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Seasonal Variation of Febrile Seizure: A Hospital Based Study

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Abstract **Original Research Article**

Background: Febrile seizures (FS) are the most common type of convulsions in children from 6 months to 5 years of age and usually occur without central nervous system involvement, but precipitated by fever in children. Incidence of FS has been observed to vary seasonally, possibly associated with environmental factors and seasonal illnesses. This hospital-based study aims to characterize seasonal and diurnal patterns of FS to provide guidance for preventive as well as therapeutic strategies. ***Methods:*** This cross sectional study conducted at Department of Paediatrics, Institute of Dr. MR Khan Shishu Hospital & Institute of Child Health, Dhaka from January 2012 to December 2013. A total 298 children between 5 months up to 5 years of age who had febrile seizures. They included generalized tonic-clonic seizures that lasted less than 15 minutes. ***Results:*** Febrile seizures were most common among Children aged 13 to 18 months, predominance of male (72%). Corresponding to the winter and summer seasons, seasonal peaks were in January (12%) and July (11%). A higher incidence occurred between noon and evening (51.7 %) and between evening and midnight (31.5 %), whereas incidence between morning and noon (10.4 %) and between midnight and morning (6.4 %) were lower. The mean duration of febrile illness at presentation was 7.6 hours. ***Conclusion****:* This study shows that FS incidence is seasonal, with peaks of winter and summer. Increased cases were also observed in diurnal variation with more cases occurring in the afternoon and evening hours.

Keywords: febrile seizures, seasonal variation, Diurnal pattern, pediatric convulsions.

INTRODUCTION

The International League against Epilepsy (ILAE) definition of febrile seizures is 'a seizure occurring in childhood after one month of age and associated with a febrile illness not caused by a central nervous system infection, without previous neonatal seizures or a previous unprovoked seizure, and not meeting the criteria for other acute symptomatic seizures [1]. The febrile seizures are classified as simple or complicated in terms of their complexity. Simple febrile seizures are defined as they involve a single (lasting less than 10 minutes) tonic clonic convulsion that occurs less than once per 24 hours period. There are no focal features and it resolves spontaneously [2]. Conversely, complex febrile seizures are prolonged (greater than 10-15 minutes), focal, or multiple (recurrent within the same febrile illness over a 24-hour period). While the majority of febrile seizures are simple (70-75%), 9-35% of febrile seizures are complex [3,4].

Usually the lifetime risk (LTR) for febrile seizures in the tropics seems to be higher than the 2-4% seen in developed, non-tropical zones. A cross-national study conducted in three countries namely Pakistan, Bangladesh and Jamaica reported that febrile seizures were the most common of neuro disability, with an LTR of 10.9-68.2/1,000 [5]. The findings derived from the birth cohort Chamorro people of Guam, showed that febrile seizures occurred in 94/1000 [6], and comparative rates obtained from surveys of healthcare workers in the same regions had a much lower detection rate. In Turkey and southern India, the LTRs were 9.7% and 10.1% respectively [7], but these febrile seizures were associated with a history of perinatal injury and may have included children with previously unrecognized brain injury and provoked seizures rather than a febrile seizure [8]. A population-based study in Nigeria covering both urban and rural regions found that 8% of the children, experienced febrile seizures [9]. Majority of them occurred in children between 6 and 12 months of age, a somewhat lower age than the usual age of the seizure. A large-scale 3-year, population-based study of more than 17 thousand children is conducted in Japan showed that febrile seizures occur in 8.3% of children at risk (9.0% in males and 7.5% in females) [10].

