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Original Research Article

Patterns of febrile seizures: analysing seasonal, diurnal and socioeconomic correlations in Bangladesh

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ABSTRACT

Background: Febrile seizures (FS) are a common neurological disorder in children, often triggered by fever without evidence of central nervous system infections. This study explores the demographic, seasonal, diurnal and socioeconomic patterns of febrile seizures among children in Bangladesh.
Methods: A cross-sectional study was conducted on 298 children aged 5 months to 5 years admitted with febrile seizures at a tertiary care hospital. Data were collected on demographic characteristics, comorbidities, seizure patterns and socioeconomic status and analyzed using descriptive statistics.
Results: The majority of febrile seizures occurred in children aged 13–18 months (35.57%) with a male predominance (72.48%). Seizures were brief, with 50.34% lasting≤1 minute and most occurred within 6 hours of fever onset (51.01%). Diurnal variation showed the highest incidence between noon and evening (51.68%). A bimodal seasonal distribution was observed, with peaks in January (12.08%) and July (11.07%). Bronchiolitis (37.92%) and diarrhea (27.18%) were the most common comorbidities. Firstborn children (86.58%) and those with normal nutritional status (93.29%) were predominantly affected.
Conclusions: Febrile seizures in the study population showed distinct demographic, temporal and socioeconomic patterns, aligning with global trends. The findings underscore the importance of early fever management, targeted interventions during seasonal peaks and caregiver education to reduce seizure-related morbidity.

Keywords: Bangladesh, Comorbidities, Diurnal variation, Epidemiology, Febrile seizures, Prematurity, Pediatric neurology, Socioeconomic factors, Seasonal variation

INTRODUCTION

Febrile seizures (FS) are the most common neurological disorder in children aged 6 months to 5 years, characterized by convulsions associated with fever in the absence of central nervous system infections or metabolic disturbances. Globally, FS affect 2–5% of children, with significantly higher prevalence in certain regions such as Japan and India, reaching up to 14% in some populations.[1,2] In Bangladesh, FS represent a leading cause of pediatric emergency visits, reflecting the pressing need for comprehensive epidemiological and clinical research in this domain.[3] These episodes, though often benign and self-limiting, are a major source of anxiety for caregivers and can result in mismanagement or overtreatment, particularly in resource-constrained settings.[4] Understanding the unique demographic, seasonal and socioeconomic factors influencing FS in Bangladesh is critical for optimizing prevention and management strategies.

Epidemiological studies have highlighted variations in FS prevalence and incidence based on age, sex and geographic location. Boys are at a slightly higher risk than girls, with an overall male predominance reported across regions, including Bangladesh and South Korea.[5,6] FS predominantly occur in children under 3 years of age, with peak incidence between 12 and 18 months,

coinciding with the period of heightened susceptibility to febrile illnesses due to immature immune systems.[7] Family history and genetic predisposition further amplify FS risk, with children of parents or siblings with FS history exhibiting significantly higher susceptibility.[8]

Additionally, environmental and infectious triggers play a critical role, with respiratory tract infections being the most common underlying cause in Bangladesh.[3,9] Seasonal and diurnal patterns in FS occurrence reflect the role of environmental and physiological factors. Several studies have documented peaks in FS incidence during colder months, attributed to the higher prevalence of respiratory infections like influenza.[9,10]

In Bangladesh, the dual peaks in FS cases during winter and monsoon seasons suggest an interaction between climate, viral epidemics and population health behaviors.[3,11] Diurnally, FS predominantly occur in the late afternoon and evening, aligning with circadian variations in immune response and fever manifestation.[10] Socioeconomic factors, including parental education, income levels and healthcare access, significantly influence FS outcomes. Children from lower-income households or with parents of lower educational attainment have higher FS rates, often due to delayed healthcare access or inadequate fever management practices.[12]

In rural areas of Bangladesh, disparities in healthcare infrastructure exacerbate these risks, limiting timely diagnosis and appropriate interventions.[13] Cultural perceptions, such as attributing FS to spiritual causes, further hinder evidence-based management, as families often rely on traditional remedies before seeking medical care.[14] Despite FS being well-documented globally, significant knowledge gaps persist in low-resource settings like Bangladesh, where demographic, cultural and healthcare system dynamics differ markedly from high-income contexts. Localized studies are essential to address these disparities and provide actionable insights. Prior research has underscored the importance of identifying infection patterns and seasonality, which can guide public health interventions and caregiver education campaigns.[3,9]

Additionally, improving socioeconomic conditions and enhancing healthcare accessibility are pivotal for mitigating FS-related morbidity and caregiver distress.[12,13] This study aims to explore the patterns of febrile seizures in Bangladeshi children, focusing on seasonal, diurnal and socioeconomic correlations.

