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Original Research Article

Clinical Profile and Etiology of Febrile Convulsions and Epilepsy in Paediatric Population: A Comprehensive Analysis

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Abstract:

Background: Seizure disorders represent a significant proportion of paediatric neurological presentations, with febrile convulsions being the most common cause in children under five years of age. Understanding the clinical characteristics and etiological factors is essential for appropriate management and parental counselling. Aim of this study is to evaluate the etiological spectrum and clinical characteristics of febrile convulsions and epilepsy among paediatric patients presenting to a tertiary care center.

Methods: A prospective observational study was conducted at Government Medical College Krishnagiri in Department of Paediatrics over one year. Paediatric patients presenting with seizures were consecutively enrolled. Comprehensive clinical evaluation, laboratory investigations, and neurological assessments were performed. Data were analyzed using appropriate statistical methods.

Results: Among 209 seizure cases, 83 (39.7%) were febrile seizures with an overall incidence of 2.57%, while 126 (60.3%) were epileptic seizures with an incidence of 3.9%. Male predominance was observed in both groups (febrile seizures 62.65%, epilepsy 58.73%). Simple febrile seizures constituted 67.47% of cases, with upper respiratory tract infections being the leading cause (63.85%). In epilepsy cases, generalized seizures were most common (67.46%), with acute symptomatic causes accounting for 47.62% of cases. Mortality was observed in 12.70% of epilepsy cases, predominantly in the acute symptomatic group (73.33% of deaths).

Conclusions: While febrile seizures are generally benign, they cause significant parental anxiety and require accurate clinical assessment. Epilepsy in the pediatric population shows higher prevalence in developing countries, with infectious etiologies playing a major role. Comprehensive evaluation and appropriate management strategies are essential for optimal outcomes.

Keywords: Febrile Seizures, Epilepsy, Pediatric Neurology, Seizure Disorders, Clinical Profile.

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Introduction

Seizure disorders constitute one of the most common neurological presentations in pediatric practice, presenting both diagnostic and therapeutic challenges to clinicians. Fever remains the predominant trigger for convulsions in children under five years of age, with febrile seizures affecting approximately 2-4% of the pediatric population.[1,2] The male-to-female ratio shows a consistent male preponderance across various studies, though the underlying mechanisms for this gender difference remain incompletely understood.

Febrile seizures are classified into two distinct categories based on their clinical characteristics. Simple febrile seizures are isolated episodes lasting less than 15 minutes, presenting as generalized tonic-clonic movements without recurrence within 24 hours. In contrast, complex febrile seizures demonstrate focal features, prolonged duration exceeding 15 minutes, or multiple episodes within a 24-hour period.[3] This classification has important implications for prognosis and management strategies. Beyond febrile convulsions, epilepsy represents the most prevalent chronic neurological disorder worldwide, with developing nations experiencing disproportionately higher rates. The incidence in developing countries ranges from 18 per 1,000 population, significantly exceeding the 2.7-8 per 1,000 observed in developed nations.[4]

This disparity is attributed to higher rates of central nervous system infections, head trauma, birth injuries, and perinatal asphyxia in resource-limited settings. Epilepsy contributes to approximately 33% of all pediatric seizure presentations, with the epileptogenic focus originating within the brain parenchyma itself. The diagnostic criteria for epilepsy require at least two unprovoked seizure episodes occurring more than 24 hours apart. Seizures are further categorized into generalized types (including absence, myoclonic, clonic, tonic, atonic, and tonic-clonic variants) and partial seizures (simple without consciousness impairment or complex with altered consciousness).[5] The heterogeneous nature of seizure disorders necessitates comprehensive evaluation to guide appropriate therapeutic interventions. The present investigation was undertaken to systematically analyze the etiological factors and clinical characteristics of both febrile convulsions and epilepsy in a pediatric population, with the aim of contributing to improved understanding and management of these conditions.

Materials and Methods

This prospective observational study was conducted at Government Medical College Krishnagiri in Department of Paediatrics over a one-year period. The study setting provided access to a diverse paediatric population representative of the regional demographic profile, allowing for comprehensive evaluation of seizure disorders across various age groups and etiological categories.

Paediatric patients of either sex presenting with a history of seizures were eligible for inclusion in the study, regardless of the underlying etiology. Informed consent was obtained from parents or legal guardians prior to enrollment. Patients were excluded from the study if parents or guardians were unwilling to provide consent or if clinical data were incomplete. Study participants were recruited consecutively from the paediatric ward as they presented with seizures, ensuring unbiased representation of the seizure population and minimizing selection bias.

