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Admission Rate of Patients with Most Common Psychiatric Disorders in Relation to Seasons and Climatic Factors During 2010/2011

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ORIGINAL PAPER

SUMMARY

Introduction: Climate and its impact on human health and mental illness have been in the focus of the research since years in the field. **Aim:** the aim of the research is to study the admissions rate to the psychiatric clinic in correlation to seasons and climate. **Material and method:** The research was conducted in a Psychiatric clinic of the Clinical Center in Sarajevo. Randomly selected subjects (aged 5-89 years, 1316 males and 1039 females) N=2355, were interviewed by the Structural Clinical Interview (SCID) which generated DSM-IV. In this retrospective-prospective, clinical-epidemiological study subjects were divided into groups according to type of disorders. Correlation between the impact of seasons and the rate of admissions to a Psychiatric clinic was analyzed. Certain data were taken from Federal Hydrometeorological Institute in Sarajevo of the climatic situation for period of the study. **Results and conclusions:** Of the total number of subjects who were admitted to the clinic in the period of 2010/2011 the most common diagnoses were F10-F19, F20-F29, F30-F39, F40-F48, and the suicide attempts as the separate entity. It was found correlation between certain seasons and the effects of the certain weather parameters at an increased admission rate of subjects with the certain diseases.

Key words: climate, climatic factors and elements, meteoropathy, mental illness.

1. INTRODUCTION

Long time ago, before any clinical study, it was believed that most suicides occur in the fall and winter, when there is less light, which in humans leads to mood swings (1, 2). The human body is very sensitive to changes in temperature, humidity, wind, air pressure, insolation, precipitation, positive or negative air ionization, particularly when these factors increase or decrease (3). With the increasing number of publications and increasingly rigorous studies, it became clear that the period of spring and early summer are periods for the most frequent occurrence of suicide (4, 5).

From the cooperation between meteorologists and doctors urged a specific subtype of weather-forecast bio prognosis. The term meteropathy in recent times is increasingly used.

Meteropathy is defined as a group of symptoms and

reactions that are manifested when there is a change of one or more meteorological factors (3). Usually there is a case of middle-aged women, the elderly and chronically ill, or in total of every third inhabitant of our planet (5,6).

Weather conditions affect human mood, and many people believe that they are happier when the days are longer with sunny intervals, then when the days are shorter, darker and rainy (5). Season of certain psychological disorders is a theory that has long been "pushed" forward, and has been particularly linked with affective disorders and tragic consequences in the suicides (5, 6). The term climate is considered to be a set of meteorological phenomena and factors in a given period of time which constitute the state of the atmosphere over some part of the Earth's surface (7). Contemporary definitions define climate as a dynamic system in which participate affect each other the atmosphere, oceans, lithosphere,

ice and snow cover and biosphere including human impact (7, 8).

Based on the collected data and their values the climate is divided into several so-called climate zones and our country is divided into three zones: north – temperate continental, central part with the continental and south with mediterranean climate (8). Some weather parameters in a certain way alter the functions of the human organism and are considered as “stressful time”. Strong ionized wind known as the Foöhn and so called warm fronts are the two most common climatic stress factors (8, 9).

2. GOALS

- Determine the total number of patients admitted to Psychiatric Clinic during the period 2010/2011.
- Determine the most common psychiatric disorders in the examined period.
- Determine whether there is an increased incidence of some psychiatric disorders in certain seasons during the 2010/2011.
- Determine whether specific weather parameters affect the increased incidence of some psychiatric disorders.

3. MATERIAL AND METHODS

This study was conducted in the period from January 1st 2010 to December 31st 2011 at the Psychiatric Clinic, Clinical Center of Sarajevo University and includes respondents selected randomly. On a total of 2355 respondents, aged from 5 to 89 years there was 1316 males and 1039 females. During the 2010 there was 669 (58%) male respondents was, and during 2011–647 or 54%. Female respondents in 2010 was 486 (42%), and in 2011–553 (46%).

The idea was grouping of patients into groups based on diagnoses that are commonly present in this period, and processing of data on subjects relevant to the study itself. The survey instrument that was used is structured psychiatric interview and the diagnosis made according to ICD-10 classification system.

