

# THE RELATIONSHIP OF EPILEPTIFORM WAVES IN ELECTROENCEPHALOGRAM WITH EPILEPSY TYPE OF SCHOOL-AGE EPILEPSY PATIENTS

Jerome Constantine Lekatompessy<sup>1</sup>, Bertha Jean Que<sup>2</sup>, Laura Bianca Sylvia Huwae<sup>2</sup>

**Correspondence:** [berthaque1966@gmail.com](mailto:berthaque1966@gmail.com)

<sup>1</sup>Faculty of Medicine, Universitas Pattimura, Ambon, Indonesia.

<sup>2</sup>Neurology Department, Faculty of Medicine, Universitas Pattimura, Ambon, Indonesia.

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## ABSTRACT

**Background:** Epilepsy in children causes memory problems in the learning process, so an early diagnosis of epilepsy is needed. The modality for determining the diagnosis of epilepsy is an electroencephalogram (EEG) examination. EEG recording results in epilepsy patients are epileptiform waves that can vary according to the type of epilepsy suffered.

**Objective:** This study aims to determine the relationship of epileptiform waves on an electroencephalogram (EEG) with the type of epilepsy in school-age epilepsy patients.

**Methods:** This study is an analytical study that uses secondary data in the form of medical records with cross sectional design. The research subjects were 106 patients taken with total sampling technique. Data collection is done by recording medical record data on the data collection form made by researchers. Correlation analysis between variables in this study used the Fisher test.

**Results:** The results of this study indicate there is a relationship between epileptiform waves on the electroencephalogram (EEG) with the type of epilepsy in school-age epilepsy patients, with  $p = 0.018$  in 0.050 significance value.

**Conclusion:** It can be concluded that there is a correlation between epileptiform waves on an electroencephalogram (EEG) with the type of epilepsy in school-age epilepsy patients.

**Keywords:** Epilepsy, electroencephalogram, epileptiform waves

## Introduction

According to data from the World Health Organization (WHO), there are more than 50 million people in the world suffer from epilepsy and 80% of that number are in developing countries. The incidence of epilepsy in children in developed countries is estimated at 40 per 100,000 population and 50-100 per 100,000 population in developing countries.<sup>1</sup> Particular learning problems are more common in epileptic children even with normal IQ value. Impairment of learning abilities is a risk for the children with epilepsy.<sup>2</sup> Results from several studies show that children with epilepsy have lower scores in memory in contrast with the control.<sup>3</sup>

An efficient, inexpensive, non-invasive method used in clinical investigations to look at the electrical activity of the brain is called an electroencephalogram (EEG).<sup>4</sup> The EEG is a device to record electrical action emerging from the brain and very useful to examine patients with epilepsy.<sup>5</sup> To determine epileptic area in the brain, it is mandatory to have EEG recording provided. Interictal epileptiform discharges (IEDs) are the main findings to support the epilepsy diagnosis. The epileptiform waves that occur in patients with epilepsy can be in form of generalized or focal slow activity of the background.<sup>6</sup>

Epilepsy characteristics study conducted by Tjandrajani et al<sup>7</sup> showed that from 141 subjects, there were 22 cases of generalized seizure type and 3 cases of focal type which had normal EEG results, while abnormal EEG results were found in 89 cases of generalized seizure type, 24 cases of focal type of seizure, and 3 cases of the focal seizure type became common. Based on a study conducted by Douglas<sup>8</sup>, the most frequent EEG waves that appeared in the generalized type of epilepsy were sharp waves, followed by normal waves, slow and sharp waves, sharp waves and spikes, slow waves, and beta waves. In patients with partial or focal epilepsy, the most frequent EEG waves appeared were sharp waves, followed by slow waves, normal waves, and beta waves.

The disadvantage of the EEG examination is its low sensitivity. A study that compared the accuracy of video electroencephalography (vEEG) and routine EEG (rEEG) showed that sensitivity of vEEG was 0.54 while the specificity was 0.88, both with 95% confidence intervals (0.44 to 0.64 for sensitivity and 0.84 to 0.92 for specificity). It was concluded that the sensitivity of vEEG is statistically higher than that of rEEG and age was the only factor affecting the fidelity of diagnosis.<sup>9</sup> In addition, one of the reasons for the limitations in assessing the results of the EEG examination is that if the EEG examination shows both diffuse and focal epileptiform features, it can be confusing to

classify seizures into partial seizures or generalized seizures.<sup>10</sup> Based on the description and data related to epilepsy and the diagnostic modality in the form of EEG, the researchers are interested in conducting research on the relationship between epileptiform waves on the electroencephalogram (EEG) and the type of epilepsy in school-age epilepsy patients.

## Methods

This study is an analytical study that uses secondary data in the form of medical records with a cross sectional design. The research was conducted at Dr. M. Haulussy Hospital. The population of this study were school-age epilepsy patients at Dr. M. Haulussy Hospital in 2016-2018. Sampling was carried out using total sampling with criteria in the form of epilepsy patients aged 6 years to < 18 years with the type of epilepsy that had been established by a neurologist and had performed an EEG recording. The analytical method used in this research is univariate analysis on each variable and then bivariate analysis to see the relationship between the two variables. Bivariate analysis in this study used Fisher's exact test with a confidence interval ( $\alpha=0.05$ ).

Ethical approval was obtained from the Ethics Committee of The Medical Faculty of Pattimura University (No: 019/FK-KOM.ETIK/VIII/2019).

