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Paroxysmal Non-Epileptic Events in Pediatric Patients: A Three-Year Experience from a Tertiary Center



Emek Uyur¹ , Nilüfer Eldeş Hacifazlıoğlu¹ , Derya Güder¹ , Bilgihan Bıkmazer¹ , Azize Büyükoç²  &
Rabia Gönül Sezer Yamanel³ 

¹ University of Health Sciences, Zeynep Kamil Maternity and Children's Diseases Training and Research Hospital, Department of Pediatric Neurology, Istanbul, Türkiye

² University of Health Sciences, Zeynep Kamil Maternity and Children's Diseases Training and Research Hospital, Department of Developmental Pediatrics, Istanbul, Türkiye

³ University of Health Sciences, Zeynep Kamil Maternity and Children's Diseases Training and Research Hospital, Department of Pediatrics, Istanbul, Türkiye

Abstract

Objectives: Paroxysmal non-epileptic events (PNEs) are common in the pediatric age group. PNEs can generally be differentiated by their distinct symptomatology and the absence of epileptiform activity on electroencephalography (EEG). This study aimed to examine the types and distribution of PNEs among children referred to a tertiary pediatric neurology center.

Materials and methods: The data of 512 patients who were referred to the Pediatric Neurology outpatient clinic for the differential diagnosis of epilepsy and subsequently diagnosed with PNEs between January 2022 and December 2024 were retrospectively evaluated.

Results: Of the 512 patients, 255 were male (49.8%). The most common diagnosis was syncope (38.3%), followed by breath-holding spells (27.9%) and tic disorders (9.6%). Less frequent conditions included night terrors (4.9%), shuddering attacks (4.7%), benign sleep myoclonus (3.7%), gratification disorder (3.5%), and psychogenic non-epileptic seizures (2.5%). Additional rare diagnoses, each <2%, were also identified. Tic disorder was significantly more common in males ($p < 0.001$), whereas syncope was more frequent in females ($p = 0.002$). Home video recordings were available in 20.9% of patients at the initial visit. During the follow-up, additional recordings were obtained in all cases, except for syncope. Video-EEG monitoring was required for diagnostic confirmation in only 4.5% of cases.

Conclusion: Distinguishing PNEs from epileptic seizures can be difficult; however, a detailed clinical history and examination are essential for an accurate diagnosis. Breath-holding spells were more common in early childhood, whereas syncope and tic disorders predominated in older children. Home video recordings were helpful in supporting the diagnosis and often reduced the need for video-EEG. Identifying typical patterns in outpatient settings may improve diagnostic accuracy and help prevent unnecessary tests and treatments.

Keywords

Nonepileptic event • Paroxysmal event • Childhood • Breath-holding spell • Syncope • Electroencephalography



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✉ Corresponding author: Emek Uyur emekuyur@gmail.com



INTRODUCTION

Paroxysmal nonepileptic events (PNEs) are sudden, episodic occurrences involving changes in consciousness, behavior, or movement that can closely mimic epileptic seizures. Due to their similarities, distinguishing between the two conditions can at times be challenging (1). However, they can often be differentiated through their distinct symptomatology and the absence of epileptiform activity on electroencephalography (EEG) (1-4). PNEs are particularly common in the pediatric population and are frequently misdiagnosed due to their clinical heterogeneity (5, 6). The clinical evaluation of PNEs in pediatric patients is notably complex. A comprehensive clinical history is crucial for an accurate diagnosis, focusing on factors such as the age at symptom onset, the frequency and progression of episodes, and any past or recent medical conditions (3-5, 7-9).

Growing awareness is crucial for enabling prompt diagnostic decisions and avoiding unnecessary procedures and potentially severe side effects caused by inappropriate or unnecessary treatments. Diagnostic tools such as EEG should be employed based on particular clinical suspicions (3, 9). Increasingly, home video recordings (HVRs) captured via mobile phones have become invaluable in aiding accurate diagnosis (3, 10-12).

