

# The rising trends of self-harm in Brazil: an ecological analysis of notifications, hospitalisations, and mortality between 2011 and 2022

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## Summary

**Background** Self-harm is considered an important public health issue and is comprised by a wide range of definitions and behaviours. It is estimated that suicide affects more than 700,000 individuals every year, although, globally, there is a lack of evidence on other self-harm behaviour, such as attempted suicide. The objective of this study is to report and examine temporal trends of notifications, hospitalisations related to self-harm and suicide rates in Brazil between 2011 and 2022, as well as investigating differences in sociodemographic characteristics, methods, and region.

**Methods** This ecological study used secondary, Brazilian Health Information System data between 2011 and 2022. Self-harm notifications were collected from the Notifiable Diseases Information System (SINAN); self-harm hospitalisations from the Hospital Information System (SIH), and suicide data from the Mortality Information System (SIM). We calculated self-harm notifications, hospitalisations, and suicide rates by sex, age, race, region, and overall. We assessed time-related trends using Joinpoint regression analyses.

**Findings** From 2011 to 2022, 720,480 self-harm notifications, 104,458 self-harm hospitalisations, and 147,698 suicides were recorded in Brazil. In this period, self-harm notifications (AAPC: 21.13 (CI: 17.50, 25.33)) and suicide (AAPC: 3.70 (CI: 3.05, 4.38)) have increased in the country. Male adults (25–59 years old) and the elderly (>60 years old) continue to be the groups most affected by suicide, with respective rates of 9.59 and 8.60/100,000 in 2022. However, the largest percentage increases have been seen in young people (AAPC: 6.14 (CI: 4.57, 7.88)). The Indigenous population had the highest self-harm notification (103.72, 10,000) and suicide (16.58/100,000) rates, but the lowest hospitalisation rates (1.14/100,000) in 2022), compared to the overall population (70.06, 7.27, and 4.69/100,000, respectively, in 2022).

**Interpretation** The observed trend of increased self-harm notifications and suicide rates suggests the need for a greater allocation of resources to strategies to prevent self-harm and suicide. The Indigenous population seems to be the group with less access to healthcare.

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**Keywords:** Suicide; Self-harm; Self-inflicted violence; Brazil; Suicide methods

## Introduction

Suicide is a significant global public health concern, resulting in almost 700,000 annual fatalities worldwide, with a global rate of 9.0 per 100,000 inhabitants.<sup>1</sup> This

statistic represents approximately 1.3% of all deaths in 2019.<sup>1</sup> Self-harm encompasses a wide range of definitions and behaviours, which may include self-poisoning, or self-injury, often with varying degrees of suicidal

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**Research in context****Evidence before this study**

The availability of data to understand self-harm and suicide is a priority for suicide prevention, supported by the WHO and Global Mental Health Strategies. Even in the context of strong vital statistics systems, data on suicide, including attempts and self-harm, remains limited globally. To assess the existing evidence, we conducted a PubMed search for studies published between January 1, 2011, and November 2, 2023, using the search terms “self-harm” OR “suicide” AND “Brazil.” Suicide rates are rising in Brazil, though data is only available up to 2020. During the COVID-19 period, rates were relatively stable with regional, gender, and race variations, but specific demographic insights are lacking. Furthermore, suicide attempts and other self-harm behaviors remain underexplored.

**Added value of this study**

To our knowledge, no other studies, up to the date of this study, have utilized three distinct nationwide datasets to analyze and compare temporal trends in suicide, self-harm hospitalizations, and notifications across sex, age, race/color, and regions from 2011 to 2022. With a dataset of 720,480

self-harm notifications, 104,458 self-harm hospitalizations, and 147,698 suicides, we identified a sustained and significant increase in self-harm notifications and suicide over time. Notably, the Indigenous population exhibited significantly higher self-harm notifications and suicide rates, but lower hospitalisation rates, than the general population, pointing to potential barriers in accessing Urgency and Emergency care.

