Suicide trend among Brazilian adolescents between 1997 and 2016*

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Abstract

Objective: To analyze the suicide mortality trend among Brazilian adolescents from 1997 to 2016. **Methods:** This is an ecological time series study; Prais-Winsten regression was used. **Results:** 14,852 suicide deaths were recorded, with mortality rates per 100,000 inhabitants of 1.95 in 1997, 2.65 in 2016 and average of 2.14 for the period 1997-2016; deaths predominated in males (67.59%), as well as deaths due to intentional self-harm (84.19%) and suicides at home (52.69%); the Midwest region had the highest rate in the period (3.71/100,000 inhabitants), in particular the state of Mato Grosso do Sul (8.3/100,000 inhabitants); the suicide trend rose 1.35% per annum in the general adolescent population (95%CI 0.56;2.15), 1.63% in males (95%CI 0.56;2.29), 3.11% in the North (95%CI 2.25;3.98) and 4.19% in the Northeast (95%CI 2.58;5.84). **Conclusion:** Suicide mortality in Brazilian adolescents showed an upward trend in the period studied.

Keywords: Suicide; Adolescents; Time Series Studies; Public Health.

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Introduction

Suicide represents self-extermination with the aim of causing one's own death. Suicidal behavior manifests itself in the form of suicidal ideation, when there are (i) thoughts that increase the wish to kill oneself, (ii) a plan to prepare a specific means of death and (iii) the attempt to carry out actions that lead to aggression the final intention of which is death. If death is the consequence of this attempt, it is characterized as suicide.[1] Suicide attempts are estimated to be at least ten times greater than suicide deaths but such attempts are one of the main risk factors for suicide happening in the future.[2]

According to the World Health Organization (WHO), every year more than 800,000 people commit suicide, which represented one suicide death every 40 seconds.[3] Although in recent decades (1990-2015) there has been evidence of a reduction in suicide mortality in some West European countries, in other countries, such as Mexico, United States, Australia and Brazil, there has been an increase in the same period.[4]

> *Suicide is considered to be the second leading cause of death among individuals 15-29 years old. This age group stands out due to the accelerated increase in this type of death when compared to the general population.*

In Brazil, between 1996 and 2015, suicide mortality among the general population increased in the North, Northeast and Southeast regions, decreased in the Southern region and was stable in the Midwest region. In that period, 172,051 suicide deaths were recorded, 8.54% of which corresponded to the 10-19 year age group.[5]

Suicide is considered to be the second leading cause of death among individuals 15-29 years old.[3] This age group stands out due to the accelerated increase in this type of death when compared to the general population.[6] A Brazilian study indicated a 21.8% increase in suicide mortality in individuals aged 10-24 between 2000 and 2012, whereby the most frequent means used to commit suicide were hanging, firearm injuries and pesticide intake.[6] With regard to place of death, both international and national studies have shown that home is the main choice, followed by hospital and public thoroughfares.[7,8]

A study conducted in 29 countries belonging to the Organization for Economic Cooperation and Development (OECD) found that between the mid 1990s and the early 2010s suicide rates were higher among adolescents aged 15-19 and between two and three times higher among males compared to females.[9] Suicide is a multifactoral phenomenon and, among adolescents, can be related to emotional states (such as a broken relationship), financial problems, difficulties in getting established professionally or academic pressure,[6] among other reasons.

A study conducted in the United States with 6,483 adolescents aged 13-18 and their parents found the presence of at least one pre-existing mental disorder in the majority of adolescents who had suicidal behavior, such as: major depressive disorder and/or dysthymia, specific phobias, eating disorders, oppositional defiant disorder, intermittent explosive disorder, psychoactive substance abuse and behavior disorders.[10]

This scenario justifies time series studies of suicide mortality among adolescents being conducted. This type of study enables analysis of suicidal behavior over time, depicting the characteristics and local trends of such a relevant health condition.[11,12]

The objective of this study was to analyze the suicide mortality trend among Brazilian adolescents from 1997 to 2016.

Method

This was an ecological time series study using data from the Ministry of Health's Mortality Information System (SIM).

The study included all deaths of individuals aged between 10 and 19 years old (adolescents) between 1997 and 2019, the underlying cause of which was suicide, as per the following codes of the International Statistical Classification of Diseases and Related Health Problems (ICD-10): X60-X69 (intentional self-poisoning) and X70-84 (intentional self-harm).

The data were retrieved from the SIM system on the webpage of the Brazilian National Health System Information Technology Department (DATASUS) – http://datasus.saude.gov.br/ –, in March 2019. We used also population estimates, by sex and age group, produced by the Brazilian Institute of Geography and Statistics (IBGE), also available on the DATASUS website.

