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The effect of altitude and climate on the suicide rates in Turkey

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ABSTRACT

Suicide is one of the most important public health problems. There was an association between suicide and several factors such as psychiatric diseases and psychological characteristics, somatic illness, cultural, socio-economic, familial, occupational and individual risk factors. Also, high altitude and climatic factors including high temperature, cloudiness, more sunshine and low rainfalls were defined as some of these risk factors in the literature.

In this study, we aimed to investigate correlation between suicide rates and altitudes of all cities in Turkey and between suicide rates and climatic factors including Rainfall Activity Index, Winter Mean Temperatures, Summer Mean Temperatures and Temperature Difference between January and July previously defined by several authors in the broad series in Turkey.

In Turkey, 29865 suicidal deaths occurred in 10 years period between 2006 and 2015. Of them, 21020 (70.4%) were males and 8845 (29.6%) were females. In this study, we found that high altitude above 1500 m, winter median temperature lower than −10 °C and hard temperature changes above 25 °C between winter and summer of settlements were important factors that affected on female suicide rates appropriate to knowledge which defined in previous studies.

In conclusion, we suggested that the associations among suicide rates with altitudes and climate should be studied in wider series obtained from different countries for reaching more reliable results.

1. Introduction

Suicide is one of the most important public health problems. According to the estimation of World Health Organization, approximately 804000 people died of suicide worldwide in 2012, and an annual global age-standardized suicide rate was calculated as 11.4 per 100000 population.[1]

The association between suicide and several factors such as psychiatric diseases and psychological characteristics [mood disorders (major depressive episode and dysthymia), anxiety disorders (panic disorder, agoraphobia, post-traumatic stress disorder, generalized anxiety disorder, specific phobia, social phobia) and alcohol or drug abuse and dependence, the loss of a loved one, etc.],[2–5] somatic illness, cultural (honor, religion, political factors and cultural attitudes, etc.), socioeconomic (economic problems, poor financial status, insufficient social support, low gross domestic product per capita, unemployment, etc.), familial (divorce, familial conflicts, infertility and fertility, inequalities, etc.), occupational (employment and problems at work) and individual (gender, age, region, country) risk factors were well-defined in the previous studies.[5,6]

In the literature, strong positive correlation between high altitudes and suicide rates was recorded. It was reported that depression and suicide rates increase in high altitude due to hypoxia. Additionally, depression, panic disorder and anxiety disorders are associated with high altitudes and they are important risk factors of suicides.[7–9]

Also it was reported in many studies that there was a positive or negative correlation between suicide rates and several components of climatic effect such as high temperature or temperature alteration,[10–21] sunshine,[10,11,14,16,18–20,22,23] cloudiness,[10,11] rainfalls,[10,11,18,19] etc.

In this study, we aimed to investigate correlation between suicide rates and altitudes of all cities in Turkey and between suicide rates and

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climate factors including Rainfall Activity Index, Winter Mean Temperatures, Summer Mean Temperatures and Temperature Difference between January and July were previously defined by several authors in broad series in Turkey.

2. Material and methods

In this study, the data were extracted for "suicide number for each years and each city" and "population number for each years and each city" between 2006 and 2015 years from web pages of the Turkish Statistical Institute (TURKSTAT) of the Republic of Turkey.[24] Crude suicide rates for per 100000 population for each years and each of 81 cities in Turkey were calculated and mean suicide rates was found for 10 years.

After mean altitudes were calculated for every city on the basis of city altitude and its districts' altitudes,[25,26] cities were classified into four groups according to mean altitudes as 0–499 m, 500–999 m, 1000–1499 m and 1500 m and above.

Climate data of cities was obtained from the manuscript about "Climate Classification in Turkey" of Turkish Climatology Department.[27] Rainfall Activity Index (RAI), Winter Mean Temperature (WMT), Summer Mean Temperature (SMT) and Temperature Difference between January and July (TDJJ) were calculated as shown at Table 1.

Descriptive statistics for the studied variables (characteristics) were presented as median, mean, standard deviation, minimum and maximum values. Kruskal-Wallis test was performed to compare groups. Following the Kruskal-Wallis test, Dunn multiple comparison test was used to determine different groups. Statistical significance level was considered as $p < .05$ and SPSS (ver: 22) statistical program was used for all statistical computations.

