ARC Journal of Pediatrics
Volume 9 Issue 2, 2024, PP 12-17
ISSN No. (Online) 2455-5711
DOI: https://doi.org/10.20431/2455-5711.0902003
www.arcjournals.org

Association of Seasonal Factors with Febrile Seizures and Concurrent Illnesses: A Cross-Sectional Study

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Received: 25 November 2024 Accepted: 10 December 2024 Published: 16 December 2024

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Abstract

Background: *Febrile seizures, the most common convulsive event in children under the age of 5, are often triggered by fever from an infectious source. The incidence of these seizures has been noted to fluctuate seasonally, potentially linked to the prevalence of viral and bacterial infections.*

Aim of the Study:*The aim of this study was to assess the association of seasonal factors with febrile seizures and concurrent illnesses.*

Methods:*This cross-sectional study was conducted in Department of Paediatrics, Institute of Dr. MR Khan Shishu Hospital & Institute of Child Health, Dhaka, Bangladesh from January 2012 to December 2013. Total 298 children suffering from febrile were included in this study.*

Result:*This study analyzed 298 children with febrile seizures, with majority (35.6%) being in the age group of 13–18 months. The median age was 18 months ranged between 5 to 60 months. Males predominated at 72%, yielding a male-to-female ratio of 7:3. Socioeconomically, 60% were middle class, 32.9% solvent, and 7% poor. Most children (51%) presented within ≤6 hours of febrile illness. Prematurity was seen in 15%, 86.6% were first-born, and 6.7% were malnourished. Convulsions lasted ≤1 minute in 50%, and recurrence occurred in 8%. Seasonal peaks were observed in January (12%) and July (11%), with significant statistical variation (p = 0.012). Findings emphasize age, gender, and seasonal trends in febrile seizures.*

Conclusion:*This study highlights the significant association between seasonal factors and febrile seizures in children, with peaks in January and July linked to prevalent infections.*

Keywords: *Seasonal Factors, Febrile Seizures, and Concurrent Illnesses.*

1. INTRODUCTION

Febrile seizures (FS) represent a common and alarming pediatric condition globally, particularly in children aged between six months and five years, characterized by seizures occurring in the presence of fever without evidence of intracranial infections or acute metabolic imbalances (Sadleir&Scheffer, 2007).1 These seizures are the most prevalent neurological condition in children, affecting approximately 2–5% globally, with higher incidences in tropical regions (Chung & Wong, 2007).2 FS are categorized into simple febrile seizures, which are brief and generalized, and complex febrile seizures, which are focal, prolonged, or recurrent within 24 hours (Patterson et al., 2013).3 Although generally benign, febrile seizures pose significant anxiety for caregivers and demand a comprehensive understanding of their pathophysiology, triggers, and risk factors to enhance public health responses (Millichap&Millichap, 2006).4 The occurrence of febrile seizures is intricately linked to infectious diseases and environmental factors. Respiratory infections, such as influenza and respiratory syncytial virus (RSV), along with gastrointestinal infections like rotavirus, have been identified as prominent triggers of febrile responses in children (Chung & Wong, 2007).2

The release of inflammatory cytokines during infections, particularly IL-1β and TNF-α, significantly contributes to the hyperthermic and hyperexcitable state of neurons, predisposing children to febrile seizures (Mosili et al., 2020).5 Compounding these physiological

mechanisms are seasonal patterns that exacerbate infection rates. Studies have shown that the incidence of febrile seizures aligns with peaks in respiratory and gastrointestinal illnesses during colder and wetter months, where environmental factors such as temperature and humidity act as indirect modulators (Dowell, 2001).6 In Bangladesh, the pediatric population faces heightened vulnerability to febrile illnesses due to the region's unique climatic conditions, compounded by healthcare disparities and socioeconomic challenges. The country's tropical monsoon climate, characterized by high humidity and significant temperature variations, fosters an environment conducive to infectious diseases, such as dengue, pneumonia, and diarrhea, all of which are common triggers of febrile seizures (Kamruzzaman et al., 2015).7

