

A Retrospective Analysis of Clinical Characteristics and Recurrence Patterns of Febrile Seizures in Children

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Conflict of interest: Nil

Abstract:

Background: Febrile seizures constitute one of the most common types of childhood epilepsy disorders, where recurrence becomes a matter of major clinical importance.

Aim: To determine the clinical features, recurrence, and the predictive factors for recurrent febrile seizures in children.

Methodology: This is a retrospective observational study involving 120 children aged between 6 months to 5 years who were admitted to Narayan Medical College and Hospital, Sasaram, Bihar within a year. Data regarding demographic, clinical, and seizure-related details, and recurrence was analyzed statistically and logistically.

Results: Simple febrile seizures had a prevalence of 75.8%, while generalized seizures had a prevalence of 90.0%. Recurrence was seen in 30.0%. Age ≤ 24 months, family history of febrile seizures, and fever temperature $< 39^{\circ}\text{C}$ were the independent predictors of recurrence.

Conclusion: Febrile seizures commonly manifested as simple generalized seizures. Age, family history of febrile seizures, and fever temperature were important predictors of recurrence.

Keywords: Febrile seizures; Children; Recurrence; Simple febrile seizure; Risk factors; Paediatrics.

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Introduction

Febrile convulsions are amongst the commonest seizure conditions seen in childhood and are an important cause of referral for pediatric emergencies [1]. They usually occur in children between six months and five years old in association with fever without central nervous system infection, acute metabolic abnormalities, or any prior history of unprovoked seizure [2]. Despite being short and self-limiting in nature, the unpredictable nature of their onset often creates anxiety amongst parents [3]. There is a wide variation in clinical presentation with regard to the age of onset, the nature of seizure, duration, occurrence within the same episode of fever, and the underlying cause of fever [4]. In addition, some of the children suffer from multiple recurrences, thus the significance of identifying factors predicting recurrence [5].

Background of the Study: Febrile seizures are seen in about 2–5% of children globally and are the most common form of seizures seen in childhood [6]. Even though these seizures have been described as harmless and having good prognostic potential, they still cause a lot of concern for parents and often result in visits to the emergency room and admission to the hospital [7]. Studies in the past have found out that factors such as early age at first seizure, family

history of febrile seizures, the nature of the seizure, and severity of the fever play an important role in determining the recurrence rate and, in certain instances, neurological outcome [8]. However, the clinical features and recurrence of febrile seizures may be different in various communities because of differences in demographics, genetics, environment, and infections [9]. Thus, study of the clinical features and recurrence of febrile seizures in a tertiary care center is essential in understanding patients who are at risk and for management [10].

Clinical Profile and Recurrence of Febrile Seizures: There are marked differences in the clinical presentation of febrile seizures, including the age of presentation, seizure type, duration, frequency, and the actual cause of fever [11]. The majority of febrile seizures happen in children aged between 6 months and 5 years and are often represented as transient and generalized seizures during a febrile episode. Febrile seizures are usually divided into simple and complex according to their duration, whether they have a focal component, and their occurrence within 24 hours [12]. Simple febrile seizures are characterized by the presence of generalized seizures that last less than 15 minutes, and that occur only one time in 24 hours, while

complex febrile seizures could be prolonged, focal or recurring within 24 hours of the same febrile episode [13]. While the general prognosis of the disorder is good, its recurrence is a clinically significant feature, especially for those children having a first attack at younger age [14]. There are some risk factors for the recurrence of febrile seizures including a family history of the disease, younger age of onset, lower body temperature at the moment of the attack, among others [15].

Research Objectives

The objectives of the study are:

- To assess the demographic and clinical characteristics of children presenting with febrile seizures during the study period.
- To evaluate the seizure characteristics and clinical patterns of febrile seizures, including seizure type, duration, semiology, and frequency of episodes.
- To determine the frequency of recurrence of febrile seizures among the study participants.
- To identify the demographic and clinical factors associated with recurrence of febrile seizures and determine the independent predictors of recurrence.

Methodology

This research study was carried out to analyze the clinical presentation, demographics, seizure history, causative factors, and recurrence of febrile convulsions in children visiting the hospital. Since the study was retrospective in design, relevant clinical information was collected from the existing records of the hospital for the one-year study period. The following is a description of how this was done.

Study Design: The study is a retrospective observational study. Charts of pediatric patients that were identified to have been diagnosed with febrile seizures within the study period were analyzed. No manipulation of any kind was performed on the patients during the course of the study.

