



MEMORY STATUS AMONG CHILDREN WITH EPILEPSY

Paediatrics

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ABSTRACT

Objective: To study the status of visual and verbal memory status among children with epilepsy and effects on schooling. **Methods:** This descriptive cross-sectional study enrolled children aged 5 to 15 years who have been diagnosed to have epilepsy and has been seizure free during last one month. Enrolled children (81) were evaluated by using two sub tests selected from the National Institute of Mental Health and Neuro Sciences (NIMHANS) Neuropsychological Battery for Children, Rey's Auditory Verbal Learning test and Memory for Designs test, for verbal and visual memory status respectively and the child was graded on the basis of the standard scores. Schooling details were obtained by questionnaires to care taker. **Results:** Memory impairment (MI) was identified in 50 (61.7%) Children with Epilepsy (CWE) (predominantly verbal memory impairment). 20 (25%) CWE were not attending age appropriate class. Among these 20 CWE, 17(85%) children had memory impairment. p: 0.01. There were 25 CWE performing poorly, among them 22(88%) children had memory impairment. p <0.0024. A total of 8 children were school dropouts and all 8 had MI (100%). **Conclusions:** MI was found to be very common in CWE. MI among CWE was found to negatively influence age appropriate schooling and school performance. Early screening and appropriate support may improve the outcome.

KEYWORDS

Memory impairment, Children with Epilepsy, Verbal memory impairment, Visual memory impairment, School academic performance.

Epilepsy interferes with the development of brain networks that are responsible for cognition. Prolonged epilepsy may cause progressive alternations in large scale in neuronal networks throughout the childhood period.⁽¹⁾ Memory impairment (MI) can be an effect of childhood epilepsy and can have a detrimental impact on quality of life and MI is associated with difficulties in academic achievement(s).^(2,3) There is paucity of data and lack of awareness regarding visual and verbal memory status among children with epilepsy from India. Therefore, the objectives of the present study are to find out the prevalence of MI among CWE and the possible outcome on schooling.

METHODS

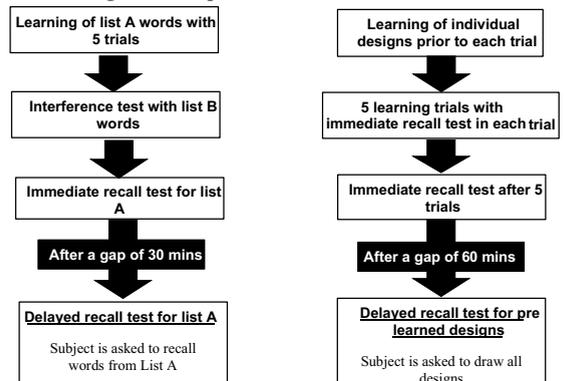
This descriptive cross-sectional study was undertaken at a private teaching hospital in Shillong, Meghalaya, India from 15th November 2017 to 15th November 2018. Institutional ethics committee approval was obtained. Consecutive children aged 5 years to 15 years who have been diagnosed to have epilepsy (at least 1 unprovoked epileptic seizure with either a second such seizure or enough EEG and clinical information to convincingly demonstrate an enduring predisposition to develop recurrences) and has been seizure free during last one month were enrolled. Focal to generalized seizure at onset, non-motor seizure, unclassified seizure, known case of visual and auditory impairment, past history of brain surgery, delayed milestones, regression of milestones, obvious intellectual disability, psychosis or neurosis were excluded. Written informed consent was taken from the caregivers and assent was obtained from children more than 7 years of age. Patient confidentiality was maintained.

Table 1: Age group and recommended series of designs to administer

| AGE GROUP | SERIES OF DESIGNS ADMINISTERED |
|---------------|--------------------------------|
| 5 to 7 years | 1- 10 |
| 8 to 10 years | 1-14 |

| | |
|----------------|------|
| 11 to 13 years | 1-16 |
| 14 to 15 years | 1-18 |

Fig. 1: Flow Diagram of Steps involved in Individual Test



Rey's Auditory Verbal Learning test

Memory for Designs test

After applying the study criteria, enrolled children's memory was assessed in the OPD using Rey's Auditory Verbal Learning test (WHO/ UCLA Version, Maj. et al., 1993)⁽⁴⁾ and Memory for Designs test (Jones- Gotman & Milner, 1986)⁽⁴⁾, for verbal and visual memory status respectively as depicted in Fig. 1 and Table 1. The score for each test was based on the number of word(s) /design(s) recalled correctly. The raw scores that were recorded were further compared with standard reference scores according to the norms for the respective age. The child was then graded on the basis of the standard scores and any score less than fifth percentile score for the age was considered as presence

of memory impairment. Children with MI were sent to department of Clinical psychology for further management.