The variables of interest for the study were:
a) sex (female; male);
b) group of causes (intentional self-poisoning [X60-69]);
c) intentional self-harm [X70-84];

d) place of residence (Brazil; Brazilian macro-regions; Federative Units);

e) place of occurrence of death (at home; hospital; other health establishment; public thoroughfare; other); and

f) year of occurrence (between 1997 and 2016).

Places where death occurred identified as 'other health establishments' are health services other than hospitals. Places where death occurred classified as "other" are places other than any kind of health establishment, residence or public thoroughfare.

The database was structured using Microsoft Office Excel® spreadsheets, with independent double data entry using the data retrieved from DATASUS. The data input to both databases were compared using the Data Compare tool in order to identify possible typing and indicator calculation inconsistencies which were later corrected by checking them with the database.

In order to calculate the specific adolescent suicide mortality rate, the number of suicide deaths among adolescents living in a given place was taken to be the numerator, the total resident population was taken to be the denominator and the result was multiplied by 100,000.[13] The age-adjusted mortality rate was calculated using the direct method, taking the WHO standardized global population,[14] based on global projections for the period 2000-2025. Crude rates were also calculated according to sex, age group, Brazilian macro-region and Federative Unit per 100,000 inhabitants. Proportional mortality was calculated for place of occurrence and group of causes.

Prais-Winsten regression as described by the researchers Antunes & Cardoso[12] with correction for first-order autocorrelation was used for rate trend analysis. The dependent variable was the rate logarithm, while the time series years were the independent variable. Annual percent change (APC) was calculated using the following formula:

$$APC = [-1 + 10^b]*100\%$$

The following formula was used to calculate the confidence intervals (CI):

$$95\%CI = [-1 + 10^{b \pm t*se}]*100\%$$

Where:

b corresponds to the annual growth rate and se corresponds to the standard error, both of which were taken from the regression analysis.

The t value was provided by the Student's t test distribution.

An increase over the time series was considered to be when the rate was positive and a decrease when the rate was negative. Stability was when there was no significant difference between its value and zero ($p > 0.05$).[12] This analysis was performed with the aid of the Stata 11.1 computer program.

This study is part of the matrix research entitled 'Suicide trends among adolescents and young adults (1997-2016)', approved by Federal University of Mato Grosso Health Research Ethics Committee (CEP-Saúde/UFMT): Opinion No. 2.840.432, issued on August 23rd 2018.

Results

Adolescent suicide deaths in Brazil totaled 14,852 between 1997 and 2016, this being equivalent to a crude average rate of 2.14 deaths per 100,000 inhab., and 2.13 deaths per 100,000 inhab. when adjusted for

Table 1 – Analysis of suicide mortality rate time series among adolescents (per 100,000 inhab.), crude, adjusted for age and by sex and age group, Brazil, 1997-2016

Mortality	Death (N)	Rate 1997	Rate 2016	Average Rate	APC[a]	95%CI[b]	Interpretation
Crude	14,852	1.96	2.65	2.14	1.35	0.56;2.15	Increase
Adjusted	14,852	1.98	2.61	2.13	1.35	0.56;2.15	Increase
Sex							
Female	4,813	1.35	1.58	1.41	2.29	-0.54;1.89	Stability
Male	10,039	2.55	3.68	2.85	1.63	0.56;2.29	Increase
Age group (years)							
10-14	2,180	0.6	0.86	0.63	2.17	1.05;3.30	Increase
15-19	12,672	3.39	4.39	3.65	1.12	0.46;1.79	Increase

a) APC: annual percent change.

b) 95%CI: 95% confidence interval.

Table 2 – Analysis of crude suicide mortality rate time series among adolescents (per 100,000 inhab.), regions and federative Units, 1997-2016

