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The Influence of Altitude and Ambient Temperatures on Suicide Deaths in Türkiye from 2007 to 2022

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Abstract

The high rate of suicide worldwide is one of biggest obstacles to meet the WHO goal of reducing deaths by one-third by 2030. Previous studies have proven that suicide risk factors have an intertwined impact on suicide rates. The aim of this study was to define the relationship between the suicide rates in all provinces in Türkiye and the altitudes of these provinces, annual average winter and summer temperatures, temperature differences between winter and summer, and to investigate the relationship between suicide rates and gender, age group, socioeconomic scores of the provinces, reasons for suicide and types of suicide.

The crude data for the current study were obtained from the Turkish Statistical Institute (TUIK) public website.

Between 2007 and 2022, there were 52,300 suicides in 81 cities in Türkiye, comprising 38,564 males and 13,736 females. An increase in altitude was found to be associated with higher suicide rates in females and young people. For children aged <15 years, a low ambient temperature increased suicide rates. A positive correlation was detected between an increase in mean temperature and suicide committed by jumping from a high place, and between an increase in the seasonal temperature difference and suicide by hanging.

The variations in suicide rates associated with altitude and ambient temperature may provide an opportunity to identify times of high risk for individuals with suicidal tendencies and thereby enable them to receive increased psychological support during these times of change.

Keywords: Suicide, Altitude, Temperature, Firearm, Jumping, Hanging.

Introduction

The World Health Organization (WHO), aims to reduce premature death from non-communicable diseases by one-third by 2030 through treatment and prevention, while also improving mental health and wellbeing. Suicide deaths worldwide are one of the major obstacles to achieve this goal. According to WHO data, the global age-standardized suicide rate was 9.0 per 100,000 people in 2019, and approximately 703,000 people die from suicide worldwide each year (1).

Previous research has found that the most important factors predisposing an individual to suicide are psychiatric diseases and psychological disorders such as borderline personality disorder, major depression, bipolar disorder, schizophrenia, anorexia nervosa, post-traumatic stress disorder, and alcohol and substance addiction. These have been reported to increase the risk of suicide by more than ten-fold (2-4). Furthermore, individual characteristics such as gender and age, physical disorders, cultural, social, national, regional, familial, and professional issues have also been reported as risk factors for suicide (4).

Previous research has examined the relationship between suicide rates and high altitude, and except for one study (24), most others have reported a full or partial positive correlation between the two (5-23). The correlation between suicide rates and climatic factors shown in previous studies has also defined a relationship between temperature change and suicide rates (5,25-33). Scientists have recently suggested that rising temperatures and temperature fluctuations linked to global warming may be related to an increase in suicide cases and attempted suicides, suggesting that climate change may raise the risk of suicide related to temperature

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(34,35). The impact on suicide rates of temperature fluctuations between summer and winter (19), low ambient temperatures (19,27), differences in cloud cover (31), duration and intensity of sunshine (31,36), humidity (30,31), and precipitation (26,30,32) has been examined in previous studies. Some of these studies have determined positive correlations between suicide rates and some of these climatic factors, and negative correlations with others. In the first of two previous studies conducted in Türkiye, it was stated that suicide attempts peak in spring and summer months for males aged 15-34 years and over 65 years, and for females aged 15-44 years. A positive correlation was also identified between the monthly averages of humidity, ambient temperature, duration and intensity of sunlight and the monthly number of suicide attempts, and a negative correlation between cloud cover and atmospheric pressure and the monthly number of suicide attempts (31). In the second study, altitude above 1500 m in settlements, average winter temperature below -10 °C and sharp temperature changes between winter and summer above 25 °C were stated to be important factors affecting female suicide rates (19).

In contrast to previous research, the primary aim of this study was to directly determine whether there is a correlation between the suicide rates of all provinces in Türkiye and the altitudes of these provinces, annual winter and summer temperature averages, temperature differences between winter and summer, and the socioeconomic level of the provinces. The secondary aim was to investigate the relationships between the suicide rates obtained by categorizing the provinces according to altitude, annual winter and summer temperature averages, temperature differences between winter and summer, and gender, age group, reasons for suicide, and types of suicide.

Material and Methods

The crude data for the current study, including the number of suicides and city populations from 2007 to 2022, were obtained from the Turkish Statistical Institute (TUIK) public website (37,38). The suicide statistics of TUIK for 2000-2011 include information taken from the General Directorate of Security and General Command of Gendarmerie. Since 2012, the coverage of suicide statistics has been expanded to add information taken from the institutions in the location where suicide occurred and from TUIK death certificates. Suicide data have been revised with updated administrative records. In the data collection forms prepared by TUIK, the age, gender, marital status, place of residence, level of education and economic status of the person who committed suicide, the method of suicide and the reason for the suicide are categorized and questioned. These data are made available in published tables. The causes of suicide are determined because of judicial investigations and reported to TUIK.

TUIK classifies people into 14 age groups: one under 15 years old, twelve groups covering 5 years between 15 and 74 years old, and one group 75 years and over. In this study, a total of eight age groups were created within the context of the classification used in previous suicide studies in Türkiye [4,39]: a group under 15 years old, six groups covering 10 years between 15 and 74 years old, and one group 75 years and over.

The reasons for suicide are classified by TUIK as “illness”, “family incompatibility”, “economic problems”, “business failure”, “emotional relationship and not marrying the person wanted”, “educational failure”, “other” and “unknown”. To provide easier statistical comparison in the current study, the four categories with the most data were used, which were determined to be “illnesses”, “economic problems”, “familial incompatibilities “and “emotional/romantic concerns” in order and all the suicides were collected under the heading of “other/unknown reasons”.

The manner of suicide is classified by TUIK as “hanging”, “taking chemicals”, “jumping from a high place”, “drowning”, “firearms”, “burning”, “using a sharp instrument”, “using natural gas or LPG etc”, “jumping off a train or another motorized vehicle” and “other”. The International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10) 2019 WHO Edition defines intentional self-harm verbs among items X60 and X84. In the classification of TUIK, a different classification method was used, and the TUIK website does not define within which classification framework suicide manners are evaluated.

In the current study, the four main headings with the most data were determined to be “hanging”, “firearms”, “jumping from a high place” and “toxic substance ingestion”, and other causes of suicide were collected under the heading of “other methods” to provide easier statistical comparison.

Crude suicide rates were used in this study because the distribution of suicides by provinces was given by TUIK based on crude suicide rates

and age-standardized rates were not defined separately for provinces. Likewise, the crude suicide rates are used as a basis in many studies around the world and by WHO due to their suitability for statistical comparisons (1).

For each province, 16 years of data that can be accessed for evaluation on the TUIK website were evaluated, and raw mean suicide rates were determined according to gender, age, reason for suicide, and manner of suicide. Then, the adjusted mean suicide rates per 100,000 people were calculated using the mean population for the same period (Supplement 1).

In this study, which is based on mean provincial altitudes determined using the mean height of all settlements inside the provincial borders, "Atlas Big" data were utilized to determine the mean altitudes of the cities (40). Meteorological data of the provinces for the same period, including the annual mean temperature (°C) (AMT), winter mean temperature (°C) (WMT), summer mean temperature (°C) (SMT), and seasonal temperature difference (°C) (STD), as an indicator of the average temperature difference between winter and summer (41). The socio-economic development scores and development rankings of the provinces were obtained from the SEGE-2017 bulletin of the Socio-Economic Development Ranking Research of Provinces and Regions of the General Directorate of Development Agencies (42) (Supplement 1).

In the following stage of the study, climate and altitude data were compared with the adjusted mean suicide rate determined for each province according to factors such as gender, age, cause of suicide, and manner of death. In the study, these data were described as "pre-classification" or "before classification".

Then, the values obtained for 81 provinces were classified into three groups, were classified into three groups, with 27 provinces in each group, and the changes in gender, age, reason for suicide, and manner of death were examined separately. In the study, these data were described as "post-classification" or "after classification".