The Netherlands study of febrile seizures in children conducted by Verburgh *et al.,* [11] found that overall incidence rate to be 4.8/1,000 person-years. Considerable age and seasonal variation was evident. A child's chances of experiencing a febrile seizure during the relevant age range (3-72 months) are 2.7%. The incidence rates are similar to those observed in the United States, England, and Sweden, although they differ from Asian studies. Tsuboi & Okada [12] however, demonstrated that the 6-year incidence rates of febrile convulsions in all 3-year-old children in Fuchu was 8.2% with boys being more frequently encountered the condition than the girls (9.0%: 7.5%, $P < 0.001$). The incidence rates varied with the month and year of birth, but the variations observed were negligible. Two peak appearances of seasonal variation was observed with first being found in November-January and in June–August. Liability to febrile convulsion was influenced by the age of children and by the seasonal variations of febrile illness, but not by the season of birth. This background information suggests that a study is essential to find the seasonal variation of febrile seizure and its association with other co-morbid illnesses.

Objective

The objective of this study were to evaluate the seasonal variations in the incidence of febrile seizure.

METHODOLOGY & MATERIALS

This cross sectional study carried out in the Department of Paediatrics, Institute of Dr. MR Khan Shishu Hospital & Institute of Child Health, Dhaka from January 2012 to December 2013. A total 298 children of 5 months to 5 years suffering from febrile seizure are included in this study.

Selection Criteria:

Inclusion Criteria:

- Age of children ranging from 5 months to 5 years.
- Convulsion lasting <15 minutes
- Generalized tonic-clonic seizure

Exclusion Criteria:

- Signs of intracranial infection (irritability, lethargy, unconsciousness, convulsion, bulged fontanelle with normal CSF study etc.)
- Any complaints of insult to the CNS
- History of any afebrile convulsion in the past.
- Recurrent seizure in same febrile episode (after 24 hours)

Data collection: Data were collected from the guardians or attendants of the patients as well as from the records of the patients using a semi-structured questionnaire (research instrument) containing the variables of interest.

Ethical consideration: This research was approved by the Institutional Review Board(IRB). 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.

Statistical analysis of data: Using computer software SPSS (Statistical Package for Social Sciences) data were processed and analysed. The test statistics used to analysis the data were descriptive statistics. Analysed data were presented in the form of table and graphs with due interpretation.

RESULTS

The present study intended to study the seasonal variation in febrile convulsion included a total 298 children (raging from 5 months to 60 months) between 1st January 2012 to 31st December 2012. The findings obtained from data analyses are presented below:

Table 1: Patients demographic characteristics (n=298)

Variables		Frequency(n)	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
Gender	Male	216	72.5
	Female	82	27.5

Age distribution shows that 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. It also shows that out of 298 children 217(72%) were male and the rest 83(28%) female giving a male to female ratio of roughly 7:3.

Table 2: Distribution of patients by duration of febrile illness (n = 298)

Duration of febrile illness (hrs)	Frequency(n)	Percentage (%)
≤ 6	152	51
7 – 12	103	34.6
13 – 18	29	9.7
19 – 24	14	4.7

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 2).

Table 3: Diurnal variation in the onset of convulsion (n = 298)

Time of onset	Frequency(n)	Percentage (%)
Midnight-Morning (12 AM-6 AM)	19	6.4
Morning-Noon (6 AM-12 PM)	31	10.4
Noon-Evening (12 PM-6 PM)	154	51.7
Evening-Midnight (6 PM-12 AM)	94	31.5

From table 3, diurnal variation in the onset of febrile convulsion is evident with more than half (51.7%) occurring between noon to evening followed by 31.5% between evening to mid-night, 10.4% between morning to noon and only 6.4% between mid-night to morning.

Recurrence of convulsion:

From the 298 patients, only 25(8%) had recurrence of convulsion and the rest 275(92%) did not have any recurrence of convulsion (Fig. 1).

