

ORIGINAL ARTICLE

Assessing the Neuro-cognition of Epileptic Patients in a Tertiary Care Hospital - A Cross-sectional Study

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ABSTRACT

Introduction: Epilepsy affects about 50 million people worldwide. Cognitive impairments—including mental slowness, memory loss, and attention deficits—occur in 70–80% of patients, often exacerbated by antiepileptic drugs (AEDs) and temporal lobe involvement. **Methods:** This cross-sectional study at Saveetha Medical College (Oct 2020–Oct 2021) evaluated 94 patients aged 18–40. Cognitive function was assessed using the Brief Cognitive Rating Scale (BCRS), Digit Symbol Substitution Test (DSST), and Trail Making Test–B (TMT-B). Data were analyzed via SPSS using one-way ANOVA and Chi-square tests to correlate clinical variables with cognitive scores. **Results:** The study included 94 participants with a mean age of 31.31 ± 7.44 years. Cognitive impairment was significantly associated with the duration of epilepsy. The BCRS score, TMT-B total time, and DSST total time showed significant cognitive decline correlating with epilepsy duration ($p < 0.05$, ANOVA), except for TMT-B error ($p = 0.08$). The mean scores indicated notable impairment in cognitive functions. Consistent with previous studies, our findings indicate significant cognitive decline in epileptic patients, particularly related to the duration of epilepsy. Cognitive impairments were evident in various domains, including memory and psychomotor speed. Early detection and intervention are crucial for preventing further cognitive deterioration. **Conclusion:** Epilepsy is linked to significant deficits in memory, attention, and executive function that worsen over time. Routine cognitive screening and early targeted interventions are essential to improve long-term patient outcomes.

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INTRODUCTION

Epilepsy is a chronic disease characterized by recurrent seizures affecting the normal day today activities of people belonging all ages. Approximately about 50 million people throughout the world are affected with epilepsy, considering this is one of the common neurological disorders worldwide (1). Hippocrates (460–377 B.C.) first recognized Epilepsy as an organic process of the brain. Since ancient days the relation between depression and epilepsy has been noticed (2). 70 – 80% of the epileptic patients will have cognitive impairment. Cognitive impairment occurs may be due to general or specific decline cognition like mental slowness, memory defect and attention deficits (3). The risk factor for cognitive impairment includes age of disease onset, type and severity of seizure, other factors. The epileptic patient treated with antiepileptic drugs (AEDs)

are the common cause for the cognitive impairment (4). The common complications of AEDs are aggression, impaired cognition, attention difficulties, depression, irritability, sexual dysfunction, confusion and sleep disturbances (5).

In adult, temporal lobe epilepsy (TLE) is the common form of focal epilepsy. This type of epilepsy advanced with increased age, longer period of epilepsy, and lesion on the temporal lobe(6). Recent studies in TLE showed that the cognitive impairment means there is impairment in letter based verbal fluency or figural memory. Person with cognitive impairment are find difficult in doing the activities of daily life, and these persons may also complains of finding word difficult, psychomotor slowing. The disturbance in memory is the most important clinical symptom. These persons they mainly use the mobile phones for calculations to check dates, and they always set reminders to do their activities. Mild type of cognitive impairment is the risk factor for the development of dementia and Alzheimer's type (7,8).

Neuropsychological scales and tests are used to assess the cognitive impairment with some limited use for clinicians. The early detection and the treatment of seizure is very important to prevent the formation of early childhood disability and progression of cognitive impairment with advanced age. In our study we used neurological scales such as BCRS scale, TMT test and DSST test to assess the severity of neuro cognition impairment in epileptic patients.

MATERIALS AND METHODS

Study setting

This hospital based cross-sectional study was done in a tertiary care hospital, Saveetha Medical College and Hospital, Chennai. The study participants were the patients coming for outpatient consultation in the department of Neurology.

Inclusion and exclusion criteria

The study included consenting patients aged 18–40 with a diagnosed seizure disorder. Individuals were excluded if they had been seizure-free for five years or presented with severe, incapacitating medical conditions. Further exclusion criteria included primary neurological disorders, head injuries, previously diagnosed psychiatric illnesses, and substance use disorders, including nicotine dependence.

Sample Size

Assuming the prevalence of 20%, with absolute precision of 9% and 95% confidence interval, the sample size calculated was 94.

Study procedure

Simple random sampling procedure was used to recruit the participants who came to the outpatient services of the Neurology department. The study period was from October 2020 to October 2021. Patients with previously diagnosed Seizure disorder were selected as per International League Against Epilepsy (ILAE).

Brief Cognitive Rating Scale, Digit Symbol Substitution Test and Trail Making Test – B were used to assess Cognitive Impairment (9-11).

