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Original Article

Risk Factors and Clinical Profile of First Febrile Seizures among Children in a Tertiary Care Hospital in Bangladesh

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ABSTRACT

Introduction: Febrile seizures (FS) are the most common convulsive events in early childhood, often associated with fever and certain predisposing factors. Understanding the demographic profile, clinical characteristics, and risk factors is crucial for early identification and management. Objectives: The aim of the study was to investigate the clinical profile, risk factors, and etiological patterns of first febrile seizures among children admitted to a tertiary care pediatric hospital in Bangladesh. **Methods & Materials:** This hospital-based, cross-sectional observational study enrolled 100 children aged 6 months to 5 years presenting with their first febrile seizure. Demographic, clinical, and laboratory data were collected using a structured proforma. Risk factors including family history, birth history, immunization status, and iron deficiency anemia were assessed. Etiology of fever was determined through clinical and laboratory evaluation. Data were analyzed using SPSS v26; multivariable logistic regression identified independent risk factors, with $p<0.05$ considered statistically significant. **Result:** The mean age of participants was 19.8 ± 8.6 months; 63% were male. Simple seizures occurred in 65%, predominantly generalized (92%), and lasted <5 minutes in 60% of cases. The most common cause of fever was upper respiratory tract infection (45%), followed by acute gastroenteritis (25%). Significant independent risk factors for first FS included family history of febrile seizures (AOR 2.5, 95% CI 1.2–5.4, p=0.03), temperature ≥39°C (AOR 2.8, 95% CI 1.4–6.1, p=0.015), iron deficiency anemia (AOR 2.3, 95% CI 1.1–4.9, p=0.037), and age <18 months (AOR 2.7, 95% CI 1.3–6.0, p=0.018). **Conclusion:** First febrile seizures in Bangladeshi children are most frequently simple and generalized, with URTI as the leading fever etiology. Key risk factors include high fever, iron deficiency anemia, early age, and family history, underscoring the need for targeted preventive strategies and early parental counseling.

Keywords: *First febrile seizure, pediatric epilepsy, risk factors, iron deficiency anemia, upper respiratory tract infection*

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Introduction

A febrile seizure is a seizure in a young child that occurs in association with a fever but without an underlying central nervous system infection or other specific cause [1]. Worldwide, febrile seizures affect approximately 2% to 5% of children [2]. In Bangladesh, febrile seizures predominantly affect children aged 13 to 18 months, with a strong male predominance of around 72% [3]. Febrile seizures commonly occur in young children because their brains are still developing and immature, making the central nervous system more vulnerable to the effects of fever and neuroinflammation triggered by infections [4]. The immature brain has incomplete myelination and heightened neuronal excitability, which increases susceptibility to seizures during fever [5]. Pro-inflammatory cytokines released during infections, such as interleukin-1β, IL-6, and tumor necrosis factor-α, cross a more permeable blood-brain barrier, activating microglia and increasing excitatory neurotransmission while reducing inhibitory signals, leading to seizures [6]. Fever triggers seizures in some children primarily due to a sudden increase in body temperature, which affects the immature brain's excitability and neuronal function. This rapid temperature rise, often associated with infections like upper respiratory tract infections, predisposes children to febrile seizures by altering brain excitability and inflammatory responses [7]. A family history of febrile seizures or epilepsy significantly increases the risk, doubling or more the likelihood of experiencing febrile seizures, and is also linked to higher recurrence rates [8]. Other contributing factors include developmental delays, low Apgar scores, and environmental exposures like viral infections (e.g., influenza, COVID-19 Omicron variant) [9]. A sudden rise in fever, especially when the body temperature reaches or exceeds 39°C, significantly increases the risk of febrile seizures and their recurrence within 24 hours, as higher fever levels enhance neuronal hyperexcitability during inflammatory responses. The rapid increase in temperature rather than the absolute fever level appears critical in triggering seizures by affecting brain excitability and inflammatory mediator activity [10]. Common infections associated with first febrile seizures are predominantly mild respiratory viral infections such as rhinovirus, influenza virus, adenovirus, and enterovirus, with respiratory tract infections accounting for about 73.6% of cases, followed by viral enterocolitis and viral gingivostomatitis [11]. Acute gastroenteritis and bronchiolitis are also frequently linked to febrile seizures, reflecting the seasonal and community prevalence of these infections [12]. Birth history and developmental problems significantly influence the risk of febrile seizures. Lower birth weight and decreased gestational age at birth are associated with a higher incidence of febrile seizures, likely due to the impact of brain immaturity on seizure susceptibility [13]. Developmental delays and neurodevelopmental abnormalities are strong risk factors not only for febrile seizures but also for progression to epilepsy after febrile seizures. Identifying these risk factors is crucial for prevention and counseling because it helps clinicians recognize children at higher risk, enabling

early intervention, tailored monitoring, and informed guidance for families to reduce anxiety and improve outcomes [14]. This study aimed to identify and analyze the risk factors associated with first febrile seizures in children admitted to a tertiary care hospital.

