The Relationship between Suicide and Five Climate Issues in a Large-scale and Long Term Study in Japan

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ABSTRACT

Objective: *Suicide rates in Japan were high in 1998 and have remained high since then. Many researchers have discussed the current state of suicide in Japan and the world; however, there are various opinions about the relationship between suicide and climate.*

Subjects and Method: *In the present study, we report on long-term data of suicide and examine five climatic issues in Japan as a whole and in 10 selected prefectures: the five with the highest suicide rates in 2006 (Akita, Iwate, Shimane, Yamagata and Miyazaki Prefectures) and the five with the lowest (Nara, Tokushima, Okayama, Kanagawa and Kyoto Prefectures).*

Results: *Annual age-adjusted suicide rates were found to have a significant inverse correlation with annual mean air temperature in the five prefectures with the highest suicide rates and in the three prefectures with the lowest suicide rates among women. Annual age-adjusted suicide rates were significantly correlated with annual mean relative humidity in the three prefectures with the highest suicide rates among women and with the annual total sunshine duration in the three prefectures with the highest suicide rates among women.*

Conclusion: *It is important that these associations between suicide and climatic factors be discussed further from various viewpoints, including those of many researchers and relevant organizations.*

Keywords: Climate, long term, suicide

La Relación entre el Suicidio y Cinco Problemas Climáticos en un Estudio a Gran Escala y a Largo Plazo en Japón

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RESUMEN

Objetivo: *Las tasas de suicidio en Japón eran altas en 1998, y han permanecido altas desde entonces. Muchos investigadores han discutido el estado actual del suicidio en Japón y el mundo, Como parte de esa discusión, existen diversas opiniones acerca de la relación entre el suicidio y el clima.*

Sujetos y Método: *El presente estudio presente constituye un reporte de datos a largo plazo sobre el suicidio y examina cinco problemas climáticos del Japón en su conjunto así como en 10 prefecturas seleccionadas: las cinco con las más altas tasas de suicidio en 2006 (las prefecturas de Akita, Iwate, Shimane, Yamagata y Miyazaki) y las cinco con las tasas más bajas (Nara, Tokushima, Okayama, Kanagawa y Kyoto).*

Resultados: *Se halló que las tasas de suicidio ajustadas por edad anualmente presentaban una correlación inversa significativa con la temperatura promedio anual del aire en las cinco prefecturas con las tasas de suicidio más altas y en las tres prefecturas con las tasas de suicidio más bajas entre las mujeres. Las tasas de suicidio anual ajustadas por edad guardaban una correlación significativa con la humedad relativa promedio anual en las tres prefecturas con las tasas del suicidio más altas*

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entre las mujeres y con la duración total anual de sol en las tres prefecturas con las tasas del suicidio más altas entre las mujeres.

Conclusión: *Es importante continuar analizando estas asociaciones entre el suicidio y los factores climáticos desde varios puntos de vista, incluyendo aquéllos de muchos investigadores y organizaciones pertinentes.*

Palabras claves: Clima, a largo plazo, suicidio

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INTRODUCTION

Japan has a high suicide ranking in the world for both men and women (1). There were approximately 32 000 suicides in Japan in 2008 as reported by the National Police Agency and there have been over 30 000 suicides per year since 1998. This continuing high suicide trend is thus a major problem that remains to be solved. One of the major reasons for the rapid increase in the number of suicides in Japan in 1998 was the increase in the number of suicides among middle-aged men (2, 3). There are reports (2, 4) concerning the current state of suicide in Japan, and some have shown an association between suicide and unemployment (4, 5). "Suffering from physical illness" and "psychiatric disorders" are also causative factors that must be taken into account (6). Therefore, it is necessary to discuss suicide in terms of its related factors with the aim of decreasing the number of suicides. There are various opinions (7–12) concerning the relationship between suicide and climate. The occurrence of violent suicides among males was shown to have a significantly positive relationship with temperature and exposure to the sun, but a significant negative relationship with humidity and rainfall in Italy (7). Souêtre *et al* (8) reported that mean annual temperature and temperature amplitude are negatively correlated with suicide. One report (9) indicated that psychiatric disorders and temperature were related in cases of suicide attempts by individuals with psychiatric disorders who were transported in emergency vehicles. The report (9) found that a treatment programme that takes temperature into account was designed in an attempt to prevent future suicide attempts in these patients. Regarding the relationship between suicide and humidity, Salib (10) found that, in North Cheshire, there was a significant positive association between suicide in the elderly and relative humidity. One study (11) suggested that there were more suicides in association with the increase in the duration of sunshine in the winter due to its influence on the depressive state. The report (11) hypothesized that a person suffering serious depression may find it difficult to act, but adds that action may become easier with an increase in sunshine duration, and if suicidal thoughts were still present, this would lead to a greater possibility of a suicide attempt. Another report (12) showed that minor changes of chronobiological rhythms can cause destabilization in vulnerable individuals. We believe that a large-scale and long-term study of the relationship between suicide and climate is necessary.

