Fabíola Stolf Brzozowski, Giovana Bacilieri Soares, Jucemar Benedet, Antonio Fernando Boing, Marco Aurélio Peres
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Suicide time trends in Brazil from 1980 to 2005

Tendência temporal do suicídio no Brasil no período 1980-2005

Fabíola Stolf Brzozowski [1]
Giovana Bacilieri Soares [1]
Jucemar Benedet [2]
Antonio Fernando Boing [1]
Marco Aurélio Peres [1]

[1] Programa de Pós-graduação em Saúde Pública, Universidade Federal de Santa Catarina, Florianópolis, Brasil.
[2] Programa de Pós-graduação em Nutrição, Universidade Federal de Santa Catarina, Florianópolis, Brasil.

Correspondence
M. A. Peres
Programa de Pós-graduação em Saúde Pública, Centro de Ciências da Saúde, Universidade Federal de Santa Catarina.
Campus Universitário Trindade, Florianópolis, SC 88010-970, Brasil.
marco.peres@pesquisador.cnpq.br

Abstract

The aim of this study was to describe suicide time trends in Brazil from 1980 to 2005. The data were obtained from the National Mortality Information System and the Brazilian Institute of Geography and Statistics (IBGE). Suicides rates were calculated for the entire period for the country as a whole and the 26 States and Federal District. Annual increases or decreases in mortality rates were also estimated using Prais-Winsten generalized linear regression. The mean suicide rate was 4.12 per 100,000 inhabitants (6.45/100,000 in men and 1.80/100,000 in women). The study showed an increasing suicide trend in men (+1.41% per year, 95%CI: 1.00;1.23) and a decreasing trend in women (-0.53% per year, 95%CI: -0.04;-1.02). Suicide rates increased with age. In general, for all age groups and for both genders, the highest rates were in São Paulo and in the States of the South and Central-West regions.

Temporal Distribution; Mortality Rate; Suicide

Introduction

Suicide is a worldwide public health problem. In 2000, suicides were the fourth leading cause of death in the 15 to 44 year age bracket. In addition, it is estimated that in 2020 some 1.53 million persons will commit suicide and from 15 to 30 million will attempt it, giving suicide 2.4% of the global burden of disease that year [1,2].

Various theories have been proposed to explain suicide: Durkheim's sociological model, which describes it as a collective phenomenon with social causes and thus part of a historical and cultural context; the psychological model, analyzing it as the result of individual internal conflicts; and the disease model, which interprets it as a disease or the result of an illness process. The three models emphasize specific aspects of the complex relationship between the individual and society that are involved in the determination of suicide [3].

In Brazil, Mello-Santos et al. [4] identified suicide rates from 1980 to 2000 varying from 3 to 4 cases per 100 thousand inhabitants, with rates three times higher among men on average. However, the magnitude of the problem varies greatly by region, with higher rates reported in the South, North, and Central-West of the country [5].

The World Health Organization (WHO) [6] emphasizes both the importance of epidemiological surveillance and local research for understanding suicide and the need to explain variations in

the rates within their regional context. National data allow the elaboration of strategies to deal with the problem in society [7].

Despite suicide's relevance and the availability of data on the phenomenon in the official mortality records, the literature shows important gaps on the issue from an epidemiological approach. A literature search in MEDLINE (Medical Literature Analysis and Retrieval System Online), Latin-American and Caribbean Center on Health Sciences Literature (LILACS), and Scientific Electronic Library Online (SciELO) using the key words "*suicide*" and "*Brazil*" or "*suicídio*" and "*Brasil*" from 2000 to 2008 failed to identify any publications that analyzed the time trend in suicide between the different Brazilian States.

The aim of this study was to describe the time trend in suicide rates in the Brazilian States and the country as a whole, from 1980 to 2005, according to age bracket and gender.

