

The Effect Of The Air Temperature On Frequency Of Epileptic Seizure

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Abstract

The purpose of this study was to determine the temperature effect on the frequency of certain types of epileptic seizures as well as on patient's subjective perception of the seizure "severity".

Subjects and methods: The study was conducted prospectively, from April, 4th 2012. and it lasted for one year. Included were patients with epilepsy. The study includes only patients without cognitive impairment or with mild cognitive impairment (a score of mini mental status MMS > 23), who regularly take antiepileptics. Daily personal epileptic seizure calendar of all subjects was monitored for twelve months, and atmospheric pressure value was monitored using biometeorological calendar. The calendar recorded the date, the time of seizure, with the assessment of the seizure "severity" (from 1 to 5) and based on autoanamnesic and heteroanamnesic data.

Results: Of the 150 subjects included in the study, 74 (49.3%) were male, while 76 (50.7%) were female. There was no statistically significant difference in age between male and female subjects, with a probability of $p = 0.082$ ($t = -1.751$). There were 58 patients with generalized tonic-clonic seizures (total 58), 56 patients with simple focal seizures, and 36 with complex focal seizures. The seizure frequency in both male and female subjects did depend on the temperature value. However, the seizure frequency is statistically significantly more frequent in days when temperature was 0 and higher in both men and women.

Conclusion: These results certainly require further monitoring of associated biometeorological parameters and their effects on seizure onset.

Key words: epileptic seizures, temperature

Introduction

Epilepsy is defined as a paroxysmal cerebral dysrhythmia defined by three important characteristics: the suddenness of the process, its brain origin and the disorder of the rhythm of the electrical brain activity (1). Seizures are common to all types of epilepsies and they include a variety of clinical manifestations or sudden episodes of disturbance of motor, sensibility, behaviour,

perception, awareness or other psychic functions, autonomic and other regulations.

The international classification of seizures, based mainly on the clinical form of seizure and the electroencephalographic findings, was adopted in 1981 and has been further modified. In 1989, ILAE (International League Against Epilepsy) adopted the International classification of epilepsies, epilepsy syndromes and disorders, which highlights the symptoms and signs that show the localization of initial cerebral dysfunction and its spread (2). The ILAE in 2017 released a new classification of seizure types, based upon the existing classification formulated in 1981. and its extension from 2010. The differences include the following: "partial seizures" become "focal"; consciousness is used as a classifier of focal seizures; terms such as „dyscognitive“, „simple partial“, „complex partial“, „psychic“ and „secondary generalized“ are eliminated; new focal seizures include automatisms, behavioural changes, hyperkinetic, autonomic, cognitive and emotional; atonic, clonic, epileptic spasms, myoclonic, and tonic seizures can be either focal or generalized phenomena; „focal seizure evolving to a bilateral tonic-clonic seizure“ replace the term „secondary generalized seizure“; new generalized types of attack are absence with eyelid myoclonia, myoclonic absence, myoclonic-atonic and myoclonic-tonic-clonic and seizures of unknown onset (3).

Biometeorology is an interdisciplinary science studying the interaction system between atmospheric processes and living organisms such as plants, animals and humans. The biometeorological warning system such as forecast, contain a description of the meteorological situation and announces the arrival of those weather conditions which may adversely affect human health in the next days. The goal of health prognosis is the organization of preventive measures for the protection of the vulnerable groups (4).

Variations in biometeorological factors have an influence on the overall balance of the human body, as well as to changes in the condition of patients, primarily those ones with chronic diseases. According to the Le Blanc and Mills (1932) one of the oldest diseases whose association with biometeorological factors is mentioned, is epilepsy (5). Fluctuation in some climatic factors, such as temperature might influence one or more of the factors, and thus lead to seizure.

The purpose of this study was to determine the effect of temperature on the specific seizure types frequency as well as on patient's subjective perception of the seizure "severity".

Subjects and methods

The study was conducted prospectively from a period of one year (April 2012 – April 2013). In this study were included patients with epilepsy who were admitted to the Epileptology unit of the Clinic for Neurology of the University Clinical Centre Tuzla, as well as patients in Health Centres of Tuzla Canton. Only patients without cognitive impairment or with mild cognitive impairment (a score of mini mental status MMS > 23), who regularly take antiepileptics are included in the study (6). Excluded are all patients whose cause of seizure might be associated with a febrile condition or some other diseases.

Patients with epilepsy were divided into three groups based of seizure type: In the first group were patients that had generalized tonic-clonic seizures, second group had simple focal seizures, and third group had complex focal seizures. Classification of epilepsy used for this study is the one released by ILAE in 1989 (2).

In the study period, daily personal epileptic seizure calendar of all patients was monitored. The calendar recorded the date, the time of seizure, with the assessment of the seizure "severity" (from 1 to 5) and

based on anamnestic and history taken data. Assessment of the seizure severity was the patient subjective experience rated on the five-point scale, ranging from 1 (slight seizure) to 5 (the most severe seizure) and according to the modified VAS pain scale (7). Temperature values are monitored using biometeorological calendar. Daily biometeorological data from the Hydrometeorological Institute of the Federation of Bosnia and Herzegovina were used.