A standardized proforma was utilized to systematically collect comprehensive clinical information from all enrolled patients. Detailed fever history was obtained, including onset, duration, pattern, and maximum recorded temperature. Seizure characteristics were meticulously documented, encompassing the type of seizure (generalized versus focal), duration of the episode, and frequency of occurrence. Specific attention was paid to whether seizures recurred within a 24-hour period, as this distinction is critical for classification purposes. The history included documentation of any previous epilepsy diagnosis and current or past antiepileptic drug usage. The level of consciousness during and immediately following the seizure event was carefully assessed and recorded. Relevant past medical history, including any prior hospitalizations, neurodevelopmental concerns, or chronic medical conditions, was obtained. Family history was explored with particular focus on seizures, epilepsy, or other neurological disorders in first- and second-degree relatives.

All patients underwent a comprehensive battery of investigations tailored to their clinical presentation and suspected etiology. Haematological investigations included complete blood count and peripheral smear examination to assess for signs of infection, anemia, or hematological abnormalities. Biochemical parameters were measured, including random blood sugar to exclude hypoglycemia or hyperglycemia, serum electrolytes (sodium, potassium, and calcium) to identify metabolic disturbances that could precipitate seizures, and renal function tests (blood urea and serum creatinine) to assess kidney function. Liver function tests were performed to evaluate hepatic status and guide medication selection. Microbiological investigations included blood culture and sensitivity testing when bacterial infection was suspected, HIV-ELISA testing as part of comprehensive infectious disease screening, and urine examination for evidence of urinary tract infection. Imaging studies, particularly chest X-ray, were performed when clinically indicated, especially in cases with suspected respiratory pathology. Neurological investigations, including lumbar puncture with cerebrospinal fluid analysis, were undertaken when central nervous system infection was suspected based on clinical presentation, examination findings, or initial laboratory results.

All patients received treatment according to established clinical practice guidelines for acute seizure management, with appropriate antiepileptic therapy selected based on seizure type and etiology. Supportive care was provided as needed, including fever management, fluid resuscitation, and treatment of underlying infections.

Data were systematically compiled and analyzed using appropriate statistical methods. Descriptive statistics including percentages and proportions were calculated for categorical variables. Chi-square test was employed to examine associations between categorical variables, and chi-square for trend was utilized to assess ordinal relationships where applicable. A p-value of less than 0.05 was considered statistically significant for all analyses.

Results

Overall Demographics and Distribution: The study enrolled 209 paediatric patients presenting

with seizures during the study period. Male patients constituted 125 cases (59.8%) while females comprised 84 cases (40.2%), yielding a male-to-female ratio of 1.49:1. Gender distribution showed no statistically significant difference using chi-square analysis.

Age distribution revealed maximum incidence in the 6 months to 3 years age group with 89 cases (42.6%), reflecting the expected epidemiological pattern for pediatric seizures.

Table 1: Overall Distribution of Seizure Cases

Parameter	Febrile Seizures	Epilepsy	Total	Percentage
Total Cases	83	126	209	100%
Male	52	74	125	59.8%
Female	31	52	84	40.2%
M:F Ratio	1.68:1	1.42:1	1.49:1	-
Overall Incidence	2.57%	3.9%	-	-
Percentage of Total	39.7%	60.3%	100%	-

Febrile Seizures: Clinical Characteristics: Among the 83 febrile seizure cases, males predominated with 52 cases (62.65%) compared to 31 females (37.35%), establishing a male-to-female ratio of 1.68:1. This gender distribution aligns with previously reported epidemiological patterns.[7,8]

Age distribution analysis revealed that 66.26% of febrile seizures occurred between 6 months and 3 years of age, with an additional 18.07% occurring between 3-5 years. Only 3.6% of cases presented before 6 months of age, while 12.04% occurred after 5 years, confirming the typical age predilection for this condition.[9] Classification of febrile seizures demonstrated that simple (typical) febrile seizures were significantly more common, accounting for 56 cases (67.47%), while complex (atypical) febrile seizures comprised 27 cases (32.53%). Among the complex subtype, generalized patterns predominated. These findings closely parallel those reported by Deng et al., who documented 66.6% simple and 33.3% complex febrile seizures in their cohort.[10]

Etiological Spectrum of Febrile Seizures: Analysis of fever etiology revealed that upper respiratory tract infections (URTI) were the predominant precipitating factor, responsible for 53 cases (63.85%). This was followed by malarial fever in 8 cases (9.64%), lower respiratory tract infections (LRTI) in 7 cases (8.44%), acute gastroenteritis (AGE) in 3 cases (3.62%), and other causes in 12 cases (14.45%). These findings corroborate previous studies by Simpson and George, who reported 70% URTI association, and Bala et al., who found 60.6% URTI causation.[11]