Regions and FUs[a]	Death (N)	Rate 1997	Rate 2016	Average Rate	APC[b]	95%CI[c]	Interpretation
North	**1,956**	**2.14**	**4.10**	**2.95**	**3.11**	**2.25;3.98**	**Increase**
Acre	101	2.34	7.47	3.31	1.44	-3.03;6.12	Stability
Amapá	134	1.95	2.32	4.76	1.86	-5.08;9.30	Stability
Amazonas	626	3.22	4.58	4.10	4.50	1.72;7.35	Increase
Pará	618	1.71	2.99	1.98	1.69	0.18;3.23	Increase
Rondônia	179	1.99	3.12	2.78	0.71	-2.16;3.67	Stability
Roraima	146	6.50	17.29	7.99	1.70	-3.13;6.79	Stability
Tocantins	152	1.11	4.14	2.69	4.37	1.53;7.28	Increase
Northeast	**3,624**	**0.98**	**2.28**	**1.72**	**4.19**	**2.58;5.84**	**Increase**
Alagoas	242	1.08	2.16	1.86	2.79	0.60;5.03	Increase
Bahia	493	0.44	1.65	0.88	5.39	3.99;6.81	Increase
Ceará	893	1.07	2.73	2.67	3.67	1.67;5.70	Increase
Maranhão	390	0.65	2.29	1.41	5.78	3.52;8.10	Increase
Paraíba	206	1.15	1.91	1.45	8.30	4.44;12.30	Increase
Pernambuco	672	2.09	2.18	1.99	-0.40	-2.07;1.31	Stability
Piauí	350	1.31	3.71	2.84	7.02	1.63;2.69	Increase
Rio Grande do Norte	193	1.01	3.02	1.59	2.15	-0.27;4.62	Stability
Sergipe	185	0.25	2.62	2.25	6.08	2.58;9.70	Increase
Midwest	**1,860**	**3.48**	**4.41**	**3.71**	**0.57**	**-0.94;2.10**	**Stability**
Distrito Federal	236	5.93	2.58	2.69	-1.95	-3.99;0.13	Stability
Goiás	565	2.67	3.50	2.64	0.54	-1.91;3.05	Stability
Mato Grosso	317	2.68	3.05	2.86	-0.82	-2.52;0.91	Stability
Mato Grosso do Sul	742	3.97	10.34	8.34	3.33	0.39;6.35	Increase
South	**3,016**	**3.60**	**3.06**	**3.19**	**-0.97**	**-2.20;0.26**	**Stability**
Paraná	1154	3.96	2.68	3.10	-1.43	-2.73;-0.12	Reduction
Rio Grande do Sul	1282	3.75	3.05	3.57	-1.41	-2.40;-0.40	Reduction
Santa Catarina	580	2.66	3.73	2.71	0.84	-1.46;3.19	Stability
Southeast	**4,396**	**1.87**	**2.06**	**1.62**	**0.40**	**-1.13;1.96**	**Stability**
Espírito Santo	190	2.05	0.48	1.48	-3.35	-7.42;0.89	Stability
Minas Gerais	1.325	1.70	2.56	1.91	2.00	0.42;3.62	Increase
Rio de Janeiro	485	1.19	1.45	0.96	0.11	-4.66;5.12	Stability
São Paulo	2,396	2.18	2.19	1.74	-0.05	-1.47;1.39	Stability

a) FUs: Federative Units.
b) APC: annual percent change.
c) 95%CI: 95% confidence interval.

age, while the crude average rate was 1.95 in 1997 and 2.65 in 2016 per 100,000 inhab.

It can be seen in Table 1 that the average rate was higher among male adolescents in the 15 (2.85/100,000 inhab.), to 19 (3.65/100,000 inhab.) age groups. Crude mortality and age-adjusted mortality increased (APC=135 – 95%CI 0.56;2.15) among males (APC=1.63 – 95%CI 0.56;2.29) and in both age groups, 10-14 years (APC=2.17 – 95%CI 1.05;3.30) and 15-19 years (APC=1.12 – 95%CI 0.46;1.79).

The proportion of intentional self-harm suicide deaths (X70-84) was higher (n=12,505; 84.19%), when compared to the proportion of intentional self-poisoning cases (X60-69) (n=2,347; 15.81%), and both

these categories displayed stability over the period, with 0.24 APC (95%CI -0.35;0.84) and -1.75 APC (95%CI -5.37;2.02), respectively.

When comparing the Brazilian macro-regions, the Midwest region had the highest average rate (3.71/100,000 inhab.), while suicide mortality increased in the Northeast region (APC=4.19 – 95%CI 2.58;5.84) and the Northern region (APC=3.11 – 95%CI 2.25;3.98), as shown in Table 2.

The three Brazilian Federative Units with the highest crude average mortality rates were Mato Grosso do Sul (8.3/100,000 inhab.), Roraima (8.0/100,000 inhab.) and Amapá (4.8/100,000 inhab.). There was an increasing trend in suicide mortality rates in 12 Federative Units:

Table 3 – Analysis of suicide death distribution time series among adolescents, by place of occurrence, Brazil, 1997-2016

Place of occurrence	Deaths		1997	2016	APC[a]	95%CI[b]	Interpretation
	N	%	%	%			
Hospital	3,713	25.32	34.27	16.01	-3.40	-4.1;-2.60	Reduction
Other health establishments	190	1.29	0.00	2.69	5.30	2.90;7.80	Increase
At home	7,729	52.69	46.44	60.92	1.60	1.20;2.00	Increase
Public thoroughfare	933	6.36	5.79	4.37	-0.64	-1.86;0.59	Stability
Other	2,102	14.34	13.50	16.01	0.52	-0.14;1.18	Stability

a) APC: Annual percent change.

b) 95%CI: 95% confidence interval.

