



# Evaluation of the Results of Patients with a First Afebrile Seizure Admitted to a Pediatric Emergency Department

## Çocuk Acil Servisine İlk Kez Ateşsiz Nöbet ile Başvuran Hastaların Sonuçlarının Değerlendirilmesi

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### Abstract

**Introduction:** This study aimed to evaluate the neuroimaging results and associated characteristics of patients admitted to a pediatric emergency department for their first afebrile seizures.

**Methods:** Patients admitted to the Emergency Room of University of Health Sciences Turkey, Ankara Dr. Sami Ulus Children's Hospital between January 1, 2016 and December 31, 2019, with a diagnosis of first afebrile seizure were included in this study. Patients in this study included children without prior neurological or chronic disease and no history of drug use. The medical files of the patients were examined retrospectively.

**Results:** In our study group, 55% were male (n=22) and 45% were female (n=18). The median age was 4.50 (0.25-17.00) years. The median seizure duration was 5.0 (0.03-30.0) minutes. Physical examinations performed in the emergency department yielded unremarkable findings in 80% (n=32) of the patients. A computed tomography scan detected a specific pathology in 10% (n=4) of the patients and magnetic resonance imaging was used in 12.5% (n=5) of the patients. There was no significant difference in terms of gender, age, and seizure duration between patients with and without pathology detected in neuroimaging (p>0.05).

**Conclusion:** On evaluating patients admitted to the emergency department with their first afebrile seizures, 85% had normal neuroimaging findings. Variables such as gender, age, and seizure duration were not associated with the presence or absence of pathology in neuroimaging.

**Keywords:** Childhood, pediatric emergency department, afebrile seizures

### Öz

**Giriş:** Bu çalışmanın amacı ilk kez ateşsiz nöbetle çocuk acil servisine başvuran hastaların beyin görüntüleme sonuçlarını ve ilişkili özelliklerini değerlendirmektir.

**Yöntemler:** Bu çalışma 1 Ocak 2016 ile 31 Aralık 2019 tarihleri arasında Sağlık Bilimleri Üniversitesi, Ankara Dr. Sami Ulus Çocuk Hastanesi Acil Servisi'ne başvuran ateşsiz nöbet tanılı hastalar ile yapıldı. Daha önce nörolojik hastalığı ya da süregelen hastalığı olmayan, herhangi bir ilaç kullanım öyküsü bulunmayan çocuklar çalışmaya dahil edildi. Hastaların tıbbi dosyaları geriye dönük olarak incelendi.

**Bulgular:** Çalışma grubumuzun %55'i erkek (n=22), %45'i kadın (n=18) idi ve ortalama yaş 4,50 (minimum=0,25-maksimum=17,00) yıl idi. Ortanca nöbet süresi 5,0 (minimum=0,03-maksimum=30,0) dakika idi. Acil serviste yapılan fizik muayenelerde hastaların %80'inde (n=32) kayda değer bulgular yoktu. Hastaların %10'unda bilgisayarlı tomografi (n=4), %12,5'inde manyetik rezonans görüntüleme (n=5) ile özgül bir patoloji saptandı. Nörogörüntüleme patolojisi olan ve olmayan hastalar arasında cinsiyet, yaş ve nöbet süresi açısından anlamlı fark yoktu (p>0,05).

**Sonuç:** İlk kez ateşsiz nöbet nedeniyle acil servise başvuran hastaların %85'inde normal beyin görüntüleme bulguları vardı. Cinsiyet, yaş ve nöbet süresi gibi değişkenler nörogörüntüleme patolojinin varlığı veya yokluğu ile ilişkili değildi.

