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Executive Functions Assessment in Adult Patients with Idiopathic Epilepsy

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Abstract

Objective: Cognitive impairments are common complaints among people with epilepsy with its occurrence to emanate a great topic in the course of the illness, so our study aimed to examine the executive functions in adult patients with idiopathic epilepsy. **Methods:** Forty consecutive adult patients with idiopathic epilepsy (either generalized or focal) with age range from 18 - 45 years old, IQ > 85, treated with either monotherapy or polytherapy, matched with forty healthy adult volunteers by age, sex and educational level. They were examined in executive functions tests: cognitive flexibility and set shifting (Wisconsin Card sorting Test), Planning (Tower of London), response inhibition (Continuous Performance Test) and working memory (verbal and visuospatial). **Results:** Patients with epilepsy showed deficits in all executive functions tests, with no difference between patients with generalized and focal epilepsy except for correct response time mean in CPT. There was significant positive correlation between frequency of seizures and mean total time, mean number of extra movies in TOL, in verbal working memory (digit back word), and omission errors in CPT; at the same time there was significant negative correlation between target accuracy rate and frequency of seizures in CPT, and in visuo-spatial part of working memory (Corsi Block-Tapping Test). **Conclusion:** Adult patients with idiopathic epilepsy had executive dysfunctions than healthy control, with no difference between generalized and focal epilepsy except for correct response time mean in CPT; the increase of the frequency of seizure is associated with impairment in planning, attention and working memory (either verbal or viuso-spatial).

Keywords

Executive Functions, Idiopathic Epilepsy, Seizures, Working Memory in Epilepsy

1. Introduction

Epilepsy is one of the chronic brain disorders characterized by a tendency to have recurrent epileptic seizures with its neurobiological, cognitive, and psychosocial sequelae [1]. Consistent with the most recent estimation of epilepsy, it affects about 50 - 70 million people worldwide and measures about 0.75% of the global burden of disease [2]. World Health Organization, 2016 estimated that an annual prevalence rate of epilepsy was 2.4 million per year [3].

Idiopathic generalized epilepsy (IGE) is considered to be one of the most common types of epilepsy, with its underlying genetic component. IGE is determined as a benign condition; patients usually have normal intellectual abilities, and their seizures are well controlled with antiepileptic drugs [4]. Partial or focal seizures: Only part of the brain is involved, so only part of the body is affected. Depending on the part of the brain having abnormal electrical activity, symptoms may vary [5]. Generalized epilepsy can also be categorized as partial with "secondary generalization" if there is evidence of a "antecedent symptom (an aura)" with the patient can describe or where there is EEG evidence of this [6]. Cognitive impairments in patients with epilepsy produce problems that continue through patients' life. For example, in childhood, cognitive impairments can be manifested by learning disabilities that diminish educational achievement and impair social skills [7]. In patients with chronic epilepsy, besides their epilepsy, they also had other risk factors such as cardiovascular disease, inflammatory process, which increase their liability for cognitive decline [8].

Executive functions (EF) are a set of cognitive and mental capacities related to goal-directed behavior. This complex system has different skills; attention, planning, receiving and manipulating information in a proper way allowing individuals to behave in an integrated manner. Inability to complete daily activities or adapting socially is owing to impairment in EF [9]. Executive functions are mediated by complex neural circuits or feedback loops that connect discrete regions in the prefrontal lobes with other cortical regions in the brain and sub cortical structures [10]. According to an influential taxonomy [11], there are three basic EFs: working memory operations such as the maintenance and updating of relevant information ("updating"), inhibition of prepotent impulses ("inhibition"), and mental set shifting ("shifting") [12]. Epilepsy had different cognitive complications such as language, attention, higher-level problem solving skills and memory [13]. There are several factors that may constitute a risk for memory impairment, e.g. TLE, frequent generalized tonic clonic seizures (GTCs), earlier age at onset, longer duration of epilepsy, a concomitant structural lesion, and episodes of status epilepticus (SE) [14].

