Section: Pediatrics

Original Research Article

CLINICO ETIOLOGICAL PROFILE OF CHILDREN AGED BETWEEN 1-18 YEARS PRESENTING WITH SEIZURES TO A TERTIARY CARE HOSPITAL A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Seizures are among the most frequent neurological emergencies in children and represent a heterogeneous group of disorders with diverse clinical presentations and etiologies. Understanding the seizure spectrum and underlying causes is essential for rational diagnostic evaluation and targeted management in pediatric practice. The objective is to study the spectrum of seizures in children aged 1–18 years and to determine the etiological and diagnostic profile of pediatric seizures presenting to a tertiary care hospital.

Materials and Methods: This cross-sectional study included 210 children aged 1–18 years presenting with seizures over a one-year period. Detailed clinical evaluation was performed, followed by appropriate laboratory investigations, electroencephalography (EEG), and neuroimaging (CT/MRI brain) as indicated. Data were analyzed using SPSS version 23.0, and p-values <0.05 were considered statistically significant.

Results: Generalized seizures predominated (54.76%, p=0.012), followed by focal seizures (30.95%). Infectious and idiopathic/unknown etiologies were most common (26.67% each, p=0.018), while structural causes constituted 22.86%. Metabolic etiologies accounted for 13.33%, with hypoglycemia being most frequent (4.76%, p=0.026). Among lumbar punctures, 42.3% had abnormal CSF findings. EEG abnormalities were noted in 54.3% (p=0.015) and neuroimaging abnormalities in 47.1% (p=0.017), highest in structural etiologies (89.58%).

Conclusion: Pediatric seizures exhibit a broad clinico-etiological spectrum, with generalized seizures and infectious or idiopathic causes predominating. EEG serves as a key diagnostic tool, while neuroimaging should be selectively employed based on etiology, emphasizing an etiology-driven diagnostic approach.

Keywords: Pediatric seizures, generalized seizures, seizure etiology, electroencephalography, neuroimaging.

INTRODUCTION

Seizures are among the most frequent neurological presentations in children and account for a substantial proportion of pediatric emergency visits and hospital admissions in the age group of 1–18 years.[1,2] They represent a heterogeneous clinical entity ranging from transient, benign events to manifestations of serious underlying neurological, metabolic, or systemic disorders, thereby posing significant diagnostic and therapeutic challenges for clinicians.[3,4] The burden of pediatric seizures is particularly high in developing countries like India, where factors such as infections, perinatal insults, and limited access to specialized care influence both presentation and outcomes.[1,5] According to the International League Against Epilepsy (ILAE) 2025 operational classification, seizures are categorized

based on onset, level of awareness, and motor or non-motor features, broadly classified as focal, generalized types, unclassified and unknown seizures allowing for standardized diagnosis and comparison across studies. Accurate clinical classification, supported by appropriate investigations, is essential for identifying the underlying etiology and guiding management, especially in children presenting with first-onset or recurrent seizures.[6,7] Multiple hospital-based studies have documented that febrile seizures, epilepsy, central nervous system infections, metabolic disturbances, and structural brain abnormalities constitute the most common etiological factors in pediatric seizures.[3,8] Indian studies from both rural and urban tertiary care settings have shown considerable variability in the clinico-etiological profile, influenced by age distribution, regional disease prevalence, and availability of neuroimaging and electroencephalography facilities.[4,5] Neuroimaging has been shown to play a pivotal role in identifying structural causes, particularly in afebrile and focal seizures.[7,9] Despite several published studies, there is a continued need for updated, region-specific data to delineate the clinical patterns and etiological spectrum of seizures in children presenting to tertiary care hospitals.[2,10] Understanding these patterns is essential for early diagnosis, rational investigation, and timely intervention. Therefore, the present cross-sectional study aims to assess the clinico-etiological profile of children aged 1–18 years presenting with seizures to a tertiary care hospital, thereby contributing valuable data to existing literature and aiding in improved pediatric seizure management.[3,5]

MATERIALS AND METHODS

Place of Study: This study was conducted in Rohilkhand Medical College and Hospital, Bareilly, UP.