Study Area

The study was carried out in the Department of Pediatrics at Narayan Medical College and Hospital, Sasaram, Bihar, India.

Study Duration: The study was conducted for a duration of one year from January 2023 to December 2023.

Study Participants: The subjects in this study were made up of children ranging from 6 months to 5 years old who had previously experienced febrile seizures during the course of the study. Febrile seizure was defined as the occurrence of a seizure related to fever in a child within this age range and having no history of infection of the central nervous system, metabolic problem, or afebrile seizures.

Inclusion and Exclusion Criteria

Inclusion Criteria

The inclusion criteria for children were:

1. Age group between 6 months to 5 years.
2. Had experienced seizure along with fever.
3. There was a recorded clinical diagnosis of febrile seizure.
4. Sufficient documentation was there in medical history concerning demographics, fever, seizure features, clinical examination, and investigations.
5. Data related to past attacks or reoccurrence of febrile seizures.

Exclusion Criteria

Children were ineligible for participation if they:

1. Had clinical or laboratory evidence or a known diagnosis of meningitis, encephalitis, or any other central nervous system infection.
2. Had prior history of afebrile seizures or epilepsy.
3. Had seizures that were due to metabolic disorders including hypoglycemia or electrolyte imbalances.
4. Had a pre-existing neurological condition that would cause them to be more susceptible to seizures.
5. Had seizures after a head injury or had any other acute neurological cause.
6. Did not have adequate or complete medical records which allowed assessment of main variables of the study.

Sample Size: Since the study involved the retrospective record-based approach, the total enumeration technique was utilized for sampling. All the pediatric patients meeting the inclusion criteria during the one-year duration of the study were considered. After the exclusion of those records which failed to meet the criteria or did not have proper documentation, 120 records of eligible children comprised the sample for the study. Consequently, no sample size calculation was done prospectively.

Procedure: Medical records of children with fever-associated seizures during the period of the study were accessed from the pediatric inpatient, outpatient and emergency department records after obtaining institutional permission. Medical records identified were then screened based on pre-set inclusion/exclusion criteria.

Data were collected from the identified records based on a structured data collection form. Variables of interest collected included: Age, sex, place of residence, presence of family history of febrile seizures, history of previous febrile seizures, age at first attack, duration and degree of fever, likely

cause of fever, type of seizure, seizure duration, number of seizures in the same febrile illness, and clinical findings.

Simple and complex febrile seizures were determined based on the clinical features reported in the medical records. Simple febrile seizures were defined as generalized seizures that occurred for less than 15 minutes without recurrence within 24 hours. A complex febrile seizure was documented if there was presence of one or more of the following features: Focal onset, duration of seizure of 15 minutes or more, or recurrent within 24 hours.

Clinical findings from diagnostic investigations such as complete blood count, blood glucose, serum electrolytes, urinalysis, cerebrospinal fluid analysis, neuroimaging, and electroencephalography, when available, were documented when done in clinically indicated cases. Diagnostic investigations were not considered to be carried out routinely in all patients and were only analyzed if present in the medical records.

Factors that could influence recurrence of febrile seizure such as younger age at first attack, family history of febrile seizures, type and duration of febrile seizures, fever associated with the seizure, and number of previous febrile seizures, were documented from available data on recurrence of febrile seizures in the patient medical records. Patient identifiers were excluded from the dataset used for analysis.

Statistical Analysis: Collected data were stored on a computerized database for analysis using IBM SPSS Statistics. The categorical data were presented

using frequencies and percentages while the continuous data were presented using means and standard deviations or medians and interquartile ranges based on the data distribution.

Clinical and demographic features of children with and without recurrence were compared. Chi-square or Fisher's exact test was conducted to determine the association between categorical data and recurrence. Independent samples t-test was conducted to determine the relationship between continuous data and recurrence when they were normally distributed while Mann-Whitney U test was conducted for those that had a non-normal distribution. Variables that had clinical significance or statistical significance with respect to recurrence were included in a binary logistic regression analysis to determine the predictors of recurrent febrile seizure. Associations between the variables and the outcome were measured using odds ratio (OR) with 95% confidence intervals (CI). All statistical tests were two-tailed, and p-values of <0.05 were considered statistically significant.

Results

Over the one-year duration of this study, the medical history of children who came with febrile seizures was evaluated based on the set inclusion criteria. Following the elimination of those records that had incomplete data or satisfied the set exclusion criteria, a total of 120 children were included for analysis in this study. The results were then analyzed based on various parameters including demographic data, clinical presentation, type of seizure, possible cause of fever, investigations, and recurrent febrile seizures.

