

Original Research Article

# Executive dysfunction in patients with idiopathic epilepsy

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	International Archives of Integrated Medicine, Vol. 5, Issue 6, June, 2018. Copy right © 2018, IAIM, All Rights Reserved. Available online at <a href="http://iaimjournal.com/">http://iaimjournal.com/</a> ISSN: 2394-0026 (P)                      ISSN: 2394-0034 (O)
	Received on: 23-05-2018                      Accepted on: 29-05-2018 Source of support: Nil                      Conflict of interest: None declared.
<b>How to cite this article:</b> Kamera Sateesh Kumar, Veena Narisetty, Changala Praveen. Executive dysfunction in patients with idiopathic epilepsy. IAIM, 2018; 5(6): 27-37.	

## Abstract

**Background:** Idiopathic epilepsy is defined as disorder in which there is no underlying cause or structural pathology other than a possible hereditary predisposition for generating seizures which can be generalized or focal in nature.

**Objective:** To study the occurrence of executive dysfunction in patients with idiopathic epilepsy and its association with age, gender, seizure type, duration of epilepsy, age at seizure onset, antiepileptic drug therapy and seizure control & the association of the interictal EEG pattern.

**Materials and methods:** 100 cases of epileptic patients with normal CT scan brain / MRI brain were studied. Frontal Assessment Battery & The Executive Interview (EXIT) were used to assess the executive functions.

**Results:** The FAB score were normal in 46% and abnormal in 54% of the cases. Executive dysfunction as per the FAB score was mild in 32% and moderately severe in 22% of the cases. Impairment in Executive function as per EXIT score was mild in 84% and moderate in 16% of the cases. Executive Dysfunction was more in cases with either primary or secondarily generalized seizures, cases with a higher seizure frequency, longer duration of epilepsy, uncontrolled epilepsy and seen in 17.5% with normal and 10% cases with an abnormal EEG.

**Conclusion:** Our study found a significant proportion of patients with idiopathic epilepsy have Executive Dysfunction, which adds to the seizure burden by reducing the capacity of an individual to successfully engage in self-care, social, academic and occupational pursuits.

## Key words

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Epilepsy, Executive dysfunction, EXIT score, FAB score, Interictal EEG.

## Introduction

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Idiopathic epilepsy is defined as disorder in which there is no underlying cause or structural pathology other than a possible hereditary predisposition for generating seizures which can be generalized or focal in nature. Idiopathic epilepsies can be classified on the basis of age at seizure onset, clinical and electroencephalographic characteristics [1].

Executive functions (EF) are a set of cognitive skills that enable an individual to perform goal oriented voluntary actions in cognitive, emotional and social areas [2]. Several epilepsy variables including, age at seizure onset, seizure type, seizure severity, disease duration and antiepileptic drug therapy seem to have an impact on cognition, behavior and academic skills [2].

It is important to study the impact of epilepsy on frontal executive functions, not only for diagnostic, prognostic and therapeutic implications but also for devising strategies to improve and enhance the quality of life in patients with idiopathic epilepsy.

There is scant and inconclusive data regarding the occurrence of frontal executive dysfunction in patients with idiopathic epilepsy, especially in the Indian literature.

## Aim and objectives

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- To study the occurrence of Executive Dysfunction in patients with idiopathic Epilepsy and the association of age, gender, seizure type, duration of epilepsy, age at seizure onset, antiepileptic drug therapy and seizure control, interictal EEG pattern with executive dysfunction in patients with idiopathic epilepsy.

## Materials and methods

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### Place of study

This was an observational Cross Sectional Study carried out at Tertiary care center - Gandhi Hospital, Hyderabad, Telangana. A total of 100 cases were studied. All patients of epilepsy  $\geq 18$  years of age, attending Neurology OPD or admitted in the ward, were screened and epileptic patients with normal CT scan brain / MRI brain were included in the study for analyses. Written informed consent was taken from the patients for inclusion in the study.

