



# Clinical and Electrophysiological Prognostic Factors of Childhood Absence Epilepsy

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## ABSTRACT

**Aim:** Childhood absence epilepsy is common idiopathic epilepsy in childhood. This epilepsy, which has been shown to impair cognition, needs to be treated promptly and correctly. Therefore, determining its prognostic factors before treatment can provide prediction on the duration of treatment, drug selection, and drug dosage.

**Materials and Methods:** The electroencephalography (EEG) and clinical findings of patients diagnosed with childhood absence epilepsy who were monitored for at least 12 months in the pediatric neurology clinics of two university hospitals between 2016 and 2020 were reviewed retrospectively. The patients were divided into two groups as responsive and unresponsive, according to seizures, EEG findings, and recurrent seizures after treatment. The epidemiological and clinical features of the two groups were compared.

**Results:** Sixty-three patients who were diagnosed with childhood absence epilepsy according to the Panayiotopoulos criteria participated in this study. Thirty-nine (62%) of the patients were responsive to treatment (group 1), the remaining 24 patients (38%) (group 2) were unresponsive to treatment. Fifteen patients were valproate resistant, and nine patients relapsed after drug treatment withdrawal in group 2. The mean age of the patients was  $7.87 \pm 1.68$ . The mean follow-up period was  $29.1 \pm 13.6$  (13-72 months) months. The mean age was lower in the responsive group of patients. The time between the onset of seizures and treatment was significantly longer in group 2. The number of patients with occipital intermittent rhythmic delta activity (OIRDA) in the responsive group was higher. A significant difference was found in the number of spike-slow wave complex and the amplitude of discharges between the two groups.

**Conclusion:** In this study, it was seen that young age was an advantage for treatment response. Early initiation of treatment and OIRDA were good prognostic factors, while high amplitude and numerous discharges were among the poor prognostic factors.

**Keywords:** Absence, prognostic factors, amplitude, EEG, response

## Introduction

Childhood absence epilepsy (CAE) constitutes 10-17% of all childhood epilepsies (1). Seizures usually begin between the ages of 4-10 years, and the peak age is between 6-7 years. It is characterized by seizures, most of which last 4-8 seconds, accompanied by brief staring spells and occasional automatism or blinking, which may repeatedly occur during one day. There is a unique pattern

in electroencephalography (EEG) in which 3Hz spike-slow waves are bilateral, symmetrical, and simultaneous (1-3).

Although the success rate of treatment in only absence-type without generalized motor seizures has been observed to be 60-95%, 25 to 40% of patients are resistant to antiepileptic treatment in CAE (4-8).

In general clinical practice, if the patient is seizure-free, and two years of treatment completed, discontinuation of

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the drug is preferred (9,10). EEG findings are important in this decision process. Some pediatric neurology clinics perform check-up EEGs after drug discontinuation if the patient is close to the driving license age or in cases where families hardly notice absence seizures. The drug discontinuation process continues if there are single brief focal discharges during sleep, but treatment usually continues for 1-2 years if generalized discharges are seen in control EEG. In addition, some clinics perform EEG without any conditions, and some do not repeat EEG if there is no complaint with the patient (11,12).

Different prognostic factors were found in studies with recurrent seizures and EEG findings after treatment cessation in CAE (4,13,14). Determining these prognostic factors without discontinuing the medication of the patients may provide the appropriate duration of drug usage and then complete remission.

Although there are many studies on juvenile absence epilepsy (JAE) and juvenile myoclonic epilepsy (JME) with recurrent seizures after treatment discontinuation, very few studies have evaluated the recurrent clinical findings and prognostic factors associated with CAE patients (6,14). There are few studies showing the relationships between resistant epilepsy or unresponsiveness to treatment with epidemiological features, clinical course, EEG features (4,8).

In almost all studies, patients with generalized motor seizures have been associated with poor prognosis. Different rates of remission, seizure-free time, and EEG recovery times were found in different studies with different drugs (15,16). However, there are many variables in these studies that could affect the conclusion. This study aims to show the prognostic factors in selected CAE patients who did not have motor seizures and who used the same drug in the same dose range.