By investigating these dimensions, this research seeks to bridge existing knowledge gaps and inform tailored public health strategies for effective FS management. The findings are anticipated to contribute to a more nuanced understanding of FS epidemiology, thereby enhancing pediatric healthcare delivery and preventive interventions in Bangladesh.

METHODS

Study type

This was cross-sectional study.

Study place

was conducted in the Department of Pediatrics, Institute of Dr. MR Khan Shishu Hospital and Institute of Child Health, Dhaka, Bangladesh.

Study duration

The study duration from January 2012 to December 2013.

Sample size

The study population comprised of 298 children aged 5 months to 5 years who were admitted with febrile seizures.

Inclusion criteria

Inclusion criteria required participants to have generalized tonic-clonic seizures lasting less than 15 minutes without signs of intracranial infection, a history of afebrile seizures or recurrent seizures within the same febrile episode.

Exclusion criteria

Exclusion criteria included clinical or laboratory evidence of intracranial infection, central nervous system insults or other unrelated neurological conditions.

A sample size of 896 was initially calculated using a 30% assumed increase in febrile seizures during winter months, with a 10% margin of error. However, due to logistical constraints, 298 eligible children were consecutively enrolled during the study period. Data were collected through caregiver interviews and clinical records using a semi-structured questionnaire.

Variables studied included demographic and socioeconomic characteristics, birth history, nutritional status, seizure characteristics and associated illnesses. Socioeconomic status was categorized based on monthly family income into poor (<10,000 BDT), middle class (10,001–20,000 BDT) and solvent (>20,000 BDT).

Ethical approval

Ethical approval was obtained in accordance with the Helsinki Declaration (1964). Parents provided informed verbal consent after being briefed about the study's objectives, procedures and voluntary participation.

Statistical analysis

Data were processed and analyzed using SPSS software (version 15), with descriptive statistics summarized in tables and graphs to present key findings.

RESULTS

The study included 298 children aged 5 months to 5 years, with the majority (35.57%) in the 13–18-month age group, followed by 26.17% in the 19–24-month group. A smaller proportion of participants were under 6 months (3.69%) or over 36 months (6.04%). Regarding gender distribution, males were predominant, accounting for 72.48% of cases, while females constituted 27.52%.

Among the 298 participants, bronchiolitis was the most common comorbidity, affecting 37.92% of the children, followed by diarrhea in 27.18% and urinary tract infections (UTI) in 17.45% of cases. Pneumonia accounted for 12.08% of the comorbid conditions, while other conditions were identified in 5.03% of participants.

The majority of febrile seizures occurred within the first 6 hours of fever onset, accounting for 51.01% of cases. An additional 34.56% of cases were observed within 7–12 hours of fever onset, while fewer cases occurred after 12 hours, with 9.73% between 13–18 hours and 4.70% between 19–24 hours. The median duration of febrile illness was 7.6±1.8 hours.

Among the 298 participants, the majority (85.57%) were born at term, with only 14.43% classified as premature. Regarding birth order, most children (86.58%) were firstborn, followed by 12.42% who were second-born and 1.01% third-born. Nutritional status was predominantly normal, with 93.29% of children falling within the healthy range, while 6.71% were identified as malnourished.

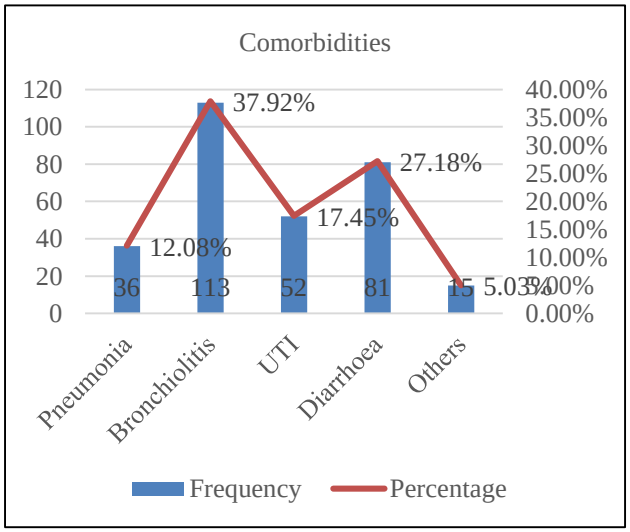

Figure 1: Distribution of participants by comorbidities (n=298).