Methods

The current study was an analysis of the time trend in suicide rates in Brazil and in each of its States from 1980 to 2005. The data came from official secondary sources. Suicide rates were calculated using the database of the Mortality Information System (SIM – http://www.datasus.gov.br/catalogo/sim.htm). The number of inhabitants in each State was obtained from the Brazilian Institute of Geography and Statistics (IBGE – http://www.ibge.gov.br) and comes from the censuses in the years when they were performed and the population counts in the other years. Tocantins was created by subdivision in 1988, and for that State the data on population and mortality from suicide were thus analyzed beginning that year.

The definition of suicide used to obtain the data from the Mortality Information System followed the ninth revision of the International Classification of Diseases (ICD-9; E950-E959, suicide and self-inflicted injury) for 1980-1995 and the tenth revision (ICD-10; X60-X84, intentional self-harm) from 1996 to 2005. The age brackets used in this study were: under 19 years of age (children and adolescents), 20-59 years (adults), and 60 years and older (elderly). The rates were calculated for the country as a whole by standardizing the values according to the world population [8]. Stratified analyses by gender and age bracket were also performed. Values corresponding to "age unknown" were excluded from calculation of the suicide rates according to age brackets.

The data were analyzed using Stata 9.0 (Stata Corp., College Station, USA). Annual suicide rates and the mean for the entire period were calculated for each State and the Federal District according to gender and age bracket. The mean rates were divided into tertiles, and TabWin 3.5 (http://www.datasus.gov.br) was used to construct spatial distribution maps. To evaluate whether the trend in suicide mortality rates increased, decreased, or remained stable during the study period, the Prais-Winsten procedure for generalized linear regression was used [9]. This technique was applied after verifying the linearity of the target time series models and, using the Durbin-Watson test, the existence of first-order autocorrelation, besides verifying the hypothesis of random distribution of the regression residues based on the performed correction [10]. Trends were considered stable when their regression coefficient did not differ from zero ($p > 0.05$), and the mean annual variations in the suicide rates and respective 95% confidence intervals were calculated. Graphic presentation of the time series used smoothing by third-order moving averages.

Results

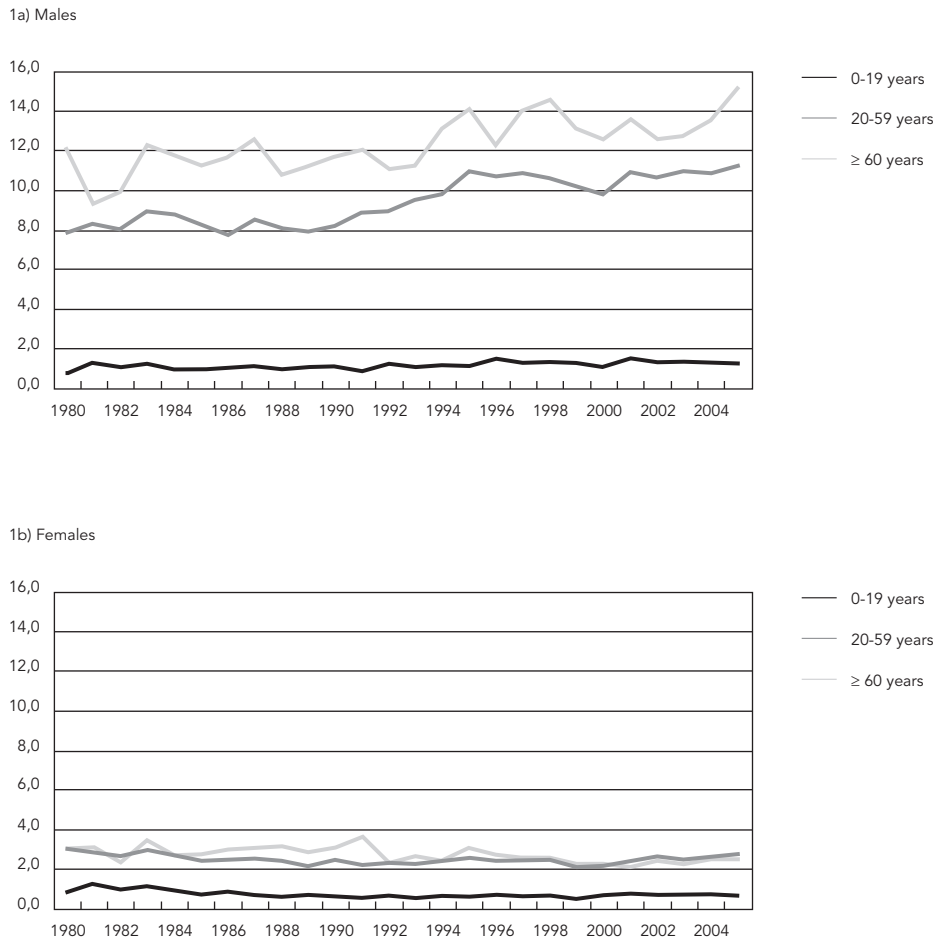
The mean suicide rate in Brazil from 1980 to 2005 was 4.12 per 100 thousand inhabitants, varying between 6.45 per 100 thousand in men and 1.80 per 100 thousand in women. Figure 1 shows this historical series by age bracket. The suicide trend increased in men (+1.41% per year, 95%CI: 1.00;1.23) and decreased in women (-0.53%, 95%CI: -0.04;-1.02).