Table 1: Demographic characteristics of the study participants (N = 120)

Characteristics	Frequency (n)	Percentage (%)
Age group		
6–12 months	24	20.0
13–24 months	42	35.0
25–36 months	27	22.5
37–48 months	16	13.3
49–60 months	11	9.2
Sex		
Male	72	60.0
Female	48	40.0
Residence		
Rural	68	56.7
Urban	52	43.3

The majority of the children were in the age category of 13-24 months (35.0%), while 22.5% were in the category of 25-36 months. The average age of the study group was 25.6±13.4 months. Male children

formed 60% of the study group with a sex ratio of 1.5:1. More than half (56.7%) of the children were from rural settings.

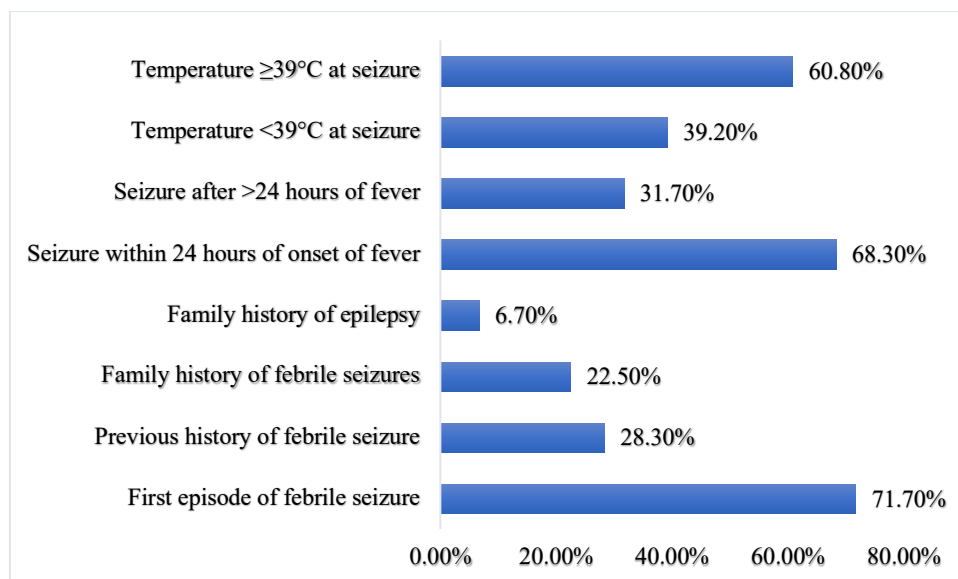


Figure 1: Clinical and historical characteristics of children with febrile seizures

In 71.7% of the children, there was a first occurrence of febrile seizures, whereas 28.3% had a past history of febrile seizures. There was a history of febrile

seizures in the family in 22.5% of the patients. Seizures were noted in most children (68.3%) within the first 24 hours of fever.

Table 2: Seizure characteristics among the study participants

Seizure characteristic	Frequency (n)	Percentage (%)
Type of febrile seizure		
Simple febrile seizure	91	75.8
Complex febrile seizure	29	24.2
Seizure semiology		
Generalized	108	90.0
Focal	12	10.0
Duration of seizure		
< 5 minutes	65	54.2
5–14 minutes	39	32.5
≥ 15 minutes	16	13.3
Number of seizures within 24 hours		
Single episode	101	84.2
Two or more episodes	19	15.8

Simple febrile seizures constituted the most common type of seizure encountered among these children, accounting for 75.8% of patients. Generalized seizures were recorded in 90.0% of patients. Over 50% (54.2%) of all the seizures had

durations of less than 5 minutes, while 13.3% of children suffered from seizures which were prolonged up to 15 minutes or more. Recurrent seizures on the same day accounted for 15.8% of patients.

