Factors Influencing the Academic Performance of School Children with Epilepsy

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Summary
The academic performance and intelligence quotient (IQ) of 50 children with epilepsy aged between 5 and 14 years, attending normal primary schools in Enugu, were compared with those of their non-epileptic classmates. The academic performance was assessed using the overall scores achieved in terminal examinations in the 2001–2002 academic year. IQ was assessed using the Draw-A-person Test. The influences of school absence rate, Rutter behavioural scores, socio-economic status and seizure-related variables on academic performance were then determined. Twenty-six percent of the children with epilepsy had a low overall score, and therefore poor academic performance, compared with 16% of the controls (p = 0.35). The mean IQ of the children with epilepsy was significantly lower than that of the controls (p = 0.02). The mean school absence rate for the children with epilepsy was significantly higher than that of the controls (p = 0.001). The mean Rutter score of the children with epilepsy was significantly higher than that for the controls (p < 0.001). On multiple linear regression analysis, only IQ (p = 0.01) and seizure type (p = 0.03) had significant predictive effects as risk factors for low overall scores and poor academic performance. It is concluded that the academic performance of epileptic children is influenced by their IQ and type of seizures rather than by other seizure variables or socio-demographic characteristics.

Introduction
Epilepsy is the most common chronic neurological disease seen in Paediatrics Neurology Units in developing countries [1, 2] and has a prevalence of 5–10/1000 in developing countries [3]. Epilepsy, like other chronic disorders such as sickle cell disease, diabetes mellitus and bronchial asthma has been found to negatively affect school attendance and academic performance [4–6]. While academic under-achievement and poor school attendance in children with other chronic conditions are due to recurrent morbidity, the effect of epilepsy is thought to be due to relatively reduced intelligence, psychosocial problem, anti-epileptic medication and the influence of seizure variables such as seizure type, age at onset, EEG findings and seizure control [7]. However, there is a controversy regarding the relative importance of these factors [8–10].

In another study, the academic performance of children with epilepsy was investigated. The present study was undertaken to determine the factors that influences the academic performance of epileptic children attending normal primary schools in Enugu. It is hoped that the findings from this study will aid in formulating a suitable educational programme for these children.

Materials and Methods
This controlled study was carried out between 2 January and 29 July 2002. Fifty consecutive children who presented at the Paediatric Neurology clinic of University of Nigeria Teaching Hospital (UNTH), Enugu and had epileptic seizures conforming to those described by the International League Against Epilepsy (ILAE) [11] were recruited to the study if they met the set criteria. All the children should have been attending the Paediatric Neurology clinic of UNTH, Enugu, for at least 2 years, or should have been seizure free and should have been considered fit for discontinuation of anti-epileptic drug therapy, but were being followed up. These gave one the opportunity to assess seizure control. They were also attending normal primary schools in Enugu. Excluded from the study were children with other defined chronic diseases like sickle cell disease, bronchial asthma, tuberculosis and cerebral palsy in association with epilepsy. This was necessary because these diseases on their own are known to affect
academic performance [12], hence the independent effect of epilepsy may be difficult to determine. Also excluded from the study were those attending special institutions including institutions for the handicapped, and normal schools outside Enugu.

Controls, who were class mates of the children with epilepsy, matched for age, sex and socio-economic status, were selected using the method proposed by Richard and Burlew [5]. The academic performance was assessed using the method proposed by Ogunfowora as previously documented [6]. The number of days each child was absent from school was documented. High and low absences, as suggested by Weitzman, et al. [13], were defined as being absent for more than 12 days and less than 12 days from school, respectively, in a year. The intelligence quotient (IQ) of the subjects were assessed using the Draw-A-Person Test (DAPT) validated for Nigerian children [14], in which a Draw-a-person quotient ≥75% was considered as normal, while the behaviour of each child was assessed using the Rutter’s behavioural scale (B2) for children (Teachers scale) as standardized for Nigerian children [15]. Rutter’s score of ≥10 was regarded as abnormal. Oyedeji’s method was used in social classification [16]. Seizure-related factors were obtained from the case records. Information obtained included seizure type, age at onset of seizure, seizure frequency at diagnosis and at the time of the study, seizure control, anti-epileptic drugs and EEG findings.