Descriptive statistics for the studied variables were presented as mean values. The paired samples correlations were performed to determine the correlations between the crude suicide rates and the mean values of unclassified features considered in the study. The One-way ANOVA test was used to evaluate relationships between classified data, and Duncan analysis was used for post-hoc analyses. The level of statistical significance was 5%. All the statistical analyses were performed using SPSS (ver:25) software.

Results

In the 16-year period between 2007 and 2022, there were 52,300 suicides in the 81 provinces of Türkiye, comprising 38,564 (73.7%) males and 13,736 (26.3%) females. The annual mean crude suicide rate per 100,000 people was 6.45 for males, 2.49 for females, and 4.49 for the overall population. During the 16-year period, the lowest suicide rates were in Gümüşhane for the total population (1.84 per 100,000 population) and both genders (2.63 per 100,000 population for males and 1.04 per 100,000 population for females), and the highest suicide rates for the total population (8.9 per 100,000 population) and for males (12.7 per 100,000 population) were in Tunceli and for females (5.45 per 100,000 population) in Muş (Supplement 1). The suicide rates showed an upward trend by years for males (Figure 1).

Of the total suicides, 23.1% (n=12,060) were in the 15-24 years age group, 21.4% (n=11,207) in the 25-34 years age group, 17.2% (n=8,946) in the 35-44 years age group, 14% (n=7,338) in the 45-54 years age group, 10.3% (n=5,373) in the 55-64 years age group, 6.1% (n=3,197) in the 65-74 years age group, 5.3% (n=2,807) in those aged ≥75 years, and 2.6% (n=1,372) in those aged <15 years. It was observed that suicide rates were low in the <15 years age group (0.54 for the 100,000 population), formed a peak in the 15-24 years age group (6.48 for the 100,000 population), subsequently decreased, and then increased again after the age of 75 years, reaching the highest level (6.93 for the 100,000 population) (Figure 2).

The reasons for suicide were defined as illnesses in 21.8% of cases (n=11,410), economic problems in 8.3% (n=4,366), familial incompatibility in 7.1% (n=3,721) and emotional and romantic concerns in 3.4% (n=1,799). In 59.4% (n=31,004) of cases, the reason for suicide was either unknown or classified as "other reasons".

The means of suicide were determined to be hanging in 48.7% (n=25,444), firearms in 26.4% (n=13,798), jumping from a high place in 11% (n=5,767), toxic substance ingestion in 6.6% (n=3,474), and other methods in 7.3% (n=3,817).

Correlations between altitude and suicide rates (Table 1): The mean altitude of Türkiye is 1,059.3±542.1 meters (minimum: 103.2 m (Edirne); maximum: 2,251.5 m (Van)). Although there was no statistically significant correlation

Table 1: Relationships between the "Altitude" of Provinces and "Suicide Rates" according to Gender, Age Groups, the Reason for Suicide and the Manner of Suicide

				Mean Suicide Rates per 100,000 Population			
Altitude		r	P1	<850 m	850-1,220 m	>1,220 m	P2
Gender	Female	.422	.000	2.170a	2.358a	2.956b	.002
	Male	-.198	.076	6.663	6.613	6.084	.413
	Total	.015	.893	4.432	4.477	4.556	.921
Age Groups (years)	<15	.526	.000	0.366a	0.487a	0.764b	.000
	15-24	.446	.000	5.627a	6.061a	7.739b	.001
	25-34	.058	.606	5.616	5.916	6.077	.518
	35-44	-.160	.153	5.198	5.260	4.790	.462
	45-54	-.089	.432	5.057	5.229	4.853	.655
	55-64	-.281	.011	5.446	4.912	4.379	.083
	65-74	-.372	.001	5.468b	4.829ab	3.971a	.014
	≥75	-.225	.044	7.561	7.057	6.164	.377
The Reason for Suicide	Illnesses	-.325	.003	0.941	0.912	0.787	.177
	Economic Problems	-.372	.001	0.372b	0.353b	0.254a	.011
	Familial Incompatibilities	.041	.718	0.302	0.349	0.323	.334
	Emotional/ Romantic Concerns	-.103	.360	0.145	0.138	0.137	.860
	Other/Unknown Reasons	.216	.052	2.673	2.726	3.054	.195
The Manner of Suicide	Hanging	.011	.921	2.236	2.246	2.245	.999
	Firearms	.252	.023	1.201	1.292	1.445	.081
	Jumping From a High Place	-.282	.011	0.348	0.379	0.281	.152
	Toxic Substance Ingestion	-.172	.125	0.328	0.289	0.274	.488
	Other Methods	-.088	.433	0.319	0.273	0.308	.363

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between the altitudes of the provinces and the adjusted mean suicide rates in the overall population and in males, there was seen to be a positive correlation between suicide rates and altitude for females ($p<0.001$), with suicide rates increasing above 1,220 m altitude in females ($p=0.002$). A statistically significant positive correlation was observed between altitude and suicide rates in those aged ≤24 years ($p<0.001$), and a statistically significant negative correlation was observed in those aged ≥55 years ($p<0.05$). Suicide rates among 15–24-year-olds increased statistically significantly ($p=0.001$) and among 65–74-year-olds decreased statistically significantly ($p=0.014$) at altitudes over 1220 m. Before the altitude classification, there was a statistically significant negative correlation between altitude and suicide rates due to illness ($p=0.003$) and suicide rates due to economic problems ($p=0.001$), while at altitudes above 1220 m, there was a significant decrease in suicide rates due to economic problems ($p=0.011$) and an insignificant decrease in suicide rates due to illness ($p=0.177$). A positive correlation was found between altitude and the rates of suicide by firearms ($p=0.025$), and a negative correlation was found between altitude and suicide by jumping from a high place ($p=0.011$). When altitude was classified, no statistically significant relationship was found between any suicide manner and suicide rate.

Table 2: Relationships between the "Annual Mean Temperature (AMT)" of Provinces and "Suicide Rates" according to Gender, Age Groups, the Reason for Suicide and the Manner of Suicide

				Mean Suicide Rates per 100,000 Population			
AMT		r	P1	<12.2 °C	12.2 -14.6 °C	>14.6 °C	P2
Gender	Female	-.274	.013	2.622	2.461	2.400	.629
	Male	.037	.743	6.080	7.117	6.163	.053
	Total	-.081	.470	4.357	4.816	4.291	.171
Age Groups (years)	<15	-.357	.001	0.689b	0.474a	0.454a	.040
	15-24	-.190	.089	6.798	5.989	6.641	.368
	25-34	.017	.878	5.595	6.151	5.863	.394
	35-44	.015	.893	4.859	5.529	4.860	.166
	45-54	-.068	.544	5.127	5.169	4.842	.686
	55-64	.052	.648	4.435a	5.624b	4.678ab	.030
	65-74	.195	.081	3.894a	5.699b	4.676ab	.002
	≥75	.100	.375	5.825a	8.732b	6.225a	.006
The Reason for Suicide	Illnesses	.218	.050	0.747a	1.026b	0.867ab	.005
	Economic Problems	.055	.623	0.314	0.350	0.315	.634
	Familial Incompatibilities	-.086	.448	0.339	0.321	0.314	.711
	Emotional/ Romantic Concerns	.122	.280	0.125	0.148	0.148	.252
	Other/Unknown Reasons	-.199	.075	2.832	2.972	2.648	.368
The Manner of Suicide	Hanging	-.213	.057	2.253ab	2.490b	1.984a	.049
	Firearms	-.150	.182	1.317	1.384	1.237	.418
	Jumping From a High Place	.421	.000	0.278a	0.307ab	0.423b	.010
	Toxic Substance Ingestion	.214	.055	0.245	0.313	0.333	.135
	Other Methods	.130	.249	0.266	0.319	0.316	.215

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No statistically significant correlation was observed between the mean altitudes of provinces and other age groups, other reasons, or other manners of suicide in both pre- and post-classification comparisons.