### Inclusion criteria

Cases of generalized or focal idiopathic epilepsy of age  $\geq 18$  years with normal CT scan or MR brain

### Exclusion criteria

Mental retarded Patients and Patients with dementia/ psychosis, chronic medical disorder, recent ( $< 6$  weeks) traumatic brain injury, stroke or neurological deficit, meningo-encephalitis, history of alcohol and drug abuse.

### Data collection

All patients with idiopathic epilepsy were evaluated by taking a detailed history and conducting a clinical examination, neuroimaging and interictal EEG recording. Details of the history, examination and the investigations were recorded on a pre-designed proforma.

For the purpose of this study controlled and uncontrolled epilepsy were defined as follows:

**Controlled epilepsy:** Patients who have been seizure free for a minimum period of 6 months.

**Uncontrolled epilepsy:** Patients having one or more seizures in last 6 months.

Compliance was defined as:

**Poor** – missing medications one or more times per month

**Fair** - missing medication  $<$  once a month

**Good** – never missed a dose

**Executive Function Testing: The following two batteries were used to assess executive dysfunction:-**

**Frontal Assessment Battery**

The Frontal Assessment Battery has 6 subtests (Score: 0-3) including testing for Similarities (conceptualization), Lexical fluency (mental flexibility), Motor series “Luria” test (programming), Conflicting instructions (sensitivity to interference), Go–No Go (inhibitory control), Prehension behaviour (environmental autonomy). The total score is from a maximum of 18, higher scores indicating better performance.

**Scoring:** 16-18:- Normal or non-significant  
13-15:- Mild impairment significant  
7-12:- Moderate impairment  
0-6:- Severe impairment

**The Executive Interview (EXIT)**

The Executive Interview (EXIT) has 25 subtests (Score: 0-2) including testing for Number-Letter Task, Word Fluency, Design Fluency, Anomalous Sentence Repetition, Thematic Perception, Memory /Distraction Task, Interference Task, Automatic Behavior I, Automatic Behavior II, Grasp Reflex, Social Habit, Motor Impersistence, Snout Reflex, Finger-Nose-Finger Task, Go/No-Go Task, Echopraxia, Luria Hand Sequence I, Luria Hand Sequence II, Grip Task, Echopraxia II, Complex Command Task, Serial Order Reversal Task, Counting Task I, Utilization Behavior, Imitation Behavior. It has a total score of 50, higher scores indicating poor performance.

**Scoring:**

0-15: Mild impairment  
16-30: Moderate impairment  
31-50: Severe impairment

In patients with uncontrolled seizures, Executive Function Testing was done after a time lapse of at least 72 hours of the last recent seizure.

**Statistical Analysis**

Statistical analysis was done with SPSS software. All categorical data was analysed using Chi

square test or Fischer exact test and continuous variables were analyzed using the ‘student t test’. The level of significance was set at p value <0.05.

**Ethical Consideration:** Each volunteer was informed about the study and explained the purpose of the study. The right to quit the study at any time without having to give the reasons for doing so was secured. Patient’s information was dealt with confidentiality.

**Results**

100 consecutive cases with normal CT Scan brain / MRI brain were screened for idiopathic epilepsy and for evaluation of executive dysfunction.

Age of the patients ranged from 19 to 48 years with a mean age of 27.92 years. The majority (46%) of the cases fell in the 21-30 years age group.

There were 62 (62%) males and 38 (38%) females, with the male: female ratio being 1.63:1.

14% (n=14) were illiterate, 48% (n=48) were school dropouts, 16% (n=16) had studied till high school and 22% (n=22) were graduates.

Around 56% (n=56) of the cases in the study population belonged to the middle socio economic strata while 44% (n=44) fell in the low socio economic strata.

The age at seizure onset ranged from 8 to 39 years with a mean age of  $20.76 \pm 8.39$  years.

The total duration of epilepsy in the study population ranged from 6 months to 22 years. The mean duration of the epilepsy was  $7.06 \pm 5.71$  years.

Seizure frequency in the study population ranged from 1 seizure per week to 1 seizure every 3

years. Mean seizure frequency was  $3.85 \pm 7.51$  per year.

Family history of seizures was positive in around 14% (n=14) cases only.

