

## Correlation of Electroencephalogram (EEG), and Neuroimaging in Seizures among Children: A cross-sectional study

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### Abstract:

**Aim:** To assess the correlation of Electroencephalogram (EEG), and Neuroimaging in Seizures among Children

**Study design:** A cross-sectional study

**Place and Duration:** This study conducted in Pakistan Institute of Medical Sciences Islamabad, Pakistan from December 2019 and December 2020.

**Methodology:** The children in this study were between two months to fifteen years. The study included children having any types of seizures, like simple and complex febrile seizures, epileptic seizures, and seizures due to metabolic disorders. The results were analyzed based on the neuroimaging and electroencephalogram reports.

**Results:** A total of 180 individuals were admitted during the trial. Among these, there were 110 cases of febrile and unprovoked seizures. During the research, 60 patients were chosen for study. The most frequent seizure disorder among children was generalized seizure

disorder. Abnormal EEG, Magnetic Resonance Imaging (MRI), and Computed Tomography (CT) of the brain were found in 75 %, 80%, and 55 % of the cases, respectively.

**Conclusion:** MRI is the best study method for detecting CNS abnormalities in partial seizure conditions. According to the study, EEG must be the usual modality of test for patients' having seizure disorders

**Keywords:** Children, Electroencephalogram, Neuroimaging, Seizures

### **Introduction:**

Seizures in newborns admitted to neonatal intensive care units are typical findings. (1) The most frequent neurological emergency in infants is neonatal seizures (NS), occurring in 1–4 per 1000 live births. (2) The global prevalence is 1.5 %, whereas, in Pakistan, the frequency of NS in hospitalized neonates is 4.8 %. (3) Cerebral palsy, global developmental delay, irreversible impairment, epilepsy, and death are among the severe morbidities linked to them. (4) Seizures are generally the first indicator of a neurological issue, and it is crucial to recognize them in neonates. (5) Children under the age of three are most likely to develop epilepsy, with 1/5<sup>th</sup> of all children experiencing unprovoked seizures acquiring epilepsy. (6) Febrile seizures impact 3% of all children under six years of age. In the first 16 years of life, about 4% to 10% of children had at least one seizure. (7)

NS often indicates a serious underlying brain injury, requiring rapid diagnosis and treatment. Due to advancements in perinatal care, MRI, and positron emission tomography scans, the etiological profile of NS has evolved during the last few decades. (8) NS is difficult to distinguish from adults and older children without using the EEG signal. (9) Because seizures in neonates are usually subclinical, they are easily confused with normal actions, including lip-smacking, sucking, chewing, and blinking. As a result, highly trained experts are needed to detect seizures in newborns using EEG signals. Due to the complexity of EEG signals, this technique is time-consuming and difficult. (10)

Despite advances in newborn intensive care, clinicians dealing with seizures still present significant prognostic and therapeutic issues. (11) The purpose of this study was to assess the correlation of Electroencephalogram (EEG), and Neuroimaging in Seizures among Children

### **Methodology:**

This study conducted in Pakistan Institute of Medical Sciences Islamabad, Pakistan from December 2019 and December 2020. a longitudinal study was conducted on children with

seizures aged two months to fifteen years . The study included children having any types of seizures, like simple and complex febrile seizures, epileptic seizures, and seizures due to metabolic disorders. Patients with primary seizure complaints were examined using the case record proforma, which included a complete medical history and a thorough clinical examination and investigations. An ethical review committee of the institute provided ethical clearance and parental agreement prior to the cases being enrolled.