Conducted is a clinical study which includes a retrospective-prospective study, based on observation and analysis of the variables present, the processing of diagnostic entities, and the same grouping. Also performed is the comparison the incidence of certain psychiatric disorders in certain months of the year in order to find possible correlation between the occurrence of certain diseases and seasons, and the correlation of certain weather parameters (temperature, humidity, barometric pressure, precipitation) and increased admission rates of patients at Psychiatric clinic.

The study used data from the Federal Hydrometeorological In-

2010	F10-F19		F20-F29		F30-F39		F40-F48		Suicide attempt	
	N	%	N	%	N	%	N	%	N	%
Spring	13	22	93	27	73	28	88	23	1	50
Summer	14	24	84	25	55	20	80	20	0	0
Autumn	25	42	85	25	67	25	107	28	0	0
Winter	7	12	76	23	71	27	110	29	1	50
Total	59	100	338	100	266	100	385	100	2	100

$\chi^2=79.648$ $p=0.0001$

Table 1. Most common diagnosis by seasons during 2010.

2011	F10-F19		F20-F29		F30-F39		F40-F48		Suicide attempt	
	N	%	N	%	N	%	N	%	N	%
Spring	16	30	84	25	70	26	84	24	5	33
Summer	8	15	93	27	55	20	66	18	1	7
Autumn	14	26	80	24	69	26	92	26	3	20
Winter	15	29	81	24	74	28	111	32	6	40
Total	53	100	338	100	268	100	353	100	15	100

$\chi^2=31.648$ $p=0.0001$

Table 2. Most common diagnosis by seasons during 2011.

stitute in Sarajevo on the values of climatic parameters for 2010 and 2011, relevant to the research and related to the climatological analysis of the situation in these years.

4. RESULTS

Statistical analysis of data obtained during the study was performed using StigmaStat 3.5 and Microsoft Office Excel 2007. The data are, after the statistical analysis presented in tables and charts, and included the number of patients in certain diagnosis and reporting to Clinic in certain seasons and months of the year.

Statistical significance between the groups was tested by Chi-square test and Kolmogorov-Smirnov test, depending on the data type. During processing data of the respondents (N-2355) who were admitted to Clinic during the period from 2010 and 2011, set aside the fact that the

Month 2010	Temp. (C)	Precipitation (l/m2)	Humidity (%)	Air pressure (mb)	F10-F19	F20-F29	F30-F39	F40-F48	Suicide attempt
I	-0.5	102.2	83	940.1			↑-27		%
II	1.0	53.7	73	937.8		↓-22			
III	4.7	83.6	74	939.4	↓-1			↑-44	1
IV	12.2	61.3	70	941.9					
V	16.2	63.5	67	945.4	↑-31	↑-26		↓-19	1
VI	17.8	154.5	74	941.9		↑-35			
VII	20.6	86.1	71	943.8			↓-10		
VIII	20.4	52.6	70	945.5	↑-12	↑-31			
IX	16.6	20.0	71	946.4					
X	9.1	171.5	81	944.1	↑-10			↑-41	
XI	8.1	64.1	81	942.5		↑-32			
XII	3.2	144.9	85	936.3	↑-7				

Table 3. Weather parameters with the mean monthly values and the increase/decrease in the number of patients with each diagnosis in certain months of 2010.

majority of hospitalized were under the diagnosis of schizophrenia, anxiety disorders, reaction to severe stress, mood disorders, bipolar disorder, depression and behavioral disorders due to use of psychoactive substances. We also discussed the frequency of suicide in the same period.

From the Table 1 it is evident that with the diagnosis F10-F19 most respondents was admitted during the falloff 42%, then the summer-24%, 22% during the spring and 12% during winter. With the diagnosis F20-F29 most patients was admitted in the spring-27%, then in the summer and fall with 25% and 23% during the winter. With diagnosis F30-F39 most patients were admitted in the spring 28%, then 27% during the winter, fall 25% and 20% during the summer. With diagnosis F40-F48 the most patients were admitted in the winter 29%, then fall 28%, 23% during the spring and 20% during summer. In case of suicide attempts 50% of respondents were admitted during the spring and the same percent during winter. Chi-square test revealed statistically significant differences in the prevalence of certain diagnostic groups according to the seasons of 2010 at the confidence level of 99% or $p < 0.01$.