SUBJECTS AND METHODS

In the present study, we researched the annual number of suicides and age-classified suicides during 1977–2008 in both Japan as a whole and in 10 selected prefectures by vital statistics (13), as well as population numbers for the same areas in the reports of 1975, 1980, 1985, 1990, 1995, 2000 and 2005 based on the Population Census of Japan (14), which is issued every five years. For the purposes of the present study, the 1975 population census was used for the period of 1977–1979, the 1980 population census for 1980–1984, the 1985 population census for 1985–1989, the 1990 population census for 1990–1994, the 1995 population census for 1995–1999, the 2000 population census for 2000–2004, and the 2005 population census for 2005–2008. Age-adjusted suicide rates in the present study are based on these data. The 10 prefectures selected for the present study were the five prefectures with the highest suicide rates in 2006 (Akita, Iwate, Shimane, Yamagata and Miyazaki) and the five with the lowest (Nara, Tokushima, Okayama, Kanagawa and Kyoto) based on vital statistics. In 2006, Kyoto Prefecture and the Tokyo metropolitan area showed the same suicide rate, however, the rate of Kyoto Prefecture was lower than that of Tokyo in 2004 and 2005, so Kyoto Prefecture was selected as one of the prefectures with a low suicide rate in this study. The selected prefectures with the highest and lowest suicide rates showed rates that were all higher and lower, respectively, than the national averages of Japan in 2004 and 2005.

We also researched annual mean air temperature, annual mean sea level air pressure, annual mean relative humidity, annual total of sunshine duration, and annual total of precipitation during 1977–2008 both in Japan as a whole and the 10 selected prefectures based on data provided by the Japan Meteorological Agency (15). The specific areas in the prefectures where data were collected were Akita, Morioka, Matsue, Yamagata, Miyazaki, Nara, Tokushima, Okayama, Yokohama and Kyoto. Data in Japan as a whole were gathered in Tokyo, the capital of Japan. There was a change during the study period from Jordan sunshine recorders to other sunshine recorders to measure sunshine duration; appropriate corrections were made following the method suggested by the Japan Meteorological Agency (15). We assessed the correlation between age-adjusted suicide rate and rates of five climate issues during the study period.

Statistical analysis was performed using Pearson's correlation in SPSS version 12.0J.

RESULTS

In both genders during the study period, the annual age-adjusted suicide rates (per 100 000 population) ranged from 20.8 to 34.9 in Akita Prefecture, from 20.9 to 33.0 in Iwate Prefecture, from 16.3 to 31.9 in Shimane Prefecture, from 15.7 to 27.2 in Yamagata Prefecture, from 18.7 to 30.3 in Miyazaki Prefecture, from 11.3 to 23.0 in Nara Prefecture, from 12.4 to 24.3 in Tokushima Prefecture, from 11.8 to 19.9 in Okayama Prefecture, from 13.0 to 21.1 in Kanagawa Prefecture, and from 13.2 to 21.4 in Kyoto Prefecture. The annual age-adjusted suicide rates in Japan as a whole during the same period ranged from 15.0 to 22.7 for both genders.

The annual age-adjusted suicide rates by gender are shown in Table 1.