Despite advancements in public health, inequalities in healthcare access persist, with significant proportions of children from low-income families receiving inadequate or untrained care (Najnin et al., 2011).8 Moreover, climate change exacerbates these issues, with rising temperatures and altered rainfall patterns contributing to increased disease burdens (Kabir et al., 2016).9 Globally, understanding the epidemiological link between seasonal factors and febrile seizures remains challenging due to limited integration of climatic, cultural, and healthcare dynamics in research. For example, while some studies correlate febrile seizure spikes with seasonal disease outbreaks, they often fail to account for regional variations in healthcare systems and public health infrastructure (Christensen et al., 2022).10 In Bangladesh, this gap is even more pronounced, as local studies addressing the interplay between environmental triggers, febrile illnesses, and healthcare challenges are sparse. Early identification of at-risk populations and an improved understanding of how seasonal and infection-related factors contribute to febrile seizures can inform preventive strategies and healthcare policies. Interventions such as caregiver education, early-warning systems during peak seasons, and strengthening access to pediatric healthcare facilities in underserved regions are critical to mitigating the impact of febrile seizures (Sultana et al., 2019).11 Therefore, this research aims to fill critical knowledge gaps by evaluating the association between seasonal factors, concurrent illnesses, and febrile seizures in children in Bangladesh, providing insights to guide tailored public health responses and reduce disparities in pediatric health outcomes.

2. Objectives

To assess the association of seasonal factors with febrile seizures and concurrent illnesses.

3. Methodology & Materials

This cross-sectional study was conducted in Department of Paediatrics, Institute of, *Institute of Dr. MR Khan Shishu Hospital & Institute of Child Health*. Dhaka, Bangladesh from January 2012 to December 2013. Total 298 children suffering from febrile seizure admitted in the Department of Paediatrics were included inthis study.The study included children aged 5 months to 5 years who experienced convulsions lasting less than 15 minutes and presented with generalized tonic-clonic seizures. Exclusion criteria were applied to children showing signs of intracranial infection, such as irritability, lethargy, unconsciousness, convulsions, or a bulged fontanelle with normal cerebrospinal fluid (CSF) findings. Additionally, children with any history of central nervous system (CNS) insult, past occurrences of afebrile convulsions, or recurrent seizures within the same febrile episode after 24 hours were excluded from the study. The variables studied were demographic characteristics, birth history, nutritional status, detailed history of seizure and associated illnesses. The outcome variable was seasonal variation in febrile convulsion. Keeping compliance with Helsinki Declaration for Medical Research Involving Human Subjects 1964, the parents of the study subjects were informed verbally about the study design, the purpose of the study, and their right to withdraw themselves from the project at any time, for any reason, whatsoever. The parents of study subjects who gave informed consent to participate in the study were included as study sample. Using computer software SPSS (Statistical Package for Social Sciences) data were processed and analyzed. The test statistics used to analysis the data were descriptive statistics. Analyzed data were presented in the form of table and graphs with due interpretation. P value of less than 0.05 was considered statistically significant.

4. Result

Table I presents the demographic characteristics of the study patients. In this study, 106(35.6%)

children were from 13 -18 months of age, followed by 78(26.2%) from 19-24 months, 49(16.4%) from 7-12 months and 36(12.1%) from 25-36 months. Very few children were below 6 and over 36 months of age. The median age of the children was 18 months and the youngest and the oldest children were 5 and 60 months respectively. Out 298 children 217(72%) were male and the rest 83(28%) female giving a male to female ratio of roughly 7:3. Socioeconomic status was arbitrarily divided into three classes based on monthly family. Accordingly, over 60% of the children belonged to middle class family, 32.9% to solvent and only 7% to poor family. Figure 1 highlights the duration of febrile illness of the study patients. Over half (51%) of the children had history 6 or < 6 hours of febrile illness at presentation, 34.6% from 7-12 hours, 9.7% 13-18 hours and 4.7% 19-24 hours of illness. The mean duration of illness was 7.6 hours and the shortest and the longest durations of illness were 1 and 24 hours respectively. Table II shows characteristics of the children. About 15% of the children were premature. Majority of the children (86.6%) was of 1st birth order. Only 6.7% were malnourished (according to Gomez classification 6.7% of the children's weight was below 70% for their age). Table III illustrates the duration of convulsion in the series. Half of the patients' convulsion persisted for 1 or < 1 minute and 43% for 2-4 minutes. Only 17(5.7%) patients experienced persistence of convulsion for 5-10 minutes and even few had convulsion for 10 or > 10 minutes. Of the 298 patients, only 25(8%) had recurrence of convulsion and the rest 275(92%) did not have any recurrence of convulsion. Figure 2 depicts the seasonal variation of febrile convulsion with 2 peaks – one in the month of January (12%) and another in the month July (11%). Repeated measure ANOVA statistics demonstrates that two seasonal peaks of febrile convulsion are statistically significant compared to those occurring in other seasons (p = 0.012).