From Table 2 is obvious that most patients with diagnoses F10-F19 were admitted in the spring-30%. With diagnosis F20-F29 most patients were admitted in the summer-27%. With diagnosis F30-F39 most patients were admitted in the winter-28%. With diagnosis F40-F48 most patients were treated during the winter-32%. In case of suicide attempts most patients attempted suicide in the winter-40%. Chi-square test revealed statistically significant differences in the prevalence of certain diagnostic groups according to the seasons of 2011 at the confidence level of 99% or $p < 0.01$.

Table 3 shows the weather parameters, whose influence was studied in the course of study with their values for all months in 2010 as well as an increase or decrease the number of patients admitted during the month in which significant changes were observed. So it is determined the increase in diagnoses F10-F19 in August, October, December and decline in March. The increase in diagnoses F20-F29 in the months of January and May and decrease in November. For diagnosis F30-F39 increase was observed in January and May and decrease in July. For diagnosis F40-F48 increase was present in March and October and decrease in May. Suicide attempts were registered in March and May of 2010.

Table 4 shows the weather parameters, whose influence was studied in the course of this study and their values for all months in 2011 as well as an increase or decrease in the number patients admitted during the months in which significant changes were observed.

Month 2011	Temp. (C)	Precipitation (l/m2)	Humidity (%)	Air pressure (mb)	F10-F19	F20-F29	F30-F39	F40-F48	Suicide attempt
I	0.4	161.3	80	937.8				↑-45	%
II	1.8	95.9	77	934.4		↓-18			1
III	5.2	63.1	66	944.4			↑-31	↑-41	4
IV	10.4	59.1	68	943.9					2
V	14.4	93.2	63	939.0					1
VI	18.1	181.5	69	940.5	↑-8				2
VII	20.8	29.2	65	943.6	↓-2		↓-11	↓-19	
VIII	21.6	44.2	58	942.4					1
IX	15.0	126.4	71	942.6		↑-34			
X	8.7	81.1	79	942.7					1
XI	9.5	139.4	69	936.3		↑-37	↑-30		1
XII	1.5	112.7	75	938.0		↓-18			1

Table 4. Weather parameters with the mean monthly values and the increase/decrease in the number of patients with each diagnosis in certain months of 2011.

	F10-F19	F20-F29	F30-F39	F40-F48	Suicide attempts
Month	r=0.032 p=0.852	r=-0.526 p=0.001	r=0.185 p=0.257	r=0.625 p=0.001	r=0.025 p=0.852
Temp. (C)	r=0.326 p=0.042	r=0.429 p=0.025	r=0.524 p=0.001	r=0.128 p=0.627	r=0.052 p=0.726
Precipitation (l/m2)	r=0.305 p=0.047	r=-0.167 p=0.657	r=-0.185 p=0.267	r=0.147 p=0.529	r=0.124 p=0.534
Humidity (%)	r=0.298 p=0.049	r=-0.264 p=0.428	r=-0.157 p=0.532	r=0.246 p=0.429	r=0.063 p=0.625
Air pressure (mb)	r=0.057 p=0.624	r=-0.102 p=0.368	r=-0.176 p=0.429	r=0.056 p=0.952	r=0.152 p=0.506

Table 5: Correlation of climatic factors and admission rates

It was found the increase in the number of patients with diagnoses F10-F19 in June and decrease in July. The increase in diagnoses F20-F29 was recorded in September and November and decrease was recorded in December. For diagnosis F30-F39 increase was recorded in March and November and decrease in July. For diagnosis F40-F48 increase was present in January and March and decrease in July. There were a total of 15 suicide attempts in 2011. Most of them in March 4, 2 in April and June, and one attempt in January, February, May, August, October, November and December.