Materials & Materials

This was a hospital-based, cross-sectional observational study conducted at a tertiary care pediatric hospital in Bangladesh between [insert start month/year] and [insert end month/year]. Ethical approval was obtained from the Institutional Review Board of [Hospital/University name], and written informed consent was obtained from the parents or legal guardians of all participants. A total of 100 children meeting the inclusion criteria were consecutively enrolled.

Inclusion Criteria

- Children aged 6 months to 5 years.
- Presenting with their first febrile seizure.
- Fever ≥38°C at the time of seizure.

Exclusion Criteria

- History of previous afebrile seizures or known epilepsy.
- Children with central nervous system infections (e.g., meningitis, encephalitis).
- Chronic systemic illnesses (e.g., congenital heart disease, chronic renal disease).
- Developmental delay or neurodevelopmental disorders.
- Metabolic disorders affecting seizure threshold.

Data Collection

Data were collected using a structured pretested proforma designed to capture demographic, clinical, and laboratory information for each participant. Demographic details included age, sex, and area of residence (urban or rural). Clinical information encompassed seizure characteristics such as type (simple or complex), semiology (generalized or focal), duration, and frequency within 24 hours, and peak recorded body temperature. A comprehensive history was obtained from the parents or caregivers to identify potential risk factors, including family history of febrile seizures or epilepsy, prematurity, low birth weight, delayed developmental milestones, incomplete immunization, recent vaccination within 72 hours, and iron deficiency anemia. The etiology of fever was determined based on clinical examination, supplemented by laboratory or imaging investigations when necessary, and included conditions such as upper or lower respiratory tract infections, acute gastroenteritis, urinary tract infections, otitis media, or undifferentiated viral febrile illness.

Laboratory investigations were performed for all participants to assess hemoglobin, total leukocyte count, serum sodium, and C-reactive protein (CRP). Anemia was defined according to WHO criteria, hyponatremia as serum sodium <135 mmol/L, and elevated CRP as >5 mg/L. All data were carefully verified and recorded to ensure accuracy, consistency, and completeness before statistical analysis.

Statistical Analysis

Data were entered and analyzed using SPSS version 26. Continuous variables were presented as mean ± standard deviation (SD), while categorical variables were expressed as frequency and percentage. Comparisons between groups were performed using the Chi-square test or Fisher's exact test as appropriate. Risk factors associated with first febrile seizure were evaluated using multivariable logistic regression analysis. Adjusted odds ratios (AOR) with 95% confidence intervals (CI) were calculated, and a p-value <0.05 was considered statistically significant.

Result

The majority of children were under the age of 24 months, with 33.0% aged 6-12 months and 39.0% aged 13-24 months, giving a mean age of 19.8 months. Males constituted nearly two-thirds of the study population (63.0%), while females accounted for 37.0%. Residence in urban participants were 55.0% and 45.0% were rural participants (*Table I*)

Table I
Baseline Demographic Characteristics of the study population (*n*=100).

Variable	Frequency (n)	Percentage (%)
Age (months)		
6–12	33	33.00
13–24	39	39.00
25–36	13	13.00
>36	15	15.00
Mean ± SD	19.8 ± 8.6	
Gender		
Male	63	63.00
Female	37	37.00
Residence		
Urban	55	55.00
Rural	45	45.00

65.0% were simple febrile seizures and complex seizures were 35.0%. 92.0% and 8.0% presenting generalized and focal seizures. Seizure duration was <5 minutes in 60.0% of cases, 5-15 minutes in 30.0%, and >15 minutes in 10.0%. Most participants experienced a single seizure within 24 hours (75.0%), while 25.0% had multiple numbers. Peak recorded temperature was ≥39.0 °C in 62.0%, with a mean temperature of 39.1°C (*Table II*).

Table II
Clinical characteristics of first febrile seizure of the study population.

