# BEYOND THE VIRUS: HOW COVID-19 ACCELERATED THE SUICIDE CRISIS IN BRAZIL

# PARA ALÉM DO VÍRUS: COMO A COVID-19 ACELEROU A CRISE DE SUICÍDIOS NO BRASIL

# MÁS ALLÁ DEL VIRUS: CÓMO LA COVID-19 ACELERÓ LA CRISIS DE SUICIDIO EN BRASIL

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**ABSTRACT**

The COVID-19 pandemic significantly impacted global mental health, with a noticeable increase in suicide rates. This study analyzes the impact of the pandemic on suicides in Brazil between 2015 and 2023, using a Bayesian time series model to identify the causal relationship between the health crisis and the worsening psychological conditions of the population. The results show a substantial rise in suicide cases starting in 2020, associated with social isolation, economic difficulties, and emotional deprivation. The study highlights the importance of public policies focused on suicide prevention and strengthening social support networks, suggesting that health crises exacerbate mental health issues and require effective responses to minimize their impacts.

**Keywords:** COVID-19. Suicide. Mental Health. Impact. Brazil.

**RESUMO**

A pandemia de COVID-19 impactou significativamente a saúde mental global, com um aumento notável nos índices de suicídio. Este estudo analisa o impacto da pandemia nos suicídios no Brasil entre 2015 e 2023, utilizando um modelo bayesiano de séries temporais para identificar a relação causal entre a crise sanitária e a piora das condições psicológicas da população. Os resultados indicam um aumento substancial nos casos de suicídio a partir de 2020, associado ao isolamento social, dificuldades econômicas e privação emocional. O estudo destaca a importância de políticas públicas focadas na prevenção do suicídio e no fortalecimento das redes de apoio social, sugerindo que crises sanitárias exacerbam problemas de saúde mental e exigem respostas eficazes para minimizar seus impactos.

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**Palavras-chave:** COVID-19. Suicídio. Saúde Mental. Impacto. Brasil.

**RESUMEN**
La pandemia de COVID-19 impactó significativamente la salud mental global, con un notable aumento en las tasas de suicidio. Este estudio analiza el impacto de la pandemia en los suicidios en Brasil entre 2015 y 2023, utilizando un modelo bayesiano de series de tiempo para identificar la relación causal entre la crisis sanitaria y el empeoramiento de las condiciones psicológicas de la población. Los resultados muestran un aumento sustancial en los casos de suicidio a partir de 2020, asociado con el aislamiento social, las dificultades económicas y la privación emocional. El estudio destaca la importancia de políticas públicas centradas en la prevención del suicidio y el fortalecimiento de las redes de apoyo social, sugiriendo que las crisis sanitarias exacerban los problemas de salud mental y requieren respuestas efectivas para minimizar sus impactos.

**Palabras clave:** COVID-19. Suicidio. Salud Mental. Impacto. Brasil.

# 1 INTRODUCTION

## 1.1 SUICIDE AS A PUBLIC HEALTH PROBLEM

Suicide is a serious global public health problem, being among the main causes of preventable deaths in several countries. In addition to the alarming numbers, this tragedy deeply impacts families, communities, and society as a whole. The emotional and economic effects are particularly devastating in young and adult age groups, making prevention a key challenge for health systems.

In Brazil, suicide rates have been growing over the last few decades, reflecting not only individual factors, but also social and economic issues that contribute to psychological distress and limit access to emotional support resources. Although the Brazilian suicide rate is lower than that of countries such as Russia, South Korea, and Japan, Brazil leads Latin America in negative mental health indicators (MINISTRY OF HEALTH, 2022), highlighting the need for more effective preventive actions. The crisis has been exacerbated by the phenomenon that experts call the "second pandemic" – a silent collapse of mental health, intensified by social and economic changes post-COVID-19 pandemic (FEDERAL COUNCIL OF NURSING, 2023).

The World Health Organization (WHO) warns that suicide is responsible for about one in every 100 global deaths, surpassing fatalities from HIV, malaria, breast cancer, wars and homicides (BRASIL, 2015). In Brazil, suicides in 2023 surpassed other relevant causes of death, such as prostate cancer, AIDS, police interventions, and femicides. In addition, the numbers approached the cases of death from breast cancer, one of the diseases with the greatest impact on public health. These data reinforce the need to deepen knowledge about the factors that contribute to the increase in suicides and to support public prevention policies.

Suicide records in Brazil between 2015 and 2023 demonstrate a continuous growth trend, with a more significant increase in the critical years of the COVID-19 pandemic, suggesting a possible and alarming relationship between the pandemic context and the worsening of the population's mental health. Although the growth in suicide cases was already noticeable before the health crisis, factors such as social isolation, economic insecurity, and difficulty in accessing mental health services certainly accelerated this process. This problem, although not restricted to Brazil, acquires specific characteristics in the country, such as regional inequality and overload of the health system, making it even more crucial to monitor the rates and understand the factors that feed this devastating phenomenon.

## 1.2 THE COVID PANDEMIC AND ITS IMPACTS

The COVID-19 pandemic, officially declared by the WHO on March 11, 2020, is not only a health crisis, but an extreme event of historic proportions, which has profoundly affected global public health. The speed and severity of the spread of SARS-CoV-2 has resulted in millions of infections and deaths. By the end of 2022, the WHO estimated more than 6.5 million confirmed deaths worldwide, with the possibility that the real number was much higher due to underreporting and excess indirect mortality. Brazil, one of the most affected countries, recorded approximately 700 thousand deaths, second only to the United States. The critical peaks occurred between March and April 2021, when the Brazilian health system collapsed in several regions, facing shortages of ICU beds, oxygen, and essential medicines, a scenario of immeasurable human suffering.

The containment measures adopted to reduce the spread of the virus, such as quarantines, social distancing, and the closure of establishments, have drastically changed the population's routine. While necessary, these restrictions have had a direct and significant impact on mental health, resulting in an alarming increase in feelings of loneliness, anxiety, and depression (CAO et al., 2020; WHO, 2022). The closure of face-to-face psychological and psychiatric care services has further aggravated this situation, making it difficult for the population to access specialized support (CFP, 2020). At the same time, the global economic recession triggered by the pandemic, with the closure of companies and the increase in job insecurity, especially in the tourism, commerce, and services sectors, has further increased the risk of psychological disorders and self-injurious behaviors.