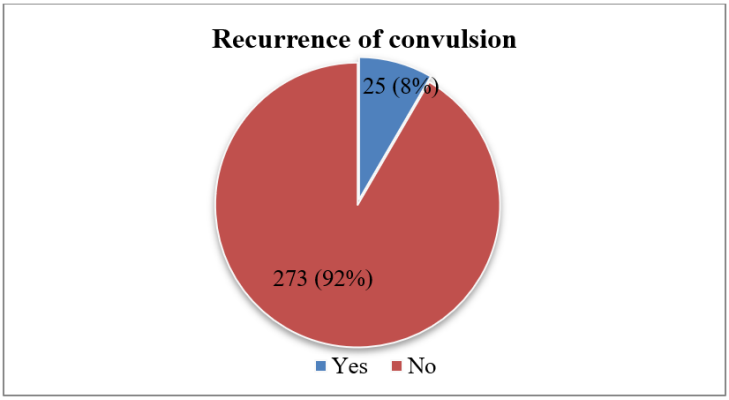

Fig. 1: Distribution of patients by recurrence of convulsion (n = 298)

Seasonal variation of febrile convulsion:

Fig 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) (Fig. 2).

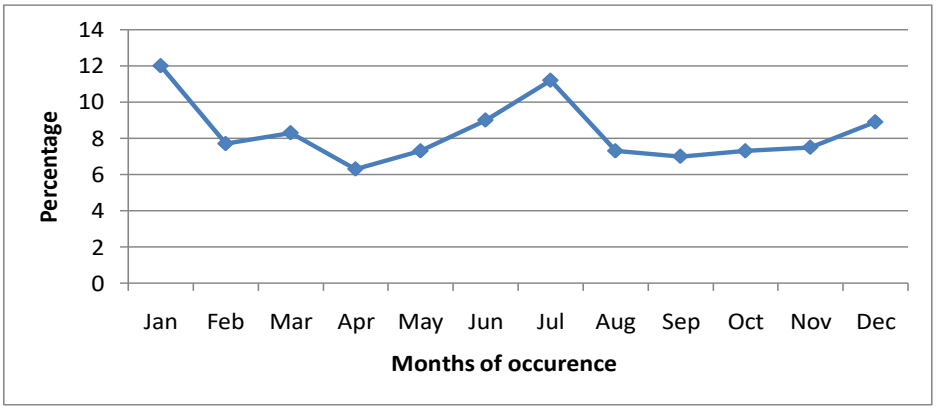

Figure 2: Seasonal variation of febrile convulsion

Table 4: History of convulsion (n=298)

Variables	Frequency(n)	Percentage (%)
Previous history of convulsion	281	94.3
Family history of convulsion	261	87.6

Table 4 shows the previous history of convulsion among the patients. Nearly 95% of the children had past history of convulsion and 87.6% had family history of convulsion.

DISCUSSION

The present study revealed that febrile convulsion is more common between 13 – 18 months of age followed by 19 – 24 months, there after it decreases with advancing age up to 60 months. A male predominance was also observed in the series. The mean duration of illness at presentation was 7.6 hours.

The admission data of children with febrile convulsion of a full-calendar year (from 1st January to 31st December 2012) indicate that there is variation in the incidence of febrile convulsion with 2 peaks in a year – one in the month of January (12%) and another in the month July (11%). Tsuboi and Okada (1984) demonstrated 6-year incidence rates of febrile convulsions in all 3-year-old children in Fuchu (covering 95% of children, number examined 17,044) to be 8.2%. They also observed two peaks in the seasonal variation of febrile convulsion – one between November-January and in another between June–August which is quite consistent with the findings of the present study. The former could be interpreted as a tendency to winter virus infection of the upper respiratory tract in children. The other peak in summer could be explained as a tendency to gastrointestinal infection. Liability to febrile convulsion was influenced by the age of children and by the seasonal variations of febrile illness [12]. In an attempt to determine whether the occurrence of febrile seizures (FSs) correlates with the seasons of the year, Teran and associates [13] studied 219 patients febrile seizures; of them 135 (61.4%) cases had the etiology of the FS diagnosed. Upper respiratory tract infection, otitis media, urinary infection, and pneumonia were the most common diagnoses attributed to the fever. Leukocytosis was present in 48 24%, and neutrophilia in 91% of cases. Low bicarbonate levels were common among every age group. Only 1 blood culture was positive for *Salmonella*. The incidence of FS was higher during the winter (49.3% of the cases), and it closely paralleled the seasonal variation of viral infections.