Paroxysmal non-epileptic events can be classified into the following groups: generalized paroxysmal events such as breath-holding spells, syncope, apnea, cyclic vomiting syndrome, and benign paroxysmal vertigo; abnormal posture and movements including neonatal jitteriness, benign myoclonus of infancy, shuddering episodes, Sandifer syndrome, benign paroxysmal torticollis of infancy, motor tics, gratification disorder, stereotypes, and rage attacks; sleep-related disorders such as benign sleep myoclonus, restless leg syndrome, night terrors, narcolepsy, and cataplexy; and oculomotor disturbances including opsoclonus myoclonus syndrome, spasms nutans, and oculomotor apraxia (4, 9, 13). The distribution and clinical features of PNEs differ considerably across pediatric age groups, likely reflecting underlying developmental stages and comorbidities (2, 6, 14, 15).

Paroxysmal events account for over 4% of emergency calls worldwide, particularly in children (16, 17). PNEs are frequently encountered in pediatric neurology outpatient settings. Unlike epilepsy, epidemiological studies on PNEs remain limited. Therefore, this study aimed to examine the types and age-related distribution of PNEs among children who were referred to a tertiary pediatric neurology outpatient clinic for the differential diagnosis of epilepsy.

MATERIAL AND METHODS

Study Population

This study was conducted between January 2022 and December 2024 at the Department of Pediatric Neurology, University of Health

Sciences, Zeynep Kamil Maternity and Children's Diseases Training and Research Hospital. Between January 2021 and December 2024, a total of 43,120 visits were made to the Pediatric Neurology outpatient clinic of our hospital. As some of these were repeated visits by the same patients, it was determined that 11,248 unique patients were followed in the clinic during this 3-year period, and 2,654 of them were diagnosed with epilepsy. Figure 1 illustrates the flow chart of the study population.

A total of 512 patients were diagnosed with PNEs during follow-up. The rest consisted of patients with diagnoses such as high-risk infants, febrile seizure, headache, migraine, vertigo, developmental delay, cerebral palsy, autism, and neurogenetic or neurometabolic disorders. Patients with electroclinical evidence epilepsy were excluded from the study, including those with PNEs who also had comorbid epilepsy. In addition, patients who did not continue with regular follow-up or had incomplete medical records were excluded from the study.

The data of 512 patients diagnosed with a broad spectrum of PNEs were retrospectively reviewed. Neonates were not included in this study because of the specific characteristics of the age group. Infants older than 1 month, children, and adolescents up to 18 years of age were included.

Age, gender, symptom onset time, duration and frequency, accompanying additional symptoms, comorbidities, family history, physical and neurological examination findings, laboratory tests (complete blood count, serum electrolytes, kidney and liver function tests, thyroid function tests, folic acid and vitamin B12 levels), cranial imaging (transfontanel ultrasonography, computed tomography [CT], and/or magnetic resonance imaging [MRI]), electroencephalography (EEG) findings, and trauma/medication history were obtained from patient files. Those diagnosed with syncope also underwent comprehensive cardiac assessment, including electrocardiography, echocardiography, and, when indicated, rhythm Holter monitoring.

Although clinical history can be particularly valuable for diagnosing certain conditions such as breath-holding spells, syncope in older children, and tics, EEG recordings were performed for all patients during follow-up evaluations. Routine EEG examinations were performed using the 18-channel digital Nihon Kohden and the International 10-20 system of electrode placement, including a full wake and sleep cycle for all patients. EEG recordings were obtained during a 30-min resting state with eyes closed, including 3 min of hyperventilation (for patients able to perform it) and intermittent photic stimulation in accordance with the international protocol. For patients requiring diagnostic clarification, repeated and prolonged video-EEG monitoring—preferably during the event—was performed on an outpatient basis. Those requiring inpatient evaluation were referred to the pediatric video-EEG monitoring unit.



Ethical Approval

This study adhered to the principles of the Declaration of Helsinki and received approval from both the Ministry of Health of Türkiye and the ethics committee of our hospital (Zeynep Kamil Maternity and Children Hospital, İstanbul, Türkiye) (approval date: 09/04/2025, approval number:49). Informed consent for EEG recording and for the use of anonymized data for scientific purposes was obtained routinely from all patients or their legal guardians; given the retrospective design of the study, no additional consent was required.

Statistical Analyses

This study was designed as a retrospective cohort analysis incorporating both descriptive and analytical components to address the research objectives. The descriptive component summarized the main findings using frequencies and percentages. The analytical component involved comparing groups based on factors such as age and gender to explore significant differences, with categorical variables analyzed using the chi-square test. A p-value 0.05 was considered statistically significant. In the study, the IBM SPSS Statistics 22 (IBM SPSS, Türkiye) program was used for statistical analysis.