## Materials and Methods

The medical and EEG records of 63 cases diagnosed with CAE and who were followed up for at least 12 months between 2016 and 2020 in two different pediatric neurology outpatient clinics of two tertiary treatment centres were reviewed retrospectively. The local ethics committee approved this study (118/88 11.12.2020). CAE was defined according to the Panayiotopoulos criteria (17). The patients' gender, age, age of seizure onset, history of febrile convulsions, family history of epilepsy, time between the onset of seizures and diagnosis, time until the control of seizures with antiepileptic treatment, EEG findings, follow-up period, antiepileptic drugs used and their doses were noted. The authors evaluated the maximum duration of generalized discharges, the maximum amplitude of ictal spike discharge, the effect of hyperventilation (HPV) and

photic stimulation (PS) on EEG, focal abnormality, and the presence of occipital intermittent rhythmic delta activity (OIRDA) in interictal EEG.

### Definitions

**Hyperventilation sensitivity (HPV):** EEG background rhythm change during HPV or ictal discharge with HPV.

**Photoparoxysmal response (PS):** Change in EEG background rhythm or emergence of ictal discharges with PS.

**The number of slow spike-wave complexes:** Each slow spike-wave observed between 4-20 sec was counted as one complex regardless of the duration of the complex block. The slow spike-wave complexes and properties during HPV were not used in the study data.

**Slow spike-wave complex duration:** The longest duration (sec) of slow spike-wave complex in one-hour EEG.

A typical absence seizure on electroencephalogram, characterized by 3 Hz (2,7-3,5 Hz) generalized slow spike-wave complexes, with an abrupt onset and offset, lasting 4-20 seconds.

**Time for EEG recovery time:** The first EEG which does not have slow spike-wave complexes observed in 1-hour EEG after the treatment is started, but abnormal findings may be found in later EEGs. This time period does not mean that the discharges do not occur again.

**Time until control of seizures with antiepileptic treatment:** When the seizure disappears after treatment, seizures may occur later. This time period does not mean that the seizures do not recur.

### Participants Groups

#### Group 1: Responsive group

1. Those cases whose seizures were controlled for one year with valproate treatment and their seizures did not recur during the follow-up, and generalized slow spike-wave complexes were not observed in EEG.

2. Those patients whose seizures did not recur after treatment was discontinued, and no generalized slow spike-wave complexes were detected in their EEGs after treatment.

#### Group 2: Non-responsive group

3. Those cases whose seizures continued despite an effective dose of valproate treatment (25-40 mg/kg/day, 2-3 divided doses, orally) or whose generalized slow spike-wave complexes on EEG persisted despite being seizure-free for one year.

4. Those patients with recurrent seizures or generalized spike-wave complexes in their EEGs after the withdrawal of antiepileptic drug treatment.

## Inclusion and Exclusion Criteria

### Clinical criteria

#### Inclusion

- Frequent (many per day), brief (4-20 sec) typical absences with abrupt and severe consciousness impairment.

- Age of onset between 4-10 years.

#### Exclusion

- Absences with marked eyelid or perioral myoclonus, single or rhythmic limb, and myoclonic trunk jerks.

- Absences with mild or not clinically detectable consciousness impairment.

- Other types of epileptic seizures

### EEG criteria

#### Inclusion

- Generalized, spike or double-spike and slow spike-wave regular complexes at 3 Hz (2.7-3.5 Hz)

#### Exclusion

- Discharge fragmentation and multiple spikes

- Discharges are characterized by multiple irregular spikes or slow waves followed by multiple spikes.

- Predominantly brief discharges of less than four seconds

## Statistical Analysis

Measurements such as mean, median, frequency, and standard deviation (SD) were made using the Statistical Package for Social Sciences software for Windows, version 23.0, and the results are given as mean  $\pm$  SD. Variables were evaluated with chi-square and Student's t-test. Student's t-test was used to compare the means between the two groups. The normality of the distribution between the two groups was evaluated with the Kolmogorov-Smirnov test. A value of  $p < 0.05$  was considered statistically significant.

## Results

A total of 63 cases (40 female, 23 male) were included in this study. Thirty-nine (62%) of the patients were treatment-responsive (group 1), 15 of the remaining 24 (38%) were valproate-resistant, and 9 were patients with

relapse after drug treatment withdrawal (group 2). The mean age of the patients was  $7.87 \pm 1.68$  years. The mean follow-up period was  $29.1 \pm 13.6$  (13-72) months. There was no significant difference between the follow-up periods of the drug treatment withdrawal patients from group 1 and group 2. Gender distribution among the groups was normal, and there is no significant difference between these two groups ( $p > 0.05$ ). The mean age was lower in the responsive group of patients ( $p < 0.05$ ). The family history of epilepsy of the patients was 32%, having a febrile convulsion was 21%, and there was no difference between the groups ( $p > 0.05$ ) (Table I).