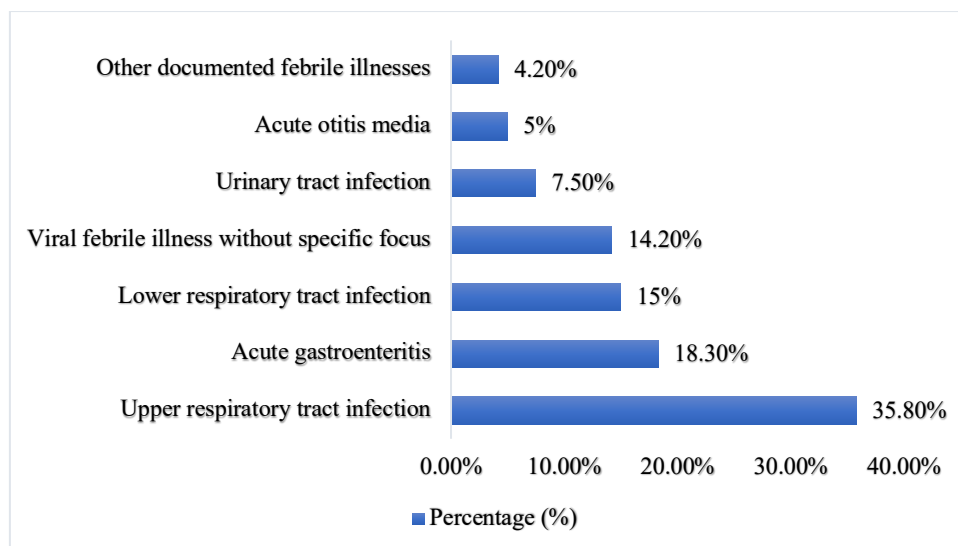


Figure 2: Probable causes of fever among children with febrile seizures

The most common probable cause of fever was upper respiratory tract infection, representing 35.8% of all cases. Acute gastroenteritis and lower

respiratory tract infection followed, which contributed to 18.3% and 15.0% of fever cases, respectively.

Table 3: Laboratory and diagnostic investigations documented among study participants

Investigation	Patients investigated, n (%)	Abnormal findings, n (%)
Complete blood count	112 (93.3)	41 (36.6)
Blood glucose	108 (90.0)	7 (6.5)
Serum electrolytes	76 (63.3)	11 (14.5)
Urine examination	53 (44.2)	9 (17.0)
Cerebrospinal fluid examination	18 (15.0)	0 (0.0)
Electroencephalography	14 (11.7)	3 (21.4)
Neuroimaging	11 (9.2)	2 (18.2)

Percentages for abnormal findings were calculated among children who underwent the respective investigation.

The investigations which were most commonly mentioned include CBC and blood glucose levels. The cerebrospinal fluid analysis was done in 18

children where there was suspicion of central nervous system infection, and there were no abnormalities in them related to either meningitis or encephalitis. EEG and neuroimaging were done selectively.

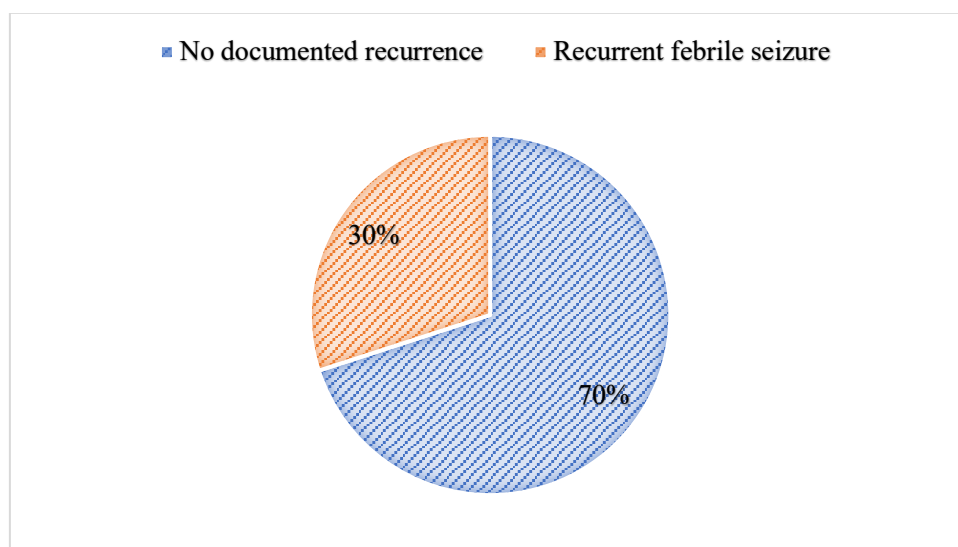


Figure 3: Recurrence of febrile seizures among the study participants

Recurrence of febrile seizures was documented in 36 children (30.0%), whereas 84 children (70.0%) had

no documented recurrence during the period covered by the available medical records.