Also one of important factors is the use of antiepileptic drugs (AEDs), which not only reduce neuronal irritability but may also impair neuronal excitability [15].

So our study aims to assess the executive functions in adult patients with idiopathic epilepsy.

2. Participants & Methods

It is a case-control study conducted in the outpatients clinic of the neuropsychiatric department at Sohag university hospital which located at Sohag governate that is one of upper Egypt cities.

Participants:

Include forty consecutive adult patients with inclusion criteria were as follow:

- Age range from 18 - 45 years old;
- Idiopathic epilepsy (either generalized or focal) diagnosed by a clinical neurologist on basis of clinical history, imaging, and EEG findings according to International League Against Epilepsy (ILAE) 1989 classification of epilepsies [16];
- The patient treated with either monotherapy or polytherapy antiepileptic drugs;
- Intelligence Quotient (IQ) greater than 85 according to the Wechsler Adult Intelligence Scale—Revised Arabic version [17].

Exclusion criteria:

- Clinical or structural brain imaging evidence of organic brain diseases that may affect cognitive function (such as fever, infection, head injury, cerebrovascular disease, brain tumors);
- Presence of psychiatric illness;
- Current Substance abuse or use of other medication than antiepileptic medication;
- Symptoms or signs of illnesses other than epilepsy;
- Occurrence of seizures in the 24 hour preceding cognitive function assessment.

The control group consisted of forty healthy adult volunteers matched by age, sex, and educational level, meeting all the inclusion criteria except of epilepsy at any time of their lives. Educational level was determined to all participants and it was classified as low educational level who completed primary grade, intermediate level who completed preparatory school or secondary school, and high level who either in faculty or completed it.

Methods:

All subjects either patients and healthy control were subjected for **Evaluation of IQ** using Wechsler Intelligence Scale [18] Revised Arabic version [17]. It is a battery comprising 12 subtests; each is scored separately and divided into two parts to evaluate performance IQ: 1) the Verbal Scale Subtest and 2) the Performance Scale Subtest.

Both scores yield the Full-Scale IQ, which is the average index of general intellectual functioning.

Executive Functions Battery:

- We chose our battery from the Psychology Experiment Building Language (Version 0.13) [Software]. Available from http://pebl.sourceforge.net.
- It consists of 50 tests, including many classic ones in experimental psycholo-

gy and behavioral neurology [19] [20].

From these tests we chose the following for assessment:

1) Set shifting and cognitive flexibility:

PEBL, Wisconsin (Berg) Card Sort Test: Its aim is to assess set shifting. This test was originally conceptualized by Berg [21], & Grant and Berg [22]. The original design of the task involved physically placing cards in one of four piles based on the characteristics of the stimuli. The rule for correctly sorting the stimuli changes regularly and the ability to switch strategies based on the shape, color, or number of stimuli is recorded. A response in which the earlier rule is incorrectly employed is considered a perseverative error [23].

2) Planning: PEBL, Tower of London: This is a well-known test used in applied clinical neuropsychology for the assessment of executive functioning specifically to detect deficits in planning, which may occur in a variety of medical and neuropsychiatric conditions. It is related to the classic problem solving puzzle known as the Tower of Hanoi [24].

3) Response Inhibition: PEBL, the Conners' Continuous Performance Test (CPT): This test measures a person's sustained, selective attention and impulsivity. This widely used measure is a 14-min, computerized task during which participants are asked to press the space bar when any letter except the target letter is displayed [25].

4) Working memory:

a) PEBL, the Corsi Block-Tapping Test: It used to assess visuo-spatial working memory. It involves mimicking a researcher as he/she taps a sequence of up to nine identical spatially separated blocks. The sequence starts out simple, usually using two blocks, but becomes more complex until the subject's performance fails [26].

b) Verbal Working Memory-Digit Span Test: It was used to assess the ability to hold and manipulate verbal information. Whereas the digits forward segment primarily assesses attention and memory span, the digits backward segment is a sensitive measure of verbal working memory [19].