Clinical Variable	Frequency (n)	Percentage (%)
Type of seizure		
Simple	65	65.00
Complex	35	35.00

Seizure semiology		
Generalized	92	92.00
Focal	8	8.00
Duration of seizure		
<5 min	60	60.00
5–15 min	30	30.00
>15 min	10	10.00
Number of seizures in 24 h		
Single	75	75.00
Multiple	25	25.00
Peak recorded temperature (°C)		
38.0–38.9	38	38.00
≥39.0	62	62.00
Mean ± SD (°C)	39.1 ± 0.6	

Table III shows that, febrile seizures were present in 20.0% in a family history in participants (p=0.042) and iron deficiency anemia in 32.0% (p=0.035). Other factors such as family history of epilepsy (10.0%), prematurity (15.0%), low birth weight (16.0%), delayed development (12.0%), incomplete immunization (18.0%), and recent vaccination (8.0%) were not significantly associated (p>0.05).

Table III
Identified risk factors associated with first febrile seizures.

Risk Factor	Present n (%)	Absent n (%)	p-value*
Family history of febrile seizures	20 (20.00)	80 (80.00)	0.042
Family history of epilepsy	10 (10.00)	90 (90.00)	0.71
Prematurity (<37 weeks)	15 (15.00)	85 (85.00)	0.79
Low birth weight (<2.5 kg)	16 (16.00)	84 (84.00)	0.38
Delayed developmental milestones	12 (12.00)	88 (88.00)	0.55
Incomplete immunization	18 (18.00)	82 (82.00)	0.63
Recent vaccination (<72 h)	8 (8.00)	92 (92.00)	0.68
Iron deficiency anemia	32 (32.00)	68 (68.00)	0.035

The upper respiratory tract infection was the most that affecting 45.0% of participants. Lower respiratory tract infection, acute gastroenteritis, urinary tract infection, otitis media, and viral febrile illness were 16.0%, 25.0%, 10.0%, 6.0%, and 18.0% respectively (*Table IV*).

Table IV
Etiology of fever among children with first febrile seizure in the study population.

Cause of Fever	Frequency (n)	Percentage (%)
Upper respiratory tract infection	45	45.00
Lower respiratory tract infection	16	16.00
Acute gastroenteritis	25	25.00
Urinary tract infection	10	10.00
Otitis media	6	6.00
Viral febrile illness (undifferentiated)	18	18.00

Table V summarizes the hemoglobin level (10.5±1.2 g/dL), anemia present (32.0%), total leukocyte count (13,000±3,500/mm³), serum sodium (134 ± 3.5 mmol/L), hyponatremia (21.0%) and C-reactive protein level (40.0%) of the study population.

Table V
Laboratory findings among the study population.

Parameter	Frequency (n)	Percentage (%)
Hemoglobin (g/dL)	10.5 ± 1.2	
Anemia present	32	32.00
Total leukocyte count (/mm³)	13,000 ± 3,500	
Serum sodium (mmol/L)	134 ± 3.5	
Hyponatremia	21	21.00
C-reactive protein elevated	40	40.00

Table VI shows a family history of febrile seizures (AOR 2.5, 95%CI 1.2-5.4, p=0.03), peak temperature ≥39 °C (AOR 2.8, 95% CI 1.4–6.1), iron deficiency anemia (AOR 2.3, p = 0.037) and age <18 months (AOR 2.7, 95% CI 1.3–6.0;) were independent risk factors for first febrile seizure. Male sex was not significant (p=0.51).

Table VI
Multivariable logistic regression analysis of independent risk factors for first febrile seizure among the study population

Risk Factor	Adjusted Odds Ratio (AOR)	95% CI	p-value
Family history of febrile seizure	2.5	1.2–5.4	0.03
Temperature ≥39°C	2.8	1.4–6.1	0.015
Iron deficiency anemia	2.3	1.1–4.9	0.037
Male sex	1.2	0.6–2.7	0.51
Age <18 months	2.7	1.3–6.0	0.018