We have seen that febrile seizures have a seasonal predisposition. In malaria prone regions, children invariably suffer from more fevers during the malaria season with consequent increase in the incidences of febrile convulsion [14]. In children pharyngitis, chest infections and gastroenteritis are mostly caused by viral infections. As these viral infections have seasonality, febrile convulsions associated with these infections also vary with respect to seasons [15]. As these infections have a higher predilection in the month of winter and summer seasons, the highest incidence of febrile convulsion was seen in the month of January and July.

Diurnal variation in the onset of febrile convulsion was also a characteristic feature observed in the present study with more than half (51.7%) occurring between afternoon and evening followed by about one-third (31.7%) between evening to mid-night. The incidence of the condition between morning to noon is low (10.3%) and mid-night to morning is even lower (6.3%). In another study time of occurrence of 188 first febrile seizures (FS) was recorded, both by four 6-hour periods and by hourly intervals. The frequency of events was significantly increased from 6 to 11.59 PM with a peak between 5 and 8 PM. A seasonal peak was observed in January [16]. The role of viral infection in the etiology of febrile seizures is a relatively neglected field of neurologic research. A National Institutes of Health Consensus Conference (1981) omitted reference to causes of infections and the role of fever in febrile seizures, and emphasized outcome and anticonvulsant treatment. In an earlier review of the world literature (1924-1964), except for roseola infantum, viral infections as a cause of febrile seizures were rarely diagnosed. The present review includes reports of viruses most commonly associated with febrile seizures in the last decade, especially human herpesvirus-6 and influenza. The specificity and neurotropic properties of some viruses in the febrile seizure mechanism, a possible encephalitic or encephalopathic pathology, and the essential role of fever and height of the body temperature as a measure of the febrile seizure threshold are discussed. Cytokine and immune response to infection, and a genetic susceptibility to febrile seizures are additional etiologic factors [17].

Most epidemiologic studies of febrile seizures in the tropics have confirmed that, as in developed regions, genetic vulnerability plays a role. A family history of febrile seizures is consistently found to be a risk factor for tropical febrile seizures [9,14,18]. The findings of the present study in terms of family history of febrile convulsion go in favour of these studies.

In our study, we found that most of the children with febrile convulsion have positive family history of febrile convulsion. The same result was found in a recently conducted study by Esmaili Gourabi H and Colleague in Iran in 2012. They found that out of 214

children 109 children had positive family history of febrile convulsion [19].

According to the International League, febrile seizures are an acute, symptomatic type—that is, a "special," situation-related—seizure. Febrile seizures are not associated with a structural or developmental anomaly of brain, though the existence of such pathology may enhance the susceptibility to febrile seizures. The majority of febrile seizures occurs between 6 months and 3 years of age, with the peak incidence at about 18 months. In the present we also found a peak incidence between 13-24 months. The findings of the study suggest seasonality and diurnal variation of febrile convulsion.

CONCLUSION

From the findings of the study it can be concluded that there is seasonal variation in the incidence of febrile convulsion with two peaks – one in the winter season (in the month of January) and another in the summer season (in the month of July). Diurnal variation in the onset of febrile convulsion is also a prominent feature with majority occurring between afternoon to mid-night. The variation in the occurrence of febrile convulsion might be associated with viral infections which also vary with seasonal variations.

Limitations and recommendations

To reduce febrile seizures this study recommends increasing parents and caregiver knowledge on the management of children's fever, particularly during high-risk winter and summer periods. The rollout should target particularly vulnerable children aged 13–18 months. However, the single-center data, small sample size, and reliance on caregiver reports may limit the findings. These patterns should be confirmed with future research using larger, multi-center studies.

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Conflicts of interest: There are no conflicts of interest.

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

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