Ethical consideration:

The approval of the Ethical Committee of the Sohag University was obtained with written informed consent was taken.

Statistical analysis:

The results of the study were obtained using the statistical package of social sciences (SPSS), version 16. Statistical analyses were performed with Student t Test for comparison between means of cases and control.

3. Results

Sociodemographic & clinical data:

There is no statistical difference between cases and control regarding age, sex, educational level and IQ. The mean age in case group was 25 years old while in control group was 24 years old with mean age of onset of epilepsy was around 21

years old, with male to female ratio was 2:1, the mean of IQ in case group was 97 while the mean of IQ in control group was 99. The mean frequency of fits per year in the epileptic group was 17 fit per year. Patients with generalized tonic clonic fits were n = 31 (77.5%) while n = 9 (22.5%) had focal epilepsy. n = 35 (87.5%) had paroxysmal EEG changes on the background. Regarding antiepileptic medications, n = 25 (62.5%) were treated with single antiepileptic drug, n = 15 (37.5%) were treated with polytherapy of antiepileptic drugs. The majority of patients n = 25 (62.5%) showed negative family history of similar condition & negative consanguinity, n = 11 (27.5%) had negative family history of similar condition & positive consanguinity, n = 2 (5%) of patient's group had positive family history of similar condition & positive degree of consanguinity, n = 2 (5%) had family history of similar condition & negative consanguinity. Two thirds of cases have taken single therapy for epilepsy with n = 25 (62.5%), Double Therapy n = 13 (32.5%), Triple Therapy n = 1 (2.5%) and Tetra Therapy n = 1 (2.5%). Finally, all of cases had neither history of status epilepticus, history of febrile convulsions nor history of substance, with normal CT brain and MRI, as shown in Tables 1-3.

Comparison between cases and control as regard executive function tests:

Patients with epilepsy showed worse score in all tests of executive functions than healthy control, in WCST (Berg), there was statistically significant difference between patients with epilepsy and healthy control in correct responses, total errors, Non perservative errors (P value < 0.001) while no significant difference could be found in perservative responses, trails to complete 1st categories, and failure to maintain set. In TOL, patients with epilepsy displayed statistically significant difference than control in mean total time and mean number of extra movies (P value < 0.001). In CPT, patients with epilepsy had statistically

Table 1. Sociodemographic data.

	Cases	Control	Tests t or X^2	P-value
Age				
Mean ± SD	24.82 ± 6.08	24.10 ± 5.30	0.562	0.576
Sex				
Female	13 (16.0%)	12 (32.0%)	0.058	0.809
Male	27 (84%)	28 (68%)		
Educational Level				
Intermediate School	1 (2.5%)	1 (2.5%)		
Low Education	25 (62.5%)	25 (62.5%)	3.854	0.989
Intermediate Education	2 (5%)	2 (5%)		
High Education	12 (30%)	12 (30%)		
IQ				
Mean ± SD	97.79 ± 6.441	99.05 ± 5.760	0.914	0.364

Abbreviations: SD, Standard Deviation; IQ, Intillegence Quotient.

Table 2. History data of the case group.

Category		Frequency	Percent
Family History-Similar Condition	Yes & +ve Consanguinity	2	5%
	Yes & −ve Consanguinity	2	5%
	No & +ve Consanguinity	11	27.5%
	No & −ve Consanguinity	25	62.5%
	Total	40	100%
Type of Epilepsy	GTC	31	77.5%
	focal	9	22.5%
	Total	40	100%
History of Antiepileptic Medication	Single Drug	25	62.5%
	Double Therapy	13	32.5%
	Triple Therapy	1	2.5%
	Tetra Therapy	1	2.5%
	Total	40	100%
EEG	Normal	5	12.5%
	Epileptic	35	87.5%
	Total	40	100%
		Frequency	Percent
History of Status Epileptics	Yes	0	0%
	No	40	100%
History of Febrile Seizures	Yes	0	0%
	No	40	100%
History of Substance	Yes	0	0%
	No	40	100%
CT Brain or MRI Brain	Abnormal	0	0%
	Normal	40	100%

Abbreviations: GTC, Generalized Tonic Clonic; EEG, Electroencephalogram; CT, Computerized Topograghy; MRI, Magnetic Resonant Imaging.