Figure 2 shows the spatial distribution of the mean suicide rates from 1980 to 2005 by age brackets and gender. The rates increased with age in both genders, reaching the highest levels in men 60 years or older (38.40/100 thousand). In this age bracket, the suicide rates in men were up to four times those in women. Among younger individuals the rates ratios between men and women were lower. In general, for all the age brackets and both genders, the highest rates were in the States of the South and Central-West and São Paulo.

Among young individuals (Table 1), the suicide rates increased in males (+1.1% per year; 95%CI: 0.6;1.7) and remained stable or tended to decrease in females (-1.4% per year; 95%CI: -3.1;0.3). In males, the highest increases occurred in the States of Tocantins (7.8%), Mato Grosso do Sul (7.0%), Mato Grosso (6.5%), and Ceará and Piauí (both with 6.3%). Among male children and adolescents, only São Paulo showed a statistically significant decrease (-1.5%; 95%CI: 2.6;-0.4). In young females, most of the States showed stable rates; the largest annual increases occurred

Figure 1

Suicide time trend in Brazil in males and females from 1980 to 2005.



Note: rates per 100,000 inhabitants.

in Piauí (5.6%), Pernambuco (5.5%). Maranhão (4.8%), and Amazonas (3.5%). Suicide rates in young females decreased in the States of São Paulo (-4.9%), Roraima (-4.7%), Paraíba (-4.6%), Alagoas (-3.3%), Goiás (-3.0%), and Santa Catarina (-2.8%).

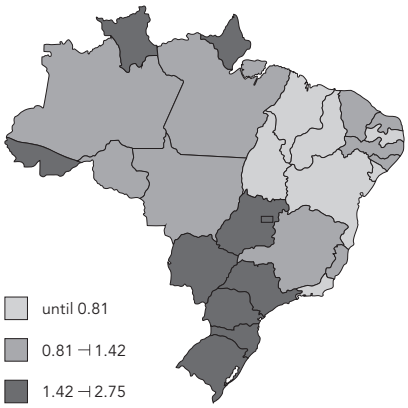
Table 2 shows the suicide rates in adults. No State showed a decrease in men. The rates remained stable in São Paulo, Rio de Janeiro, and the Federal District and increased in all the other States, varying from 0.8% per year in Paraná to 8.1% per year in Mato Grosso. For women, five States showed an increasing suicide rates (Tocantins, Sergipe, Maranhão, Mato Grosso, and Ceará), varying from 3.6% per year in Ceará to 9.3% per year in Tocantins. Four States showed annual reductions in suicide rates among women: Roraima (-3.5%), São Paulo (-2.4%), Paraná (-1.1%), and Rio Grande do Sul (-1%). All the other States showed stable rates during the study period.

