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# The evaluation of accesses for febrile and afebrile seizures in the pediatric emergency department during COVID-19 lockdown

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**Abstract**

We aimed to evaluate the admissions to the Pediatric Emergency Department (PED) due to seizures one year before and one year after the first COVID-19 case in Turkey. We divided the admission time into two: The prelockdown period (March 2019-February 2020) and the lockdown period (March 2020 – February 2021). We divided the seizures into six parts: First simple febrile convulsion (FK), first complex FK, recurrent simple FK, recurrent complex FK, first non-febrile seizure, and recurrent non-febrile seizure. We compared the prelockdown and lockdown periods in terms of demographic and clinical characteristics and monthly admission of patients. The total number of patients admitted to PED was 37.323 and 10.191 during the prelockdown and lockdown period, respectively. While seizure-related PED accesses were 918 during the prelockdown period, 508 patients were admitted to PED during the lockdown period. Monthly average admissions decreased in all seizure types during the lockdown period. The ratio of first simple febrile seizures to total seizures decreased from 22.4% (206/918) to 16.3% (83/508), while the ratio of first afebrile seizures to total seizures increased from 29.6% (272/918) to 36.8% (186/508). While the rate of first febrile seizures decreased, we observed a significant increase in the rate of first afebrile seizures. The findings suggested that risk factors such as depression/anxiety or screen exposure may have caused seizures in patients with a predisposition to seizures.

**Keywords:** pediatric emergency department, children, COVID-19, pandemic, seizure, lockdown

## 1. Introduction

As of mid-December 2019, a new type of coronavirus infection was identified in Wuhan, China, and spread rapidly to most world countries (1). It reached pandemic status on March 12, 2020 (2).

The first patient in Turkey was reported on March 11, and schools were closed on March 16, 2020, to control transmission, then all non-essential businesses and services were closed. On May 23, 2020, the country closed completely. After the closure of schools in Turkey, students continued the academic year through distance education and remained isolated at home.

Since then, according to the literature, there has been a worldwide decrease in pediatric admissions to the Pediatric Emergency Department (PED), both because of the mild clinical course in childhood, the higher incidence of COVID-19 in advanced age groups, and the fear of contagion (3, 4). Parents' concerns, such as the increased risk of transmitting the infection to their children in the hospital setting, delayed the diagnosis of severe acute diseases that needed to be treated. Other viral infections have also decreased due to social distancing measures and isolation (5).

At the same time, lockdown, contact restrictions, isolation, and financial closure have changed the psychosocial environment, and increasing mental health disorders such as anxiety and depression have been observed in children (6).

This new condition has pressured children and adolescents, including sleep disturbances and limited access to street playgrounds. As a result, the use of smartphones, television, tablets and video consoles has increased (7).

Patients with epilepsy are susceptible to many factors, such as physical or emotional disorders or lifestyle and environmental changes. Many factors such as illness and fever, sleep deprivation, stress and disruption in antiepileptic drug treatments can increase the risk of seizures (8). The admissions of these patients to ED were evaluated in short periods (2-4 months) in the literature (7, 8). We aimed to evaluate the effects of life changes on the admissions to the PED due to febrile or afebrile seizures as one year before COVID-19 quarantine (prelockdown period) and one year during COVID-19 quarantine (lockdown period).

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## 2. Materials and methods

### 2.1. Patients and data collections

To evaluate the accesses to PED due to seizures during the COVID-19 quarantine, we divided the admission time into the prelockdown period (March 11, 2019-March 11, 2020) and lockdown period (March 11, 2020-March 11, 2021). We included children less than 18 years who applied to the Ondokuz Mayıs University Medical Faculty Pediatric Emergency Department during these periods due to febrile and afebrile seizures and excluded those with non-epileptic conditions. We received ethics committee approval from the Ethics Committee of Ondokuz Mayıs University (2021/324, Date: 16/07/2021).

We divided the patients into two groups: Febrile and afebrile seizures, and further divided these two groups into two: First seizure and recurrent seizure. We subgrouped febrile convulsions into simple febrile convulsions and complex febrile convulsions. Definition of a febrile seizure: A febrile seizure is an event associated with fever, usually occurring between the ages of six months and five years, but without intracranial infection or an identified cause. Febrile seizures that develop after afebrile seizures are excluded from this definition. Febrile seizures are not considered a type of epilepsy characterized by recurrent non-febrile seizures (9).

The febrile seizures criteria include (10):

- The convulsion that occurs at a temperature higher than 38°C
- Children over six months and under five years old
- No infection of the central nervous system
- Absence of underlying metabolic disease
- No previous history of afebrile seizures

Febrile seizures are divided into simple and complex categories (11).