It is important to highlight that the relationship between global crises and the increase in suicide cases is not a recent phenomenon. In times of economic recession, wars, and natural disasters, there has historically been an increase in rates of psychological distress and suicides. The Great Depression of 1929 and the financial crisis of 2008, for example, were followed by significant increases in suicide rates (NEGÓCIOS, 2008). However, the COVID-19 pandemic has had a much deeper and more far-reaching impact, not only because of the economic recession but because of its multidimensional nature, simultaneously affecting the physical, mental, and economic health of billions of people around the world. The magnitude of this crisis, with its devastating effects on all aspects of human life, places it as one of the largest and most significant extreme health events of the twenty-first century.

This work, therefore, is not a simple study of a health crisis, but rather an analysis of a unique event in contemporary history, whose repercussions go far beyond public health. The COVID-19 pandemic cannot be underestimated. It is not just a health event, but a global tragedy

that has affected the lives of millions, and it is essential that the impact of this event be studied in depth to understand its causes, consequences and, above all, to identify solutions that can mitigate the devastating effects on mental health and society as a whole.

It is crucial to recognize that crises of such magnitude are not limited to the COVID-19 pandemic. Other extreme events, such as future pandemics, global economic recessions, and even environmental catastrophes, have the potential to generate similar effects, significantly increasing the risk of psychological distress and suicides. Thus, the key question of this work arises: did the COVID-19 pandemic have an impact on the number of suicides in Brazil and its regions?

The research problem is centered on quantitatively analyzing the effect of the pandemic on the number of people who took their own lives. The importance of analyzing this problem lies in understanding a possible causality between the COVID-19 pandemic and the number of suicides. The present study is based on the hypothesis that the COVID-19 pandemic exerted a significant influence on the increase in suicide numbers, both in Brazil and in its regions.

The general objective of this study is to analyze the temporal and spatial dynamics of suicide rates in Brazil and its regions from January 2015 to April 2023[4]. Specifically, it is intended to: a) analyze the dynamics of the behavior of the suicide rate in Brazil and its regions; b) to identify the possible existence of a causal link between the COVID-19 pandemic and the incidence of suicides in Brazil.

The results may highlight not only the direct influence of the pandemic on the mental health of the population, but also the urgency of adopting a comprehensive approach in the face of extreme events. It is essential to understand that, in addition to mitigating the immediate effects of the event, it is necessary to deal with the lasting psychological impacts by offering ongoing mental health support as part of a global and effective response.

Regarding the causal impacts of public health events on suicide indicators at the regional level, this research is one of the first attempts. The contribution that is intended to be brought is in the quantitative focus of the research, which until now has been little addressed by the existing literature on the subject.

The work is structured as follows: after the introduction, there is the methodology, which contains the theoretical framework, in which a link between theory and research problem is defined, the analytical framework, in which the empirical model is presented, and the data source, in which the variables used and their origin are presented.

[4] The year 2015 marks the beginning of the historical series on suicide rates in Brazil and April 2023 was chosen as the end of the study, as it marks the end of the pandemic, as declared by the World Health Organization (WHO), given the significant reduction in cases and deaths from COVID-19 in Brazil.

## 2 METHODOLOGY

### 2.1 THEORETICAL FRAMEWORK

The Theory of Social Deprivation (WEISS, 1973) lays a crucial foundation for understanding the effects of the absence of meaningful social interactions on people's emotional and psychological well-being. According to Weiss, human beings are essentially social creatures, whose mental health depends on deep and sustainable bonds. The absence of these ties not only generates discomfort, but can also cause a series of negative consequences, increasing the risk of disorders such as depression, anxiety and, in more severe cases, suicidal tendencies. Thus, the theory suggests that prolonged isolation leads to progressive deterioration of mental health, making the individual feel helpless, vulnerable, and lost in the midst of loneliness.

Weiss differentiates between two types of loneliness: emotional and social. Emotional loneliness refers to the absence of an intimate bond, such as a relationship with a partner or close friend, while social loneliness involves the absence of a wider support network, such as family members, colleagues, or neighbors. These two types of deprivation are interconnected in different ways, but both affect mental health, reinforcing feelings of exclusion and disconnection. During modern life, marked by busy schedules and a constant emphasis on productivity, many people experience both types of loneliness, as, although surrounded by people, they lack truly meaningful relationships and a sense of community.

The Theory of Social Deprivation has been widely applied to analyze the effects of isolation in different contexts. A study by Victor and Bowling (2012), in the United Kingdom, showed that older adults in long-term care facilities who did not receive regular visits had significantly higher levels of depression and anxiety compared to those who had frequent contact with family and friends. Another example comes from Haney's (2018) research, which investigated the effects of solitary confinement in prisons in the United States, revealing that prolonged isolation is associated with increased disorders such as post-traumatic stress, hallucinations, and self-injurious behavior.

During the COVID-19 pandemic, the Theory of Social Deprivation has become more relevant than ever. The need to adopt social distancing measures to contain the spread of the virus has generated a crisis of contact deprivation on a global scale. Millions of people have abruptly faced a break with their emotional support circles, whether family, friends or co-workers. The sudden deprivation of physical encounters, touch, and interpersonal closeness exposed the population to significant psychological risks. Studies have revealed increased rates

of depression, anxiety, and suicidal ideation, intensifying the perception that loneliness is not just discomfort, but a real threat to public health.

A study conducted by Meyer et al. (2021), in Germany, indicated that remote work and prolonged isolation contributed to increased feelings of social loneliness, especially among workers without a solid support network outside the work environment. These individuals reported worsening mental health, including symptoms of anxiety and depression.

Thus, Weiss's theory provides a robust framework for understanding how isolation can destabilize the human mind and provoke feelings of despair. During the pandemic, many individuals were deprived of their emotional support networks, facing deep loneliness. Those already vulnerable – such as the elderly and people living alone – were especially affected, experiencing intense emotional loneliness without being able to count on close bonds to help them face adversity. For these people, deprivation has become a triggering factor for psychological disorders and even loss of purpose and hope.

In the Brazilian context, the theory suggests that the increase in isolation during the pandemic directly affected suicide rates. The imposed isolation, combined with economic uncertainty and the absence of adequate support, created a favorable scenario for the worsening of psychological disorders. The theory highlights that the importance of human connections for the maintenance of mental health cannot be underestimated and that the psychic suffering generated by the deprivation of contact is collective, requiring support strategies that involve families, communities and government actions.

