Trends
in Psychiatry and Psychotherapy

JOURNAL ARTICLE PRE-PROOF
(as accepted)

Brief Communication

Impact of the COVID-19 pandemic on suicide mortality in Brazil: an interrupted time series analysis

Matheus Santos Melo, Thiago Alves Martins, Rivadávio Fernandes Batista de Amorim, Tainá Raiol, Caíque Jordan Nunes Ribeiro, Allan Dantas dos Santos

Impact of the COVID-19 pandemic on suicide mortality in Brazil: an interrupted time series analysis

COVID-19's Impact on Suicide Mortality in Brazil

Matheus Santos Melo[a, b, c*], Thiago Alves Martins[d], Rivadávio Fernandes Batista de Amorim[d], Tainá Raiol[c], Caíque Jordan Nunes Ribeiro[e], Allan Dantas dos Santos[e]

[a] Graduate Program in Tropical Medicine, University of Brasília, Brasília, DF, Brazil

[b] Department of Communicable Diseases, Ministry of Health, Brasília, DF, Brazil.

[c] Center for Epidemiology and Health Surveillance, Oswaldo Cruz Foundation, Rio de Janeiro, RJ, Brazil.

[d] Graduate Program in Medical Sciences, College of Medicine, University of Brasília, Brasília, DF, Brazil.

[e] Graduate Nursing Program, Department of Nursing, Federal University of Sergipe, Aracaju, SE, Brazil.

*Corresponding author: Matheus Santos Melo

E-mail: matheussmelo@live.com

Tel.: +55 79 999753192

Abstract

Background: The COVID-19 pandemic has impacted global mental health, affecting mortality from suicide. This study evaluated the impact of COVID-19 on suicide mortality in Brazil from 2000 to 2022.

Methods: Study of temporal events with data of events by suicide of the Mortality Information System (MIS). Mortality were calculated per 100,000 inhabitants. Differences before and during the pandemic were evaluated with the Wilcoxon Signed-Rank Test and Prais-Winsten regression. Interrupted Temporal Series (ITS) analysis was performed.

Results: Between 2000 and 2022, there were 243,143 cases of suicide in Brazil. During the pandemic, the median monthly mortality increased from 0.4 to 0.6 per 100,000 inhabitants, with a trend of an increase of 0.78% per month.

Limitations: Because it is an ecological study, it is not possible to have individual conclusions. Secondary data and population estimates may be inaccurate.

Conclusions: The COVID-19 pandemic has increased suicide mortality in Brazil, highlighting the need for more effective mental health policies.

Keywords: Interrupted Time Series Analysis; COVID-19; Suicide; Mental Health; Brazil.

1. Introduction

The COVID-19 pandemic has had a substantial impact on the mental health of people around the world, which can be attributed to the disturbances in emotional, psychological and social well-being caused by it.[1] Suicide deaths, in turn, are directly influenced by mental health issues, which can be exacerbated in crisis situations, such as the COVID-19 pandemic.[2]

Previous studies suggest significant heterogeneity in the temporal patterns of suicide mortality in different countries of the world during the pandemic.[3] In the USA, for example, there was a reduction in deaths by suicide during the pandemic period, with 4,100 fewer deaths than expected.[3] On the other hand, in Japan there was an increase in the number of suicides when considering the complete period of the pandemic.[3]

Given this scenario of variation in mortality patterns between different countries, and considering the fact that Brazil was one of the countries most affected by COVID-19,[4] there was a need to assess the impact of the pandemic on the suicide mortality in the national context.

Therefore, the objective of this study was to evaluate the impact of the COVID-19 pandemic on the temporal trend of the suicide mortality in Brazil, from 2000 to 2022.

2. Material and Methods

We conducted a time series and population-based study using data on deaths from suicides recorded in Brazil from 2000 to 2022.