Type of Study: It was a cross-sectional study.

Duration of Study: The study was conducted from 1st August 2024 to 31st July 2025.

Study Population: Children in the age group of 1 year to 18 years who presented with the complaint of any type of seizures were included.

Sample Size

P = anticipated proportion of seizures due to cerebral palsy.[5]

Q= 100-p

L = absolute error (5%)

N = 4pq/l2

= (4 x 15 x 85)/25

= 204

~ 210

Thus, the sample size planned for this study is 210.

Inclusion Criteria

All the children who satisfied the following criteria were made part of the study:

- The Pediatric age group of 1 year and 18 years who presented with any type of convulsion in the pediatric ward and pediatric ICU were included.
- Children admitted with any other illness who experienced seizures during the period of admission were also included.

Exclusion Criteria

- Children below 1 year and above 18 years were excluded.
- Patients who already had head trauma in history were excluded.
- Those who were not willing to give consent or participate in the study were excluded.

Methodology: After taking clearance from Institutional Ethics Committee, Rohilkhand Medical College and Hospital, Bareilly, the study was conducted over one year (1 August 2024–31 July 2025), 210 consecutive children aged 1–18 years presenting with any seizure to the pediatric ward or PICU of Rohilkhand Medical College and Hospital, Bareilly, were enrolled. Written informed consent was taken from parents/guardians of all the patients participating in the study in a language they can understand.

Detailed history (demographic data, perinatal events, seizure semiology, family history), general and neurological examination, and basic investigations (CBC, blood glucose, serum electrolytes) were performed in all. CSF analysis was done where CNS infection was suspected. EEG and CT/MRI brain were obtained based on clinical indication. Seizures were classified by type and etiology into infectious, structural, metabolic, febrile and idiopathic/unknown categories.

Statistical Analysis: Data were coded, compiled, and analyzed using SPSS version 23.0; tests were applied based on data type and distribution, results presented in tables and figures, with p-values <0.05 considered significant.

RESULTS

Table 1: Age Distribution of Pediatric Seizure Patients (n=210)

Age Group (years)	Number of Patients (n)	Percentage (%)	p-value
1 - 5	88	41.90	0.027
6 - 10	62	29.52	
11 - 15	39	18.57	
16 - 18	21	10.00	

The age distribution of pediatric seizure patients (n=210) shows the highest proportion in the 1–5 years age group at 41.90%, followed by 29.52% in children aged 6–10 years. Patients aged 11–15 years

account for 18.57%, while the 16–18 years group represents 10.00%. The p-value of 0.027 indicates a statistically meaningful variation in seizure frequency across these age groups.

Table 2: Gender Distribution of Seizure Patients

Gender	Number of Patients (n)	Percentage (%)	p-value
Male	128	60.95	0.043
Female	82	39.05	

The gender distribution of pediatric seizure patients (n=210) shows that males account for 60.95% and females for 39.05% of the cases. The p-value of 0.043 indicates a statistically significant difference between genders in the study population.

In [Figure 1], generalized seizures constituted the largest proportion, observed in 115 children (54.76%), followed by focal seizures in 65 cases (30.95%). Unknown seizure types were documented in 14 patients (6.67%), while 8 children (3.81%) presented with unclassified seizure patterns. The predominance of generalized seizures over other categories was statistically meaningful variation (p = 0.012).