RESULTS

A total of 512 pediatric patients were included in the study. Of the 512 patients, 255 were male (49.8%) and 257 were female (50.2%). The mean age was 86.9 months, with a median of 78.5 months and an age range of 2–215 months. The mean follow-up duration of the patients was 15.8 months, with a median of 12.0 months, ranging from 2 to 110 months.

The most common diagnosis was syncope, observed in 196 patients (38.3%). This was followed by breath-holding spells in 143 patients (27.9%) and tic disorders in 49 patients (9.6%). Other less frequent diagnoses included night terrors in 25 patients (4.9%), shuddering attacks in 24 (4.7%), benign sleep myoclonus in 19 (3.7%), gratification disorder in 18 (3.5%), and psychogenic non-epileptic seizures in 13 (2.5%). Rare diagnoses consisted of benign paroxysmal tonic upward gaze (BPTU) ($n = 9$, 1.8%), sleepwalking ($n = 5$, 1.0%), Sandifer syndrome ($n = 3$, 0.6%), hyperekplexia ($n = 2$, 0.4%), confusional arousal ($n = 2$, 0.4%), benign paroxysmal vertigo ($n = 2$, 0.4%), jactatio capitis ($n = 1$, 0.2%), and benign paroxysmal torticollis ($n = 1$, 0.2%). The various types of PNEs identified in our patients, along with their overall and gender-based distribution, are presented in Table 1 and Table 2, respectively.

Table 1. Various types of paroxysmal nonepileptic events in our patients

Diagnosis	Patient count	Percentage (%)	Mean age (range; months)
Syncope	196	38.3	147.7 (12-214)
Breath-holding spell	143	27.9	19.7 (8-68)
Tic disorder	49	9.6	116.9 (48-215)
Night terror	25	4.9	61.1 (38-101)
Shuddering attack	24	4.7	18.1 (11-36)
Benign sleep myoclonus	19	3.7	11.4 (2-27)
Gratification disorder	18	3.5	39.5 (24-62)
Psychogenic nonepileptic seizures	13	2.5	180.1 (127-213)
Benign paroxysmal tonic upward gaze	9	1.8	26.3 (3-168)
Sleepwalking	5	1.0	147.4 (79-204)
Sandifer syndrome	3	0.6	8.7 (7-10)
Hyperekplexia	2	0.4	136.5 (89-184)
Confusional arousal	2	0.4	100.0 (94-106)
Benign paroxysmal vertigo	2	0.4	82.0 (80-84)
Jactatio capitis	1	0.2	120.0
Benign paroxysmal torticollis	1	0.2	24.0

Table 2. Gender-based distribution of the various types of paroxysmal nonepileptic events in our patients

Diagnosis	Females n (%)	Males n (%)
Syncope	116 (59.2)	80 (40.8)
Breath-holding spell	65 (45.5)	78 (54.5)
Tic disorder	7 (14.3)	42 (85.7)
Night terror	13 (52.0)	12 (48.0)
Shuddering attack	13 (54.2)	11 (45.8)
Benign sleep myoclonus	9 (47.4)	10 (52.6)
Gratification disorder	13 (72.2)	5 (27.8)
Psychogenic nonepileptic seizures	9 (69.2)	4 (30.8)
Benign paroxysmal tonic upward gaze	6 (66.7)	3 (33.3)
Sleepwalking	0	5 (100.0)
Sandifer syndrome	1 (33.3)	2 (66.7)
Hyperekplexia	0	2 (100.0)
Confusional arousal	2 (100.0)	0
Benign paroxysmal vertigo	2 (100.0)	0
Jactatio capitis	0	1 (100.0)
Benign paroxysmal torticollis	1 (100.0)	0
Total (n:512)	257	255

As the study included only patients with PNEs, no comparison could be made between patients with and without PNEs to assess the association between gender and the occurrence of PNEs. Among the PNE subgroups, tic disorder was significantly more common in males ($\chi^2 = 26.384$, $p < 0.001$), whereas syncope was more frequent in females ($\chi^2 = 9.689$, $p = 0.002$). For other PNE subgroups such as psychogenic seizures, breath-holding spells, night terrors, and

others, gender differences were not statistically significant ($p > 0.05$ for all).