Correlations between AMT and suicide rates (Table 2): The AMT of Türkiye is 13.2±3.3°C (minimum: 3.7°C (Ardahan); maximum: 19.3°C (Mersin)). While a statistically significant correlation was observed between the average AMT values of the provinces before the classification and the suicide rates in females

Table 3: Relationships between the "Winter Mean Temperature (WMT)" of Provinces and "Suicide Rates" according to Gender, Age Groups, the Reason for Suicide and the Manner of Suicide

				Mean Suicide Rates per 100,000 Population			
WMT		r	P1	<6 °C	6-10.3 °C	>10.3 °C	P2
Gender	Female	-.313	.004	2.693	2.492	2.299	.251
	Male	-.028	.807	6.249	6.987	6.124	.150
	Total	-.148	.188	4.480	4.770	4.216	.191
Age Groups (years)	<15	-.397	.000	0.719b	0.468a	0.429a	.008
	15-24	-.275	.013	7.123	6.181	6.124	.178
	25-34	-.053	.639	5.756	6.094	5.758	.635
	35-44	-.040	.722	4.991	5.493	4.764	.189
	45-54	-.125	.266	5.161	5.209	4.768	.495
	55-64	.020	.863	4.555	5.437	4.744	.154
	65-74	.172	.125	3.921a	5.576b	4.772ab	.005
	≥75	.065	.564	6.029	8.319	6.434	.050
The Reason for Suicide	Illnesses	.163	.146	0.770a	0.995b	0.876ab	.034
	Economic Problems	.000	1.000	0.316	0.363	0.301	.321
	Familial Incompatibilities	-.144	.200	0.346	0.318	0.310	.496
	Emotional/ Romantic Concerns	.065	.564	0.134	0.148	0.139	.658
	Other/Unknown Reasons	-.244	.028	2.914	2.949	2.589	.223
The Manner of Suicide	Hanging	-.266	.016	2.326ab	2.466b	1.936a	.028
	Firearms	-.185	.098	1.360	1.344	1.234	.467
	Jumping From a High Place	.347	.001	0.260a	0.348ab	0.400b	.022
	Toxic Substance Ingestion	.184	.100	0.253	0.311	0.326	.252
	Other Methods	.127	.258	0.280	0.300	0.319	.523

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(p=0.013), no statistically significant correlation was observed between the AMT values and the average suicide rates by gender after the classification. Before the classification, a statistically significant negative correlation was observed between the AMT value of the provinces and the suicide rates only in the <15 years age group (p<0.01). No statistically significant correlation was observed between the suicide rates and the AMT values in other age groups. After the

Table 4: Relationships between the "Summer Mean Temperature (SMT)" of Provinces and "Suicide Rates" according to Gender, Age Groups, the Reason for Suicide and the Manner of Suicide

SMT		r	P1	Mean Suicide Rates per 100,000 Population <17.9 °C	17.9-19.6 °C	>19.6 °C	P2
Gender	Female	-.215	.054	2.740	2.389	2.354	.196
	Male	.113	.317	6.220	6.668	6.472	.650
	Total	.003	.982	4.490	4.551	4.423	.917
Age Groups (years)	<15	-.295	.007	0.666	0.495	0.456	.097
	15-24	-.102	.367	6.811	6.139	6.478	.543
	25-34	.096	.395	5.723	6.087	5.799	.643
	35-44	.080	.477	4.903	5.266	5.079	.678
	45-54	-.008	.942	5.094	4.992	5.052	.969
	55-64	.086	.443	4.683	5.117	4.936	.667
	65-74	.210	.060	4.199	5.017	5.052	.183
	≥75	.160	.153	6.509	7.311	6.962	.732
The Reason for Suicide	Illnesses	.261	.019	0.786	0.914	0.940	.169
	Economic Problems	.108	.337	0.308	0.310	0.361	.372
	Familial Incompatibilities	-.022	.843	0.351	0.299	0.323	.253
	Emotional/ Romantic Concerns	.161	.151	0.132	0.139	0.150	.537
	Other/Unknown Reasons	-.125	.267	2.913	2.889	2.650	.447
The Manner of Suicide	Hanging	-.121	.284	2.317	2.267	2.143	.691
	Firearms	-.108	.337	1.357	1.354	1.227	.410
	Jumping From a High Place	.435	.000	0.251a	0.344ab	0.413b	.006
	Toxic Substance Ingestion	.239	.032	0.276	0.279	0.336	.358
	Other Methods	.133	.238	0.287	0.306	0.307	.819

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Table 5: Relationships between the "Seasonal Temperature Difference (STD)" of Provinces and "Suicide Rates" according to Gender, Age Groups, the Reason for Suicide and the Manner of Suicide

				Mean Suicide Rates per 100,000 Population			
STD		r	P1	<10.9 °C	10.9 -12.1 °C	>12.1 °C	P2
Gender	Female	.254	.022	2.166	2.643	2.674	.052
	Male	.215	.054	5.873	6.598	6.889	.091
	Total	.272	.014	4.036a	4.624ab	4.806b	.028
Age Groups (years)	<15	.289	.009	0.385a	0.591ab	0.640b	.031
	15-24	.351	.001	5.444a	7.051b	6.932b	.010
	25-34	.237	.033	5.351	5.955	6.302	.057
	35-44	.191	.088	4.592	5.233	5.422	.102
	45-54	.215	.054	4.703a	4.798a	5.638b	.038
	55-64	.091	.421	4.637	5.078	5.021	.612
	65-74	-.003	.976	4.581	5.245	4.442	.263
	≥75	.117	.300	6.192	6.760	7.830	.258
The Reason of Suicide	Illnesses	.087	.438	0.824	0.868	0.948	.362
	Economic Problems	.158	.158	0.283	0.362	0.335	.169
	Familial Incompatibilities	.230	.039	0.281	0.341	0.351	.055
	Emotional/ Romantic Concerns	.118	.294	0.133	0.153	0.134	.381
	Other/Unknown Reasons	.261	.019	2.513	2.901	3.038	.056
The Manner of Suicide	Hanging	.306	.005	1.883a	2.353ab	2.491b	.007
	Firearms	.178	.112	1.214	1.347	1.377	.294
	Jumping From a High Place	.010	.931	0.337	0.330	0.341	.980
	Toxic Substance Ingestion	.017	.878	0.294	0.319	0.279	.693
	Other Methods	-.036	.748	0.307	0.274	0.319	.385

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classification, it was observed that suicide rates peaked in provinces with AMT values between 12.2 and 14.6 °C for people over the age of 55 years ($p<0.05$; for each) and in provinces with AMT values < 12.2 14.6 °C for people aged <15 years ($p=0.040$).

There was a positive correlation between AMT and illness-related suicide rates ($p=0.050$). Illness-related suicide rates were also highest in provinces with AMT values of 12.2-14.6 °C ($p<0.05$). Before the classification, a statistically significant negative correlation was observed between the AMT value of the provinces and suicide rates by jumping from a high place ($p<0.001$). There was no statistically significant correlation between suicide by other means and AMT values. After the classification, the rate of suicide by hanging was highest in provinces with AMT values of 12.2-14.6 °C ($p=0.049$) and the rate of suicide by jumping from a high place was highest in provinces with AMT values > 14.6 °C ($p=0.010$).

No statistically significant correlation was observed between the ATD values of provinces and other age groups, other reasons, or other manners of suicide in both pre- and post-classification comparisons.

Fig. 1. Variations in suicide rates per 100,000 population in Türkiye between 2007 and 2022

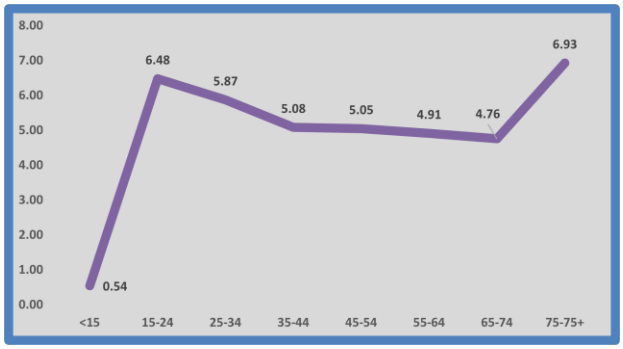

Fig. 2. Distribution of the raw suicide rates calculated per 100,000 population and representing the average of 2007–2002 by age groups

Correlations between WMT and suicide rates (Table 3): The mean WMT of Türkiye is 7.9±3.8°C (minimum: -2.4°C (Ardahan); maximum: 14.9°C (Mersin)). While a statistically significant correlation was observed between the average WMT values of the provinces before the classification and the suicide rates in females (p=0.004), no statistically significant correlation was observed between the AMT values and the average suicide rates by gender after the classification. A statistically significant negative correlation was observed between the WMT of provinces and suicide rates in those aged <15 years (p<0.001) and in the 15-24 years age group (p=0.013). In the post-classification comparison, no statistical significance was found for those under 24 years of age, and suicides in the 65-74 years age group (p=0.005) and the ≥75 years age group (p=0.050) peaked between 6.0 and 10.3 °C.