Data management and analysis

Data were collected, entered into Microsoft Excel, and analyzed using IBM SPSS Statistics Version 27. Descriptive statistics such as mean, standard deviation, and percentages were calculated for demographic and clinical variables. To assess the association between the duration of epilepsy and cognitive impairment scores, one-way Analysis of Variance (ANOVA) was used for continuous variables (BCRS scores, TMT-B total time, DSST scores). For categorical variables, the Chi-square test was applied. A p-value of less than 0.05 was considered statistically significant

Ethical Consideration

The study was registered with the Institutional Ethical Committee (SMCH-IEC), Saveetha Medical college and Hospital: SMC/IEC/2023/07/043

RESULTS

The study included 94 participants, with a mean age of 31.31 ± 7.44 years. Among them, 55 were male (58.51%) and 39 were female (41.48%). The majority (35.10%) belonged to the age group of 31–40 years, followed by 25.53% in the 21–30 years age group. Generalized seizures were the most common type, reported in 68 patients (72.34%), while 26 patients (27.66%) had focal seizures.

The mean duration of illness was 5.47 ± 2.73 years. Initially, the participants were categorized into three groups: <5 years (44 patients, 46.80%), 6–10 years (48 patients, 51%), and >10 years (2 patients, 2.1%).

Given the very small number of participants in the >10 years group ($n=2$), statistical analysis involving this group may not yield meaningful conclusions. Therefore, for analysis purposes, comparisons were primarily focused on the two main groups: <5 years and 6–10 years of epilepsy duration. The >10 years group is mentioned but not analysed separately due to its limited sample size.

Regarding treatment, 63.83% of patients were on monotherapy, while 36.17% were on polytherapy. The most commonly used antiepileptic drugs (AEDs) included sodium valproate (52.13%), carbamazepine (47.87%), and phenytoin (28.72%).

Cognitive functioning was assessed using the BCRS, TMT-B, and DSST. The mean BCRS score was 16.72 ± 3.78 . Patients with longer illness duration demonstrated higher BCRS scores, indicating greater cognitive impairment. TMT-B total time and error scores, as well as DSST scores, showed similar trends, with worsening performance associated with longer illness duration.

Statistical analysis revealed significant associations between epilepsy duration and BCRS scores ($p = 0.03$), TMT-B total time ($p = 0.008$), and DSST total time ($p = 0.001$). TMT-B error score showed a non-significant trend ($p = 0.08$). These results focus on comparisons between the <5 years and 6–10 years groups as the >10 years subgroup was excluded from statistical testing due to its small size (Table I).

The number of AEDs was also significantly related to cognitive scores. Patients on polytherapy performed worse across all cognitive tests compared to those on monotherapy. Significant differences were noted in BCRS scores ($p = 0.02$), TMT-B total time ($p = 0.01$), and DSST scores ($p = 0.03$).

Table 1: Cognitive impairment of the study participants with seizure disorder (n=94).

Scales	Duration of epilepsy	N	Mean	Standard deviation	p value
BCRS	<5 YEARS	18	1.09	0.122	0.023
SCORE	6-10 YEARS	74	1.28	0.234	
	>10 YEARS	2	1.23	0.141	
TMT – B	<5 YEARS	18	285.71	46.362	0.005
TOTAL	6-10 YEARS	74	338.22	62.455	
	>10 YEARS	2	372.5	53.87	
TMT B	<5 YEARS	18	0.28	0.621	0.086
ERROR	6-10 YEARS	74	1	1.0606	
	>10 YEARS	2	1	1.118	
DSST	<5 YEARS	18	357.89	70.73	0.023
TOTAL	6-10 YEARS	74	394.64	67.95	
	>10 YEARS	2	437.77	49.12	
DSST	<5 YEARS	18	0.62	1.150	0.024
ERROR	6-10 YEARS	74	1.39	1.221	
	>10 YEARS	2	2.01	1.269	

Age was significantly associated with cognitive impairment, with older patients exhibiting worse cognitive performance across BCRS ($p = 0.02$), TMT-B total time ($p = 0.01$), and DSST ($p = 0.01$).

DISCUSSION

In our study we found that there is decreased cognitive function in epileptic patients. The mean age in years was 31.31 ± 7.44 with range from 17 to 50 years where around half of the population were in the age group 31-40 years. Both males and females were almost equal, where males were slightly higher in number. Based on religion, half of the participants belonged to Hindu religion. Only 4.3% had an education level of more than PUC level and around one fourth of the participants were in the primary education level. Regarding socio-economic status 41.5% were in middle class and 22.3% were in lower class.

Previous researchers showed that the cognitive impairment occurs in epileptic patients with brain damage. Recent studies showed that generalized tonic clonic seizures patients showed cognitive impairment without the brain damage. In our study we included the epileptic patients without the head injury.

We found that the cognitive impairment among the epileptic individuals, according to BCRS total score

the mean was 5.78 ± 0.97 , mean TMT-B total time was 322.66 ± 62.85 , mean TMTB error was 70 ± 0.89 and mean DSST-total time was 386.17 ± 70.54 with significant p value with the duration of epilepsy similar to the study done by Siddharth Shetty et al (12).

Siddharth Shetty et al (12) found that the increase in age produce negative effect on cognitive functions and assessed with the help BCRS, TMT-Band DSST similar in our study we also use BCRS, TMT-Band DSST to assess the neuro cognition in epileptic patients.