Additional data was collected on school performance of the subject (subjective opinion of parent/ caregiver), socio economic status of the family, age appropriate schooling of the subject, duration of epilepsy, type of seizures at onset.

Sample size was calculated by standard cross-sectional study formulae, expected proportion in population was based on systemic review conducted by Menlove L, Reilly C. (2015)⁹

Statistical analysis: The outcome variables were tabulated in descriptive table and were subjected to the statistical measures Proportion test, Chi- Square test of independence using SPSS Version 22.0 on a Windows 10 operating system. *p* value < 0.05 was considered statistically significant.

Results

A total of 102 CWE were assessed for eligibility during the study period and 81[43 (53%) boys] CWE, aged 5 years to 15 years of age were enrolled (5 declined to participate, and 16 children fell into the exclusion criteria), amongst 81 CWE 25(31%) had verbal memory impairment alone and 25(31%) had combined impairment of both visual and verbal memory as shown in Fig.2. Almost half of the study group i.e. 40 (49.4%) of the CWE belongs to lower middle class. No significant difference in memory impairment was seen among different gender, age. The clinic demographic characteristics of the study population are presented in Table 2.

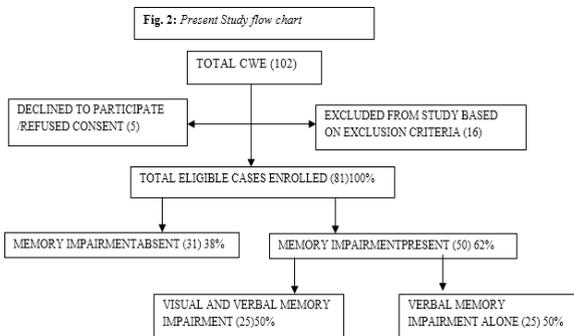


Table 2: Clinicodemographic characteristics of Children with Epilepsy (N=81)

| Characteristics | No. (%) | MI present (%) | p value |
|--------------------------|-----------|----------------|--------------|
| Age (5-10y) | 47 (58) | 27 (57) | 0.3 |
| Male | 43 (53) | 27 (63) | 0.11 |
| Lower middle class | 40 (49.4) | 24 (60) | 0.214 |
| Upper lower class | 28 (34.6) | 19 (68) | 0.07 |
| Type of seizure at onset | | | |
| Focal seizure | 3 (4) | - | - |
| Generalized Seizure | 78 (96) | 50 (64) | 0.016 |
| Duration of epilepsy | | | |
| One year or less | 35 (43) | 15 (43) | 0.4 |
| More Than One Year | 46 (57) | 35 (76) | 0.001 |

Note: Significant p-value is bolded.

In the present study there was more CWE attending school. However, among those who dropped out of school, 100 per cent had MI. Therefore, MI was statistically significant in children not attending school. *p*, 0.02. Out of the all children that were studied, 20 CWE (25%) were not attending age appropriate classes. Amongst these 20 CWE, 17(85%) children had memory impairment, *p*: 0.01. Therefore, in the present study memory impairment among CWE was found to negatively influence age appropriate schooling. Out of total children that were studied, 19 children performed well and these children who performed well in their studies had no memory impairment. There were 25(31%) children performing poorly, among them 22 (88%) children had memory impairment. The *p* < 0.0024 is statistically significant. Therefore, in the present study CWE with memory impairment were found to have poor performance than those who did not have memory impairment. As this is a subjective finding (mother's perception) conclusion cannot be made with certainty. The influence on schooling is summarized in Table 3.