Familial consanguinity was noted in 49 of the 512 cases (9.6%). Among all types of PNEs, 95 patients (18.6%) had a positive family history of similar conditions, and the distribution of PNEs by family history is presented in Table 3. Because the study cohort consisted solely of individuals with PNEs and lacked a comparison group, no statistical association could be tested between family history and the occurrence of PNEs.

Table 3. Family history–based distribution of paroxysmal nonepileptic events

Diagnosis (Total Patients)	Positive n (%)	Negative n (%)
Syncopal (n=196)	26 (13.3%)	170 (86.7%)
Breath holding spells (n = 143)	32 (22.4%)	111 (77.6%)
Tic disorder (n = 49)	13 (26.5%)	36 (73.5%)
Night Terror (n = 25)	4 (16.0%)	21 (84.0%)
Shuddering attack (n = 24)	4 (16.7%)	20 (83.3%)
Benign sleep myoclonus (n = 19)	2 (10.5%)	17 (89.5%)
Gratification disorder (n:18)	1 (5.6%)	17 (94.4%)
Psychogenic seizures (n = 13)	5 (38.5%)	8 (61.5%)
Benign paroxysmal tonic upward gaze (n = 9)	0 (0%)	9 (100%)
Sleepwalking (n=5)	3 (60.0%)	2 (40.0%)
Sandifer syndrome (n = 3)	0 (0%)	3 (100%)
Hyperekplexia (n=2)	2 (100%)	0 (0%)
Confusional arousal (n = 2)	0 (0%)	2 (100%)
Benign paroxysmal vertigo (n = 2)	2 (100%)	0 (0%)
Jactatio capitis (n = 1)	1 (100%)	0 (0%)
Benign paroxysmal torticollis (n = 1)	0 (0%)	1 (100%)
Total (n=512)	95 (18.6%)	417 (81.4%)

Statistical analysis using Fisher's exact test (two-tailed) revealed a significant association between family history and certain PNE subgroups. Significant associations were observed for syncope ($p = 0.019$), sleepwalking ($p = 0.047$), hyperekplexia ($p = 0.034$), and benign paroxysmal vertigo ($p = 0.034$), whereas no significant differences were found for the remaining subgroups (all $p > 0.05$). Psychogenic seizures, although relatively infrequent, had the highest proportion of positive family history (38.5%), followed by sleepwalking (60.0%). These findings should be interpreted with caution because of the small sample sizes in some subgroups.

In our cohort, the main causes of syncope were neurocardiogenic (vasovagal) (134/196; 68.4%), cardiac (15/196; 7.7%), and psychogenic (pseudosyncope) (8/196; 4.1%). The remaining cases were classified as unexplained syncope (39/196; 19.9%). Psychogenic syncope was analyzed within the syncope subgroup, whereas psychogenic nonepileptic seizures were evaluated as a separate category.

Children with PNEs were divided into three age groups: 1) < 7 years ($n = 269$, 52.5%), 2) 7–12 years ($n = 101$, 19.7%), and 3) > 12 years ($n = 142$, 27.7%). Breath-holding spells ($n = 143$), benign sleep myoclonus ($n =$

19), and gratification disorder ($n = 18$) were exclusively observed in children younger than 7 years. Psychogenic non-epileptic seizures ($n = 13$) were seen predominantly in the > 12 years group ($n = 12$, 92.3%), with only one patient in the 7–12 years group. Syncope ($n = 196$) was distributed across all age groups, being most common in adolescents (> 12 years, $n = 114$, 58.2%). The age distribution of PNE subtypes is summarized in Figure 2.

All patients diagnosed with PNEs underwent at least one neuroimaging modality, including TFUS, cranial CT, and/or MRI, either at our center or at referring institutions during follow-up. TFUS was available in 94 patients, revealing cavum septum pellucidum in 3 patients and mild dilatation of the lateral ventricles in 2 patients. Cranial MRI was performed in 325 patients, cranial CT in 142, and both CT and MRI in 84 patients. Structural abnormalities included cerebellar vermis hypoplasia in 3 patients, cerebellar atrophy in 1 patient, arachnoid cysts in the cerebellar or temporal regions in 5 patients, lateral ventricular asymmetry in 3 patients, and corpus callosum hypoplasia in 1 patient.