Statistical analysis by Spearman rank correlation coefficient shows that in the case of diagnostic group F10-F19 there is a weak statistically significant correlation with temperature, precipitation and humidity, which indicates that the increase of these parameters leads to the increased number of admissions of patients with these disorders.

In case of diagnostic group F20-F20 strong statistically significant correlation was found by months (more hospitalizations in the second half of the year), and the temperature which indicates that increase in temperature leads to more frequent hospitalization of people with this diagnosis.

For the diagnostic group F30-F39 demonstrated is strong statistically significant correlation only to the temperature, or that the increase in temperature affects

the number of hospitalizations with this diagnosis.

Likewise, for the diagnostic group F40-F48 was found a strong correlation with the months of the year which indicates a greater number of hospitalizations in the second half of the year (July–December).

Suicide attempts shows no statistically significant correlation with any one of the monitored parameters, which can certainly be attributed to the small number of patients in the observed period, which hinders accurate analysis.

5. DISCUSSION

As seen from the above results, this study conducted at the Psychiatric Clinic, Clinical Center of Sarajevo University included a total of 2355 respondents, of whom 1039 were women and 1316 men. During this study data were taken from the Federal Hydrometeorological Institute Bjelave in Sarajevo with the values of climatic parameters for 2010 and 2011 year that were relevant to the survey and also take the same information about the climatological analysis of the situation in that year. Patients are processed and sorted into groups according to the diagnoses under which they were admitted to the Clinic.

Followed were four diagnostic entities that have the highest percentage during these years. By analyzing and processing the collected data showed that the frequency of admission at the clinic during the two years were patients with the diagnoses F40-F48–Neurotic and somatoform disorders caused by stress, which include phobic anxiety disorder, obsessive compulsive disorder, dissociative disorders, somatoform disorders and reactions to severe stress. The total number of patients with diagnoses F40-F48, which were admitted during the 2010 was 385 and during the 2011–353 patients. Most of the patients during the 2010 were admitted in March or 44. The temperature values were then lower than the average, precipitation were higher than the average, with normal humidity and the air pressure with slightly lower than normal values. In October was admitted 41 patients. The temperature was higher than average while precipitation, humidity, and air pressure was normal. Least number of patients was admitted in May or 19. The temperature was higher, precipitation, humidity and atmospheric pressure was within normal values. During the 2011 the majority of patients were admitted in January or 45. The temperature was higher than average while precipitations, humidity, and atmospheric pressure was lowered. In the month of March was admitted 41 patients. Air temperature was higher and the amount of precipitations, with normal pressure and humidity. The smallest number of respondents was admitted in July–19, when the air temperature was lower than average and precipitation with normal pressure and humidity. From the obtained data we can say that the information on certain weather parameters were the same for 2010 and 2011 when it comes to increase the number of patients admitted, but only for two months, other months where there has been an increase in patients admitted there was no changes in weather parameters, and it can be concluded that there is a specific, constant form which could explain why these diagnoses

occur just in certain months or circumstances of some weather parameters.

Thus, the group under common diagnosis codes F40-F48 (Neurotic and somatoform disorders caused by stress), during the 2010 the majority of patients were admitted during the winter 29%, fall 28%, 23% during spring and summer with 20%. During the 2011 the majority of patients were admitted during the winter 32%, 26% fall, spring 24% and summer 18%.

Data for both years coincide. In the literature the authors come to a conclusion similar to ours that these disorders occur independently of climatic factors (2).

In second place were diagnosis F20-F29 (Schizophrenia, schizophrenia like disorders and mad states). In both years the number of respondents is the same–338. During the 2010 the most respondents 27% were admitted in spring, summer and autumn alike with 25% and 23% during the winter. Most of the respondents during the 2011 year was admitted in June or 35. Temperatures were above average for that month and for the whole year, with increased rainfall, and humidity and pressure values within the limits of normal. In November, 32 patients were admitted. The temperature was higher than the average for that month, and the values of pressure, rainfall and humidity were within normal. The least number of patients was admitted in February or 22. It was reported that the temperature during this period was higher than average and precipitation, humidity and pressure were within normal values. We can therefore conclude that the months in which increase was recorded in daily temperatures were those months in which were admitted to psychiatric clinic patients with multiple diagnoses F20-F29 in both years and that their number decreased with the months with lower temperature. These results coincide with the results of relevant literature that during the summer months there is an increased number of hospitalized patients suffering from schizophrenia (6). Also, the authors have reached research results, as in our study that the summer season is with the highest schizophrenia prevalence (10, 11).

