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The Meteorological Factors Associated with Suicide

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A B S T R A C T

Looking through the history, people have always been associating suicide with weather conditions, trying to understand and identify the relationship between meteorological factors and suicide. The aim of this study was to determine and analyze the meteorological conditions in the time of attempted or committed suicides, and examine the possible link between the changes of meteorological factors and the frequency of suicidal behavior. Retrospective study of pairs covered the period from January 2003 to January 2006. Examinees included in the study were persons who committed or attempted suicide in the region of Mostar. Meteorological factors included the days of attempts or committing of suicide, with meteorological factors of the day immediately prior to the days of attempts or committing of suicide, as well as with average monthly values of meteorological factors. Meteorological factors of the days with suicidal behavior were similar to the day prior to the days with suicidal behavior, but there was significant difference between meteorological factors of the days with suicidal behavior and average monthly values of meteorological factors: maximum pressure was significantly lower in the days with suicidal risk, as well as pressure gradient. Regarding the seasonal periods, examinees most frequently attempted to commit suicide in April. Results indicate that meteorological factors do not act as an acute stress factor for suicide behavior, but its change over time may be the trigger for a suicide attempt.

Key words: *suicide, meteorological factors, temperature, atmospheric pressure*

Introduction

Suicide is the intentional and consciously taking of one's own life[1], and one of the leading causes of death in the world, whose rate increases, and therefore represents a significant public health problem[2–4]. Looking at people with suicide risk, it has been noted that their specific characteristics increase the risk of suicidal behavior, such as gender, where women significantly more often attempt suicide[5], and age, where there is a tendency of increasing average age for persons with suicidal behavior[6]. Also, there are environmental factors and comorbid diseases that increase suicide risk. Increased rate of suicide among the elderly is often associated with physical illness, loss of social roles and interpersonal relationships as well as untreated depression[6]. Unemployment, alcohol and drugs, and mental disorders are also identified as risk factors for suicidal behavior[5]. However, although the suicide is generally a complication of psychiatric disorder, it requires additional risk factors, because most of psychiatric patients never tried to commit suicide[7,8].

Weather conditions also have influence on the human body, and the first written proof about it has been left by the old physician Hippocrates around the 400-BC. In his book »On Airs, Waters and Place«, Hippocrates among other, warns that patients should be especially looked after during sudden weather changes[9]. Previous biometeorological studies have confirmed that weather and climatic conditions have variety of influences on people[10]. It has been proven that the weather changes me may be the factors that anticipate suicidal behavior in sensitive indi-

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viduals, while long-standing climatic factors may have influence on the development of suicidal behavior[11]. Suicides most often happen in the days which are characterized by high temperature that varies[12], with decreased or changeable atmospheric pressure, increased cloudiness and fog, downfalls and thunder in summer[13,14]. There are many scientific researches that have tried to specify the connection between suicide and seasonal periods, months, days of week and the lunar stage, as well as with the types of weather[15–18].

The results are greatly different. Definis-Gojanović and associates[19] have determined the relationship with the atmospheric pressure that was significantly different in relation to the day that preceded the suicide as well as other several researches[20–22] while in some studies no connection was found between meteorological factors and suicidal behavior[23].

It is a duty of the physician to make every effort in prediction and prevention of suicidal behavior among his patients. Therefore, identification of new risk factors, such as meteorological factors, could be useful in identification of individuals who have greater risk of suicide or attempted suicide.

Participants and Methods

This retrospective study of pairs was conducted in the period from the 1st of January 2003 until the 1st of January 2006.

Participants

Participants included in the study were persons who have attempted or committed suicide in the district of Mostar. Participants, both female and male, 89 of them, were in the age's range from 15 to 78 years. Data about participants were taken, during the above mentioned period, from the Clinic for Internal Diseases, Clinic for Surgery, Department of Otorhinolaryngology and Psychiatry Clinic of University Hospital Mostar, if they were treated at those departments, because of suicide attempts. For persons who committed suicide data were taken from the Police headquarters in Mostar.

Methods

The study was based on two different environmental set of parameters. The first one included the data on gradients of atmospheric pressure, humidity and temperature in the days when participants attempted or committed suicide. The second group included meteorological factors of the day immediately prior to the days of attempts or committing of suicide, as well as the average monthly values of meteorological factors. If suicide attempts were recorded for several days consequently, the second group for those suicide attempts also included gradients of atmospheric pressure, humidity and temperature of the day that preceded all of these days in a row, on which the respondents committed or attempted suicide.

