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The Relationship Between the Lunar Cycle and Epileptic Attacks and Their Treatment

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ABSTRACT

Objective: The purpose of the present study was to evaluate the potential association between the phases of the moon and seizure attacks and treatment in patients diagnosed with epilepsy at a pediatric neurology clinic. **Materials and Methods:** 199 patients presenting to the Balıkesir University Medical Faculty pediatric neurology clinic, Turkey, diagnosed with epilepsy based on ILAE criteria were included in the study. The patients' demographic characteristics, medications used, and family histories, and the frequency and duration of attacks were investigated retrospectively. **Results:** Analysis revealed that seizures were most frequent in the full moon (N=54, 27.1%), followed by the new moon (N=52, 26.1%) and first quarter (N=47, 23.6%), and were least common in the third quarter (N=46, 23.1%). No statistically significant variation was determined in terms of attack frequencies during the different lunar phases between patients receiving monotherapy and polytherapy (p=0.206). **Conclusion:** The results of the present study suggest that there is no relationship between the lunar cycle and the frequency of epileptic attacks.

Keywords: Children, Epilepsy, Lunar Cycle.

Epileptik Ataklar ve Tedavisi ile Ay Döngüsü Arasındaki İlişki

ÖZ

Amaç: Bu çalışmanın amacı, bir pediatrik nöroloji kliniğinde epilepsi tanısı alan hastalarda ayın evreleri ile nöbet atakları ve tedavi arasındaki potansiyel ilişkiyi değerlendirmektir**. Gereç ve Yöntem:** Balikesir Üniversitesi Tıp Fakültesi Çocuk Nörolojisi Kliniğine başvuran, ILAE kriterlerine göre epilepsi tanısı alan 199 hasta çalışmaya dahil edildi. Hastaların demografik özellikleri, kullandıkları ilaçlar, aile öyküleri, atak sıklıkları ve süreleri retrospektif olarak incelendi. **Bulgular:** Analiz, nöbetlerin en sık dolunayda (N=54, %27,1), ardından yeni ayda (N=52, %26,1) ve ilk dördün (N=47, %23,6) ve en az da son dördün döneminde (N=46, %23,1) görüldüğünü ortaya koydu ve bu durum istatiksel olarak anlamlı değildi. Monoterapi ve politerapi alan hastalar arasında farklı ay fazları sırasındaki atak sıklıkları açısından istatistiksel olarak anlamlı bir farklılık saptanmadı (p=0.206). **Sonuç:** Bu çalışmanın sonuçları, ay döngüsü ile epileptik atakların sıklığı arasında bir ilişki olmadığını göstermektedir.

Anahtar Kelimeler: Çocuklar, Epilepsi, Ay Döngüsü.

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INTRODUCTION

The belief that celestial bodies can affect numerous physiopathological processes, particularly human behaviors, is an ancient one (Owens & McGowan, 2006). The moon is a satellite of the earth and the closest celestial body to it. Historically, phenomena such as increased sexual desire, menstruation, sleepwalking, and some mental disorders and suicide have been attributed to supernatural powers acting through the brightness of the moon (Oliven, 1943). The fact that the word 'lunacy' derives from the Roman goddess Luna shows that mental disorders were previously associated with the moon (Owens & McGowan, 2006).

The periodic changes in the luminous surface of the moon that are visible from earth are known as the 'lunar cycle.' This cycle lasts four weeks and involves four distinct phases – the new moon, the first quarter, the full moon, and the third (final) quarter (Nissani, 1994). The potential effects of the lunar cycle on different variables on earth and on human health have historically attracted the interest of numerous researchers. Although no relationship has been shown in the majority of studies, others have associated the lunar cycle with medical phenomena such as cardiopulmonary resuscitation, fertility, acute coronary events, and neuropsychiatric findings (Abell & Greenspan, 1979, Eisenburger, et al., 2003, Gorvin & Roberts, 1994). Studies have also reported an increase in acute behavioral disorders, non-effective psychotic disorders, depression, gastrointestinal bleeding, reproductive functions, acute myocardial infarction, and sudden unexpected deaths (Bevington, 2015; Calver, Stokes & Isbister, 2009; Chakraborty, 2014). Some survey studies among health workers also confirm that such personnel also believe in this association (Vance, 1995).

