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Effects of Seasonal and Climatic Changes on Epileptic Seizures

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Abstract: Introduction: Epileptic seizures are defined as sudden bursts of electrical activity in the brain. The most significant causes of seizures are family history and neurodevelopmental conditions, including genetic and developmental factors. Although studies have indicated that environmental factors may influence the occurrence of epileptic seizures. Consequently, this study was designed to examine the relationship between epileptic seizures and seasonality and climate conditions. **Materials and Methods:** This study was conducted retrospectively on cases of gastrointestinal hemorrhage that were admitted to the emergency department between 01/01/2023-31/12/2023 and had experienced an epileptic seizure were included in the study. The meteorological data for the Antalya Muratpaşa (07030) region, where the hospital is situated. Meteorological data, including temperature, relative humidity, dew point, pressure, wind speed, and weather conditions of patients diagnosed with epilepsy at the time of admission, were recorded and a daily database was created. **Results:** In the course of our study, we observed a total of 114 instances of epileptic seizures, yielding a prevalence rate of 0.03%. No significant difference was observed between the days with and without cases in terms of temperature, dew point, humidity, wind speed, and pressure. While epileptic seizures were most frequently observed on clear days (45.3%), no significant difference was observed in the comparison between case distributions and weather conditions ($p = 0.140$)..The analysis of the frequency of cases by month revealed that December exhibited the highest incidence of epileptic seizures. A significant difference was observed in the frequency of cases by month ($p = 0.270$). **Conclusion:** Although there are many factors affecting seizure frequency based on the results of our study, we think that there is no relationship between seizure frequency and meteorological factors such as temperature, Dew point, Humidity, wind speed and pressure.

Keywords: Epileptic seizure, seasonality, climate.

INTRODUCTION AND BACKGROUND

Epileptic seizures are defined as sudden bursts of electrical activity in the brain, which can manifest in a variety of symptoms, including involuntary movements, loss of consciousness, and unusual behaviour [Katyayan, A. *et al*., 2021]. These seizures are the defining characteristic of epilepsy, a chronic neurological disorder that affects millions of people worldwide. The capacity to identify and anticipate epileptic seizures is of paramount importance for the effective management and enhancement of the quality of life of individuals with epilepsy [Thijs, R. D. *et al*., 2019]. Recent advances in technology and machine learning have markedly enhanced the capacity to detect and predict seizures through the analysis of electroencephalogram (EEG) data [García Morales, I. *et al*., 2020; Thijs, R. D. *et al*., 2019]. Seizures can be classified as focal, generalized, or unknown according to their onset. Epilepsy can affect individuals of all ages, with specific risk factors and outcomes differing in different populations [Wirrell, E, 2022]. The most common focal seizures are focal, generalized, and febrile seizures. The most significant causes of seizures are family history and neurodevelopmental conditions, including genetic and developmental factors [Pressler, R. M. *et al*., 2020]. However, other medical causes, such as infections, metabolic disorders, and head injuries, as well as stressors such as stress, lack of sleep, and exposure to flashing lights, also contribute to the occurrence of seizures [Bank, A. M. *et al*., 2019].

Although studies have indicated that environmental factors may influence the occurrence of epileptic seizures and that significant alterations in weather patterns may also act as an environmental trigger for seizures, the current body of research does not provide sufficient evidence to ascertain the impact of this phenomenon on seizures and its relationship with weather conditions and seasonality. Consequently, this study was designed to examine the relationship between epileptic seizures and seasonality and climate conditions.

MATERİALS AND METHODS

This study was conducted retrospectively on cases of gastrointestinal hemorrhage that were admitted to the emergency department of a tertiary education and research hospital. Following the acquisition of ethical approval, all patients aged 18 and above who presented to the emergency department between 01/01/2023 and 31/12/2023 and had experienced an epileptic seizure were included in the study. Patients who had been diagnosed with epilepsy and were brought to the hospital after an epileptic seizure or had an epileptic seizure during follow-up were included in the study. Using the hospital information management system, the days that the patients

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presented and the number of patients who presented on those days were defined, and the relationship between weather conditions was analyzed.