Siddharth Shetty et al (12) found that duration of epilepsy as a clinical variable. the author explained that the duration of seizure for more than 5 years is usually have worsen cognitive outcome. The present study also showed that the cognitive impairment is associated with the duration epilepsy as seen by the p value which is statistically significant ($p < 0.05$).

This study provides robust evidence that cognitive impairment is a significant comorbidity in patients with epilepsy, with a clear and progressive association between illness duration and the severity of neurocognitive decline. Our findings align with the systematic review titled "Cognitive Impairment in People with Epilepsy (13)", which highlights that cognitive deficits in epilepsy are common, multifactorial, and involve memory, attention, and executive functions. Similarly, in our study, we observed pronounced impairments in these cognitive domains, as reflected by worsening scores across standardized tools such as the Brief Cognitive Rating Scale (BCRS), Digit Symbol Substitution Test (DSST), and Trail Making Test – B (TMT-B).

Further, our results resonate with the systematic review on "Mechanisms of Cognitive Impairment in Temporal Lobe Epilepsy" (14), which discusses how recurrent seizures and aberrant resting-state functional connectivity contribute to memory, attention, and executive dysfunction. Although our study was not limited to temporal lobe epilepsy, the progressive cognitive deterioration seen in patients with longer disease duration supports the hypothesis that recurrent seizures and possibly subclinical epileptiform activity play a critical role in cumulative cognitive burden. Additionally, prolonged exposure to antiepileptic drugs (AEDs), known for their cognitive side effects, may further exacerbate these deficits, as also reported in the literature. The proposed neurobiological mechanisms underlying seizure-related cognitive impairment are summarized in Figure 1.

Importantly, our study reinforces the growing recognition that epilepsy is not merely a seizure disorder but a neurological condition with profound cognitive ramifications affecting quality of life, daily functioning, social integration, and long-term independence. Patients with epilepsy exceeding ten years of disease

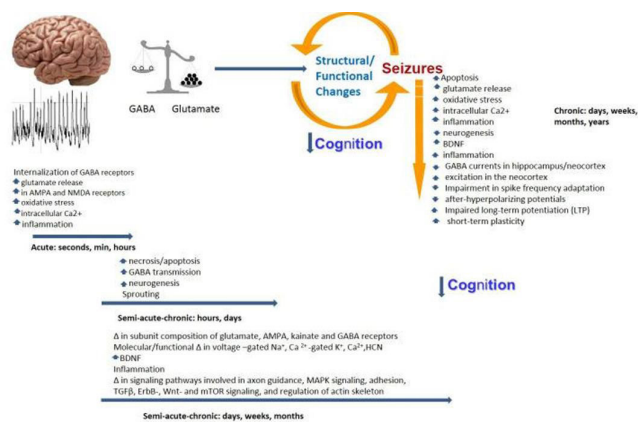


Figure 1: Schematic representation of the neurobiological mechanisms underlying cognitive impairment in epilepsy. Recurrent seizures lead to imbalance in excitatory (glutamate) and inhibitory (GABA) neurotransmission, oxidative stress, inflammation, and intracellular calcium dysregulation. These changes contribute to structural and functional brain alterations, impaired synaptic plasticity, and progressive cognitive decline.

duration demonstrated the highest levels of cognitive dysfunction, underscoring the cumulative impact of seizures and AED exposure.

Clinically, this study advocates for the routine integration of cognitive assessments into epilepsy care, particularly for those with chronic epilepsy. Utilizing tools like BCRS, DSST, and TMT-B allows for early detection of cognitive impairments, which is critical for implementing targeted interventions such as AED regimen adjustments, cognitive rehabilitation strategies, psychoeducation, and lifestyle modifications aimed at preserving cognitive health.

Moreover, consistent with recommendations from both systematic reviews, our findings emphasize the need for multidisciplinary care models involving neuropsychologists, occupational therapists, and mental health professionals to provide comprehensive management of cognitive impairments. This approach may help prevent further cognitive decline and mitigate secondary complications such as dementia.

In the broader context, our study highlights the necessity for future longitudinal research to explore reversible aspects of cognitive impairment, the role of newer AEDs with better cognitive profiles, and the impact of achieving optimal seizure control on cognitive outcomes. Further exploration is also warranted to delineate the influence of epilepsy subtypes, seizure severity, and specific drug effects on cognition.

However, our study has several limitations that must be considered. Firstly, the sample was recruited from a single tertiary care hospital, which may limit the generalizability of the findings. Patients attending this

hospital may differ socio-demographically or clinically from the broader epilepsy population. Secondly, the subgroup with epilepsy duration >10 years included only 2 participants, limiting the reliability of statistical analyses for this group. Future studies should aim for larger and more balanced subgroup sizes to allow more meaningful comparisons.

CONCLUSION

Epilepsy management must extend beyond seizure control to incorporate cognitive preservation as a central therapeutic objective. Timely assessment, monitoring, and interventions targeting cognitive health will enhance patient autonomy, improve prognosis, and significantly elevate the quality of life in individuals living with epilepsy. The findings of this study, in concordance with the existing systematic reviews, advocate for a holistic, neurobiologically informed, and psychosocially sensitive approach to epilepsy care.

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