The time between the onset of seizures and treatment was significantly longer in group 2. However, there was no difference between the two groups in terms of the number of seizures before treatment (Table II).

There was no difference in photic effect, hyperventilation effect, and focal discharge between the two groups. The number of patients with OIRDA was higher in the responsive group ( $p < 0.05$ ).

The first EEG recording time after the initiation of treatment was  $2.84 \pm 1.94$  months, the clinical evaluation of the patient after the initiation of treatment was  $2.50 \pm 1.61$  months. There was no difference in the evaluation times of the patients between the groups ( $p > 0.05$ ).

A significant difference was found in the number of slow spike-wave complexes and the amplitude of discharges during 1 hour of EEG between the two groups (Table II) ( $p < 0.05$ ).

The duration between first seizure-free and first normal EEG with the initiation of treatment was significantly shorter in the responsive group (Table I,II) ( $p < 0.05$ ).

## Discussion

In our study, 62% of the patients responded to treatment according to the study criteria. There are similar results in the literature (4,14). Kim et al. (14) found the effect of 3 different antiepileptics and combined therapy, and the

**Table I.** Clinical features of patients with childhood absence epilepsy

Variables	AED* responsive patients (n=39)	AED non-responsive patients (n=24)	p-value
Sex ratio (female:male)	24/15	16/8	0.68
Age at diagnosis	$7.48 \pm 1.62$	$8.50 \pm 1.64$	0.02
Family history of epilepsy	13	7	0.73
History of febrile convulsion	11	6	0.78
Seizure duration after the diagnosis (months)	$4.25 \pm 3.25$	$8.41 \pm 6.48$	0.01
The daily mean number of absence seizures before the admission	$15.58 \pm 15.5$	$16.5 \pm 10.58$	0.78
Seizure free time after treatment (months)	$3.28 \pm 2.91$	$5.00 \pm 3.71$	0.04

\*AED: Antiepileptic drug

**Table II.** EEG findings in patients with epilepsy

EEG finding	AED responsive patients (n=39)	AED non-responsive patients (n=24)	p-value
Number of 2.7-3.5 Hz generalized spike-wave complexes	5.71±4.01	11.16±10.56	0.02
OIRDA	17	4	0.02
Photoparoxysmal response	4	2	0.23
Maximum amplitude of epileptic discharges (µV)	307.69±55.94	370.83±80.64	0.01
Hyperventilation sensitivity	32	13	0.57
Focal epileptic activity	8	9	0.17
The maximum duration of generalized spike-wave complex (sec)	7.53±3.20	8.04±3.38	0.14
Time to first normal EEG after treatment (months)	4.72±3.57	8.45±6.05	0.01

EEG: Electroencephalography, AED: Antiepileptic drug, OIRDA: Occipital intermittent rhythmic delta activity

highest effect with a single drug was reported with valproate treatment, with a rate of 70%. Absence epilepsy is the most cognitive disruptive type of idiopathic generalized epilepsy (18-20). Therefore, prognostic studies might be important for the early detection of risk factors for poor prognosis, how often electrophysiological and clinical follow-up needs to be performed, and the timing to the withdrawal of the drug treatment.

The wide range of response rates among studies in CAE may be due to the definition of CAE, the criteria for non-response, and treatment with different doses and different drugs.

Grosso et al. (5) evaluated relapse and remission rates using the ILAE 1989 and Panayiotopoulos diagnostic criteria (17,21). Since the Panayiotopoulos criteria are much more stringent both clinically and electrophysiologically (excluding many other diagnoses such as motor seizures, atypical absence, and possible juvenile syndromes), recurrence and non-response rates were found to be relatively low (17). The success rate of our study was 62%, and the relapse rate after withdrawal of treatment was 32%.

Wirrell et al. (4) conducted the first study investigating the prognostic factors of absence epilepsy. Sixty percent of 86 patients, most of whom had CAE and some of whom had JAE, responded to the first antiepileptic. However, different antiepileptics were used as the first antiepileptic. There are different results in the comparative superiority studies of these different antiepileptics in the literature (15,16).

