairment. The presence and type of co-morbidities were not significantly related to the presence of VI among the CWE, as shown in Table IV

Table V shows the relationship between schooling and VI among CWE. Among the 100 CWE, 39 were not in school (27 were not of school age, 12 had dropped out of school, and 10 were not enrolled). All five of the CWE who were visually impaired were of school age, and three (60%) were in the appropriate class for their age, but two (40%) had repeated a class at least once, and the only child who was in a special school was not visually impaired. There was no statistically significant relationship between schooling history and the presence of VI (p = 0.363) among CWE. Three (60%) of the CWE with VI regarding school performance were rated below average. The observed poorer school performance among the CWE with VI was not statistically significant compared to those with normal vision (p =0.130).

DISCUSSION

In this comparative assessment of visual impairment (VI) among children with epilepsy (CWE) being managed at JUTH with their age and sex matched controls, the prevalence of VI was found to be significantly higher among the CWE (5.0%) compared to the control group (2.0%).

The prevalence of VI among CWE in this study, is similar to 3.0% reported by Mung'ala-Odera et al[21] among CWE in Kenya. But much lower than the 9.8% and 16.3% reported by Burton et al[22] and Ogunlesi et al[5] among CWE in Tanzania and Sagamu, Nigeria

respectively. While some of these studies did not state or describe the VA assessment methods used, none of them had a control group.[5,21-22] The wide variation in prevalence of VI observed between these studies may in part be due to the differences in the visual acuity (VA) assessment methods and VI classification used.15 It is widely recognized that VA assessment methods in children differ, choice of which is guided by factors such as age, literacy level and presence of

Table III: Prevalence of visual impairment in CWE and controls.

Visual acuity category	CWE Frequency (%)	Control Frequency (%)	Total (%)	Fishers exact P value
Normal vision (6/6-6/12)	60 (60.0)	97 (97.0)	157 (78.5)	
Mild Visual impairment (< 6/12 – 6/18)	0 (0.0)	0 (0.0)	0 (0.0)	
Moderate visual impairment (< 6/18-6/60)	5(5.0)	2(2.0)	7(3.5)	
Severe visual impairment (< 6/60 – 3/60)	0 (0.0)	0 (0.0)	0 (0.0)	<0.0001
Blindness (< 3/60-NPL)	0 (0.0)	0 (0.0)	0 (0.0)	
Fixation to light (central, steady and maintained)	35(35.0)	1(1.0)	36 (18.0)	
Total	100 (100)	100 (100)	200 (100)	

NPL-Nil perception of light

Table IV: Relationship between visual impairment and clinical parameters of CWE

Factors	Visual impairment N= 5 (%)	No Visual impairment (%) N= 95	Total (%) N=100	Fisher's Exact *p*-value
Age at onset of seizure (years)				
<1	0 (0.0)	21 (22.1)	21 (21.0)	
1-5	3 (60.0)	42 (44.2)	45 (45.0)	
>5-10	2(40.)	25 (26.3)	27 (27.0)	0.722
>10	0 (0.0)	7 (7.4)	7 (7.0)	
Type of seizure				
Generalize	3 (60.0)	67 (70.5)	70 (70.0)	0.635
Focal	2 (40.0)	28(29.5)	30(30.0)	
Severity of seizure				
Severe	3 (60.0)	61(64.2)	64 (64.0)	1.000
Not severe	2 (40.0)	34 (35.8)	36 (36.0)	
Anti-epileptic drug				
Carbamazepine	2 (40.0)	55(57.9)	57 (57.0)	
Ethosuximide	0 (0.0)	5 (5.3)	5 (5.0)	
Levetiracetam	1 (20.0)	1(1.1)	2 (2.0)	0.222
Phenobarbitone	0 (0.0)	6 (6.3)	6 (6.0)	
Sodium Valproate	2 (40.0)	27 (28.4)	29 (29.0)	
Others	0 (0.0)	1 (1.1)	1 (1.0)	
Co-morbidity ADHD				
Absent	3 (60.0)	67 (70.5)	70 (70.0)	0.266
Present	2 (40.0)	28 (29.5)	30 (30.0)	
Intellectual impairment				
Absent	4 (80.0)	60 (63.2)	64 (64.0)	1.000
Present	1 (20.0)	35 (36.8)	36 (36.0)	
Hearing impairment				
Absent	3 (60.0)	73 (76.8)	76 (76.0)	0.591
Present	2 (40.0)	22 (23.2)	24 (24.0)	