The units of analysis were the months of occurrence of deaths. The characteristics of the deaths were obtained through the Department of Informatics of the Unified Health System. Population data, including the number of inhabitants by gender, age group, and region, were obtained from population estimates conducted by the Brazilian Institute of Geography and Statistics (IBGE) and made available by the Ministry in the report from the Department of Monitoring, Evaluation, and Dissemination of Strategic Health Information, available at: https://www.gov.br/saude/pt-br/composicao/seidigi/demas. The population for the year was used consistently for all months, without changes throughout the period.. We considered suicides as deaths in individuals aged 5 years or older, with the underlying cause recorded under codes X60-X84 and Y87.0 of the International Classification of Diseases, 10th Revision (ICD-10), as defined by the Ministry of Health of Brazil. To adjust the mortality by gender and age group, we used the proportions of suicides for each gender, dividing the number of suicides in women by the total number of women in the population. The same procedure was applied to men and different age groups. This allowed us to calculate the age- and gender-adjusted mortality for each group..[5]

The mortality was calculated per 100,000 inhabitants from the monthly number of deaths from suicides. To determine the statistical significance between the medians, we used the Wilcoxon Signed-Rank Test.[6]

In order to explore the temporal trends of suicide mortality we adopted the Prais-Winsten regression method.[7] We considered the mortality coefficient after logarithmic transformation as a dependent variable and time, in months, as an independent variable. Although the calculation of the percentage change is often applied on an annual basis in studies assessing trends, we adapted this methodology to calculate the monthly percentage change (MPC) to fit the monthly data structure in our analysis. The beta coefficients obtained in the regressions, together with their respective confidence intervals, were used to calculate the MPC.[8]

Subsequently, the Interrupted Time Series (ITS) analysis was used, which is a technique used to evaluate the effectiveness of public health interventions at the population level considering interventions with a clearly defined period.[7] In this study, the first case of COVID-19 in Brazil, which occurred on February 26,

2020, was considered as an intervention. The coefficients referring to the Level percentage change (LPC) and slope (SPC) were calculated according to the formula presented for the calculation of the MPC.

All analyses were performed using R software (version 3.3.0). P-values < 0.05 were considered statistically significant.

The study was not submitted to a Research Ethics Committee, since it exclusively used information in the public domain.

3. Results

Between 2000 and 2022, 243,143 deaths from suicides were recorded in Brazil, resulting in a median annual mortality of 5.1 deaths per 100,000 inhabitants. The median coefficient until 2019 is 4.9 deaths per 100,000 inhabitants and as of 2020, 7.3 deaths per 100,000 inhabitants.

Before the first case of COVID-19 was recorded, the median monthly suicide mortality in Brazil was 0.4 deaths per 100,000 inhabitants. During the pandemic, this median increased significantly at the level of 0.6 deaths per 100,000 inhabitants (p-value < 0.001) (**Figure 1A**). No evidence of change in the level of the monthly mortality coefficient (LPC = -1.00; p-value = 0.752) was found. However, there was a change in the slope of the estimated trend of the suicide mortality, which increased 0.78% per month (95% CI: 0.48 to 1.07%).