Table 3: Summary of influence on schooling

| SCHOOLING VARIABLES | Character n ₁ (%) | Presence of MI n ₂ (%) | p value |
|-----------------------|------------------------------|-----------------------------------|---------------|
| School dropout | Yes 8(10) | 8(100) | 0.2 |
| | No 73(90) | 42(58) | |
| Age appropriate class | Yes 61 (75) | 33(54) | 0.52 |
| | No 20 (25) | 17(85) | 0.01 |
| School performance | Good 19 (23.5) | 0(-) | - |
| | Average 37 (45.7) | 28(76) | 0.0055 |
| | Poor 25 (30.9) | 22(88) | 0.0024 |

Note: Significant p-value is bolded.

Discussion:

This descriptive cross-sectional study explored the clinical profile, memory status and schooling outcomes of CWE, in the setting of a developing country. A total of 102 CWE were identified. After excluding cases based on exclusion criteria as well as those who refused consent, 81 patients were included and enrolled in the present study. Out of 81, 50 CWE had memory impairment and were of generalized type of seizure and among them 25 CWE had verbal memory impairment alone, 25 CWE had both verbal and visual memory impairment and none had isolated visual memory impairment as depicted in Fig. 2. Memory impairment among CWE was found to negatively influence age appropriate schooling (*p*, 0.014) and were found to have performed lower school academic performance than those who did not have memory impairment (*p* < 0.001). As this is a subjective finding conclusion cannot be made with certainty. Children living with epilepsy for more than 1 year had significant contribution towards presence of memory impairment (*p*, 0.0086), details are summarized in Table 2.

In the present study, out of 81 CWE 50 children had memory impairment. Hence, prevalence of memory impairment among CWE in the present study is 61.7%. Similar result was found in study conducted by Reilly C et al.,⁵. In contrast to the present study, studies conducted by various authors like Ibinga E et al.,⁶ and Putra BP et al.,⁷ found to have prevalence lower than the present study. The probable reasons behind this difference in the prevalence may be attributed to greater number of children in the present study were having longer duration life spent with epilepsy, 96 per cent of CWE had generalized seizure at onset and a greater number of children with multiple episodes of seizure, as these could affect the developing neuronal networks. However, prevalence in the present study is lower than the study carried out by Menlove L, Reilly C.⁸, this could be because as the above study was a systemic review using particular terms like 'memory', 'children' and 'epilepsy', therefore the majority of the studies published reported memory impairment in CWE. In our study we had found that a greater number of children are attending school and majority of the CWE were on mono-therapy and compliant to therapy which may have contributed to the lesser prevalence. Comparison has been tabulated in Table 4.

Table 4: Various studies showing prevalence of MI among CWE

| Authors | Type of study | Year | Place | Prevalence |
|--------------------------------|-----------------------------|------|-----------------|------------|
| Present study | Descriptive cross-sectional | 2018 | Shillong, India | 61.7% |
| Putra BP et al., ⁷ | Descriptive cross-sectional | 2019 | Indonesia | 42.5% |
| Menlove L et al., ⁸ | Systemic review | 2015 | PUBMED database | 78% |
| Reilly C et al., ⁵ | Population based | 2015 | Lingfield, UK | 58% |
| Ibinga E et al., ⁶ | Community based | 2015 | Gabon, Africa | 49.4% |

SCHOOL DROPOUT: In the present study, out of all CWE, 8 (10%) children were school dropout and all the 8 had memory deficit, after applying tools to calculate statistical significance of the results, it was concluded that presence of memory impairment in CWE had significantly contributed to school dropout even through the ratio of child are less than the study conducted by Ibinga E et al.,⁶ which has reported that 37 per cent of them were not attending the school. The proportion of school dropouts in the present study was less, probably because our study had a greater number of literate mothers and majority of them belonged to higher socioeconomic class and greater

emphasis would have been put on education. In the 10% of school dropouts that were present in our study, the reasons for school dropout were not only memory impairment but also associated factors such as greater number of seizure episodes requiring frequent hospital visits and hospitalization, underlying disease process, use of multiple anti-epileptic drugs that had some sedative effect, social stigma and fear of injuries and fall. There was discouragement by teachers to attend school because of apprehension amongst teachers about occurrence of a seizure episode at school. The study by Ibinga E *et al.*,⁽⁶⁾ however was a community-based study and therefore more likely to pick up school dropouts in the community.