For the purpose of our study, patients with no seizure in the previous 6 months were regarded as controlled and the remaining as uncontrolled epileptics. As per this criteria seizures were well controlled in 46% (n=46) and uncontrolled in around 54% (n=54) of the cases.

Time gap between the last seizure and assessment ranged from 5 days to 5 years.

Majority (48%; n=48) of the cases suffered from generalized tonic-clonic seizures only. Simple partial seizures were seen in 2% (n=2), complex partial seizures in 10% (n=10) and partial seizures with secondary generalization in around 14% (n=14) cases. Around 26% (n=26) cases with a diagnosis of myoclonic epilepsy had myoclonic seizures.

EEG was normal in majority (80%; n=80) of the cases and abnormal in around 20% (n=20) cases only.

At the time of assessment, around 74% (n=74) cases were on monotherapy and receiving a single antiepileptic drug while 26% (n=26) were on polytherapy.

In 74/100 (74%) cases on monotherapy, prescribed antiepileptic drugs included: valproate in 28% (n=28), levetiracetam in 14% (n=14), phenytoin in 26% (n=26), and carbamazepine in 6% (n=6) cases. Around 20% (n=20) were receiving 2 drugs while 6% (n=6) were on 3 of the above mentioned drugs in varying combination.

Treatment compliance was good (never missed a dose) in 56% (n=56), fair (missed medication < once a month) in 38% (n=38) and poor (missed medication one or more times per month) in 6% (n=6) cases. In 54/100 (54%) cases with

uncontrolled epilepsy drug compliance was good in 24 (44.44%), fair in 24 (44.44%) and poor in 6 (11.11%) cases.

The FAB score in our study population, ranged from 9 to 18. Overall, the FAB score was normal or non-significant (16-18) in 46% (n=46) and abnormal (<16) in 54% (n=54) cases with idiopathic epilepsy.

A mild impairment (13-15) in the FAB score was documented in 32% (n=32) and a moderate impairment (7-12) in 22% (n=22) of the cases. None of our cases displayed a severe impairment (0-6).

The FAB has 6 subtests (score: 0-3). In our study a subtest score of  $\leq 2$  was taken as abnormal.

Out of 100 cases of idiopathic epilepsy, FAB subtest scores revealed an impairment in lexical fluency in 94% (n=94); similarities in 70% (n=70); inhibitory control in 26% (n=26); conflicting instructions in 26% (n=26); motor series programming in 24% (n=24) and environmental control in 24% (n=24) cases.

Mean duration of epilepsy was higher in patients with an abnormal as compared to those with a normal FAB score ( $7.7593 \pm 6.57994$  versus  $6.2461 \pm 4.49304$ ) but this difference was statistically insignificant (p-value - 0.653).

On applying the Spearman's correlation coefficient (r), a similar statistically insignificant (p - value = 0.592) negative correlation was observed between the duration of epilepsy and the total FAB score (r-value = -0.078).

Mean seizure frequency was higher in patients with an abnormal as compared to those with a normal FAB score ( $5.5370 \pm 9.90234$  versus  $1.8870 \pm 1.54664$ ) but this difference was statistically insignificant (p-value = 0.058).

FAB score was abnormal in 14.28% (2/14) cases with a positive as compared to 60.46% (52/86) cases with negative family history of seizures but this difference was statistically significant (p-

value =0.039). However, the mean FAB score was significantly higher (p-value = 0.000) in cases with a positive as compared to those with negative family history of seizures (16.43 ± 0.787 versus 14.28 ± 2.684) implying more executive dysfunction in cases with a negative family history of seizures.

FAB score was abnormal in 55.55% (30/54) cases with uncontrolled as compared to 52.17% (24/46) cases with controlled epilepsy but this difference was statistically insignificant (p-value = 1.000). Mean FAB score was 14.63 ± 2.372 in cases with uncontrolled and 14.52 ± 2.921 in cases with controlled epilepsy, implying more executive dysfunction in cases with controlled epilepsy but as measured by t-test for equality of means, this difference was statistically insignificant (p-value = 0.886).

