Introduction

Suicide is a serious public health problem and one of the leading causes of death worldwide. According to the World Health Organization (WHO), close to 800,000 people die by suicide every year, resulting in a global average rate of 10.6 per 100,000 individuals, which is projected to increase in the next decades. In Brazil alone, approximately 10,000 individuals die by suicide per year, resulting in a crude suicide rate of 5.5 per 100,000 in 2015. In an attempt to counter these disheartening projections, Brazil and other countries, guided by the latest WHO Mental Health Action Plan, have been working toward a 10% reduction in their suicide rates by 2020 (considering 2012-year or 2013-year suicide rates as baseline).

With a population of more than 200 million, Brazil is the fifth largest country in the world and the eighth richest by Gross Domestic Product (GDP). Furthermore, it also has one of the world’s highest levels of social and income inequality, which has a direct impact on population health and on causes of death such as suicide.

It is known that suicide is a complex and multifactorial phenomenon that involves sociocultural, economic, psychological, biological, and environmental issues. Therefore, regional variations in suicide rates in a large, heterogeneous, developing country like Brazil are to be expected.

In such settings, time-series ecological studies can be an important epidemiological tool for formulating regional explanatory hypotheses and indirectly evaluating the effectiveness of public policies, as they allow forecasting and provide information on the distribution of events.

Within this context, the aims of our study were to analyze time trends of suicide rates in Brazil overall and in individual states from 1997 to 2015 and to compare projected suicide rates for 2020 with the WHO Mental Health Action Plan target.

Methods

This ecological study was an analysis of the time trend in suicide rates in Brazil as a whole and in Brazilian states from 1997 to 2015, stratified by sex and by age groups (15-29 years, 30-39 years, 40-59 years, and 60 years and older). In total, 224 units of analysis were studied.

All data were obtained from official secondary sources. The number of suicides was obtained from the Mortality Information System (Sistema de Informações sobre Mortalidade [SIM]) database, maintained by the Brazilian Ministry of Health. The population of each state was obtained from the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística).
Suicide rates in Brazil, 1997-2015

Results

According to official data, from 1997 to 2015, 164,276 suicides occurred in people aged 15 years and over in Brazil. Men accounted for 79.3% of total deaths. Considering the age groups analyzed, 32.4% of deaths occurred among people aged 40-59, 30.7% among people aged 15-29, 21.6% among people aged 30-39, and 15.3% among people aged 60 years and over.

The mean rates in men ranged from 0.89 (Acre, age ≥ 60 years) to 6.54 per 100,000 population (Rio Grande do Sul, age ≥ 60), while in men, they ranged from 3.78 (Rio de Janeiro, age 15-29) to 37.45 per 100,000 (Rio Grande do Sul, age ≥ 60).

The mean rates were higher in men than women in all age groups and throughout the country (Tables 1 to 4). Except in men aged 15-29 in the states of Maranhão, Paraíba, Bahia, and Rio de Janeiro, the mean suicide rate in male surpassed 5.00 per 100,000.

A comparison between projected suicide rates for 2020 versus the WHO Mental Health Action Plan target is presented in Tables 5 and 6. Of the 224 units of analysis, 67% will not meet the WHO target by 2020. Considering only the 21 units of analysis that showed a decreasing trend, 14 will still not meet the WHO target by 2020.

Discussion

Our ecological study showed three main results. First, 90.6% of units of analysis had a stable or increasing trend in suicide rates from 1997 to 2015; if these trends are maintained, 67% of the 224 units of analysis will not achieve a 10% reduction in suicide rates by 2020 as recommended by WHO. Second, there was great variability in mean suicide rate among the Brazilian states. In general, the highest mean suicide rate was found among people aged 60 years and older. However, approximately 85% of suicides occurred in the young and adult population (15-59 years). Furthermore, mean suicide rates in men were always higher than in women, regardless of age group or state of Brazil.

The Brazilian mental health system was reorganized by a psychiatric reform that began in 1978. Since then, mental health care network services have been expanded to provide assistance in the community and to avoid hospitalization. However, only a small part of these services received training for suicide management. Only since 2006 has suicide been recognized as a priority challenge for public health in the country. In 2017, the Brazilian Ministry of Health, rectifying this concern, designed the 2017-2020 Strategic Action Agenda for Suicide Surveillance and Prevention and Health Promotion in Brazil (Agenda de Ações Estratégicas para a Vigilância e Prevenção do Suicídio e Promoção da Saúde no Brasil 2017-2020), based on the WHO Mental Health Action Plan. This document establishes a series of actions to improve the quality of health promotion, suicide surveillance, suicide prevention, and care to victims of attempted suicide and their relatives. Considering the projections of our study, it is essential that these strategies be quickly and effectively implemented throughout Brazil, with special emphasis on vulnerable groups and those with high suicide concentrations.

