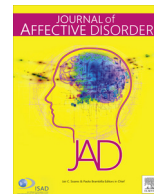




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## Research paper

## Climate change but not unemployment explains the changing suicidality in Thessaloniki Greece (2000–2012)



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## ABSTRACT

**Introduction:** Recently there was a debate concerning the etiology behind attempts and completed suicides. The aim of the current study was to search for possible correlations between the rates of attempted and completed suicide and climate variables and regional unemployment per year in the county of Thessaloniki, Macedonia, northern Greece, for the years 2000–12.

**Material and methods:** The regional rates of suicide and attempted suicide as well as regional unemployment were available from previous publications of the authors. The climate variables were calculated from the daily E-OBS gridded dataset which is based on observational data

**Results:** Only the male suicide rates correlate significantly with high mean annual temperature but not with unemployment. The multiple linear regression analysis results suggest that temperature is the only variable that determines male suicides and explains 51% of their variance. Unemployment fails to contribute significantly to the model.

There seems to be a seasonal distribution for attempts with mean rates being higher for the period from May to October and the rates clearly correlate with temperature. The highest mean rates were observed during May and August and the lowest during December and February. Multiple linear regression analysis suggests that temperature also determines the female attempts rate although the explained variable is significant but very low (3–5%)

**Conclusion:** Climate variables and specifically high temperature correlate both with suicide and attempted suicide rates but with a different way between males and females. The climate effect was stronger than the effect of unemployment.

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## 1. Introduction

Since 2008, Europe and especially Greece have entered a long period of economic crisis. It has been reported that the suicide rates are increasing in most countries and again especially in Greece although the relationship to the economic situation is fuzzy (Fountoulakis et al., 2012, 2014a, 2013a, 2013b, 2013c; Hellenic Statistical Authority, 2011; Kentikelenis et al., 2011; Stuckler et al., 2011). Following this, a telephone survey reported that there was a 36% increase in the number who reported having attempted suicide in the month before the survey took place (Economou et al.,

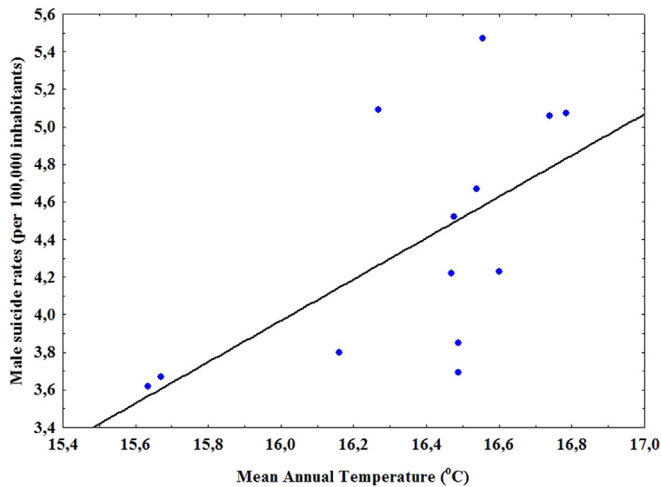


Fig. 1. Scatterplot of the linear correlation between male suicidal rate and temperature.

2011) but a more recent report from our group reported that the actual attempts rate are decreasing (Fountoulakis et al., 2014b).

Attempts and reported attempts or suicidal ideation are quite different from completed suicide. Rates are also completely different. A recent paper from our group reported that in Greece, cross-sectionally and depending on the frequency, approximately 8% were thinking that it is not worth living, 6% had a past history of self-injury, 2% had a history of suicide attempts and 1.5% had current suicidal ideation (Fig. 1) (Fountoulakis et al., 2012). These results were collected before 2008, that is before the beginning of the current crisis and are in accord with the literature (Platt et al., 1992; Schmidtke et al., 1996).

Several risk factors for the manifestation of any kind of suicidal behavior have been identified. These risk factors are classified as primary (such as the presence of psychiatric and medical conditions, severe somatic illness, previous suicide attempts), secondary (adverse life situations and psychosocial risk factors) and tertiary (demographic factors such as male gender and old age) (Henriksson et al., 1993; Rihmer et al., 2002). The role of climate has not been adequately studied so far although a significant number of publications exist and a possible seasonality has been repeatedly reported but not proven beyond doubt (Baydin et al., 2005; Hiltunen et al., 2012; Jessen et al., 1999; Kordic et al., 2010; Mergl et al., 2010; Preti and Miotto, 2000; Valtonen et al., 2006; Yip and Yang, 2004).

