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Seasonal Variation of Febrile Seizures in Children Aged 6 Months to 5 Years: A Cross-Sectional Study in Shahroud, Iran

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Abstract

Background: *Circadian rhythms are actually daily periodic fluctuations in the organism's physiology, metabolism or behaviour. Among the areas of the brain that were seen to have a pattern of daily changes are the areas related to reward. The aim of this study was to investigate seasonal changes in febrile seizures in children aged 6 months to 5 years in Shahroud city.*

Methods: *This descriptive cross-sectional study was conducted retrospectively on patients' records. Investigators assessed the records of patients with simple FS aged 6 to 60 months referred to Emergency Department of Bahar Hospital, Shahroud, Iran during March 2021 to March 2022. Data were gathered by a checklist including age, sex, temperature, seasonal, months, diurnal variation and simple or complex FS.*

Results: *Out of 97 children examined, 51 (52.6%) were boys and the rest were girls with an average age of 24.4±14.6 months. The mean temperature of patients was 38.5±0.7 °C. Simple FS was 77 (79.4%) and complex FS was 20 (20.6%). Most of the FS occurred in afternoon 31 (32%) and in April and December 15 (15.5%). Autumn had the highest proportion 29 (29.9%), while summer had the lowest 15 (15.5%). It was also found that there is a significant relationship between the age group of patients and the season of FS (P-value=0.016) and it is more in spring and autumn.*

Conclusions: *The present study showed that the occurrence of FS has a specific circadian rhythm, so that it is more in the spring and autumn seasons and in the afternoon hours, and it is necessary to monitor children with fever, especially at the age of one to two years. be placed in these times.*

Keywords: Temperature, Circadian rhythm, Children, Febrile seizure.
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Introduction

Febrile seizure (FS) is the most common form of pediatric seizure, which occurs in 2%-5% of children. Eighteen months old is the estimated peak age for its occurrence[1]. FS is defined as the seizure with febrile illness during 6-60 months of age, which does not happen because of central nervous system infection or metabolic disorders. Children do not have any history of afebrile seizures and body temperature should be at least 38 °C[2]. FS is classified into simple and complex types. Simple FS is determined by generalized seizure with less than 15 min duration and one seizure during febrile illness, while complex FS is focal, prolonged, or recurrent seizures[3].

Yet the cause of FS is unknown. Genetic factors can affect the occurrence[4]. Of this age-dependent seizure commonly most of the patients report the familial history of febrile seizure. Usually, in most patients with positive familial history, FS happens as an autosomal dominant disease[5]. Otherwise, core body temperature has circadian rhythm during 24 h which varies from 36.5 °C (early morning) to 37.5 °C (early evening)[6]. Specific cells in hypothalamus control the body temperature that varies by circadian rhythm. This rhythm emerges from at least 1 months of age in children[7]. From 18 months of age, the duration of morning nap gradually decreases and 6 years old child has only nocturnal sleep[6], the circadian rhythm works properly during the specific age of FS (6 to 60 months)[8]. Circadian rhythm and the secondary cyclic changes in hormones and the sleep-wake cycles can have potential effect on the time of seizures occurrence[9]. Regarding the clinical experiences, the increased rate of seizure in patients with epilepsy may be associated with the nocturnal melatonin rise. Although the pharmacological level of melatonin prohibits the occurrence of seizure, the physiologic level of this hormone can induce seizure by inhibiting effect on dopaminergic system (inhibit seizure)[10]. In addition, some studies have shown that FS can be affected by seasonal changes, but this is not yet clear. Many studies have investigated the seasonality of FS in Iran; one of them reported summer peaks, although there is some disagreement on this[11-13]. Considering the importance of the topic and the lack of definitive documentation in this regard, the present study was conducted with the aim of seasonal variation of febrile seizures in children aged 6 months to 5 years in Shahroud, Iran.

Materials and Methods

This descriptive cross-sectional study was conducted retrospectively on patients' records. The records of patients with FS aged 6 to 5 years referred to Emergency Department of Bahar Hospital, Shahroud, Iran during March 2021 to March

2022 were assessed. Cases with a history of epilepsy or CNS infection were excluded. Data were gathered by a checklist including age, sex, temperature, seasonal, months, diurnal variation and simple or complex FS. The axillary temperature was taken immediately or up to 30 min after FS and the temperature, more than 37.5 °C indicates fever. The diurnal variation was mentioned by 4 classifications: morning (6 A.M. to 11:59 A.M.), afternoon (12:00 A.M. to 5:59 P.M.) evening (6:00 P.M. to 11:59 P.M.) and night (12:00 to 5:59 A.M.). Data were analyzed using SPSS software 23 version. Chi-square tests compared categorical variables, with logistic regression adjusting for age and sex.

Results

Out of 97 children examined, 51 (52.6%) were boys and 46 (47.4%) were girls with an average age of 24.4±14.6 months. The age group of 19 to 24 months was the most frequent group of patients with 1.35 percent. The mean temperature of patients was 38.45 °C. Simple FS was 77 (79.4%) and complex FS was 20 (20.6%). Most of the FS occurred in afternoon 31 (32%) and in April and December 15 (15.5%). The results of variables related to seizures are shown in Table 1.