## 2.2 ANALYTICAL FRAMEWORK

To assess the impact of social isolation on suicide rates, the Bayesian structural model of time series is used, according to Brodersen et al. (2015). This model calculates a counterfactual to estimate suicide rates if the pandemic had not occurred.

### 2.2.1 Main Elements

The Bayesian structural model of time series uses two main equations to model the historical series of suicide rates and estimate the causal impact of the pandemic. The first of these is the observation equation, which relates the observed indices to the latent states of the series, allowing the model to capture the observed variability over time:

$$yt = Ztαt + \epsilon t, \epsilon t \sim N(0, \sigma 2) \qquad (01)$$

In this equation, it represents the observed suicide rate over time, while it is the vector that connects observations to the internal states of the system. The state vector represents latent variables, providing a framework that allows you to identify patterns over time. The term, which follows a normal distribution, represents the observation error, capturing possible discrepancies between the observed and predicted values, adjusting the accuracy of subsequent projections. The observation equation thus links the actual data to the latent structure of the model, absorbing the observed fluctuations in suicide rates.$y_t t Z_t \alpha_t \epsilon_t N(0, \sigma^2)$

The second main equation, the equation of state, describes how latent states evolve over time, enabling the model to capture pattern changes and respond to external shocks, such as the impact of the pandemic:$\alpha_t$

$$\alpha t + 1 = T t \alpha t + R t \eta t, \eta t \sim N(0, Q t) \quad (02)$$

In this expression, it is the transition matrix that relates the current state to the future state, essential to model the continuity of the time series. The matrix controls the influence of the error term, normally distributed as , which represents variations not directly explained by the model. This term adjusts the model to unforeseen changes or external events, such as social isolation and other restrictions imposed by the pandemic. The equation of state, therefore, allows the model to capture the internal dynamics and adapt to variations in suicide rates, reflecting possible impacts of the social and public health context.$\mathrm{T_t \alpha_t \alpha_{t+1} R_t \eta_t N(0, Q_t)}$

These two equations, when applied together, allow the Bayesian structural model of time series to accurately project counterfactual scenarios, serving as a basis for inferring the causal impact of the pandemic on suicide rates.

### 2.2.2 Model Components

The model includes specific components to capture local trends and possible seasonalities in suicide rate data. The trend is modeled by a random walk process, described by the following equations:

$$\mu_{t+1} = \mu_t + \delta_t + \eta_{\mu,t} \quad (03)$$

$$\delta_{t+1} = \delta_t + \eta_{\delta,t} \quad (04)$$

Where is the value of the trend in time and represents the slope or rate of change of the trend. These components allow the model to adjust for natural fluctuations in suicide rates over

time. Seasonality is also incorporated into the model, representing the periodic variations in suicide rates that can occur in certain months or times of the year. The inclusion of these components allows the model to provide more accurate projections over time.$\mu_t t \delta_t$

### 2.2.3 Counterfactual Estimation

To measure the impact of the pandemic, the model calculates a counterfactual estimate of suicide rates, representing what would have been expected if the pandemic had not occurred. From the date of the beginning of the pandemic, the model uses the parameters and the structure established with the historical data to project the counterfactual series. The difference between the observed values and the counterfactual projection during the pandemic period represents the causal impact. For each point in the pandemic period, the causal impact is calculated as follows:$t \Delta y_t$

$$\Delta y_t = y_{observado,t} - y_{contrafactual,t} \qquad (05)$$

where is the actual suicide rate in time, and is the value projected by the model in the absence of the pandemic. This difference makes it possible to estimate the specific impact of the pandemic on suicide rates.$y_{observado,t} t y_{contrafactual,t}$

To calculate the cumulative impact over the pandemic period, the differences are added:$\Delta y_t$

$$\text{Total impact} = \sum \Delta y_t \qquad (06)$$

The model also calculates credibility intervals for the counterfactual projection, offering a measure of the uncertainty associated with the estimate and strengthening confidence in the results.

### 2.2.4 Data Source

The data used in this research were obtained through the National Information System for Public Security, Prisons, Traceability of Weapons and Ammunition, Genetic Material, Fingerprints and Drugs (SINESP), an agency linked to the Ministry of Justice and Public Security. The time series covers the period from January 2015 to April 2023, with data organized monthly. The variable analyzed in this research is the number of suicide victims.

The year 2015 was chosen as the starting point, as it represents the oldest data available, allowing a broad and detailed analysis of trends over the years, in addition to enabling the evaluation of the impact of changes in public safety and mental health indicators. The period ends in April 2023, the month that marks the official end of the COVID-19 pandemic, according to the WHO decree, allowing the end of the analysis along with the end of the pandemic.

## 3 RESULTS AND DISCUSSIONS

### 3.1 DYNAMICS OF SUICIDES IN BRAZIL AND REGIONS

The analysis of monthly suicide records in Brazil between January 2015 and March 2023 shows a growing trend, with a significant increase from 2020 onwards.

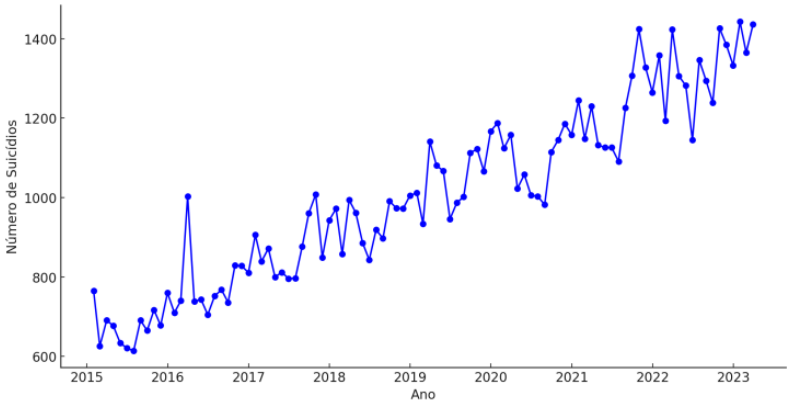
Between 2015 and 2019, the monthly average was approximately 864.55 cases, while between 2020 and 2023, this average rose to 1,224.82 cases per month, representing a growth of 41.67% in the period. This increase suggests the influence of the COVID-19 pandemic on the intensification of risk factors for suicide, such as social isolation, financial difficulties, and restrictions on access to mental health services.

The annual growth rate between 2015 and 2019 ranged between 7.76% and 15.05%, while between 2020 and 2023 the annual growth was more moderate, ranging between 7.39% and 11.43%. In terms of monthly growth, the average number of suicides increased by 41.67%, from 864.55 to 1,224.82 cases, indicating a substantial change in the number of victims over the period analyzed.