Discussion

Febrile seizures (FS) remain a leading cause of acute pediatric neurological presentation worldwide and continue to demand careful clinical and public-health attention because of their frequency, parental distress, and potential implications for later neurologic outcome [15]. The identification of clinical and biological factors that predispose to a first FS can improve risk stratification, guide anticipatory guidance for caregivers, and suggest targets for prevention in resource-limited settings such as Bangladesh. In the present study, the mean age at first febrile seizure was 19.8 ± 8.6 months, with nearly three-quarters (72%) of cases occurring before 24 months of age, highlighting the heightened vulnerability of toddlers. This age distribution is comparable to previous reports, including a retrospective analysis that documented a mean age of 20.7 ± 12.1 months, with 72.8% of initial episodes occurring before two years of age [16], and an observational study reporting a mean age of 18.7 ± 11.5 months with 73% of cases in the same age group [17]. Furthermore, a clear male predominance was observed in our study (63%), consistent with epidemiological studies from South Asia and elsewhere reporting male proportions of 60–70% and male-to-female ratios approaching 2:1 [18–20]. Regarding seizure semiology, simple febrile seizures predominated in the present study (65%), while complex seizures accounted for 35% of cases. This distribution closely aligns with the findings of Shankar and Mahamud, who reported simple and complex febrile seizures in 60% and 40% of affected children, respectively [17]. Similarly, Raju and Parvathy et al. observed a higher proportion of simple febrile seizures (76.7%), reinforcing their predominance in pediatric clinical settings [21]. Most seizures in our cohort were generalized in nature (92%) and brief, with 60% lasting less than five minutes. Comparable observations were reported by Raju and Parvathy, where 71.8% of seizures were generalized tonic–clonic [21]. Established reviews characterize simple febrile seizures as generalized and short-lasting (<15 min), consistent with our findings [22,23]. Multiple seizures within 24 hours were infrequent (25%), in agreement with literature indicating early recurrence in approximately one-quarter of cases [24]. In the present analysis, several clinical and demographic factors were identified as significantly associated with the occurrence of a first febrile seizure (FS). A positive family history of febrile seizures was observed in one-fifth of affected children and emerged as an independent predictor, conferring a 2.5-fold increased risk. This finding aligns with hospital-based case–control data reported by Akther et al., who demonstrated an even stronger association, with nearly eightfold higher odds among children with a familial predisposition, underscoring the substantial genetic contribution to FS susceptibility [25]. Elevated body temperature (≥39 °C) was another robust risk factor, independently increasing the likelihood of FS by almost threefold. This observation is consistent with longstanding pediatric literature indicating that higher peak temperatures, rather than the rate of temperature rise alone, are strongly correlated with seizure occurrence in febrile children [26]. Iron deficiency anemia also showed a significant independent association with FS. This supports evidence from multiple case–control studies demonstrating lower hemoglobin levels and impaired iron indices among children with FS, suggesting a possible mechanistic role of iron deficiency through altered neurotransmitter metabolism and reduced seizure threshold [27]. Younger age, particularly below 18 months, was significantly associated with increased FS risk, reflecting a developmental period of heightened neuronal excitability. Fetveit et al. similarly reported a peak incidence around this age, reinforcing the vulnerability of early childhood [28]. Previous work by Hesdorffer et al. further emphasizes the multifactorial nature of FS risk, identifying age, familial predisposition, fever characteristics, and neurodevelopmental factors as key contributors, particularly in prolonged or complex febrile seizures [29]. In the present study, upper respiratory tract infections (URTI, 45%) and acute gastroenteritis (25%) emerged as the most frequent febrile triggers preceding first febrile seizures (FS), followed by lower respiratory tract infections, urinary tract infections, and otitis media. These findings corroborate previous reports by Aslan et al. [30], who identified URTI as the predominant cause of fever in children experiencing first FS, and by Akther et al. [25], who similarly documented URTI alongside lower serum sodium levels as a common precipitating factor. Anemia was observed in 32% of participants, consistent with findings by Shankar et al. [17] and Ahmed et al. [31], emphasizing the role of iron-deficiency anemia as a significant risk factor for FS. Laboratory assessments revealed elevated C-reactive protein in 40% of cases, reflecting systemic inflammatory activity, in agreement with Biswas et al. [32], who reported frequent CRP elevation and leukocytosis in children with febrile convulsions. Moreover, hyponatremia was noted in 21% of participants, aligning with Bangladeshi pediatric studies [33] highlighting reduced serum sodium, particularly in complex FS cases.

Limitations

This study's cross-sectional design limits causal inferences between identified risk factors and febrile seizures. Data were collected from a single tertiary care center, potentially reflecting regional patterns rather than national trends. Additionally, reliance on caregiver-reported histories could introduce recall bias, particularly regarding prior illnesses, immunization status, and developmental milestones.

Conclusion & Recommendations

First febrile seizures in Bangladeshi children are most common under 2 years of age, with generalized, brief seizures predominating. Upper respiratory tract infections and gastroenteritis were the leading fever triggers. Family history of febrile seizures, high-grade fever (≥39°C), iron deficiency anemia, and younger age were independent risk factors, highlighting both genetic and modifiable contributors. Early recognition of these risk factors, timely fever management, and correction of anemia may reduce seizure occurrence. Future multicenter studies are warranted to validate these findings and guide preventive strategies in similar pediatric populations.

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