3. Results

In Turkey, 29865 suicidal deaths occurred in 10 years period between 2006 and 2015. Of them, 21020 (70.4%) were males and 8845 (29.6%) were females. Mean suicidal death rates for 10 years were calculated as 5.6 (per 100000 population) in males, 2.4 (per 100000 population) in females and 4.0 (per 100000 population) totally. When we investigated the changes of suicide rates annually, it was seen that it increased 1.1 per 100000 population in males, decreased 0.6 per 100000 population in females and increased 0.3 per 100000 population in total from 2006 to 2015 whereas it showed fluctuation (Fig. 1). For ten years, lowest suicide rates were in Bayburt (2.84 per 100000 population) for males, Çankırı (0.86 per 100000 population) for females and Gümüºhane (2.20 per 100000 population) for total whilst highest suicide rates were in Tunceli (11.28 per 100000 population) for males, Ardahan (6.48 per 100000 population) for females and Tunceli (8.14 per 100000 population) for total (Table 2).

Altitude of Turkey changes from 0 to 5137 m. Karayazı village of Erzurum city is highest settlement (2450 m). Altitude was 0 in Çanakkale and 1890 in Erzurum. Of cities in Turkey, 30 were settled among 0–499 m, 22 among 500–999 m, 21 among 1000–1499 m and 8 above 1500 m. There were not statistically significant relations between mean suicidal death rates in males ($p = .094$) or total population ($p = .664$) and the mean altitudes of cities but there was a significant relation in females ($p = .014$) (Table 3).

There was not a statistically significant relation between suicidal deaths and RAI. However there was a statistically significant relation between suicidal deaths and WMT in females ($p = .016$) whilst there was not statistically significant in males and total population. Whilst SMT was not affected on suicidal death rates, TDJJ was significantly affected to suicidal death rates in both genders ($p = .006$ for males and $p = .000$ for females). When TDJJ was hard (higher than 25 °C), suicidal death rates increased in females ($p = .000$). Also male suicidal death rates increased when TDJJ was moderate (between 20 °C and 25 °C) ($p = .006$) (Table 4).

Table 1
Classification of climate types (Modified from the manuscript about "Climate Classification in Turkey" of Turkish Climatology Department[27]).

Climate Classification According to Erinç's Rainfall Activity Index (RAI)	Rainfall Activity Index (RAI) (the proportion of the total annual precipitation (mm) to annual average maximum temperature (°C))
Dry/Semi-Dry	< 23
Semi-Moist	23–40
Moist/Very Moist	40 <
Climate Classification According to Winter Mean Temperatures (WMT)	**Winter Mean Temperature (WMT) (January average temperature)**
Very Cold Winters	< −10 °C
Cold Winters	−10-0 °C
Cool/Warm Winters	0 °C <
Climate Classification According to Summer Mean Temperatures (SMT)	**Summer Mean Temperature (SMT) (July average temperature)**
Warm Summers	< 23 °C
Hot Summers	23-28 °C
Very Hot Summers	28 °C <
Climate Classification According to Temperature Difference between January and July (TDJJ)	**Temperature Difference between January and July (TDJJ)**
Soft	< 20 °C
Moderate	20-25 °C
Hard	25 °C <

4. Discussion

In Turkey, the suicide rates (per 100000 population) were reported as 3.5 in 1996 and 4.8 in 2005 for males, 2.2 in 1996 and 2.7 in 2005 for females and 2.9 in 1996 and 3.8 in 2005 for total population in previous decade.[5] In the present study, it was found that these rates increased from 4.8 to 5.9 in males, decreased from 2.8 to 2.2 in females and increased from 3.8 to 4.1 in total population between 2006 and 2015. Also, 70.4% of the suicides was males whilst this rate was 61.1% in previous decade.[5] These findings show that female suicide rates remained stable at last twenty years whereas male and total suicide rates significantly increased. However it was reported in the previous studies that the rising of suicide mortality rates were 5 times higher in men than women.[5,28,29]

In the literature, strong positive correlation between high altitudes and suicide rates was recorded.[30] It was reported that the association between altitude and high suicide rates might be explained with many possible reasons.[31] Hypoxia and disorders developed depending on it such as depression, panic disorder and anxiety disorders and increasing of cocaine use at altitudes above 2000 m were defined important risk factors of suicides.[7–9] In this study we determined that there was a relation between mean suicidal death rates and mean altitudes of cities in females. However this relation was not observed in males and total population. Some authors reported that progesterone level show an increase in women, especially in pregnant women who had a prolonged stay at high altitude, but no change in pituitary, gonadal and adrenal hormones.[32,33] Also, Mousavi et al. defined a relation between recurrent suicide attempts and increased progesterone level.[34] The presented study is based on the statistical database and no information was available on whether female victims of suicides had any problems related to pregnancy, menstrual cycle disorder or endocrine disorders. We suggest that, the relation between the increase of female suicide rates and the increased progesterone level at high altitudes is an issue needs to be investigated in broader clinical series.