Although the analysis of the data shows an increasing trend, there is no significant volatility in records after 2020, which suggests that, after the initial peak of the health crisis, factors associated with the pandemic, such as social isolation and economic difficulties, continued to impact suicide rates almost constantly until the end of the pandemic. Figure 1 illustrates this escalation, allowing us to visualize the intensification of suicide records over the years.

**Figure 1**

*Monthly evolution of the total number of suicides in Brazil (2015-2023)*




Source: Prepared by the author based on data from the National Public Security Information System (SINESP), 2024

To identify evidence of the magnitude of the impact of the COVID-19 pandemic on suicides, Student's t-test was applied to compare the means of the pre-pandemic (2015-2019) and post-pandemic (2020-2023) periods.

The result of the test indicated a statistically significant difference between the means of suicides in these two periods. The extremely low p-value ($< 2.2 \times 10^{-16}$) and the t-statistic of -11.696 suggest that the average number of suicides in the post-pandemic period was considerably higher compared to the pre-pandemic period. The 95% confidence interval for the difference between the means was from -414.75 to -294.42, confirming the increase in suicide rates after the beginning of the pandemic (Table 2).

In addition, the results of the t-test reveal that the observed increase was not an isolated phenomenon, but rather a substantial change in suicide rates in Brazil. The impact of the pandemic seems to have created a plateau in the records, with no return to previous levels. The significant difference between the averages reinforces the hypothesis that the pandemic had a substantial and lasting effect on suicide rates.

**Table 1**

*Results of the Student's t-test for comparison of means before and after the pandemic.*

| Parameter | Value |
|---|---|
| Statistics t | -11,696 |
| Degrees of Freedom (df) | 97 |
| p-value | $< 2.2 \times 10^{-16}$ |
| 95% confidence interval | -414.75 to -294.42 |
| Average "before the pandemic" | 873,95 |
| Average "after the pandemic" | 1.228,54 |

Source: Survey results.

While the growth in the total number of suicides is evident, the regional analysis reveals significant disparities. The Southeast, as it concentrates the largest population, registers the highest absolute numbers, but, when considering the rate per 100 thousand inhabitants, the South stands out as the most affected region. In 2015, the suicide rate in the South was 8.0 per 100,000 inhabitants, while the national average was 4.7. In 2023, the rate in the South rose to 10.9, while the national average reached 6.8. The Central-West also showed a significant growth, changing from 4.6 to 9.0 per 100 thousand inhabitants in the same period. These data show that the increase in suicides does not occur homogeneously in the country, reflecting possible socioeconomic, cultural, and access to mental health services differences between regions.

**Table 3**

*Suicide rates per 100 thousand inhabitants in Brazil and regions (2015-2023)*

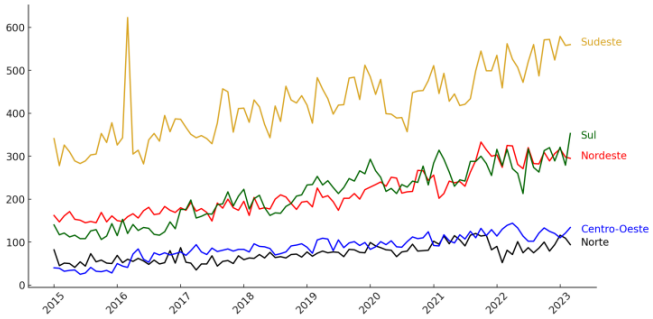
| Year | Brazil | North | Northeast | Midwest | Southeast | South |
|---|---|---|---|---|---|---|
| 2015 | 4,7 | 3,8 | 4,0 | 4,6 | 4,6 | 8,0 |
| 2016 | 5,1 | 4,0 | 4,3 | 4,9 | 5,1 | 8,6 |
| 2017 | 5,3 | 3,8 | 4,4 | 6,1 | 5,2 | 7,4 |
| 2018 | 5,5 | 4,5 | 4,1 | 6,4 | 5,7 | 7,6 |
| 2019 | 6,3 | 5,1 | 4,9 | 7,1 | 6,1 | 9,6 |
| 2020 | 6,3 | 5,5 | 5,1 | 7,3 | 5,9 | 9,6 |
| 2021 | 7,0 | 6,9 | 5,5 | 8,1 | 6,4 | 10,8 |
| 2022 | 7,5 | 6,0 | 6,2 | 8,8 | 7,1 | 11,2 |
| 2023 | 7,8 | 7,0 | 6,8 | 9,0 | 7,3 | 10,9 |

Source: Prepared by the author based on data from the National Public Security Information System (SINESP), 2024.

Figure 2 illustrates the evolution of the absolute number of suicides by region, while Table 2 details the variation in rates per 100 thousand inhabitants over the years. These differences may be associated with regional factors, such as cultural, socioeconomic, and environmental aspects. Studies suggest that in the South, the higher prevalence of diagnosed psychiatric disorders, lower exposure to sunlight, and differences in social structure may contribute to higher suicide rates.

**Figure 2**

*Monthly number of suicides by region of the country*




Source: Prepared by the author based on data from the National Public Security Information System (SINESP), 2024.

In addition, the COVID-19 pandemic has had a notable impact on suicide rates in all regions of Brazil. Table 8 shows the results of suicides by region before and during the pandemic, revealing significant increases in all areas of the country.

**Table 3**

*Annual average of suicides by region before and during the pandemic*

| Region | Before the pandemic | After the pandemic |
|---|---|---|
| North | 62,95 | 91,43 |
| Northeast | 179,68 | 270,16 |
| Midwest | 71,97 | 113,73 |
| Southeast | 384,15 | 483,00 |
| South | 175,69 | 271,03 |

Source: Survey results.

These increases are even more significant when we look at the results of the Student's t-tests to compare the means before and during the pandemic, presented in Table 5. In all regions, the p-values were extremely low, indicating that the differences in the means of suicides did not occur by chance, but reflect the profound emotional impact of the health crisis.

