Section: Paediatrics

Original Research Article

CLINICO-ETIOLOGICAL PROFILE AND IMMEDIATE OUTCOME OF SEIZURES IN CHILDREN AGED 2 MONTHS TO 12 YEARS: A HOSPITAL-BASED CROSS-SECTIONAL STUDY

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Received *: 16/05/2026*
Received in revised form *: 08/07/2026*
Accepted *: 23/07/2026*

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DOI: 10.70034/ijmedph.2026.3.466

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 2977-2983

ABSTRACT

Background: Seizures are among the most common neurological emergencies in children and account for a significant proportion of paediatric hospital admissions. The clinical presentation and underlying causes of seizures vary with age, making early identification of the aetiology essential for appropriate management and improved outcomes. This study was undertaken to evaluate the clinico-etiological profile of seizures in children aged 2 months to 12 years. **Objectives:** To study the clinico-etiological profile of seizures in children aged 2 months to 12 years by analysing the types of seizures, age-wise distribution, underlying causes, and immediate clinical outcomes.

Materials and Methods: A hospital-based descriptive cross-sectional study was conducted in the Department of Paediatrics, Meenakshi Mission Hospital and Research Institute, Madurai, from March 2021 to February 2022. Seventy-three children aged 2 months to 12 years presenting with seizures were enrolled. Demographic details, clinical history, examination findings, laboratory investigations, electroencephalography, and neuroimaging findings, whenever indicated, were recorded using a structured proforma. Data were analysed using SPSS version 19.0. Categorical variables were compared using the Chi-square test, and a p-value <0.05 was considered statistically significant.

Results: Generalized tonic-clonic seizures were the predominant seizure type, accounting for 94.5% of cases. The majority of children were below five years of age. Simple febrile seizures were the most common diagnosis (28.7%), followed by seizure disorders (27.4%) and atypical febrile seizures (11.0%). A significant association was observed between the clinical diagnosis and seizure type ($p<0.001$), as well as between loss of consciousness and seizure type ($p<0.001$). No significant association was found between seizure type and age, sex, socioeconomic status, family history, birth weight, mode of delivery, pregnancy complications or associated complaints.

Conclusion: Generalized tonic-clonic seizures and febrile seizures constituted the predominant clinical and etiological patterns among children with seizures. Comprehensive clinical evaluation supported by appropriate investigations facilitates early diagnosis and timely management, thereby improving immediate clinical outcomes and reducing seizure-related morbidity.

Keywords: Seizures, Children, Generalized tonic-clonic seizures, Febrile seizures, Etiology, Clinical profile.

INTRODUCTION

Seizures are among the most common neurological emergencies encountered in children and constitute a significant cause of hospital admissions worldwide. A seizure is defined as a transient occurrence of signs and/or symptoms resulting from abnormal, excessive or synchronous neuronal activity in the brain. The clinical manifestations range from subtle behavioural changes to generalized convulsions, depending on the age of the child, the site of neuronal involvement and the underlying aetiology. Childhood seizures are associated with considerable morbidity, parental anxiety and, in some cases, long-term neurodevelopmental impairment, making early diagnosis and appropriate management essential.[1] Globally, approximately 4–10% of children experience at least one seizure before the age of 16 years, while epilepsy affects nearly 0.5–1% of the paediatric population. The burden is greater in low- and middle-income countries because of higher rates of perinatal insults, central nervous system (CNS) infections, malnutrition and limited access to specialised neurological services. India contributes substantially to the global burden of childhood epilepsy owing to its large paediatric population and diverse socio-economic and healthcare settings.[2,3] The causes of seizures in children vary considerably with age and geographical region. Febrile seizures are the most common cause in children between 6 months and 5 years of age and generally have a favourable prognosis. In contrast, afebrile seizures may result from epilepsy syndromes, structural brain abnormalities, metabolic disturbances, infections, vascular disorders, immune-mediated diseases or genetic disorders. Advances in neuroimaging, electroencephalography (EEG), metabolic evaluation and molecular genetics have improved the identification of seizure aetiology, facilitating targeted treatment and improving clinical outcomes.[4,5] The International League Against Epilepsy (ILAE) has introduced revised classifications of seizure types and epilepsy, enabling clinicians to categorise seizures according to onset, clinical features and aetiology. This classification has enhanced diagnostic accuracy and standardised reporting across studies. Identification of the underlying cause is crucial because treatment strategies, prognosis and recurrence risk differ significantly among various seizure disorders.[6]