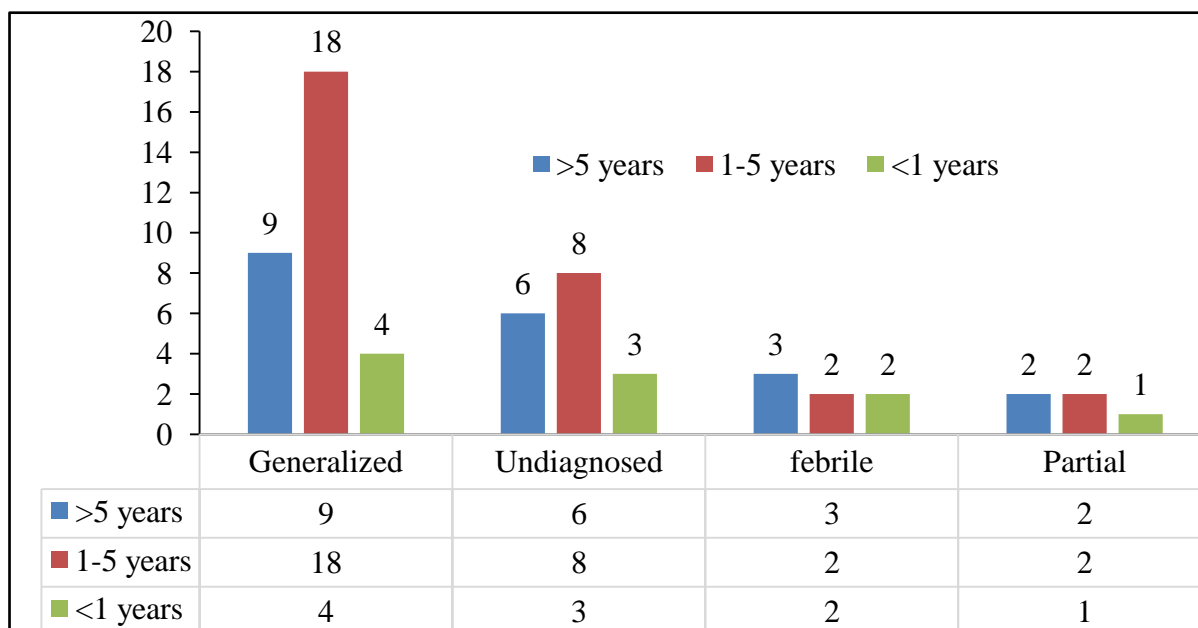
All patients underwent a thorough history, examination, and investigation, including hematological and biochemical tests. Based on their medical history and examination, CSF, EEG, blood culture, metabolic screening, and CT scans were performed on selected individuals. The developmental history, family history, and socioeconomic level were all considered. Chi-square analysis was used to determine the proportionate differences in the collected data. For data entry and analysis, SPSS version 21 was used.

## **Results:**

During the study period, 180 children were hospitalized in the pediatric ward, a total of 110 of them having febrile, unprovoked seizures, and neonatal seizures. During the study, 60 patients were included for study. There were 35 males (58.4%) and 25 females (41.6%) (As shown in Table 1). The male to female ratio was 2.55:1. The hospital-based prevalence of seizures in children was 8% (110/180). The majority of children who have seizures are between the ages of 1 and 5 years 30 (47.5 %). Similarly, generalized seizure disorder 18 (60%) was the most common in children, while undiagnosed, febrile, and partial seizures were 8 (26.6%), 2 (6.6%), and 2 (6.6%), respectively. (As shown in Figure 1) The most common cause of the seizure is non-infectious, accounting for 48 (80%) of cases. Idiopathic epilepsy is the most common cause of non-infectious epilepsy, accounting for 28 cases (58 %). Simple febrile seizures were identified in 15 (25 %) patients. Our study found abnormal EEG recordings in n=45 (75%) of the overall patients. In generalized seizures, abnormal EEG recordings are quite common n=20 (94%). Children with simple febrile seizures, on the other hand, had no abnormal EEG (As shown in Table 2). We detected no significant difference in the seizure groups when we looked at CT brain scans in seizure patients, with normal CT brain scans in 18 (45%) children and abnormal CT brain scans in 22 (55%) children. In these epileptic children with partial seizures, MRI is a more useful diagnostic method performed in n=28 (80 %). It was observed that abnormal EEG in seizure children is better linked with MRI of the brain. MRI abnormalities were seen in over 18 (72%) of children with seizures, compared to 15 (60%) of children with abnormal EEG (As shown in Table 3)

**Table 1: Gender wise distribution of study participants**

Gender	Male	Female	Total
Number	35	25	60
Percentage	(58.4)	(41.6)	100



**Figure 1: Types of Seizures in children aged two months to fifteen years**

**Table 2: EEG observations in various seizure kinds in children aged two months to fifteen years**

Type of Seizure	Normal EEG, (n=15)	Abnormal EEG, (n=45)	Total (%), n=60
Generalised	3 (13%)	20 (94)	23 (38%)
Partial	5 (29%)	12 (70%)	17 (28%)
Simple febrile	2 (100%)	0	2 (3.3%)
Complex febrile	3 (27%)	8 (72%)	11 (18.3%)
Undiagnosed	2 (28%)	5 (71%)	7 (11.6%)
<b>Total (%)</b>	<b>15 (25%)</b>	<b>45 (75%)</b>	<b>60 (100%)</b>