Before the classification, no significant correlation was found between the average WMT values of the provinces and the suicide rates according to reasons. Illness-related suicide rates were highest at WMT values of 6.0–10.3 °C (p=0.034).

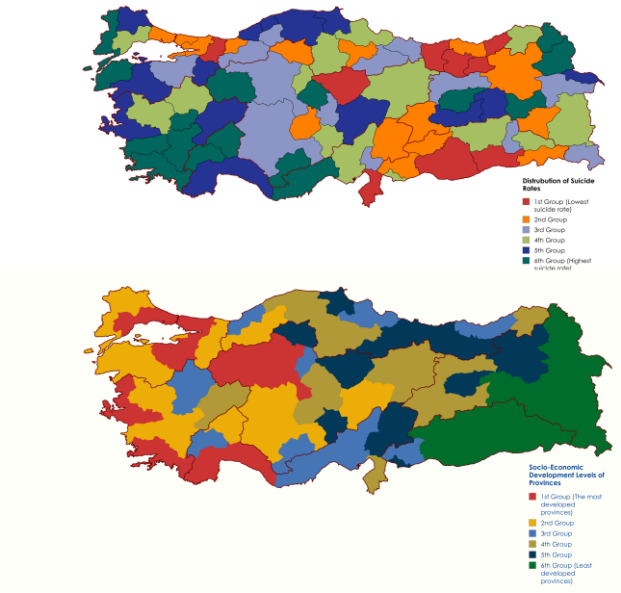

Fig. 3. The suicide rate rankings of the provinces according to the general population and their rankings according to the socio-economic development scores (Maps are produced by the authors. There is no legal restriction or claim of rights)

Mean WMT values were found to be positively correlated with jumping from a high place (p=0.001) and negatively correlated with suicide by hanging (p=0.016). In provinces where the average WMT value was >10.3 °C, suicide rates by hanging were lowest (p=0.028) and suicide rates by jumping from a high place were highest (p=0.022).

No statistically significant correlation was observed between the WMT values of provinces and other age groups, other reasons, or other manners of suicide in both pre- and post-classification comparisons.

Correlations between SMT and suicide rates (Table 4): The mean SMT value of Türkiye is 19±3.1°C (minimum: 10.9°C (Ardahan); maximum: 25.4°C (Adana)). No statistically significant correlation was detected between the SMT values and gender/age groups in both pre- and post-classification comparisons (p>0.05 for each). Although a positive correlation was observed between illness-related suicide rates and SMT values in the pre-classification evaluation (p=0.019), no statistically significant correlation was observed after classification (p=0.169). The SMT values were found to be positively correlated with suicides committed by jumping from a high place (p<0.001) and toxic substance ingestion (p=0.032). In the post-classification evaluation, only the suicide rate committed by jumping from a

Supplement 1: Suicide Rates Between 2007 and 2022, Adjusted For The 100,000 Population Of Each Province According To Gender, Age Groups, Reason For Suicide, and Manner of Suicide

		PARAMETERS					Suicide Death Rates Adjusted for 100,000 Population between 2007 and 2022.																				
							GENDER			AGE GROUPS								REASON OF SUICIDE						MANNER OF DEATH			
NO	CITY	ALTITUDE (m)	ANNUAL MEAN TEMPARATURE (°C) (AMT)	WINTER MEAN TEMPARATURE (°C) (WMT)	SUMMER MEAN TEMPARATURE (°C) (SMT)	SEASONAL TEMPARATURE DIFFERENCE (°C) (STD)	FEMALE	MALE	TOTAL POPULATION	<15	15-24	25-34	35-44	45-54	55-64	65-74	75-75+	ILLNESS	ECONOMIC PROBLEMS	FAMILIAL INCOMPATIBILITIES	EMOTIONAL/ ROMANTIC CONCERNS	OTHER / UNKNOWN REASONS	HANGING	FIREARMS	THROW FROM HIGH	INTOXICATION	OTHER
1	Adana	661,9	19,2	13,9	25,4	11,5	2,67	6,71	4,69	0,45	7,51	6,60	5,94	5,49	5,20	3,99	6,75	1,26	0,46	0,36	0,22	2,40	1,81	1,25	0,70	0,50	0,44
2	Adıyaman	940,5	17,4	12,1	23,1	11,0	2,32	4,76	3,54	0,44	5,93	5,04	3,79	4,48	3,95	4,65	6,03	0,66	0,15	0,19	0,09	2,45	1,65	1,07	0,33	0,19	0,31
3	Afyonkarahisar	1193,5	11,3	5,1	17,4	12,3	2,64	6,99	4,80	0,72	7,57	5,67	5,74	5,59	5,43	4,33	7,50	0,69	0,37	0,48	0,18	3,08	2,68	1,25	0,17	0,40	0,30
4	Ağrı	2069,7	6,2	-0,4	13,0	13,4	3,93	4,58	4,27	1,57	9,39	4,64	4,06	3,44	3,00	4,75	3,19	0,44	0,15	0,19	0,08	3,41	1,84	1,94	0,13	0,08	0,28
5	Aksaray	1091,3	12,1	6,2	18,7	12,5	1,48	5,82	3,64	0,48	6,08	5,78	2,94	6,04	2,17	3,33	5,44	0,62	0,27	0,21	0,05	2,50	1,80	1,22	0,19	0,27	0,16
6	Amasya	874,9	13,6	8,0	20,1	12,1	1,33	5,90	3,61	0,57	5,19	3,82	4,43	3,58	4,25	4,30	5,38	0,85	0,46	0,17	0,11	2,01	1,80	1,27	0,19	0,13	0,21
7	Ankara	1042,7	11,9	6,3	17,8	11,5	1,87	6,18	4,01	0,29	4,79	5,44	4,91	4,88	4,86	4,86	5,87	1,19	0,44	0,31	0,15	1,92	1,79	0,97	0,71	0,25	0,28
8	Antalya	968,0	18,8	13,8	24,2	10,4	2,60	7,14	4,89	0,37	6,41	6,90	5,67	5,86	5,68	4,90	9,69	1,09	0,37	0,37	0,22	2,84	2,14	1,10	0,70	0,50	0,46
9	Ardahan	2149,7	3,7	-2,4	10,9	13,3	5,09	8,63	6,93	1,55	12,88	7,88	6,38	8,28	6,82	4,38	10,78	0,80	0,49	0,49	0,18	4,97	4,42	1,78	0,06	0,37	0,31
10	Artvin	1617,2	12,3	8,5	17,4	8,9	3,96	5,46	4,72	0,21	7,59	8,97	5,48	3,95	3,86	1,32	7,40	0,74	0,26	0,45	0,15	3,12	1,93	0,93	0,30	1,15	0,41
11	Aydın	437,2	17,7	12,0	24,6	12,6	3,09	10,72	6,90	0,48	6,60	8,19	9,00	8,88	8,40	8,41	12,61	1,63	0,61	0,55	0,16	3,94	4,03	1,50	0,43	0,47	0,47
12	Balıkesir	437,4	14,8	8,9	21,2	12,3	2,33	7,77	5,05	0,39	5,55	5,71	6,31	5,68	6,65	5,48	7,94	1,17	0,41	0,23	0,17	3,06	2,75	1,24	0,29	0,34	0,42
13	Bartın	476,1	12,8	7,7	19,2	11,5	3,33	7,06	5,17	0,36	6,13	5,98	5,42	4,38	6,40	8,55	10,40	0,68	0,26	0,16	0,03	4,03	2,60	1,46	0,29	0,49	0,33
14	Batman	942,9	15,9	8,9	23,8	14,9	2,97	4,87	3,92	0,70	8,43	5,92	3,93	4,19	2,91	3,54	2,05	0,75	0,17	0,26	0,13	2,62	1,58	1,40	0,46	0,30	0,19
15	Bayburt	1946,5	7,1	1,4	13,9	12,5	1,44	3,06	2,27	0,00	3,35	6,74	1,29	1,53	0,95	0,00	3,48	0,70	0,31	0,16	0,00	1,10	1,25	0,16	0,23	0,08	0,55
16	Bilecik	736,0	12,5	8,1	17,8	9,7	2,20	7,78	5,11	0,15	5,32	4,82	6,05	6,49	7,54	7,96	10,26	1,37	0,41	0,32	0,20	2,81	2,89	1,49	0,23	0,20	0,29
17	Bingöl	1750,6	12,2	6,6	18,6	12,0	3,75	6,45	5,12	1,06	10,63	6,39	4,01	3,75	5,81	5,49	6,58	0,75	0,12	0,16	0,21	3,89	2,54	1,89	0,33	0,09	0,28
18	Bitlis	1828,4	9,2	4,1	14,3	10,2	3,35	3,80	3,59	1,04	8,96	3,83	3,27	3,02	1,88	0,63	2,14	0,42	0,20	0,44	0,11	2,41	1,42	1,82	0,11	0,13	0,11

