

Seasonal Variation in Suicidal Deaths in Chile: Its Relationship to Latitude

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Key Words

Suicide · Seasons · Latitude · Chile

Abstract

Background: Studies in the northern and southern hemispheres consistently identified seasonal influences on monthly and semester suicide distribution. The variations of sunlight exposure in zones of increasing latitude has been suggested as one of the most plausible explanations for this phenomenon. Some recent studies in the northern hemisphere could not find seasonal asymmetries of suicides. The current study examines the monthly, seasonal and semester distribution of suicidal deaths in Chile and the influence of seasons in zones of low latitude as compared with regions of high or very high latitude, trying to determine if a seasonal pattern still exists in a country of the southern hemisphere. **Methods:** Monthly, seasonal and semester suicidal data over the period 1995–1999 were examined for the whole sample and for gender-specific subgroups in Chile. Four different latitudinal zones were analyzed separately, in order to investigate the effect of the photoperiod on suicide distribution. Results were analyzed by χ^2 tests for multinomials, as an overall measure of deviation. **Results:** We found a significant unimodal springtime peak for both genders in the global territory. Among the 4,710 male and 829 female suicides reported in this period there were no gender differences in the seasonal pattern of

suicidal deaths. When divided into four different latitudinal zones, the regions with low latitude (north of the country) showed no significant differences, while central and southern zones (higher latitude) show a significant springtime pattern. In the extreme south of the country, no significant differences were found, probably due to the very small number of cases. **Conclusion:** The study confirms the existence of a unimodal springtime peak of suicides in Chile, but not in the zone of low latitude. Results support the notion that the seasonal impact on suicidal distribution is a function of photoperiod.

Introduction

Since the study of Emil Durkheim of 1897, a large number of investigations reported an asymmetry in the yearly seasonal distribution of suicides, with a peak in the late spring and early summer months. Psychological, social and physical environmental theories have been raised as possible explanations for this phenomenon [1]. Climate could contribute to this biological risk by modifying both, the responsiveness of the circuits that control mood and behavior and also the frequency and intensity of social interaction.

As far as climatic variables are concerned, most authors agree that seasonal changes in sunlight exposure offer the most plausible explanation for this phenomenon.

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Because sunlight exposure and the duration of the day varies with latitude, these seasonal asymmetries should be different at distinct latitudes of one hemisphere, but similar for both hemispheres.

Several experimental studies exploring the influence of changes in sunlight duration have shown an unequal distribution of suicides with respect to latitude, with a peak in the extreme latitudes. Preti [2] found higher suicide rates for both genders in places of Italy which are less exposed to the sun. Altamura et al. [3] found a significant suicide peak related to seasonal variation in Cagliari, Italy. In the southern hemisphere, Trucco [4] and Flisher et al. [5] found a similar pattern of seasonality of suicides to the northern hemisphere, with a significant increase in springtime.

Lester [6, 7] confirms a seasonal pattern of suicides in New York and describes a yearly bimodal distribution, with two peaks of higher incidence: a major peak in the months of spring and a minor in autumn (beginning of winter). This bimodal distribution was confirmed by Meares et al. [8] in England and Wales, but only among women, whereas males showed the classical unimodal curve with the spring peak. No explanation for this difference was immediately apparent. Skutsch [9] tried a neurobiological explanation, associating seasonal changes with neurotransmission and female hormonal cycles.

In New South Wales, Australia, Parker and Walter [10] found a similar distribution of gender differences described previously by Meares et al. [8] in England (unimodal for males and bimodal for females) associating these curves to psychiatric hospitalizations for mood disorders, while Näyhä [11] associated the bimodal curve in Finland with occupational differences. Lester and Frank [12] suggested that the gender differences in the annual distribution of suicides can only be accepted if other variables like age or suicide method are considered. Lester [13] found not only latitudinal but also longitudinal differences in Australia, Canada and United States (greater in higher latitudes), suggesting the influence of cultural factors in the 'borderline territories'.

Because the duration of the day varies very little in regions of low latitude, the seasonal asymmetries of suicide distribution should vanish in equatorial zones. In an equatorial region, Parker et al. [14] found no seasonal patterning of suicidal deaths. However, Cantor et al. [15] studied seasonal variations of suicides in a Caucasian population living relatively close to the equator. They found a spring/early summer peak, but not a secondary autumn peak for males. In this study, no significant seasonal variations were found for distance from the equa-

tor. They concluded that climatic influences may produce greater variation in suicide rates where the climatic variation itself is greater.

Based on these controversies, we decided to run a national register study from 1995 to 1999 of 5,539 suicidal deaths in Chile, a country of the southern hemisphere with a relative homogeneous population and very large latitudinal variations. Our aim was to verify if the increasing contrasts of the seasons exert a direct influence on seasonal suicidal distribution and if there remains at least one seasonal peak of suicide deaths in the central and southern zones of the Chilean territory, when compared with the northern zones of lower latitude.