The variability in suicide rates and trends in Brazilian states evidenced by our study was expected, and had already been observed in previous investigations in the country. The literature has also shown heterogeneity in these rates within the country, which have been explained by cultural, environmental, and socioeconomic differences. It is worth noting that Brazil has one of the world’s largest GDPs and one of the highest rates of social and income inequality. In addition, its vast territory, populated by several ethnic groups and cultures from various parts of the world, account for this heterogeneous scenario.

Regardless of the Brazilian state analyzed, our findings have reinforced the magnitude of suicide in men and older adults. According to the WHO, men from richer countries are three times as likely to die by suicide than women, while the male-to-female ratio of suicide deaths in
Table 1 Trends in suicide rates among people aged 15-29, stratified by sex (Brazil, 1997 to 2015)

| Region          | Female |               |          | Male |               |          |
|-----------------|--------|---------------|----------|------|---------------|----------|
|                 | Mean*  | \(\beta_x\)  | \(R^2\)  | p-value | Trend        | Mean*    | \(\beta_x\)  | \(R^2\)  | p-value | Trend        |
| Brazil          | 2.22   | 0.01          | 0.25     | 0.029 | Increasing   | 8.23     | 0.09          | 0.74     | < 0.001 | Increasing   |
| North           |        |               |          |       |              |          |              |          |          |              |
| Acre            | 2.89   | 0.00          | 0.00     | 0.056 | Stable       | 11.17    | 0.56          | 0.55     | 0.002 | Increasing   |
| Amazonas        | 3.53   | 0.16          | 0.34     | 0.037 | Increasing   | 14.55    | 0.10          | 0.01     | 0.061 | Stable       |
| Pará            | 2.47   | 0.12          | 0.54     | 0.002 | Increasing   | 11.93    | 0.68          | 0.88     | < 0.001 | Increasing   |
| Roraima         | 3.12   | -0.09         | 0.37     | 0.025 | Decreasing   | 5.39     | 0.14          | 0.45     | 0.008 | Increasing   |
| Tocantins       | 5.68   | -0.03         | 0.00     | 0.799 | Stable       | 20.06    | 0.06          | 0.00     | 0.841 | Stable       |
| Northeast       |        |               |          |       |              |          |              |          |          |              |
| Alagoas         | 1.93   | 0.05          | 0.24     | 0.03  | Increasing   | 6.16     | 0.06          | 0.03     | 0.500 | Stable       |
| Bahia           | 1.10   | 0.03          | 0.31     | 0.014 | Increasing   | 3.88     | 0.19          | 0.72     | < 0.001 | Increasing   |
| Ceará           | 2.67   | 0.09          | 0.68     | < 0.001 | Increasing | 10.69    | 0.18          | 0.64     | < 0.001 | Increasing   |
| Maranhão        | 1.56   | 0.04          | 0.21     | 0.050 | Increasing   | 4.98     | 0.39          | 0.84     | < 0.001 | Increasing   |
| Paraíba         | 1.71   | 0.12          | 0.39     | 0.005 | Increasing   | 4.86     | 0.30          | 0.76     | < 0.001 | Increasing   |
| Pernambuco      | 2.32   | -0.04         | 0.44     | 0.010 | Decreasing   | 6.35     | -0.05         | 0.13     | 0.129 | Stable       |
| Piauí           | 3.37   | 0.19          | 0.71     | < 0.001 | Increasing | 9.85     | 0.56          | 0.83     | < 0.001 | Increasing   |
| Rio Grande do Norte | 1.83 | -0.03         | 0.08     | 0.231 | Stable       | 6.49     | 0.13          | 0.48     | 0.006 | Increasing   |
| Sergipe         | 2.92   | 0.12          | 0.46     | 0.007 | Increasing   | 7.28     | 0.32          | 0.64     | < 0.001 | Increasing   |
| Center-West     |        |               |          |       |              |          |              |          |          |              |
| Distrito Federal | 2.50  | -0.00         | 0.00     | 0.881 | Stable       | 9.23     | -0.13         | 0.12     | 0.154 | Stable       |
| Mato Grosso     | 3.27   | -0.11         | 0.48     | 0.005 | Decreasing   | 9.68     | 0.05          | 0.02     | 0.554 | Stable       |
| Mato Grosso do Sul | 5.44 | 0.04          | 0.03     | 0.461 | Stable       | 17.29    | 0.39          | 0.53     | 0.002 | Increasing   |
| Goiás           | 2.89   | -0.03         | 0.12     | 0.152 | Stable       | 10.94    | 0.05          | 0.03     | 0.459 | Stable       |
| Southeast       |        |               |          |       |              |          |              |          |          |              |
| Espírito Santo  | 1.76   | 0.05          | 0.21     | 0.051 | Stable       | 6.34     | -0.12         | 0.14     | 0.109 | Stable       |
| Minas Gerais    | 2.22   | 0.05          | 0.35     | 0.022 | Increasing   | 8.64     | 0.17          | 0.61     | < 0.001 | Increasing   |
| Rio de Janeiro  | 1.34   | 0.01          | 0.01     | 0.700 | Stable       | 3.78     | 0.00          | 0.00     | 0.893 | Stable       |
| São Paulo       | 1.88   | 0.02          | 0.45     | 0.009 | Increasing   | 8.35     | 0.01          | 0.38     | 0.023 | Increasing   |
| South           |        |               |          |       |              |          |              |          |          |              |
| Paraná          | 3.08   | -0.07         | 0.35     | 0.008 | Decreasing   | 11.56    | -0.17         | 0.51     | 0.001 | Decreasing   |
| Santa Catarina  | 2.71   | -0.01         | 0.01     | 0.619 | Stable       | 11.11    | 0.02          | 0.01     | 0.655 | Stable       |
| Rio Grande do Sul | 3.37 | -0.07         | 0.43     | 0.011 | Decreasing   | 14.27    | -0.18         | 0.44     | 0.009 | Decreasing   |

