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ORIGINAL RESEARCH

Seasonal variations of schizophrenic patients in emergency departments in Sofia, Bulgaria

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Abstract

Aim: The purpose of this study was to reveal the seasonal distribution of emergency department visits of schizophrenic patients in Sofia, Bulgaria.
Methods: We collected daily data for visits of patients with schizophrenia, schizotypal and delusional disorders in the emergency center of the regional dispenser for mental disorders in the city of Sofia for the period 1998-2003. The total number of emergency visits was 5723 (mean daily visits: 5.04±2.4). T-test was used to compare the monthly and seasonal distribution of visits.
Results: The season with the highest levels of emergency visits was summer, and the lowest levels were observed in winter ($P<0.0001$). Spring and autumn had intermediate values close to the mean value, and significantly differentiated from winter values. The month with the highest admission rates was September, followed by May and the three summer's months. The lowest levels were observed in December, October and January, with statistically significant differences observed between the values of all the three months. Differences between July values compared with December and October values were significant, but not with January values.
Conclusion: The study showed significant seasonal and monthly differences in emergency schizophrenics' visits. The data confirm the outcome of similar studies conducted in countries with temperate climate in the Northern Hemisphere. These results could prove useful for psychiatrists, public health specialists, and governmental authorities dealing with team planning and prevention programs in the field of psychiatry.

Keywords: month, schizophrenia, season.

Introduction

Schizophrenia is a mental disorder characterized by enormous societal and economic costs due to the extensive therapeutic care and loss of economic productivity, as well as personal suffering and stigma which often affect the patient and his/her family for most of the patient's life. As for schizophrenia patients, there is still no cure, the research of etiologic factors, particularly environmental ones that could be avoided and used in effective prevention programs, is essential (1).

Many studies have demonstrated evidence of seasonal patterns in the incidence of psychotic disorders, and schizophrenia in particular. It is known since the time of Esquirol (1838) that the number of patients admitted in mental hospitals increases in summer months and decreases in winter (1). Most of the studies for seasonal distribution of hospital admissions in schizophrenia also report summer peaks (2,3), some of these for female patients only (4).

Shiloh et al. (5) conducted research on admissions of schizophrenia and schizoaffective disorder patients to Tel-Aviv's seven public psychiatric hospitals during 11 consecutive years. They found that the mean monthly admission rates are significantly higher during the summer (for schizophrenia patients) and fall (for schizoaffective patients).

Clarke et al. (6) studied first admissions for the diagnosis of schizophrenia, citing April and October as peak months.

In a few publications (7-10), no significant difference between admissions in various seasons was observed. Eastwood and Stiasny (7) failed to replicate the summer peak in the admissions for schizophrenia in Ontario, Canada. Partonen and Lonnqvist (8), in a study of 295 schizophrenic patients, also reported no significant seasonal variation of admission with schizophrenia (cited by 9). De Graaf et al. (11) did not find seasonal variations for schizophrenia. The authors concluded there are only limited seasonal variations in mental disorders in general population studies, at least in countries with a mild maritime climate.

It is interesting that while most of the studies conducted in the Northern Hemisphere found summer peaks in hospital admissions for schizophrenia, results from three studies in the Southern Hemisphere show converse results – winter peaks (9,12,13). Owens and McGorry (13) analyzed data for six years and found that only male cases of schizophrenia showed a significant seasonal distribution in the dates of onset of symptoms, with a peak in August. The other two studies: Davies et al. (12) in first episode schizophrenia (strongly visible for the males, but the pattern for females also displayed annual periodicity) in Queensland, Australia and Daniels et al. (9) in male patients with schizoaffective disorder in Tasmania also showed austral winter peaks in admission data.

While the problem of seasonal admissions of patients with schizophrenia has been widely discussed in Western Europe, America and Australia, in Eastern Europe it has been neglected. In this region, we are only familiar with research conducted in Poland by Kotsur and Gurski, where the authors confirmed the presence of seasonality in admission of schizophrenic patients (14). We are not aware of any published research on this subject in Bulgaria, which makes the present study important as a contribution to the scientific literature on the problem in the country and in the South East Europe (SEE) region. Its findings could also raise the awareness of the problem of health care management for psychiatric patients in SEE countries besides Bulgaria.