Method

Chile is a very long country, with extreme variations of light exposure and seasonal variations in the south and very low variations in the north. The country is located from latitude 17° to 56° S. In most part of its territory there are no significant cultural or psychosocial differences. The major proportion of the population lives in urban areas located in the center of the country. While the differences in the mean temperatures in summer and winter are moderate, there are significant variations in seasonal changes and the duration of the day between north and south. It appears to be well suited for a study of the influences of light and seasons on suicide distribution.

Chile has a growing population of 15,000,000 inhabitants. The climate is mild and dry in the north and less warm and wet in the south. The northern areas of lower latitude have very little seasonal changes during the year, with small variations in the duration of daylight, while the central and southern zones have important changes across the year.

The suicide registers of the population from 1995 to 1999 were provided by the National Institute of Legal Medicine. This institution receives all the reports of suicides in the country legally extended by physicians. During this 5-year period, a total number of 5,539 suicides were reported.

Considering the distribution of the Chilean population, the territory was divided into four geographical zones, namely *north*, from latitudes 17° to 30°, *central north*, from latitudes 30° to 36°30', *central south*, from latitudes 36°30' to 43° and *south*, from latitudes 43° to 56°.

The seasons were defined as usual for the southern hemisphere, namely summer (December, January, February), autumn (March, April, May), winter (June, July, August) and spring (September, October, November). The semester distribution was defined on the basis of one 'sunny' semester from July to December and the other, moving to a growing darkness.

The seasonal, semester and monthly changes in the distribution of suicides for the whole territory and between the different latitudinal zones were analyzed by χ^2 tests for multinomials, as an overall measure of deviation.

Table 1. Differences in the monthly distribution of completed suicides in four different latitudinal zones of Chile and in its total territory

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	χ^2
North	32	25	47	23	24	22	23	37	30	35	25	27	$p < 0.05$
Center-north	360	301	307	290	278	278	303	362	344	349	365	372	$p < 0.05$
Center-south	108	113	72	97	76	63	106	98	91	90	104	132	$p < 0.05$
South	15	11	12	7	4	4	13	10	12	14	14	8	n.s.
National	515	450	438	419	383	367	445	510	477	488	508	539	$p < 0.05$

Table 2. Differences in the seasonal distribution of completed suicides in four different latitudinal zones of Chile and in its total territory

	Summer	Autum	Winter	Spring	χ^2
North	87	58	72	75	n.s.
Center-north	968	846	1,009	1,086	$p < 0.05$
Center-south	293	236	295	326	$p < 0.05$
South	30	15	33	31	$p < 0.05$
National	1,185	1,006	1,209	1,310	$p < 0.05$

Table 3. Differences in the semester distribution of completed suicides in four distinct latitudinal zones of Chile and in its total territory

	Turning lighter and warmer	Turning darker and colder	χ^2
North	194	159	n.s.
Center-north	2,054	1,855	n.s.
Center-south	619	531	$p < 0.05$
South	74	50	$p < 0.05$
National	2,938	2,601	$p < 0.05$

Results

4,710 (85.03%) of the 5,539 suicide cases registered between 1995 and 1999 in Chile were males, with a male:female suicide rate of 5.5:1.

Table 1 shows the differences in the monthly distribution of completed suicides in four different latitudinal zones of Chile and in its total territory. No differences between male and female distribution was observed in the national territory. The northern zones exhibit a small peak in autumn, with no increase in the classical spring months. The central north and central south zones show a significant increase in suicides in springtime, from August to January and July to February, respectively. The zone with the highest latitude, the extreme south zone, shows no significant differences, probably because of the very small number of cases. The national distribution across the Chilean territory shows an increase in the suicide numbers from August to January, with a peak in December.

Table 2 shows the differences in the seasonal distribution of completed suicides in four different latitudinal zones of Chile and in its total territory. While there are no seasonal differences in the north of the country, there

is an increase in suicides in springtime in the central north and central-southern zones. In the southern zones, there is a decrease in suicides in autumn. The national distribution across the seasons confirms a significant peak in springtime.

Table 3 shows the differences in the semester distribution of completed suicides in four distinct latitudinal zones of Chile and in its total territory. All the studied zones show an increase in suicides during the semester of growing daylight exposure, but only the center-south and the south zones exhibit significant differences. The global territory also shows a significant increase in the total suicide numbers during the semester of growing daylight exposure.