* Mean per 100,000 population from 1997 to 2015.
† Annual increase per 100,000 population.
Table 2  Trends in suicide rates among people aged 30-39, stratified by sex (Brazil, 1997 to 2015)

| Region       | Female | Male |
|--------------|--------|------|
|              | Mean*  | β±   | R^2 | p-value | Trend  | Mean*  | β±   | R^2 | p-value | Trend  |
| Brazil       | 2.55   | 0.03 | 0.46 | 0.002    | Increasing | 11.16  | 0.09 | 0.74 | < 0.001 | Increasing |
| North        |        |      |     |          |         |        |      |     |          |         |
| Acre         | 3.61   | 0.03 | 0.00 | 0.806    | Stable   | 12.15  | 0.37 | 0.14 | 0.118   | Stable  |
| Amapá        | 1.36   | 0.00 | 0.00 | 0.990    | Stable   | 10.71  | 0.25 | 0.31 | 0.049   | Increasing |
| Amazonas     | 1.38   | 0.13 | 0.39 | 0.004    | Increasing | 8.72   | 0.40 | 0.79 | < 0.001 | Increasing |
| Pará         | 1.53   | 0.01 | 0.01 | 0.754    | Stable   | 5.67   | 0.14 | 0.39 | 0.019   | Increasing |
| Rondônia     | 2.82   | 0.17 | 0.26 | 0.025    | Increasing | 9.90   | 0.18 | 0.07 | 0.282   | Stable  |
| Roraima      | 4.18   | 0.16 | 0.06 | 0.307    | Stable   | 13.81  | -0.30 | 0.06 | 0.333   | Stable  |
| Tocantins    | 2.96   | 0.11 | 0.08 | 0.236    | Stable   | 10.49  | 0.70 | 0.67 | < 0.001 | Increasing |
| Northeast    |        |      |     |          |         |        |      |     |          |         |
| Alagoas      | 1.68   | 0.03 | 0.06 | 0.324    | Stable   | 7.21   | 0.07 | 0.04 | 0.435   | Stable  |
| Bahia        | 1.19   | 0.04 | 0.26 | 0.027    | Increasing | 5.60   | 0.25 | 0.65 | < 0.001 | Increasing |
| Ceará        | 2.91   | 0.01 | 0.01 | 0.723    | Stable   | 14.74  | 0.24 | 0.63 | < 0.001 | Increasing |
| Maranhão     | 1.65   | 0.05 | 0.12 | 0.146    | Stable   | 5.90   | 0.38 | 0.86 | < 0.001 | Increasing |
| Paraíba      | 1.69   | 0.07 | 0.33 | 0.042    | Increasing | 8.22   | 0.47 | 0.68 | < 0.001 | Increasing |
| Pernambuco   | 2.07   | -0.03 | 0.05 | 0.336    | Stable   | 8.02   | -0.12 | 0.15 | 0.096   | Stable  |
| Piauí        | 3.18   | 0.18 | 0.56 | 0.002    | Increasing | 12.53  | 0.72 | 0.66 | < 0.001 | Increasing |
| Rio Grande do Norte | 2.20 | 0.03 | 0.03 | 0.468    | Stable   | 10.72  | 0.04 | 0.01 | 0.686   | Stable  |
| Sergipe      | 2.59   | 0.06 | 0.40 | 0.017    | Increasing | 10.94  | 0.34 | 0.27 | 0.022   | Increasing |
| Center-West  |        |      |     |          |         |        |      |     |          |         |
| Distrito Federal | 2.28 | 0.02 | 0.02 | 0.532    | Stable   | 10.37  | -0.03 | 0.00 | 0.777   | Stable  |
| Mato Grosso  | 3.44   | -0.12 | 0.16 | 0.085    | Stable   | 11.90  | -0.07 | 0.03 | 0.464   | Stable  |
| Mato Grosso do Sul | 4.10 | 0.09 | 0.23 | 0.040    | Increasing | 15.49  | 0.29 | 0.23 | 0.040   | Increasing |
| Goiás        | 3.53   | -0.01 | 0.00 | 0.831    | Stable   | 12.90  | -0.01 | 0.00 | 0.933   | Stable  |
| Southeast    |        |      |     |          |         |        |      |     |          |         |
| Espírito Santo | 2.70 | 0.14 | 0.58 | 0.001    | Increasing | 9.46   | -0.04 | 0.04 | 0.397   | Stable  |
| Minas Gerais | 3.12   | 0.07 | 0.52 | 0.003    | Increasing | 11.91  | 0.30 | 0.77 | < 0.001 | Increasing |
| Rio de Janeiro | 1.84 | 0.00 | 0.00 | 0.822    | Stable   | 5.40   | 0.02 | 0.61 | 0.001   | Increasing |
| São Paulo    | 2.33   | 0.03 | 0.57 | 0.001    | Increasing | 10.87  | 0.11 | 0.70 | < 0.001 | Increasing |
| South        |        |      |     |          |         |        |      |     |          |         |
| Paraná       | 3.44   | -0.03 | 0.03 | 0.469    | Stable   | 13.57  | -0.20 | 0.47 | 0.001   | Decreasing |
| Santa Catarina | 3.81 | 0.15 | 0.60 | 0.001    | Increasing | 15.39  | -0.28 | 0.56 | 0.001   | Decreasing |
| Rio Grande do Sul | 4.22 | 0.03 | 0.09 | 0.226    | Stable   | 19.38  | -0.21 | 0.36 | 0.007   | Decreasing |