Table 1

Rates of suicides and attempted suicides as well as unemployment and climate variables for the years 2000–2012 for Thessaloniki county, Greece.

Year	Attempts			Suicides			Regional unemployment	Temperature				Mean rainfall (mm/month)
	Total	Males	Females	Total	Males	Females		Mean annual	min	max	max–min	
2000	45.32	23.37	65.50	2.52	3.67	1.47	8.70	15.67	−0.30	27.90	28.20	17.03
2001	56.10	38.96	71.87	2.28	3.62	1.04	7.50	15.63	−1.30	28.10	29.40	12.55
2002	60.38	34.23	84.45	2.57	3.80	1.44	8.40	16.16	1.50	27.20	25.70	14.62
2003	48.10	35.65	59.76	2.97	5.09	1.02	6.70	16.27	1.90	27.00	25.10	12.82
2004	38.41	26.40	49.48	3.27	5.06	1.62	7.00	16.74	2.90	26.30	23.40	12.14
2005	–	–	–	3.25	5.47	1.21	7.30	16.56	4.50	26.50	22.00	17.02
2006	70.77	27.33	110.82	1.98	3.69	0.40	6.50	16.49	2.60	26.70	24.10	18.63
2007	62.60	37.26	85.96	2.69	4.52	0.99	6.10	16.48	4.40	28.30	23.90	19.25
2008	60.30	38.71	80.19	2.46	3.85	1.18	5.40	16.49	4.30	27.60	23.30	21.30
2009	64.53	40.34	85.24	2.85	4.67	1.17	8.90	16.54	5.30	26.70	21.40	23.77
2010	56.53	34.23	76.86	2.13	4.23	0.19	10.40	16.60	5.90	28.20	22.30	25.00
2011	29.57	16.69	41.43	3.44	5.07	1.95	16.80	16.78	5.30	27.20	21.90	22.08
2012 <sup>a</sup>	46.08	31.68	59.33	2.73	4.22	1.36	24.70	16.47	2.70	29.10	26.40	21.90
Mean	53.22	32.07	72.57	2.70	4.38	1.16	9.57	16.38	3.05	27.45	24.39	18.32

<sup>a</sup> Calculated on the same general population as previous year.

The aim of the current study was investigate the effect of climate and more specifically of temperature and rainfalls on the rates of suicide and attempted suicide in the county of Thessaloniki, Greece, for the years 2000–12.

## 2. Material and methods

The rates concerning suicide attempts in the county of Thessaloniki Greece had been calculated and published before by our group (Fountoulakis et al., 2014b), while the suicidal rates and unemployment for the same region were obtained by the Hellenic Statistics Authority (Hellenic Statistical Authority, 2011). The temperature and rainfall monthly values for the region of Thessaloniki were calculated from the daily E-OBS gridded dataset which is based on observational data (Haylock et al., 2008) with a spatial resolution of 0.22° on a rotated grid (<http://www.ecad.eu>).

The database which was used for the current analysis is shown in Table 1 and in the webappendix. As for the qualitative characteristics of the attempts, in terms of method, 95.93% attempted with medications. It has been estimated that 15.34% of persons who attempted once, repeated the attempt and almost half of them had done so within the same year. Within two years 75% of those who repeated the attempt had done so.

The analysis included the calculation of Spearman and Pearson correlation coefficients alone. Spearman was used for the calculation of the correlations between suicidal rates and climate variables since the suicidal rates were available at the year level (13 cases only), while the Pearson coefficient was used to calculate the correlations of the attempts rate since they were available at the month level (13 years by 12 months = 156 cases).

The analysis also included multiple linear regression analysis as follows:

1. With the use of annual suicide and suicide attempts rate separately (also total, male and female separately) each one as dependent variables. Temperament, rainfalls and unemployment were used as independent. This makes 6 separate regression analyses.
2. With the use of monthly suicide attempts rate (total, male and female separately) expressed in two different ways: as rates per 10<sup>5</sup> or as % of total annual rate as dependent variables. Temperament and rainfalls were used as independent. This makes 6 separate regression analyses.

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