Statistical analysis

Kolmogorov Smirnov test has been used to analyze the variable distribution. For normally distributed variables we have used mean and standard deviation as a measure of central tendency and dispersion, and for non-normal distributed variables median and interquartile range has been used. Nominal and ordinal variables have been analyzed with χ^2-test. Mann-Whitney U-test has been used for comparison of two independent variables with non-normal distribution, and Student t-test for variables with normal distribution (equality of variances was tested with Levene's test). Statistically significant difference was at $p<0.05$.

For statistical analysis of the obtained data software system SPSS for Windows (inačica 13.0, SPSS Inc, Chicago, Illinois, SAD) and Microsoft Excel (version 11. Microsoft Corporation, Redmond, WA, SAD) were used.

Results

A total of 89 participants were included, of which 61 (68.5%) participants have attempted suicide, and 28 (31.5%) participants committed suicide. Significantly more participants (n=57; 93.4%) committed suicide by invisible wounds (diverse intoxications), than visible wounds (mechanical or asphyxial) (n=4, 6.6%) ($\chi^2=46.05$; $p<0.001$).

From total number of participants, 45 (50.6%) of them were females, while 44 (49.4%) of them were males, which was not a significant difference ($\chi^2=0.01$; df=1; $p=0.916$), but males have committed suicide in 54.5% (n=24) of cases, versus 8.9% (n=4) of females, which proved to be statistically significant difference ($\chi^2=21.51$; df=1; $p<0.001$). The average age of examinees who have attempted suicide was 40.95±14.19 years (M±SD), while the average age of examinees who committed suicide was significantly higher (51.38±16.14 years) ($t=4.27$; $p<0.001$).

Comparing variables that define the weather conditions, such as atmospheric factors and seasonal periods, a significant difference was identified in days with and without suicidal risk.

Although there was no statistically significant difference in the atmospheric factors between the days when there was a suicide committed or attempted (test group), and days that immediately preceded the suicide attempt (control group) (Table 1), comparison of the average monthly atmospheric factors and atmospheric factors of the suicidal days showed a significant difference (Table 2).

On days when the suicide was attempted or committed, the maximum atmospheric pressure was 1005.47±5.49 milibars, while the average monthly value of maximum pressure was 1019.56±64.18 milibars, and thus significantly more than the test group ($t=2.06$; $p=0.042$). Also, the pressure gradient was significantly lower in the test group (3.70±2.15 milibars; C±Q), compared to the control group (4.52±1.92 milibars) (Mann-Whitney $U=2624.0$; $p<0.001$) (Table 2).

TABLE 1
COMPARISON OF ATMOSPHERIC FACTORS BETWEEN TEST GROUP (DAY WHEN SUICIDE WAS ATTEMPTED OR COMMITTED) AND CONTROL GROUP (DAY WHICH IMMEDIATELY PRECEDED THE TEST DAY)

Variables	$\overline{X}$±SD		Student t-test	p
	Test group	Control group		
Maximum pressure	1005.47±5.49	1004.59±5.87	1.039	0.300
Minimum pressure	1001.17±6.06	1000.37±6.86	0.821	0.413
Humidity of day	56.97±14.23	59.92±14.41	1.376	0.170
Average temperature	16.83±7.96	16.79±8.09	0.036	0.917
Maximum temperature	22.05±9.45	21.97±9.61	0.057	0.955
Minimum temperature	12.17±7.06	12.05±6.64	0.111	0.911
Gradient of temperature	9.95±4.16	9.88±4.14	0.105	0.917
	Median ± interquartile range			
	Test group	Control group	Mann-Whitney U	p
Gradient of pressure	3.70±2.15	3.80±1.95	3727.0	0.497
Humidity of month	57.00±7.00	57.00±8.00	3869.5	0.790

TABLE 2
COMPARISON OF ATMOSPHERIC FACTORS BETWEEN TEST GROUP (DAY WHEN SUICIDE WAS ATTEMPTED OR COMMITTED) AND CONTROL GROUP (AVERAGE MONTHLY VALUES OF ATMOSPHERIC FACTORS)