In third place were diagnosis F30-F39-Mood disorders, which include episodes of mania, bipolar disorders, depression, recurrent depressive disorder, constant mood disorders and other mood disorders. During the 2010, 266 respondents were admitted, and during the 2011, 268. During the 2010 the maximum of the respondents admitted was during the month of January – 27. Temperatures were below average, precipitations increased, and the values of humidity and atmospheric pressure within the limits of normal. In May the 25 patients were admitted. Temperatures were higher than average, humidity and atmospheric pressure within normal values. The least number patients were admitted in July or 10. Temperatures then were higher than average as well as precipitation, and the values of relative humidity and atmospheric pressure were normal.

During the 2011 the most patients were admitted in March–31 and November – 30. The temperature in these months was above the average value as well as the amount of rainfall, and the values of humidity and atmospheric

pressure were within normal. The least number of patients were admitted in July–11, when the temperature was normal for the month, rainfall decreased and the values of humidity and atmospheric pressure normal. From this we can conclude that the month of July was the month where it was registered both the lowest rate in patients admitted at the Psychiatric Clinic, and this is the month with a relatively nice weather and higher temperatures as the data show. Months in which there was an increase of the admissions are January, March, May and November, months where the mean monthly temperatures was lower than the month of July, no matter what the value of these months were above average, and this could be taken as possible explanation for the obtained data. Thus, during most of 2010 patients were admitted in the spring or 28%, then during the winter with 27%, with 25% fall and 20% during summer when it comes to mood disorders. During the 2011 the most admitted patients or 28% was during the winter, autumn and spring, with 26% and 20% during the summer.

The results are similar to previous studies. The study of a mood disorders shows the existence of one of the two peaks which appear in spring and autumn as well as appearing semi-cyclic and cyclic periods of the same diagnostic group of respondents who belong to the same diagnostic groups (9, 12). Admission rates for subjects suffering from mood disorders depends on climatic factors and us higher in spring and autumn (9, 12, 13, 14).

At the fourth place in this study were diagnoses F10-F19 (Mental and behavioral disorders caused by the use of psychoactive substances). During the 2010 at the Clinic 59 patients were admitted, and 53 during the 2011. During the 2010 the majority of patients were admitted in the fall of 42%, then 24% in the summer, spring 22% and winter 12%. In 2010 the highest admission rate was recorded in the fall, but the fall of that year by the data of the Hydrometeorological Institute was warmer than average and this can be considered as a possible reason. During the 2011 the majority of patients with this diagnosis was admitted in the the spring (June) 30%, then 29% during the winter, autumn 26% and summer 15%. These results are similar to relevant studies. Many authors agree that high-lighted part of spring as the top of the hot season increases the number of patients admitted with this diagnosis (8,9,10). Also, these data coincide with our data for 2011 where most of the respondents were admitted in the spring.

Respondents were also analyzed, in addition to sex and most diagnoses according to age and were found that most respondents are aged between 51 and 60 years with 35%, and least in the age of 15-18 years with 2%.

As a separate entity was analyzed a group of patients who attempted suicide, because there is some evidence to argue that suicide attempts occur at certain times of the year (4, 5). During the 2010 there were 2 attempted suicides, one in March and another in July. In March the temperature was lower than average, with increasing amounts of precipitation for the month, increasing humidity and low air pressure. In July the temperature was normal, with increased precipitation, while humidity and

air pressure are normal. We could draw the conclusion that an increase in rainfall in both months could present information that might indicate a connection with attempted suicide, although the sample is extremely small that we could make quality conclusions. As for the 2011, there were significantly more suicide attempts in relation to the 2010r. Whether it was because of the weather, difficult social situation, or some other problem to which the patients were more exposed is unknown. A total of 15 patients attempted suicide, the highest number in the March 4, April 2, in January, February, May, August, October, November and December 1, and none in June and September. Most suicide attempts were registered or 40% in winter, spring 33%, 20% during fall and summer with 7%.