Seizure frequency was classified into <6/year, 6–24/year and >24/year as suggested by Iloeje [17]. Patients with generalized tonic clonic (GTC) seizures received phenobarbitone or sodium valproate, those with partial seizures were on carbamazepine, and those with absence seizures were placed on ethosuximide or sodium valproate. Some children received more than one type of drugs, but monotherapy was the treatment of choice. Seizure control was also classified into good control if there was ≥80% reduction in seizure frequency from that at presentation, while it is fair if the reduction was between 51% and 79%, and poor if the reduction was ≤50% in line with the criteria used by Iloeje [17]. EEG findings were categorized into normal and abnormal [17].

The Ethical Committee of UNTH, Enugu, approved the study and informed verbal consent was obtained from parents/care givers. Analysis was performed using SPSS version 11.0. Means were compared using Students’ t-test. Chi-square test was used for association. Yate’s corrected Chi-square-test or Fisher’s exact test was used as appropriate. Multiple linear regression analysis was used to determine the factors with predictive effect(s) on academic performance. p < 0.05 was taken as statistical significance.

### Table 1

<table>
<thead>
<tr>
<th>Overall score</th>
<th>Epileptics No. (%)</th>
<th>Controls No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>13 (26)</td>
<td>8 (16)</td>
</tr>
<tr>
<td>Average</td>
<td>19 (38)</td>
<td>18 (36)</td>
</tr>
<tr>
<td>High</td>
<td>18 (36)</td>
<td>24 (48)</td>
</tr>
<tr>
<td>Total</td>
<td>50 (100)</td>
<td>50 (100)</td>
</tr>
</tbody>
</table>

χ² = 2.07; df = 2, p = 0.35.

### Results

#### Demographic characteristics

Fifty children with epilepsy and fifty controls were drawn from 37 primary schools in Enugu. There were 36 (72%) males and 14 (28%) females, (male: female ratio 1.5: 1). The age range was between 5 and 14 years. There was no significant difference between the distribution of epileptic children and control, with regards to socio-economic status (χ² = 1.11, p = 0.77). The most common was GTC seizures (58%), followed by complex partial (CP) seizure (20%). Mixed epilepsy and simple partial seizure occurred in 12% of the children in equal ratio (6% each). The rest were tonic seizure (4%), simple absence (1%), atypical absence (1%) and atonic seizure (1%).

#### Academic performance

Thirteen (26%) children with epilepsy and 8(16%) controls were low scorers; and hence had poor academic performance. However, the difference in their academic performance was not statistically significant (χ² = 2.1, df = 2, p = 0.35) (Table 1).

#### Influence of non-seizure-related variables

**Intelligence.** Nineteen (38%) children with epilepsy and 14(28%) controls had a DAPQ of <75%. The difference was not statistically significant (χ² = 1.13, df = 1, p = 0.29). The mean DAPQ for the subjects was 82.03 ± 20.3%, while that of controls was 91.9 ± 24.8%. The difference was statistically significant (t = 2.42, df = 49, p = 0.02).

The relationship between overall class score and DAPQ among the children with epilepsy was also statistically significant (χ² = 7.62, df = 2, p = 0.02), while that between DAPQ and overall score in the controls was not significant (χ² = 2.32, df = 2, p = 0.3) (Table 2).

**School absence.** Twenty three (46%) children with epilepsy and 16 (32%) of the controls had high
absence rate, but the difference was not significant ($\chi^2=2.06$, df=1, $p=0.15$). The mean and SD of days a child with epilepsy was absent in the 2001–2002 session was 15.3 ± 13.8 days while that of the controls was 9.4 ± 9.6 days. The difference was statistically significant ($t=3.4$, df=49, $p<0.001$). None of the subjects was admitted into any hospital during the period of the study.

There was no significant relationship between absenteeism rate and overall academic score either among children with epilepsy ($\chi^2=6.34$, df=4, $p=0.18$) or among controls ($\chi^2=1.43$, df=2, $p=0.49$).

**Behavioural disorder.** The mean Rutter’s score for the subjects was 12.35 ±11.9 while that for the controls was 5.0 ±5.3. The difference was statistically significant ($t=-4.3$, df=49, $p<0.001$). Twenty four (48%) subjects compared with 6 (12%) controls had abnormal Rutter’s score. The difference was also significant ($\chi^2=15.43$, df=1, $p<0.001$).

Variations in are between Rutter’s score and the overall academic score were not significant in both the children with epilepsy ($\chi^2=0.27$, df=2, $p=0.87$) and the controls, ($\chi^2=3.1$, df=2, $p=0.20$).