In developing countries such as India, CNS infections, neurocysticercosis, tuberculous meningitis, perinatal hypoxic-ischaemic injury and metabolic abnormalities continue to contribute substantially to childhood seizures, unlike high-income countries where genetic and developmental epilepsies are increasingly recognised. Several Indian hospital-based studies have demonstrated that febrile seizures remain the predominant presentation, followed by epilepsy syndromes, CNS infections and structural brain lesions. However, regional variations exist due to differences in disease prevalence, healthcare accessibility and referral patterns.[7-10] Recent prospective studies from India have also shown that careful clinical evaluation combined with appropriate laboratory investigations, EEG and neuroimaging can establish the underlying etiology in the majority of children presenting with seizures. Early recognition of potentially reversible causes such as electrolyte imbalance, hypoglycaemia and CNS infections is particularly important in reducing mortality and preventing neurological sequelae. Furthermore, identifying seizure patterns and their age-wise distribution assists clinicians in selecting appropriate investigations and initiating timely therapy.[9,11] Despite considerable advances in paediatric neurology, comprehensive data regarding the clinico-etiological profile of seizures among children in different regions of India remain limited. Variations in demographic characteristics, infectious diseases, nutritional status and availability of diagnostic facilities necessitate region-specific studies to understand the prevailing spectrum of childhood seizures. Such information is valuable for improving diagnostic protocols, optimising management strategies and planning preventive healthcare interventions. Therefore, the present study was undertaken to evaluate the clinical presentation and etiological profile of seizures among children aged 2 months to 12 years attending a tertiary care hospital.[9,12]

Aim and objectives: To study the clinico-etiological profile of seizures in children aged 2 months to 12 years by analysing the types of seizures, age-wise distribution, underlying causes, and immediate clinical outcomes, thereby providing insights into the spectrum of childhood seizures and facilitating early diagnosis and appropriate management.

MATERIALS AND METHODS

Study design: This hospital-based descriptive cross-sectional study was conducted to evaluate the clinico-etiological profile of seizures in children aged 2 months to 12 years.

Study setting: The study population comprised children aged 2 months to 12 years presenting with seizures to the Paediatric Emergency Department, Outpatient Department (OPD), or Inpatient Department (IPD) during the study period.

Study period: The study was conducted over a period of one year, from March 2021 to February 2022.

Inclusion Criteria

1. Children aged 2 months to 12 years.
2. Children presenting with one or more episodes of seizures.
3. Parents or legal guardians willing to provide written informed consent.

Exclusion Criteria

1. Children with seizures secondary to head injury.
2. Children whose parents or guardians declined to provide informed consent.

Sampling technique: A consecutive sampling technique was adopted, wherein all eligible children presenting with seizures during the study period were included until the required sample size was achieved.

Ethical considerations: Prior approval for the study was obtained from the Institutional Human Ethics Committee of Meenakshi Mission Hospital and Research Institute, Madurai. Written informed consent was obtained from the parents or legal guardians before enrolment.

Methodology: Children presenting with seizures to the Paediatric Emergency Department, OPD or IPD during the study period were screened for eligibility. After obtaining written informed consent, demographic details including age, sex and residential status were recorded using a predesigned and pretested case record proforma. A detailed clinical history was obtained from the parents or caregivers, including the characteristics of seizures, duration, frequency, fever, developmental history, birth history, immunisation status, family history of seizures or epilepsy, drug history and associated symptoms. A comprehensive general physical examination and systemic examination with emphasis on neurological assessment were performed by the investigator. The seizure type was classified according to the International League Against Epilepsy (ILAE) classification wherever applicable.

Outcome Measures: The primary outcome was the clinico-etiological profile of seizures in children aged 2 months to 12 years.