Table 3. Clinical data in patients of epilepsy.

Mean Age of Onset of Epilepsy	21.13 ± 4.821
Mean Frequency of Fits per Year	17.27 ± 23.76
Type of Epilepsy	
GTC	n = 31 (77.5%)
Focal	n = 9 (22.5%)
Paroxysmal Discharges in EEG Background	n = 35 (87.5%)
Normal EEG Background	n = 5 (12.5%)
Antiepileptic Medication	
Single Drug	n = 25 (62.5%)
Poly Therapy	n = 15 (37.5%)

Abbreviations: GTC, Generalized Tonic Clonic; EEG, Electroencephalogram.

significant difference in commission error, omission error, correct response time mean & SD and error response time mean & SD, while no significant difference in Target accuracy rate & foil accuracy rate. In working memory, patients with epilepsy demonstrated significant difference than control in either verbal part (digit back word) or visuospatial part (Corsi Block-Tapping Test) (P value < 0.001), as shown in Table 4.

Comparison between patients with GTC fits and patients with focal epilepsy in executive functions:

The only significant difference was found in executive functions between patients with generalized epilepsy and patients with focal epilepsy was in correct response time mean in CPT, as shown in Table 5.

Table 4. Comparison between cases and control as regard executive function tests.

	Cases	Control	t test	
	Mean ± SD	Mean ± SD	t	P value
WCST				
Correct responses	75.08 ± 4.792	82.40 ± 2.865	4.891	**<0.001*** **
Total errors	26.92 ± 4.793	16.60 ± 2.864	4.890	**<0.001*** **
Perservative responses	29.31 ± 4.797	28.25 ± 3.650	1.116	0.268
Non-perservative errors	13.05 ± 7.561	7.73 ± 2.857	2.349	**<0.001*** **
Trails to complete 1st cat	16.10 ± 6.384	16.68 ± 6.158	0.410	0.683
Failure to maintain set	0.93 ± 0.917	1.03 ± 0.920	0.487	0.628
TOL				
Mean total time	44.20 ± 16.048	26.15 ± 13.089	5.513	**<0.001*** **
Mean number of extra movies	258.29 ± 108.179	161.17 ± 71.702	4.733	**<0.001*** **
CPT				
Target accuracy rate	0.96 ± 0.027	0.97 ± 0.017	1.561	0.123
Foil accuracy rate	0.43 ± 0.131	0.44 ± 0.131	0.308	0.759
Commission Error	20.55 ± 5.857	17.28 ± 3.782	3.821	**<0.001*** **
Omission Error	11.83 ± 8.753	7.38 ± 5.362	2.510	**0.009****
Correct response time mean	426.02 ± 54.562	387.37 ± 48.190	3.359	**0.001*****
Correct response time standard deviation	177.45 ± 62.846	141.28 ± 57.217	2.691	**0.009****
Error response time mean	530.24 ± 126.958	433.30 ± 86.147	3.996	**<0.001*** **
Error response time standard deviation	417.95 ± 244.937	317.07 ± 202.376	3.136	**<0.001*** **
Working memory				
Verbal: Digit backward test	2.700 ± 0.799	3.597 ± 0.716	4.435	**<0.001 *** **
Visuo-spatial part				
The Corsi block-tapping test	4.30 ± 0.597	4.91 ± 0.530	4.854	**<0.001*** **

Abbreviations: SD, Standard Deviation; WCST, Wisconsin (Berg) Card Sort Test TOL, Tower of London; CPT, Continous Performance Test.

Table 5. Comparison between patients with GTC fits and patients with focal epilepsy in executive functions.