**Table 5**

*Student's t-test results for comparison of means before and during the pandemic by region*

| Region | Statistics t | p-value | 95% confidence interval |
|---|---|---|---|
| North | -9,3995 | $2,657 \times 10^{-15}$ | -34.49 to -22.47 |
| Northeast | -15,169 | $< 2.2 \times 10^{-16}$ | -102.32 to -78.65 |
| Midwest | -9,7025 | $5,886 \times 10^{-16}$ | -50.30 to -33.22 |
| Southeast | -7,4008 | $4,921 \times 10^{-11}$ | -125.37 to -72.34 |
| South | -10,181 | $< 2.2 \times 10^{-16}$ | -113.92 to -76.75 |

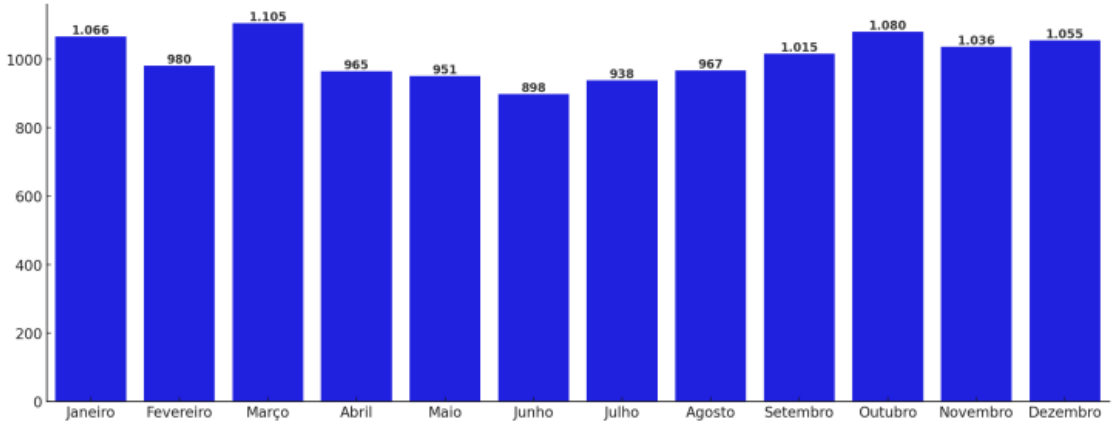
Source: Survey results.

These data indicate that the pandemic has had a significant negative impact on the mental health of the population, with a generalized increase in suicide rates, especially in regions with higher rates before the pandemic, such as the Southeast. The increase was also notable in areas with lower rates, such as the North. Factors such as social isolation, economic uncertainty, and the overload of health systems have likely exacerbated this effect, reinforcing the need for psychological and mental health support measures in times of crisis.

In addition to the regional differences, it is possible to observe, as shown in Figure 03, that over the years, some months have relatively higher numbers of suicides, such as March, September and December, while February and June register the lowest rates. However, there is no clear or consistent seasonality in the data. These monthly variations do not follow a fixed pattern and therefore cannot be attributed to specific seasonal factors.

**Figure 3**

*Monthly variations in suicide records in Brazil from 2015 to 2023*




Source: Prepared by the author based on data from the National Public Security Information System (SINESP), 2024.

Analysis by gender also reveals significant differences. Between 2015 and 2023, men accounted for the majority of cases, but the growth among women was proportionally higher.

The monthly average for men rose from 658 to 956 cases (+43%), while the female average went from 174 to 267 cases (+56%). This proportionally higher increase among women suggests that recent external factors, such as the COVID-19 pandemic, may have impacted genders differently.

Although the absolute number of suicides among men is still higher, women have shown a more significant growth in the last decade. This phenomenon may be related to changes in social roles, greater exposure to psychological stress, and difficulties in accessing mental health services.

To test this hypothesis, a t-Student's mean test was performed to compare the numbers of suicides before and after the pandemic for both genders. The result for men indicated a significant difference between the means, with a t-value of -11.257, degrees of freedom (df) equal to 97 and a p-value of less than $2.2 \times 10^{-16}$.

The averages for male suicides were 657.42 (pre-pandemic) and 956.86 (during), with a 95% confidence interval between -352.239 and -246.652. This result confirms that the difference in the means is not equal to zero, indicating that there was a significant change in the number of suicides among men during this period.

For women, the Student's t-test also showed a significant difference in the means before and after the pandemic. The t-value was -11.524, with 97 degrees of freedom and a p-value lower than $2.2 \times 10^{-16}$. The averages observed were 173.90 (pre-pandemic) and 266.68 (during), with a 95% confidence interval between -108.75 and -76.79. This result suggests a substantial difference in female suicides before and after the beginning of the pandemic, with a more significant increase compared to men. Below, we present the table with the results of the Student's t-test for the comparison of the means before and after the pandemic for males and females.

**Table 5**

*Student's t-test results for comparison of means before and during the pandemic by gender*

| Gender | Statistics t | p-value | 95% confidence interval |
|---|---|---|---|
| Men | -11,257 | $< 2.2 \times 10^{-16}$ | -352,239 to -246,652 |
| Women | -11,524 | $< 2.2 \times 10^{-16}$ | -108.75 to -76.79 |

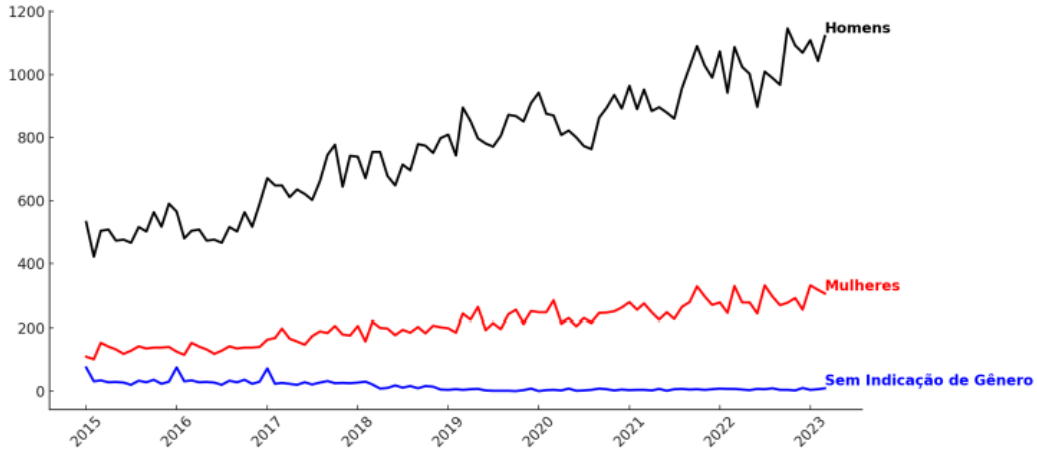
Source: Survey results.