Table 1. The results of variables related to FS

Variable	Number (%) or mean±SD (n=97)
Sex	
Male	51 (52.6)
Female	46 (47.4)
Mean age (months)	24.4±14.6
Age groups (months)	
<12	17 (17.5)
12-24	50 (52.0)
25-36	16 (16.5)
>36	14 (14.4)
Mean Temperatures (ºC Axillary)	38.5±0.7
Temperatures group (ºC Axillary)	
<38	20 (20.6)
38-38.5	36 (37.1)
38.6-39	23 (23.7)
39.1-39.5	12 (12.4)
>39.5	6 (6.2)
Seizure season	
Spring	29 (29.9)
Summer	15 (15.5)
Autumn	29 (29.9)
Winter	24 (24.7)
Seizure type	
Simple	77 (79.4)
Complex	20 (20.6)
Seizure time	
Morning (6-12)	25 (25.8)
Afternoon (12-18)	31 (32.0)
The beginning of the night (18-24)	29 (29.9)
End of the night (24-6)	12 (12.4)

It was also found that there was a significant relationship between the age group of patients and the season of seizures, such that children aged 12 to 24 months had a higher rate of autumn seizures (45%) compared to other seasons (P-value=0.016).The results of the relationship between the age of patients and the season of seizures are presented in Table 2.

Table 2. The relationship between the age of patients and the season of FC

Age (month) / Season	<12	12-24	25-26	>36	Total	P-value
Spring	3 (17.6)	13 (26.0)	5 (38.5)	8 (57.1)	29 (29.9)	
Summer	3 (17.6)	10 (20.0)	2 (15.4)	0 (0)	15 (15.5)	
Autumn	1 (5.9)	16 (32.0)	6 (46.1)	6 (42.9)	29 (29.9)	0.016
Winter	10 (58.8)	11 (22.0)	3 (23.1)	0 (0)	24 (24.7)	
Total	17 (17.5)	50 (51.4)	13 (13.4)	14 (14.4)	97 (100)	

Discussion

Body temperature adjusted by hypothalamus affecting by circadian rhythm FS is the most common form of seizure in childhood occurred by multifactorial issues. Otherwise, the occurrence of seizure in patients with epilepsy may be affected by the circadian rhythm. Seizures happen more frequent at a specific time in 24 h during a day. In this study, most of the seizures occurred at afternoon (12:00 A.M. to 5:59 P.M.) and then in the beginning of the night (6-12 P.M.). This finding is in complete agreement with the results of Khoda Panahandeh et al.'s study[11]. Polkinghorne et al. also showed in their research that the highest frequency of FS was at 12-6 in the afternoon and especially in the cold seasons of the year, which is completely consistent with our study[12]. This result may be noted regarding the normal circadian rhythm of body temperature. As the highest temperature commonly occurs at evening and afternoon, respectively, and this temperature may be near the mentioned threshold for FS (38 °C), it can lead to higher FS rate. Temperatures may increase fever incidence, though viral infection cycles (e.g., enteroviruses) could also contribute[12, 13]. In this study, the highest frequency of FS occurred at spring and autumn and especially in April and December. Our autumn peak aligns with studies in temperate climates but differs from tropical regions where FS are year-round. This finding is almost consistent with the results of Han et al.'s research, so that in Han's study, the most common conflict season is the beginning of spring[13].

In our study, it was found that there was a significant relationship between children's age and the season of seizure occurrence, so that the age of 12 to 24 months and in the spring and autumn seasons accounted for the most cases (P-value=0.016).

This higher frequency may be due to the higher frequency of febrile diseases and infections in spring and autumn. The incidence of FS is higher in certain seasons (especially in spring and autumn) and certain times of the day. In the research of Mikkonen et al., it was also shown that the most frequent seizures occurred in the spring, but the most frequent patients were in the age group of 3 to 5 years, which is not consistent with the present study, and perhaps the most important reason for the difference between the two studies above is related to the selection of patients or their sample size[14].

According to the results of the present study and the confirmation of the existence of a relatively specific circadian rhythm in the occurrence of febrile seizures in the relatively cold seasons of the year (spring and autumn) and in the afternoon hours, parents should pay more attention to their children's febrile illnesses and have time available during these seasons. Also, healthcare providers should prioritize FS education and fever management for parents during the autumn. Since daily and long-term treatment with anticonvulsant drugs is not allowed in childhood due to its side effects, the best way to prevent febrile seizures is to administer diazepam during fever in children and to take more careful care of them.

Incomplete parental history may have understated the rate of seizure recurrence. Incomplete patient medical records were also another problem. It is hoped that more comprehensive investigations will be planned and implemented in future studies.

Ethical Considerations

This study has an ethics code number (IR.SHMU.REC.1400.199) from the research deputy of Shahroud University of Medical Sciences. Informed consent was obtained from all individual participants included in the study.

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Conflict of Interest

The authors declared that they have no conflict of interest.

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