Table V: Relationship between visual impairment and schooling among 100 CWE

Factors	Visual Impairment (%)	No Visual impairment (%)	Total (%)	Fisher's Exact P-value
Schooling Age (years)				
< 5	0 (0.0)	27 (28.4)	27 (27.0)	
≥ 5	5 (100.0)	68 (71.6)	73 (73.0)	0.320
Total	**5 (100)**	**95 (100)**	**100(100)**	
Schooling history (children ≥ 5yrs) N=73				
Appropriate	3 (60.0)	42 (61.8)	45 (61.6)	
Repeat	2 (40.0)	12 (17.6)	14 (19.2)	
Dropout	0 (0.0)	2 (2.9)	2 (2.7)	
In and out of school	0 (0.0)	1 (1.5)	1 (1.4)	0.363
Not enrolled	0 (0.0)	10 (14.7)	10 (13.7)	
Special school	0 (0.0)	1 (1.5)	1 (1.4)	
Total	**5 (100)**	**68 (100)**	**73 (100)**	
School performance children of children in school only) N=61				
Below average	3 (60.0)	24 (42.9)	27 (27.0)	
Average	1 (20.0)	17 (30.3)	18 (18.0)	0.130
Above Average	1 (20.0)	15 (26.8)	16 (16.0)	
Total	**5 (100)**	**56 (100)**	**61 (100)**	

was done in this current study.[4,24-25] VI and visual field defects from retinal toxicity have been associated with learning difficulties.[15] Furthermore, there is also the possibility that the prevalence of VI in our study might have been under reported since the VA of 35% of the CWE who were either below three years of age or who were older but had intellectual disability could not be captured in the conventional International statistical Centre for Disease (ICD 11) classification of VI. But because they had adequate fixation and following of light they were adjudged to have normal vision as has been done by some authors in the past.[8,17] Moreover, the AAP guideline for VA assessment in infants, children and young adults suggest that failure to develop the milestone of fixation and following of targets by the age of six months is to be considered abnormal vison warranting an ophthalmologist referral. However, previous studies from within and outside Nigeria have reported presence of ocular disorders as cataract, squints, nystagmus, optic atrophy, refractive error, cranial nerve six palsy and colour vision defects among CWE.[17,23]

Although majority of the CWE in this study had severe generalized seizures, were predominantly on carbamazepine and had other neurologic co-morbidities there was no statistically significant association between these clinical parameters and the presence of VI. Some authors have reported high prevalence of VI among CWE in some parts of Nigeria, but they neither documented specific proportions for some antiseizure medication especially vigabatrin from some studies outside Nigeria.[10,11] Worthy of note is that, none of the patients in this study had been treated with vigabatrin in keeping with reports from similar studies in Nigeria.[5,23]

Generally, VI is known to contribute significantly to learning difficulties resulting in poor school performance.[6,15,26] Regardless of the fact that 40% of the CWE in this study who were visually impaired had repeated a class at least once and 60% of them performed below average in school, when compared with the proportion of CWE with normal vision, no statistically significant association between presence of VI with poorer schooling history and academic performance was found. In a study among CWE in India, Gogate et al[26] demonstrated that about 40% of CWE in special schools who had learning disability in India were also visually impaired. Furthermore, even though 36% CWE had different degrees of intellectual disability, only one CWE who had no visual impairment was in a special school.

Previous studies have shown that multiple factors such as stigma, frequency of seizures, duration of illness and age at onset of seizures have been associated with schooling problems among CWE.[27-28] The rating of school performance of CWE in this study was based on caregiver perception and is therefore subject to bias. To better understand the complex interplay between VI and school performance among CWE, a longitudinal study in the future would be necessary. The prospective study is most ideal for exploring the concepts of transient visual loss

associated with epilepsy, epileptic blindness or visual evoked seizures as has been described by some authors.[1,8,11-13]

Limitation

Due to the robust nature of the data collected in this study, the authors where unable to retrieve the causes of vision loss among CWE and controls after their ophthalmology review. Hence, this study does not provide data regarding the aetiology of vision loss among the cases and controls.

CONCLUSION

The prevalence of VI among CWE managed at the JUTH is significantly higher compared to the control group. Routine vision screening of CWE is vital for prompt detection and management of any associated VI. This will require an interdisciplinary approach involving parents/caregivers, teachers and paediatricians and ophthalmologist.

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