Figure 1B shows the values predicted by the Prais-Winsten regression, comparing them with the scenario without the pandemic (counterfactual). There was a gradual and sustained increase of 0.78% in the suicide mortality in Brazil each month, from March 2020 to December 2022.
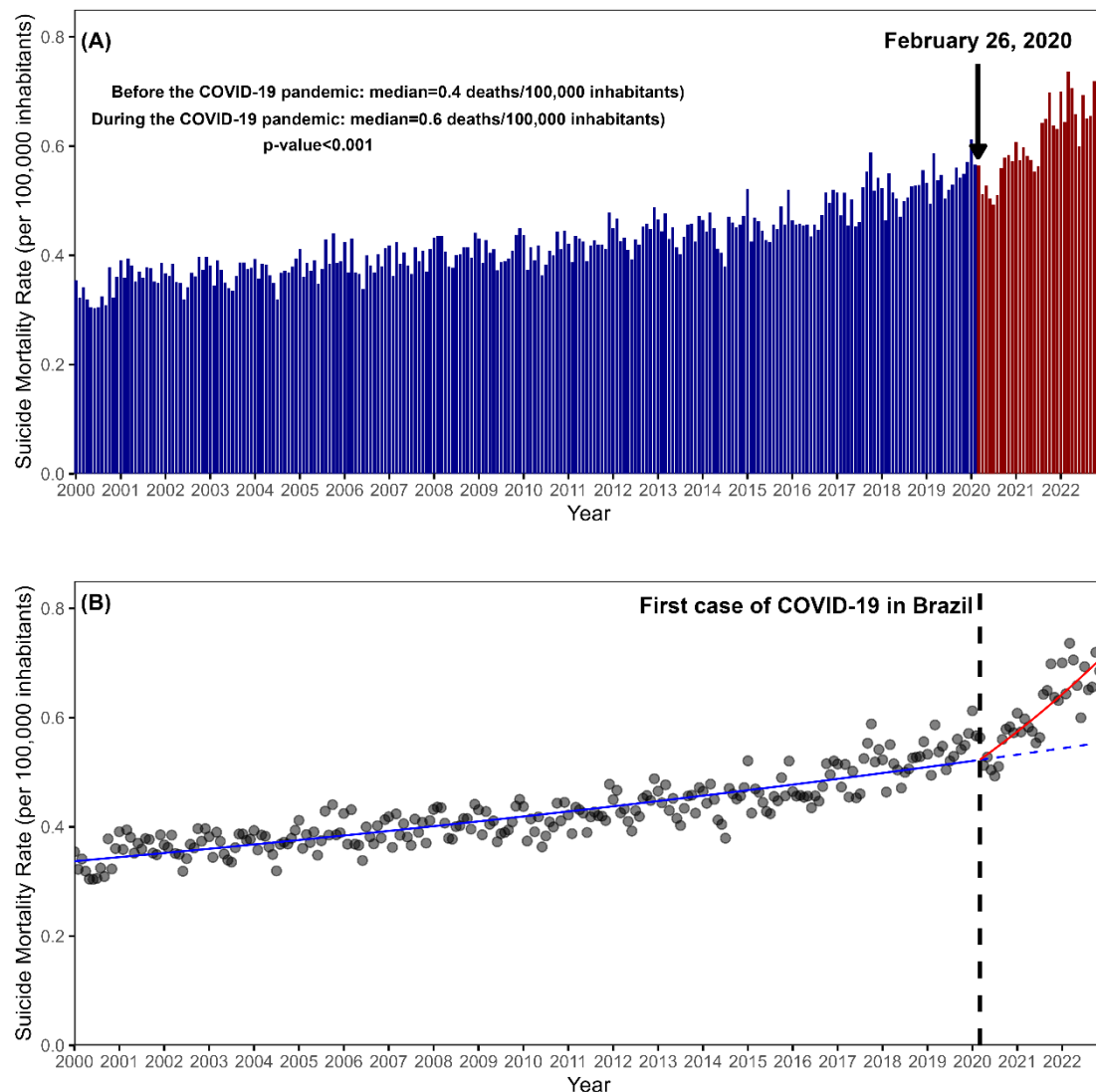
Figure 1. Interrupted time series of suicide incidence in Brazil from 2000 to 2022: (A) histogram in blue representing the monthly incidence of suicides pre-COVID-19 pandemic and in red throughout pandemic; (B) scatter plot representing the monthly incidence of suicides and lines representing the estimated trend of pre-pandemic suicide incidence (solid blue line), the pandemic counterfactual scenario (dashed line), and the estimated pandemic suicide incidence trend (red line).

p-value: Wilcoxon Signed-Rank Test

As shown in **Supplementary file**, the temporal trends observed before and during the pandemic were increasing in all groups analyzed, with the exception of mortality among individuals aged 60 years or older during the pandemic, which showed a stationary trend (MPC = 1.00; p-value = 0.273). Additionally, it is noteworthy that, for all other groups, MPC values were

statistically significant and higher than MPC values in the period prior to the COVID-19 pandemic. No evidence of an increase in the level of mortality was found in any of the groups studied. However, there was a positive change in the slope of the estimated trend of the suicide mortality in all groups studied, except for the age groups under 20 years (SPC = 0.49; 95% CI = -0.27 to 1.25; p-value = 0.210) and 60 years or more (SPC = 0.15; 95% CI = -0.27 to 0.57; p-value = 0.482).