**Anahtar Kelimeler:** Çocuk, pediatrik acil servis, ateşsiz nöbet

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## Introduction

The term "seizure" can be briefly defined as the clinical manifestation of abnormal electrical stimulation in the brain. Seizures frequently encountered in childhood constitute an important proportion of pediatric emergencies. During childhood, admission to the emergency department with a seizure is a common occurrence, especially in children younger than 24 months.<sup>1,2</sup> Seizures and related symptoms constitute approximately 1% of all visits to the emergency department.<sup>3</sup> Seizures can be grouped according to the localization of the physical manifestation (focal or generalized) and presence or absence of fever.<sup>4,5</sup> Most of the seizures seen in the childhood are febrile.<sup>6,7</sup> Afebrile seizures are seen less frequently, but they are more likely associated with structural pathologies.<sup>6,7</sup> Computed tomography (CT) is the primary imaging modality used for the immediate evaluation of pediatric patients presenting to the emergency department with an afebrile seizure and is the preferred imaging method to rule out situations that require immediate intervention. However, magnetic resonance imaging (MRI) must be performed when indicated.<sup>8,9</sup> To detect possible pathologies, it is important when evaluating patients presenting to the emergency department with afebrile seizures to use imaging methods such as CT and MRI to minimize the probability and severity of sequelae. Several studies have reported that patients with facilitating factors, including younger age and longer seizure duration, have more frequent pathological findings in the neuroimaging results.<sup>9-13</sup>

Clinicians should predict the possibility of neurological pathologies whenever neuroimaging methods, such as CT or MRI, are indicated, and this is not only to be able to make an accurate diagnosis, but also determine the extent of neurological damage and treatment approach as quickly as possible. This study aimed to evaluate the frequency of neuroimaging findings and determine the relationships between these findings and various characteristics of patients who presented to a pediatric emergency department with their first afebrile seizures.

## Materials and Methods

This study included patients admitted to the Department of Pediatric Radiology, University of Health Sciences Turkey, Ankara Dr. Sami Ulus Training and Research Hospital, with a diagnosis of first afebrile seizure, between January 1, 2016, and December 31, 2019. All patients (except for those with incomplete medical records) diagnosed with their first afebrile seizures at the specified dates were included in the study. Patients in this study included children without prior neurological or chronic disease and no history of drug use. The

medical files of the patients were examined retrospectively. All patients had undergone CT within the first 24-48 hours after admission, and MRI investigations were performed when clinically indicated. The results were evaluated and recorded by a pediatric radiologist and pediatrician. Ethics committee approval was obtained from the Ethics Committee of University of Health Sciences Turkey, Ankara Dr. Sami Ulus Obstetrics and Gynecology Child Health and Diseases Training and Research Hospital (date: 16/12/2019, no: 2019/12). Written informed consent was obtained from all subjects (patients or parents).

## Statistical Analysis

All analyses were performed using SPSS v21 (SPSS Inc., Chicago, IL, USA). Fisher's Exact test was used to compare categorical data in pairs. The Shapiro-Wilk test was used to determine whether quantitative variables were normally distributed. Due to the lack of adherence to parametric assumptions, the Mann-Whitney U test was used to compare the age and seizure duration of groups with and without pathology. A p-value less than 0.05 was considered statistically in all tests.

## Results

55% of the subjects were male (n=22) and 45% were female (n=18). The median age was 4.50 (0.25-17.00) years. Information regarding seizure frequency before admission to the emergency department is as follows: 75% (n=30) experienced seizures one time; 7.5% (n=3), two times; 5.0% (n=2), three times; 12.5% (n=4), four times. The median seizure duration was 5.0 (0.03-30.0) minutes. Medical history showed that 32.5% of the patients (n=13) presented to our outpatient clinic with other reasons at least once in the same year before presenting to the emergency department with an afebrile seizure (Table 1). Physical examination performed in the emergency department was unremarkable in 80% (n=32) of the patients, whereas 10% (n=4) of the patients were deemed in a moderate/poor status, and one child (2.5%) had no response to painful stimulation in addition to being intubated, agitated, and asleep.

The CT scan detected a specific pathology in 10% of the patients (n=4), and MRI was used in 12.5% of the patients (n=5). In four patients (10%), abnormal CT findings were acute hydrocephalus, choroid plexus cyst, secondary infarction in the mild infarct in right posterior border zone, and arachnoid cyst. The CT images also showed an effusion with air-fluid level in the right maxillary sinus in one patient and loss of aeration in the right mastoid in another patient. Pathologies detected on MRI are diffusion restriction in the corpus callosum splenium, infarct, pineal cyst, choroid plexus cyst, and cystic

encephalomalacic cavity in the temporoparietal region. A form of pathology was detected by an imaging method in 15% (n=6) of the patients. The median number of follow-up visits to our hospital after the afebrile seizure was three (0-15). 87.5% (n=35) of the patients were recommended to present to the neurology department, 12.5% (n=5) of the patients were asked to have a neurology consultation, and 20% (n=8) of the patients presented to the neurology department (Table 2).