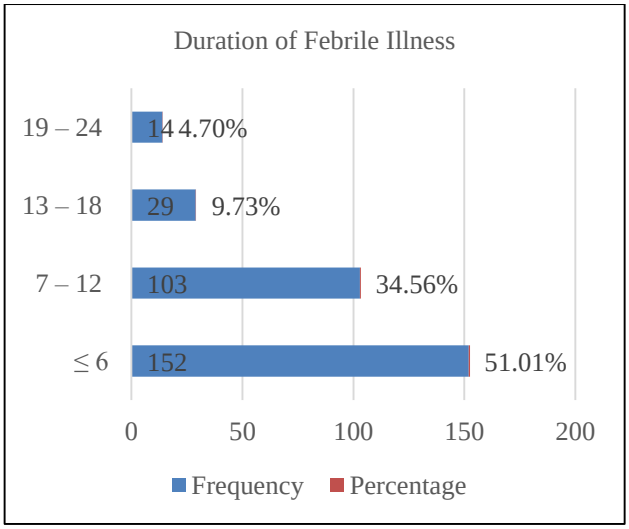

Figure 2: Distribution of participants by duration of febrile illness (n=298).

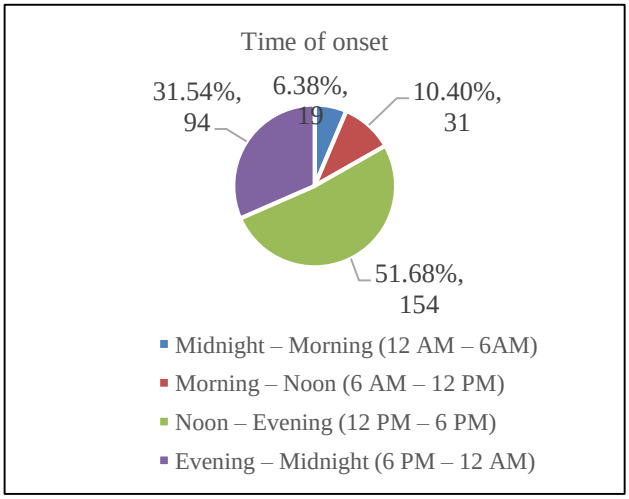

Figure 3: Distribution of diurnal variation in the onset of convulsion (n=298).

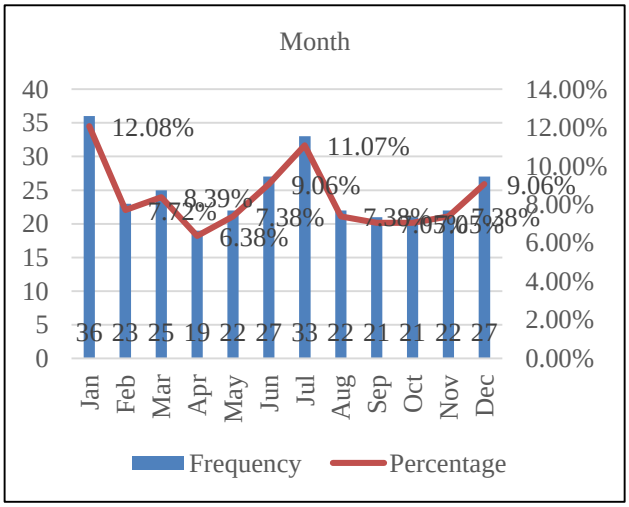

Figure 4: Seasonal variation of febrile convulsion (n=298).

The majority of febrile seizures occurred during the noon to evening period (12 PM–6 PM), accounting for 51.68% of cases, followed by 31.54% during the evening to midnight period (6 PM–12 AM). A smaller proportion occurred during the morning to noon period (6 AM – 12 PM), contributing 10.40% and the least during the midnight to morning period (12 AM–6 AM), with 6.38%.

The majority of febrile seizures were brief, with 50.34% lasting 1 minute or less and 42.95% lasting between 2–4 minutes. Longer convulsions were less common, with 5.70% lasting 5–10 minutes and only 1.01% exceeding 10 minutes. The incidence of febrile seizures demonstrated distinct seasonal patterns, with peaks observed in January (12.08%) and July (11.07%). Secondary peaks were noted in June and December, both accounting for 9.06%. The lowest occurrences were recorded in April (6.38%) and September (7.05%).

Table 1: Distribution of participants by demographic characteristics (n=298).

