

**An etiological Analysis of Seizure Associated with Fever in Children Aged 2 - 12 Years Admitted to a Tertiary Care Hospital - A Cross - Sectional Study**

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Abstract

Background: Seizure associated with fever is one of the most common paediatric neurological presentations, with causes ranging from benign typical febrile seizure to life-threatening central nervous system (CNS) infections such as bacterial meningitis and encephalitis. A etiological patterns vary considerably by region, and dedicated data from this part of eastern India are scarce.

Objective: To study an etiological distribution, clinical progression, and outcome of fever with convulsion in children aged 2–12 years admitted to a tertiary care hospital.

Methods: This hospital-based cross-sectional observational study was conducted in the Department of Paediatrics, MGM Medical College, Kishanganj, Bihar,

over two years (15 December 2020 to September 2022). One hundred and twenty children aged 2–12 years admitted with fever and convulsion were enrolled after excluding those with structural space-occupying lesions, systemic causes of seizure (e.g., hypertensive encephalopathy), and seizure-mimicking disorders. Demographic, clinical, and investigational data were recorded on a pre-structured proforma and analysed using SPSS version 20, with the chi-square test used to compare categorical variables (significance at $p < 0.05$).

Results: The cohort had a near-equal split between children under 5 years (45.0%) and those aged 5–10 years (49.2%), with a male preponderance (64.2%) and rural predominance (69.2%). Typical febrile seizure was the leading a etiology (50.8%), followed by acute

encephalitic syndrome (20.0%), atypical febrile seizure (10.8%), acute bacterial meningitis (10.0%), acute gastro enteritis with dyselectrolytemia (5.8%), tubercular meningitis (1.7%), and neuro cysticercosis (0.8%). Fever and convulsion resolved in the great majority of children by day 7 (93.3% and 96.7%, respectively), and all patients were a febrile, convulsion - free, and neuro logically normal at discharge. Electroencephalography was abnormal in 37.5% of children and neuro imaging in 8.4%. Clinical parameters improved significantly across the hospital stay ($p < 0.0001$ for most).

Conclusion: Typical febrile seizure remains the single most common cause of fever with convulsion in children aged 2–12 years in this region, but a substantial minority present with acute encephalitic syndrome or bacterial meningitis, underscoring the need for careful clinical evaluation to identify children at risk of serious CNS infection.

Keywords: Febrile Seizure, Fever with Convulsion, Acute Encephalitic Syndrome, Bacterial Meningitis, Children, An Etiology

Introduction

Seizure associated with fever is among the commonest paediatric neurological presentations, spanning a spectrum from benign typical febrile seizure to life-threatening central nervous system (CNS) infection such as bacterial meningitis and encephalitis.¹ Febrile seizure (FS) is defined as a seizure occurring in infancy or childhood with a temperature $\geq 38^{\circ}\text{C}$, in the absence of CNS infection, acute metabolic derangement, or a prior a febrile seizure, and is classified as simple or complex depending on duration, focality, and recurrence within 24 hours.^{2,3} The probability of acute bacterial meningitis in a child presenting with fever and seizure has been reported to range from under 1% to 6–7%.^{4,5}

In India, acute encephalitic syndrome — including litchi - associated encephalopathy first described in Muzaffarpur, Bihar — and viral encephalitis remain important and potentially preventable causes of fever with seizure and altered sensorium in children, and the lack of uniform diagnostic and management guidelines continues to constrain care in resource-limited settings.^{6,7} Regional and international series have reported markedly different a etiological distributions for fever with seizure, ranging from predominantly benign febrile seizure to a substantial burden of CNS infection and neuro cysticercosis, depending on the population studied.⁸⁻¹⁵

Most published series have focused on children under 5 years of age, and dedicated an etiological data for children aged 2–12 years from this part of Bihar are lacking. This study was therefore undertaken to determine an etiology, clinical progression, and outcome of fever with convulsion in children aged 2–12 years admitted to a tertiary care hospital in this region.

Materials and Methods

Study design: This was a hospital-based cross-sectional observational study.

- **Setting:** The study was conducted among children admitted to the Department of Paediatrics, MGM Medical College, Kishanganj, Bihar, India.
- **Study period:** The study was carried out over a two-year period, from 15 December 2020 to September 2022.
- **Study population:** Children aged 2–12 years admitted with fever and convulsion to MGM Medical College formed the study population.
- **Sample size:** The sample size was calculated using the formula $N = Z^2p(1-p)/e^2$, based on a reference prevalence of 8.4% for febrile seizure reported in tertiary care hospitals by Assogba et al.⁸ and Shrestha et al.¹⁵

With $Z = 1.96$ (95% confidence level) and an allowable error (e) of 5%, the minimum calculated sample size was $N = (3.8416 \times 0.084 \times 0.916) / (0.05)^2 \approx 118$. A total of 120 children fulfilling the inclusion criteria were finally recruited.