Statistical Analysis: The collected data were entered into Microsoft Excel and analysed using Statistical Package for the Social Sciences (SPSS) version 19.0. Continuous variables were expressed as mean ± standard deviation (SD) or median with interquartile range (IQR), depending on data distribution. Categorical variables were presented as frequencies and percentages. Associations between categorical variables were analysed using the Chi-square test or Fisher's exact test, wherever appropriate. Continuous variables were compared using the Student's t-test or Mann–Whitney U test based on normality of distribution. A p-value <0.05 was considered statistically significant throughout the analysis.

RESULTS

In the present study evaluating the clinico-etiological profile of seizures in children, generalized tonic-clonic seizures (GTCS) were the most common seizure type, observed in 94.5% of the participants. Myoclonic seizures accounted for 2.7% of cases, while focal seizures and clonic seizures were each observed in 1.4% of the children (Table 1). The distribution of seizure types according to age group showed that among children aged 2 months to 2 years, 38.4% had generalized tonic-clonic seizures (GTCS), while 5.5% presented with other seizure types. In the 2–5 years age group, all children (27.4% of the total study population) had GTCS. Among children aged 5–10 years, 24.7% had GTCS, and in the 10–12 years age group, 4.1% had GTCS. Although GTCS was the predominant seizure type across all age groups, there was no statistically significant association between age group and seizure type (Chi-square test, p = 0.143) (Table 2). The distribution of seizure types according to sex showed that females constituted 52.1% of the study population, of whom 47.9% had generalized tonic-clonic seizures (GTCS) and 4.1% had other seizure types. Males accounted for 47.9% of the participants, with 46.6% presenting with GTCS and 1.4% with other seizure types. Although GTCS was the predominant seizure type in both sexes, there was no statistically significant association between sex and the type of seizure (Chi-square test, p = 0.345) (Table 3). The distribution of seizure types according to socioeconomic status revealed that among children belonging to the lower socioeconomic class, 43.8% had generalized tonic-clonic seizures (GTCS), while 1.4% had other seizure types. Among children from the lower middle socioeconomic class, 24.7% presented with GTCS and 2.7% had other seizure types. In the upper lower and upper middle socioeconomic classes, GTCS was observed in 20.5% and 5.5% of the children, respectively. Although GTCS was the predominant seizure type across all socioeconomic classes, no statistically significant association was observed between socioeconomic status and seizure type (Chi-square test, p = 0.253) (Table 4). The distribution of seizure types according to maternal pregnancy complications showed that among children born to mothers with anaemia during pregnancy, all cases (4.1%) presented with generalized tonic-clonic seizures (GTCS). Among children with a history of birth asphyxia, 1.4% had seizure types other than GTCS. Maternal gestational diabetes mellitus (GDM) and hypothyroidism were each associated with GTCS in 1.4% of the children. Among children born to mothers without any documented pregnancy complications, 87.7% presented with GTCS, while 4.1% had other seizure types. These findings indicate that GTCS was the predominant seizure type irrespective of maternal pregnancy complications (Table 5). The distribution of seizure types according to family history revealed that among children with a positive family history of seizures, 27.4% presented with generalized tonic-clonic seizures (GTCS). Among those without a family history of seizures, 67.1% had GTCS. Although GTCS was the predominant seizure type in both groups, there was no statistically significant