Table 1: Range in annual age-adjusted suicide rates (per 100 000 population) in the present study among men and women during the study period

	Men	Women
Akita	29.2 – 56.0	11.6 – 22.3
Iwate	28.6 – 52.3	10.9 – 20.5
Shimane	24.4 – 49.2	7.6 –19.5
Yamagata	21.3 – 43.8	8.5 – 17.4
Miyazaki	28.2 – 48.9	10.3 – 19.0
Kyoto	17.9 – 31.9	8.5 – 16.1
Kanagawa	16.4 – 29.9	8.2 – 14.3
Okayama	16.5 – 30.8	7.0 – 14.0
Tokushima	14.7 – 32.8	6.9 – 16.9
Nara	14.5 – 30.5	7.3 – 18.2
Japan	20.0 – 33.2	9.2 – 15.3

The ranges of the annual mean air temperature (°C), annual mean sea level air pressure (hPa), annual mean relative humidity (%), annual total of sunshine duration (h), and annual total of precipitation (mm) during the study period are shown in Table 2.

Table 2: Range in annual mean air temperature, annual mean sea level air pressure, annual mean relative humidity, annual total of sunshine duration and annual total of precipitation during the study period

	Air temperature (°C)	Sea level air pressure (hPa)	Relative humidity (%)	Sunshine duration (h)	Precipitation (mm)
Akita	10.6 – 12.7	1012.8 – 1015.0	71 – 76	1361.5 – 1775.3	1230.5 – 2142.0
Morioka	9.0 – 11.3	1012.8 – 1015.1	71 – 75	1488.2 – 1927.1	827.5 – 1702.0
Matsue	13.5 – 16.0	1014.7 – 1015.9	72 – 79	1369.3 – 1987.8	1338.5 – 2314.5
Yamagata	10.4 – 12.9	1013.2 – 1015.4	72 – 78	1399.4 – 1896.0	837.5 – 1526.0
Miyazaki	16.6 – 19.2	1014.3 – 1015.6	69 – 78	1842.5 – 2368.4	1789.5 – 4174.5
Kyoto	14.6 – 17.1	1014.4 – 1016.0	62 – 69	1519.8 – 2016.0	880.5 – 2042.0
Yokohama	14.3 – 16.9	1012.8 – 1014.9	63 – 75	1594.0 – 2247.9	996.0 – 2317.0
Okayama	14.1 – 17.3	1014.6 – 1016.1	63 – 74	1674.5 – 2288.3	732.5 – 1646.5
Tokushima	15.4 – 17.7	1014.6 – 1015.8	63 – 70	1798.7 – 2387.1	860.5 – 2628.5
Nara	13.9 – 16.0	1014.4 – 1015.9	69 – 75	1509.2 – 2128.4	715.5 – 1693.0
Tokyo	14.9 – 17.3	1012.8 – 1014.8	57 – 68	1535.4 – 2132.7	879.5 – 2042.0

For Japan as a whole and for the 10 selected prefectures, the correlations between annual age-adjusted suicide rates and the five climate issues for both genders, for men only and for women only are shown in Tables 3–5. The annual age-adjusted suicide rates had a significant inverse correlation with annual mean air temperature in Akita, Iwate, Shimane, Yamagata, Miyazaki, Nara, Tokushima and Okayama Prefectures among women. Among the five prefectures with the highest suicide rates, annual age-adjusted suicide rates were significantly correlated with the annual mean relative humidity among women in Shimane, Yamagata and Miyazaki Prefectures, and were significantly correlated with the annual total of sunshine duration among women in Akita, Iwate and Yamagata Prefectures.

DISCUSSION

Among women, the annual data of the present study indicated that the age-adjusted suicide rates were significantly inversely correlated with mean air temperature in the five and three prefectures with the highest and lowest suicide rates, respectively. A previous report (8) also found a negative correlation between suicide and the mean annual temperature. In the present study, the annual mean air temperature in four of the five prefectures with the highest annual suicide rates (all but Miyazaki Prefecture) was lower than that in Tokyo every year during the study period.

The present study found that the age-adjusted suicide rates had a significant correlation with mean relative humidity in the three prefectures with the highest suicide rates annually among women. One report (16) indicates that variations in humidity are significantly correlated with suicide in the young. Therefore, further study of the possibility that humidity may influence suicide is necessary.