* Mean per 100,000 population from 1997 to 2015.
† Annual increase per 100,000 population.
### Table 3 Trends in suicide rates among people aged 40-59, stratified by sex (Brazil, 1997 to 2015)

| Region              | Female |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|---------------------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                     | Mean*  | β^1   | R^2   | p-value| Trend  | Mean*  | β^1   | R^2   | p-value| Trend  |
| Brazil              | 3.03   | 0.05  | 0.70  | < 0.001| Increasing | 11.68 | 0.04  | 0.36  | 0.030 | Increasing |
| North               |        |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Acre                | 1.72   | 0.00  | 0.00  | 0.956 | Stable | 8.81   | 0.35  | 0.18  | 0.073 | Stable |
| Amapá               | 2.08   | 0.03  | 0.01  | 0.753 | Stable | 9.51   | -0.25 | 0.08  | 0.231 | Stable |
| Amazonas            | 1.40   | 0.09  | 0.53  | 0.002 | Increasing | 6.73   | 0.11  | 0.17  | 0.078 | Stable |
| Pará                | 1.39   | -0.03 | 0.16  | 0.088 | Stable | 5.45   | 0.08  | 0.17  | 0.084 | Stable |
| Rondônia            | 3.01   | -0.03 | 0.02  | 0.566 | Stable | 9.69   | -0.09 | 0.02  | 0.533 | Stable |
| Roraima             | 2.12   | 0.03  | 0.00  | 0.824 | Stable | 12.24  | -0.00 | 0.00  | 0.996 | Stable |
| Tocantins           | 3.62   | 0.10  | 0.33  | 0.04  | Increasing | 11.83  | 0.28  | 0.37  | 0.024 | Increasing |
| Northeast           |        |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Alagoas             | 1.79   | 0.05  | 0.34  | 0.037 | Increasing | 7.90   | 0.14  | 0.16  | 0.085 | Stable |
| Bahia               | 1.39   | 0.06  | 0.44  | 0.002 | Increasing | 6.69   | 0.25  | 0.85  | < 0.001 | Increasing |
| Ceará               | 2.47   | 0.04  | 0.07  | 0.265 | Stable | 14.46  | 0.32  | 0.52  | 0.003 | Increasing |
| Maranhão            | 1.47   | 0.09  | 0.65  | < 0.001 | Increasing | 5.94   | 0.29  | 0.71  | < 0.001 | Increasing |
| Paraíba             | 2.11   | 0.13  | 0.50  | 0.004 | Increasing | 8.44   | 0.52  | 0.76  | < 0.001 | Increasing |
| Pernambuco          | 2.40   | 0.01  | 0.02  | 0.604 | Stable | 9.17   | -0.11 | 0.22  | 0.041 | Decreasing |
| Piauí               | 3.48   | 0.18  | 0.51  | 0.001 | Increasing | 12.83  | 0.82  | 0.80  | < 0.001 | Increasing |
| Rio Grande do Norte | 2.48   | 0.02  | 0.01  | 0.706 | Stable | 11.88  | 0.26  | 0.35  | 0.030 | Increasing |
| Sergipe             | 2.96   | 0.09  | 0.15  | 0.106 | Stable | 10.39  | 0.38  | 0.58  | 0.001 | Increasing |
| Center-West         |        |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Distrito Federal    | 3.56   | 0.06  | 0.07  | 0.271 | Stable | 9.45   | 0.09  | 0.07  | 0.269 | Stable |
| Mato Grosso         | 3.46   | 0.02  | 0.01  | 0.750 | Stable | 12.82  | -0.21 | 0.17  | 0.086 | Stable |
| Mato Grosso do Sul  | 3.42   | -0.05 | 0.10  | 0.181 | Stable | 14.25  | 0.08  | 0.03  | 0.459 | Stable |
| Goiás               | 3.88   | 0.04  | 0.08  | 0.250 | Stable | 13.85  | -0.10 | 0.05  | 0.378 | Stable |
| Southeast           |        |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Espírito Santo      | 3.62   | 0.15  | 0.50  | 0.004 | Increasing | 10.67  | 0.05  | 0.05  | 0.378 | Stable |
| Minas Gerais        | 3.46   | 0.17  | 0.81  | < 0.001 | Increasing | 12.17  | 0.38  | 0.79  | < 0.001 | Increasing |
| Rio de Janeiro      | 2.08   | 0.01  | 0.03  | 0.513 | Stable | 6.09   | 0.03  | 0.03  | 0.484 | Stable |
| São Paulo           | 2.84   | 0.03  | 0.19  | 0.066 | Stable | 10.25  | -0.05 | 0.65  | < 0.001 | Decreasing |
| South               |        |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Paraná              | 3.56   | -0.01 | 0.01  | 0.751 | Stable | 14.76  | -0.24 | 0.73  | < 0.001 | Decreasing |
| Santa Catarina      | 5.38   | 0.13  | 0.45  | 0.008 | Increasing | 21.24  | -0.26 | 0.58  | 0.001 | Decreasing |
| Rio Grande do Sul   | 5.94   | 0.03  | 0.31  | 0.049 | Increasing | 26.34  | -0.35 | 0.61  | < 0.001 | Decreasing |