Meteorological Data

The meteorological data for the Antalya Muratpaşa (07030) region, where the hospital is situated, were obtained from the "General Directorate of Meteorology" database via the application programming interface (API). Meteorological data, including temperature, relative humidity, dew point, pressure, wind speed, and weather conditions of patients diagnosed with epilepsy at the time of admission, were recorded and a daily database was created. The seasons were arranged as follows: spring (March, April, May), summer (June, July, August), and autumn (September, October, November).

STATİSTİCAL ANALYSİS

The data obtained from the study, comprising both patient data and meteorological data, were subjected to analysis using the statistical software package SPSS version 27 (IBM Co., USA). The generation of graphical representations was accomplished with the Graphpad Prism 9 program. Once the data had been defined, the categorical data were expressed as a percentage and frequency. A correlation analysis was conducted to examine the relationship between categorical variables. A distribution analysis of the numerical data was conducted. Data that exhibited a normal distribution were defined as mean ± standard deviation. A two-sample t-test was employed to analyze the numerical data that exhibited a normal distribution. A p-value of less than 0.05 was deemed to be statistically significant.

RESULTS

In the course of our study, we observed a total of 114 instances of epileptic seizures, yielding a prevalence rate of 0.03%. The number of days on which cases were observed was determined to be 185. No significant difference was observed between the days with and without cases in terms of temperature, dew point, humidity, wind speed, and pressure. Table 1 illustrates the correlation between seasonal attributes and the incidence of epileptic seizures.

While epileptic seizures were most frequently observed on clear days (45.3%), no significant difference was observed in the comparison between case distributions and weather conditions ($p = 0.140$). Table 2 illustrates the correlation between meteorological conditions and the incidence of epileptic seizures.

The analysis of the frequency of cases by month revealed that December exhibited the highest incidence of epileptic seizures. A significant difference was observed in the frequency of cases by month ($p = 0.270$). The distribution of epileptic seizures by month is illustrated in Figure 1. No significant difference was observed in case frequencies when the data were compared according to seasons ($p = 0.235$). The distribution of cases according to seasons is illustrated in Figure 2.

Table 1: Seasonal characteristics of days with and without epileptic seizures

	Free (n= 259)	Case day (n=106)	p-value
Temperature	22,47±7,92	21,41±8,02	0,760
Dew Point	11,19±7,49	10,90±7,44	0,836
Humidity (%)	53,66±21,03	55,65±21,03	0,820
Wind speed	13,84±7,84	12,63±8,19	0,683
Pressure	1007,21±6,11	1007,45±5,65	0,469

Table 2: Days with epileptic seizures according to weather conditions

	Free (n=180)	Case day (n=185)	p-value
Fair	135 (%52,1)	48 (%45,3)	0,140
Windy	9 (%3,5)	5 (%4,7)	
Rainy	16 (%6,2)	6 (%5,7)	
Cloudy	99 (%38,2)	47 (%44,3)	

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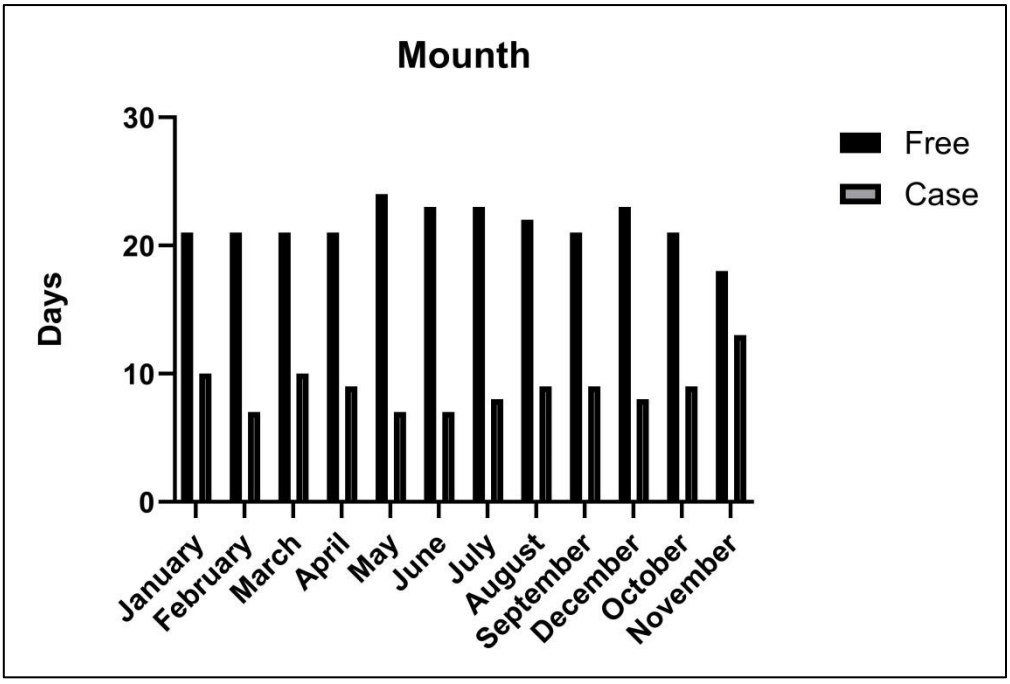