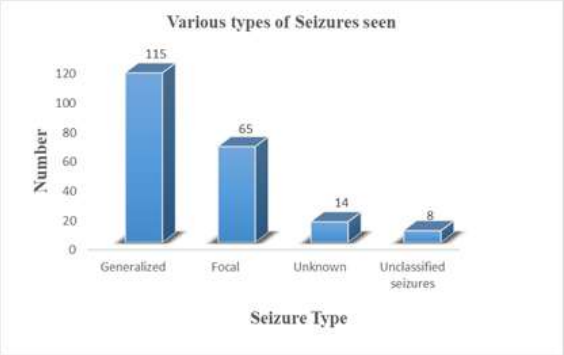

Figure 1: Various types of Seizures seen

Table 3: Age-wise Distribution of Febrile Seizures

Age Group (years)	Number of Febrile Seizure Cases (n)	Percentage of Febrile Cases (%)	Percentage of Total Patients (n=210)	p-value
1 - 3	12	54.55	5.71	0.034
4 - 6	6	27.27	2.86	
7 - 10	3	13.64	1.43	
11 - 18	1	4.55	0.48	

Among the pediatric seizure patients (n=210), febrile seizures were distributed as follows: 12 cases (54.55% of febrile seizures; 5.71% of total patients) in the 1–3 years age group, 6 cases (27.27%; 2.86%) in the 4–6 years group, 3 cases (13.64%; 1.43%) in the 7–10 years group, and 1 case (4.55%; 0.48%) in the 11–18 years group. The p-value of 0.034 indicates a statistically significant difference in febrile seizure distribution by age.

Table 4: Distribution of Status Epilepticus Cases (n = 210)

Type of Status Epilepticus	Number of Cases (n)	Percentage (%)	p-Value
Generalised Status Epilepticus	5	2.4%	0.41
Focal Status Epilepticus	3	1.4%	
Total Status Epilepticus Cases	8	3.8%	

In this study, status epilepticus was identified in 8 out of 210 children (3.8%). Generalised status epilepticus accounted for 5 cases (2.4%), while focal status epilepticus was observed in 3 children (1.4%). The distribution between generalized and focal forms did not show statistical significance (p = 0.41).

Table 5: Seizures associated with family history

Family History Status	Number of Patients (n)	Percentage (%)	p-value
Positive	56	26.67	0.031
Negative	154	73.33	

Among the pediatric seizure patients (n=210), 56 patients (26.67%) had family member who had history of seizures, while 154 patients (73.33%) had no such history. The p-value of 0.031 indicates a statistically significant difference in family history status within the study population.

Table 6: Birth History – Abnormalities

Birth History Status	Number of Patients (n)	Percentage (%)	p-value
Prematurity/Birth Asphyxia	38	18.10	0.028
Normal Birth History	172	81.90	

Among the pediatric seizure patients (n=210), 38 patients (18.10%) had a history of prematurity or birth asphyxia, while 172 patients (81.90%) had a normal birth history. The p-value of 0.028 indicates a statistically meaningful variation in birth history status within the study population.

Among the pediatric seizure patients (n=210), associated symptoms included fever in 115 patients (54.76%), vomiting in 63 patients (30.00%), headache in 51 patients (24.29%), and altered sensorium in 41 patients (19.52%). The p-value of 0.011 indicates a statistically significant variation in these symptoms within the study population.

Table 7: Neurological Examination Abnormalities

Neurological Finding	Number of Patients (n)	Percentage (%)	p-value
Present	54	25.71	0.019
Absent	156	74.29	

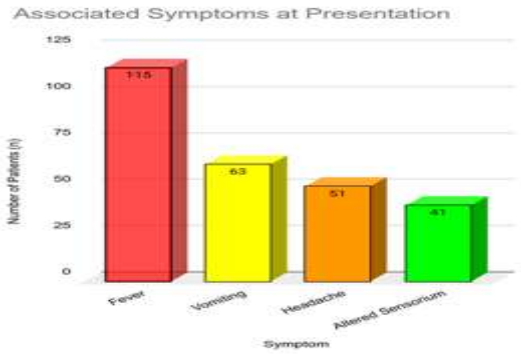

Figure 2: Associated Symptoms at Presentation

Among the pediatric seizure patients (n=210), neurological abnormalities were present in 54 patients (25.71%) and absent in 156 patients (74.29%). The p-value of 0.019 indicates a statistically significant difference in the presence of neurological findings within the study population.