Among elderly males the suicide rates increased in 14 States, varying from 1.1% per year in Rondônia to 7.5% per year in Mato Grosso, remained stable in 11, and decreased in two (-4.8% per year in Roraima and -1% per year in São Paulo). For elderly women, in six States (all in the North of Brazil) it was not possible to calculate the time trend because of the null values in many years of the historical series. The rates showed a decreasing trend in seven States, varying from -2% per year in Paraná and Rio Grande do Sul

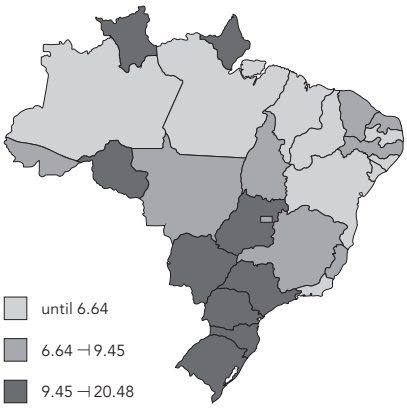
Figure 2

Mean suicide rates (per 100,000 inhabitants) in Brazil from 1980 to 2005.

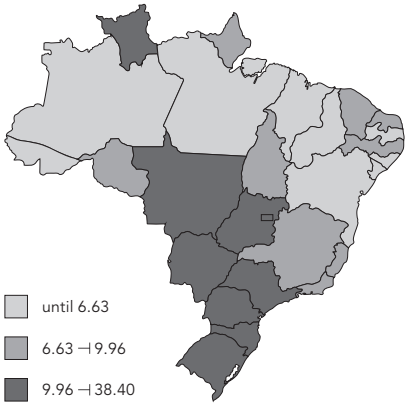
2a) Males up to 19 years of age



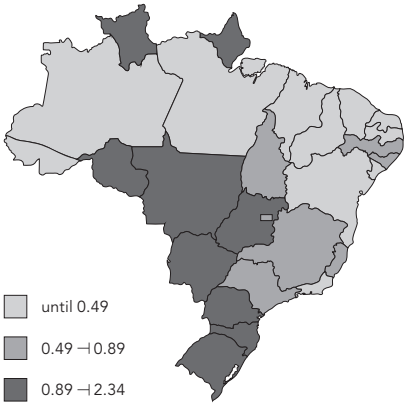
2b) Males 20 to 59 years of age



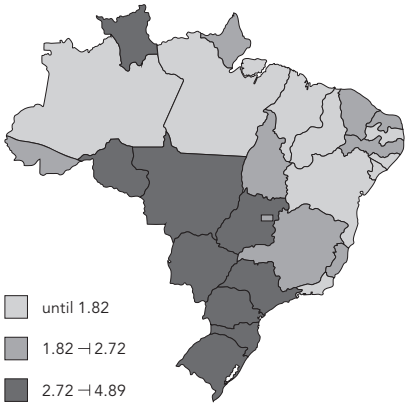
2c) Males 60 years or older



2d) Females up to 19 years of age



2e) Females 20 to 59 years of age



2f) Females 60 years or older

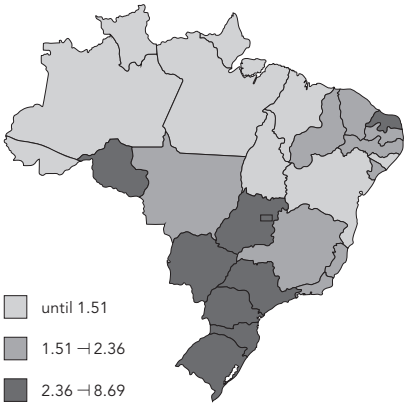


Table 1

Annual trend, percentage (%), and 95% confidence intervals (95%CI) for suicide rates in young individuals (0-19 years) in the States of Brazil and Federal District, by gender, from 1980 to 2005.