Although ethosuximide is recommended as the first option in CAE in meta-analysis studies, the difficulty of obtaining it in our country has led us to employ valproate treatment, which has comparable efficacy (22). Another feature of our study is that valproic acid was initiated as the first antiepileptic in all patients in the same dosage range; thus, variability due to different drug activities was eliminated.

Myoclonus or generalized motor seizures occurring after the onset of absence seizures indicate that JME and JAE have converted to juvenile idiopathic epilepsy (JIE) or they already have JIE and have a poor prognosis compared to CAE (23). Patients with seizures other than absence were not included in our study. Late-onset age, absence status, mental retardation, multiple spike waves on EEG and slow background activity, and discharge shorter than 3Hz are other factors associated with poor prognosis in various studies (5,6,24). In our study, patients with background rhythm abnormalities on EEG were excluded. The fact that most of the known poor prognostic factors were excluded from our study group is valuable for us to determine the previously unassessed characteristics of the patients independently from other factors.

There are studies in the literature indicating that discharge below 3 Hz is a poor prognostic factor (5). However, there was no difference between the groups in terms of the frequency (Hz) of spike-slow wave complex on EEG in our study. This data also could be associated with using the Panayiotopoulos criteria for the definition of CAE.

OIRDA is characterized by rhythmic bursts at 2.5-4 Hz over the occipital regions, which was defined as a good prognostic factor in most studies and was significantly associated with good prognosis in our study (14,25).

Female predominance is present in CAE, and 63% of our patients were female. However, no prognostic significance of gender was found in our patients. Although there is a study showing that the male gender is a poor prognostic factor, most studies showed gender is not a prognostic factor for CAE (4,6,13,26).

Family history of epilepsy or absence epilepsy did not show prognostic features in our patient group. In most literature, the presence of seizures in the family is a risk factor for the development of seizures, while it is often not

significant in terms of prognosis (4,5,14).

In our study, the average age of the patients in Group 1 was significantly lower. It is known that absence seizures below the age of 4 may be of genetic origin as in GLUT-1 deficiency and are one of the poor prognostic factors (27-29). Epilepsies that begin after puberty or after the age of 10 are likely to evolve into JAE and JME and are associated with poor prognosis (5,24). Wirrell et al. (24) showed 65% remission with a mean age of 5.8 years, and 44% of patients who did not respond to antiepileptics converted to JME in a long observation period of 20 years. The age range in our study was 4 to 10 years. Under four and over ten years of age, which are associated with poor prognosis, were not included in this study, although age was found to be significant between the two groups. In group 2, the average age was higher ( $p < 0.05$ ).

In CAE, the occurrence of focal discharges is around 20-50%.<sup>28,29</sup> It was present in 27% of our patients, but it did not have any prognostic significance.

We also had patients with photosensitivity but this had no prognostic value. However, Incecik et al. (13) found this to be a poor prognostic factor in their study. The relation of PS, especially to myoclonic seizures, is known. PS response was observed in a small number of our patients. This may be related to the exclusion of any seizure other than absence in this study. In addition, since the age limit was 10 in this study, patients with photosensitivity who could evolve to JME were eliminated.

As expected, the presence of ictal discharges with hyperventilation was 80%, and this EEG feature, which was seen at a high rate in both groups, was not prognostic. Since the duration and number of discharges that occur during HPV can cause confusion, they were not used in this study. However, discharges with HPV were recorded as HPV sensitivity.

There has been no study evaluating the amplitude of generalized ictal discharges as a prognostic value to date. Non-responders had a higher amplitude of generalized ictal discharges in EEG at the time of diagnosis in our study. We could not determine a cut-off value due to the small number of patients, but this is an important finding. Prospective randomized future studies need to determine amplitude values for the prediction of prognosis.

Valproate was started immediately after diagnosis, and the first normal EEG and first seizure-free detection time afterward were significantly shorter in the responsive group than the non-responsive group. Callenbach et al. (30) showed that failure to be seizure-free in the first six months was a significant risk factor for relapses. In this study, the duration between diagnosis and first normal EEG of the responsive group was 4.7 months. While this is consistent

with the literature, seizure-free time after treatment was longer than in the literature with 3.2 months (14). One of the reasons for this might be that we started valproate as an initial treatment (10 mg/kg/day) with a low dose and increased it slowly, when compared to many other studies.