The aim of the present research was to study the seasonal distribution of emergency department visits (not planned visits) of schizophrenic patients in the city of Sofia, Bulgaria (42°40' North latitude, 23°18' East longitude).

Methods

We collected daily data for visits of patients with schizophrenia, schizotypal and delusional disorders (F20-F29, ICD-10) in the emergency center of the regional dispenser for mental disorders in the city of Sofia for the period 1 January 1998 – 30 June 2003. The total number of emergency visits of schizophrenic patients was 5723 (mean daily visits: $\bar{x}$=5.04, σ=2.4). The total number of

analyzed days was 1135 (data was missing for a part of the period). Data was categorized by months and then by meteorological seasons – the Winter season defined as December, January and February; the Spring season as March, April and May; the Summer season as the months of June, July and August; and the Autumn (Fall) season as the months of September, October and November.

Because of missing information for some of the days during the period, the mean *daily* (not monthly) values were calculated for the particular month and season, and then the values were compared by using *t*-test.

Mathematically, this method could be used by application of the following formula:

$$t = \frac{\overline{x_1} - \overline{x_2}}{\sqrt{\frac{\sigma_1^{\ 2}}{n_1} + \frac{\sigma_2^{\ 2}}{n_2}}}$$

where, $\overline{x_1}$ and $\overline{x_2}$ are the mean arithmetic values of the two samples, σ_1 and σ_2 are the dispersions of the two samples, and n_1 and n_2 are the numbers of the two samples.

Results obtained by t-test were compared with table values, which show the probability connected with the zero-hypothesis. For this purpose, the degrees of freedom are calculated using the following formula:

$$K = n_1 + n_2 - 2$$

The calculated value of the degree of freedom was subsequently compared with the table critical value. If the t-test value is lower or equivalent to the critical value, then it is accepted that there are occasional differences between the two samples. If the t-test value is higher than the critical value it is accepted that the differences between the two samples are statistically significant, thus rejecting the zero-hypothesis.

Results

The season with the highest levels of emergency visits was summer ($\overline{x}$=5.44) and the lowest levels were observed in winter ($\overline{x}$= 4.63) (Figure 1), with statistically significant differences between these two seasons (*t*= 4.12*, p<0.0001) (Table 1).

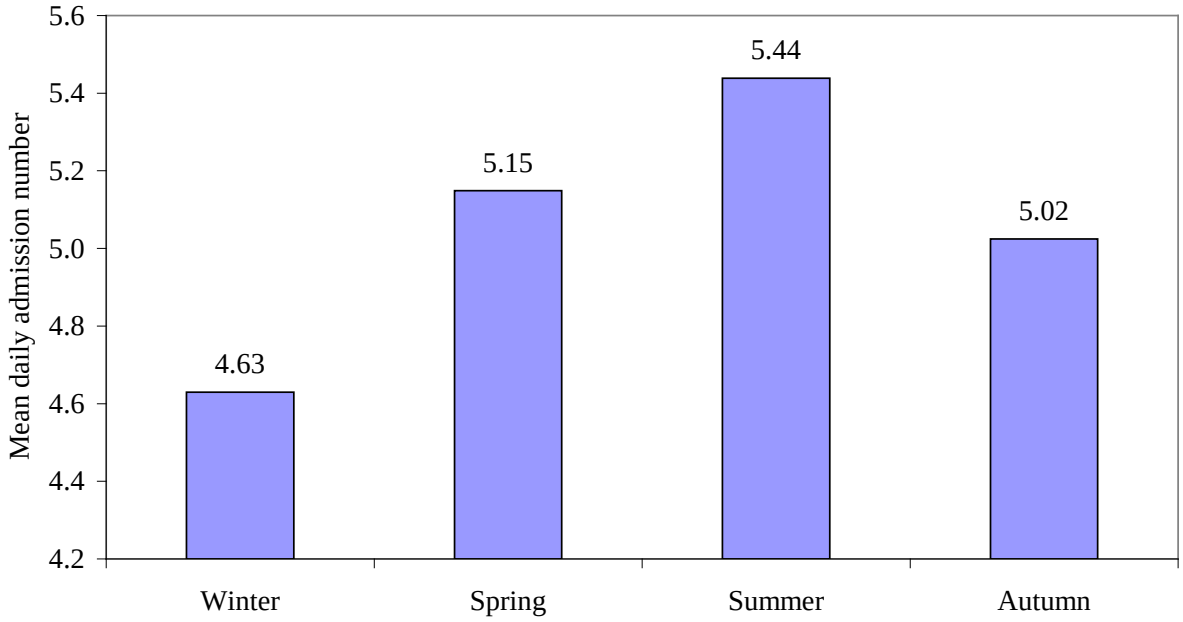
Spring and autumn had intermediate values close to the mean value (respectively, 5.15 and 5.02). Spring and autumn values also significantly differentiated from winter values (*t*=2.78*, p=0.006 and *t*=2.07*, p=0.035, respectively) (Figure 1).