* Mean per 100,000 population from 1997 to 2015.

† Annual increase per 100,000 population.
| Region            | Female | Male |
|-------------------|--------|------|
| **Mean**^a        | **β_{x}**  | **R²** | **p-value** | **Trend** | **Mean** | **β_{x}**  | **R²** | **p-value** | **Trend** |
| Brazil            | 2.57   | 0.02  | 0.30         | 0.015     | Increasing | 13.84   | 0.03  | 0.07         | 0.285     | Stable   |
| North             |        |       |              |           |           |         |       |              |           |          |
| Acre              | 0.89   | -0.01 | 0.00         | 0.897     | Stable    | 8.86    | 0.22  | 0.04         | 0.424     | Stable   |
| Amapá             | 1.46   | -0.18 | 0.08         | 0.234     | Stable    | 10.44   | 0.28  | 0.02         | 0.572     | Stable   |
| Amazonas          | 1.18   | 0.06  | 0.16         | 0.091     | Stable    | 6.77    | 0.20  | 0.16         | 0.091     | Stable   |
| Pará              | 0.96   | 0.03  | 0.07         | 0.279     | Stable    | 6.22    | 0.13  | 0.17         | 0.080     | Stable   |
| Rondônia          | 1.84   | -0.00 | 0.00         | 0.982     | Stable    | 10.02   | -0.09 | 0.01         | 0.732     | Stable   |
| Roraima           | 2.71   | 0.31  | 0.10         | 0.196     | Stable    | 14.25   | -0.38 | 0.04         | 0.429     | Stable   |
| Tocantins         | 3.11   | 0.20  | 0.24         | 0.033     | Increasing| 14.75   | 0.75  | 0.33         | 0.010     | Increasing|
| Northeast         |        |       |              |           |           |         |       |              |           |          |
| Alagoas           | 1.60   | 0.05  | 0.07         | 0.273     | Stable    | 8.96    | 0.30  | 0.24         | 0.035     | Increasing|
| Bahia             | 1.22   | 0.06  | 0.29         | 0.017     | Increasing| 8.05    | 0.34  | 0.55         | 0.002     | Increasing|
| Ceará             | 2.76   | 0.07  | 0.32         | 0.044     | Increasing| 14.97   | 0.44  | 0.02         | 0.001     | Increasing|
| Maranhão          | 1.24   | 0.07  | 0.26         | 0.024     | Increasing| 6.49    | 0.61  | 0.81         | < 0.001   | Increasing|
| Paraíba           | 2.24   | 0.06  | 0.14         | 0.121     | Stable    | 11.18   | 0.69  | 0.72         | < 0.001   | Increasing|
| Pernambuco        | 2.53   | -0.07 | 0.54         | 0.002     | Decreasing| 11.37   | -0.05 | 0.02         | 0.547     | Stable   |
| Piauí             | 3.74   | 0.27  | 0.54         | 0.002     | Increasing| 16.63   | 1.13  | 0.84         | < 0.001   | Increasing|
| Rio Grande do Norte | 2.97   | 0.05  | 0.04         | 0.438     | Stable    | 14.34   | 0.051| 0.46         | 0.008     | Increasing|
| Sergipe           | 3.14   | 0.16  | 0.24         | 0.034     | Increasing| 12.70   | 0.64  | 0.43         | 0.011     | Increasing|
| Center-West       |        |       |              |           |           |         |       |              |           |          |
| Distrito Federal  | 2.11   | 0.02  | 0.01         | 0.727     | Stable    | 12.09   | -0.12 | 0.02         | 0.570     | Stable   |
| Mato Grosso       | 2.86   | -0.03 | 0.01         | 0.691     | Stable    | 16.52   | -0.03 | 0.00         | 0.858     | Stable   |
| Mato Grosso do Sul | 3.80   | -0.04 | 0.02         | 0.553     | Stable    | 21.23   | -0.62 | 0.41         | 0.015     | Decreasing|
| Goiás             | 2.99   | -0.01 | 0.00         | 0.896     | Stable    | 18.66   | 0.06  | 0.02         | 0.532     | Stable   |
| Southeast         |        |       |              |           |           |         |       |              |           |          |
| Espírito Santo    | 2.26   | 0.02  | 0.01         | 0.753     | Stable    | 11.17   | -0.00 | 0.00         | 0.976     | Stable   |
| Minas Gerais      | 2.08   | 0.11  | 0.68         | < 0.001   | Increasing| 11.06   | 0.32  | 0.55         | < 0.001   | Increasing|
| Rio de Janeiro    | 1.63   | 0.01  | 0.01         | 0.730     | Stable    | 8.06    | -0.12 | 0.15         | 0.102     | Stable   |
| São Paulo         | 2.25   | -0.00 | 0.00         | 0.903     | Stable    | 11.30   | -0.17 | 0.51         | 0.003     | Decreasing|
| South             |        |       |              |           |           |         |       |              |           |          |
| Paraná            | 2.63   | -0.04 | 0.12         | 0.149     | Stable    | 16.91   | -0.45 | 0.55         | 0.002     | Decreasing|
| Santa Catarina    | 5.33   | 0.06  | 0.07         | 0.265     | Stable    | 30.03   | -0.53 | 0.56         | 0.001     | Decreasing|
| Rio Grande do Sul | 6.54   | -0.07 | 0.13         | 0.130     | Stable    | 37.45   | -0.59 | 0.59         | 0.001     | Decreasing|