FAB score was abnormal in 85.71% (12/14) cases having partial seizures with secondary generalization, 60% (6/10) cases with CPS, 54.16% (26/48) cases with GTCS, and 38.46% (10/26) cases with ME, implying more ED in cases with primary or secondarily generalized seizures, but as measured by Pearson Chi-square test, the difference between these subtypes was statistically insignificant (p value = 0.896).

FAB score was abnormal 60% (12/20) cases with an abnormal and 52.5% (42/80) cases with a normal EEG, but as measured by Pearson Chi-square test, this difference was statistically insignificant (p-value = 0.736). Mean FAB score was 14.80 ± 2.530 in cases with an abnormal and 14.52 ± 2.660 in cases with a normal EEG.

FAB score was abnormal in 84.61% (22/26) cases on polytherapy as compared to 43.24% (32/74) cases on monotherapy, signifying more ED in the polytherapy group.

This difference was statistically significant, as measured by Pearson Chi-square test (p value = 0.021). Mean FAB score was also significantly lower in the polytherapy as compared to the monotherapy group (13.31 ± 2.689 versus 15.03

± 2.466), indicating more ED in polytherapy group, as measured by t-test for equality of means (p value = 0.040).

The EXIT score in our study population, ranged from 0 to 17. A mild impairment (score: 0-15) in executive function was documented in 84% (n=84) and a moderate impairment (score: 16-30) in 16% (n=16) of our cases. Severe executive dysfunction (score: 31-50) was not documented in any of the cases.

Overall, 25 EXIT subtests (score: 0-2) performed in 100 cases of idiopathic epilepsy, revealed an impairment in design fluency in 96% (96/100); word fluency in 84% (84/100); anomalous sentence repetition in 52% (52/100); complex command task in 44% (44/100); Luria hand sequence II in 36% (36/100); finger nose finger test in 32% (32/100); serial order reversal task in 30% (30/100); echopraxia II in 24% (24/100); Go – No –Go task in 20% (20/100); and counting task in 20% (20/100)cases. Other affected subtests included: imitation behavior in 18% (18/100); number letter task in 14% (14/100); social habit in 14% (14/100); automatic behavior II in 12% (12/100); echopraxia I in 8% (8/100); motor impersistence in 8% (8/100); automatic behavior I in 6% (6/100); grasp reflex in 6% (6/100); memory distraction task in 4% (4/100);thematic perception in 4% (4/100); Luria hand sequence I in 2% (2/100).

None of the cases displayed utilization behavior, snout reflex or an impairment in either the grip or interference task.

Overall executive dysfunction and moderate impairment in EXIT score (>15) was detected in 16 out of 100 cases of idiopathic epilepsy. In the 16 cases having moderate impairment in EXIT score (>15), word fluency and serial order reversal task was impaired in all the 16 (100%) cases while design Fluency, anomalous sentence repetition, finger nose finger task, Luria hand sequence II and complex command task was impaired in 14 (87.5%%) cases. Other affected subtests included: number letter task in 12

(75%), counting task in 12 (75%), Imitation behavior in 12 (75%), social habit in 8 (50%), motor impersistence in 8 (50%), Go – No – Go task in 8 (50%), echopraxia I in 8 (50%), grasp reflex in 6 (37.5%), echopraxia II in 6 (37.5%), automatic behavior I in 4 (25%), automatic behavior II in 4 (25%), thematic perception in 2 (12.5%), and memory / distraction task in 2 (12.5%).

No case with moderate impairment in EXIT score (>15) had involvement of interference task, snout reflex, Luria hand sequence I, grip task and utilization behavior.

On comparative analysis of FAB versus EXIT scores, the pickup rate of ED was higher with the EXIT test (100% on EXIT vs. 54% on FAB).

In contrast to the EXIT test which detected executive dysfunction (ED) in all the cases (mild in 84% and moderate in 16% cases), the FAB test battery picked up ED in 54% cases only (mild in 32% and moderate in 22% cases). This discrepancy may be accounted for by the fact that as compared to the FAB test, the EXIT test is more exhaustive and covers more cognitive domains and is therefore more likely to detect subtle impairment in cognitive function.