	Patients with GTC	Patients with focal epilepsy	t-test	
	Mean ± SD	Mean ± SD	t	P-value
WCST				
Correct responses	77.38 ± 4.19	76.04 ± 6.67	0.735	0.467
Total errors	22.62 ± 4.19	23.96 ± 6.68	0.735	0.467
Perservative responses	29.80 ± 3.63	27.60 ± 7.65	1.219	0.231
Non-perservative errors	9.49 ± 4.25	11.98 ± 8.81	1.188	0.242
Trails to complete 1st cat	15.55 ± 4.85	18.00 ± 10.26	1.015	0.317
Failure to maintain set	0.81 ± 0.83	1.33 ± 1.12	1.545	0.131
TOL				
Mean total time	246.29 ± 108.523	299.62 ± 102.007	1.314	0.197
Mean number of extra movies	44.03 ± 16.726	44.78 ± 14.351	0.121	0.904
CPT				
Target accuracy rate	0.96 ± 0.029	0.97 ± 0.018	1.037	0.306
Foil accuracy rate	0.42 ± 0.098	0.49 ± 0.208	1.500	0.142
Commission error	20.90 ± 5.485	19.33 ± 7.228	0.703	0.486
Omission error	12.58 ± 9.384	9.22 ± 5.783	1.014	0.317
Correct response time mean	416.94 ± 49.435	457.32 ± 62.665	2.031	0.049*
Correct response time standard deviation	176.50 ± 62.803	180.72 ± 66.692	0.175	0.862
Error response time mean	521.57 ± 120.707	560.07 ± 150.490	0.797	0.430
Error response time standard deviation	421.66 ± 239.834	405.15 ± 276.646	0.176	0.861
Working memory				
Verbal: Digit backward test	4.68 ± 0.748	4.44 ± 0.527	0.870	0.390

Abbreviations: SD, Standard Deviation; GTC, Generalized Tonic Clonic; WCST Wisconsin (Berg) Card Sort Test TOL, Tower of London; CPT, Continous Performance Test.

Studying the relation between frequency of seizures and executive functions:

Frequency of seizures (per year):

There were nonsignificant results when using WCST but when using TOL there was postive, and significant correlation, P value (0.014) between Targets and frequency of seizures (per year) and also there was postive, and significant correlation, P value (0.012) between Over Clicks and frequency of seizures (per year). When applying CPT there was only positive, moderate and significant, P value (0.004) correlation between Ommission Errors and frequency of seizures (per year) and moderate and significant, P value (0.004) correlation between Target Acc Rat and frequency of seizures (per year), as shown in Table 6.

Table 6. Relation between frequency of seizures and executive functions: Frequency of seizures (per year).

WCST	
Correct Responses	0.163
r	
P value	0.315
Total Errors	0.060
R	
P value	0.715
Perseverative Responses	−0.111
r	
P value	0.496
Non-Perseverative Errors	0.115
r	
P value	0.480
Trials to Complete	−0.051
r	
P value	0.753
Failure to Maintain Set	−0.060
r	
P value	0.715
TOL	
Mean Number of Extra Movies	0.366
r	
P value	**0.020***
Mean Total Time	0.391
r	
P value	**0.013***
Correct Trials	−0.311
r	
P value	0.051
CPT	
Target Accuracy Rate	−0.444
r	
P value	0.004
Foil Accuracy Rate	0.214
r	
P value	0.185
Commission Errors	0.093
r	
P value	0.567
Ommission Errors	**0.449**
r	
P value	**0.004**
Correct RT Mean	0.199
r	
P value	0.218

Continued

Correct RT SD	0.237
r	
P value	0.141
Error RT Mean	0.104
r	
P value	0.522
Error RT SD	0.167
r	
P value	0.303
Working Memory Verbal part: Digit span test	0.303
r	
P value	0.028
Visuo-Spatial Part The Corsi block-tapping test	−0.313
r	
P value	0.049

Abbreviations: r, Relative Coefficient; GTC, Generalized Tonic Clonic; WCST Wisconsin (Berg) Card Sort Test TOL, Tower of London; CPT, Continous Performance Test.