association between family history of seizures and the type of seizure (Chi-square test, p = 0.206) (Table 6). The distribution of seizure types according to diagnosis demonstrated that all children diagnosed with simple febrile seizures (28.7%), atypical febrile seizures (11.0%), and seizure disorders (27.4%) presented with generalized tonic-clonic seizures (GTCS). Among children with unprovoked seizures, 9.6% had GTCS, while 1.4% presented with other seizure types. Similarly, GTCS was observed in all children diagnosed with febrile status epilepticus (4.1%), central nervous system (CNS) infections (5.5%), tuberculous meningitis (2.7%), and hypoglycaemic seizures (2.7%). In contrast, children with hypocalcaemic seizures presented exclusively with seizure types other than GTCS. A statistically significant association was observed between the clinical diagnosis and the type of seizure (Chi-square test, p < 0.001) (table 7). The distribution of seizure types according to the age at onset of seizures showed that among children aged 2 months to 2 years, 38.4% had generalized tonic-clonic seizures (GTCS), while 5.5% presented with other seizure types. In the 2–5 years age group, all children (27.4%) had GTCS. Similarly, GTCS was observed in 24.7% of children aged 5–10 years and 4.1% of those aged 10–12 years. Although GTCS was the predominant seizure type across all age groups, there was no statistically significant association between the age at onset of seizures and the type of seizure (Chi-square test, p = 0.143) (Table 8). In the present study, among children presenting with loss of consciousness, 93.2% had generalized tonic-clonic seizures (GTCS), while 2.7% had other seizure types. A statistically significant association was observed between loss of consciousness and the type of seizure (Chi-square test, p < 0.001), indicating that loss of consciousness was significantly more common among children with GTCS (Table 9). The distribution of seizure types according to the presence of associated complaints showed that among children with associated clinical complaints, 87.7% presented with generalized tonic-clonic seizures (GTCS), while 4.1% had other seizure types. Among children without associated complaints, 6.8% had GTCS and 1.4% had other seizure types. Although GTCS was the predominant seizure type in both groups, there was no statistically significant association between the presence of associated complaints and the type of seizure (Chi-square test, p = 0.209) (Table 10). The distribution of seizure types according to the mode of delivery showed that among children born by spontaneous vaginal delivery (SVD), 56.2% presented with generalized tonic-clonic seizures (GTCS), while 1.4% had other seizure types. Among children delivered by lower segment caesarean section (LSCS), 38.4% had GTCS and 4.1% presented with other seizure types. Although GTCS was the predominant seizure type irrespective of the mode of delivery, no statistically significant association was observed between the mode of delivery and the type of seizure (Chi-square test, p = 0.176) (Table 11). The distribution of seizure types according to birth weight revealed that among children with a birth weight of 1001–1500 g, 2.7% had generalized tonic-clonic seizures (GTCS), while 1.4% presented with other seizure types. Among those with a birth weight of 1501–<2500 g, GTCS was observed in 12.3% of the children, whereas 1.4% had other seizure types. In the birth weight category of 2500–3500 g, 65.8% of the children had GTCS and 2.7% had other seizure types. All children with a birth weight of >3500 g (13.7%) presented with GTCS. Although GTCS was the predominant seizure type across all birth weight categories, there was no statistically significant association between birth weight and seizure type (Chi-square test, p = 0.128). [Table 12]

Table 1: Type of Seizure among the study participants

Type of seizure	Frequency	Percentage
GTCS	69	94.5
Myoclonic seizure	2	2.7
Focal seizures	1	1.4
Clonic seizures	1	1.4
Total	73	100.0

Table 2: Association between age group and the type of seizure among the study participants

Age groups	Typeofseizure		Total	P value
	GTCS	Other Seizures		
2 months-2 years	28 (38.4)	4 (5.5)	32 (43.8)	0.143
2 years -5 years	20 (27.4)	0 (0.0)	20 (27.4)	
5 years -10 years	18 (24.7)	0 (0.0)	18 (24.7)	
10years -12 years	3 (4.1)	0 (0.0)	3 (4.1)	
Total	69 (94.5)	4 (5.5)	73 (100)	

Table 3: Association between Sex of the children Vs type of Seizure

Sex	Type of seizure		Total	P value
	GTCS	Other Seizures		
Female child	35 (47.9)	3 (4.1)	38 (52.1)	0.345
Male child	34 (46.6)	1 (1.4)	35 (47.9)	
Total	69 (94.5)	4 (5.5)	73 (100.0)	

Table 4: Association between Socio economic statusVs Type of seizure

Socio economic status	Type of seizure		Total	P value
	GTCS	Other Seizures		
Lower class	32 (43.8)	1 (1.4)	33 (45.2)	0.253
Lower middle class	18 (24.7)	2 (2.7)	20 (27.4)	
Upper lower class	15 (20.5)	0 (0.0)	15 (20.5)	
Upper middle class	4 (5.5)	1 (1.4)	5 (6.8)	
Total	69 (94.5)	4 (5.5)	73 (100)	