**Implications of all the available evidence**

Our study, supported by other findings and theoretical considerations, emphasize the importance of utilizing real-world data to enhance our understanding of self-harm and suicide. This is particularly crucial in the context of rising suicide rates in Latin America, despite the global decrease. As demonstrated in Brazil, the use of real-world data from three distinct datasets has revealed inequalities that might go unnoticed when focusing solely on a single outcome. This information can inform research, healthcare, prevention strategies, and clinical practices to address urgent public health concerns, providing valuable insights for evidence-based interventions and policies.

intent.<sup>2,3</sup> According to this definition, attempted suicide, and other forms of self-harm are employed within the framework of self-harm nomenclature.<sup>2-4</sup> It is estimated that for each completed suicide, there are more than 20 attempted suicides.<sup>3</sup> Nonetheless, the frequency of suicide remains a pressing issue, marked by underestimation and underreporting, due to a complex interplay of political, cultural, and societal stigmas. This underreporting is further pronounced for attempted suicide and other self-harm behaviour, which are more difficult for health systems to identify, remaining an underexplored phenomenon.<sup>1,2</sup>

Suicide and self-harm systematically vary by age, sex, and the means employed.<sup>2,5</sup> A complex multifactorial interaction underlies the occurrence of suicidal behaviour, including risk and protective factors at the individual, family, and community level, such as the presence of mental disorders, and access to the means of suicide.<sup>2-5</sup>

In 2019, the suicide rate was 6.7 per 100,000 inhabitants in Brazil.<sup>6,7</sup> Despite a 36% worldwide reduction in the number of suicides from 2000 to 2019, the Americas region demonstrated a 17% increase during this period,<sup>1</sup> with Brazil ranking among the countries with the most significant rise (43%).<sup>1,6</sup> In 2020, the world was hit by the COVID-19 pandemic, and Brazil was one of the most affected countries, being responsible for 10% of world COVID-19 deaths in this year.<sup>8</sup> In 2020, researchers reported the suicide rates in Brazil as stable overall, but with important variations depending on the region, sex, and race.<sup>8,9</sup> However, despite studies

evaluating suicide trends, there is limited knowledge of these rates for specific groups. Furthermore, attempted suicide and other self-harm behaviour have received less investigation. A previous Brazilian study found that self-harm hospitalisation rates decreased in the country between 1994 and 2014 (from 7.1/100,000 to 5.1/100,000).<sup>10</sup>

In Brazil, information on suicide cases is collected from mortality information systems covering the entire country, while data on non-fatal self-harm cases is taken from hospitalisation information systems, containing information on hospital stays in public healthcare facilities, or their networks.<sup>11</sup> Since 2011, self-harm has also been reported on the Information System for Notifiable Diseases (SINAN), enabling a better approach to quantify this phenomenon in Brazil, but studies have not yet investigated this data for the entire country.<sup>12</sup>

The use of real-world data—data related to patient health status and healthcare, routinely collected from various sources—provides a valuable, cost-effective alternative and a robust data source, compared to traditionally collected data.<sup>13</sup> This is particularly valuable in lower- and middle-income countries such as those in Latin America, where suicide rates are rising.<sup>1</sup> Current information on suicidal behaviour is still limited in scope, even in nations with robust vital statistics systems, and suicide attempts and other self-harm behaviour have received less attention.<sup>1</sup> Providing information from three diverse datasets and outcomes of suicide and self-harm behaviours may offer a more comprehensive understanding of this phenomenon. This, in turn, may

greatly enhance research, inform policy decisions, and improve treatment efforts, ultimately contributing to the broader global goal of comprehending and preventing suicide.<sup>2</sup> Therefore, the objective of this study was to report and examine temporal trends of notifications, hospitalisations, and mortality related to self-harm and suicide rates in Brazil between 2011 and 2022, as well as to investigate differences by sociodemographic characteristics, methods, and region.

## Methods

### Study design and data sources

This is an ecological study conducted in Brazil between the period 2011 and 2022, utilising real-world data. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline for observational studies.