Mean duration of epilepsy was higher in cases with an abnormal as compared to those with a normal EXIT Score ( $11.25 \pm 7.977$  versus  $6.265 \pm 4.903$ ), implying more ED in cases with a longer duration of epilepsy and this difference was statistically significant as measured by t-test for equality of means (p value = 0.022).

Average seizure frequency was higher in cases with an abnormal as compared to those with normal EXIT Score ( $8.625 \pm 16.185$  versus  $2.95 \pm 4.182$  seizures per year), implying more ED in cases with a higher seizure frequency and this difference was statistically significant, as measured by t-test for equality of means (p value = 0.049).

Mean EXIT score was higher in cases with uncontrolled as compared to those with

controlled epilepsy ( $7.30 \pm 5.210$  versus  $6.04 \pm 5.669$ ), implying more executive dysfunctions in cases with uncontrolled epilepsy but the difference was statistically insignificant as measured by t-test for equality of means (p value = 0.420)

EXIT score was abnormal in 12.5% (6/48) with GTCS, 42.85% (6/14) with partial seizure with secondary generalization and 15.38% (4/26) cases with ME but none of the cases with simple or complex partial seizures, implying that ED is more common in patients with either primary or secondarily generalized seizures. The group differences were however, statistically insignificant as measured by Pearson Chi square test (p value = 0.364).

Abnormal EXIT score was seen in 17.5% (14/80) with normal and 10% (2/20) cases with an abnormal EEG but the difference was statistically insignificant as measured by Pearson Chi-square test (p value = 1.000).

Mean EXIT score was higher in cases on polytherapy as compared to those on monotherapy ( $9.46 \pm 5.739$  versus  $5.76 \pm 5.013$ ), reflecting more ED in cases receiving polytherapy and this difference was statistically significant as measured by t-test for equality of means (p value = 0.032).

## Discussion

This study was undertaken to find out the occurrence of executive dysfunction in patients with idiopathic epilepsy.

Idiopathic epilepsies are characterized by generalized or partial seizures in otherwise normal infants, children, adolescents and young adults with normal brain imaging.

The various syndromes of idiopathic epilepsies differ in age of onset. In our study, age of the patients with idiopathic epilepsy ranged from 19 to 48 years (mean age: 27.92 years). The majority (46%) of the cases fell in the 21-30

years age group. Age at seizure onset ranged from 8 to 39 years (mean age:  $20.76 \pm 8.39$  years). Majority (54%) had their seizure onset between 11 to 20 years of age. According to a study by G.A. Shehata, et al. [3], mean age of patients with idiopathic epilepsy was  $28.92 \pm 8.70$  years while mean age at seizure onset was  $20.19 \pm 9.82$  years, similar to that observed in our study. In another study by Giedre Gelziniene, et al. [4], mean age of idiopathic epilepsy patients was 15.5 years and age at seizure onset was 13.6 years.

Our study showed a slight male preponderance (31 males and 19 females), the male: female ratio being 1.63: 1. Similar slight male preponderance (20 males and 17 females; M: F ratio – 1.17: 1) was also observed by Tian, et al. [5], in their study in patient of idiopathic generalized epilepsy. In a study by Paolo Piccinelli, et al. [6], in idiopathic epilepsy patients, there was almost equal proportion of males and females (21 boys and 22 girls). Another study by Giedre Gelziniene, et al. [4], showed female preponderance (24 males and 35 females, M: F ratio – 1:1.45).

Sturniolo, et al. [7], in their study of 41 children of idiopathic epilepsy, found that school underachievement occurred in 25 children (61%). Another study by Davidson, et al. [8] observed that 23.8% of idiopathic generalized epilepsy patients had at some time received learning support. In our study also, a similar trend was observed. Majority (62%) of the cases were either illiterate or school dropouts.

In our study, around 56% cases belonged to the middle and 44% cases to the low socio economic strata. None of the cases belonged to high socioeconomic strata. Sturniolo, et al. [7], found that out of 41 children of idiopathic epilepsy, 11 belonged to the middle class and 30 to the lower class. These figures reflect the overall poor socioeconomic status of the population attending a government tertiary care hospital for free healthcare.