4. Discussion

Our study showed a median annual mortality of 4.9 per 100,000 inhabitants between 2000 and 2019 in Brazil. Worldwide, the mortality was 9.0 per 100,000 inhabitants in 2019.[9] Some possible hypotheses for this lower suicide rate in Brazil in relation to the world mean would be explained by socio-cultural factors. In Brazil, the propensity for a cohesive family structure and the marked presence of Christian religions would tend to reduce the incidence of suicides. Nevertheless, it is important to note that the influence of Christianity can be complex, not always being protective in all contexts, and other socioeconomic and cultural factors may play a more significant role. In addition, the Brazilian age pyramid is predominantly young and suicide rates are higher among older populations.[9]

However, changes in suicide rates cannot be explained solely by differences in population structure, such as the distribution by gender and age group. Other factors, such as socioeconomic issues, psychological factors, and the impact of crises like the COVID-19 pandemic, play a crucial role in the variation of suicide rates, regardless of the population composition.

During the pandemic, there was an increase in the median mortality from suicide in Brazil, reaching 7.3 deaths per 100,000 inhabitants. A review by Martínes-Alés et al. demonstrated heterogeneity between several countries regarding the mortality from suicides during the pandemic.[10] With an increase in the trend in countries such as Japan, Mexico, India and Spain and a reduction in countries such as the United States, Canada, Chile and Italy.[3,11] This heterogeneity could be explained by differences in the risk of contagion and

deaths from COVID-19, in addition to the inherent socioeconomic vulnerabilities of each country.[1] The fact that Brazil was one of the countries severely impacted by COVID-19, especially in social and economic aspects, in addition to the interruption of several mental health care services, could justify the important increase in suicide mortality experienced during the pandemic.[1]

The analysis of trends throughout the pandemic revealed a complexity in the changes in suicide rates, with an initial reduction at the beginning of the pandemic, reflecting greater family cohesion and decreased access to suicide methods due to social isolation. However, as the crisis prolonged, an increase in psychological and economic problems was observed, which could have significantly contributed to the rise in suicide rates. A trend of reduction in suicide mortality in the first months of the pandemic was also demonstrated, followed by a reversal of this trend, with a significant increase in suicide mortality. The reduction in mortality at the beginning of the pandemic is in line with other studies conducted in Brazil and other countries during the early years of the pandemic, and this can be explained by factors such as increased family support and decreased access to suicide methods, with social isolation in the early stages of the pandemic. However, as the pandemic continued, there was a deepening of mental and economic problems, which may have contributed to the increase in suicide mortality..[12–15]

Regarding age groups, our results showed an increasing trend in suicide mortality rates across all age groups, except for those over 60 years old and those under 20 years old. This can largely be explained by stronger family support, which tends to be more prominent for these age groups, as well as the economic adaptability of older individuals, who may not be as affected by economic crises as the economically active adult population. Perhaps the greater family support for younger and older people could explain this difference in relation to the age group of adults, as well as the fact that the adult population is economically active, being more affected by trade restrictions during the pandemic.[1] Mental health support is especially critical during times of heightened social stress, such as the COVID-19 pandemic, when factors like isolation, economic insecurity, and uncertainties intensify psychological and emotional risks.[16]

It is imperative to consider some limitations of this study. As this research falls within the domain of ecological studies, it is not possible to draw conclusions about the individual characteristics of the population. Due to the use of secondary data sources, it is possible that there was a loss of information on the record of deaths by suicide, which could lead to an underestimation of the results presented.

It is concluded that, despite not having an immediate impact, the COVID-19 pandemic was responsible for a gradual and sustained increase in suicide mortality in Brazil. This unprecedented and relevant finding can support the direction of public policies and a better approach and management of suicide, which is a serious public health problem in Brazil and, as shown in this study, was exacerbated during the pandemic.

References

1. Sher L. The impact of the COVID-19 pandemic on suicide rates. QJM: An International Journal of Medicine. 2020 Oct 1;113(10):707–12.