State	Males			Females		
	%	95%CI	Interpretation	%	95%CI	Interpretation
Rondônia	0.9	-1.5;3.3	Stable	-1.7	-5.7;2.5	Stable
Acre	0.4	-3.0;4.0	Stable	-3.3	-6.3;-0.3	Decrease
Amazonas	4.6	2.4;6.9	Increase	3.5	1.4;5.6	Increase
Roraima	-1.6	-5.8;2.8	Stable	-4.7	-6.9;-2.5	Decrease
Pará	0.8	-1.9;3.7	Stable	0.9	-2.3;4.3	Stable
Amapá	0.2	-6.9;7.8	Stable	-4.9	-7.9;-1.7	Decrease
Tocantins	7.8	2.3;13.7	Increase	3.7	-0.5;8.0	Stable
Maranhão	1.9	-1.7;5.6	Stable	4.8	0.0;9.8	Increase
Piauí	6.3	1.2;11.6	Increase	5.6	1.4;10.1	Increase
Ceará	6.3	3.7;9.1	Increase	4.6	-0.1;9.5	Stable
Rio Grande do Norte	0.9	-2.7;4.6	Stable	-0.1	-2.0;1.8	Stable
Paraíba	0.0	-2.1;2.1	Stable	-4.6	-6.9;-2.2	Decrease
Pernambuco	3.0	0.1;6.0	Increase	5.5	4.5;6.4	Increase
Alagoas	0.2	-2.9;3.4	Stable	3.2	-1.1;7.8	Stable
Sergipe	3.3	-0.7;7.5	Stable	1.5	-2.3;5.5	Stable
Bahia	2.6	0.7;4.4	Increase	0.9	-4.7;6.8	Stable
Minas Gerais	0.1	-1.5;1.8	Stable	-2.7	-6.4;1.3	Stable
Espírito Santo	2.5	-1.5;6.6	Stable	-0.4	-2.5;1.9	Stable
Rio de Janeiro	1.4	-0.3;3.1	Stable	-2.9	-6.8;1.2	Stable
São Paulo	-1.5	-2.6;-0.4	Decrease	-4.9	-5.8;-4.1	Decrease
Paraná	1.3	0.4;2.2	Increase	-3.8	-4.6;-3.0	Decrease
Santa Catarina	1.7	0.6;2.7	Increase	-2.8	-4.1;-1.6	Decrease
Rio Grande do Sul	0.1	-0.8;1.0	Stable	-2.8	-4.1;-1.6	Decrease
Mato Grosso do Sul	7.0	4.3;9.7	Increase	3.3	-0.9;7.8	Stable
Mato Grosso	6.5	1.7;11.5	Increase	2.5	-1.1;6.3	Stable
Goiás	0.8	-0.1;1.8	Stable	-3.0	-5.7;-0.3	Decrease
Federal District	-2.4	-7.0;2.4	Stable	0.2	-1.8;2.3	Stable
Brazil	1.1	0.6;1.7	Increase	-1.4	-3.1;0.3	Stable

to -6.1% per year in Paraíba. Four States showed an upward trend (5.7% per year in Pernambuco, 2.5% in Bahia and Rio Grande do Norte, and 1.8% no Piauí). The other States showed stable rates (Table 3).

Discussion

Psychological, biological, economic, and sociocultural factors make suicide a complex phenomenon. In this context, time trend studies are an important epidemiological tool, because knowledge concerning distribution of the events can help formulate explanatory hypotheses and indirectly evaluating the effectiveness of public policies.

The results of the current study in relation to age and gender distribution are consistent with the findings in other countries [5,11,12,13,14]. In Spain, from 1986 to 2002, the suicide ratio between men and women was 3.4, and the oldest age group showed the highest rates [11]. A study in Southern Italy showed similar results [14]. In Colombia there was a considerable increase in suicide rates beginning in 1998, with the highest rates in men 20 to 29 years of age and over 70 years. Meanwhile, among females the highest rates were in the 10 to 19 year bracket [15]. In Mexico, during the year 2001, the suicide rate was 3.72 per 100 thousand inhabitants, and was higher in men (6.14) than in women (1.32), and higher in the over-65 age group [16]. In Latin America, besides Brazil, an increase in suicide rates has been observed in recent years in Chile, Colombia, Paraguay, and

Table 2

Annual trend, percentage (%), and 95% confidence intervals (95%CI) for suicide rates in adults 20 to 59 years of age in the States of Brazil and Federal District, by gender, from 1980 to 2005.