Another relevant point is that suicide records without gender information remained low throughout the period analyzed, but from 2020 onwards there was a slight increase in these cases. This may be related to changes in the way data is collected or the rise of non-traditional gender identities in registries.

In addition to general trends, monthly fluctuations in suicide records also showed differences between genders. Among men, the months of March, July and September recorded the highest numbers of cases, while among women, the peaks occurred in December and April. These patterns may be related to distinct emotional and social factors, such as economic crises and family events, which impact each group differently.

**Figure 5**

*Monthly evolution of the number of suicides by gender (2015-2023)*




Source: Prepared by the author based on data from the National Public Security Information System (SINESP), 2024.

## 3.2 EFFECTS OF COVID-19 ON SUICIDES IN BRAZIL

The COVID-19 pandemic has had a profound and significant impact on the increase in the number of suicides in Brazil, with significant growth in rates over the past few years. When comparing the observed data with the counterfactual forecasts, which indicate what would have happened without the pandemic, the direct and causal effect of the health crisis on the mental health of the Brazilian population becomes evident, reflected in a substantial increase in suicide rates.

Before the pandemic, the monthly average of suicides was 888, but that number rose to 1,230 after the crisis began, resulting in an additional 342 suicides per month. This difference is highly significant, with a confidence interval of 95%, proving the dramatic impact of the pandemic on the mental health of Brazilians.

Between 2020 and 2023, the total number of suicides observed was 44,298, compared to a counterfactual forecast of 31,970 suicides in the same period. The cumulative increase of 12,328 additional suicides represents a 39% growth in the total number of suicides in Brazil, highlighting not only the severity of the pandemic's effect, but also the urgent need for public policies to address mental health challenges in the country.

**Table 7**

*Causal effects of the COVID-19 pandemic on suicide rates in Brazil*

| Metric | Average | Cumulative |
|---|---|---|
| Observed | 1.230 | 44.298 |
| Counterfactual | 888 (33) | 31.970 (1.176) |
| Absolute effect | 342 (33) | 12.328 (1.176) |
| Relative effect | 39% (5,1%) | 39% (5,1%) |
| p-value | 0,001 | |

Source: Survey results.

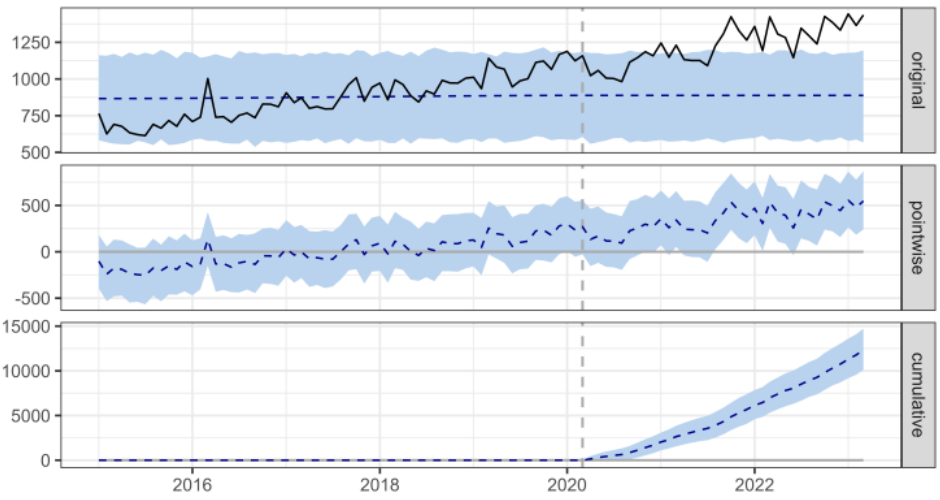
Figure 6 provides a clear and detailed representation of the significant impact of the COVID-19 pandemic on suicide rates in Brazil. The top graph, called the *original*, shows the actual data of suicides observed over time, with the black line representing the actual numbers. The middle graph, called *pointwise*, focuses on what would have happened without the pandemic, highlighting monthly predictions of the number of suicides without the effect of the crisis. The lower graph, *cumulative*, shows the accumulated difference over time between actual suicides and counterfactual predictions, allowing us to visualize the total impact of the pandemic.

From 2020, when the pandemic began, it is possible to observe a growing disparity between the two lines, showing a significant increase in suicides, especially after the beginning of the pandemic. This increase is accentuated as the months progress, with the black line showing a continuous increase in both monthly values and cumulative total, compared to the predicted rates. The difference between the actual values and the counterfactual forecasts underlines the direct and substantial impact of the pandemic on the mental health of the Brazilian population.

These graphs show the persistent and growing impact of the pandemic on suicide rates in Brazil, both in monthly and cumulative terms. The observed pattern reinforces the urgency of public policies focused on suicide prevention and care for the population's mental health.

**Figure 6**

*Counterfactual prediction and actual number of suicides in Brazil during the COVID-19 pandemic*




Source: Survey results.

Bayesian analysis revealed that the probability of the observed increase being the result of random fluctuations is extremely low. The p-value was 0.001, indicating high statistical significance, and the subsequent probability that the pandemic had a direct causal effect on the increase in suicides was 99.9%. These figures indicate that the increase in the number of suicides in Brazil is not a mere coincidence, but rather a significant consequence of the pandemic, reinforcing the hypothesis that factors related to the health crisis, such as social isolation, economic instability, and increased psychological stress, played a crucial role in this phenomenon. This is an important finding for the formulation of public policies focused on mental health in Brazil, especially during periods of crisis.

These results are in line with studies carried out in Brazil, such as those by Gunnell et al. (2020) and Tanaka & Okamoto (2021), which point out that large-scale events, such as pandemics and economic crises, have negative and long-lasting effects on the mental health of populations, significantly increasing the risk of suicides.

In the Brazilian context, the psychosocial impact of the pandemic has been particularly accentuated due to social inequality, the collapse of the health system, and economic insecurity. These factors, combined with the disruption of social support networks, are crucial elements that contributed to the increase in suicides in Brazil during the pandemic.

The Social Deprivation Theory, which suggests that social isolation and the absence of emotional support networks exacerbate mental health problems and increase vulnerability to suicidal behaviors, can be applied to the Brazilian context. During the pandemic, many people

in Brazil experienced emotional loneliness and social loneliness, both aspects of social deprivation. Emotional loneliness, referring to the absence of intimate bonds, and social loneliness, due to the lack of a broad support network, are critical factors that contribute to psychological suffering.