2. Matsubayashi T, Sawada Y, Ueda M. Natural disasters and suicide: Evidence from Japan. Soc Sci Med. 2013 Apr;82:126–33.

3.   Pirkis J, John A, Shin S, DelPozo-Banos M, Arya V, Analuisa-Aguilar P, et al. Suicide trends in the early months of the COVID-19 pandemic: an interrupted time-series analysis of preliminary data from 21 countries. Lancet Psychiatry. 2021 Jul;8(7):579–88.

4.   Goularte JF, Serafim SD, Colombo R, Hogg B, Caldieraro MA, Rosa AR. COVID-19 and mental health in Brazil: Psychiatric symptoms in the general population. J Psychiatr Res. 2021 Jan;132:32–7.

5.   Ministério da Saúde. Panorama dos suicídios e lesões autoprovocadas no Brasil de 2010 a 2021. 2024. 1–18 p.

6.   Rosner B, Glynn RJ, Lee MT. The Wilcoxon Signed Rank Test for Paired Comparisons of Clustered Data. Biometrics. 2006 Mar 7;62(1):185–92.

7.   Bottomley C, Ooko M, Gasparrini A, Keogh R. Prais-Winsten: An evaluation of methods used to account for autocorrelation in interrupted time series. Stat Med. 2023 Apr 15;42(8):1277–88.

8.   Silva Júnior JN de B, Couto R de M, Alves LC, Silva DA da, Heráclio I de L, Pelissari DM, et al. Trends in tuberculosis incidence and mortality coefficients in Brazil, 2011–2019: analysis by inflection points. Revista Panamericana de Salud Pública. 2023 Nov 6;47:1.

9.   World Health Organization (WHO). Suicide worldwide in 2019. Global Health Estimates. 2019. 1–35 p.

10.   Martínez-Alés G, Szmulewicz A, López-Cuadrado T, Morrison CN, Keyes KM, Susser ES. Suicide Following the COVID-19 Pandemic Outbreak: Variation Across Place, Over Time, and Across Sociodemographic Groups. A Systematic Integrative Review. Curr Psychiatry Rep. 2023 Jul 25;25(7):283–300.

11.   Pirkis J, John A, Shin S, DelPozo-Banos, Arya V, Analuisa-Aguilar P, et al. Correction to Lancet Psychiatry 2021; published online April 13. https://doi.org/10.1016/S2215-0366(21)00091-2. Lancet Psychiatry. 2021 Aug;8(8):e18.

12.   Ornell F, Benzano D, Borelli WV, Narvaez JC de M, Moura HF, Passos IC, et al. Differential impact in suicide mortality during the COVID-19 pandemic in Brazil. Brazilian Journal of Psychiatry. 2022.

13.   Cabral S, Rocha T, Caetano S, Mari J, Borschmann R, Asevedo E. Decrease in suicide rates in Brazil during the COVID-19 pandemic. Psychiatry Res. 2023 Nov;329:115443.

14.   Orellana JDY, de Souza MLP. Excess suicides in Brazil: Inequalities according to age groups and regions during the COVID-19 pandemic. International Journal of Social Psychiatry. 2022 Aug 27;68(5):997–1009.

15.   Oliveira Alves FJ, Fialho E, Paiva de Araújo JA, Naslund JA, Barreto ML, Patel V, et al. The rising trends of self-harm in Brazil: an ecological analysis

of notifications, hospitalisations, and mortality between 2011 and 2022. The Lancet Regional Health - Americas. 2024 Mar;31:100691.

16. Bacchi P, Suen P, Fatori D, Razza LB, Afonso L, Klein I, Cavendish B, Moreno ML, Santos IS, Benseñor I, Lotufo P, Brunoni AR. Incidence of Suicidal Ideation in a Civil Servants Cohort During the COVID-19 Pandemic in Brazil: Insights from the ELSA-Brasil Study. Trends Psychiatry Psychother. 2024 Jan 6. doi: 10.47626/2237-6089-2023-0701. Epub ahead of print. PMID: 38183668.