**Table 3: The relationship between MRI & EEG findings in seizures children**

<b>MRI</b>	<b>Normal EEG, (n=10 )</b>	<b>Abnormal EEG, (n=15)</b>	<b>Total, n=25</b>
<b>Normal</b>	4 (16%)	3 (12%)	7 (28%)
<b>Abnormal</b>	6 (24%)	12 (48%)	18 (72%)
<b>Total</b>	10 (40%)	15 (60%)	25 (100%)

### **Discussion:-**

In neonates, seizures are the most prevalent neurological disease. They are found in 0.1 to 0.5 % of term infants and 10 to 23 % of preterm neonates over the world. After emergency seizure rescue therapy, cause-directed therapy is required to address this condition. (12) In our analysis, the percentage of male patients was greater, which was also observed in the literature. (8, 13) This could be linked to the injuries received, and males are more likely to have seizures.

A study performed in Pakistan to detect possible structural brain abnormalities in patients with various types of epilepsy during routine scanning reported that 21.31 % of the scans were abnormal. Many patients with familial, idiopathic epilepsy and those with no neurological deficits were discovered to have structural brain lesions, which could be the cause of their seizures. (14) The higher percentage could be due to the difference in selection criteria, as the current study only enrolled children.

Fever was present in 60% of the children who had a generalized seizure, vomiting was present in 17%, altered sensorium was present in 25%, meningeal symptoms were present in 14%, and evidence of elevated intracranial tension was present in 8% of the children who had a generalized seizure. Fever, altered sensorium, and vomiting were the most common clinical characteristics with congruent findings in Pakistan, Nigeria, and South India. (15-18)

Moreover, 60% had a generalized seizure, 6.6% had a febrile seizure, and 2% had an undiagnosed seizure out of n=30 (50%) instances in the 1-5 year age range. Additionally, 40% of the ten children under the age of one experienced a generalized seizure, while 20% had a febrile seizure. There were 45% generalized seizures and 10% partial seizures among 20 patients in the >5-year age group. A study found that the prevalence of generalized tonic

seizures was 54.5 %, 62.8 %, and 53.3 %, respectively, in the age groups of 1 year, 1-5 years, and > 5 years. (19)

Approximately 94 % of generalized seizure cases had abnormal EEGs, while 75 % of partial seizure cases had abnormal EEGs. Furthermore, the EEG was normal in 86 % of undiagnosed seizures and 59.6 % of complex febrile seizures. In diverse investigations, previous studies reported that abnormal EEG was found in 81 % of partial seizure episodes and 78 % of generalised seizure cases. (20, 21). Another study reported that an abnormal EEG was found in 73% of patients with partial seizures and 76.9% of patients with generalized seizures. (22) These findings were in line with a previous study that used EEG readings from children with seizures and epilepsy. (23)

Rajper et al. showed that 86.7 % of patients had generalized seizures, whereas 13.3 % had focal seizures. EEG was performed in 45.3 % of children within 24 hours. 55.2 % of the patients had abnormal EEGs. In 15.6 % of the cases, abnormalities were discovered in the background. (24)

When we examined CT brain scans in seizure patients, we noticed no significant difference between the seizure groups, with normal CT brain scans in 45% of children and abnormal CT brain scans in 55% of children. MRI was proven to be a more useful diagnostic technique in these epileptic children. It was discovered that aberrant EEG in seizure children is more closely linked to a brain MRI. Over 18 (72%) of children with seizures had abnormal MRI findings, compared to 15 (60%) of children with normal EEG findings. This study has several limitations because it did not include outpatient cases. Furthermore, the limited number of samples was a single-center study. Moreover, we could not do CT/MRI/EEG on all of the patients due to various issues.

### **Conclusion:-**

According to our findings, EEG should be the first test conducted on each newly diagnosed seizure patient, and children with abnormal EEG should undergo additional neuroimaging. An abnormal EEG raises the risks of abnormal neuroimaging in partial seizures.

### **Funding source**

None

## **Conflict of interest**

None

## **Permission**

Permission was taken from the ethical review committee of the institute

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