State	Males			Females		
	%	95%CI	Interpretation	%	95%CI	Interpretation
Rondônia	0.0	-1.4;1.3	Stable	-0.6	-2.2;1.2	Stable
Acre	4.4	-0.2;9.3	Stable	3.1	-0.8;7.1	Stable
Amazonas	2.6	1.3;3.9	Increase	-1.1	-3.0;0.9	Stable
Roraima	3.8	0.4;7.3	Increase	-3.5	-6.7;-0.2	Decrease
Pará	0.2	-0.7;1.1	Stable	-0.4	-1.7;0.9	Stable
Amapá	4.3	1.9;6.8	Increase	-2.4	-6.2;1.6	Stable
Tocantins	2.7	-5.0;11.0	Stable	12.6	9.3;16.0	Increase
Maranhão	6.0	4.2;7.9	Increase	5.1	0.8;9.6	Increase
Piauí	6.7	4.5;8.9	Increase	4.3	-0.3;9.0	Stable
Ceará	4.7	1.9;7.6	Increase	3.6	0.4;7.0	Increase
Rio Grande do Norte	3.0	1.4;4.7	Increase	-0.8	-2.1;0.4	Stable
Paraíba	-0.2	-2.7;2.4	Stable	-2.8	-5.9;0.5	Stable
Pernambuco	2.7	0.2;5.3	Increase	2.4	-0.1;4.9	Stable
Alagoas	1.1	0.1;2.1	Increase	-1.7	-4.8;1.5	Stable
Sergipe	4.3	-0.6;9.4	Stable	6.9	2.5;11.5	Increase
Bahia	3.6	2.3;4.9	Increase	2.1	-1.0;5.2	Stable
Minas Gerais	1.4	0.0;2.8	Increase	0.1	-1.8;2.1	Stable
Espírito Santo	2.1	1.2;2.9	Increase	0.8	-1.5;3.3	Stable
Rio de Janeiro	1.4	-0.1;2.9	Stable	0.3	-1.6;2.2	Stable
São Paulo	-0.2	-1.3;1.0	Stable	-2.4	-3.0;-1.8	Decrease
Paraná	0.8	0.0;1.6	Increase	-1.1	-1.8;-0.4	Decrease
Santa Catarina	2.0	0.8;3.2	Increase	0.6	-0.4;1.7	Stable
Rio Grande do Sul	1.0	0.2;1.8	Increase	-1.0	-1.7;-0.3	Decrease
Mato Grosso do Sul	2.8	1.9;3.7	Increase	0.3	-2.5;3.1	Stable
Mato Grosso	8.1	4.9;11.3	Increase	4.6	1.1;8.3	Increase
Goiás	2.2	0.9;3.4	Increase	0.0	-1.2;1.2	Stable
Federal District	3.0	-0.7;6.9	Stable	1.4	-2.1;5.0	Stable
Brazil	1.3	0.7;1.9	Increase	-0.3	-1.2;0.5	Stable

Ecuador, remaining stable in Venezuela and decreasing in Peru [17].

The mean suicide rate from 1980 to 2005, as described in the current study (4.12 deaths per 100 thousand inhabitants), was lower than the mean for 53 countries with complete data available, which showed an aggregate and standardized rate of 15.1 deaths per 100 thousand inhabitants [6], and was also lower than the rate of 17.6/100 thousand inhabitants in Japan from 1995 to 1997 [12].

Lower suicide rates have been associated with lower rates of alcoholism, greater religiosity, and flexibility towards social norms. These characteristics are more prevalent among women, which could explain the observed gender differences. Compared to men, women also tend to recognize risk situations early and seek help in times of crisis. Meanwhile, typically male behaviors can predispose men to suicide, like competitiveness, impulsiveness, and greater access to firearms and other lethal technologies [18].