Variables	Frequency	%
Age (in years)		
<6	11	3.69
7–12	49	16.44
13–18	106	35.57
19–24	78	26.17
25–36	36	12.08
>36	18	6.04
Gender		
Male	216	72.48
Female	82	27.52

Table 2: Distribution of participants by relevant characteristics of the children (n=298).

Characteristics of children	Frequency	%
Prematurity		
Yes	43	14.43
No	255	85.57
Birth order		
1st	258	86.58
2nd	37	12.42
3rd	3	1.01
Nutritional status		
Normal	278	93.29
Malnourished	20	6.71

Table 3: Distribution of convulsion duration among the participants (N=298).

Duration of convulsion (min)	Frequency	%
≤1	150	50.34
2–4	128	42.95
5–10	17	5.70
≥10	3	1.01

DISCUSSION

Febrile seizures are a common neurological event in children, with their occurrence influenced by various demographic, temporal and clinical factors. In the current study, the highest incidence of febrile seizures was observed in children aged 13–18 months (35.57%), followed by the 19–24-month group (26.17%), with younger and older children showing significantly lower frequencies.

These findings are consistent with global observations, which indicate a peak incidence in the second year of life due to increased exposure to infections and the developing immune system.[10]

Male predominance (72.48%) further aligns with previous studies reporting a male-to-female ratio of approximately 1.3:1, which may reflect genetic or hormonal differences influencing seizure susceptibility.[5] A notable finding in this study is the early onset of febrile seizures within the febrile course, with 51.01% occurring within the first 6 hours and an additional 34.56% within 7–12 hours of fever onset. This pattern mirrors findings from prior studies indicating that febrile seizures are most likely to occur shortly after fever onset, often within the first day.[15]

These early occurrences underline the importance of timely medical attention and effective fever management to prevent seizures. Bronchiolitis (37.92%) and diarrhea (27.18%) were identified as the most common comorbidities in the study population, followed by urinary tract infections (UTI, 17.45%).

The prominent role of respiratory illnesses like bronchiolitis aligns with studies linking respiratory syncytial virus and influenza to febrile seizures, particularly during seasonal peaks.[9] Similarly, UTIs have been consistently highlighted as significant triggers, emphasizing the need for comprehensive evaluation of febrile children to identify underlying infections.[16]

The diurnal variation in febrile seizures observed in this study, with the highest incidence between noon and evening (51.68%), aligns with findings from Finland and other regions, where circadian rhythms influence seizure timing, likely due to physiological factors such as fever progression and cytokine activity.[17] The predominance of brief seizures in this study, with 50.34% lasting 1 minute or less and 42.95% lasting 2–4 minutes, further supports existing evidence that most febrile seizures are simple, self-limiting events.[18]

The seasonal variation observed in this study, with peaks in January (12.08%) and July (11.07%), reflects a bimodal distribution linked to respiratory and viral infection patterns. This is consistent with findings from Iran and Korea, where winter and summer peaks have been associated with influenza and enterovirus infections,

respectively.[11,19] The secondary peaks in June and December in our study may be influenced by local environmental and healthcare factors, emphasizing the need for targeted public health interventions during high-risk periods. Prematurity, reported in 14.43% of participants and a predominance of firstborn children (86.58%) further highlight significant demographic characteristics.

Prior studies have similarly identified prematurity and low birth weight as risk factors for febrile seizures due to the increased vulnerability of the immature brain.[20] The high proportion of firstborns affected may reflect greater parental anxiety and healthcare-seeking behaviors, which warrants further investigation.[21]

Overall, the findings of this study align closely with established global patterns of febrile seizures, while also highlighting unique regional characteristics such as the bimodal seasonal distribution and the role of specific comorbidities. These insights underscore the importance of early fever management, awareness of high-risk periods and comprehensive evaluation of febrile children to reduce seizure-related morbidity. Future research should explore the underlying genetic and environmental factors contributing to these patterns to enhance prevention and management strategies.

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

This study provides valuable insights into the patterns of febrile seizures in children, with significant findings highlighting the peak incidence among males aged 13–18 months, the early onset within the febrile course and the predominance of brief, self-limiting seizures. The observed bimodal seasonal variation and the association with respiratory infections and other comorbidities underscore the critical role of environmental and infectious triggers.

The findings also reveal demographic and socioeconomic factors, such as prematurity and firstborn status, as contributors to seizure occurrence. These results emphasize the need for timely medical evaluation, targeted public health strategies during high-risk periods and caregiver education to mitigate the burden of febrile seizures.
Future studies should explore genetic predispositions and environmental influences to further enhance prevention and management strategies, particularly in resource-limited settings like Bangladesh.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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