Fig 1: The distribution of epileptic seizures

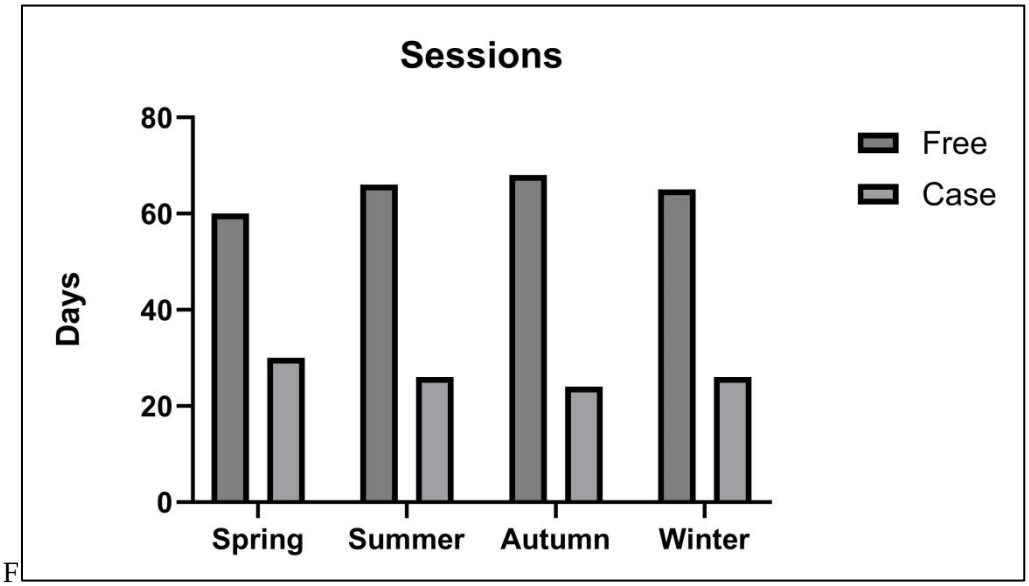

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Fig 2: The distribution of cases according to seasons

DİSCUSSİON

In the present study, an investigation was conducted to ascertain the potential correlation between epileptic seizures and climatic conditions. The findings revealed no statistically significant association between temperature, dew point, humidity, wind speed, and pressure and seizures. However, a notable increase in cases was observed during the month of December.

The relationship between weather and seizure occurrence is complex and multifaceted. The results of various studies indicate that different meteorological factors may influence seizure frequency. Some studies have indicated a correlation between specific meteorological conditions and an elevated risk of seizures, whereas others have not identified a significant association [Yalçın, G. *et al.*, 2022; Tomasović, S. *et al.*, 2022]. One study that examined the relationship between climate conditions and seizure frequency found that low ambient temperatures were associated with an increased risk of seizures. The study also reported a significant increase in seizure frequency when a one-degree temperature decrease was detected [Chang, K. C. *et al.*, 2019]. In a study conducted by Rakers *et al.*, an inverse relationship was identified

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between temperature increase and seizure frequency. The findings of this study indicate that there is an approximately 50% reduction in seizure frequency when the temperature is above 20°C. In our study, we also observed an increase in cases during the winter months.