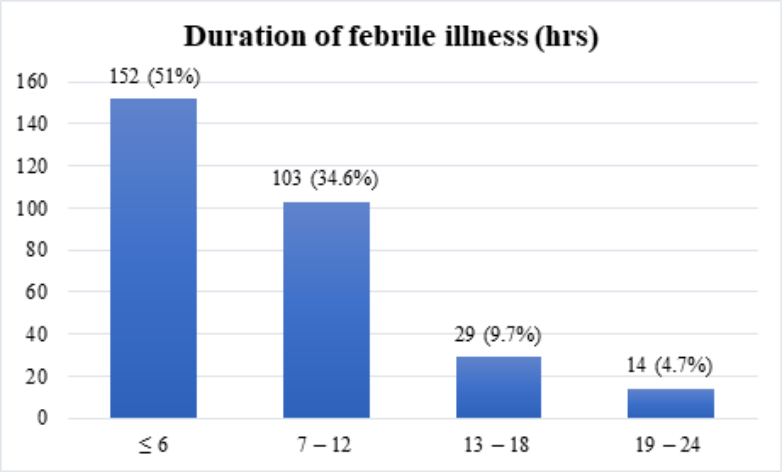

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Figure1. *Duration of febrile illness (hours)*

Table1. *Demographic characteristics of the study patients (N=298)*

Characteristics	Frequency	Percentage
Age (months)		
< 6	11	3.7
7 – 12	49	16.4
13 – 18	106	35.6
19 – 24	78	26.2
25 – 36	36	12.1
> 36	18	6
Mean ± SD	18 ± 10.0	
Range	5-60	
Sex		
Male	216	72.5
Female	82	27.5
Socioeconomic status		
Poor	21	7
Middle class	179	60.1
Solvent	98	32.9

Table2. *Distribution of patients by characteristics of children (N = 298)*

Characteristics of children	Frequency	Percentage
Prematurity		
Yes	43	14.4
No	255	85.6
Birth order		
1st	258	86.6
2nd	37	12.4
3rd	3	1
Nutritional status		
Normal	278	93.3
Malnourished	20	6.7

Table3. *Distribution of patients by characteristics of convulsion (N = 298)*

Characteristics	Frequency	Percentage
Duration of convulsion (minutes)		
≤ 1	150	50.3
2 – 4	128	43
5 – 10	17	5.7
≥ 10	3	1
Mean ± SD	1.5 ± 0.1	
Range	30 second-14 minutes	
Recurrence of convulsion		
Yes	25	8
No	273	92