## Results

The subjects in this study were 106 school-age epilepsy patients at RSUD Dr. M. Haulussy Hospital in 2016-2018. The demographic data (Table 1) shows that the most research subjects were male. Based on age, the majority of school-age epilepsy sufferers were in the age range of 14-17 years old and the least were in the age range of 6-9 years old. Mostly, the subjects were at the level of senior high school and the least was at the elementary school.

**Table 1.** Characteristics of school-age epilepsy patients

Variable	n = 106	(%)
<b>Gender</b>		
Male	55	51.9
Female	51	48.1
<b>Age</b>		
6-9 years old	24	22.7
10-13 years old	29	27.3
14-17 years old	53	50
<b>Level of education</b>		
Elementary school	30	28.3
Junior high school	34	32.1
Senior high school	42	39.6

**Table 2.** Patient's epileptiform waves

Epileptiform waves	n = 106	(%)
Sharp wave	99	93
Spike	1	1
Spike-wave complex	0	0
Polyspike	6	6
Polyspike-wave complex	0	0

The results showed that the most widely read epileptiform waves on the EEG of the patients were sharp waves, followed by polyspike waves (Table 2). The most common type of epilepsy found in school-age epilepsy patients at Dr. M. Haulussy Hospital in 2016-2018 was generalized

epilepsy, while the least common type of epilepsy found was focal epilepsy (Table 3).

The results of the analysis of epileptiform waves on the EEG with the type of epilepsy showed that the sharp wave types of epilepsy that appeared were general epilepsy (92.9%) and focal epilepsy (7.1%). The types of epilepsy that appear in spike and polyspike waves are general epilepsy (57.1%) and focal epilepsy (42.9%) (Table 3). The results of Fisher's exact analysis with a significance of 0.050 showed a *p* value of 0.018. Therefore it's concluded that there is a significant relationship between epileptiform waves on the electroencephalogram (EEG) and the type of epilepsy in school-age epilepsy patients.

**Table 3.** Patient's epilepsy types

Epilepsy types	n = 106	(%)
Focal	10	9.4
Generalized	96	90.6
Combined generalized and focal	0	0
Unknown	0	0

**Table 4.** Relationship of epileptiform waves with the type of epilepsy

Epileptiform waves	Epilepsy types		<i>P</i> value
	Focal n = 10	Generalized n = 96	
Sharp wave	7 (7.1)	92 (92.9)	0.018
Spike + Polyspike	3 (42.9)	4 (57.1)	

## Discussion

The results of this study indicate that the most widely read epileptiform waves on the EEG are sharp waves. These results are consistent with a study by Douglas<sup>8</sup> which stated that sharp waves were more commonly found in epilepsy patients. The study found that 63 out of 100 people with epilepsy had sharp waves on the EEG. The most common type of epilepsy found in this study was generalized epilepsy. These results are in accordance with the results of a study by Sarmila<sup>11</sup> which stated that epilepsy patients who had the highest frequency based on epileptic seizures were the generalized type of epilepsy, namely 83 patients out of 122 patients. The results of this study also show that in the generalized type of epilepsy, the dominant waves formed are sharp waves followed by polyspikes and spikes. This shows that there is no spike-wave complex (3 Hz) that is typical of the absence seizure type as the type of seizure that is often found in generalized epilepsy, especially in children.

Based on the analysis that has been carried out in this study, there is a relationship between the epileptiform waves on the electroencephalogram (EEG) and the type of epilepsy in school-age epilepsy patients at Dr. M Haulussy Hospital in 2016-2018. This result is in line with the results of a study conducted by Bhuyan et al<sup>12</sup> on 113 epilepsy patients who stated that certain wave patterns on EEG recordings were associated with the type of epilepsy diagnosed ( $p < 0.001$ ). Research conducted by Moorthy et al<sup>13</sup> also showed that in 61 epilepsy patients there were epileptiform waves in the form of spikes, sharp waves, and spike-wave complexes that were detected, both in generalized (n=15) and focal (n=51) epilepsy patients with a value of  $p < 0.001$ , so the EEG results help determine the type of seizure and the choice of antiepileptic drug therapy and predict prognosis.

Generalized epileptic seizures affect nearly the whole brain, whereas partial or focal epileptic seizures only affect small portion of the brain. However, it is arduous and time-consuming to identify epileptiform activity in EEG signals of EEG recording. Furthermore, to identify epileptiform activity, a group of experts must examine the complete span of the EEG data. A reliable method for identifying epileptiform activity in EEG signals would provide an objective assessment of patients, facilitate patient care, and enhance epilepsy diagnosis.<sup>14</sup>

Research conducted by Anesh et al<sup>15</sup> stated that epileptiform waves such as sharp waves and spikes are markers of interictal epileptic patient and is an early sign of focal seizures so it is used to distinguish focal epileptic activity from generalized epileptic activity. Another study conducted by Owolabi et al<sup>16</sup> also showed that epileptiform activity in the form of sharp waves and spikes found in the majority of epilepsy patients was related to the type of epilepsy suffered ( $p < 0.05$ ). Focal epileptiform waves describe abnormally large and rapid electrical potentials from a number of neurons in a limited area of the brain, whereas generalized epileptiform waves arise due to the simultaneous discharge of abnormal neuronal electrical potentials in all areas of the brain.

## Conclusion

The results of the analysis in this study indicate a relationship between epileptiform waves on the electroencephalogram (EEG) and the type of epilepsy in school-age epilepsy patients. This research can be continued by considering factors that were not investigated in this study, for example hyperventilation treatment, sedation, and the length of time the patient was awake from sleep until an EEG examination was performed. Further research is needed regarding the seizure pattern that tends to occur at this time.

## Conflict of Interest

The authors report no conflict of interest in this research.

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