- Inclusion criteria: Paediatric patients aged 2–12 years with a history of seizure and fever.
- Exclusion criteria: (1) Diagnosed structural space-occupying lesion of the brain; (2) systemic illness giving rise to seizures, e.g., hypertensive encephalopathy; (3) seizure-mimicking disorders such as breath-holding spells, migraine, syncope, and panic attacks.
- Ethical considerations: Approval was obtained from the institutional hospital ethics committee, and written informed consent was obtained from parents/guardians of all participants prior to enrolment.
- Study procedure: Data were collected by clinical examination of the enrolled children using a pre-structured proforma capturing age, sex, demographic profile, presenting history, and clinical progression, along with relevant investigations including complete blood count, blood glucose, serum electrolytes, calcium, phosphate, magnesium, blood urea nitrogen, cerebrospinal fluid (CSF) analysis, electro encephalography (EEG), and neuro imaging.
- Statistical analysis: Data were analysed using SPSS software (IBM Corporation), version 20. Continuous

variables were summarised as mean and standard deviation, and categorical variables as number and percentage. The independent t-test and chi-square test were used to compare continuous and categorical variables, respectively, between groups, and multiple logistic regression was used to calculate odds ratios adjusted for confounding factors. A p-value < 0.05 was considered statistically significant and <0.01 highly significant.

Results

A total of 120 children aged 2–12 years admitted with fever and convulsion were enrolled, exceeding the minimum calculated sample size of 118. Categorical variables are presented as frequency and percentage; the chi-square test was used for comparisons, with significance set at $p < 0.05$.

Demographic characteristics

The 5–10-year age group was the largest (49.2%), closely followed by children under 5 years (45.0%), with only 5.8% aged over 10 years. Males predominated (64.2% vs. 35.8% females), most children were from rural areas (69.2%), and 70.8% were fully immunised for age (Table 1). A past history of seizure was present in 15.8% of children and a history of contact with a similar illness in 1.7%.

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

Characteristic	Category	n	%
Age group (years)	<5	54	45.0
	5 to 10	59	49.2
	>10	7	5.8
Sex	Female	43	35.8
	Male	77	64.2

Residence	Rural	83	69.2
	Urban	37	30.8
Immunization status	Immunized	85	70.8
	Non-immunized	35	29.2

A etiological distribution

Typical febrile seizure was the leading diagnosis, accounting for just over half of all cases (50.8%), followed by acute encephalitic syndrome (20.0%), atypical febrile seizure (10.8%), acute bacterial meningitis (10.0%), acute gastroenteritis with dyselectrolytemia (5.8%), tubercular meningitis (1.7%), and neuro cysticercosis (0.8%) (Table 2).

Table 2: A etiological distribution of fever with convulsion (N = 120)

A etiology	n	%
Typical febrile seizure	61	50.8
Acute encephalitic syndrome	24	20.0
Atypical febrile seizure	13	10.8
Acute bacterial meningitis	12	10.0
Acute gastroenteritis with dyselectrolytemia	7	5.8
Tubercular meningitis	2	1.7
Neuro cysticercosis	1	0.8
Total	120	100.0

Presenting symptoms

Loss of consciousness was the most frequent presenting symptom (38.3%), followed by vomiting (25.8%), headache (11.7%), limb weakness (10.8%), and difficulty swallowing (4.2%); photophobia was not observed in any child (Table 3).

Table 3: Presenting symptoms among study participants (N = 120).

Symptom	Present, n (%)
Loss of consciousness	46 (38.3)
Vomiting	31 (25.8)
Headache	14 (11.7)
Limb weakness	13 (10.8)
Difficulty swallowing	5 (4.2)
Photophobia	0 (0.0)

Clinical progression during hospital stay

All children had fever, convulsion, and altered sensorium at admission. Fever resolved in 93.3% of children by day 7 and in all children by discharge; convulsion resolved in 96.7% by day 7 and in all children by discharge. Meningeal signs, abnormal speech, increased reflexes, tone or power abnormalities, and features of raised intracranial tension (ICT) all declined progressively and were absent in all children at discharge, with the exception of focal neurological signs, which did not change significantly over time (Table 4). Improvement across the hospital stay was statistically

significant for all parameters except focal neurological sign.

Table 4: Progression of key clinical parameters from admission to discharge (N = 120).

Parameter	Abnormal at Day 1, n (%)	Abnormal at Day 7, n (%)	Abnormal at Discharge, n (%)	χ^2	p-value
Fever	120 (100.0)	8 (6.7)	0 (0.0)	323.82	<0.0001
Convulsion	120 (100.0)	4 (3.3)	0 (0.0)	345.37	<0.0001
Altered sensorium	118 (98.3)	19 (15.8)*	0 (0.0)	346.89	<0.0001
Meningeal sign	24 (20.0)	11 (9.2)	0 (0.0)	28.62	<0.0001
Abnormal speech	51 (42.5)	24 (20.0)	0 (0.0)	72.17	<0.0001
Increased reflexes	21 (17.5)	13 (10.8)	0 (0.0)	23.45	<0.0001
Abnormal tone (upper limb)	16 (13.3)	3 (2.5)	0 (0.0)	60.13	<0.0001
Decreased power (upper limb)	15 (12.5)	3 (2.5)	0 (0.0)	44.89	<0.0001
Focal neurological sign	2 (1.7)	1 (0.8)	0 (0.0)	2.22	0.527
Feature of raised ICT	8 (6.7)	1 (0.8)	0 (0.0)	12.93	0.0048

*Sum of confused, irritable, and lethargic categories at day 7 (normal sensorium in 84.2%). Tone and power are reported for the upper limb (lower-limb values were closely similar). ICT = intracranial tension.