Discussion

Recent studies found no asymmetries in the seasonal distribution of suicides in the northern hemisphere [16–19]. According to some authors, the marked seasonal fluctuation in suicide rates observed in the past appears to be diminishing, and in some cases, to have vanished. A recent investigation in England and Wales [16] showed a

very weak influence of seasons on suicide, while another independent study performed in California (USA) [17] showed no seasonal effect on suicide rates. Fruehwald et al. [18] could not find a seasonal pattern of suicides in a high-risk population of Vienna and Simkin et al. [19] did not find a spring peak of suicides among farmers in England and Wales. For some authors, this decrease of the spring and summer peak in countries of the northern hemisphere happened between 1980 and 2000, when prescription of antidepressants (SSRI's) increased dramatically, suggesting that the more depressed patients are pharmacologically treated, the less influence of seasons on suicide will be observed [20].

However, recent data from both hemispheres do not support this hypothesis. Our results support the notion that despite the generalized use of SSRIs the seasonal influence on suicide distribution in Chile has not vanished. In Finland, Hakko et al. [21] could also confirm recently a seasonal effect on suicides. Petridou et al. [22] found a consistent pattern of seasonality with peak incidence around June in the northern hemisphere and December in the southern hemisphere. Voracek et al. [23] found a continuous seasonal pattern of suicides in Romania. They suggested that the recent reported decreases in the seasonality of suicide might not generalize to societies in political and social transition.

Our data show that in Chile the distribution of suicide varies between months, seasons and semesters, with a yearly unimodal peak in late springtime, and that these variations increase with growing latitude. A similar asymmetry of the distribution of suicides was found in the Seventies [4] and Nineties [24] in Santiago, the capital of Chile. Therefore, we can confirm that the seasonal pattern of suicides has not changed in the central valley of Chile in the last three decades.

Our results are consistent with a unimodal seasonal distribution of suicides described by many authors. However, other investigations have reported a bimodal distribution [8, 9, 21, 25]. Gender factors have been proposed as an explanation for these differences. Preti and Miotto [25] reported that male violent suicides show a significant positive relationship with indicators of temperature and exposure to the sun, while female suicides show less significant relationships with climate indicators. Hakko et al. [21] found a spring/early summer suicide peak for males and a bimodal distribution for females. Our study has the limitation that the population of suicide deaths was composed mainly (85.03%) of males. However, a significant unimodal distribution with only one springtime peak was observed for both genders. This result supports

the notion that the bimodal distribution among women might not generalize to all countries.

Another limitation of this study is the lack of information about suicide method, which has been raised as being an important factor in the determination of a uni- or bimodal seasonal pattern of suicides [26]. Hakko et al. [21] have recently examined the suicide method-related seasonality of suicide occurrence in Finland. They found a unimodal distribution only among violent suicides, but for nonviolent suicides the distribution was bimodal. This result was also supported by Ajdacic-Gross et al. in Switzerland [27], who found that the seasonality of the overall Swiss suicide frequencies largely depends on specific suicide methods and different cyclical dynamics. Rasanen et al. [28] investigated the seasonal distribution of the specific suicide methods for both genders during a 16-year period. In this study, hanging peaked in springtime for both genders. The bimodality in female suicides with autumn peaks was explained by poisoning and drowning.

Téllez et al. [29] found that the large majority of the suicides in Chile are executed by hanging. Therefore, we could assume that the unimodal distribution in Chile may be associated with this violent suicidal method. But hanging is the most frequent method used all around the country, while the seasonal variation of suicides only emerges in the central and southern zones of Chile. Therefore, we have to assume that not only the method seems to be important in the occurrence of the seasonal impact on suicides.

Photoperiod – a function of geographical latitude and light exposure – has also been suggested as being a relevant factor. The springtime increase in suicides in Chile is only evident in zones of higher latitude. In the comparison of the distribution of suicides among two semesters, one turning to more light and the other to more darkness, it appears to be evident that the change towards a greater amount of daylight has an impact on the frequency of suicides in zones of higher latitude. This does not happen in zones of low latitude or less seasonal changes.

The hypothesis of a stronger influence of latitude on the seasonal pattern of suicides is also supported by data from investigations of seasonal variations and other forms of violence [30]. Some studies have reported a distinct pattern of seasonal variations in the frequency of homicide and sexual abuse that varies systematically with latitude [28–30].

How light could influence suicidal and violent behavior is still obscure. The studies of the seasonality of mood disorders are indicating that rapid increases in luminance

may influence specific central nervous system activity related to mood and increasing vulnerability to affective disorders. An understanding of these variations could increase our comprehension of the relationship between mood and suicide and the underlying factors contributing to its prevention. Additionally, the consideration of these

variables can be helpful in the treatment and better understanding of the chronobiology of psychiatric disorders and suicide. More replication studies with precise diagnostic considerations are needed for an adequate examination of the associations between suicide, seasonal changes and psychiatric disorders.

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