Table 2: Etiological Distribution and Clinical Characteristics of Febrile Seizures

Etiology	Number of Cases	Percentage	Clinical Notes
Upper Respiratory Tract Infection (URTI)	53	63.85%	Most common cause
Malarial Fever	8	9.64%	Second leading cause
Lower Respiratory Tract Infection (LRTI)	7	8.44%	Pneumonia, bronchiolitis
Acute Gastroenteritis (AGE)	3	3.62%	With dehydration
Other Infections	12	14.45%	Urinary tract, otitis media
Total	**83**	**100%**	-
Seizure Type			
Simple Febrile Seizures	56	67.47%	<15 min, generalized, single
Complex Febrile Seizures	27	32.53%	>15 min, focal, or recurrent
Complications	**None observed**	-	Benign course in all cases

Importantly, no complications were observed in the febrile seizure cohort, supporting the generally benign prognosis of this condition.

Epilepsy: Clinical Profile and Classification: The epilepsy cohort comprised 126 cases with an overall incidence of 3.9%, representing 60.3% of total seizure presentations. Gender distribution showed 74 males (58.73%) and 52 females (41.27%), maintaining the observed male preponderance.

Seizure type classification revealed that generalized seizures were most prevalent at 85 cases (67.46%), followed by focal seizures in 36 cases (28.57%), while 5 cases (3.97%) remained unclassified due to insufficient clinical data.

Etiological categorization identified acute symptomatic seizures as the most common subtype with 60 cases (47.62%), followed by idiopathic (cryptogenic) epilepsy in 45 cases (35.71%), and remote symptomatic causes in 21 cases (16.67%). Among acute symptomatic cases, viral encephalitis emerged as the leading cause, accounting for 28.34% of this subgroup. These findings parallel the distribution reported by Murthy et al., who

documented 54% acute symptomatic, 19% idiopathic, and 27% remote symptomatic cases.[13]

The incidence rate of 3.9% observed in our study is lower than the 27.27 per 100,000 population per year reported in a recent urban Kolkata study,[12] likely reflecting differences between hospital-based and population-based surveillance methodologies.

Table 3: Classification and Outcomes of Epilepsy Cases

Classification	Number	Percentage	Survival	Deaths	Mortality Rate
By Seizure Type					
Generalized Seizures	85	67.46%	76	9	10.59%
Focal Seizures	36	28.57%	32	4	11.11%
Unclassified	5	3.97%	2	3	60.00%
By Etiology					
Acute Symptomatic	60	47.62%	49	11	18.33%
(CNS Infections)					
Idiopathic/Cryptogenic	45	35.71%	43	2	4.44%
Remote Symptomatic	21	16.67%	18	3	14.29%
Overall Outcomes	**126**	**100%**	**110**	**16**	**12.70%**

Mortality Analysis: Among 126 epilepsy cases, 110 patients (87.30%) survived to hospital discharge, while 16 patients (12.70%) succumbed during the acute phase. Mortality was disproportionately concentrated in the acute symptomatic epilepsy group, which accounted for 11 deaths (73.33% of total mortality). This elevated mortality in acute symptomatic cases, particularly those associated with central nervous system infections, underscores the severity of underlying pathology.

Statistical analysis of mortality patterns by gender revealed no significant difference, suggesting that outcome was primarily determined by etiology and seizure characteristics rather than patient sex.

Discussion

This comprehensive analysis of 209 paediatric seizure cases provides valuable insights into the clinical spectrum and etiological diversity of seizure disorders in a developing country setting. The distribution pattern, with 60.3% epileptic seizures and 39.7% febrile seizures, closely aligns with the findings of Verma et al., who reported 69.5% epileptic and 30.5% febrile seizures in their cohort of 69 patients.[6]

Febrile Seizures: Demographic and Clinical Patterns: The observed male preponderance in febrile seizures (Male: Female ratio 1.68:1) is consistent with established epidemiological data. Sehgal et al. documented 65% male preponderance in their series of 150 cases, while Forsgren et al. reported a nearly identical male-to-female ratio of 1.72:1 in 128 cases.[7,8] The biological basis for this gender difference remains incompletely elucidated but may relate to developmental variations in seizure threshold or fever response patterns.