Table 5: Complications of pregnancy Vs Type of seizure among the study participants

Complications of pregnancy	Type of seizure		Total
	GTCS	Other Seizures	
Anemia	3 (4.1)	0 (0.0)	3 (4.1)
Birth asphyxia	0 (0.0)	1 (1.4)	1 (1.4)
GDM	1 (1.4)	0 (0.0)	1 (1.4)
Hypothyroidism	1 (1.4)	0 (0.0)	1 (1.4)
None	64 (87.7)	3 (4.1)	67 (91.8)
Total	69 (94.5)	4 (5.5)	73 (100)

Table 6: Association between Family history of seizure and Type of seizure

Family history of seizures	Type of seizure		Total	P value
	GTCS	Other Seizures		
Present	20 (27.4)	0 (0.0)	20 (27.4)	0.206
Absent	49 (67.1)	4 (5.5)	53 (72.6)	
Total	69 (94.5)	4 (5.5)	73 (100.0)	

Table 7: Table 7: Association between Diagnosis and Type of Seizure among the children with seizures

Diagnosis	Type of seizure		Total	P value
	GTCS	Other Seizures		
Simple febrile seizure	21 (28.7)	0 (0.0)	21 (28.7)	0.000*
Atypical febrile seizure	8 (11.0)	0 (0.0)	8 (11.0)	
Seizure disorder	20 (27.4)	0 (0.0)	20 (27.4)	
Unprovoked seizure	7 (9.6)	1 (1.4)	8 (11.0)	
Febrile status epilepticus	3 (4.1)	0 (0.0)	3 (4.1)	
CNS infection	4 (5.5)	0 (0.0)	4 (5.5)	
TB meningitis	2 (2.7)	0 (0.0)	2 (2.7)	
Cerebral palsy	2 (2.7)	1 (1.4)	3 (4.1)	
Hypocalcemic seizure	0 (0.0)	2 (2.7)	2 (2.7)	
Hypoglycemic seizure	2 (2.7)	0 (0.0)	2 (2.7)	
Total	69 (94.5)	4 (5.5)	73 (100.0)	

Table 8: Association between age at onset of seizures and type of seizures

Age at onset of seizures	Type of seizure		Total	P value
	GTCS	Other Seizures		
2 months - 2 years	28 (38.4)	4 (5.5)	32 (43.8)	0.143
2 years - 5 years	20 (27.4)	0 (0.0)	20 (27.4)	
5 years - 10 years	18 (24.7)	0 (0.0)	18 (24.7)	
10years - 12 years	3 (4.1)	0 (0.0)	3 (4.1)	
Total	69 (94.5)	4 (5.5)	73 (100.0)	

Table 9: Loss of consciousness Vs Type of seizure

Loss of Consciousness	Type of seizure		Total	P value
	GTCS	Other Seizures		
Present	68 (93.2)	2 (2.7)	70 (95.9)	0.000*
Absent	1 (1.4)	2 (2.7)	3 (4.1)	
Total	69 (94.5)	4 (5.5)	73 (100.0)	

Table 10: Associated between other associated complaints and type of seizures

Associated Complaints	Type of seizure		Total	P value
	GTCS	Other Seizures		
Present	64 (87.7)	3 (4.1)	67 (91.8)	0.209
Absent	5 (6.8)	1 (1.4)	6 (8.2)	
Total	69 (94.5)	4 (5.5)	73 (100.0)	

Table 11: Mode of delivery Vs Type of seizure among the study subjects

Mode of delivery	Type of seizure		Total	P value
	GTCS	Other Seizures		
NVD	41 (56.2)	1 (1.4)	42 (57.5)	0.176
LSCS	28 (38.4)	3 (4.1)	31 (42.5)	
Total	69 (94.5)	4 (5.5)	73 (100)	

Table 12: Association between birth weight and type of seizure among the children

Birth weight	Type of seizure		Total	P value
	GTCS	Other Seizures		
1001-1500 gms	2 (2.7)	1 (1.4)	3 (4.1)	0.128
1501- < 2500 gms	9 (12.3)	1 (1.4)	10 (13.7)	
2500-3500 gms	48 (65.8)	2 (2.7)	50 (68.5)	
>3500 gms	10 (13.7)	0 (0.0)	10 (13.7)	
Total	69 (94.5)	4 (5.5)	73 (100)	