4. Discussion

Cognitive impairments are common complaints among people with epilepsy which its occurrence emanate a great topic in the course of the illness [27]. Our study compared adult patients with idiopathic epilepsy either generalized or focal with normal IQ > 85 with healthy adults control in their executive functions. In our study there was 40 adult patients with idiopathic epilepsy and 40 healthy volunteers in the control group referred from the outpatient clinic and the mean age of the sample in the study groups is around 25 years in case group and 24 years in control group, the males represent (n = 55) 76% and female (n = 25) 24%, with male: female ratio (3:1). This was similar to the study done by Berg *et al.* 2008 as their study involved 108 patients (52 males and 56 females), mean age of their patients was 28 years [28]. Also in the study of Kanner *et al.* (2010) the mean age of the patients was 30 years, (70%) were male and (30%) were females with male: female ratio (3:1) [29].

Our study also shows that all patients were educated with the majority of cases were low educated (62.5%), high educated (30%), Intermediate educated (5%) Intermediate school (2.5%), also our study shows that the mean IQ of the study groups is around 98 in case group and 99 in control group this is in line with Ghaydaa *et al.*, 2008 which included 71 patients with idiopathic epilepsy whose had a total IQ between 85 and 97 [30].

Our goal in this study was to study executive function among adult patient with idiopathic epilepsy. In our study we found impaired excutive function among adult patient with idiopathic epilepsy that is explained when testing Cognitive flexibility & Set shifting: Test used to assess cognitive flexibility in patient include the Wisconsin Card Sorting Test (WCST) that help us to differen-

tiate between cases and control in many parameters (Correct responses, Total errors, Perseverative errors, Non-perservative errors, and Unique errors). We found statistically significant difference between cases and control as regard to (WCST). Patient with idiopathic epilepsy had worse performance on this executive test: This indicates that the patients had deficits mental flexibility, goal maintenance. And concept building and this is agreed with different studies [31] [32].

Also when using the Trail Making Test which evaluates self-monitoring, visuospatial orientation for simple and alternating sequences, sustained attention, and divided attention, our study showed that there was statistically significant difference between cases and control as regard time needed to complete the task and accuracy rate. This finding is in agreement with the four meta-analyses [33] [34] [35] [36].

When using Continuous Performance Test (CPT) to evaluate Alertness/arousal, selective attention, reaction time and sustained attention are evaluated [37]. Our results revealed that there is statistically significant difference between cases & control in all parameters of CPT (Target accuracy rate, Foil accuracy rate, Commission errors, Omission errors, Correct response time mean, and Error response time mean), which was in line with many studies [38] [39]. Conversely, attention difficulties could be explained by marked ictal cortical activity during sleep, as shown by Sanchez-Carpintero and Neville [40]. This hypothesis could not be verified in our sample because not all our patients underwent EEG recording during sleep.

As regard using the Digit Span Forward and Digit Span Backward Tests which evaluate attention span, working memory, and mental control with auditory-verbal stimuli, our study show there is statistically significant difference between cases and control in digit forward test also there is statistically significant difference between cases and control in digit backward test and this was in consistent with many of previous studies [41] [42].

When testing the planning ability using Tower of London (TOL) that evaluates the subject's ability to plan and to anticipate his actions, our study show there is statistically significant difference between cases & control in the mean time needed to complete the test and the number of extra moves. This finding is in agreement with other studies [43] [44].

Another important aspect is the study of correlation between frequency of seizures and Executive Functions Battery. It is noticed that when we applied Cognitive flexibility & Set shifting to evaluate the effects of seizure frequency independent from effects of duration or severity of epilepsy, there was no feasible effect. However, there is convincing evidence in our study showing that higher frequency are associated with more cognitive deficiency in some parameters of (WCST) as (correct responses, total errors, non-perseverative errors) in the other hand our study show non-significant correlation between frequency of seizures and (perseverative responses, trials to complete, failure to maintain set parameters in (WCST). This is in agreement with earlier studies [45] [46].