The age distribution, with peak incidence between 6 months and 3 years (66.26%), corresponds to the period of maximum neurological maturation and frequent febrile illnesses. Bhandari et al. similarly reported that 76.5% of febrile seizures occurred before age three,[9] reinforcing this as a critical developmental window for seizure susceptibility. The predominance of simple febrile seizures (67.47%) over complex types (32.53%) is prognostically favourable and mirrors global patterns. Deng et al.'s study of 117 cases yielded nearly identical proportions (66.6% simple, 33.3% complex),[10] suggesting this distribution is relatively consistent across different populations.

Etiological Considerations in Febrile Seizures: Upper respiratory tract infections emerged as the overwhelming precipitant of febrile seizures (63.85%), followed distantly by malarial fever (9.64%).

This pattern reflects both the high frequency of URTI in childhood and the neurological susceptibility during these infections. Simpson and George found 70% URTI association, while Bala et al. documented 60.6%,[11] demonstrating remarkable consistency across different study populations and geographic settings.

The absence of complications in our febrile seizure cohort reinforces the generally benign nature of this condition. However, this should not diminish the profound anxiety experienced by families witnessing these events, which places significant responsibility on clinicians to provide accurate information and appropriate reassurance.

Epilepsy: Burden and Characteristics: The epilepsy incidence of 3.9% in our hospital-based cohort reflects the substantial burden of this condition in developing countries. While lower than the community-based annual incidence of 27.27 per 100,000 reported from urban

Kolkata,[12] this difference likely reflects methodological variations between hospital-based case series and population surveillance studies. Nevertheless, our findings underscore that epilepsy represents a significant proportion of paediatric neurological presentations.

The continued male predominance in epilepsy cases (58.73%) parallels the febrile seizure pattern, though the magnitude is somewhat attenuated. This consistent gender difference across seizure types warrants further investigation into potential sex-linked factors influencing seizure susceptibility.

Etiological Spectrum and Implications: The high proportion of acute symptomatic epilepsy (47.62%), predominantly due to central nervous system infections including viral encephalitis (28.34% of acute symptomatic cases), highlights the critical role of infectious etiologies in developing country settings.

This distribution closely resembles that reported by Murthy et al., who documented 54% acute symptomatic seizures.[13] The prevalence of CNS infections reflects ongoing challenges with infectious disease control, healthcare access, and potentially nutritional factors affecting immune function.

Idiopathic (cryptogenic) epilepsy accounted for 35.71% of cases, while remote symptomatic causes comprised 16.67%. The substantial proportion of idiopathic epilepsy suggests that many cases result from genetic or developmental factors rather than identifiable acquired brain injury.

Mortality Patterns and Prognostic Implications: The overall mortality rate of 12.70% in epilepsy cases, with 73.33% of deaths occurring in the acute symptomatic group, emphasizes the severe nature of seizures secondary to acute CNS infections.

This mortality concentration in acute symptomatic cases likely reflects both the severity of underlying infections (particularly encephalitis) and potential complications including status epilepticus, cerebral edema, and multi-organ dysfunction.

The absence of significant gender differences in mortality suggests that prognosis is primarily determined by seizure etiology and underlying pathophysiology rather than sex-related factors. This finding has important implications for risk stratification and resource allocation.

Conclusions

This comprehensive analysis of paediatric seizure disorders demonstrates that while febrile seizures are generally benign with favorable outcomes, they generate significant parental anxiety and require skilled clinical assessment to differentiate simple from complex types and to identify rare cases at risk for adverse outcomes.

The predominance of simple febrile seizures (67.47%) and absence of complications in our cohort is reassuring, though clinicians must remain vigilant for atypical features.

Epilepsy represents a substantial burden in the paediatric population, with infectious etiologies playing a disproportionately large role in developing countries. The high mortality associated with acute symptomatic epilepsy (18.33%) underscores the need for improved prevention, early recognition, and aggressive management of CNS infections. The substantial proportion of idiopathic epilepsy (35.71%) highlights the importance of genetic and developmental factors.

Healthcare providers must be equipped with current evidence-based knowledge to appropriately counsel families, recognize special febrile seizure syndromes with potential for long-term neurological abnormalities, and implement optimal treatment strategies.

Continued research into the mechanisms, pathways, correlations, and clinical implications of seizures is essential to advance the field and improve outcomes for affected children. The challenge for modern paediatric neurology is to integrate growing scientific understanding with practical clinical application, ensuring that all children with seizure disorders receive timely diagnosis, appropriate treatment, and comprehensive long-term care regardless of geographic or socioeconomic circumstances.

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