- Simple febrile seizures, the most common type, are characterized by generalized seizures that last less than 15 minutes and do not recur within 24 hours.
- Complex febrile seizures are characterized by focal-onset episodes lasting longer than 15 minutes or occurring more than once in 24 hours.

### 2. 2. Statistical analysis

We conducted statistical analyses using the SPSS software (v22.0, IBM Corp., Armonk, NY, USA) and expressed all data as mean±standard error of the mean (SEM). We used the Shapiro-Wilk test to determine the normal distribution of the data. We used the unpaired t-test or Mann-Whitney U test as applicable to determine the differences between the groups and the Chi-squared and Fisher's exact tests for testing the relationships between categorical variables. We defined significance as $p<0.05$.

## 3. Results

The total number of patients admitted to PED between March 2019-March 2020 (prelockdown period) was 37.323, whereas it was 10.191 between March 2020 and March 21 (lockdown period).

Seizure-related PED applications were n=918 and n=508, and the mean age was 5.59±0.16 and 6.06±0.24 years during the prelockdown and lockdown periods, respectively. Male patient admission was predominant during both periods.

The ratio of the number of patients presenting with any seizure to the total number of patients during the prelockdown period was 2.45% (918/37323), while it was 4.98% (508/10191) during the lockdown period.

The ratio of first simple febrile seizure to total seizure decreased from 22.4% (206/918) to 16.3% (83/508), while the rate of first afebrile seizure to total seizure increased from 29.6% (272/918) to 36.8% (186/508). We found no statistically significant difference in other seizure types (Table 1).

There was no difference in terms of the gender of the children admitted between the prelockdown and lockdown periods (p=0.5402).

There was no difference between the two periods in terms of age, except for recurrent non-febrile seizures. We determined that the mean age of children presenting with recurrent afebrile seizures increased during the lockdown period (7.45±0.27 vs 8.51±0.40) (Table 1).

**Table 1.** Demographic and clinical characteristics of patients admitted to the emergency department during the one year before and after the pandemic

| Demographic and clinical characteristics | 2019 Mar-2020 Feb | 2020 Mar-2021 Feb | *P value* |
|---|---|---|---|
| **Total admission (All patients)** | 37.323 | 10.191 | - |
| **Total admission with seizure** | 918 (100 %) | 508 (100 %) | - |
| **First simple FK*** | 206 (22.4 %) | 83 (16.3 %) | **0.0059** |
| **First complex FK*** | 29 (3.3 %) | 17 (3.3 %) | 0.8762 |
| **Recurrent simple FK*** | 50 (5.4 %) | 25 (4.9 %) | 0.7117 |
| **Recurrent complex FK*** | 4 (0.4 %) | 1 (0.2 %) | - |
| **First afebrile seizure** | 272 (29.6 %) | 186 (36.8 %) | **0.0077** |
| **Recurrent afebrile seizure** | 357 (38.8 %) | 196 (38.4 %) | 0.9548 |
| **Gender (male)** | 512 (55.8 %) | 292 (57.5 %) | 0.5402 |
| **Age (year)** | 5.59 ± 0.16 | 6.06 ± 0.24 | 0.2517 |
| **First simple FK*** | 2.05 ± 0.18 | 2.33 ± 0.13 | 0.1541 |
| **First complex FK*** | 2.18 ± 0.30 | 2.28 ± 0.34 | 0.3305 |
| **Recurrent simple FK*** | 3.14 ± 0.26 | 3.11 ± 0.41 | 0.4767 |
| **Recurrent complex FK*** | 1.56 ± 0.35 | 0,66 | - |

| | | | |
|---|---|---|---|
| **First afebrile seizure** | 6.50 ± 0.31 | 6.03 ± 0.39 | 0.1008 |
| **Recurrent afebrile seizure** | 7.45 ± 0.27 | 8.51 ± 0.40 | **0.0206** |
| **Mean hospitalization day** | 1.13 ± 0.03 | 1.26 ± 0.08 | 0.2788 |
| **First simple FK*** | 1.10 ± 0.04 | 1.18 ± 0.07 | 0.2637 |
| **First complex FK*** | 1.10 ± 0.10 | 1.17 ± 0.17 | 0.4327 |
| **Recurrent simple FK*** | 1.07 ± 0.07 | 1.15 ± 0.10 | 0.3495 |
| **Recurrent complex FK*** | 0.25 ± 0.25 | 0 | - |
| **First afebrile seizure** | 1.13 ± 0.05 | 1.31 ± 0.16 | 0.3182 |
| **Recurrent afebrile seizure** | 1.20 ± 0.06 | 1.13 ± 0.07 | 0.2062 |
| **Arrival by ambulance** | 152 (16.6 %) | 53 (10.4 %) | **0.0016** |

*FK: febrile convulsion

Table 2 reveals that the average monthly seizure admission decreased in the lockdown period compared to the prelockdown period.