Among the study participants, 48 children (22.86%) had abnormal total leukocyte counts, whereas 162 (77.14%) showed normal TLC values. This difference in distribution was statistically meaningful variation (p = 0.023), suggesting a notable association between TLC abnormality and seizure occurrence in the cohort.

Table 8: Complete Blood Count Abnormalities

CBC Parameter	Number of Patients (n)	Percentage (%)	p-value
TLC Abnomal	48	22.86	0.023
Normal	162	77.14	

Table 9: Metabolic Abnormalities Detected in Pediatric Seizure Patients

Metabolic Abnormality	Number of Patients (n)	Percentage of Metabolic Cases (%)	Percentage of Total Cases (n=210)	Diagnostic Test(s) Used	p-value
Hypoglycemia	10	35.71	4.76	Blood glucose measurement	0.026
Hyponatremia	8	28.57	3.81	Serum electrolytes	
Hypocalcemia	5	17.86	2.38	Serum calcium levels	
Hypomagnesemia	3	10.71	1.43	Serum magnesium levels	
Others (e.g., metabolic acidosis)	2	7.14	0.95	Biochemical panels	

In [Table 9], among pediatric seizure patients (n=210), metabolic abnormalities were identified in a subset of 28 cases (13.33%). Hypoglycemia was the major metabolic cause, affecting 10 patients (35.71% of metabolic cases; 4.76% of total), diagnosed via blood glucose measurement. Hyponatremia occurred in 8 patients (28.57% of metabolic cases; 3.81% of total), identified through serum electrolyte analysis. Hypocalcemia was seen in five patients (17.86% of metabolic cases; 2.38% of total), detected by serum calcium levels. Hypomagnesemia affected 3 patients (10.71% of metabolic cases; 1.43% of total), and other metabolic disturbances, such as metabolic acidosis, were observed in 2 patients (7.14% of metabolic cases; 0.95% of total). Diagnostic tests focussed on blood glucose levels, serum electrolytes levels, calcium level, magnesium levels, and biochemical panels. The p-value of 0.026 suggests a statistically significant presence of these metabolic disturbances within the study population, emphasizing their role in pediatric seizure etiology and the need for comprehensive metabolic evaluation.

Table 10: CSF Abnormalities Among Children Who Underwent Lumbar Puncture (n = 52)

CSF Diagnosis Pattern	Number of Cases (n)	Percentage (%)	p-value
Normal CSF	30	57.7%	–
Viral / Aseptic Meningoencephalitis Pattern	11	21.2%	0.04
Acute Bacterial Meningitis Pattern	6	11.5%	0.03
Tuberculous Meningitis Pattern	3	5.8%	0.02
Non-specific Inflammatory CSF (raised protein only / mild cells)	2	3.8%	0.21
Total CSF Samples	52	100%	–

Of the 52 children evaluated with CSF analysis, 30 (57.7%) had normal findings. Viral/aseptic patterns were seen in 11 cases (21.2%), acute bacterial meningitis in 6 (11.5%), and tuberculous meningitis in 3 children (5.8%), each showing statistical significance. Non-specific inflammatory changes were observed in 2 cases (3.8%) without significant association.

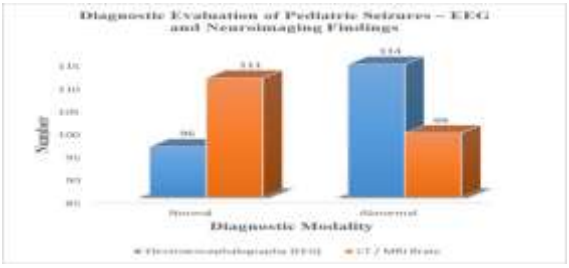

Figure 3: Diagnostic Evaluation of Pediatric Seizures – EEG and Neuroimaging Findings.