At the initial outpatient visit, a smartphone or home video recording was available in 107 of 512 patients (20.9%). Routine wakefulness–sleep EEG recordings were performed in all patients and were interpreted as normal. During follow-up, long-term video-EEG monitoring was utilized in 23 patients (4.5%) for definitive diagnostic clarification. All patients ultimately diagnosed with psychogenic nonepileptic seizures ($n = 13$) underwent video-EEG, which was essential for confirming the diagnosis. Furthermore, video-EEG contributed to the diagnostic clarification in 4 of 143 patients with breath-holding spells, 4 of 196 with syncope, and 2 of 3 with Sandifer syndrome.

DISCUSSION

Both epilepsy and PNEs are more frequently observed during childhood than in other age groups (14,18). PNEs in children encompass a broad spectrum of phenomena, including benign developmental manifestations, sleep-related behaviors, functional (psychogenic) episodes, and reflex responses (9, 13–15). A considerable number of children referred with a preliminary diagnosis of epilepsy are ultimately found to have PNEs (1, 2, 4).

Advances in clinical evaluation, along with the increasing use of home video recordings, have enabled the accurate diagnosis of many cases at the primary care level (2, 3, 10–12). Nevertheless, electroencephalographic assessment—particularly wake–sleep EEG and prolonged video-EEG monitoring—remains critical for differential diagnosis and diagnostic confirmation (13, 19). While previous studies have predominantly focused on the proportion of such referrals resulting in a PNE diagnosis, the present retrospective study aimed to characterize the clinical spectrum and distribution of PNEs among children evaluated in routine pediatric neurology outpatient practice (2, 5, 13, 19).

Over a 3-year period, 11,248 patients were evaluated in our clinic, with 25.4% diagnosed with epilepsy and 4.6% with PNEs. The reported frequencies of PNEs in pediatric cohorts vary widely across studies, ranging from 3.5% to 25% (2, 13, 20-22). In a study conducted by Chen et al. on children aged ≤ 2 years who were diagnosed with PNEs based on video-EEG recordings, the prevalence of PNEs was reported to be 38.3% (23). The 4.6% frequency observed in our cohort falls within this previously reported range and underscores the importance of clinical awareness and accurate differential diagnosis of PNES in pediatric practice. In the literature, most studies reporting a diagnosis of PNEs have been conducted in pediatric video-EEG monitoring units (2,19,20,24). In contrast to these studies, our cohort comprised patients diagnosed with PNEs in a pediatric outpatient clinic setting. During the diagnostic process, all patients underwent routine wake-sleep EEG recordings. Of these, 23 patients required long-term video-EEG monitoring for the diagnostic confirmation of PNEs, with the majority of this subgroup (13 out of 23) ultimately diagnosed with psychogenic non-epileptic seizures.

The age-dependent distribution of the PNE subtypes observed in our study is consistent with previous reports. Earlier studies have shown that physiologic events, including breath-holding spells and benign sleep phenomena, are predominantly observed in early childhood, while psychogenic non-epileptic seizures tend to occur during adolescence (6, 14, 15). Syncope, although present across all pediatric age groups, has been reported to increase with age, particularly in the second decade of life. These findings highlight the relevance of age-specific diagnostic considerations in routine pediatric practice.

Syncope is one of the most common types of nonepileptic events in both children and adolescents. It is characterized by a brief loss of consciousness and muscle tone, followed by full recovery without any lasting neurological effects (25). In our study, syncope emerged as the most prevalent PNE in the pediatric population, with a frequency of 38.3%. This rate is considerably higher than previously reported figures, which range between 13% and 17.5% (13, 21). This difference may be attributed to variations in referral patterns and the clinical setting. Specifically, our data were obtained from a general outpatient neurology clinic rather than a video-EEG monitoring unit, which may have contributed to the increased frequency of syncope observed.

Furthermore, Thabit et al. similarly reported a female predominance (73.3%) and a low rate of positive family history (3.3%) among patients with syncope (13). In contrast, our cohort demonstrated a higher prevalence of syncope, and although the proportion of female patients was lower (59.2%), the gender difference remained statistically significant. Additionally, previous research has suggested that adolescent girls may be more susceptible to autonomic instability and psychosocial stress, which could contribute to the observed gender differences (26, 27).