The present study found that the age-adjusted suicide rates were significantly correlated with total sunshine dura-

Table 3: Correlation between annual age-adjusted suicide rates and annual values for each of five climate issues for both genders

	Air temperature	Sea level air pressure	Relative humidity	Sunshine duration	Precipitation
Akita	r = 0.096, p = 0.601	r = -0.069, p = 0.709	r = -0.032, p = 0.863	r = -0.290, p = 0.107	r = -0.053, p = 0.772
Iwate	r = -0.284, p = 0.115	r = 0.131, p = 0.476	r = 0.123, p = 0.504	r = 0.234, p = 0.198	r = 0.047, p = 0.799
Shimane	r = -0.029, p = 0.877	r = -0.319, p = 0.075	r = - 0.243, p = 0.181	r = 0.127, p = 0.489	r = -0.059, p = 0.748
Yamagata	r = -0.066, p = 0.721	r = -0.246, p = 0.176	r = 0.335, p = 0.061	r = 0.054, p = 0.770	r = 0.271, p = 0.134
Miyazaki	r = 0.136, p = 0.456	r = -0.208, p = 0.254	r = -0.048, p = 0.793	r = -0.003, p = 0.998	r = 0.025, p = 0.890
Kyoto	r = 0.082, p = 0.656	r = -0.128, p = 0.485	r = -0.200, p = 0.272	r = 0.060, p = 0.743	r = -0.075, p = 0.682
Kanagawa	r = -0.016, p = 0.933	r = 0.069, p = 0.707	r = 0.095, p = 0.605	r = 0.016, p = 0.929	r = -0.208, p = 0.254
Okayama	r = 0.069, p = 0.709	r = -0.151, p = 0.410	r = -0.058, p = 0.752	r = 0.323, p = 0.072	r = -0.336, p = 0.060
Tokushima	r = -0.528, p = 0.002**	r = 0.087, p = 0.635	r = 0.085, p = 0.642	r = 0.090, p = 0.625	r = -0.006, p = 0.973
Nara	r = -0.020, p = 0.915	r = -0.038, p = 0.836	r = 0.208, p = 0.254	r = 0.307, p = 0.088	r = 0.098, p = 0.595
Japan	r = -0.025, p = 0.894	r = 0.037, p = 0.840	r = -0.021, p = 0.909	r = -0.150, p = 0.412	r = -0.121, p = 0.510

*$p < 0.05$, **$p < 0.01$

Table 4: Correlation between annual age-adjusted suicide rates and annual values for each of five climate issues for men

	Air temperature	Sea level air pressure	Relative humidity	Sunshine duration	Precipitation
Akita	r = 0.266, p = 0.141	r = -0.158, p = 0.388	r = -0.090, p = 0.625	r = -0.393, p = 0.026*	r = 0.003, p = 0.987
Iwate	r =- 0.121, p = 0.510	r = 0.020, p = 0.914	r = 0.064, p = 0.726	r = 0.030, p = 0.870	r = 0.092, p = 0.616
Shimane	r = 0.238, p = 0.190	r = -0.440, p = 0.012*	r = -0.482, p = 0.005**	r = 0.138, p = 0.451	r = -0.049, p = 0.790
Yamagata	r = 0.134, p = 0.464	r =-0.350, p = 0.049*	r = 0.216, p = 0.235	r = -0.070, p = 0.702	r = 0.308, p = 0.087
Miyazaki	r = 0.380, p = 0.032*	r = -0.291, p = 0.106	r = -0.320, p = 0.074	r = -0.033, p = 0.859	r = 0.081, p = 0.661
Kyoto	r = 0.241 p = 0.184	r = -0.284, p = 0.115	r = -0.347, p = 0.052	r = 0.156, p = 0.394	r = -0.041, p = 0.824
Kanagawa	r = 0.050, p = 0.788	r = -0.010, p = 0.957	r = 0.021, p = 0.909	r = 0.023, p = 0.899	r = -0.174, p = 0.340
Okayama	r = 0.306, p = 0.089	r = -0.239, p = 0.187	r = -0.292, p = 0.104	r = 0.366, p = 0.039*	r = -0.340 p = 0.057
Tokushima	r = -0.309, p = 0.086	r = -0.017, p = 0.925	r = 0.003, p = 0.989	r = 0.223, p = 0.221	r = 0.012, p = 0.949
Nara	r = 0.286, p = 0.112	r = -0.187, p = 0.305	r = 0.070, p = 0.705	r = 0.250, p = 0.167	r = 0.039, p = 0.832
Japan	r = 0.149, p = 0.415	r = -0.029, p = 0.873	r = -0.219, p = 0.228	r = -0.013, p = 0.945	r = -0.039, p = 0.831