While the number of daily seizures in both groups before treatment was similar, a short duration between diagnosis and treatment initiation for absence seizures was a positive prognostic factor. The mean time between the recognition of absence seizures and the initiation of treatment in the non-responsive group was eight months. As a result of this long period of time without treatment in group 2, an epileptic network may have developed, as in many epilepsies.

Another reason for not admitting to the hospital for such a long time may be low socioeconomic status, which is an independent risk factor for resistant epilepsies (31). However, we did not evaluate this aspect of the patients in this study.

Although there was a significant difference between the groups in term of the number of discharges on EEG at the time of diagnosis, there was no difference between their maximum duration. This is due to definitions of duration time and slow spike-wave complexes. The number of spike-wave complexes was calculated by defining all discharges that distinctly appeared for a certain time as "one" complex. Duration of discharges shows the time that this one longest complex lasts. In Sadleir et al.'s (28) study, ictal discharges were on average 9.4 seconds, whereas, in our patients, it was 7.5 seconds and 8 seconds in Groups 1 and 2 respectively. Kessler and McGinnis (11) determined that patients whose shortest seizure lasted longer than 7.5 seconds were more likely to respond to initial treatment than those whose shortest seizure lasted less than 7.5 seconds. Future studies are needed to examine patients in this respect and to find cut-off values.

The short follow-up period, the low number of patients, and the retrospective nature of the study are the limitations of this study.

The advantages of the study are the scarcity of studies on this subject, the fact that some of the evaluated prognostic parameters have not been found in any studies to date, all patients receiving the same drug as a first antiepileptic in the same dose range, and EEG and patients being evaluated by the same clinician.

## Conclusion

Young age, OIRDA, and early treatment were determined as good prognostic factors. High amplitude and high frequency of spike slow-wave discharge as poor prognostic factors in CAE. Family history, febrile convulsion,

photoparoxysmal response, focal epileptic activity, and HPV were not related to prognosis.

### Ethics

**Ethics Committee Approval:** The local ethics committee approved this study (118/88 11.12.2020).

**Informed Consent:** Retrospective study.

**Peer-review:** Externally and internally peer-reviewed.

### Authorship Contributions

Concept: H.G.T., Design: H.G.T., Data Collection or Processing: T.K., Analysis or Interpretation: H.G.T., P.E., Writing: P.K., P.E.