Information on self-harm behaviours was accessed in three distinct datasets: through the Unified National Health System (SUS) IT Department (DATASUS), provided by the Brazilian Health Ministry (<https://datasus.saude.gov.br/>).<sup>11</sup> Self-harm notifications were collected from the Notifiable Diseases Information System (SINAN/DATASUS); hospitalisations from the Hospital Information System (SIH/SUS), and mortality data from the Mortality Information System (SIM) (Tabnet, 2022).<sup>11</sup> Since 2011, SINAN has provided data on notifications of self-harm cases for all health services, whether public or private, in Brazil.<sup>12</sup> Data collection on suspect, or confirmed violence, in healthcare services is mandatory across the country, and must be carried out by healthcare professionals. SIH/SUS provides data on hospital morbidity, procedures performed during public hospital hospitalisations, and those associated with the SUS.<sup>11</sup> It is estimated that the public healthcare service accounts for approximately 70% of total admissions in Brazil.<sup>13,14</sup> In Brazil, medical professionals certify all deaths, and the cause of death is coded in accordance with the International Classification of Diseases, 10th revision (ICD-10).<sup>15</sup> Deaths due to external causes, including suicide, homicide, and accidents, are handled at the Legal Medical Institute (IML), where an examining doctor, based on autopsy findings and relevant factors, issues death certificates. The Mortality Information System database provides nationwide coverage, with over 90% completeness achieved in 93% of municipalities.<sup>16</sup> The three databases are publicly available as aggregate datasets.

Population data was taken from the Brazilian Institute of Geography and Statistics (IBGE) demographic censuses.<sup>17</sup>

### Variables

For self-harm notifications, all reports of suspected or confirmed violence registered on SINAN/DATASUS were considered, and the “self-inflicted injury” field was

selected. Self-harm hospitalisations follow the same ICD-10 codes identified for suicide (X60–X84) as the primary diagnosis. For suicide rates, all deaths with the immediate cause of death (the final disease, injury, or complication directly causing death) assigned as intentional self-harm (ICD-10 codes X60–X84), were considered.

Rates were stratified by sex, age, and race. In order to improve estimates for the Indigenous population, projections were calculated according to the following steps: 1) Calculating the proportion of Indigenous people in the 2010 census by sex, age group, and region; 2) Obtaining the annual estimates of the population residing in Brazil provided by the IBGE; 3) Calculating the Indigenous population for each projected year, based on the proportions established in the 2010 census.<sup>18</sup>

Considering the rarity of suicide in children under the age of 10, all rates were calculated considering the population from this age upwards, in line with a previous study.<sup>19</sup>

### Statistical analysis

We calculated the self-harm notification, hospitalisation, and suicide rates per 100,000 people per year over the study period. To describe the changes, we calculated the percentage differences in the rates over the period, using the formula  $[(\text{rate in 2022} - \text{rate in 2011}) / \text{rate in 2011}] \times 100$ . We used Joinpoint software, version 5.0.2 (<https://seer.cancer.gov/stdpopulations/world.who.html>) to estimate piecewise log-linear trends in the rates over time.<sup>20</sup> The Joinpoint method was valuable to evaluate alterations in time series data, and to effectively pinpoint shifts in population structure over time, as well as to determine the timing of these changes.<sup>20</sup> An annual percentage change (APC) with a 95% confidence interval was estimated for each identified trend. The average APC (AAPC), serving as a single summary measure, was used to characterise the overall rate of change across the entire study period.

To identify the main means of suicide and hospitalisations, the proportions of each means were calculated, according to the ICD-10 categories (X60–X84) for the entire period, and then grouped into: 1. Causes resulting from self-poisoning (X60–X69), and 2. Causes resulting from self-injuries (X70–X84). The percentages were then recalculated. We categorised the means employed by self-harm notifications based on the available categories in the SINAN.<sup>6</sup>

All data was acquired from May 06, 2022 to October 15, 2023. This study exclusively used secondary data from the public domain and, therefore, Research Ethics Committee approval was not a requirement.

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## Results

### Self-harm notifications

From 2011 to 2022, 720,480 self-harm notifications were registered in Brazil through SINAN/DATASUS. The overall self-harm rates increased nine-fold, from 7.6 to 70.1 per 100,000 inhabitants between 2011 and 2022, with an AAPC of 21.13% (CI: 17.50, 25.33) (Fig. 1, Table 1, Table 2, Table S1, and Figure S1).