Laboratory, CSF, EEG, and neuro imaging findings

Total leucocyte count was raised in 37.5% of children, and serum calcium, potassium, and sodium were reduced in 10.0%, 3.3%, and 1.7%, respectively. CSF analysis showed a cloudy appearance in 2.5%, a polymorph

onuclear predominance in 11.7%, and a raised cell count in 27.5%; Gram stain and culture were negative in all children. Electroencephalography was abnormal in 37.5% (generalized tonic-clonic pattern in 35.8%, focal in 1.7%), and MRI brain was abnormal in 8.4%, most often showing basal ganglia or temporal lobe T1/T2 signal change; one child had imaging features suggestive of neuro cysticercosis (Table 5).

Table 5: Laboratory, CSF, EEG, and neuro imaging findings (N = 120)

Investigation	Abnormal finding	n	%
Total leucocyte count	Increased	45	37.5
Serum calcium	Decreased	12	10.0
Serum potassium	Decreased	4	3.3
Serum sodium	Decreased	2	1.7
CSF cell count	Increased	33	27.5
CSF cell type	Polymorphs	14	11.7
CSF appearance	Cloudy	3	2.5
EEG	GTCS / focal pattern	45	37.5
MRI brain	Abnormal (any)	10	8.4

Discussion

In this cross-sectional study of 120 children aged 2–12 years admitted with fever and convulsion, the highest frequency of seizure was seen in the 5–10-year age group (49.2%), closely followed by children under 5 years (45.0%). This differs somewhat from Shetty et al.,¹⁰ who reported the highest incidence in children aged 1–3 years (43.0%), and from Singh and Suryavanshi,¹³ who found the highest frequency in the 6-month–5-year group (50.0%); such differences likely reflect variation in the age ranges studied and in the relative contribution of febrile seizure versus other etiologies across cohorts. A male preponderance was observed in this study (64.2% vs. 35.8%), consistent with Shetty et al.,¹⁰ Chaudhary et al.,¹¹ Singh and Suryavanshi,¹³ and Shrestha et al.,¹⁵ all of whom reported higher rates of seizure or febrile seizure in boys than girls.

Typical febrile seizure was the leading a etiology in this cohort (50.8%), followed by acute encephalitic syndrome (20.0%), atypical febrile seizure (10.8%), and acute bacterial meningitis (10.0%). This pattern broadly mirrors Shetty et al.,¹⁰ who reported febrile seizure as the leading cause (45.71%) followed by atypical febrile seizure (22.86%). Singh and Suryavanshi¹³ similarly found CNS infection contributing to 31.0% of cases overall, with viral infection, pyogenic meningitis, and tuberculous meningitis the leading infective causes, while Shrestha et al.¹⁵ reported simple febrile seizure in the large majority (77.4%) of their cohort, most often triggered by upper respiratory tract infection. Together with the present findings, this reinforces that although typical febrile seizure remains the dominant aetiology of fever with convulsion in this age group, a clinically important minority — approximately one in five children in this cohort — present with acute encephalitic

syndrome or bacterial/tubercular meningitis, conditions that require prompt recognition and targeted treatment.

Clinical parameters, including fever, convulsion, sensorium, meningeal signs, speech, reflexes, tone, power, and features of raised intracranial tension, improved significantly over the course of admission, and all children were a febrile, convulsion-free, and neurologically normal at discharge.

This near-universal recovery is reassuring but does not diminish the need for vigilant assessment at presentation - including examination for meningeal signs, altered sensorium, and focal neurological deficits in every child presenting with fever and convulsion, given that a substantial minority in this cohort required cerebrospinal fluid analysis and targeted therapy for CNS infection.

Conclusion

Among 120 children, aged 2–12 years admitted with fever and convulsion to this tertiary care hospital, typical febrile seizure was the most common a etiology, accounting for just over half of all cases. The majority of children recovered completely by discharge, with only a small proportion showing residual neurological findings. Clinical presentations consistent with acute encephalitic syndrome or meningitis were seen in a clinically significant minority and require detailed investigation and appropriate management. Fever with convulsion remains a common presentation in this region, and although typical febrile seizure predominates, the substantial burden of potentially serious CNS infection warrants continued clinical vigilance.

Limitations

This study has several limitations. It was conducted at a single centre, which may limit the generalisability of the findings. The long-term prognosis of children diagnosed with acute encephalitic syndrome was not determined,

and long-term follow-up of the cohort could not be performed.

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