AGE APPROPRIATE SCHOOLING: In the present study, out of all CWE that was studied, 20 (24.6%) CWE were not going to age appropriate grades. Amongst those CWE who were studying grades lower than their current age, 17 (85%) children had memory impairment. After applying tools to calculate statistical significance of the results, it was concluded that presence of memory impairment in CWE had significantly influenced age appropriate schooling ($p, 0.01$). The reason behind influence of epilepsy on age appropriate schooling was probably due to poor attention and learning, leading to poor school academic performance and academic failures, fears of parents and/ or teachers of seizure episodes in school/ way to school and seizure related injuries may be contributed to CWE skipping academic year when the child was actively having seizures. Also poorly controlled seizure and recurrent hospital admissions, were likely to increase school absence among CWE. However, other studies there were reviewed did not consider age appropriate schooling as a variable in their study. The present study suggests that CWE attending age appropriate grades were less likely to show MI.

SCHOOL ACADEMIC PERFORMANCE: In the present study, 19(23%) children that performed well in their studies had no memory impairment. However, the good performers were least in comparison to those who were average or poor performers. There were 25(31%) children who performed poorly and 37(46%) average performers. Among the 25 CWE who performed poorly, 22 (88%) children had memory impairment, whereas among 37 children who performed average, 38 (76%) children had memory impairment. These results were statistically significant, $p, 0.005$ and 0.002 respectively. These findings could be probably attributed to reasons such as decreased in memory and learning process due to inattentiveness in class room, and to reasons that have already been discussed already. However, the subjective assessment of school academic performance by parent's/ caretaker's opinion brings about an uncertainty to comment on the impact of MI on academic performance. Investigations done by Wo SW *et al.*,⁽⁹⁾ and Reilly C *et al.*,⁽¹⁰⁾ showed similar prevalence of lower academic performance among CWE. However, in contrast to the present study, studies conducted by Jackson DC *et al.*,⁽¹¹⁾ and Vinayan KP *et al.*,⁽¹²⁾ had report lower prevalence of lower academic performance among CWE. Table 5 compares the present study with other published studies.

Table 5: Various studies- their percentage of CWE with lower academic performance

| Authors | Year | Percentage |
|--|------|---|
| Present study | 2018 | 88% performed poorly 76% performed average |
| Wo SW <i>et al.</i> , ⁽⁹⁾ | 2015 | 70% |
| Jackson DC <i>et al.</i> , ⁽¹¹⁾ | 2013 | 50% |
| Reilly C <i>et al.</i> , ⁽¹⁰⁾ | 2012 | 79% |
| Vinayan KP <i>et al.</i> , ⁽¹²⁾ | 2005 | 54% |

In our study, one of the limitations was the lack of a control group. Hence direct impact/ casual effect on memory impairment of the variables studied could not be assessed as normal children may also have similar memory impairment due to various other reasons. Another limitation of this study was subjective measure of school academic performance that may have provided false positive or false negative outcome as it was based on parent's opinion. Lobe of seizure origin was also not assessed and its relation to MI was not assessed in the present study. Due to lesser duration of study(1 year) follow up of CWE was not considered, which might have revealed the natural course of the memory status in CWE.

In conclusion, the present study demonstrates that CWE show significant deficits in verbal and visual memory. In addition, type of epilepsy, earlier age at epilepsy onset, and longer active duration of

epilepsy were associated with memory impairment. Our research findings underline the importance of offering early assessments, especially for CWE, with a longer duration and an early age at epilepsy onset, with extensive neuropsychological assessment protocols that include several measures of memory. Knowing the outcome of these groups of children with epilepsy in memory tests gives clinicians and psychologists the possibility to establish adequate and timely school intervention program to diminish the negative influence that these memory problems have on their academic achievement. Along with efficacious medical management of the seizures, psychosocial support for child, family, and school will be essential and will likely involve effective screening and improving teacher, child, and parent knowledge and attitudes.

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Contributors: Arun John was the principal investigator and corresponding author. SD, JML, PRG were the co investigators. Pramod Paharia helped in the study design. Prasenjit Paul, SY and AK along with all other authors prepared and reviewed the manuscript.

Conflict of Interest: Nil

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