DISCUSSION

Seizures remain one of the commonest neurological emergencies encountered in paediatric practice and represent a major cause of hospital admissions. Identifying the clinical pattern and underlying aetiology is essential for timely diagnosis, appropriate management and prevention of neurological sequelae. The present study evaluated the clinico-etiological profile of seizures among children aged 2 months to 12 years attending a tertiary care hospital. Generalized tonic-clonic seizures (GTCS) constituted the predominant seizure type (94.5%) in the present study. This finding is comparable with several hospital-based studies from India and neighbouring countries, which have consistently reported generalized seizures as the most common seizure type among children. Although recent studies adopting the International League Against Epilepsy (ILAE) 2017 classification have reported a higher proportion of focal-onset seizures due to improved recognition, GTCS continues to be the commonest presentation in tertiary care settings.[13,14] The majority of children in the present study experienced seizure onset before five years of age, with the highest proportion occurring between 2 months and 2 years. Early childhood is recognised as the period of greatest susceptibility to seizures because of brain immaturity, increased prevalence of febrile illnesses and metabolic disturbances. Similar age distributions have been documented in Indian studies evaluating first-episode seizures in children.[13,15]

Although females marginally outnumbered males in the present study, no significant association was observed between sex and seizure type. Most Indian studies have reported a slight male predominance, which is often attributed to differences in healthcare-seeking behaviour rather than biological susceptibility. However, seizure semiology has generally not been shown to differ significantly between boys and girls, which is consistent with the findings of the present study.[13,16] Simple febrile seizures were the most common diagnosis in the present study, followed by seizure disorders and atypical febrile seizures. This observation agrees with several recent studies demonstrating that febrile seizures remain the leading cause of seizures among children younger than five years. The predominance of febrile seizures reflects the high incidence of viral infections and fever during early childhood.[13,17,18] A statistically significant association was observed between diagnosis and seizure type. Children with simple febrile seizures, atypical febrile seizures, central nervous system infections, tuberculous meningitis and hypoglycaemic seizures predominantly presented with GTCS, whereas hypocalcaemic seizures were associated with other seizure types. Similar observations have been reported by previous investigators, highlighting that febrile illnesses, CNS infections and metabolic abnormalities are major causes of generalized seizures in developing countries.[13,14,19] No statistically significant association was found between seizure type and socioeconomic status, family history of seizures, maternal pregnancy complications, mode of delivery or birth weight. These findings are comparable with several published studies suggesting that although these factors may increase the risk of seizure occurrence, they do not necessarily influence seizure semiology. Regional differences in socioeconomic conditions, nutritional status and healthcare access may account for variations observed across studies.[15,16,20] Loss of consciousness showed a significant association with GTCS in the present study. This is expected because impairment of consciousness is a characteristic feature of generalized seizures resulting from bilateral cortical involvement. Similar observations have been reported in studies evaluating seizure semiology among children. Fever was the most frequent associated complaint, reflecting the predominance of febrile seizures in the study population. [14,17,21] Overall, the present study confirms that GTCS is the most common seizure type in children aged 2 months to 12 years, with febrile seizures representing the leading aetiology. Careful clinical assessment supported by appropriate biochemical investigations, electroencephalography and neuroimaging whenever indicated enables accurate identification of the underlying cause and facilitates early treatment. Such an approach is essential to minimise morbidity, improve prognosis and optimise long-term neurological outcomes in affected children.[13,14,22-27]

CONCLUSION

The present study demonstrated that generalized tonic-clonic seizures were the most common seizure type among children aged 2 months to 12 years, with febrile seizures being the predominant aetiology. Most seizures occurred in children below five years of age. A significant association was

observed between the clinical diagnosis and seizure type, whereas demographic and perinatal factors showed no significant association. Early clinical evaluation, timely identification of the underlying cause, and appropriate investigations are essential for accurate diagnosis, prompt management, and improved clinical outcomes in children with seizures.

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