Variables	$\overline{X}$±SD		Student t-test	p
	Test group	Control group		
Maximum pressure	1005.47±5.49	1019.56±64.18	2.064	0.042
Minimum pressure	1001.17±6.06	1001.15±2.45	0.030	0.976
Average temperature	16.83±7.96	16.47±7.73	0.304	0.761
Maximum temperature	22.05±9.45	22.18±9.07	0.094	0.925
Minimum temperature	12.17±7.06	11.76±6.58	0.393	0.695
Gradient of temperature	9.95±4.16	10.41±2.92	0.867	0.387
	Median ± interquartile range			
	Test group	Control group	Mann-Whitney U	p
Gradient of pressure	3.70±2.15	4.52±1.92	2624.0	<0.001
Humidity of month	57.00±7.00	57.00±7.00	3908.0	0.878

Examinees most frequently (n=15; 16.9%), attempted or committed suicide in April (χ^2=24.39; p<0.001; Figure 1). Comparison of the average annual values of atmospheric factors with atmospheric factors of the test group – the days when the suicide was attempted or committed, did not reveal significant differences (Table 3).

Discussion

Significant difference which existed between the meteorological factors on the day of suicide and their average monthly values showed that meteorological factors at specific time increase suicide risk. Although there was no significant difference in meteorological factors between days when the suicide was attempted or committed, and control days, where we chose the day that preceded the suicide days, comparison of atmospheric factors on test days with their average monthly values, showed that values of test days in some variables like pressure gradient and maximum pressure significantly differ from average monthly values of atmospheric factors, what indicates their possible connection with the occurrence of suicide[22,23,26].

Looking at atmospheric factors during longer time periods and their relationship to suicide, it seems that the maximum number of examinees attempted or committed suicide in April, while difference between test days and average annual values of atmospheric factors, does not exist. Similar results in his work were obtained by Benedito-Silva, whereby the suicide rate was highest in early spring, but when atmospheric factors in days with suicide were compared with their average annual values in semi-annual period, there were no significant differences between them[27].

TABLE 3
COMPARISON OF ATMOSPHERIC FACTORS BETWEEN TEST GROUP (DAY WHEN SUICIDE WAS ATTEMPTED OR COMMITTED) AND CONTROL GROUP (AVERAGE ANNUAL VALUES OF ATMOSPHERIC FACTORS)

Variables	$\overline{X}$±SD		Student t-test	p
	Test group	Control group		
Maximum pressure	1005.47±5.49	1014.93±81.92	1.087	0.279
Minimum pressure	1001.17±6.06	1010.34±81.79	1.055	0.293
Average temperature	16.83±7.96	15.64±1.37	1.683	0.096
Maximum temperature	22.05±9.45	20.56±2.14	1.448	0.151
Minimum temperature	12.17±7.06	10.73±0.93	1.905	0.060
Gradient of temperature	9.95±4.16	9.83±1.81	0.105	0.916
	Median± interquartile range			
	Test group	Control group	Mann-Whitney U	p
Gradient of pressure	3.70±2.15	4.45±1.44	3648.0	0.982
Humidity of month	57.00±7.00	56.00±18.00	3305.000	0.192

Results of researches regarding meteorological factors are very different: certain quote same results[28], while in other studies there was not any connection found[11], or there was a negative relationship towards suicidal behavior[19]. Also, watching the results of this and foreign researches about comparison of other atmospheric factors (temperature and air humidity) with suicidal behavior, a great diversity was confirmed among them: in this study no statistically significant difference has been obtained between test and control days, which is in line with the research of Deisenhammer and Wang[11,20], although Gabilondo and his associates in their research reported significant relationship with these factors[29].

Pathophysiological mechanisms of the influence of atmospheric factors on human organism are unknown and can vary considerably, as can be seen from the results of the aforementioned researches. It is very likely, due to differences of results in many studies involved in this issue, that this mechanism is complex, and that it includes not only atmospheric factors, but environmental influences as well as biological, psychological and social factors.

Because of all these differences in the results and the difference in the choice of examinees and methodologies, by now it is not possible to define meteorological situation that could be called »suicide time«. Because of this and other[27] researches, it is noticeable that relationship between atmospheric factors and suicide risk also depends on the time period in which meteorological changes occur.

Days of suicide do not significantly differ from the day which immediately preceded suicide day but they significantly differ from their average monthly values. These results indicate that suicide may not be happening because of the fast changes in some atmospheric factors in one day, but may happen due to changes of the same factors in specific period, when they are at their peak, suggesting a possible suicide attempt trigger. Also, the role of common climate in the area where people live should not be ignored, because the impact of changes in atmospheric factors depends on life habits of people in certain weather conditions, where a bias from their normal values may represent a suicide risk[27].