Also when applying, Trail Making Test: Our study also shows that there is postive, and significant correlation between targets and frequency of seizures (per year) and shows that there is positive, and significant correlation between Over Clicks and frequency of seizures (per year). Our findings corroborate those of previous studies in which the frequency of seizures was identified as an important factor for cognitive function (visuospatial Orientation and attention) in idiopathic epilepsy [47] [48] [49].

However when applying Continuous Performance Test (CPT), our study also shows positive, correlation between seizur frequency and some parameters of (CPT) as Foil Acc, Ommission Errors, RT Mean, RT SD but non-significant correlation between the former and other parameters as Correct Trials, Target Acc Rat, Commission Errors, Error RT Mean, Error RT SD which was in line with many studies [38]. When using Digital Span Test: Our study shows that there is negative, weak and non-significant correlation between Digit Span Test and frequency of seizures. But our result was in contrast to the studies as [50]. Also our study shows that there is positive, weak and significant correlation between Extramovies Total time and frequency of seizures that are in agreement with others [43].

Another important and serious aspect is the study of the correlation between type of epilepsy and executive functions battery. So when using Cognitive flexibility & Set shifting: Our study show there is no significant difference in all Wisconison card sorting tests with type of epilepsy either GTC or focal types in the case group, but this was in disagreement with an early study of Smith *et al.* that found patients with generalized epilepsy appeared to have a greater effect on cognition than focal epilepsy [51]. Also our study shows that there is no significant difference in Trail Making Test between GTC & focal epilepsy and these finding is in agreement with other studies [52]. Regarding using CPT, our study shows that there is significant difference in correct RT mean between GTC & focal epilepsy and non-significant correlation between other parameters and type of seizure which was in line with many studies [38] [39]. There is also is negative, weak and non-significant correlation between Digit Span Test and types of epilepsy, which was in contrast to other studies [50].

The Corsi Block-Tapping Test shows that there is no significant difference between GTC & focal epilepsy in the case group. This finding is in agreement with other studies [52].

Also the Tower of London (TOL) shows no significant difference between GTC & focal epilepsy which is in line with other studies [43].

Finally, our study refers to the need for comprehensive neuropsychological batteries in patients with idiopathic epilepsies, in order to provide a more extensive evaluation of attentional and executive functions and also to avoid that some relevant deficits have been missed. Our study has accumulating evidence that "benign" idiopathic epilepsies also have cognitive sequelae and not only the malignant epilepsy. Accordingly, the terms "idiopathic" and "benign" are not the neuropsychological findings in idiopathic epilepsies and should have its implica-

tions for the treatment and rehabilitation of these disorders. Choice of AEDs is a determinant factor of excutive function, most studies agree that some differences exist among the older AEDs with regard to the effects on cognition, and some newer generation molecules may have a better cognitive profile than older AEDs [53]. Subtle cognitive impairment must not go undiagnosed and should lead to early, maximum care Progress in the neuropsychology of idiopathic epilepsies. Combining EEG recording, functional imaging such as functional MRI, neuropsychological testing and psychiatric assessment will result in improved patient care.

5. Conclusion

Adult patients with idiopathic epilepsy had executive dysfunctions than healthy control, with no difference between generalized and focal epilepsy except for correct response time mean in CPT; increased frequency of seizure is associated with impairment in planning, attention and working memory (either verbal or viuso-spatial).

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Conflicts of Interest

The authors declare no conflict of interest.

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List of Abbreviation

CPT	Continuous Performance Test
EEG	Electroencephalogram
EF	Executive Function
IGE	Idiopathic Generalized Epilepsy
IQ	Intellectual Quotient
ILAE	International League against Epilepsy
MRI	Magnetic Resonance Imaging
PEBL	Psychology Experiment Building Language
SD	Standard Deviation
SPSS	Statistical Package for Social Sciences
TMT	Trail Making Test
TOL	Tower of London
WCST	Wisconsin Card Sorting Task
GTC	Generalized Tonic Clonic