This study's findings showed a higher increase in suicide rates in the States with the lowest rates, except for Mato Grosso. A plausible hypothesis for this phenomenon could be an improvement in the quality of records, especially in less developed regions. This could partially explain the increase in rates in the vast majority of the States in the North and Northeast of Brazil. In general, mortality data in underdeveloped countries tend to be deficient, while those in developed countries reach reliable levels [19]. In Brazil, analysis of data quality from 2000 to 2002 showed that only 5% of the municipalities in the Northeast showed a satisfactory level for records on deaths, births,

Table 3

Annual trend, percentage (%), and 95% confidence intervals (95%CI) for suicide rates in elderly (≥ 60 years) in the States of Brazil and Federal District, by gender, from 1980 to 2005.

State	Males			Females		
	%	95%CI	Interpretation	%	95%CI	Interpretation
Rondônia	1.1	-1.7;3.9	Stable	*	*	*
Acre	-1.0	-3.7;1.8	Stable	*	*	*
Amazonas	0.2	-3.2;3.8	Stable	*	*	*
Roraima	-4.8	-7.4;-2.0	Decrease	*	*	*
Pará	1.4	-0.2;3.0	Stable	-4.9	-7.5;-2.2	Decrease
Amapá	1.8	-2.9;6.7	Stable	*	*	*
Tocantins	3.1	-1.6;8.1	Stable	*	*	*
Maranhão	2.7	0.6;4.7	Increase	-2.3	-4.2;-0.2	Decrease
Piauí	4.8	1.1;8.7	Increase	1.8	-0.8;4.6	Increase
Ceará	6.9	5.1;8.8	Increase	2.2	-1.9;6.4	Stable
Rio Grande do Norte	3.2	1.2;5.3	Increase	2.5	0.5;4.7	Increase
Paraíba	0.7	-2.7;4.3	Stable	-6.1	-8.6;-3.5	Decrease
Pernambuco	3.4	0.3;6.6	Increase	5.7	1.3;10.3	Increase
Alagoas	2.8	-1.7;7.5	Stable	-0.4	-2.3;1.5	Stable
Sergipe	4.0	0.1;8.1	Increase	-3.6	-8.0;1.0	Stable
Bahia	3.4	1.5;5.3	Increase	2.5	0.4;4.6	Increase
Minas Gerais	1.0	-0.1;2.1	Stable	0.2	-1.4;1.9	Stable
Espírito Santo	2.8	0.1;5.5	Increase	-1.8	-6.5;3.1	Stable
Rio de Janeiro	1.6	0.1;3.1	Increase	-1.6	-3.4;0.3	Stable
São Paulo	-1.0	-1.7;-0.3	Decrease	-2.4	-3.5;-1.3	Decrease
Paraná	0.6	-0.7;2.0	Stable	-2.0	-3.6;-0.3	Decrease
Santa Catarina	1.8	0.0;3.6	Increase	-0.4	-2.7;2.0	Stable
Rio Grande do Sul	0.4	-0.5;1.3	Stable	-2.0	-3.1;-1.0	Decrease
Mato Grosso do Sul	3.2	1.0;5.4	Increase	-1.0	-3.5;1.6	Stable
Mato Grosso	7.5	5.4;9.7	Increase	-2.5	-4.5;-0.5	Decrease
Goiás	3.2	1.3;5.2	Increase	0.8	-0.6;2.3	Stable
Federal District	4.1	2.1;6.1	Increase	-1.9	-7.2;3.7	Stable
Brazil	1.1	0.7;1.5	Increase	-0.9	-1.6;-0.2	Decrease

* It was not possible to estimate the annual trend (%) in these cases, since many years showed null values.

and ill-defined causes, while 63% of the municipalities in the South were found to have satisfactory records. The Northeast Region showed the worst rates of adequate information on underlying cause of death, followed by the North [20]. Importantly, the social taboos surrounding suicide may contribute to its underreporting. It is also important to note that it was not possible to analyze the time trend in suicides according to skin color, one of this study's initial objectives. Approximately 50% of the deaths from suicide lacked information on skin color, thus making such analyses impossible and showing that the Mortality Information System has still not achieved the desired quality.

It is suggested that the more economically developed States of Brazil (in the South and Southeast regions) probably showed an improvement in their vital statistics recording systems at a time not investigated in the past, and that this phenomenon may be occurring in recent years in regions of the country with more recent development.