**Table 2.** Average number of patients admitted to the emergency department per month during the one year before and after the pandemic

| **Monthly average admission** | **2019 Mar-2020 Feb** | **2020 Mar-2021 Feb** | ***P value*** |
|---|---|---|---|
| **Total admission** | 76.50 ± 3.30 | 42.33 ± 2.93 | **<0.0001** |
| **Febrile seizures** | 24.17±3.33 | 10.42±1.45 | **<0.0001** |
| *First simple FK** | 17.17±2.99 | 6.92 ± 1.05 | **<0.0003** |
| ***First** complex FK** | 2.5 ± 0.51 | 1.42 ± 0.31 | **<0.0430** |
| ***Recurrent** simple FK** | 4.17 ± 0.68 | 2.08 ± 0.50 | **<0.0111** |
| *Recurrent complex FK** | 0.33 ± 0.19 | 0.08 ± 0.08 | - |
| **Nonfebrile seizures** | 52.33±1.92 | 31.92±2.21 | **<0.0001** |
| *First nonfebrile seizure* | 22.67±1.31 | 15.58±1.56 | **0.0016** |
| *Recurrent nonfebrile seizure* | 29.67±1.84 | 16.25±1.40 | **<0.0001** |

*FK: febrile convulsion

Fig. 1 shows the total number of accesses to PED in all types of seizures.

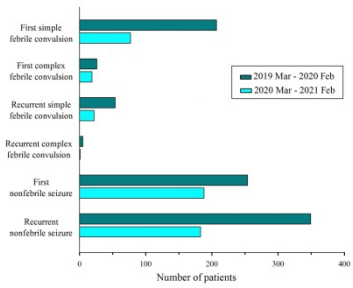


**Fig. 1.** Total number of visits by seizure type

Fig. 2 shows the monthly PED visits during the lockdown and prelockdown periods, while Figs. 3 and 4 demonstrate the monthly numbers of febrile and afebrile seizure-related visits, respectively.

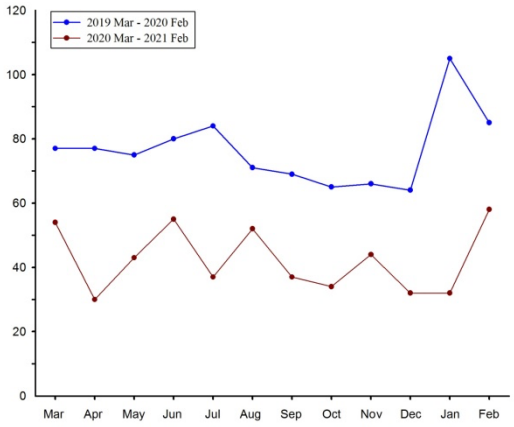


**Fig. 2.** Monthly number of seizure-related visits

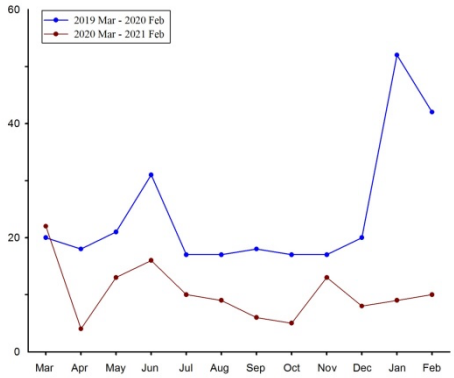


**Fig. 3.** Monthly number of febrile seizure-related visits

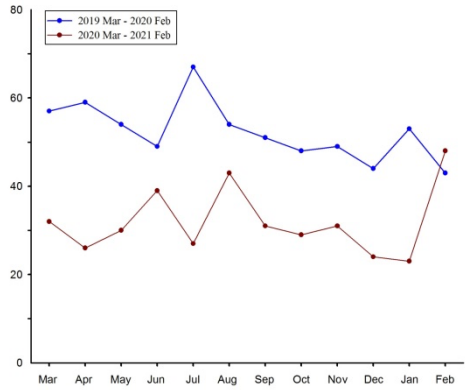


**Fig. 4.** Monthly number of afebrile seizure-related visits admitted to the emergency department during the one year before and after the pandemic

## 4. Discussion

The impact of the lockdown on healthcare was evident, with the suspension of routine outpatient services and the postponement of all non-emergency care (5). There has been a decrease in PED admissions for many diseases such as asthma and acute respiratory tract infections (12). However, the access frequency to PED for severe medical illnesses such as seizures is not expected to change.