Weiss's Theory of Social Deprivation (1973) states that, in contexts of social deprivation, the increase in feelings of hopelessness and helplessness can be a decisive factor for the increase in suicides. The increase in isolation and the decrease in physical interactions during the pandemic may have amplified these effects, particularly in vulnerable populations in Brazil, such as the elderly, people with preexisting mental health problems, and those in situations of social vulnerability.

In Brazil, data from 2023 indicate that the number of suicides continues to be a growing problem, with more than 16,000 cases recorded this year alone. These figures put the country in an alarming situation, in line with the results of our analysis, reinforcing the need for a more robust approach to mental health care.

### 3.3 REGIONAL EFFECTS OF COVID-19 ON SUICIDES IN BRAZIL

The analysis of the impact of the COVID-19 pandemic on suicides reveals a significant increase in all five regions of Brazil, reinforcing the hypothesis that the health crisis had a direct effect on the mental health of the population. Comparing the observed data with the counterfactual forecasts, we found a significant increase in suicides in absolute and relative terms in all regions, although with variations in the magnitude of the impact.

In the North Region, monthly suicides averaged 92 cases after the beginning of the pandemic, while the counterfactual forecast was 64 cases per month. This represents an average absolute increase of 27 monthly suicides, corresponding to a growth of 42%. The cumulative impact between 2020 and 2023 resulted in 981 additional suicides, bringing the total observed to 3,296 cases. The vulnerability of the North Region may be associated with limited access to mental health services, socioeconomic difficulties, and geographic isolation, factors that may have exacerbated the impact of the pandemic on the psychological health of the population.

The Northeast Region showed an even more significant increase, with a monthly average of 271 suicides, while the counterfactual forecast was 182 cases per month. The average increase of 89 monthly suicides resulted in a relative increase of 49%. In the cumulative period between 2020 and 2023, 3,208 additional suicides were recorded, bringing the total to 9,756 cases. The region was already facing structural challenges, such as high rates of inequality and

poor access to mental health services, which may have amplified the pandemic's impact on suicides.

In the Midwest, the percentage impact was even greater, with an average increase of 41 monthly suicides, raising the average from 73 to 114 suicides per month. The relative growth was 56%, resulting in an increase of 1,464 suicides in the accumulated period, bringing the total observed to 4,107 cases. The combination of rapid urban growth, economic pressure, and limited specialized mental health services may have contributed to this substantial increase.

The Southeast Region, despite presenting the smallest percentage increase, had the greatest absolute impact in total numbers. The monthly average rose from 388 to 483 suicides per month, an absolute increase of 95 monthly suicides (+25%). In total, there were 3,410 additional suicides in the period analyzed, bringing the total number of cases to 17,392. The region, which concentrates the largest urban centers in the country, faced challenges such as increased economic instability, social isolation, and overload on health services, factors that may have contributed to this significant increase.

The South Region had one of the highest percentage impacts, with a 51% growth in suicides. The monthly average rose from 180 to 272 suicides, an absolute increase of 91 monthly suicides. In the accumulated between 2020 and 2023, there were 3,293 additional suicides, bringing the total observed to 9,777 cases. Historically, the South already had higher suicide rates than other regions of Brazil, and the pandemic may have intensified this scenario, amplifying the challenges related to mental health.

The table below summarizes the causal effects of the pandemic on suicides in each region, presenting the observed values, counterfactual predictions, and absolute and relative effects.

**Table 8**

*Causal effects of the COVID-19 pandemic on suicide rates by region*

| Region | Observed Average | Counterfactual Average | Relative Effect |
|---|---|---|---|
| North | 92 | 64 | +42% |
| Northeast | 271 | 182 | +49% |
| Midwest | 114 | 73 | +56% |
| Southeast | 483 | 388 | +25% |
| South | 272 | 180 | +51% |

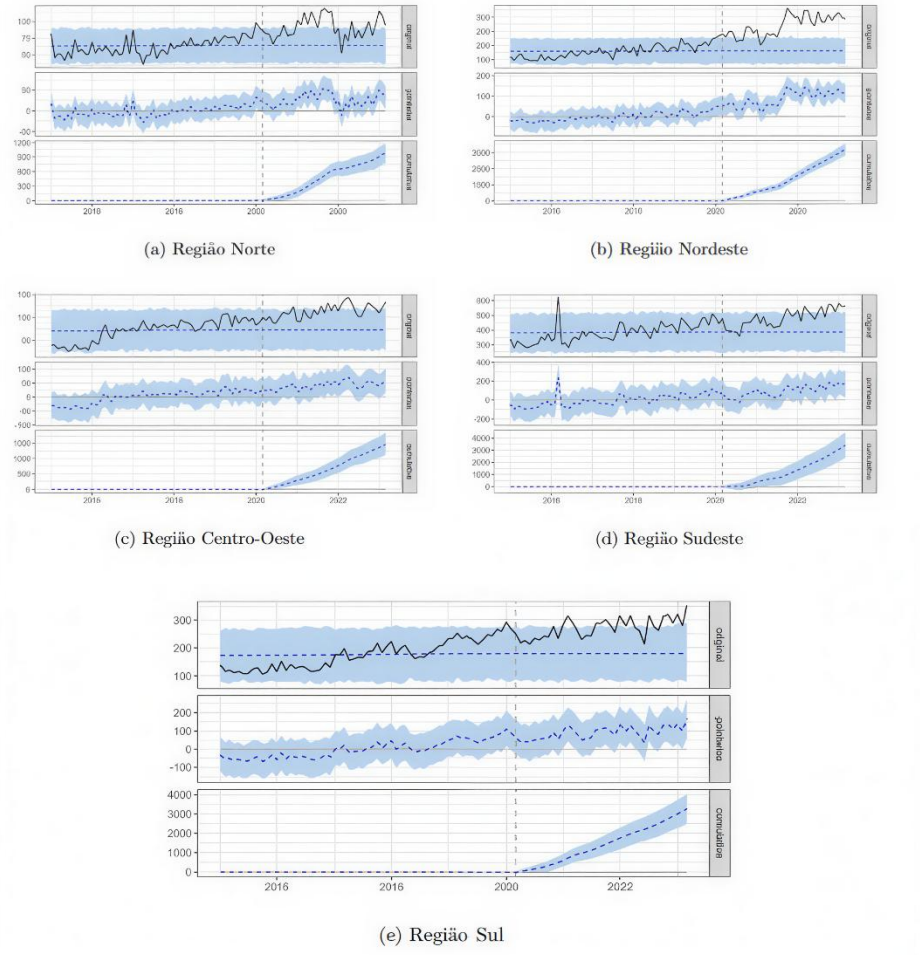
Source: Survey results.