Table 4: Association of demographic and clinical factors with recurrence of febrile seizures

Factor	Recurrence (n = 36) n (%)	No recurrence (n = 84) n (%)	p-value
Age ≤ 24 months	27 (75.0)	39 (46.4)	0.004
Male sex	23 (63.9)	49 (58.3)	0.570
Rural residence	22 (61.1)	46 (54.8)	0.520
Family history of febrile seizures	14 (38.9)	13 (15.5)	0.005
Complex febrile seizure	13 (36.1)	16 (19.0)	0.043
Seizure duration ≥ 15 minutes	8 (22.2)	8 (9.5)	0.061
Temperature $< 39^\circ\text{C}$ at seizure	20 (55.6)	27 (32.1)	0.016
Seizure within 24 hours of fever onset	29 (80.6)	53 (63.1)	0.060

There were statistically significant differences between patients with recurrent episodes belonging to ages ≤ 24 months ($p = 0.004$), having positive family history for fever convulsion ($p = 0.005$), complex fever convulsion ($p = 0.043$) and having

convulsions at a temperature less than 39°C ($p = 0.016$). The variables such as sex and place of living were not found to have significant association with recurrence.

Table 5: Binary logistic regression analysis of predictors of recurrent febrile seizures

Predictor	Adjusted OR	95% CI	p-value
Age ≤ 24 months	2.84	1.20–6.72	0.017
Family history of febrile seizures	2.97	1.18–7.47	0.021
Complex febrile seizure	2.08	0.86–5.04	0.104
Temperature $< 39^\circ\text{C}$ at seizure	2.31	1.01–5.30	0.048

OR: Odds ratio; CI: Confidence interval.

According to the results of multivariable logistic regression analysis, age ≤ 24 months was significantly related to increased 2.8-fold likelihood of recurrence (OR = 2.84; 95% CI: 1.20–6.72; $p = 0.017$). Family history of febrile seizures was another significant predictor of recurrence (OR = 2.97; 95% CI: 1.18–7.47; $p = 0.021$). The occurrence of seizure at body temperature $< 39^\circ\text{C}$ was also significantly associated with recurrence (OR = 2.31; 95% CI: 1.01–5.30; $p = 0.048$). Although the recurrence rate was higher among the cases with complex febrile seizures, but the association was no longer statistically significant after adjusting for other factors ($p = 0.104$).

Overall, simple, generalized, and short-lasting febrile seizures formed the predominant clinical presentation of the condition in the study sample. Recurrence was found in about one-third of cases. Younger age, family history of febrile seizures, and occurrence of seizure at relatively lower body temperature were the most important independent risk factors for recurrent febrile seizures.

Discussion

The current study found febrile seizures to be highly prevalent in younger children, with those aged 13–24 months and male predominance of 60.0%, simple febrile seizures (75.8%) being more common than complex febrile seizures (24.2%), with generalized seizures accounting for 90.0% of cases. These results were similar to findings by Shrestha et al.

(2014) [16], who found the prevalence of febrile seizures with male predominance and prevalence of simple febrile seizures. Graves et al. (2012) [17] also found simple, generalized febrile seizures to be the most common clinical presentation.

Febrile seizures had a recurrence rate of 30.0%, which was statistically related to age of ≤ 24 months, positive family history, complex febrile seizures, and presence of febrile seizures at a temperature less than 39°C . These results were similar to those found by Jeong et al. (2014) [18], where clinical and familial factors influencing recurrent febrile seizures were investigated. The significance of clinical and familial factors in febrile seizures prognosis was also shown by Wo et al. (2013) [19].

After the multivariable analysis, age ≤ 24 months, positive family history and temperature below 39°C were shown to be independent predictors of recurrence. However, complex febrile seizures lost its statistical significance. Finally, the selective use of EEG in the present study was similar to the study conducted by Harini et al. (2015) [20], where the utility of EEG was studied in complex febrile seizures. Thus, the results provided the confirmation of the previous research on the factors influencing recurrent febrile seizures.

Conclusion

The present research found out that febrile seizures were more prevalent among young children especially those aged less than two years with male

predominance. The most frequent type of febrile seizure was the simple, generalized, and short duration types of seizure. The recurrence rate was 30.0% in children. Thus, a high percentage of children had recurrent febrile seizures. Children aged less than 24 months, history of febrile seizures among family members, and occurrence of seizure at temperatures lower than 39°C were independent predictors of recurrence of febrile seizures. While complex febrile seizures were related to recurrence of febrile seizures in the initial analysis, this association lost its statistical significance after adjustments. The results of the present study showed the necessity of taking into consideration the recurrence of febrile seizures and related factors which should be considered during the clinical assessment of patients.

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