19	Bolu	1184,1	10,4	4,7	17,2	12,5	2,20	6,41	4,29	0,34	5,62	6,47	4,17	4,09	4,22	3,73	9,65	0,68	0,26	0,34	0,13	2,88	2,33	0,96	0,23	0,51	0,26
20	Burdur	1180,3	13,3	7,6	19,5	11,9	3,64	9,13	6,38	0,39	6,31	8,05	7,55	6,49	8,36	8,51	11,59	1,18	0,41	0,50	0,17	4,13	3,67	1,78	0,29	0,38	0,26
21	Bursa	506,1	14,6	9,1	20,4	11,3	1,57	6,65	4,11	0,18	3,88	5,36	4,97	5,78	5,56	6,57	6,50	1,13	0,45	0,26	0,16	2,11	2,62	0,75	0,39	0,19	0,16
22	Çanakkale	250,7	15,2	10,8	19,7	8,9	2,86	8,14	5,54	0,30	6,01	7,79	6,78	6,55	5,67	6,34	6,62	1,08	0,56	0,38	0,12	3,40	2,81	1,19	0,45	0,57	0,51
23	Çankırı	1171,4	11,4	5,0	18,1	13,1	1,74	4,99	3,37	0,52	3,22	3,43	7,12	5,19	3,95	1,49	2,74	0,70	0,30	0,27	0,10	2,00	1,83	0,87	0,37	0,17	0,13
24	Çorum	990,9	10,9	4,3	17,6	13,3	2,14	7,17	4,63	0,33	6,00	6,96	4,63	5,99	5,58	4,53	6,83	0,84	0,35	0,39	0,19	2,86	2,12	1,84	0,22	0,25	0,20
25	Denizli	981,6	16,3	10,8	22,6	11,8	2,61	9,51	6,05	0,33	6,84	8,38	7,29	7,76	7,48	7,35	8,18	1,16	0,57	0,51	0,29	3,52	3,12	1,57	0,44	0,56	0,35
26	Diyarbakır	906,1	15,9	8,9	22,7	13,8	3,57	5,86	4,73	0,97	10,81	6,11	4,02	5,00	4,24	3,59	3,51	0,91	0,25	0,40	0,21	2,96	1,70	1,84	0,85	0,19	0,15
27	Düzce	619,0	13,2	8,6	19,4	10,8	1,41	5,13	3,27	0,39	3,26	4,17	4,51	2,87	5,50	3,89	6,43	0,46	0,14	0,21	0,09	2,37	1,65	1,00	0,19	0,24	0,19
28	Edirne	103,2	13,8	8,4	19,8	11,4	2,08	9,72	5,96	0,20	6,13	4,94	8,66	7,07	7,16	7,59	9,92	1,38	0,92	0,45	0,16	3,06	3,24	1,50	0,29	0,39	0,53
29	Elazığ	1222,5	13,2	7,6	19,1	11,5	3,26	6,99	5,11	0,55	7,27	7,32	4,88	5,58	6,40	7,04	8,54	1,33	0,31	0,34	0,22	2,91	2,69	1,33	0,67	0,16	0,25
30	Erzincan	1819,0	10,9	4,8	17,4	12,6	2,21	5,93	4,11	0,93	4,83	4,51	4,19	5,79	3,66	3,81	10,93	0,75	0,31	0,25	0,06	2,75	2,17	1,25	0,22	0,14	0,33
31	Erzurum	2081,2	5,8	-0,5	12,0	12,5	2,71	4,42	3,57	0,76	6,70	4,22	4,27	3,86	3,21	3,88	2,40	0,54	0,19	0,18	0,08	2,58	2,00	0,95	0,32	0,18	0,13
32	Eskişehir	979,1	11,0	4,4	17,8	13,4	2,67	8,87	5,75	0,42	6,00	7,54	6,83	7,97	6,37	6,33	7,87	1,61	0,62	0,39	0,14	2,99	3,09	1,16	0,65	0,34	0,52
33	Gaziantep	717,6	15,3	9,4	21,6	12,2	2,20	5,11	3,66	0,40	6,91	5,48	4,72	4,20	3,70	2,24	8,11	0,83	0,34	0,34	0,12	2,04	1,81	0,98	0,48	0,20	0,21
34	Giresun	1310,5	14,7	11,8	18,0	6,2	1,75	4,59	3,16	0,16	3,36	4,86	5,65	4,19	3,11	2,63	1,50	0,92	0,27	0,25	0,12	1,60	1,28	1,23	0,23	0,13	0,29
35	Gümüşhane	1858,6	9,6	4,4	16,5	12,1	1,04	2,63	1,84	0,00	3,03	2,00	3,07	1,14	2,75	0,66	2,48	0,30	0,00	0,17	0,21	1,16	0,73	0,51	0,21	0,17	0,21
36	Hakkari	2139,1	10,3	5,5	15,5	10,0	2,33	5,35	3,94	0,90	7,19	4,27	5,08	6,42	1,24	4,80	0,00	0,37	0,16	0,18	0,12	3,11	1,61	1,77	0,02	0,18	0,35
37	Hatay	447,7	18,3	14,0	23,2	9,2	1,30	4,26	2,79	0,43	5,08	4,29	2,67	3,10	3,04	3,59	2,73	0,52	0,18	0,18	0,08	1,83	1,08	0,99	0,27	0,22	0,23
38	Iğdır	1502,5	12,3	5,7	19,1	13,4	3,15	7,00	5,13	0,61	11,03	7,17	4,63	5,28	4,14	6,26	5,68	0,58	0,29	0,49	0,16	3,60	2,24	1,82	0,19	0,29	0,58
39	Isparta	1312,7	12,3	6,7	18,4	11,7	2,93	8,11	5,54	0,53	6,58	7,12	6,08	6,58	6,62	6,23	9,57	1,40	0,50	0,50	0,17	2,97	3,29	1,28	0,28	0,48	0,20
40	İstanbul	114,3	15,2	11,9	19,3	7,4	1,48	5,00	3,25	0,19	3,82	4,55	3,97	3,94	3,83	4,34	6,00	0,79	0,30	0,19	0,11	1,86	1,57	0,65	0,55	0,14	0,34
41	İzmir	340,9	17,9	13,6	22,7	9,1	2,06	7,75	4,90	0,25	5,39	6,32	5,44	5,87	6,26	5,97	9,05	1,09	0,55	0,37	0,21	2,66	2,31	1,16	0,66	0,42	0,35
42	Kahramanmaraş	1325,0	16,7	11,6	23,0	11,4	2,23	4,85	3,56	0,62	6,14	5,01	3,90	3,07	3,04	5,35	9,40	0,59	0,20	0,27	0,12	2,38	1,74	0,97	0,36	0,25	0,23
43	Karabük	908,0	13,6	7,8	20,6	12,8	1,99	6,04	4,02	0,30	2,96	4,60	5,54	4,47	5,26	4,62	10,48	1,57	0,11	0,27	0,08	2,00	2,40	0,69	0,56	0,16	0,21
44	Karaman	1381,9	12,2	5,5	18,8	13,3	2,11	9,56	5,82	0,98	8,61	8,40	6,78	6,56	6,14	2,66	11,12	1,83	0,46	0,21	0,28	3,04	3,32	1,55	0,23	0,46	0,26
45	Kars	1973,3	4,8	-1,7	11,6	13,3	4,34	7,93	6,20	0,94	12,13	6,90	6,52	7,62	9,09	5,66	2,92	0,61	0,36	0,61	0,23	4,38	3,32	2,05	0,13	0,40	0,30
46	Kastamonu	1031,2	9,9	4,1	16,4	12,3	2,68	7,78	5,21	0,48	5,30	6,61	6,22	6,49	4,16	6,75	9,98	1,07	0,39	0,61	0,07	3,08	2,40	2,00	0,32	0,22	0,27
47	Kayseri	1565,0	10,7	3,0	18,1	15,1	2,81	6,89	4,86	0,54	6,68	7,37	6,41	5,34	5,29	4,30	8,47	1,08	0,38	0,31	0,18	2,91	2,28	0,91	1,01	0,36	0,29
48	Kırıkkale	953,3	12,5	6,9	18,6	11,7	1,94	7,02	4,48	0,44	5,26	5,37	6,56	4,62	6,39	4,72	5,79	0,59	0,45	0,34	0,14	2,97	2,03	1,69	0,29	0,11	0,36
49	Kırklareli	252,2	13,3	8,8	18,9	10,1	2,02	8,17	5,16	0,55	4,34	4,92	6,09	6,94	6,51	7,94	8,09	0,90	0,54	0,25	0,20	3,28	2,82	1,43	0,29	0,32	0,30
50	Kırşehir	1110,9	11,5	5,5	17,6	12,1	2,53	8,04	5,27	0,52	7,61	7,06	5,86	5,24	6,98	4,51	8,52	0,92	0,46	0,41	0,08	3,39	3,23	1,25	0,30	0,24	0,24
51	Kilis	655,2	17,2	11,9	23,4	11,5	1,90	7,36	4,64	0,80	9,19	6,80	5,07	4,95	2,71	5,05	4,47	0,76	0,33	0,24	0,19	3,13	2,42	1,71	0,14	0,14	0,24
52	Kocaeli	269,5	14,9	10,9	19,8	8,9	1,46	5,43	3,47	0,09	3,84	4,51	4,12	4,90	4,82	4,95	8,32	0,88	0,35	0,30	0,14	1,80	1,84	0,84	0,34	0,17	0,29
53	Konya	1185,3	11,7	5,4	18,1	12,7	2,25	6,02	4,12	0,55	5,86	5,80	5,15	5,06	5,04	3,71	5,32	0,86	0,38	0,29	0,14	2,45	2,10	1,17	0,38	0,24	0,24
54	Kütahya	1101,7	10,8	4,9	17,1	12,2	2,27	7,04	4,64	0,23	4,30	4,71	5,62	5,44	6,87	4,52	13,05	1,04	0,33	0,38	0,13	2,76	2,73	1,15	0,23	0,22	0,32
55	Malatya	1391,0	13,7	8,4	19,1	10,7	1,89	5,75	3,81	0,33	5,67	5,75	3,99	4,83	3,42	4,23	6,86	0,96	0,22	0,27	0,10	2,27	1,69	1,24	0,32	0,22	0,34
56	Manisa	476,2	16,9	11,1	22,9	11,8	2,10	6,65	4,39	0,37	5,56	5,56	4,86	4,85	5,42	5,83	8,52	0,90	0,51	0,36	0,12	2,50	2,20	1,14	0,25	0,56	0,24
57	Mardin	804,1	16,1	12,3	20,2	7,9	2,47	3,88	3,18	0,77	7,05	4,66	2,17	3,20	3,34	1,87	2,50	0,53	0,13	0,23	0,09	2,21	1,39	1,16	0,19	0,24	0,20