<b>Age (years)</b>	<b>4.50 (0.25-17.00)</b>
<b>Gender</b>	
Male	22 (55.0)
Female	18 (45.0)
<b>Admission to the outpatient clinic</b>	
Not admitted to hospital	27 (67.5)
1-2	6 (15.0)
≥3	7 (17.5)
<b>Number of seizures</b>	
1	30 (75.0)
≥2	10 (25.0)
Seizure duration (minutes)	5.0 (0.03-30.0)
Data are given as median (minimum-maximum) for continuous variables and frequency (percentage) for categorical variables	

<b>CT findings</b>	
Normal	36 (90.0)
Abnormal	4 (10.0)
<b>CT additional findings</b>	
No	38 (95.0)
Yes	2 (5.0)
<b>MRI findings</b>	
No MRI	17 (42.5)
Normal	18 (45.0)
Abnormal	5 (12.5)
<b>Referral to the neurology</b>	
Recommended to apply	35 (87.5)
Consultation requested	5 (12.5)
<b>Neurology follow-up status</b>	
Followed	8 (20.0)
Not followed	32 (80.0)
<b>Number of follow-up visits after a afebrile seizure</b>	
No follow-up	8 (20.0)
1-2	10 (25.0)
≥3	22 (55.0)
Data are given as frequency (percentage) for categorical variables, CT: Computed tomography, MRI: Magnetic resonance imaging	

Neuroimaging was found to be abnormal in 22.7% of males (n=5) and 5.6% of females (n=1) (p=0.197). The median age in patients with normal neuroimaging was 5.50 (0.25-17.00) years and 3.0 (5.0-14.0) years in patients with a pathology (p=0.361). The median seizure duration in patients with normal neuroimaging was 4.00 (0.33-30.00) minutes and 22.50 (0.25-30.0) minutes for those with pathology (p=0.132). There was no significant difference in terms of gender, age, and seizure duration between patients with and without pathology in neuroimaging. The median seizure duration is five (0.33-30.0) minutes in patients under the age of five years and four (0.25-0.30) minutes in patients aged five years and older (p=0.935). In patients under five years of age, pathology was detected in 15.0% of the patients (n=3) on using CT and 36.4% of the patients (n=4) on using MRI (p=0.605). In patients aged five years and older, pathology was detected in 5.0% of the patients (n=1) on using CT and 9.1% of the patients (n=1) on using MRI (p=0.311).

On examining the treatments given to the patients, it was found that 42.5% of the patients (n=17) were given levetiracetam; 15% (n=6), phenobarbital; 12.5% (n=5), valproic acid; 2.5% (n=1), nasal midazolam and levetiracetam; 2.5% (n=1), nasal midazolam and phenytoin; 2.5% (n=1), levetiracetam and phenytoin; 22.5% of the patients (n=9) received no medications.

## Discussion

Afebrile seizures may be the first sign of important pathologies that are frequently seen in pediatric emergency and adversely affect the child. Therefore, it is crucial to closely examine these patients and provide appropriate treatment(s). In this study, 80% of patients who presented to the emergency department with their first afebrile seizure had an unremarkable physical examination, 90% had normal CT results, and 78% had normal MRI results. Regardless of the imaging method, pathology was detected in 15% of patients undergoing neuroimaging. Gender, age, and seizure duration were similar between patients with normal neuroimaging results and those with any pathology observed in the imaging studies.

CT can be used in patients having seizures without fever. In our study, CT was the first choice imaging method because, compared with MRI, the advantages of CT are rapid acquisition of images and easy performance and needing no sedation. In a similar study, Güneş and Cebeci<sup>14</sup> assessed the imaging results of 64 children admitted to the emergency department with afebrile seizures. They reported that 84% of children with afebrile seizures had normal CT results and 67% had normal MRI results.<sup>14</sup> Al-Shami et al.<sup>9</sup> also reported that 67% of children had normal MRI and CT findings. Additionally, they found that patients aged less than two years and those with