In our study, duration of epilepsy ranged from 6 months to 22 years (mean duration:  $7.06 \pm 5.71$  years). Seizure frequency ranged from around 1 per week to 1 seizure every 3 years or so. Majority (86%) had a seizure frequency of 1 to 12 per year (mean seizure frequency:  $3.85 \pm 7.51$  per year). In a study by G. A. Shehata, et al. [3], mean duration of epilepsy was  $9.34 \pm 6.89$  years. In the same study, mean seizure frequency was 1/year in 50.9%, 1/month in 23.6%, 1/week in 21.8% and daily in 3.6%. Another study by Fahmida, et al. [9], showed mean epilepsy duration of 21.57 years. In a study done by Andrea Bandeira, et al. [2], duration of epilepsy ranged from 12 to 120 months, with a mean of  $53.37 \pm 30.7$  months. Davidson, et al. [8], in their study of patients with idiopathic generalized epilepsy, observed seizure frequency of less than 1 per month in 33.3%, 1 or 2 per month in 9.5%, 1 or 2 per week in 19% and daily in 14.3% cases.

In our study, family history of seizures was positive in 14% cases only. Almost similar trend was observed in a study by Paolo Piccinelli, et al. [6], who showed positive family history in 11.6% cases of idiopathic epilepsy. Another study by G. A. Shehata, et al. [3] showed positive family history in 18.2% cases of idiopathic generalized epilepsy.

According to a study by Andrea Bandeira, et al. [2] family history of epilepsy was positive in 25.8% cases.

In our study, seizure type was GTCS in 48%, simple partial in 2%, complex partial in 10% and partial seizures with secondary generalization in around 14% cases. Around 26% cases with ME had both GTCS and myoclonic seizures.

In our study major seizure type was generalized seizure.

A study by Paolo Piccinelli, et al. [6] showed generalized seizures in 53.5%, partial seizure in 18.6% and partial with secondary generalization in 27.9%. Another study by Andrea Bandeira, et al. [2] showed that 71% patients had generalized

epilepsy and 25.8% had focal epilepsy. G. A. Shehata, et al. [3] in their study, observed generalized seizures in 77.46% and focal seizures in 22.53% cases. A similar observation was made in our study also, the most common seizure type being generalized seizure.

EEG abnormalities were seen in around 50% cases of idiopathic generalized epilepsy, in a study by Fahmida, et al. [9]. Another study by Giedre Gelziniene, et al. [4] also observed EEG abnormality in 50% of new onset idiopathic generalized epilepsy patients. In our study however, EEG abnormalities were detected in around 20% cases only.

Majority (74%) of our cases were on monotherapy [valproate (28%), levetiracetam (14%), phenytoin (26%), and carbamazepine (6%)]. Only 26% cases were on polytherapy (2 drugs: 20%; 3 drugs: 6%). In a study by Andrea Bandeira, et al. [2], 67.7% patients were on monotherapy, 19.4% were on polytherapy and 9.7% patients discontinued antiepileptic drugs in the last year. In another study of patients with idiopathic generalized epilepsy, by Giedre Gelziniene, et al. [4], majority of subjects received monotherapy. In this study, 74.1% were treated with valproic acid, 14.8% with lamotrigine, and 11.1% received both drugs. In a study by Davidson, et al. [8], majority of idiopathic generalised epilepsy patients treated with monotherapy (sodium valproate in 47.6% and lamotrigine in 19%). In this study 4.8% cases received sodium valproate plus lamotrigine polytherapy and another 4.8% cases received levetiracetam plus clobazam polytherapy. 22.7% cases didn't receive any antiepileptic drug. A similar pattern was observed in our study also. Majority of our patients were on monotherapy and sodium valproate was the most commonly used antiepileptic.

In our study, we used the Frontal Assessment Battery (FAB) and the Executive Interview (EXIT) to assess the presence of executive dysfunctions in 100 cases of idiopathic epilepsy.