**Effect of seizure-related variables**

**Seizure type.** The relationship between seizure type and overall class score is shown in Table 3. This relationship was not statistically significant ($\chi^2=3.06$, df=4, $p=0.55$).

**Age at onset of seizure.** The relationship between overall class score and age at onset of seizure is shown in Table 3. The relationship was not statistically significant ($\chi^2=0.69$, df=2, $p=0.71$).

**Seizure control.** Twelve of the subjects had poor seizure control, while eight had fair control and 30 had good seizure control. Of those with good seizure control, 24 were still on medications, the medications of two were being tailed off, while four had discontinued their drugs but were being followed up. The relationship between seizure control and overall class score was not significant ($\chi^2=2.42$, df=4, $p=0.66$) (Table 3).

**Anti-convulsant therapy.** Forty patients received one type of anti-epileptic drug (monotherapy) while 10 received two or more types (polytherapy). The drugs used in monotherapy included phenobarbitone (25), sodium valproate (2), carbamazepine (12) and ethosuximide (1). The drugs used in polytherapy included sodium valproate and phenobarbitone (5), phenobarbitone and carbamazepine (4) and sodium valproate and nitrazepam (1). The relationship between overall class score and anti-epileptic therapies is shown in Table 4. There was no significant difference between monotherapy and polytherapy ($\chi^2=0.59$, df=2, $p=0.75$). Among children on monotherapy, the prevalence of low scorers was

### Table 2

<table>
<thead>
<tr>
<th>DAPQ</th>
<th>Overall score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>epilepsy</td>
<td>9</td>
</tr>
<tr>
<td>controls</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
</tr>
</tbody>
</table>

Statistics for epileptic children: $\chi^2=7.62$, df=2, $p=0.02$; statistics for controls: $\chi^2=2.32$, df=2, $p=0.31$.

### Table 3

<table>
<thead>
<tr>
<th>Variables</th>
<th>Overall score</th>
<th>$p$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Average</td>
</tr>
<tr>
<td>Seizure type</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>GTC</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>CP</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Othersa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age at onset (years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&lt;5$</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>$\geq 5$</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td>Seizure control</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Poor</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Fair</td>
<td>13</td>
<td>13</td>
</tr>
</tbody>
</table>

*Simple partial (3); mixed epilepsy (3); atonic seizures (2); absence seizures (2); tonic seizures (1). GTC, generalized tonic clonic; CP, complex partial.

TABLE 3

Relationship between some seizure variables and overall score of children with epilepsy

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significantly lower than that of the controls (χ² = 6.58, p = 0.01).

**Other variables**
The overall class score (academic performance) was not significantly influenced by seizure frequency (χ² = 6.72, df = 4, p = 0.15), EEG findings (χ² = 1.64, df = 2, p = 0.68) or history of status epileptics (χ² = 3.96, df = 2, p = 0.14). There was also no significant relationship between academic performance and sex among epileptics (χ² = 3.90, df = 2, p = 0.14) and controls (χ² = 1.22, df = 2, p = 0.54). Among children with epilepsy (χ² = 7.97, df = 6, p = 0.24) and controls (χ² = 3.69, df = 6, P = 0.72) socio-economic status did not influence their overall class score.

**Multiple linear regression analysis of factors associated with academic performance**
Table 5 shows the result of multiple regression analysis of factors significantly predictive of academic performance among children with epilepsy. These were only IQ and seizure type. Among the controls, no variable had a predictive effect on academic performance.

### Discussion
The mean DAPQ of children with epilepsy was significantly lower than that of the controls (82 vs. 91.9%), but that of the children with epilepsy was nonetheless within the normal range [14]. This pattern has been reported previously [7, 18]. The cause of reduced intelligence in children with epilepsy in this study was not specifically evaluated. Ellenberg, et al. [18] have reported that seizures per se do not necessarily cause intellectual deterioration. However, the aetiology of the seizures such as neurological insults and malformations may contribute to intellectual impairment [17, 18].

There was a significant relationship between DAPQ and academic performance among the children with epilepsy in this study. This agrees with the observation of Sturmiolo and Galleti [19], but contrasts somewhat with the observation of Seidenberg, et al. [7], who noted that children with epilepsy made less progress than expected for their IQ level and age. The correlation of scholastic achievement with IQ level is not unexpected and IQ could be used in the proper placement of school children, particularly at the outset of their education [20].

School absenteeism was significantly more frequent in children with epilepsy than controls in this study. Since the children were not admitted in any hospital during the period of this study, the reason for the high rate of school absenteeism could be due to psychosocial factors rather than severity of the illness [21].