A study by Rakers *et al*. examined the relationship between atmospheric conditions and seizures. The findings indicated that a decrease in atmospheric pressure of 10 hpA was associated with an increase in seizure risk exceeding 10%. Similarly, an examination of the relationship between humidity and seizure frequency has revealed that significant increases in relative humidity result in an increase in seizure frequency a few days after exposure (Bao, X. *et al*., 2019-Kim, S. H. *et al*., 2011). A recent study by Yamaguchi *et al*. demonstrated a positive correlation between precipitation frequency and seizure frequency [Yamaguchi, H. *et al*., 2021]. It is established that seizure frequency increases during periods of higher precipitation [Chen, Z. *et al*., 2022]. Additionally, studies have identified a relationship between air pollution and seizure frequency. In one such study, methane gas was found to increase seizure cases, while nitrogen dioxide was observed to reduce them. Air pollutants such as methane and nitrogen dioxide have been linked to an increase in methane seizure cases [Kim, S. H. *et al*., 2017-Fernandes, M. J. S. *et al*., 2019].

A number of studies have indicated that the frequency of seizures may increase during the colder months. However, other research has demonstrated that lower temperatures and reduced sunlight exposure can also lead to an increase in seizure frequency [Rakers, F. *et al*., 2017, Benninger, F. *et al*., 2017]. A study conducted in Asian countries has demonstrated a correlation between elevated atmospheric pressure and an increased frequency of emergency ambulance dispatches for individuals with epilepsy [Mutlucan, U. O. *et al*., 2024]. A study conducted in a hot country has demonstrated that temperatures exceeding 26°C are associated with a 4.3% increase in the risk of hospitalization for seizures, with a greater impact observed in women and young adults [Zhang, Y. *et al*., 2023]. A study conducted in Europe has demonstrated that unstable weather conditions, particularly during the winter, spring, and autumn months, are associated with an increased frequency of seizures [Motta, E. *et al*., 2011]. However, this association is less pronounced during the summer months. A study conducted by Tomosevic *et al*. observed an increased incidence of seizures on days with elevated temperatures and in situations where synoptic conditions exhibited low or non-gradient pressure areas in a European country [Tomasović, S. *et al*., 2022]. Despite the emphasis placed on the correlation between environmental factors and seizure occurrences, our findings did not reveal a statistically significant relationship between temperature, dew point, humidity, wind speed, and pressure and the incidence of seizures.

It should be noted that our study is subject to certain limitations. Primarily, as our study is of a retrospective nature, the weather conditions were assessed retrospectively. Consequently, there is a possibility of instantaneous changes in conditions and minor discrepancies in the location where the reports were obtained. One of the limitations of our study is the difficulty in determining hourly changes in weather conditions and similar variables. It is our contention that a large-scale population-based prospective study may prove invaluable in demonstrating the significance of our findings.

CONCLUSİON

Although there are many factors affecting seizure frequency based on the results of our study, we think that there is no relationship between seizure frequency and meteorological factors such as temperature, Dew point, Humidity, wind speed and pressure.

REFERENCES

1. Katyayan, A. & Diaz-Medina, G. "Epilepsy: Epileptic syndromes and treatment." *Neurologic Clinics*, 39.3 (2021): 779-795.
2. Thijs, R. D., Surges, R., O'Brien, T. J. & Sander, J. W. "Epilepsy in adults." *The Lancet*, 393.10172 (2019): 689-701.
3. García Morales, I., Fernández Alonso, C., Behzadi Koochani, N., Serratosa Fernández, J. M., Gil-Nagel Rein, A., Toledo, M., González, F. J. & Santamarina Pérez, E. "Emergency management of epileptic seizures: A consensus statement." *Emergencias*, 32.5 (2020): 353-362.
4. Wirrell, E. "Evaluation of first seizure and newly diagnosed epilepsy." *Continuum (Minneapolis, Minnesota)*, 28.2 (2022): 230-260.
5. Pressler, R. M. & Lagae, L. "Why we urgently need improved seizure and epilepsy therapies