Macroeconomic trends like the unemployment rate and expectations towards the economy and consumption may also contribute to the increase in suicide rates, with different effects on men and women and different age brackets [21]. This study's results indicate an increase in rates in States with the worst social and economic development. An extensive review of this issue by Rehkpof & Buka [22] concluded that there is generally an inverse association between a region's socioeconomic conditions and suicide rates.

Although the observed differences cannot be attributed exclusively to socioeconomic factors, the social inequalities based on income differences and expected income may be related to the variations in suicide rates between economically distinct regions.

In the current study, some States with outstanding agricultural production, like Mato Grosso and Mato Grosso do Sul, or with an expansion in their farming area in recent years, like Goiás, Tocantins and Amazonas, were among those with the highest increases in suicide rates. An increased risk of suicide among farmers in given regions has been reported in other studies in Brazil [18,23], although other studies have failed to show this association [24]. In some countries, like Australia [25], Scotland [26] and India [27], an association between farming activities and suicide has been identified. This higher mortality could be reflecting this population segment's precarious living conditions, including indebtedness, land concentration, and rural exodus; or, it could be influenced by the intense exposure to pesticides, a factor associated which depressive states [17] which could ultimately lead to suicide.

Another hypothesis for the increasing rates in some States of the Central-West and North is the increase in suicide incidence in the indigenous population (proportionally larger in these States). Statistics show that suicide mortality among indigenous peoples in Brazil is higher than in the general population, up to 40 times higher in some peoples [28]. The exhaustion of possibilities for further retreating from the encroachment of "civilization", with the resulting loss of their cultural values, may explain the high suicide rates among indigenous peoples [29]. The constant extension of the agricultural and cattle-raising frontier is associated with this phenomenon, which may also be occurring in a relatively milder form in some States of the North that display increasing rates.

Despite the suggested hypotheses, suicide and the variability in rates cannot be explained exclusively by the determinants mentioned in this study. The complexity of suicide certainly involves numerous determinants, whose impact on the rates is uncertain. Understanding the phenomena that contribute to the recent increase in rates may allow the adoption of more effective interventions. This requires more in-depth studies on the causes of suicide, since there is still little epidemiological literature on the subject. This study's results reveal the need to investigate the relations between suicide and more specific macro-social issues in developing regions, areas with heavy agricultural activity, and among indigenous peoples. Such studies will be important for identifying risk factors and effectively implementing strategic prevention. Epidemiological studies coupled with anthropological, psychological, and sociological research should be performed in order to better understand the problem.

Resumo

O objetivo deste estudo foi descrever a tendência temporal das taxas de mortalidade por suicídio no Brasil, no período de 1980 a 2005. Os dados foram obtidos junto ao Sistema de Informações sobre Mortalidade e ao Instituto Brasileiro de Geografia e Estatística. Foram calculadas as taxas médias de suicídio para todo o período, para cada estado, Distrito Federal e para o país como um todo, segundo sexo e faixas etárias. Também foram calculadas as variações médias anuais do suicídio pela regressão linear generalizada de Prais-Winsten. Foi observada, no período, taxa média de suicídio de 4,12 por 100 mil habitantes, variando de 6,45 por 100 mil habitantes entre homens a 1,80 por 100 mil habitantes entre mulheres, com tendência de ascensão entre os homens (+1,41% ao ano, IC95%: 1,00;1,23) e de declínio entre as mulheres (-0,53%, IC95%: -0,04; -1,02). O suicídio aumentou com o avanço da idade em ambos os sexos. De uma maneira geral, para todas as faixas etárias e para ambos os sexos, as maiores taxas foram encontradas em São Paulo e nos estados das regiões Sul e Centro-oeste.

Distribuição Temporal; Coeficiente de Mortalidade; Suicídio

Contributors

F. S. Brzozowski performed the bibliographic research and wrote the article. G. B. Soares and J. Benedet performed the bibliographic research and contributed to writing the article. A. F. Boing conducted the analyses and collaborated in writing the article. M. A. Peres conceived the study, conducted the analyses, and contributed to writing the article.

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