* Mean per 100,000 population from 1997 to 2015.
† Annual increase per 100,000 population.
| Region      | 15-29 years | 30-39 years | 40-59 years | 60 years |
|-------------|-------------|-------------|-------------|----------|
|             | Projection 2020 | WHO 2020 | Projection 2020 | WHO 2020 | Projection 2020 | WHO 2020 | Projection 2020 | WHO 2020 |
| Brazil      | 2.36        | 2.02       | 2.97         | 2.24     | 3.73         | 3.19     | 2.85           | 2.80     |
| North       |             |            |              |          |              |          |                |          |
| Acre        | 2.89        | 4.93       | 3.61         | 3.15     | 1.72         | 0.00     | 0.09           | 0.00     |
| Amapá       | 0.83        | 2.54       | 1.36         | 0.00     | 2.08         | 3.07     | 1.46           | 0.00     |
| Amazonas    | 7.57        | 4.24       | 3.20         | 3.39     | 6.11         | 0.56     | 1.18           | 2.39     |
| Pará        | 2.57        | 1.53       | 1.53         | 1.33     | 1.39         | 1.27     | 0.96           | 1.57     |
| Rondônia    | 3.12        | 1.50       | 5.20         | 4.48     | 3.01         | 2.01     | 1.84           | 0.00     |
| Roraima     | 5.68        | 5.09       | 4.18         | 5.03     | 2.12         | 2.23     | 2.71           | 7.61     |
| Tocantins   | 2.79        | 3.54       | 2.96         | 2.35     | 0.00         | 1.30     | 5.91           | 1.53     |
| Northeast   |             |            |              |          |              |          |                |          |
| Alagoas     | 2.63        | 1.80       | 1.68         | 1.02     | 4.02         | 2.40     | 1.60           | 2.24     |
| Bahia       | 1.52        | 1.13       | 1.75         | 1.34     | 2.23         | 1.95     | 2.06           | 2.46     |
| Ceará       | 2.36        | 2.69       | 2.91         | 2.49     | 3.47         | 3.35     | 5.36           | 3.76     |
| Maranhão    | 2.12        | 1.80       | 1.65         | 0.52     | 2.73         | 1.95     | 2.22           | 2.45     |
| Paraíba     | 3.39        | 2.10       | 0.96         | 2.24     | 3.80         | 2.92     | 2.24           | 2.90     |
| Pernambuco  | 0.13        | 1.64       | 2.07         | 0.83     | 2.40         | 1.89     | 4.84           | 1.81     |
| Piauí       | 2.75        | 3.63       | 2.40         | 3.10     | 6.00         | 1.61     | 4.09           | 7.79     |
| Rio Grande do Norte | 1.83    | 1.00       | 2.20         | 1.68     | 2.48         | 2.64     | 2.97           | 3.18     |
| Sergipe     | 1.30        | 3.26       | 0.00         | 1.99     | 2.96         | 4.23     | 5.38           | 2.52     |
| Center-West |             |            |              |          |              |          |                |          |
| Distrito Federal | 2.50  | 2.46       | 2.28         | 3.65     | 3.56         | 2.60     | 2.11           | 1.30     |
| Mato Grosso | 0.00        | 1.93       | 1.76         | 2.11     | 3.46         | 5.69     | 2.86           | 2.79     |
| Mato Grosso do Sul | 5.44  | 4.89       | 3.44         | 5.74     | 3.42         | 3.59     | 3.80           | 3.33     |
| Goiás       | 2.89        | 2.36       | 3.53         | 2.33     | 3.88         | 4.37     | 2.99           | 3.36     |
| Southeast   |             |            |              |          |              |          |                |          |
| Espírito Santo | 1.76  | 0.74       | 6.18         | 4.02     | 4.11         | 4.08     | 2.26           | 3.60     |
| Minas Gerais | 1.14  | 2.05       | 2.42         | 2.34     | 5.84         | 4.19     | 5.43           | 2.76     |
| Rio de Janeiro | 1.34  | 1.08       | 1.84         | 1.72     | 2.08         | 1.91     | 1.63           | 1.36     |
| São Paulo   | 3.95        | 1.96       | 0.15         | 2.05     | 2.84         | 2.94     | 2.25           | 2.07     |
| South       |             |            |              |          |              |          |                |          |
| Paraná      | 2.03        | 1.78       | 3.44         | 2.40     | 3.56         | 3.52     | 2.63           | 2.68     |
| Santa Catarina | 2.71  | 1.70       | 7.58         | 3.67     | 10.45        | 6.75     | 5.33           | 5.70     |
| Rio Grande do Sul | 4.05  | 3.17       | 4.22         | 3.87     | 7.92         | 5.77     | 6.54           | 6.23     |

* Using polynomial regression models and a 1997-2015 time series.
† WHO Mental Health Action Plan target: a 10% reduction in suicide rate by 2020, using 2013-year rates as baseline.
### Table 6: Comparison between projected suicide rates (per 100,000 population) for 2020* and the World Health Organization (WHO) Mental Health Action Plan target† for men, stratified by age group