Results and discussion

Out of 150 subjects that were included in the study, 74 (49.3%) were male, while 76 (50.7%) were female. The average age of male subjects was 26.72 (± 2.52), with an average deviation from the average for 11.05 years, while the average age of female subjects was 29.99 (± 2.65) with a standard deviation of 11.81 years. There is no statistically significant difference in the age between male and female subjects, with a probability of $p = 0.082$ ($t = -1.751$).

The patients were divided into three groups on the basis of seizure type. Total number of patients with generalized tonic-clonic seizures (first group) was 58, 30 (51.7%) were males and 28 (48.3%) were females ($p = 0.793$, $X = 0.069$). The total number of patients with simple focal seizures (second group) was 56, 29 (51.8%) were males and 27 (48.2%) were females ($p = 0.789$, $X = 0.071$). The third group consisted of 36 patients, 15 (41.7%) males and 21 (58.3%) females ($p = 0.317$, $X = 1.00$) (Table 1. Figure 1)

Table 1. Seizure type according to sex

Seizure type	Sex				Total (type)	X p
	Male		Female			
	n	%	n	%		
GTC	30	51,7	28	48,3	58	0,069 0,793
Simple focal	29	51,8	27	48,2	56	0,071 0,789
Complex focal	15	41,7	21	58,3	36	1,000 0,317
Total (sex)	74	49,3	76	50,7	n=150	

X –value of chi-squared test, p- probability of rejecting the null hypothesis, n-number of respondents

The seizure frequency in both male and female was statistically significantly more frequent on days when the air temperature was 0°C and higher than on days when the air temperature was less than 0°C (Tables 2 and 3).

Table 2. The seizure frequency in male subjects according to air temperature value

Air temperature	Seizure frequency	%	X ² p
-11,00 – 0,00 st C	16	30,44	1,270 0,530
1,00 – 9,00 st C	49	38,26	
≥ 10,00 st C	50	31,30	
Total	115	100	

X –value of chi-squared test, p- probability of rejecting the null hypothesis

Table 3. The seizure frequency in female subjects according to air temperature value

Air temperature	Seizure frequency	%	χ^2 p
-11,00 – 0,00 st C	40	33,06	0,116 0,944
1,00 – 9,00 st C	39	32,23	
≥ 10,00 st C	42	34,71	
Total	121	100	

X –value of chi-squared test, p- probability of rejecting the null hypothesis

The results also show that the seizure frequency is statistically significantly more frequent in days of air temperature change (either decrease or increase) in both men and women (Table 4 and 5).

Table 4. Seizure frequency in male subjects according to the level of air temperature change

Air temperature change	Seizure frequency	%	χ^2 p
Decrease in air temperature	62	53,92	28,817 0,000
No change in air temperature	15	13,04	
Increase in air temperature	38	33,04	
Total	115	100	

X –value of chi-squared test, p- probability of rejecting the null hypothesis

Table 5. Seizure frequency in female subjects according to the level of air temperature change

Air temperature change	Seizure frequency	%	χ^2 p
Decrease in air temperature	58	47,93	26,793 0,000
No change in air temperature	14	11,57	
Increase in air temperature	49	40,50	
Total	121	100	

X –value of chi-squared test, p- probability of rejecting the null hypothesis

Discussion

Various environmental conditions have been studied extensively for their role as precipitating or modifying factors related to human health. Particularly, meteorological and climate factors, both short and long-term, have been a subject of interest for health professionals for years, without unequivocal consensus about their role, be it a direct, or an indirect role, such as a predisposition for the propagation of infectious diseases. Results of one study suggest that temperature is the only meteorological factor among observed which affects seizure occurrence. Humidity, atmospheric pressure, precipitation, and number of hours of sunshine were not correlated to seizure incidence. Chiang et al. also showed that ambient temperature affects seizure occurrence. Moreover, they noted that some air pollutants, including CH₄ and NO, are positively correlated with seizure incidence. In our study, the seizure frequency in both male and female was statistically significantly more frequent on days when the air temperature was 0°C and higher than on days when the air temperature was less than 0°C. The results also show that the seizure frequency is statistically significantly more frequent in days of air temperature change (either decrease or increase) in both men and women.

Conclusion

The seizure frequency in both male and female subjects depended on the air temperature value. The frequency was statistically significantly higher in days when the air temperature was above 0 degree. below pressure change (increase or decrease) comparing to days when these changes did not occur. There is no significant correlation between seizure type and atmospheric pressure and its changes.

On days of change in air temperature (either fall or rise), the frequency of epileptic seizures of any kind in both men and women is statistically significantly higher compared to days when there was no change in temperature.

These results certainly require further monitoring of associated biometeorological parameters and their effects on seizure onset.

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