Changes in the lunar cycle are known to alter the force of gravity on the earth and the rises and falls in the ocean tides (Bevington, 2015). However, their potential effects on human health and the effect mechanisms involved remain a mystery. The potential effect of the lunar cycle of human physiology and diseases is known as the 'Transylvania effect' in the literature (Owens & McGowan, 2006; Mason, 1997). Although the mechanism of this effect is unclear, it has essentially been linked to effects on 'biological rhythms' [Baxendale & Fisher, 2008; Myers, 1995). Research shows that the different lunar phases can cause changes in 'biological rhythms' in humans in association with their effects on the earth's electromagnetic field and gravity (Chakraborty, 2014). Autonomic nervous system, cardiovascular and endocrine changes occurring during the cycle are thought to underlie potential changes in human physiopathology (Chakraborty, 2014; Kalra, Agrawal & Sahay, 2012; Cajochen, Altanay-Ekici, Munch, Frey, Knoblauch & Wirz-Justice, 2013). It has also been reported that changes in the lunar cycle can have a direct impact on the body's water mass, as well as on the planet's bodies of water (Myers, 1995).

It has long been known that the seizures can be triggered by various environmental factors and functional changes in the human body (Vul, 1976). Some central nervous system and cerebrovascular diseases and factors such as alcohol intake, stress, and excessive light can precipitate seizures in patients with epilepsy (Elger & Schmidt, 2008). The possibility of an association between epileptic seizures and the lunar cycle has also been suggested since very ancient times (Temkin, 1994; Bruno et al., 2011). Studies have reported an increase in the frequency of epileptic attacks in the full and new moon phases, and that the full moon triggers and exacerbates attacks (Vul, 1976).

The significance of circadian rhythm disturbances on the pathophysiology of several diseases, including epilepsy, has been investigated in recent years. Chronopharmacology maintains that therapeutic management can be optimized by adjusting the treatments to be administered in these diseases according to individual rhythms (Sion & Bégou, 2021). The purpose of the present study was to evaluate the potential association between the phases of the moon and seizure attacks and treatment in patients diagnosed with epilepsy at a pediatric neurology clinic.

MATERIALS AND METHODS

199 patients presenting to the Balıkesir University Medical Faculty pediatric neurology clinic, Turkey, between 01.08.19 and 01.03.2022 diagnosed with epilepsy based on ILAE criteria were included in the study. The patients' demographic characteristics, medications used. The use of levetiracetam, valproic acid, phenobarbital, lamotrigine, clonazepam, carbamazepine, oxcarbazepine, topiramate as single drug-monotherapy or multi-drug-polytherapy and family histories, and the frequency and duration of attacks were investigated retrospectively. Patients undergoing attacks during the investigation were enrolled. Patients with deficient data or whose attack dates were not recorded were excluded from the analysis. The lunar phase during which attacks occurred was determined based on the lunar calendar from the "Time and Date" website (timeanddate.com).

Statistical analysis

Statistical analyses were performed on SPSS version 15 software. Once the patients' demographic data had been collected, associations between gender, age group, treatments, electroencephalography (EEG) and cranial magnetic resonance imaging (MRI) findings, lunar phases, and attacks were evaluated using the Chi-square test.

Ethical considerations

The requisite approval was obtained from the Balıkesir University Ethics Committee before the study commenced (No. 2022/57).

RESULTS

The mean age of the patients enrolled in the study (N=199) was 10.07±4.90 years. The patients were most frequently in the 12-18 age range (N=83, 41.7%). with 64 (32.2%) being aged 6-12, 39 (19.6%) aged 2-6, and only six (3%) aged 0-1 year. The majority of patients were male (N=104, 52.3%).