*$p < 0.05$, **$p < 0.01$

Table 5: Correlation between annual age-adjusted suicide rates and annual values for each of five climate issues for women

	Air temperature	Sea level air pressure	Relative humidity	Sunshine duration	Precipitation
Akita	r = -0.512, p = 0.003**	r = 0.335, p = 0.061	r = 0.256, p = 0.158	r = 0.372, p = 0.036*	r = -0.164, p = 0.370
Iwate	r = -0.436, p = 0.013*	r = 0.274, p = 0.129	r = 0.175, p = 0.339	r = 0.524, p = 0.002**	r = -0.105, p = 0.569
Shimane	r = -0.537, p = 0.002**	r = 0.196, p = 0.283	r = 0.459, p = 0.008**	r = 0.034, p = 0.853	r = -0.011, p = 0.952
Yamagata	r = -0.537, p = 0.002**	r = 0.224, p = 0.219	r = 0.376, p = 0.034*	r = 0.352, p = 0.048*	r = -0.055, p = 0.766
Miyazaki	r = -0.495, p = 0.004**	r = 0.151, p = 0.410	r = 0.573, p = 0.001**	r = 0.060, p = 0.746	r = -0.117, p = 0.523
Kyoto	r = -0.322, p = 0.073	r = 0.251, p = 0.166	r = 0.252, p = 0.165	r = -0.169, p = 0.356	r = -0.063, p = 0.730
Kanagawa	r = -0.169, p = 0.355	r = 0.239, p = 0.189	r = 0.250, p = 0.168	r = -0.006, p = 0.976	r = -0.220, p = 0.226
Okayama	r = -0.522, p = 0.002**	r = 0.189, p = 0.301	r = 0.526, p = 0.002**	r = 0.027, p = 0.883	r = -0.088, p = 0.632
Tokushima	r = -0.628, p < 0.001**	r = 0.224, p = 0.218	r = 0.186, p = 0.307	r = -0.113, p = 0.536	r = -0.021, p = 0.908
Nara	r = -0.437, p = 0.012*	r = 0.198, p = 0.277	r = 0.336, p = 0.060	r = 0.257, p = 0.155	r = 0.145, p = 0.429
Japan	r = -0.409, p = 0.020*	r = 0.187, p = 0.304	r = 0.468, p = 0.007**	r = -0.354, p = 0.047*	r = -0.260, p = 0.151

*p < 0.05, **p < 0.01

tion in the three prefectures with the highest suicide rates. Salib (10) also found a significant positive association between suicide in the elderly and hours of sunshine in the data of various five-year periods in North Cheshire, while another study (17) showed that the seasonal amplitude of suicide has a positive association with total sunshine duration. Therefore, taken together with the findings of the study by Egashira *et al* (11), these results suggest that the increase in sunshine duration might influence the increase in suicide.

Barker *et al* (18) reported small but highly significant correlations, more marked in women, between rates of parasuicide and certain weather parameters. It is also necessary to discuss the findings of the present study in light of the report by Barker *et al* (18). In the present study, the association between suicide and climate showed constant tendencies among women, with suicide showing an especially significantly inverse correlation with mean air temperature in the prefectures with the highest and lowest suicide rates. Reports in some prefectures showed that economic constraint was an important factor in suicides among men, especially middle-aged men (19, 20). Therefore, the discussion of the relative factors contributing to the occurrence of suicide in men and women is important.

Nevertheless, the literature (6, 21–27) makes it clear that there are various opinions about the relationships between suicide and air temperature, humidity and sunshine duration. Therefore, it is important to examine these relationships in greater detail so that the relevant organizations may better understand them and be better able to implement appropriate suicide prevention measures in Japan.

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