Seizures are one of the most common reasons for PED

visits in children (13). Hartnett et al (14) observed reductions in PED visits in patients seeking medical care for reasons other than COVID-19, including patients with epilepsy. In this study, while the total number of patients admitted to PED during the prelockdown period was 37.323, it decreased more than three times to 10.191 during the lockdown period, consistent with the literature. Furthermore, the number of pediatric patients with total seizures was 918 in the prelockdown period and decreased to 508 in the lockdown period in the current study. The decrease in seizure admissions was not as dramatic as total admissions.

The literature reported increasing depression and sleep disorders in children during the pandemic (15). It also led to children forming unwanted habits about food, screen time and physical activities due to social restrictions (16). Children were exposed to social media through tools such as tablets, TVs and smartphones at home (17).

The COVID-19 pandemic can exacerbate existing mental health issues due to the unique combination of anxiety, uncertainty, fear of getting sick or losing our daily routines, seeing a loved one sick and life's challenges (18). Segre et al. (19) showed that 78% of children aged 6-14 years developed anxiety symptoms due to the COVID-19 pandemic quarantine measures, and most of the participants in this study stated they had difficulty adapting to learning at home and changed their eating and sleeping habits. It is commonly known that patients with epilepsy are susceptible to physical or emotional deterioration or lifestyle and environmental changes, and these changes may trigger seizures in patients with a predisposition to seizures (8).

We evaluated the number of patients with febrile and afebrile seizures admitted to the pediatric PED before and after lockdown for one year each. We found the first simple febrile seizure rate to be significantly lower after closure, which may be the result of a decrease in other infections due to complete closure and the importance given to hygiene. Although not statistically significant, there was a slight decrease in recurrent febrile seizures.

Smarrazzo et al. (20) reported that the percentage of febrile seizures admitted to PED during the lockdown period between March 1 and May 31 increased from 2.06% to 11.62%. Only 2 of 25 febrile seizure patients tested positive for COVID-19 during this period. In our study, 4 of 126 patients presenting with febrile seizures tested positive for COVID-19.

This study evinced a significant increase in the rate of first afebrile seizures during the lockdown period. These findings confirm the view that changes in living habits, including mobile device use and sleep changes, and possible stressors may have promoted the occurrence of epileptic seizures in a child population during the COVID-19 quarantine.

We also found there was no increase or decrease in recurrent afebrile seizures, although the rate of first afebrile seizures increased. These patients might not have applied to the hospital even if they had seizures. It also showed that they used the seizure drugs regularly despite the lockdown.

Cheliet al (21) reported a decrease in the number of patients presenting to PED for seizures during the pandemic, but the decrease was not as dramatic as the decrease in overall ED attendance. They also reported an increase in the number of first seizures despite this decrease, similar to the current study.

Palladino et al. (7) found a significant increase in the prevalence and incidence of admissions to PED due to seizures in the first three months of lockdown. In the study of Sanchez-Larsen et al. (8) conducted in adults, 27% of patients reported a >50% increase in seizure frequency and this increase in seizures was associated with stress/anxiety during lockdown period.

A study from Italy (22) reported a 72% decrease in all pediatric PED accesses during the three-month quarantine period compared to the corresponding 2019 period and a 38% reduction (n=41 vs. n=66) in the number of patients presenting to ED with seizures. The observed reduction in seizure-related ED access was not accompanied by significant changes in age, gender, or hospitalization day (22). Huang et al. (23) showed that a small proportion of adult patients with epilepsy experienced increased seizures during the outbreak of COVID-19 and suggested that stress was an independent factor for triggering seizures in these patients. Chiu et al. (24) observed a significant decrease during the first four months of closure in the rate of patients who applied to PED with seizures; especially, the decrease in the 0-6 age group was more significant than the 7-18 age group. This study evinced a slight increase in the mean age of recurrent afebrile seizures in the lockdown period. While the mean age was 7.45±0.27 years in the prelockdown period, it increased to 8.51±0.40 years in the lockdown period (p=0.0206). There was no difference between the two periods in terms of the mean age of other seizures. The mean age in the first afebrile seizure group, which had an increased rate during the lockdown period, was 6.03±0.39 years, and this was the age when there was no online education.

In conclusion, we observed a significant decrease in the number of admissions to PED in febrile seizures patients. While observing no significant change at admission with recurrent afebrile seizures, there was a significant increase in the rate of first afebrile seizures. This suggested that risk factors such as depression/anxiety or screen exposure may have caused seizures in children who had a predisposition to seizures. The limitation of this publication is that it is a single-center study; it can be carried out in a larger population with several centers.

**Conflict of interest**
The authors declared no conflict of interest.

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**Authors' contributions**
Concept: E.A.Ö, G.A., T.A.D., Design: E.A.Ö., G.A., Data Collection or Processing: E.A.Ö., T.A.D., Analysis or Interpretation: G.A., Literature Search: E.A.Ö., Writing: E.A.Ö.

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