In [Figure 3], Electroencephalography (EEG) showed abnormalities in 114 children (54.3%) compared to 96 (45.7%) with normal findings, indicating a statistically significant diagnostic yield (p = 0.015). Neuroimaging (CT/MRI brain) revealed abnormal findings in 99 children (47.1%), while 111 (52.9%) had normal scans, which was also statistically significant (p = 0.017), highlighting the complementary role of EEG and neuroimaging in evaluating pediatric seizures.

Table 11: Types of Structural Brain Abnormalities (Among Abnormal Imaging)

Abnormality Type	Number of Cases (n)	Percentage (%)	p-value
Cerebral Atrophy	27	38.57	0.022
Calcifications	18	25.71	
Tumors/Lesions	12	17.14	
Others	13	18.57	

Among the 70 pediatric seizure patients associated with neuroimaging abnormalities, 27 cases (38.57%) demonstrated cerebral atrophy, 18 cases (25.71%) showed calcifications, 12 cases (17.14%) had tumors or lesions, and 13 cases (18.57%) presented with other abnormalities. The p-value of 0.022 indicates a statistically significant variation in the types of structural abnormalities observed within the abnormal imaging group.

Table 12: Neuroimaging Findings by Etiology

Etiology	Normal Imaging (n)	Abnormal Imaging (n)	Percentage Abnormal Imaging (%)	p-value
Infectious	25	31	55.36	0.014
Structural	5	43	89.58	
Metabolic	18	10	35.71	
Febrile Seizures	21	1	4.55	
Idiopathic/Unknown	42	14	25	

In [Table 12], among the pediatric seizure patients (n=210), neuroimaging results varied according to seizure etiology. In the infectious group, 25 patients had normal imaging and 31 showed abnormalities, with 55.36% exhibiting abnormal findings. The structural group showed a higher prevalence of abnormalities, with 43 patients affected and only 5 normal scans, resulting in 89.58% abnormal imaging. Metabolic cases had 18 normal and 10 abnormal images, with 35.71% abnormality. Febrile seizures primarily presented with normal imaging (21 patients) and only 1 abnormal case (4.55%). In the idiopathic/unknown category, 42 patients had normal scans and 14 had abnormalities (25%). The p-value of 0.014 indicates a statistically significant difference in imaging abnormalities across different etiologies.

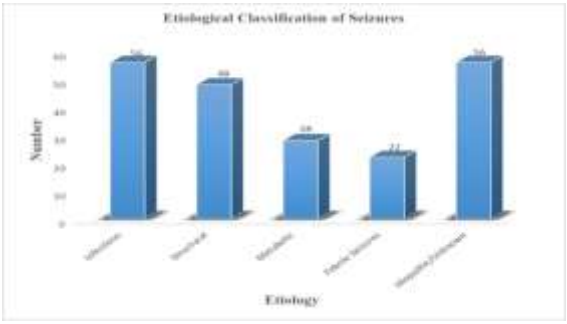

Figure 4: Etiological Classification of Seizures

In Figure 4, The etiological classification of seizures among pediatric patients (n=210) identified infectious causes in 56 patients (26.67%), structural causes in 48 patients (22.86%), metabolic causes in 28 patients (13.33%), febrile seizures in 22 patients (10.48%), and idiopathic or unknown causes in 56 patients (26.67%). The p-value of 0.018 indicates a statistically significant variation in the distribution of seizure etiologies within the study population.