seizure duration of more than five minutes were more likely to have some form of pathology in their imaging.<sup>9</sup> Although the frequency of pathological findings in imaging studies was similar, we did not find any relationship between patient characteristics. This may be associated with the relatively small number of patients included in the study. Sharma et al.<sup>10</sup> reported that 83% of the children had completely normal and 92% had clinically insignificant neuroimaging results in their study with a large number of participants and compiled the emergent neuroimaging results of children with afebrile seizures. Besides these studies, several studies have reported that pathological findings were detected in patients who underwent neuroimaging results after afebrile seizures, with frequencies ranging from 8% to 67%.<sup>15-19</sup> In the current study, 36 of 40 patients had normal CT results, while MRI results were normal in 18 of the 23 patients who underwent MRI imaging. Regardless of the imaging method used, at least one type of pathology was detected in 15% of the patients. On evaluating other studies, it was found that the results of our study are compatible with previous findings in the literature. The differences in the frequency of pathologies may be associated with various factors, such as patient inclusion/exclusion criteria, medical history of patients (prior seizures, comorbidities), and hospitals/departments where these studies were conducted.

Various variables have been examined in hopes that they may provide a chance to predict patients with higher severity in afebrile seizures. Among these, neuroimaging results may be the most reliable due to their consistency. Therefore, we investigated the relationship between detecting pathology on neuroimaging results and variables such as gender, age, and seizure duration. However, there was no significant association between any of these variables and the presence/absence of pathological findings in imaging studies. Besli et al.<sup>15</sup> reported that pathologies were found more frequently in children who were younger than two years and had factors increasing the risk of seizures. Similar to our study, they also found that the duration of seizure did not affect the frequency of pathology presence.<sup>15</sup> In many studies, the neuroimaging results of patients who had their first afebrile seizure at a younger age were more frequently abnormal.<sup>9-13</sup> In most of these studies, the cut-off point of age was between one and five years. Seizures are most commonly seen in infants younger than one year, and the majority of these seizures are febrile.<sup>4</sup> Besides age, longer duration of seizure may also be associated with more frequent pathological findings, and the presence of pathological findings in neuroimaging and longer seizure duration are also among the factors suggested to be associated with poor prognosis.<sup>9</sup> In contrast to these studies, there are also studies similar to ours in which no significant differences were found between the presence/absence of

pathology in neuroimaging and the duration of seizures.<sup>14,15</sup> In our study, no significant relationship was found between age or seizure duration and the determination of pathology on CT or MRI. The limited number of individuals evaluated in our study and the relatively small number of pathologies detected in neuroimaging may be the reason for the lack of a relationship.

### Study Limitations

This study has some limitations. Our study is a single-center study, and its generalizability is limited. Most of the studies in the literature included patients who had afebrile seizures for the first time. Patients who received medications that could trigger seizures were excluded from the studies. In our study, patients who previously had afebrile seizures were excluded, but the use of drugs to trigger seizures was not questioned. Another important limitation was that patients were not questioned in terms of seizure facilitating factors, such as family history, comorbidities, and abnormal laboratory results. Finally, in this study, we evaluated patient admissions to our hospital only and did not assess the results of admissions elsewhere. Participants may have presented to other health institutions before or after they were included in our study. These limitations must be kept in mind when evaluating our results.

### Conclusion

On evaluating patients who presented to the emergency department with their first afebrile seizures, we found that 85% had normal results in neuroimaging. Variables such as gender, age, and seizure duration were not associated with pathology detection in neuroimaging, indicating a lack of specific relationships between imaging results and patient characteristics. In further studies, the inclusion of a higher number of patients and more detailed examination of a broader set of variables could help in the identification of the severity of patients with afebrile seizures. Such relationships may aid clinicians in determining patients who require immediate intervention.

### Ethics

**Ethics Committee Approval:** Ethics committee approval was obtained from the Ethics Committee of University of Health Sciences Turkey, Ankara Dr. Sami Ulus Obstetrics and Gynecology Child Health and Diseases Training and Research Hospital (date: 16/12/2019, no: 2019/12).

**Informed Consent:** Written informed consent was obtained from all subjects (patients or parents).

**Peer-review:** Externally peer-reviewed.

## Authorship Contributions

Concept: Ç.Ü., C.D.K., Design: Ç.Ü., C.D.K., Data Collection or Processing: Ç.Ü., A.T., Analysis or Interpretation: Ç.Ü., C.D.K., Literature Search: Ç.Ü., A.T., Writing: Ç.Ü.