When we look at the values of weather parameters for the month of March when it there was most suicide attempts it can be seen that the value of air temperature was higher than average as well as precipitation with a slightly lower percentage of humidity and normal atmospheric pressure. In April when the two patients attempted suicide temperature was normal with normal precipitation, normal values of humidity and air pressure. In July and September, the month when no one has attempted suicide temperature was normal with very little rainfall and humidity, with normal air pressure, and we could talk about a possible correlation between increased rainfall and increased number of suicides, if we could be able to exclude other possible factors that could lead to attempting suicide. By analyzing the data, we conclude that in 2010 one male respondent attempted suicide in the spring, which coincides with data from relevant studies, and one female during the winter period which does not coincide with data from relevant studies (4,5). Similar results reached the authors of the research on suicide in correlation with the seasons (4,5,15). During the 2011 the more men attempted suicide in the spring of 27%, which again coincides with the relevant data, and women during the winter 26% and 20% fall, which again as for a period of 2010 does not coincide with the relevant literature (4, 5, 11, 14, 15,). Number of attempted suicides in this period is negligibly small to be able based on this number draw a conclusion and compare it with other studies. Further investigations in this area are needed.

When we talk about a possible deviation of some results from those studies in the literature should be taken into account that no one has taken the relevant studies conducted in Bosnia and Herzegovina or of this part of the European continent, where the different climatic conditions and where people are exposed to different climatic factors and elements. It should also be taken into consideration whether the respondents were due to other reasons were admitted to the clinic, or whether the worsening of their underlying disease was caused by some specific condition or situation, and that weather in the period of health worsening they were in open or indoors, and whether they were generally exposed to the weather, because there are in fact in some studies done in psychiatric asylums where patients part of the day spent outdoors. As for research directly related to

suicide attempts, the sample is small to be able to make some precise conclusions, and we need to continue research in this field.

Statistical analysis confirmed the hypothesis that the rate of admissions with the most common psychiatric illnesses during the 2010 and 2011 is in correlation with the climatic elements and weather conditions and tends to increase with climate change in certain parameters, and that the admission rate of patients with the most common psychiatric illnesses during the 2010 and 2011 increase in certain seasons. Specifically, as can be seen from Table 5 statistical analysis Spearman rank correlation coefficient indicates that the climate and climatic factors have a statistically significant effect on the rate of patients admitted to treatment in all diagnostic groups except for F10-F19. For this diagnostic group, there is a weak statistically significant correlation with temperature, precipitation and humidity, which indicates that the increase of these parameters leads to the increasing number of patients admitted with these disorders. Also suicide attempts shows no statistically significant correlation with any one of the monitored parameters, which can certainly be attributed to the small number of patients in the observed period, which hinders accurate analysis.

One explanation is that the correlation in this study, which explains higher frequency of meteoropathy today's is modern lifestyle, which is further away from nature. Scientists believe that life is mainly carried out in sealed, air-conditioned spaces often reduces the ability of our body's natural adaptation to different environmental conditions. The human body is accustomed to closed spaces, which are often overheated in winter and cooled in summer so that self-regulation mechanisms are no longer able to optimally respond to sudden weather changes (3).

6. CONCLUSION

Statistical analysis by Spearman correlation coefficient indicates that the climate and climatic factors have a statistically significant effect on the rate of patients admitted for the treatment in all diagnostic groups except for F10-F19. For this diagnostic group, there is a weak statistically significant correlation with temperature, precipitation and humidity, which indicates that the increase of these parameters leads to the increasing number of patients admitted with these disorders. Also suicide attempts shows no statistically significant correlation with any one of the monitored parameters, which can certainly be attributed to the small number of patients in the observed period, which hinders accurate analysis.

Comparing the results we obtained by analyzing the data of conducted study with other literature studies we obtained partial matching results.

The results of these studies induce the need for future

research, especially the correlation of suicide attempts and climatic factors (this sample is small to be able to make some important conclusions).

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