Table 1. Comparative analysis of the mean seasonal visits of schizophrenic patients in the emergency department of the regional dispenser for mental disorders in Sofia, Bulgaria, January 1998-June 2003

Season	Winter	Spring	Summer	Autumn
Winter	-			
Spring	2.78*	-		
Summer	4.12*	1.36	-	
Autumn	2.07*	0.63	1.95	-

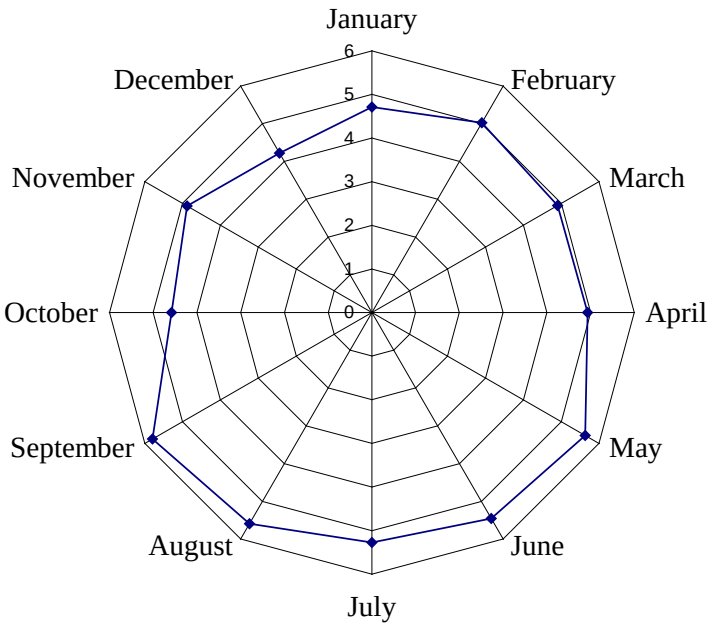
* The quotients marked with an asterisk are statistically significant (p<0.05).

Figure 1. Seasonal patterns of admissions of schizophrenic patients in the Emergency center of the Regional dispanser for mental disorders in the city of Sofia



The month with the highest admission levels was September ($\bar{x}$ = 5.79), followed by May ($\bar{x}$ = 5.63), and the summer months (August, June and July). The lowest levels were observed during the cold months: December ($\bar{x}$ = 4.22), followed by October ($\bar{x}$ = 4.58), and January ($\bar{x}$ = 4.71) (Figure 2).

Figure 2. Monthly distribution of visits of schizophrenic patients in the Emergency center of the Regional dispenser in Sofia



Statistically significant differences were observed between the values of all the three months, with the highest levels compared with the three months with the lowest levels. Differences between July values compared with December and October values were significant, but not with January values (Table 2).

Table 2. Comparative analysis of the mean monthly visits of patients with schizophrenia in the emergency department of the regional dispenser for mental disorders in Sofia, Bulgaria, January 1998 – June 2003

Month	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
January	-											
February	1.07	-										
March	0.61	0.35	-									
April	0.78	0.29	0.09	-								
May	2.76*	1.7	1.95	1.99*	-							
June	2.28*	1.22	1.5	1.51	0.47	-						
July	1.86	0.78	1.06	1.05	0.97	0.5	-					
August	2.51*	1.52	1.77	1.79	0.09	0.35	0.83	-				
September	3.04*	2.03*	2.25*	2.3*	0.38	0.84	1.34	0.47	-			
October	0.42	1.33	0.92	1.08	2.84*	2.41*	2.02*	2.62*	3.1*	-		
November	0.59	0.44	0.06	0.16	2.11*	1.64	1.19	1.91	2.41*	0.91	-	
December	1.8	2.64*	2.11*	2.4*	4.1*	3.67*	3.35*	3.8*	4.3*	1.14	2.2*	-

* The quotients marked with an asterisk are statistically significant ($p<0.05$).