Note: Unknown places of occurrence corresponded to 1.3% (n=185) of records (APC=10.0% – 95%CI -13.51;-6.41).

Alagoas, Amazonas, Bahia, Ceará, Maranhão, Mato Grosso do Sul, Minas Gerais, Pará, Paraíba, Piauí, Sergipe and Tocantins (Table 2).

In Table 3 it can be seen that the highest proportion of deaths occurred at home (n=7,729; 52.69%), followed by hospital (n=3,713; 25.32%). There was an increase in the proportion of deaths at home (APC=1.6 – 95%CI 1.2;2.0) and in other health establishments (APC=5.3 – 95%CI 2.9;7.8).

Discussion

The temporal trend of both the crude and the age-adjusted suicide mortality rate among Brazilian adolescents increased between 1997 and 2016. Different patterns were found according to sex, Brazilian macro-regions, Federative Units and places where suicide occurred.

Adolescent suicide mortality increased among males, in the 10-14 and 15-19 age groups, in the country's North and Northeast region and in the Federative Units of Alagoas, Amazonas, Bahia, Ceará, Maranhão, Mato Grosso do Sul, Minas Gerais, Pará, Paraíba, Piauí, Sergipe and Tocantins. There was an increase in the proportion of deaths at home and in health establishments other than hospitals.

An increasing trend in adolescent suicide mortality has also been found in other countries, such as the United States (1999-2016),[15] Argentina, Chile, Ecuador, Mexico and Suriname (2001-2008).[16] It is noteworthy that an increase in suicide mortality has been found in the entire Brazilian population and not just the population studied here.[4,5] Researchers suggest[17] that among other aspects this finding may be related to improved mortality records in Brazil.

Mental health problems become more prevalent during adolescence and, along with psychosocial risk factors, exacerbate vulnerability to suicide.[8] This increase can be related to academic stress, negative relationships with peers and parents,[18] negative individual and family life events, such as parental separation, psychoactive substance abuse, social isolation, mental disorders, childhood abuse, low self-esteem, low socioeconomic level and limited education.[19]

The increase in the overall trend of adolescent suicide occurred above all due to the increase of this event among male adolescents, and this was also found by another Brazilian study.[20] The trend in Brazil and other South American countries is the opposite of the global trend, as shown by a study which analyzed adolescent suicide in 81 countries between 1990 and 2009. That study also found a reduction in rates among males on all continents, except South America, where there was a significant increase in adolescent suicide.[17]

Discrepancy in suicide rates between the sexes has also been found in international and national investigations.[20,21] Although these studies show that occurrence of suicide attempts is higher among girls,[19] boys commit suicide 2.06 times more.[20] The higher suicide rate among male individuals may be due to greater propensity to alcohol abuse, choice of more lethal suicide attempt methods, greater inclination towards violence and externalizing behaviors.[21]

Another study conducted with data from 29 countries for the period between the mid 1990s and the early 2010s also identified higher suicide mortality rates among adolescents aged 15-19.[9] This age group can suffer greater academic stress, experience negative events in personal and family life and have greater psychoactive substance abuse.[18,19] However, the increasing trend of mortality among adolescents aged 10-14 demonstrates increasingly early exposure to these risk factors.

Intentional self-harm was predominant in our study,

thus ratifying the findings of a Brazilian study covering the period 2004-2014.[22] Self-inflicted injuries are a more violent method, practiced mainly by male individuals. As a consequence, intentional self-poisoning suicide records stand out, characterized as the most reversible suicide method and which, in turn, is found more frequently among the female population.[23]

Increased suicide mortality in North and Northeast Brazil has been found by other studies, both among adolescents[20] and among the general population[5] In addition, another study reaffirmed a higher proportion of suicide deaths among adolescents in the Midwest region.[20]

The Federative Units of Mato Grosso do Sul, Roraima and Amapá had higher adolescent suicide mortality rates and this was also found by another investigation.[8] One possibility for this finding lies in the fact that Mato Grosso do Sul has the second highest proportion of indigenous people among the Brazilian states. Between 2000 and 2011, 555 suicides were recorded for this group, 70% of whom were in the 15-29 age group.[24]

Correlation between suicide and the indigenous population has also been found in the state of Roraima. According to a study conducted between 2009 and 2013,[25] there were 170 suicides among indigenous people, which was higher than the number found among non-indigenous people (n=141). Standing out among those who committed suicide are indigenous people aged 15-24. However, our study did not investigate the race/skin color variable or other elements that may have influenced the findings. As such, new studies on this theme need to be conducted.