| Region            | 15-29 years | 30-39 years | 40-59 years | ≥ 60 years |
|-------------------|-------------|-------------|-------------|------------|
|                   | Projection 2020 | WHO 2020 | Projection 2020 | WHO 2020 | Projection 2020 | WHO 2020 | Projection 2020 | WHO 2020 |
| Brazil            | 9.49        | 7.99        | 13.49       | 10.69      | 13.92        | 10.87      | 13.84        | 12.49      |
| North             |             |             |             |            |              |            |              |            |
| Acre              | 17.27       | 13.68       | 12.15       | 15.44      | 8.81         | 8.37       | 8.86         | 0.00       |
| Amazonas          | 29.77       | 17.11       | 22.52       | 11.35      | 6.73         | 5.97       | 6.77         | 5.21       |
| Pará              | 8.97        | 5.34        | 10.8        | 6.77       | 5.45         | 5.72       | 6.22         | 7.39       |
| Rondônia          | 9.26        | 9.35        | 9.90        | 13.16      | 9.69         | 8.59       | 10.02        | 7.18       |
| Roraima           | 20.06       | 13.54       | 13.81       | 12.29      | 12.24        | 14.03      | 14.25        | 6.89       |
| Tocantins         | 10.82       | 10.71       | 10.28       | 15.81      | 7.59         | 13.57      | 10.27        | 16.37      |
| Northeast         |             |             |             |            |              |            |              |            |
| Alagoas           | 6.16        | 8.84        | 7.21        | 8.62       | 7.90         | 9.19       | 13.16        | 13.01      |
| Bahia             | 4.81        | 3.87        | 7.49        | 6.37       | 8.57         | 7.67       | 11.07        | 11.99      |
| Ceará             | 6.56        | 11.11       | 8.11        | 14.41      | 12.21        | 14.63      | 14.56        | 17.84      |
| Maranhão          | 12.16       | 6.52        | 14.66       | 7.96       | 10.00        | 7.79       | 18.30        | 10.61      |
| Paraíba           | 9.06        | 6.02        | 14.8        | 10.92      | 17.35        | 12.92      | 15.74        | 14.58      |
| Pernambuco        | 6.35        | 5.02        | 8.02        | 9.55       | 7.63         | 7.50       | 11.37        | 10.39      |
| Piauí             | 14.46       | 12.19       | 9.97        | 12.17      | 19.46        | 17.23      | 32.45        | 18.48      |
| Rio Grande do Norte | 3.46    | 6.48        | 10.72       | 9.12       | 10.41        | 11.54      | 14.85        | 13.21      |
| Sergipe           | 11.76       | 8.68        | 15.70       | 9.80       | 7.38         | 12.49      | 16.55        | 14.26      |
| Center-West       |             |             |             |            |              |            |              |            |
| Distrito Federal  | 9.23        | 8.96        | 10.37       | 8.91       | 9.45         | 9.23       | 12.09        | 8.86       |
| Mato Grosso       | 9.68        | 9.41        | 11.90       | 8.76       | 12.82        | 10.62      | 16.52        | 14.86      |
| Mato Grosso do Sul | 16.07  | 17.45       | 19.55       | 15.34      | 14.25        | 15.34      | 15.80        | 15.77      |
| Goiás             | 10.94       | 10.83       | 12.90       | 11.61      | 13.85        | 13.86      | 18.66        | 14.94      |
| Southeast         |             |             |             |            |              |            |              |            |