Discussion

The results obtained in this study confirm the presence of seasonality in the emergency visits of schizophrenic patients in Sofia. Our findings confirm many of the studies conducted in the Northern Hemisphere (summer peak) in countries with continental temperate climate (3,4,6).

With respect to the factors responsible for the summer excess of admissions, Myers and Davies (15) have suggested a rise in ambient temperature; Parker and Walter (16), the increasing luminance; and Carney et al. (17), the length of day. Social factors, such as summer holidays, *"are unlikely to have an effect"* (4).

Some publications confirm a straight relationship between the ambient temperature and hospital admissions of patients with diagnosis schizophrenia. Such a relationship was found by Gupta and Murray (18) and Faust (19). Hansen et al. investigated the effect of heat waves on mental health in Australia (temperate climate) and found that hospital admissions were increased by 7.3% during heat waves. Mortalities attributed to mental disorders also increased during heat waves in the age group of 65-74 years and in persons with schizophrenia (20). Shiloh et al. (5) concluded that the mean rates of monthly admissions of patients with schizophrenia correlate with the maximum mean monthly environment temperature (R=0.35). They connect the admission rates with the higher summer temperatures, and conclude that *"persistent high environmental temperature may be a contributing factor for psychotic exacerbation in schizophrenia patients and their consequent admission to mental hospitals"*.

In previous research (21) using the present data, we also found a positive straight relationship between mean ambient temperature and the emergency visits of schizophrenic patients in Sofia.

The analysis of the observed relationship is somehow complicated because of many uncertainties coming from the etiology of the mental disorders. From a physiological point of view, there are still not firm conclusions about the reasons for the outcome of these disorders in psychiatry, and

many theories try to explain these uncertainties. Yet, some conclusions could be made from a theoretical point of view and the literature review.

Since we have been interested in the effect of meteorological factors on the mental crises manifesting, comparatively most important is the theory connected with the fundamental physiological processes in the cerebral cortex – as we are interested in the changeable side of environmental factors influencing the damaged human psyche. First, the Russian scientist Pavlov developed on a theoretical level his hypothesis in relation to the concept of the so-called "Patho-dynamical structures" ("sick point"). The patho-dynamical structure is characterized by a change in the ratio between the basic neural processes – excitement and suppression, which leads itself to the development of phase states. Depending on the structures involved in the pathological process, the external manifestations of the disorders are different (22).

With respect to schizophrenia, strategic guidance for the interpretation of the impact of the ambient temperature on the occurrence of mental crisis could be made by applying the theory of Pavlov. According to him, the main emphasis should be placed on spilled retention, which covers the cortex and sometimes spread on the sub-cortex and brain stem departments, as well as the transition between wakefulness and sleep phases. The main reason for the increased retention of hemispheres in schizophrenia, the Russian scientist sees, is the weakness of the nervous system, when multiple stimuli from the environment are super strong, causing over the limit detention. Such detention in some departments of the brain can lead to release and positive induction of others, and ultimately to a distortion of the interaction of brain structures, such as the relationship between signaling systems, bark and under-bark (cited by 22). Considering that the ambient temperature has a direct impact on the physiological processes in humans by thermo-receptors, it could be expected that its impact will play the role of these super strong as – Pavlov calls them – stimuli. They act as stressors on the body – especially the nervous system – and consequently, in combination with other stimuli (predominantly of the social character), lead to disturbance of the balance and induce psychological crisis.

Conclusion

Our study shows significant seasonal and monthly differences in emergency visits of schizophrenia patients. The results confirm the outcome of many other studies conducted in countries with temperate climate in the Northern Hemisphere.

Results from this study could be useful for psychiatrists and medical staff working in emergency centers and mental health hospitals, public health specialists and governmental authorities dealing with team planning and prevention programs in the field of psychiatry.

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