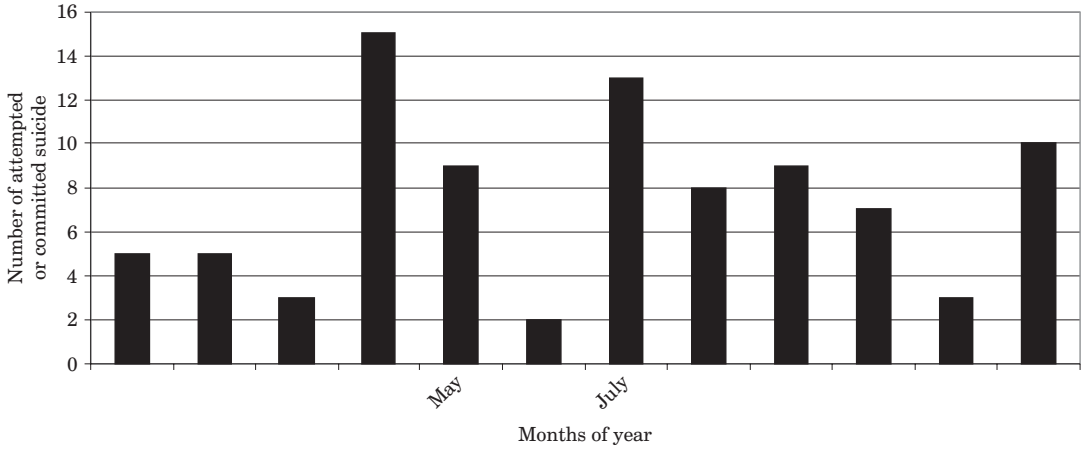

Fig 1. Overview of attempted or committed suicides by months of the year.

In analysis of other variables that are observed in the survey (gender, age, type of injury) it is important to notice, because of suicidal behavior prevention, that here the results of previous researches are mostly confirmed: persons who committed suicide were in older age than examinees who attempted suicide[25], and males significantly more often commit suicide compared to the females[24]. The difference in relation to other research exists only in the type of injury in attempting of suicide, because in this work significantly more respondents committed suicide with invisible injuries[30].

In order to explain more clearly the connection between meteorological factors and suicidal risk, future researches should determine more precisely the time period in which suicide risk increases after the weather conditions are changed, which could not have been done due to methodological limits of this study.

Conclusion

The research results confirm the relationship between atmospheric factors and suicide behavior, which is not accomplished because of the fast movement in values of some atmospheric factors, and thus do not act as an acute stress factors for suicide behavior, but because of their change during longer period of time they become an additional stress factor for possible suicide attempt in individuals who have predisposition for suicidal behavior.

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POVEZANOST SMETEOROLOŠKIH ČIMBENIKA I SAMOUBOJSTVA

SAŽETAK

Gledajući kroz povijest, ljudi su oduvijek povezivali samoubojstvo s vremenskim prilikama, pokušavajući razumjeti i utvrditi odnos meteoroloških čimbenika i suicidalnog ponašanja. U ovom radu cilj je bio utvrditi i analizirati meteorološke prilike u vrijeme pokušaja ili počinjenja suicida, te ispitati moguću povezanost promjena meteoroloških prilika i učestalosti suicidalnosti. Retrospektivna studija parova obuhvatila je razdoblje od 1. siječnja 2003. godine do 1. siječnja 2006. godine. Ispitanici uključeni u studiju su osobe koje su pokušale ili počinile samoubojstvo na području općine Mostar. Uspoređeni su meteorološki čimbenici u danima kad su ispitanici pokušali ili izvršili samoubojstvo s atmosferskim čimbenicima dana koji je neposredno prethodio danu suicidalnosti, kao i s prosječnim mjesečnim vrijednostima atmosferskih čimbenika. Meteorološki čimbenici dana sa suicidalnim ponašanjem i prethodnog dana slični, ali je postojala značajna razlika u meteorološkim čimbenicima između dana suicidalnosti i prosječnih mjesečnih vrijednosti meteoroloških čimbenika: maksimalni tlak je tad bio značajno niži u danima suicidalnosti isto kao i gradijent tlaka. U odnosu na godišnja doba, ispitanici su najučestalije, pokušavali počiniti samoubojstvo u travnju. Rezultati upućuju na to da atmosferski čimbenici ne djeluju kao akutni stresni čimbenik za suicidalno ponašanje, već svojom promjenom u dužem razdoblju, mogu biti okidač za pokušaj samoubojstva.