No prenatal pathological characteristic was present in 80.4% (N=160) of the cases. A history of delivery at <37 weeks was present in 12.6% of the patients and at >42 weeks in 1.5%. Additionally, 48.3% were delivered by the normal spontaneous vaginal route and 51.8% by cesarean section. The majority of cases had normal birth weights, while 30.7% (N=61) weighed <3000 g and 6% (N=12) >4000 g. Fifty-five (%27.6) patients had histories of incubation for various reasons. Histories of consanguinity in the family was present in 26 (13.1%) cases (Table 1).

Table 1. Clinical characteristic features of epileptic patients.

Age (years)	10.07±4.90 (1-18)
Sex	**N (%)**
Boys	104 (52.3%)
Girls	95 (47.7%)
Seizure type	
Focal	53 (26.6%)
Generalized	84 (42.2%)
Unknown	62 (31.2%)
Electroencephalogram features	
Normal	84 (42.2%)
Abnormal	81 (40.7%)
Epileptiform discharges	34 (17.1%)
Magnetic resonance imaging features	
Normal	130 (65.3%)
Anormal	69 (34.7%)
Antiseizure drugs	
Monotherapy	167 (83.9%)
Polytherapy	32 (16.1%)

Seizures were most frequent when the patient was awake (N=68, 34.2%). Analysis revealed that seizures were most frequent in the full moon (N=54, 27.1%), followed by the new moon (N=52, 26.1%) and first quarter (N=47, 23.6%), and were least common in the third quarter (N=46, 23.1%). Boys represented the majority of patients undergoing attacks in the new moon and first quarter, and girls the majority during the full moon. Gender distributions of attacks in the third quarter were equal. No significant association was observed between attack frequency and lunar phases in terms of age group or gender (p=0.746 and p=0.779, respectively) (Table 2,3).

Table 2. Gender distribution according to lunar cycles of epileptic attacks.

	Girls N (%)	Boys N (%)
New Moon	22 (11.06%)	30 (15.08%)
First Quarter	22 (11.06%)	25 (12.56%)
Full Moon	28 (14.07%)	26 (13.07%)
Third Quarter	23 (11.56%)	23 (11.56%)

Table 3. Distribution of age groups according to lunar cycles of epileptic attacks.

	0-1 year N (%)	1-2 years N (%)	2-6 years N (%)	6-12 years N (%)	12-18 years N (%)	p
New Moon	-	2 (1.01%)	12 (6.03%)	20 (10.05%)	18 (9.05%)	0.48*
First Quarter	2 (1.01%)	1 (0.50%)	9 (4.52%)	13 (6.53%)	22 (11.06%)	
Full Moon	1 (0.50%)	3 (1.51%)	11 (5.53%)	18 (9.05%)	21 (10.55%)	(*Comparison between 12 years old and under 12 years old)
Third Quarter	3 (1.51%)	1 (0.50%)	7 (3.52%)	13 (6.53%)	22 (11.06%)	

Table 4. Distribution of clinical features of patients according to lunar cycles of epileptic attack

Characteristics of the Patients	**Lunar Cycle**				
	New Moon	**First Quarter**	**Full Moon**	**Third Quarter**	**p**
Age (years) mean ±SD (min.-max.)	9.83±4.65 2-17	10.34±4.99 1-17	9.93±5.03 1-18	10.22±5.09 1-17	0.75
Gender N (%)					0.77
Female	22 (11.06%)	22 (11.06%)	28 (14.07%)	23 (11.56%)	
Male	30 (15.08%)	25 (12.56%)	26 (13.07%)	23 (11.56%)	
Epilepsy type N (%)					0.11
Focal	15 (7.54%)	11(5.53%)	13(6.53%)	14 (7.04%)	
Generalized	15 (7.54%)	27(13.57%)	25 (12.56%)	17 (8.54%)	
Unknown	22 (11.06%)	9 (4.52%)	16 (8.04%)	15 (7.54%)	
EEG features N (%)					0.31
Epileptiform	8 (4.02%)	9 (4.52%)	11 (5.53%)	6 (3.02%)	
Normal	29 (14.57%)	16 (8.04%)	21 (10.55%)	18 (9.05%)	
Abnormal	15 (7.54%)	22 (11.06%)	22 (11.06%)	22 (11.06%)	
Cranial MRI N (%)					0.57
Normal	35 (17.59%)	27 (13.57%)	38 (19.10%)	30 (15.08%)	
Abnormal	17 (8.54%)	20 (10.05%)	16 (8.04%)	16 (8.04%)	
Patient receiving antiseizure drug treatment N (%)					0.2
Monoteraphy	48 (24.12%)	38 (19.10%)	42 (21.11%)	39 (19.60%)	
Polyteraphy	4 (2.01%)	9 (4.52%)	12 (6.03%)	7 (3.52%)	