Similar to the findings reported by Thabit et al., the three main causes of syncope in our cohort were neurocardiogenic (118/196; 60.2%), cardiac (21/196; 10.7%), and psychogenic (16/196; 8.2%) or unexplained syncope (41/196; 20.9%) (13). Notably, a statistically significant association with family history was identified within the syncope subgroup ($p = 0.019$), suggesting a potentially stronger familial contribution in this clinical subset, which might be partially explained by the high consanguinity rate (9.6%) observed in our study population.

We found that 95 of 512 patients diagnosed with PNEs (18.6%) had a family history of similar episodes. However, because the study cohort consisted solely of individuals diagnosed with PNEs and lacked a control group, it was not possible to evaluate a statistical association between family history and the occurrence of PNEs. Nevertheless, the observed rate of familial PNEs raises the possibility of familial aggregation, highlighting the need for further investigation in controlled studies.

We found that breath-holding spells represented the second most common type of PNES in our cohort, diagnosed in 27.9% of the patients, which is consistent with previous findings in the literature (13, 21). Although the literature includes studies reporting both male and female predominance among patients with breath-holding spells, our cohort showed a slightly higher proportion of boys (54.5%) (13, 20).

Additionally, a positive family history was identified in 22.4% of our patients. This discrepancy may be related to differences in the population characteristics, referral patterns, or genetic background. Several reports have shown similar rates of positive family history in breath-holding spell cases, with proportions ranging from 30.9% to 51%, possibly reflecting elevated consanguinity levels in those cohorts (13, 28).

Tics are defined as abrupt, brief, repetitive, and nonrhythmic motor movements or vocalizations that may be intermittent or persistent. They may involve a single or multiple muscle groups and are often temporarily suppressible (29). Although diagnosis is generally achievable through detailed clinical evaluation, distinguishing these motor phenomena from epileptic seizures is crucial for accurate diagnosis and appropriate management (3, 4, 29). In our cohort, tic disorders represented the third most common PNES subgroup, identified in 49 children (9.6%). Notably, the majority of these patients (85.7%) were boys, suggesting a strong male predominance within this subgroup. These findings align with the existing literature, which reports a higher prevalence of tic disorders among males (13, 22, 30). A low prevalence rate of 2.8% has also been reported in the literature, likely reflecting the fact that most tic disorders can be diagnosed clinically without the need for video-EEG monitoring (21).

Psychogenic non-epileptic seizures present with sudden and noticeable changes in behavior or consciousness that closely

resemble epileptic seizures; however, unlike true seizures, they are not accompanied by the characteristic electrical discharges on EEG. This type of paroxysmal event is commonly observed in children and adolescents (13, 14, 31). Although psychogenic non-epileptic seizures have been widely studied in adults, reports focusing on pediatric populations remain limited (24, 32, 33), despite evidence of a female predominance in both groups (24, 33, 34).

Psychogenic nonepileptic seizures are relatively common yet frequently underrecognized in pediatric patients, with many children initially misdiagnosed with epilepsy and unnecessarily treated with antiseizure medications (5, 33). Although clinical evaluation remains fundamental, video-EEG monitoring is essential for the definitive diagnosis of PNE in this group, particularly when psychogenic seizures coexist with true epileptic seizures, making the diagnostic process more complex (24, 30, 33). In our cohort, 9 of 13 patients were female, corresponding to a female-to-male ratio of 2.25:1. All of our patients were in the adolescent age group. Patients with both epilepsy and psychogenic nonepileptic seizures were not included in our study because they were classified within the epilepsy group.

The prevalence of psychogenic nonepileptic seizures was 2.5%, which is lower than the 12.3%–38.3% reported in video-EEG monitoring unit-based studies (2, 19, 21, 22). Patients suspected of having psychogenic nonepileptic seizures constitute a large subgroup in video-EEG monitoring units, as they are routinely referred there for diagnostic confirmation (19, 22, 33). Because our study was conducted in a general pediatric neurology outpatient clinic rather than a video-EEG unit, the lower PNES rate we observed likely reflects differences in the study setting and patient selection.

Sleep disorders are an important consideration in the differential diagnosis of epilepsy and were observed in 6.4% of our cohort, a prevalence that falls within the wide range reported in the literature (1.8%–14.4%) (13, 19, 30). This variability across studies likely reflects differences in the types of disorders included. Furthermore, although no overall gender difference was observed, all patients with sleepwalking were male, consistent with previous reports suggesting a male predominance in this condition (35).