**Conflict of Interest:** There is no conflict of interest is declared by the authors.

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### References

- Loiseau P, Duché B, Pédespan JM. Absence epilepsies. *Epilepsia* 1995; 36:1182-6.
- Albuja AC, Murphy PB. Absence Seizure. 2020 Nov 21. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021.
- Fisher RS. The new classification of seizures by the International League Against Epilepsy 2017. *Curr Neurol Neurosci Rep* 2017; 17:48.
- Wirrell E, Camfield C, Camfield P, Dooley J. Prognostic significance of failure of the initial antiepileptic drug in children with absence epilepsy. *Epilepsia* 2001; 42:760-3.
- Grosso S, Galimberti D, Vezzosi P, et al. Childhood absence epilepsy: evolution and prognostic factors. *Epilepsia* 2005; 46:1796-1801.
- Covanis A, Skiadas K, Loli N, Lada C, Theodorou V. Absence epilepsy: early prognostic signs. *Seizure* 1992; 1:281-9.
- Sreedharan M, Devadathan K, Pathan HK, Chalipat S, Mohammed KPA. Amantadine for the treatment of refractory absence seizures in children. *J Pediatr Neurosci* 2018; 13:131-6.
- Ollivier ML, Dubois MF, Krajcinovic M, Cossette P, Carmant L. Risk factors for valproic acid resistance in childhood absence epilepsy. *Seizure* 2009; 18:690-4.
- Wirrell EC, Camfield CS, Camfield PR, Dooley JM, Gordon KE, Smith B. Long-term psychosocial outcome in typical absence epilepsy. Sometimes a wolf in sheep's clothing. *Arch Pediatr Adolesc Med* 1997; 151:152-8.
- Shinnar S, Berg AT, Moshé SL, et al. Discontinuing antiepileptic drugs in children with epilepsy: a prospective study. *Ann Neurol* 1994; 35:534-45.
- Kessler SK, McGinnis E. A practical guide to treatment of childhood absence epilepsy. *Paediatr Drugs* 2019; 21:15-24.
- Verrotti A, D'Egidio C, Agostinelli S, et al. Antiepileptic drug withdrawal in childhood epilepsy: what are the risk factors associated with seizure relapse? *Eur J Paediatr Neurol EJPN Off J Eur Paediatr Neurol Soc* 2012; 16:599-604.
- Incecik F, Altunbasak S, Herguner OM. First-drug treatment failures in children with typical absence epilepsy. *Brain Dev* 2015; 37:311-4.
- Kim HR, Kim GH, Eun SH, Eun BL, Byeon JH. Therapeutic outcomes and prognostic factors in childhood absence epilepsy. *J Clin Neurol* 2016; 12:160-5.
- Gurbani S, Chayasirisobhon S, Gurbani A, McCall N. Does early recognition of treatment failure and changing anti-epilepsy medication regimen improve short-term seizure remission rates in childhood absence epilepsy? *Acta Neurol Taiwan* 2020; 29:46-53.
- Glauser TA, Cnaan A, Shinnar S, et al. Ethosuximide, valproic acid, and lamotrigine in childhood absence epilepsy. *N Engl J Med* 2010; 362:790-9.
- Panayiotopoulos CP, Obeid T, Waheed G. Differentiation of typical absence seizures in epileptic syndromes. A video EEG study of 224 seizures in 20 patients. *Brain* 1989; 112:1039-56.
- Matricardi S, Verrotti A, Chiarelli F, Cerminara C, Curatolo P. Current advances in childhood absence epilepsy. *Pediatr Neurol* 2014; 50:205-12.
- Mandelbaum DE, Burack GD. The effect of seizure type and medication on cognitive and behavioral functioning in children with idiopathic epilepsy. *Dev Med Child Neurol* 1997; 39:731-5.
- Caplan R, Siddarth P, Vona P, et al. Language in pediatric epilepsy. *Epilepsia* 2009; 50:2397-407.
- Proposal for revised classification of epilepsies and epileptic syndromes. Commission on classification and terminology of the International League Against Epilepsy. *Epilepsia* 1989; 30:389-99.
- Brigo F, Igwe SC, Lattanzi S. Ethosuximide, sodium valproate or lamotrigine for absence seizures in children and adolescents. *Cochrane database Syst Rev* 2019; 2:CD003032. doi:10.1002/14651858.CD003032.pub4
- Panayiotopoulos CP. Treatment of typical absence seizures and related epileptic syndromes. *Paediatr Drugs* 2001; 3:379-403.
- Wirrell EC, Camfield CS, Camfield PR, Gordon KE, Dooley JM. Long-term prognosis of typical childhood absence epilepsy: remission or progression to juvenile myoclonic epilepsy. *Neurology* 1996; 47:912-8.
- Guilhoto LMFF, Manreza MLG, Yacubian EMT. Occipital intermittent rhythmic delta activity in absence epilepsy. *Arq Neuropsiquiatr* 2006; 64:193-7.
- Nadler B, Shevell MI. Childhood absence epilepsy requiring more than one medication for seizure control. *Can J Neurol Sci Le J Can des Sci Neurol* 2008; 35:297-300.
- Suls A, Mullen SA, Weber YG, et al. Early-onset absence epilepsy caused by mutations in the glucose transporter GLUT1. *Ann Neurol* 2009; 66:415-9.
- Sadler LG, Scheffer IE, Smith S, Carstensen B, Farrell K, Connolly MB. EEG features of absence seizures in idiopathic generalized epilepsy: impact of syndrome, age, and state. *Epilepsia* 2009; 50:1572-8.
- Sadler LG, Farrell K, Smith S, Connolly MB, Scheffer IE. Electroclinical features of absence seizures in childhood absence epilepsy. *Neurology* 2006; 67:413-8.
- Callenbach PMC, Bouma PAD, Geerts AT, et al. Long-term outcome of childhood absence epilepsy: Dutch study of epilepsy in Childhood. *Epilepsy Res* 2009; 83:249-56.
- Espinosa-Jovel C, Toledano R, Aledo-Serrano Á, García-Morales I, Gil-Nagel A. Epidemiological profile of epilepsy in low income populations. *Seizure* 2018; 56:67-72.