DISCUSSION

The largest proportion of seizure episodes occurred in the one to five year age group (41.90%), with a statistically important age clustering (p = 0.027). This predominance of younger children is broadly concordant with Verma V et al (2022) [10], who reported the highest incidence (56.5%) in children aged 1 month to <5 years and with Mondal et al (2022).[7] The present study demonstrated a predominance of generalized seizures (54.76%, p=0.012), followed by focal seizures (30.95%), a pattern that aligns with the observations of Mondal et al,[7] (2022) and Verma et al,[10] (2022) both of whom reported generalized-onset seizures as the most frequent presentation in pediatric populations. A similar male-predominant, generalized seizure pattern was also noted by Chagantipati et al,[11] (2024) although with a lower proportion of

generalized seizures (58.4%) compared to the current findings. Etiologically, infectious causes (26.67%) and idiopathic/unknown causes (26.67%) were the leading categories in this study, which is comparable to the high contribution of CNS infections reported by Chagantipati et al,[11] (2024) while Mondal et al,[7] (2022) and Verma et al,[10] (2022) reported a higher burden of febrile seizures than observed here (10.48%). Associated symptoms at presentation in this thesis were dominated by fever in 115 patients (54.76%), while Mondal et al,[7] (2022) reported that 88.23% of first seizure episodes were associated with fever, and febrile seizures accounted for 54.17% of etiologies.Adverse birth history in the form of prematurity or birth asphyxia was documented in 38 children (18.10%). Ramesh S et al,[5] (2020) reported cerebral palsy in 15% of documented seizure cases, indirectly reflecting the long-term consequences of perinatal hypoxic–ischemic injury. Similarly, Babu BV et al,[14] (2018) identified hypoxic-ischemic encephalopathy as the major reason leading to seizures in neonate. Structural causes (22.86%) were comparable to the neuroimaging-correlated etiologies described by Prabha et al (2024).[12] Total leukocyte count was abnormal in 48 children (22.86%) where as Muraleedharan D,[13] (2024) reported that more than half of children with febrile seizures had elevated leukocyte counts and two-thirds had raised CRP, underscoring the frequent coexistence of systemic inflammation and seizures .Metabolic abnormalities were identified in 13.33% of cases, with hypoglycemia (4.76% of total cases, p=0.026) being most frequent; this detailed metabolic stratification represents a distinct observation in the present study, as prior studies largely emphasized infectious, febrile, or structural etiologies without comparable metabolic breakdowns, highlighting a unique contributory dimension in the etiological profile.A higher proportion of abnormal EEG findings (54.3%, p=0.015) than normal recordings, which is comparable to the high EEG abnormality rates reported by Verma et al,[10] (2022) and Chagantipati et al,[11] (2024) both emphasizing the diagnostic yield of EEG in pediatric seizures. Similarly, abnormal neuroimaging was observed in 47.1% of cases (p=0.017), aligning with Prabha et al. (2024),[12] who highlighted significant clinico-radiological correlations. On etiological stratification, structural causes showed the highest abnormal imaging yield (89.58%), comparable to imaging-driven diagnoses in Prabha et al. (2024),[12] while infectious etiologies demonstrated moderate abnormality rates similar to Chagantipati et al (2024).[11] In contrast, febrile seizures showed minimal imaging abnormalities (4.55%), lower than proportions emphasized by Mondal et al. (2022),[7] underscoring the limited role of routine imaging in uncomplicated febrile seizures.

CONCLUSION

This study comprehensively delineates the clinico-etiological spectrum of seizures among children aged 1–18 years presenting to a tertiary care pediatric setting, fulfilling both primary and secondary objectives. . Seizure occurrence was concentrated in early childhood, with a clear male preponderance, generalized seizures constituted the predominant seizure type, with a substantial burden of focal seizures, underscoring the heterogeneity of pediatric seizure presentations. Infectious and idiopathic etiologies emerged as the leading causes, while structural abnormalities demonstrated the highest diagnostic yield on neuroimaging, reaffirming the importance of etiological classification in guiding investigations. Metabolic causes, though less frequent, were clinically significant, with hypoglycemia and electrolyte disturbances contributing to acute symptomatic seizures. The high proportion of abnormal EEG findings highlights its pivotal role in seizure characterization, whereas neuroimaging proved selectively valuable, particularly in structural and infectious etiologies. Overall, the findings emphasize the need for a rational, etiology-directed diagnostic approach to optimize evaluation and management of pediatric seizures.

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