58	Mersin	1030,7	19,3	14,9	23,4	8,5	2,98	7,51	5,24	0,56	7,36	6,60	6,25	5,53	6,19	8,16	11,12	1,06	0,36	0,30	0,17	3,34	2,28	1,20	0,80	0,46	0,51
59	Muğla	606,2	15,2	9,6	21,3	11,7	2,77	9,09	5,99	0,25	7,80	7,42	7,09	6,34	7,75	6,20	10,61	0,87	0,42	0,31	0,24	4,16	3,13	1,44	0,23	0,64	0,55
60	Muş	1699,7	9,8	4,3	16,0	11,7	5,45	5,56	5,50	2,22	12,68	5,66	4,66	4,00	4,81	3,31	2,85	0,54	0,11	0,29	0,06	4,51	2,70	2,27	0,15	0,17	0,21
61	Nevşehir	1212,9	10,8	5,4	16,5	11,1	1,95	6,51	4,20	0,47	6,39	6,19	4,67	5,46	4,44	3,98	3,66	0,64	0,58	0,60	0,15	2,23	2,38	1,22	0,24	0,24	0,13
62	Niğde	1602,0	11,2	5,1	17,6	12,5	1,86	7,31	4,59	0,42	6,93	6,39	6,84	4,95	4,49	4,81	5,61	0,73	0,43	0,36	0,09	2,97	1,70	1,59	0,34	0,47	0,48
63	Ordu	889,5	14,5	11,3	18,4	7,1	2,26	5,76	4,01	0,36	4,40	5,29	4,34	4,87	5,40	5,35	6,25	0,71	0,25	0,22	0,09	2,73	1,93	1,30	0,19	0,27	0,31
64	Osmaniye	564,7	18,7	12,8	24,9	12,1	2,13	5,63	3,89	0,35	7,94	4,68	4,30	3,23	5,15	4,42	7,07	0,81	0,22	0,44	0,20	2,22	1,51	1,37	0,31	0,47	0,23
65	Rize	1469,3	14,5	11,2	18,2	7,0	1,35	5,17	3,25	0,09	5,70	4,04	2,99	3,50	5,14	2,53	3,16	0,89	0,15	0,25	0,09	1,87	1,11	1,30	0,34	0,28	0,21
66	Sakarya	355,8	14,5	10,1	20,1	10,0	1,29	4,69	2,99	0,09	3,21	4,31	3,12	4,32	3,74	4,24	5,59	0,77	0,33	0,21	0,12	1,57	1,57	1,00	0,13	0,13	0,16
67	Samsun	528,4	14,6	11,1	18,3	7,2	2,19	6,45	4,30	0,49	6,16	6,43	4,88	4,74	4,76	3,97	5,69	0,98	0,32	0,33	0,13	2,53	1,68	1,36	0,46	0,40	0,39
68	Siirt	1262,5	16,3	11,0	21,8	10,9	4,02	5,14	4,59	1,21	9,71	6,98	4,18	4,88	1,80	3,60	1,11	0,57	0,20	0,53	0,08	3,21	1,62	1,75	0,61	0,41	0,20
69	Sinop	692,9	14,3	11,6	17,3	5,7	2,38	7,52	4,93	0,99	4,22	6,08	5,89	4,70	6,11	5,28	10,33	1,26	0,21	0,33	0,15	2,98	2,61	1,56	0,27	0,18	0,30
70	Sivas	1602,2	9,0	2,9	15,4	12,5	2,18	6,54	4,37	0,70	5,64	5,10	4,38	6,44	4,99	3,89	9,88	1,01	0,29	0,30	0,21	2,57	2,56	1,09	0,29	0,20	0,24
71	Şanlıurfa	624,5	18,5	12,7	24,5	11,8	2,67	3,60	3,13	0,43	7,47	4,59	2,92	3,18	3,91	3,60	3,72	0,57	0,15	0,25	0,04	2,12	1,30	1,05	0,30	0,26	0,23
72	Şırnak	1337,6	15,3	11,0	19,5	8,5	2,50	4,96	3,78	0,42	8,85	5,17	3,48	3,65	4,07	1,37	5,08	0,40	0,10	0,24	0,17	2,87	1,66	1,53	0,15	0,14	0,30
73	Tekirdağ	158,1	14,1	10,3	17,9	7,6	2,07	7,22	4,72	0,28	4,22	5,46	6,27	5,52	6,63	8,59	10,25	0,95	0,48	0,35	0,18	2,75	2,73	1,05	0,44	0,22	0,28
74	Tokat	1080,0	12,5	7,2	18,8	11,6	2,38	5,98	4,17	0,99	7,02	5,72	5,08	3,14	2,19	4,79	8,15	0,76	0,31	0,37	0,12	2,60	1,91	1,40	0,23	0,34	0,29
75	Trabzon	1165,3	14,8	11,8	18,1	6,3	2,13	4,45	3,28	0,39	5,45	4,14	3,96	3,98	2,35	4,57	2,17	0,71	0,16	0,18	0,05	2,18	1,18	1,21	0,50	0,12	0,26
76	Tunceli	1614,6	12,7	6,8	19,6	12,8	4,16	12,70	8,90	0,97	7,79	11,85	8,70	8,85	8,85	8,94	23,87	1,56	0,22	0,52	0,07	6,53	4,82	2,82	0,22	0,22	0,82
77	Uşak	921,1	12,5	6,8	18,5	11,7	2,89	8,00	5,43	0,62	7,76	7,77	6,99	5,11	4,07	5,78	9,44	1,19	0,60	0,42	0,25	2,97	3,13	1,19	0,25	0,60	0,27
78	Van	2251,5	9,5	3,8	15,0	11,2	4,01	4,91	4,47	1,32	9,62	5,54	4,16	4,52	3,65	4,69	1,43	0,45	0,19	0,31	0,15	3,37	2,69	1,29	0,14	0,19	0,16
79	Yalova	283,0	14,7	10,4	19,1	8,7	1,64	5,67	3,66	0,13	4,29	6,04	3,74	3,79	5,63	4,25	3,21	0,90	0,19	0,24	0,13	2,20	1,67	0,87	0,40	0,40	0,32
80	Yozgat	1199,8	9,2	4,0	14,7	10,6	1,63	4,79	3,21	0,36	4,79	4,35	2,75	4,65	3,84	3,49	4,29	0,58	0,17	0,24	0,10	2,13	1,65	1,11	0,14	0,14	0,17
81	Zonguldak	367,3	13,7	10,6	17,1	6,5	2,93	6,75	4,82	0,11	5,06	5,97	5,38	5,59	5,64	6,52	12,45	0,93	0,28	0,31	0,16	3,14	2,33	1,29	0,42	0,36	0,41
	MEAN	**1059,3**	**13,2**	**7,9**	**19,0**	**11,1**	**2,49**	**6,45**	**4,49**	**0,54**	**6,48**	**5,87**	**5,08**	**5,05**	**4,91**	**4,76**	**6,93**	**0,88**	**0,33**	**0,32**	**0,14**	**2,82**	**2,24**	**1,31**	**0,34**	**0,30**	**0,30**