| Espírito Santo    | 6.34        | 4.10        | 9.46        | 8.43       | 10.67        | 9.67       | 11.17        | 4.85       |
| Minas Gerais      | 9.36        | 8.38        | 12.72       | 10.57      | 15.95        | 11.73      | 15.54        | 11.84      |
| Rio de Janeiro    | 3.78        | 2.73        | 10.75       | 6.00       | 6.09         | 5.03       | 8.06         | 6.03       |
| São Paulo         | 11.76       | 8.02        | 18.92       | 12.11      | 14.60        | 9.40       | 10.53        | 8.62       |
| South             |             |             |             |            |              |            |              |            |
| Paraná            | 9.18        | 10.02       | 10.77       | 11.75      | 18.17        | 12.28      | 20.65        | 12.71      |
| Santa Catarina    | 11.11       | 9.47        | 18.03       | 14.36      | 25.95        | 18.06      | 40.79        | 26.32      |
| Rio Grande do Sul | 10.00       | 10.69       | 16.44       | 16.92      | 21.44        | 22.78      | 30.90        | 29.19      |

* Using polynomial regression models and a 1997-2015 time series.
† WHO Mental Health Action Plan target: a 10% reduction in suicide rate by 2020, using 2013-year rates as baseline.
low- and middle-income countries is around 1.5. In addition, the suicide rate is highest in people aged 70 years and over, regardless of gender.¹

Finally, the high absolute number of suicides that occurred in the young and adult population during the period of analysis is worrisome. It bears stressing that deaths in this age group have major economic and social costs,¹⁸ besides reflecting lower quality of life in the population. A previous Brazilian study highlighted the importance and impact of external causes of premature death and disability among the population and found that suicide was the sixth leading external cause of years of life lost to death or disability.¹⁹

Although ecological studies are useful for generating hypotheses, we acknowledge that the main limitation of our study was the possibility of ecological bias, that is, the failure in reasoning that arises when an inference is made about an individual based on aggregate data for a group. The specialized literature suggests some strategies to avoid this kind of bias, one of which is the use of smaller units of analysis to make groups more homogeneous in relation to exposures.²⁰ Thus, we chose to stratify these rates by state, gender, and age groups, given the massive size of Brazil and the available official data on suicide. Furthermore, once this stratification was done, it gave us mathematical support to dismiss the standardized suicide ratio and use crude rates instead.

Another important limitation of our study was the use of data on suicide from a secondary database; specifically, the Brazilian Ministry of Health SIM. Although the Brazilian scenario is alarming, we believe that suicide can be prevented by public health strategies and social policies.²⁴ Therefore, our study contributes with well-founded data nationwide that strengthens the need for rapid implementation of actions for health promotion and prevention of this phenomenon, as provided for in the 2017-2020 Strategic Action Agenda for Suicide Surveillance and Prevention and Health Promotion in Brazil.

Disclosure
The authors report no conflicts of interest.

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