Our study identified an increasing trend in adolescent suicide in 12 Brazilian Federative Units, which is different to a study that analyzed suicide deaths between 1990 and 2015[26] and only found an increasing trend in seven Federative Units, namely: Bahia, Paraíba, Ceará, Amapá, Amazonas, Tocantins and Piauí. However, it should be noted that that study was conducted with the general population and not specifically with adolescents. It should be emphasized that the regional trends we found may be influenced by unequal income, geographical region, level of schooling, unemployment rate, economic status and mental health conditions at the regional and municipal level.[27]

Suicides predominantly occurred at home. This finding corroborates international[7] and national[8] studies, which report most suicides occurring at home owing to ease of access.

In view of the complexity of adolescent suicide, it is fundamental to implement actions capable of reducing adolescent suicide trends.[28] From this perspective, a review that analyzed literature produced over a period (2005-2015) about suicide prevention found that limiting access to lethal methods has a relevant preventive impact, principally by restricting access to analgesics and places of critical risk of suicide, such as high places from which people could throw themselves.[29] The same study also demonstrated the relevant of awareness-raising programs at school in reducing suicidal behavior, and found that pharmaceutical and non-pharmaceutical treatment were an important prevention factor.[29] Raising awareness about suicide is also fundamental for clarifying related taboos and myths that perpetuate social stigma around this condition.[2]

The following are needed in order to prevent suicide among adolescents and promote health-seeking behavior in this population: (i) investment in provision of quality mental health care, (ii) creation of suicide screening and prevention strategies in schools, (iii) development of online prevention, monitoring and support actions, and (iv) life skills training programs. These programs need to address skills of resilience, resistance to drugs, self-management and social competence.[19]

With regard to the falling trends of places where suicide occurs being recorded as unknown, it is noteworthy that suicide has been a compulsorily notifiable health condition since the publication of Ministry of Health Ordinance GM/MS No. 1271 on June 6th 2014, when attempted suicide was included on the list of conditions that municipalities must notify immediately within 24 hours.[30] This may be reflected in the improvement in suicide records.

Another aspect refers to the fact that in recent years global prevention policies have been implemented with the aim of demystifying suicidal behavior. In Brazil, however, these policies are still incipient. On the one hand efforts are being made with regard to recording/notification and encouraging prevention, but on the other hand suicidal behavior is still surrounded by stigma and prejudice and this contributes to it being underreported. All of this underlines the importance of improving suicide mortality information as well as using reliable estimates to correct data.

A limitation of this study is therefore not having carried out procedures to correct for underreporting of suicide deaths. On the other hand, it is the first study to analyze crude and age-adjusted suicide mortality among adolescents in all five Brazilian macro-regions and the country's Federative Units. Studies are scarce on this age group and further research on this theme and population are needed.

In conclusion, the trend of overall suicide rates among Brazilian adolescents between 1997 and 2016 was on the increase, as it also was in relation to males, the 10-14 and 15-19 age groups and suicides at home. Although the country's North and Northeast regions did not have the highest coefficients, they stood in terms of increasing adolescent suicide trends in the period considered.

As such, the study findings demonstrate the relevance of this theme as a Public Health problem and enable better epidemiological understanding of suicide among adolescents. This understanding is needed for the creation of intervention strategies aimed at publicizing risks, creating suicide prevention and suicide impact programs and timely treatment of mental disorders and/or disabilities arising from previous suicide attempts.

Authors' contributions

Freitas BHBM, Marcon SR and Bortolini J contributed substantially to the study concept and design. Fernandes FY, Arruda VL and Lima NVP took part in data gathering. Fernandes FY, Freitas BHBM and Gaíva MAM analyzed and interpreted the study data. Fernandes FY and Freitas BHBM drafted the preliminary versions of the manuscript. Marcon SR, Arruda VL, Lima NVP, Bortolini J and Gaíva MAM critically reviewed important intellectual content. All the authors have improved the final version of the manuscript and are responsible for all aspects thereof, in the sense of ensuring that questions related to the precision or integrity of any part of this study will be duly investigated and resolved.

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