high place was found to be statistically significantly increased at SMT values of ≥19.6° C (p=0.006).

No statistically significant correlation was observed between the SMT values of provinces and other age groups, other reasons, or other manners of suicide in both pre- and post-classification comparisons.

Correlation between STD and suicide rates (Table 5): The mean STD of Türkiye is 11.1±2.1°C (minimum: 5.7°C (Sinop); maximum: 15.1°C (Kayseri)). A positive statistically significant correlation was observed between suicide rates in females (p=0.022) and the total population (p=0.014) and STD values pre-classification. After classification, the statistical significance disappeared for females (p=0.052), and the suicide rates in the total population reached a maximum level at STD >12.1°C (p=0.028).

Pre-classification, a statistically significant positive correlation was observed between the STD of provinces and suicide rates in the age groups of <15 years (p=0.009), 15-24 years (p=0.001), and 25-34 years (p=0.033). After classification, it was observed that suicide rates in the <15 years (p=0.031), 15-24 years (p=0.010) and 45-54 years (p=0.038) age groups reached a maximum level at STD values >12.1 °C.

Although a positive correlation was observed between familial incompatibilities and other/unknown reasons-related suicide rates (p=0.039 and p=0.019, respectively) and STD values in the pre-classification evaluation, no statistically significant correlation was observed after classification.

The STD values were found to be positively correlated with suicide by hanging (p=0.005) and the rate of suicide committed by hanging was found to be statistically significantly increased at SMT values of ≥19.6°C (p=0.007).

No statistically significant correlation was observed between the STD values of provinces and other age groups, other reasons, or other manners of suicide in both pre- and post-classification comparisons.

Comparison of socio-economic development scores and suicide rates of provinces: No statistically significant correlation was found between the socio-economic development scores and the suicide rates of the general population (r=0.055; p=0.623). The suicide rate rankings of the provinces according to the general population and their rankings according to the socio-economic development scores are shown in Figure 3.

Discussion

The annual mean crude suicide rate per 100,000 individuals in Türkiye from 2007 to 2022 was 6.45 for males, 2.49 for females, and 4.49 for the overall population. It was reported that the suicide rate in the overall population increased between 1995 and 2019 in Türkiye (from 2.5/100,000 in 1995 to 4.1/100,000 in 2019) (4). The current study results showed a continuous upward trend in suicide rates for males. The male suicide rate, which was 5.11/100,000 in 2007, increased to 7.29 in 2022 (Figure 1).

In many previous studies, an increase in suicide rates has been found to be associated with higher suicide rates, and different hypotheses have been proposed to explain this increase (19). Haws et al. suggested that "hypoxia and mood disorders are both associated with glycolytic metabolic changes, and possible mitochondrial dysfunction and the decreasing oxygen saturation at high altitude may exacerbate the bioenergetic dysfunction associated with emotional illnesses, which may explain the increased suicide rates at high altitude" **(**6,23). Kim et al. reported that with increasing altitude, metabolic stress associated with mild hypoxia may have an impact on increasing suicide rates in individuals with mood disorders (8,17). DelMastro et al. obtained results supporting this hypothesis in their study (23). Studies that began in the last quarter of the 20th century revealed that human aggression and suicide are associated with low levels of serotonin metabolites and that altered serotonin metabolism may be a factor that contributes significantly to suicidal behavior (21,43,44). Likewise, it has been stated that hypoxia causes a decrease in brain serotonin metabolism (45,46), and hypoxia that develops with increasing altitude may have an impact on suicide rates in this way (14). Barometric pressure decreases as altitude increases, and the decrease in hypobaric oxygen pressure causes hypobaric hypoxia. In a study on rats, Kanekar et al. reported that altitude had a significant enhancing effect on depression-like behaviors in female rats (47). It was also stated by Benso et al. that high altitude is a sufficient trigger for endocrine secretions due to both hypoxia and low temperature (48). Previous studies have described the association between low estrogen levels and increased progesterone levels, even when estrogen levels are high, with high altitude and increased

suicide rates (49,50). According to some studies that have examined the impact of testosterone on suicide, there is a relationship between suicidal behavior and high testosterone levels in suicides, especially in suicides of females with bipolar disorders (51,52), and others have suggested that low testosterone levels increase the suicide risk in patients with schizophrenia (53,54). Conversely, there are also other studies showing no significant correlation between suicidal behavior and testosterone levels (55,56). In two different studies, Sher claimed that testosterone levels, both high and low, may be related to suicidal behavior in men of all ages. Specifically, low testosterone levels may be linked to suicidal behavior in older men, while high testosterone levels may be linked to suicidal behavior in young adults and adolescents (57,58). It has been determined that although testosterone levels in males initially increase in those who ascend to high altitudes, they return to normal values if they stay at this altitude for a long time or return to low altitudes (59-61). Even though the current study is retrospective and lacks data on hormone levels, the observed positive and statistically meaningful correlations between high altitude and suicide rates among females and those under 24 years of age (Table 1) may be explained by the neuro-humoral changes previously addressed. Except for one previous article in the literature, no other articles were discovered that examined the reason for suicide and the manner of committing suicide when assessing the correlation between altitude and suicide rates. Kim et al. reported a positive correlation between residential area altitude and suicide rates involving firearms and suicide rates not involving firearms (8). In the altitude-based classification of provinces in the current study, it was determined that suicide deaths due to economic problems were lower in provinces with higher altitudes, while they increased in provinces with lower altitudes ($p<0.05$). It is thought that the fact that most commercial and agricultural activities in Türkiye take place in low-altitude provinces increases the risk of exposure to more economic interactions in these provinces. No statistically significant relationship was found between provincial altitudes and the manner of death.