Andrea Bandeira, et al. [2], in their study, compared the executive functions of children and adolescents with idiopathic epilepsy with a control group. 31 cases and 35 controls were evaluated by the WCST (Wisconsin Card Sorting Test). In this study they concluded that patients with epilepsy had poorer executive function scores.

Another study by Giedre Gelziniene, et al. [4], compared 59 patients of idiopathic generalized epilepsy with 59 age matched controls by using 4 batteries for the evaluation of executive functions: the Verbal fluency test, the 5 point test, the Trail making test and the Stroop test. They concluded that epilepsy subjects scored worse than the controls in most of the executive function tests. G. A. Shehata, et al. [3], in their study, assessed cognitive functions among 71 adult men with idiopathic epilepsy and 58 controls. In this study they found that patients with epilepsy reported highly significant impairment in all cognitive measures. In a study by Fahmida, et al. [9], 36 with idiopathic generalized epilepsy (IGE), 38 first-degree relatives, and 40 healthy controls were examined using a battery of neuropsychological tests sensitive to frontal lobe dysfunction. They observed that patients with IGE showed deficits in nonverbal reasoning, verbal generativity, attention, and working memory. In a study by Tian, et al. [5], showed that children with IGE showed a significant deficit in their executive control network and in overall reaction time. However, they did not show any deficit in their alerting or orienting networks. These results suggest that IGE specifically affects the executive control network. Mahmood Motamedi, et al. [10], evaluated 32 patients with JME and 32 healthy controls in neuropsychological domains including orientation, mental control, logical memory, forward and backward digit spans, visual memory, associative learning, preservative errors, Stroop Test, IQ score and depression. They concluded that JME is associated with impairment in specific cognitive domains and more specifically in the frontal, prefrontal and memory domains.

Somewhat similar observations were made in our study also on the basis of FAB and EXIT scores. In our study, the FAB score ranged from 9 to 18 and was abnormal in 54% of the cases. Executive dysfunction as per the FAB score was mild (13-15) in 32% and moderately severe (7-12) in 22% of the cases. The 6 FAB subtest scores (0-3) revealed an impairment ( $\leq 2$ ) in lexical fluency in 94%, similarities in 70%, inhibitory control in 26%, conflicting instructions in 26%, motor series programming in 24% and environmental control in 24% cases.

The EXIT score (0-50) ranged from 0 to 17 in our study population. Impairment in Executive function was mild in 84% and moderate in 16% of the cases. EXIT subtests (25) scoring (0-2) revealed an impairment in design fluency in 96%; word fluency in 84%; anomalous sentence repetition in 52%; complex command task in 44%; Luria hand sequence II in 36%; finger nose finger test in 32%; serial order reversal task in 30%; echopraxia II in 24%; Go – No –Go and counting task in 20% cases each; number letter task and social habit in 14% cases each; thematic perception and memory distraction task in 4% cases each and Luria hand sequence I in 2% cases. EXIT subtests also revealed imitation behavior in 18%; automatic behavior II in 12%; echopraxia I and motor impersistence in 8% cases each and automatic behavior I and grasp reflex in 6% cases each. In contrast to the EXIT test which detected executive dysfunction (ED) in all the cases (mild in 84% and moderate in 16% cases), the FAB test battery picked up ED in 54% cases only (mild in 32% and moderate in 22% cases). This discrepancy may be accounted for by the fact that as compared to the FAB test, the EXIT test is more exhaustive and covers more cognitive domains and is therefore more likely to detect subtle impairment in cognitive function.

Socioeconomic status has also been found to affect executive functions in patients with idiopathic epilepsy. Paolo Piccinelli, et al. [6], observed that low socio-economic status was associated with cognitive impairment. In our

study also we found significantly higher executive dysfunctions in patients with low socioeconomic status. Abnormal FAB score was found in 72.72% in the low and 39.28% cases in the middle socioeconomic group (statistically significant). EXIT score was abnormal in 22.72% in the low and 10.71% cases in the middle socioeconomic group.