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for children and neonates." *Neuropharmacology*, 170 (2020): 107854.
6. Bank, A. M. & Bazil, C. W. "Emergency management of epilepsy and seizures." *Seminars in Neurology*, 39.1 (2019): 73-81.
7. Yalçın, G., Sayınbatur, B., Toktaş, İ. & Gürbay, A. "The relationship between environmental air pollution, meteorological factors, and emergency service admissions for epileptic attacks in children." *Epilepsy Research*, 187 (2022): 107026.
8. Tomasović, S., Sremec, J., Košćak Lukač, J., Sičaja, G., Bačić Baronica, K., Ostojić, V., Raifi, Z., *et al*. "Weather patterns and occurrence of epileptic seizures." *BMC Neurology*, 22.1 (2022): 33.
9. Chang, K. C., Wu, T. H., Fann, J. C., Chen, S. L., Yen, A. M., Chiu, S. Y., Liu, F. C., *et al*. "Low ambient temperature as the only meteorological risk factor of seizure occurrence: A multivariate study." *Epilepsy & Behavior*, 100.Pt A (2019): 106283.
10. Rakers, F., Walther, M., Schiffner, R., Rupprecht, S., Rasche, M., Kockler, M., *et al*. "Weather as a risk factor for epileptic seizures: A case-crossover study." *Epilepsia*, 58.7 (2017): 1287-1295.
11. Bao, X., Tian, X., Yang, C., Li, Y. & Hu, Y. "Association between ambient air pollution and hospital admission for epilepsy in Eastern China." *Epilepsy Research*, 152 (2019): 52-58.
12. HEI Collaborative Working Group on Air Pollution, Poverty, and Health in Ho Chi Minh City; Le, T. G., Ngo, L., Mehta, S., Do, V. D., Thach, T. Q., Vu, X. D., Nguyen, D. T. & Cohen, A. "Effects of short-term exposure to air pollution on hospital admissions of young children for acute lower respiratory infections in Ho Chi Minh City, Vietnam." *Research Report Health Effects Institute*, 169 (2012): 5-72; discussion 73-83.
13. Kawakami, I., Inoue, M., Adachi, S. & Koga, H. "The weather condition and epidemics as triggers for febrile seizure: A single-center retrospective observational study." *Epilepsy & Behavior*, 111 (2020): 107306.
14. Kim, S. H., Kim, J. S., Jin, M. H. & Lee, J. H. "The effects of weather on pediatric seizure: A single-center retrospective study (2005-2015)." *Science of the Total Environment*, 609 (2017): 535-540.
15. Yamaguchi, H., Nozu, K., Ishiko, S., Kondo, A., Yamamoto, N., Tamura, A., Unzaki, A., *et al*. "Multivariate analysis of the impact of weather and air pollution on emergency department visits for unprovoked seizure among children: A retrospective clinical observational study." *Epilepsy & Behavior*, 125 (2021): 108434.
16. Chen, Z., Yu, W., Xu, R., Karoly, P. J., Maturana, M. I., Payne, D. E., Li, L., *et al*. "Ambient air pollution and epileptic seizures: A panel study in Australia." *Epilepsia*, 63.7 (2022): 1682-1692.
17. Fernandes, M. J. S., Carletti, C. O., Sierra de Araújo, L. F., Santos, R. C. & Reis, J. "Respiratory gases, air pollution and epilepsy." *Revue Neurologique (Paris)*, 175.10 (2019): 604-613.
18. Benninger, F. & Holtkamp, M. "Epileptische Anfälle und Epilepsie nach einem Schlaganfall: Inzidenz, Prävention und Behandlung [Epileptic seizures and epilepsy after a stroke: Incidence, prevention and treatment]." *Der Nervenarzt*, 88.10 (2017): 1197-1207.
19. Mutlucan, U. O., Selvi, F., Bedel, C., Zortuk, Ö., Türk, C. Ç. & Korkut, M. "Use of CALLY index to predict aneurysmal subarachnoid hemorrhage patient outcome." *Neurology Asia*, 29.1 (2024).
20. Zhang, Y., Xu, R., Ye, T., Yu, W., Yu, P., Chen, Z., *et al*. "Heat exposure and hospitalisation for epileptic seizures: A nationwide case-crossover study in Brazil." *Urban Climate*, 49 (2023): 101497.
21. Motta, E., Gołba, A., Bal, A., Kazibutowska, Z. & Strzała-Orzeł, M. "Seizure frequency and bioelectric brain activity in epileptic patients in stable and unstable atmospheric pressure and temperature in different seasons of the year: A preliminary report." *Neurologia i Neurochirurgia Polska*, 45.6 (2011): 561-566.

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