Although Mykleburst [22] is of the opinion that school attendance is a critical factor in school success among children with epilepsy, the correlation between them has not been established [8, 23]. The lack of a significant relationship between academic performance and school absenteeism in this study agrees with the latter opinion.

The children with epilepsy in our study had a high rate of behavioural problems, 48% compared with 12% among the controls. The fact that behavioural problems are more common among children with epilepsy has been previously reported [24–26]. However, the prevalence of behavioural problems found in this study (48%) is higher than the 20–30% reported previously in other areas [24, 25]. The reason for the higher rate in our patients is not very obvious, but could be due to peer non-acceptance, negative teachers’ attitude and social stigmatization, which have been reported by Ojinnaka [27] in Nigeria.

### Table 4
**Relationship between overall academic score and anti-epileptic drug therapy**

<table>
<thead>
<tr>
<th>Anti-epileptic drug regimen</th>
<th>Overall score</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Average</td>
<td>High</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-----</td>
<td>---------</td>
<td>------</td>
</tr>
<tr>
<td>Monotherapy</td>
<td>11</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>Carbamazepine</td>
<td>0</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Phenobarbitone</td>
<td>10</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Others^</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Polytherapy</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
<td>19</td>
<td>18</td>
</tr>
</tbody>
</table>

^Valproate 2 (low score 1, average score 1), ethosuximide 1 (average score); statistics: carbamazepine vs. phenobarbitone: χ² = 6.58, df = 2, p = 0.01; monotherapy vs. polytherapy: χ² = 0.59, df = 2, p = 0.75.

### Table 5
**Results of multiple regression analysis of factors associated with academic performance in children with epilepsy**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>R² change</th>
<th>95% confidence Interval</th>
<th>Partial coefficient</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAPQ</td>
<td>0.39</td>
<td>0.13</td>
<td>0.20–1.04</td>
<td>0.40</td>
<td>0.01</td>
</tr>
<tr>
<td>Seizure type</td>
<td>0.29</td>
<td>0.09</td>
<td>0.01–0.24</td>
<td>0.31</td>
<td>0.03</td>
</tr>
</tbody>
</table>

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It is pertinent to note that although the prevalence of behavioural disturbances was significantly higher among children with epilepsy in this study, it did not significantly influence their school performance. It may be that in epilepsy, behavioural problems are the consequence of academic under-achievement rather than the reverse [24].

The relationship between academic performance and seizure type was not statistically significant. This is in keeping with the findings of Sturniolo and Galleti [19], but differs from those of Seidenberg et al. [7] and Sofijanov [28] who noted that academic under-achievement was worse in children with generalized epilepsy.

There was no significant difference between monotherapy and polytherapy in their relationship with academic performance in this study. This finding differs from previous studies which reported that cognitive function was worse in children on polytherapy [29, 30]. The reason could be because a majority of the children on monotherapy in this study were receiving phenobarbitone. Children on phenobarbitone were significantly more likely to have a poor academic performance. Previous reports on the effects of anti-epileptic medications are conflicting [31–33]. Each of the four drugs used in this study has been reported to have detrimental effects by some authors [33, 34] but not by others [35, 36]. However, phenobarbitone is the major drug associated with a detrimental effect on academic performance [25]. The reason for poor academic performance among children on phenobarbitone may be because it reduces attention and memory, and causes behavioural disorders [31, 32].

The other factors which did not significantly influence overall score in this study included sex, socio-economic status, seizure frequency, age at onset of seizures, seizure control, EEG findings and history of previous episodes of status epilepticus. This trend has been reported previously [7, 19, 26].

Multiple linear regression showed that only IQ and seizure type had significant predictive effects on academic performance. This agrees with the known relationship between IQ and academic achievement [19, 20] and the recognized effect of generalized seizures on intellectual ability [7, 28]. Previous studies on the academic performance of epileptic children using multiple regression either showed IQ as the only factor with independent effect [19] or that none of the factors had a strong predictive value on academic achievement [7]. However, the later study did not include IQ among the variables analysed.

In conclusion, IQ and seizure type are the most important determinants of the academic achievement in children with epilepsy attending normal primary schools.

Preschool IQ evaluation should therefore be conducted in all Nigerian children with epilepsy to detect those who cannot cope in normal schools, since IQ significantly affects their performance. These children should be identified and offered educational assistance in normal schools.

References