Duration of epilepsy can also impact cognitive function. It has been suggested that seizures could produce progressive neuronal dysfunction, leading to cumulative neurocognitive disabilities. Therefore longer duration of epilepsy is likely to affect cognitive functions in patients with idiopathic epilepsy. A study by G. A. Shehata, et al. [3] demonstrated negative impact of prolonged duration of epilepsy on cognitive functions. A similar observation was made in our study which showed more executive dysfunction in patients with longer duration of epilepsy on both FAB and EXIT tests. The mean duration of epilepsy was 7.75 years in cases with an abnormal versus 6.24 in cases with a normal FAB score. Similarly, mean duration of epilepsy was 11.25 vs. 6.26 years in cases with an abnormal versus a normal EXIT score and this was statistically significant. In contrast, another study by Andrea Bandeira, et al. [2] didn't find any correlation between duration of epilepsy and executive functions in idiopathic epilepsy.

Increased seizure frequency and uncontrolled epilepsy can also have a significant impact on cognitive function. It has been suggested that seizures can modify several unique processes that are essential for the correct formation and function of brain circuitry. Uncontrolled seizures alter brain structure and function, as reflected by gray and white matter volumetric changes and altered functional connectivity demonstrated by functional MRI in a study [11]. Therefore uncontrolled epilepsy as reflected by frequency of seizures is considered an important contributory factor producing cognitive impairments in patients with idiopathic epilepsy. A study by G. A. Shehata, et al. [3], demonstrated that higher seizure frequency had

negative impact on cognition. In our study also, mean seizure frequency was higher in cases with abnormal FAB score compared to those with normal FAB score. On EXIT scoring also, mean seizure frequency was higher in cases with abnormal EXIT score compared to those with normal EXIT score. On the contrary, study by Andrea Bandeira, et al. [2] didn't find any correlation between seizure frequency and executive functions in idiopathic epilepsy.

Family history of epilepsy may or may not impact cognitive function. A study by G. A. Shehata, et al. [3] didn't find any significant association between family history of seizures and cognitive dysfunctions in patients with idiopathic epilepsy. Similarly Mahmood Motamedi, et al. [10], in their study of assessing cognitive dysfunctions in juvenile myoclonic epilepsy, also failed to find any significant association between family history and cognitive impairment. In our study, abnormal FAB scores were found in 60.46% patients with negative versus 14.28% cases with a positive family history of seizures. EXIT score was abnormal generalized epilepsy is supposed to have a greater effect on cognition as compared to focal epilepsy. Focal seizures tend to produce more circumscribed patterns of cognitive dysfunctions than seizures with generalized onset. However, more recent studies demonstrate that even focal seizures often disrupt large scale brain networks far beyond the seizure onset zone, even without secondary generalization in 18.60% with a negative and none of the cases with a positive family history of seizures. We observed more executive dysfunction in patients with a negative family history of seizures but this probably does not reflect the true picture, as overall, only 14% of our cases had a positive family history of seizures. Both FAB and EXIT tests did not reveal any significant association between EEG abnormalities and executive dysfunction in our cases with idiopathic epilepsy. A study by Giedre Gelziniene, et al. [4] also showed no association of EEG abnormalities with executive dysfunction.

## Conclusion

Results of the FAB and EXIT test batteries do not mirror each other. This discrepancy is probably due to an inherent difference in their structural design. Since the EXIT battery covers more cognitive domains and can detect subtle impairment in cognitive function, the pickup rate of ED was higher with the EXIT (mild: 84%; moderate: 16%) as compared to the FAB (54%) test in our study population.

In conclusion, a significant proportion of patients with idiopathic epilepsy have ED, which adds to the seizure burden by reducing the capacity of an individual to successfully engage in self-care, social, academic and occupational pursuits. To improve and enhance the quality of life in patients with idiopathic epilepsy, cognitive behavioral therapy and other strategies for improving ED are as important as a good seizure control and should be included as a part of the therapeutic intervention protocol.

## Acknowledgement

We would like to thank our Ex Professor and HOD Dr. P. Dhairyawan for his continuous support and encouragement.

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