The relationship between suicide and seasonality has been the subject of many studies since the 19th century (62). Christodoulou et al. reported that most of the previous studies investigating the association between suicide and seasonality found that suicide deaths peaked in the spring and early summer, while the influence of seasonality on suicides was minimal or absent in some other studies. (63). In contrast, Nieto-Betancurt et al. noted that climate changes contributed to higher suicide rates in the spring, early autumn, and winter in many studies. They also highlighted that significant variations in weather and how these impact human activity can account for the variation in seasonal suicide rates (62). According to Fountoulokis et al., climate change is a significant factor in increasing the rates of mental illnesses and suicide, and climate variables may have a greater impact on mental health than socioeconomic factors (27). Lee et al. identified a positive correlation between temperature and suicide rates and stated that sunlight was a factor that could trigger suicidal behavior by affecting brain serotonergic activity (28). There have been reports that serotonin neurons change significantly during thermal stress and that changes in serotonergic neurotransmission are partially responsible for human weather sensitivity (64,65). It has been suggested that rising temperatures alter serotonergic transmission, which may increase impulsivity and overall human activity levels and lead to a rise in suicides (66). While many studies have shown a positive correlation between ambient temperature and suicide rates (28,29,31,32,67-70), some studies have determined a negative correlation between ambient temperature and suicide rates (19,26,30,71,72). In a study by Oravecz et al., a significant negative correlation was determined between suicide incidence and the average temperature of the three previous months (73). The current study found no statistically significant increase in suicide rates with rising mean ambient temperatures. It was determined that the suicide rate of the overall population increased in parallel to an increase in the seasonal temperature difference (STD) (Tables 2, 3 and 5). Preti et al. stated that lower temperatures and shorter periods of sun exposure were linked to higher suicide rates, especially in females (30). Inoue et al. and Ishii et al. found that mean annual temperature was significantly and negatively correlated with the suicide rate in females (26,71). According to Asirdizer et al., higher mean STD above 25 °C in provinces and WMT lower than −10 °C were significant factors influencing the incidence of female suicide (19). In the current study, although the increase in STD values was found to be effective in both males and females, no statistically significant difference was found.

An increase in suicide rates in cases aged <15 years was observed in parallel with the decrease in AMT and WMT values (Tables 2 and 3). No effect of SMT values on suicide rates was found in any age group (Table 4). The difference between summer and winter mean temperatures (STD) was identified as one of the factors affecting the increase in suicides, especially among those aged ≤24 years and in those aged 45-54 years (Table 5). Marion et al. observed a relationship between higher temperatures and increased rates of elderly suicide (74). In contrast to that study, the current study results showed that provinces with mild annual winter and summer temperatures also had higher rates of suicide among those aged ≥55 years.

It was determined in this study that suicides because of illnesses are partially affected by the decrease in temperature and were least common in the provinces with the lowest AMT and WMT values. However, it was not possible to explain this decrease.

Likhvar et al. reported a relationship between daily temperature increases and suicide rates and stated that there is an increase, especially in suicides committed by violent methods, with an increase in temperature **(29)**. It has been reported that suicides by violent means are generally more common on the day when the temperature increases and on the following day (27,29,75). An increase in suicide rates committed by "jumping from a high place" was observed as AMT and WMT values increased. Hanging was the type of suicide most affected by the increase in STDs. Likewise, suicides due to hang were most common in provinces with moderate AMT and WMT values. However, no effect was found of the increase in ambient temperature on suicides with firearms, which is the most violent type of suicide.

In the current study, no statistically significant relationship was found between socio-economic development scores and general population suicide rates (r=0.055; p=0.623) (Figure 3). Asirdizer et al determined that risk factors such as regionally obtained education level, population density, net internal migration rate, unemployment rate, gross national product per capita, average age at marriage, crude marriage rate, fertility and crude divorce rates do not have a significant effect on crude suicide rates in Türkiye. They stated that these risk factors are factors that can affect suicide victims individually rather than regional effects, and that these factors will only encourage suicide acts in people who are psychologically prone to suicide (76). Although some of the results obtained in this study have been determined to have a provincial effect on the emergence of suicides, these factors can only be evaluated as preparatory or activating risk factors. It is not possible to define these factors as the cause of suicide on their own, independent of the psychological volcano hidden within the person.

Pompili identified the following 10 points regarding suicides: (1) the common goal of suicide is to seek a solution, (2) the common goal of suicide is the end of consciousness, (3) the common stimulus in suicide is unbearable psychological pain (4) the common stress factor in suicide is frustrated psychological needs, (5) the common emotion in suicide is hopelessness and helplessness, (6) the common cognitive state in suicide is dilemma; individuals who commit suicide are usually in a dilemma between life and death in their cognitive state, (7) the common perceptual state in suicide is mental narrowing, thinking that death may be the only solution, (8) the common action in suicide is escape or exit from the cause of distress, (9) the person who will commit suicide commonly expresses this intention to other people, and (10) the common pattern in suicide is consistent with the ways of coping with difficulties throughout life (77). However, changes in suicide rates depending on altitude and ambient temperature may enable individuals with suicidal tendencies to individually identify high-risk times and receive more psychological support during these periods of change.

Limitations: One of the limitations of the study is that the real altitude and temperature values of the actual location where each suicide occurred cannot be accessed. It was only possible to compare the average altitude and temperature values of suicide rates at the province level, which is the smallest unit for which complete data can be obtained. The second limitation is that it was not possible to make a join point approach because the official institution from which the temperature values were taken, the General Directorate of Meteorology, gave average values for many years, not annual values, on its web page. As a third limitation, although a slight increase in suicide rates was observed in the years following the 2008 World Economic Crisis and the 2020 COVID-19 Pandemic (Figure 1), it was not possible to establish a definitive relationship due to the lack of sufficient data.

The current study results revealed a high positive correlation between suicide rates in Türkiye, particularly among females and young people aged < 24 years, and altitude. With a decrease in annual

and winter ambient temperatures, there was a statistically significant rise in suicide rates among younger people under the age of 15 years. Likewise, an increase in suicide rates was observed as the STD increased in those aged <24 years and in the 45–54 years age group. It was seen that the prevalence of economic problems was higher in low-altitude provinces. However, no statistically significant relationship was found between provincial socio-economic development scores and general population suicide rates in the current study. Socioeconomic development levels were thought to be factors that could affect suicide victims individually rather than provincially.

A decrease in average ambient temperature and an increase in STD was determined to be effective in increasing the suicide rates of children, especially those under the age of 15 years. A statistically significant relationship was found between the increase in mean ambient temperature in summer and winter and suicides committed by jumping from a high place, and between the increase in STD and suicides committed by hanging.

Although changes in suicide rates related to altitude and ambient temperature cannot be identified as a cause of suicide on their own, they may provide an opportunity for individuals with suicidal tendencies to personally identify high-risk times and seek more psychological support during these times of change.

List of Abbreviations

AMT: Annual Mean Temperature;

LPG: Liquified Petroleum Gas

SMT: Summer Mean Temperature;

STD: Seasonal Temperature Differences

TUIK: Turkish Statistical Institute;

WHO: World Health Organization

WMT: Winter Mean Temperature;

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