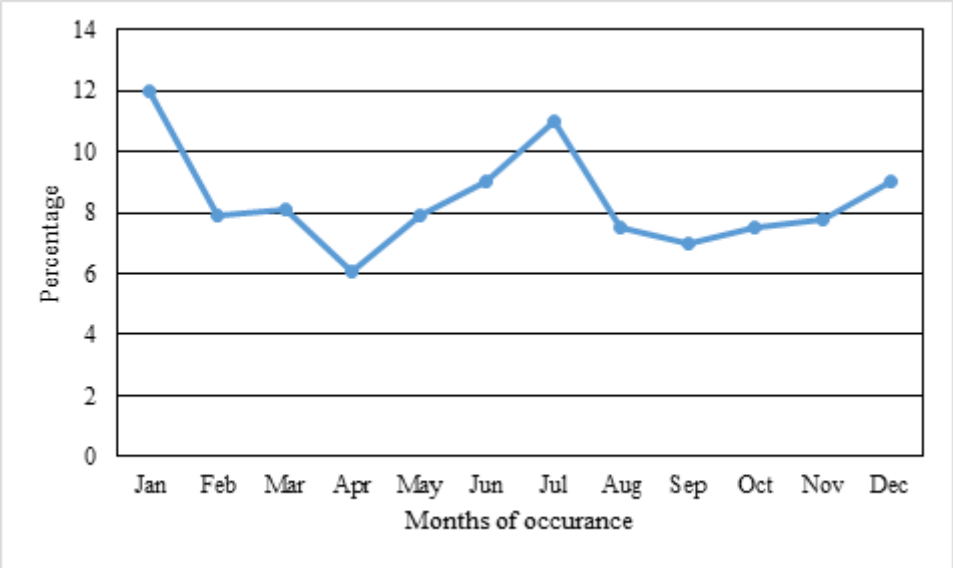

Figure2. *Seasonal variation of febrile convulsion.*

5. Discussion

In this study, the majority of children with febrile seizures were aged 13–18 months (35.6%), followed by 19–24 months (26.2%), and 7–12 months (16.4%). The median age was 18 months, with the youngest being 5 months and the oldest 60 months. These findings align with those of Chung et al.[12], who reported a mean age of febrile seizure onset at 2.1 years in Chinese children, with 43% experiencing their first seizure below 12 months. Similarly, Jeonget al.[13] observed a median age of 20 months for febrile seizures, emphasizing that this age group is at the highest risk due to the immature thermoregulatory and neural systems.

Regarding gender distribution, our study showed a male predominance (72%), with a male-to-female ratio of 7:3. This trend was similarly observed by Mikkonenet al.[14], who found that boys are more prone to febrile seizures, accounting for 60% of cases. The male dominance in febrile seizures could be attributed to genetic and hormonal factors, though further investigation is warranted. In our study, over

60% of children belonged to middle-class families, 32.9% to solvent families, and only 7% to poor families. This differs from findings by Ateşoğluet al.[15], who observed higher febrile seizure prevalence in lower socioeconomic groups due to limited access to healthcare and education. The relatively lower representation of poor families in our study might reflect disparities in healthcare access and data collection. Half of the children in this study presented with febrile illness lasting ≤6 hours, with a mean duration of 7.6 hours. The shortest and longest durations were 1 hour and 24 hours, respectively. These results are consistent with Sharawatet al.[16], who highlighted that a shorter fever duration before seizure onset is a common characteristic of febrile seizures. Prematurity was observed in 15% of children in this study, while 86.6% were first-born.

The role of prematurity as a risk factor is well-supported by Camfieldet al.[17], who found higher febrile seizure rates among premature infants due to immature neurological systems. Additionally, the association between first-born status and febrile seizures might reflect heightened parental vigilance and medical attention, as suggested by Yousifet al.[18]. Only 6.7% of children in this study were malnourished based on Gomez classification. Similar findings were noted by Hương and Son[19], who reported malnutrition as a less common risk factor for febrile seizures, likely due to better management of nutritional deficiencies in pediatric populations. In our study, 50% of convulsions lasted ≤1 minute, and 43% lasted 2–4 minutes, with only 5.7% lasting 5–10 minutes. The recurrence rate was 8%, which is lower than the 17.5% reported by Jeonget al.[13]. The shorter duration and lower recurrence in our population could be due to better acute fever management practices. Our study identified significant seasonal peaks in January (12%) and July (11%) (p=0.012). This corresponds with findings by Sharafiet al.[20], who also observed a winter peak in January. The association of febrile seizures with seasonal respiratory and gastrointestinal infections underscores the importance of infection surveillance. Our study provides valuable insights into the epidemiological, clinical, and seasonal characteristics of febrile seizures in Bangladeshi children. While our findings align with global trends, they also highlight region-specific patterns such as lower recurrence rates and the influence of socioeconomic status.

6. Limitations of the Study

In our study, there was small sample size and absence of control for comparison. Study population was selected from one center in Dhaka city, so may not represent wider population. The study was conducted at a short period of time.

7. Conclusion and Recommendations

This study highlights the significant association between seasonal factors and febrile seizures in children, with peaks in January and July linked to prevalent infections. Younger age, male gender, prematurity, and shorter febrile illness durations were prominent risk factors. Socioeconomic status influenced healthcare access, while malnutrition was a minor contributor. These findings emphasize the need for targeted public health strategies, infection control measures, and caregiver education to mitigate febrile seizure risks, particularly during seasonal peaks, in resource-constrained settings like Bangladesh.

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Citation: *Dr. Md. Ziaur Rahman et al. Association of Seasonal Factors with Febrile Seizures and Concurrent Illnesses: A Cross-Sectional Study. ARC Journal of Pediatrics. 2024; 9(2):12-17. DOI: https://doi.org/10.20431/2455-5711.0902003.*