*EEG;Electroencephalogram, MRI; Magnetic resonance imaging, SD; Standart Deviation

In terms of treatments used during attacks, 167 patients (83.9%) were receiving monotherapy and 32 (16.1%) polytherapy. The most frequently used antiseizure drug in monotherapy was levetiracetam (57.8%), followed by valproic acid (16.6%). Patients receiving monotherapy were in the majority in all the lunar phases (new moon N=48, 24.12%, first quarter N=38, 19.10%, full moon N=42, 21.11%, third quarter N=39, 19.60%). No statistically significant variation was determined in terms of attack frequencies during the different lunar phases between patients receiving monotherapy and polytherapy (p=0.206). In terms of seizure types, the undetermined type was in the majority during the new moon (N=22, 11.06%), while generalized seizures predominated in the other phases (first quarter N=27, 13.57%, full moon N=25, 12.56%, third quarter N=17, 8.54%). Focal seizures were most frequent during the new moon phase (N=15, 7.54%). Evaluation of patients' cranial EEG and MRI findings revealed normal MRI findings (N=130, 65.3%) and pathological EEG (N=115, 57.8%) findings in most cases. MRI pathologies were most common in the first quarter (N=20, 10.05%) and EEG pathologies in the full moon (N=33, 16.59%). No significant difference was observed in seizure type, or MRI and EEG findings in terms of the lunar phases (p=0.113, p=0.575, and p=0.317, respectively) (Table 4)

DISCUSSION

The lunar cycle and its potential effects on human health have attracted the interest of numerous researchers. This interest has been kept alive by the fact that the association and, if such exists, the effect mechanisms involved have not yet been explained. Both beliefs that have existed throughout the course of history and various scientific studies make it essential for the possible link, and the mechanism involved, between the lunar cycle and epilepsy to be investigated (Raison, Klein & Steckler, 1999). The present study investigated the potential association between the phases of the moon and epileptic attacks in patients presenting to the Balikesir University Medical Faculty Pediatric Neurology Clinic and diagnosed with epilepsy based on International League Against Epilepsy (ILAE) criteria.

Epileptic seizures are known to exhibit temporal patterns, the most frequently examined of which are the circadian rhythm and the sleep-wake cycle. Several researchers have investigated the effect of sleep on epileptic seizures and studies have shown that sleep deficiency triggers such seizures (Langdon-Down & Brain 1929; Shouse, Da Silva & Sammritano 1996). Sleep deficiency/deprivation has also been reported to cause seizure development even in asymptomatic individuals, and that it is highly likely to trigger seizures, especially within 48 hours of the onset of deficiency (Friis & Lund 1974; Rodin,1991) Sleep can be affected by many factors. Studies have shown that the lunar cycle also has an effect on it, and even that melatonin levels, which exhibit a sleep-related circadian rhythm, change during the full moon (Kalra, Agrawal & Sahay, 2012; Cajochen, Altanay-Ekici, Munch, Frey, Knoblauch & Wirz-Justice, 2013). Research has found that sleep efficiency decreases in the full moon, with less deep sleep and an increase in REM latency, and also a decrease in total sleep duration and subjective sleep quality (Kalra, Agrawal & Sahay, 2012; Turányi et al., 2014). Roosli et al. showed that healthy individuals sleep 20 minutes on average less during the full moon phase, and that morning fatigue is higher than during that phase (Roosli, Juni, Braun-Fahrlander, Brinkhof, Low & Egger, 2006). Researchers have therefore investigated whether or not this relative lack of sleep during the full moon phase is responsible for an increase in epileptic seizures (Raison, Klein & Steckler, 1999). However, due to the retrospective nature of our study, the relationship between epilepsy patients and sleep during the lunar cycle could not be examined.