Other PNEs, some of which are more frequently seen in early childhood, were also identified. Shuddering attacks and benign sleep myoclonus were identified in 4.7% and 3.7% of the patients in our cohort, respectively. In comparison, studies focusing exclusively on infants and toddlers reported much higher rates (21.1% and 10.5%, respectively) (23), likely reflecting the age-specific nature of these events, as both occur predominantly in infancy and early childhood. On the other hand, studies from video-EEG monitoring units have reported markedly lower rates; for instance, Thabit et al. identified only one patient (0.7%) with shuddering attacks (13). This likely reflects the fact that most cases can be diagnosed clinically or through home video recordings, without the need for referral to video-EEG monitoring. Overall, our findings indicate that this patient

group is frequently encountered and diagnosed in routine pediatric neurology outpatient practice.

In addition, gratification disorder, a condition characterized by self-stimulating behaviors and often accompanied by autonomic signs such as facial flushing, grunting, sweating, or posturing, may mimic epileptic seizures and lead to diagnostic confusion (14, 15). In our study, it was identified in 18 patients (3.5%), 13 of whom were girls (72.2%), showing a clear female predominance in line with previous reports (2, 13, 21, 23, 30).

Similar diagnostic challenges may arise with other uncommon PNEs. BPTU is a non-epileptic ocular motor phenomenon seen in infancy, marked by recurrent episodes of sustained upward eye deviation often accompanied by neck flexion and preserved horizontal gaze (14, 36). Although neurodevelopment is typically normal, some patients may present with additional neurological findings such as ataxia, developmental delay, or speech difficulties (36, 37). In our cohort, 9 patients were diagnosed with BPTU. One female patient with ataxia and developmental delay was found to carry a heterozygous pathogenic mutation in the CACNA1A gene, supporting its potential role in BPTU, while neurological evaluation was normal in the remaining eight cases.

Sandifer syndrome is a rare but notable condition within the spectrum of PNEs and should be considered in the differential diagnosis of episodic motor symptoms, especially in infants and toddlers (9, 14, 15). While Thabit et al. reported no cases of Sandifer syndrome in their video-EEG monitoring unit-based study, the previously reported prevalence rates ranged between 2.6% and 5.7% (2, 6, 13, 30). In our cohort, three patients (0.6%) were diagnosed with Sandifer syndrome, and in all cases, diagnostic confirmation was achieved through video-EEG monitoring.

Another clinical entity that may mimic epilepsy is hyperekplexia, which is characterized by a sudden and exaggerated startle response triggered by unexpected auditory, tactile, visual, or vestibular stimuli (9, 14, 15). Two male siblings were diagnosed with hereditary hyperekplexia type 2 carrying a homozygous pathogenic variant in the GLRB gene (c.122+1G>A), and their symptoms were effectively managed with clonazepam. Because the diagnosis of hyperekplexia can typically be established through detailed clinical evaluation and rarely requires video-EEG monitoring, studies conducted in video-EEG monitoring units have been observed to either report no typical hyperekplexia cases (as in the series by Thabit et al. and Gowda et al.) or report them at very low frequencies (e.g., a single case, 2.6%, as reported by Chen et al.) (13, 21, 23). In this study presenting data from a pediatric neurology outpatient clinic, we aimed to emphasize that hyperekplexia is an important clinical entity that should be considered in the differential diagnosis of epilepsy at any age.

In our cohort, a smartphone or home video recording of the paroxysmal event was available at the initial outpatient visit in 107

of 512 patients (20.9%). For patients without a video at presentation, families were instructed during follow-up visits to record any subsequent episodes. These recordings were highly informative and contributed substantially to the diagnostic process. Consequently, besides routine wake-sleep EEG evaluations, long-term inpatient video-EEG monitoring was deemed necessary in only 23 cases. This finding is consistent with previous studies reporting that caregiver-recorded videos can significantly aid in the differential diagnosis of paroxysmal events in children and may reduce the need for prolonged and resource-intensive diagnostic procedures (10-12).

Most PNEs follow a benign clinical trajectory. Accordingly, it is important to provide caregivers with clear explanations and reassurance that these episodes are not epileptic in nature (9, 15). Videos recorded by caregivers at home can be highly informative and play a supportive role in the diagnostic process. If the clinical history does not strongly point toward epilepsy, reviewing such recordings may help avoid unnecessary diagnostic procedures (3, 10-12).