Figure 7 illustrates the evolution of suicide rates in the various regions of Brazil between 2015 and 2023, highlighting the significant impact of the COVID-19 pandemic. The graph compares the observed values with counterfactual forecasts, revealing a significant growth in

suicides in all regions of the country after the beginning of the pandemic. The growing disparity between actual data and counterfactual estimates underlines the profound and widespread effect of the health crisis on the mental health of the Brazilian population.

**Figure 7**

*Causal effect of the COVID-19 pandemic on the number of suicides by region in Brazil*




(a) Região Norte

(b) Regiio Nordeste

(c) Região Centro-Oeste

(d) Região Sudeste

(e) Região Sul

Source: Survey Results.

## 4 CONCLUSIONS

The present research aimed to analyze the impact of the COVID-19 pandemic on suicide rates in Brazil, considering both the general effects and regional variations in the period from 2020 to 2023. From a robust statistical analysis, based on counterfactual predictions, it was possible to demonstrate that the pandemic generated a significant increase in the number of suicides. The findings reinforce the hypothesis that factors such as social isolation, economic instability, and increased psychological stress severely affected the mental health of the Brazilian population.

The quantitative analysis revealed a substantial increase in suicides throughout Brazil, with an average growth of 39% compared to what was expected without the pandemic. This impact was observed both at the national and regional levels, with some areas experiencing more significant variations. The Midwest region, for example, showed the highest relative growth, with a 57% increase in suicides, while the Southeast region, although it registered the highest absolute number of cases, had a proportionally smaller growth. These regional disparities highlight the influence of local factors, such as access to mental health services, socioeconomic inequalities, and available social support.

In addition to the global and regional impact, the study identified relevant seasonal patterns in the distribution of suicides throughout the year. The analysis showed that certain months, such as March, September and December, had higher incidences, while February and June recorded the lowest numbers. The identification of these seasonal variations allows the formulation of more effective public policies, such as the reinforcement of awareness campaigns and the expansion of psychological support in periods of higher incidence. Measures such as strengthening social support networks and targeted preventive strategies can contribute significantly to reducing cases in the most critical months.

Despite the contributions of the research, some limitations must be acknowledged. The use of secondary data may be subject to inaccuracies or underreporting, especially in more remote regions, which may have affected the accuracy of the estimates. In addition, the analysis did not include variables such as comorbidities or the impact of specific public policies adopted during the pandemic, which could provide a more complete picture of the factors that influenced suicides in the period analyzed. Future research can address these gaps by incorporating more detailed variables and a more in-depth longitudinal approach.

One detail cannot be forgotten, in psychology we cannot speak of causality in the economic/statistical sense. Although the method identifies causal relationships, it is not possible to state in a peremptory way that the pandemic alone causes suicide. However, there is evidence of influence.

The study also paves the way for further investigations into the impact of global crises on mental health, especially in contexts such as Brazil, where social inequalities amplify the negative effects of these crises. Future studies could explore in more detail the relationship between social vulnerability and the increase in suicides during the pandemic, as well as evaluate the effectiveness of psychological support programs implemented during these periods. Understanding these gaps will allow the development of more assertive and effective policies to cope with suicide, both in times of normality and in times of crisis.

Finally, it is necessary for the Brazilian authorities to implement effective psychological support programs, especially for populations in vulnerable situations. The pandemic has highlighted gaps in mental health support that need to be addressed in the long term. The significant increase in suicides reinforces the need to rebuild social support networks and expand public policies aimed at mental health. Only with concrete and continuous actions will it be possible to mitigate the impacts of future crises and ensure the psychological well-being of the Brazilian population.

## REFERENCES


BBC Brasil. (2015). Suicídio entre jovens cresce no Brasil, mas especialistas alertam para prevenção. https://www.bbc.com/portuguese/noticias/2015/09/150922_suicidio_jovens_fd

Brodersen, K. H., et al. (2015). Inferring causal impact using Bayesian structural time-series models. The Annals of Applied Statistics, 9(1), 247–274.

Cao, W., et al. (2020). The psychological impact of the COVID-19 epidemic on college students in China. Psychiatry Research, 287, 112934. https://doi.org/10.1016/j.psychres.2020.112934

Conselho Federal de Enfermagem. (2023). Brasil enfrenta uma segunda pandemia, agora na saúde mental.

Gunnell, D., et al. (2020). Suicide risk and prevention during the COVID-19 pandemic. The Lancet Psychiatry, 7(6), 468–471.

Haney, C. (2018). The psychological impact of incarceration: Implications for post-prison adjustment. National Institute of Justice.

Meyer, B., et al. (2021). Employee psychological well-being during the COVID-19 pandemic in Germany: A longitudinal study of demands, resources, and exhaustion. International Journal of Psychology.

Ministério da Saúde. (2022). Na América Latina, Brasil é o país com maior prevalência de depressão. https://www.gov.br/saude/pt-br/assuntos/noticias/2022/setembro/na-america-latina-brasil-e-o-pais-com-maior-prevalencia-depressao

Globo Economia e Negócios. (2008). Como em 1929, a crise econômica pode aumentar o número de suicídios. https://g1.globo.com/Noticias/Economia_Negocios/0,,MUL935158-9356,00-COMO+EM+A+CRISE+ECONOMICA+PODE+AUMENTAR+O+NUMERO+DE+SUICIDIOS.html

Conselho Federal de Psicologia. (2020). A saúde mental e o cuidado psicológico durante a pandemia de COVID-19. https://www.cfp.org.br/

Organização Mundial da Saúde. (2022). COVID-19 pandemic triggers 25% increase in prevalence of anxiety and depression worldwide. https://www.who.int/news/item/02-03-

2022-covid-19-pandemic-triggers-25%25-increase-in-prevalence-of-anxiety-and-depression-worldwide

Tanaka, T., & Okamoto, S. (2021). Increase in suicide following an initial decline during the COVID-19 pandemic in Japan. Nature Human Behaviour, 5(2), 229–238.

Victor, C. R., & Bowling, A. (2012). A longitudinal analysis of loneliness among older people in Great Britain. The Journal of Psychology: Interdisciplinary and Applied.

Weiss, R. S. (1973). Loneliness: The experience of emotional and social isolation. MIT Press.