The findings of studies of the relationship between the lunar cycle and epileptic seizures are inconsistent. Polychronopoulos et al. evaluated presentations to the emergency department due to epileptic seizures over a five-year period and detected a statistically significant increase in presentation rates during the full moon (Polychronopoulos et al., 2006) In contrast, Rüegg et al. evaluated rates of hospitalization in the intensive care unit for three years due to status epilepticus and found a statistically significant increase in the new moon quarter approximately 3-4 days after the new moon (Rüegg, Hunziker, Marsch & Schindler, 2008) Baxendale et al. also reported a negative correlation between numbers of seizures occurring in a special epilepsy unit and the fraction of the moon illuminated by the sun (Baxendale & Fisher, 2008).

However, in addition to studies supporting the idea of a relationship between the lunar cycle and epilepsy, others have observed no such association. In a three-year study conducted in an epilepsy observation center, Benbadis et al. reported finding no relationship between the phases of the moon and total numbers of seizures. However, they reported more epileptic seizures in the final quarter and psychogenic non-epileptic seizures in the full moon quarter (Benbadis, Chang, Hunter & Wang, 2004). Kim et al. also found no association between the lunar cycle and the frequency of febrile seizures, while similarly, in a study of 1710 cases, Wang et al. reported that seizures were equally distributed across the lunar phases, with no significant differences between them in terms of first seizure occurrence (Kim, Shim, Kang, Park, Jin & Lee, 2019; Wang, Boston, Lawn, & Seneviratne, 2022). In the present study, epileptic attack frequencies were 54 (27.1%) in the full moon quarter, 52 (26.1%) in the new moon quarter, 47 (23.6% in the first quarter, and 46 (23.1%) in the third quarter.

The importance and effects of circadian rhythm disorders and lunar cycles in the pathophysiology of several diseases, including epilepsy, have been investigated in recent years. Researchers have suggested that adjusting treatments in these diseases according to individual rhythms can optimize therapeutic management (Sion & Bégou, 2021). The present study investigated the relationship between the lunar cycle and the frequency of attacks in patients with epilepsy and the treatment received. The majority of our patients were receiving polytherapy and using different medications. The potential effect of the treatments administered in epilepsy could not therefore be evaluated in terms of chronopharmacology.

The existence of possible mechanisms and seizures being observed to occur mostly during the full moon in the literature increase the possibility of establishing a relationship between moonlight and epilepsy. However, the existence of studies, including the present research, in which this relationship could not be clearly demonstrated and in which contradictory results were obtained, raises the possibility that the frequency of epileptic seizures may be due to a random encounter with the lunar cycle occurring in four-week periods.

CONCLUSION

In conclusion, the results of the present study suggest that there is no relationship between the lunar cycle and the frequency of epileptic attacks. However, this study is important because it examines the relationship between epilepsy treatment (poly/monotherapy) and lunar cycles. Further studies involving larger number of patients, and pharmacokinetic and pharmacodynamic parameters such as dosage, dose interval, and blood drug levels in addition to rhythmic periods and possible therapeutic and side-effects of medications used in treatment are now needed.

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Conflict of Interest

The author declare no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Author Contributions

Plan, design: HA, OK, AI, IHB; **Material, methods and data collection:** HA, OK, AI, IHB; **Data analysis and comments:** HA, OK, AI, IHB; **Writing and corrections:** HA, OK, AI, IHB.

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