Nevertheless, when seizure activity cannot be definitively ruled out, EEG assessment remains essential. Although PNEs may present differently depending on age, the majority resolve spontaneously without lasting effects. Thus, before considering treatment with antiseizure medications, establishing an accurate diagnosis through comprehensive clinical evaluation and close observation is of utmost importance (9, 15).

CONCLUSION

To summarize, PNEs are relatively frequent in the pediatric population, often mimicking epileptic seizures and raising considerable concern among families due to their dramatic and unpredictable presentation. A detailed clinical history from caregivers and witnesses, direct observation of the episode, or video documentation—either recorded by the family or captured during EEG—plays a critical role in establishing the correct diagnosis.

In routine pediatric neurology outpatient practice, home video recordings or events documented during standard EEG may provide sufficient diagnostic clues, and in selected cases, can reduce the need for prolonged inpatient video-EEG monitoring.

Overall, we found that the distribution of PNEs in the pediatric age group in our study did not differ significantly from those reported in various populations in previous studies. Ideally, pediatricians or pediatric neurologists should approach suspected cases of PNES with caution to avoid misdiagnosis as epilepsy, and in situations where diagnostic uncertainty persists, prolonged video-EEG monitoring should be considered.

The most prevalent PNEs in our pediatric population were syncope and breath-holding spells, followed by tic disorders, night terrors, and shuddering attacks. Less commonly observed events included benign sleep myoclonus, gratification disorder, and psychogenic nonepileptic seizures. Rare entities such as benign paroxysmal tonic

upward gaze, sleepwalking, hyperekplexia, and benign paroxysmal torticollis were also identified. These findings underscore the importance of recognizing the broad clinical spectrum of PNEs in the differential diagnosis of paroxysmal events in children.

Highlights

- Paroxysmal nonepileptic events are common in the pediatric population.
- Non-epileptic events often mimic epileptic seizures, posing diagnostic challenges.
- The prevalence of PNEs was 4.6% in pediatric neurology outpatients during the study period.
- The PNEs in children are very different according to age.
- Syncope, breath-holding spells, and tic disorders are the most common types.
- Home video recordings are highly valuable in clinical evaluation.



Ethics Committee Approval This study received approval from both the Ministry of Health of Türkiye and the ethics committee of our hospital (Zeynep Kamil Maternity and Children Hospital, İstanbul, Türkiye) (approval date: 09/04/2025, approval number:49).

Informed Consent The informed consent for EEG recording and the use of the data for scientific purposes has been obtained from the patients.

Peer-review Externally peer-reviewed.

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Conflict of Interest The authors have no conflicts of interest to declare. Informed consent for EEG recording and for the use of anonymized data for scientific purposes was obtained routinely from all patients or their legal guardians; given the retrospective design of the study, no additional consent was required.

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Author Details

Emek Uyur

¹ University of Health Sciences, Zeynep Kamil Maternity and Children's Diseases Training and Research Hospital, Department of Pediatric Neurology, İstanbul, Türkiye

0000-0001-6071-6375 emekuyur@gmail.com

Nilüfer Eldeş Hacırızloğlu

¹ University of Health Sciences, Zeynep Kamil Maternity and Children's Diseases Training and Research Hospital, Department of Pediatric Neurology, İstanbul, Türkiye

0000-0001-8828-8587



Derya Güder

¹ University of Health Sciences, Zeynep Kamil Maternity and Children's Diseases Training and Research Hospital, Department of Pediatric Neurology, Istanbul, Türkiye

0000-0002-1867-6477

Bilgihan Bıkmazer

¹ University of Health Sciences, Zeynep Kamil Maternity and Children's Diseases Training and Research Hospital, Department of Pediatric Neurology, Istanbul, Türkiye

0000-0003-1974-8951

Azize Büyükköç

² University of Health Sciences, Zeynep Kamil Maternity and Children's Diseases Training and Research Hospital, Department of Developmental Pediatrics, Istanbul, Türkiye

0000-0002-2105-162X

Rabia Gönül Sezer Yamanel

³ University of Health Sciences, Zeynep Kamil Maternity and Children's Diseases Training and Research Hospital, Department of Pediatrics, Istanbul, Türkiye

0000-0002-9447-3583

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