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## References

1. Hauser WA. Epidemiology of epilepsy in children. *Neurosurg Clin N Am.* 1995;6:419-29.
2. Dayan PS, Lillis K, Bennett J, Conners G, Bailey P, et al. Interobserver agreement in the assessment of clinical findings in children with first unprovoked seizures. *Pediatrics.* 2011;127:e1266-71.
3. Pallin DJ, Goldstein JN, Moussally JS, Pelletier AJ, Green AR, et al. Seizure visits in US emergency departments: epidemiology and potential disparities in care. *Int J Emerg Med.* 2008;1:97-105.
4. Martindale JL, Goldstein JN, Pallin DJ. Emergency department seizure epidemiology. *Emerg Med Clin North Am.* 2011;29:15-27.
5. Berg AT, Berkovic SF, Brodie MJ, Buchhalter J, Cross JH, et al. Revised terminology and concepts for organization of seizures and epilepsies: report of the ILAE Commission on Classification and Terminology, 2005-2009. *Epilepsia.* 2010;51:676-85.
6. Berg AT, Jallon P, Preux PM. Chapter 43 - The epidemiology of seizure disorders in infancy and childhood: definitions and classifications. In: Dulac O, Llassonde M, Sarnat HB, eds. Chapter 43 - The epidemiology of seizure disorders in infancy and childhood: definitions and classifications, Edition ed: Elsevier; 2013:391-98.
7. Patel N, Ram D, Swiderska N, Mewasingh LD, Newton RW, et al. Febrile seizures. *BMJ.* 2015;351:h4240.
8. Duncan JS. Brain imaging in epilepsy. *Pract Neurol.* 2019;19:438-43.
9. Al-Shami R, Khair AM, Elseid M, Ibrahim K, Al-Ahmad A, et al. Neuro-imaging evaluation after the first afebrile seizure in children: A retrospective observational study. *Seizure.* 2016;43:26-31.
10. Sharma S, Riviello JJ, Harper MB, Baskin MN. The role of emergent neuroimaging in children with new-onset afebrile seizures. *Pediatrics.* 2003;111:1-5.
11. Maytal J, Krauss JM, Novak G, Nagelberg J, Patel M. The role of brain computed tomography in evaluating children with new onset of seizures in the emergency department. *Epilepsia.* 2000;41:950-4.
12. Aprahamian N, Harper MB, Prabhu SP, Monuteaux MC, Sadiq Z, et al. Pediatric first time non-febrile seizure with focal manifestations: is emergent imaging indicated? *Seizure.* 2014;23:740-5.
13. McAbee GN, Barasch ES, Kurfist LA. Results of computed tomography in "neurologically normal" children after initial onset of seizures. *Pediatr Neurol.* 1989;5:102-6.
14. Güneş A, Cebeci D. İlk Kez Afebril Nöbet Geçiren Çocuklarda Nörogörüntüleme Bulguları. *Türkiye Çocuk Hastalıkları Dergisi.* 2019;2:67-72.
15. Besli GE, Karatoprak EY, Saltık S, Özdoğan Ş, Özümüt S. First Afebrile Seizure in Children: Which Patients Require Emergent Neuroimaging? *J Pediatr Emerg Intensive Care Med.* 2017;4:47.
16. Saini N, Baghel A. Neuro-imaging abnormalities in children with first afebrile seizure. *IOSR J Dent Med Sci (IOSR-JDMS).* 2013;5:21-4.
17. Mathur S, Southern K, Sharma M. Significant findings on cranial CT scan after a first unprovoked seizure in children from North India. *J Trop Pediatr.* 2007;53:428-30.
18. Tavassoli A, Noormohammadi S. Factors related to abnormal neuroimaging in children with first unprovoked seizure. *Iranian Journal of Child Neurology.* 2011;5:15-20.
19. Shinnar S, O'Dell C, Mitnick R, Berg AT, Moshe SL. Neuroimaging abnormalities in children with an apparent first unprovoked seizure. *Epilepsy Res.* 2001;43:261-9.