Self-harm notification rates consistently increased across all regions of the country throughout the entire study period. Joinpoint regression analysis revealed that the North and Northwest regions exhibited a continuous increase throughout the entire period (AAPC: 22.47%, CI: 18.85–26.23; AAPC: 26.38%, CI: 22.47–30.43, respectively). The other regions demonstrated distinct turning points in their trends. The Central West region experienced a substantial increase from 2016 to 2019 (APC: 48.79%, CI: 33.09–62.03), while the most substantial increase in the Southeast occurred from 2011 to 2019 (APC: 24.93%, CI: 18.91–52.76). In the South region, there was a notable increase in self-harm rates from 2011 to 2019, with an APC of 28.25% (95% CI: 23.58–38.13) (Fig. 1, Table 1, Table 2, Table S1, and Figure S12).

In 2022, notifications were more than twice as high among women (96.8/100,000), compared to men (42.1/100,000), with rates among men also showing a higher average annual percentage increase (AAPC: 22.05% CI: 18.51–26.08) during the period (Fig. 1, Table 1, Table 2, Table S1, and Figure S10). The increase occurred in all age groups, with an AAPC of 28.82% (CI: 23.36–34.62) in the 10 to 24 age group (10.7/100,000 in 2011 and 158.5/100,000 in 2022), 19.76% (CI: 16.44–23.41) among people aged 25–59 (16.0/100,000 in 2011 and 54.0/100,000 in 2022), and 16.78% (CI: 13.62–19.93) among those over the age of 60 (1.4/100,000 in 2011 and 8.2/100,000 in 2022). Despite the overall increase in

rates throughout the entire period, there was a turning point in rates for individuals aged over 60 from 2019 to 2022, marked by a declining trend (APC: –17.79%, 95% CI: –31.53, –7.91) (Fig. 1, Table 1, Table 2, Table S1, and Figure S11).

The Indigenous population exhibited the highest notifications rates, recording a rate of 103.72 per 100,000 inhabitants in 2022. There is an observed upward trend in average annual self-harm notifications rates across all race/ethnicity categories, with average changes of 31.91% (95% CI: 26.36–37.53), 27.46% (95% CI: 22.61–32.66), 24.77% (95% CI: 21.67–29.63), 22.36% (95% CI: 17.96–26.99), and 19.36% (95% CI: 13.78–26.44) for Indigenous, mixed-race/Brown, Asian descendants, Black, and White people, respectively (Table 1, Table 2, Table S1, and Figure S13).

The highest occurrence of self-harm notifications was related to self-poisoning (65%,  $n = 471,506$ ), which was also the primary cause for both genders, being 70% ( $n = 349,171$ ) for females, and 56% ( $n = 122,335$ ) for males (Table 3).

### Self-harm hospitalisations

Between 2011 and 2022, 104,458 self-harm hospitalisations were recorded on the SIH. During this period, there was a non-statistically significant increase in self-harm hospitalisation rates (AAPC and APC: 0.97%; 95% CI: –0.33, 2.32) (Fig. 2, Table 1, Table 2, Table S1, and Figure S1). The North region showed a decrease in rates (AAPC: –4.53% 95% CI: –7.77, –1.09). The Northeast region (AAPC: –1.48%, 95% CI: 5.36, 1.95) showed a significant increase in rates from 2011 to 2014 (APC: 28.78%, 95% CI: 10.62, 66.14), and then demonstrated a significant decrease from 2014 to 2022 (APC: –10.90%, 95% CI: –15.47, –7.39). There was an increase in other regions, with a greater prominence in the South (AAPC: 8.25%, CI: 5.36–11.23). The highest hospitalisation rates occurred in the Southeast region, with a rate of 6.41 per 100,000 population in 2022 (Fig. 2, Table 1, Table 2, Table S1, and Figure S8).

In relation to sex, self-harm hospitalisations occurred more frequently in women (4.83/10,000) than in men (4.55/10,000) in 2022. There was an increase in

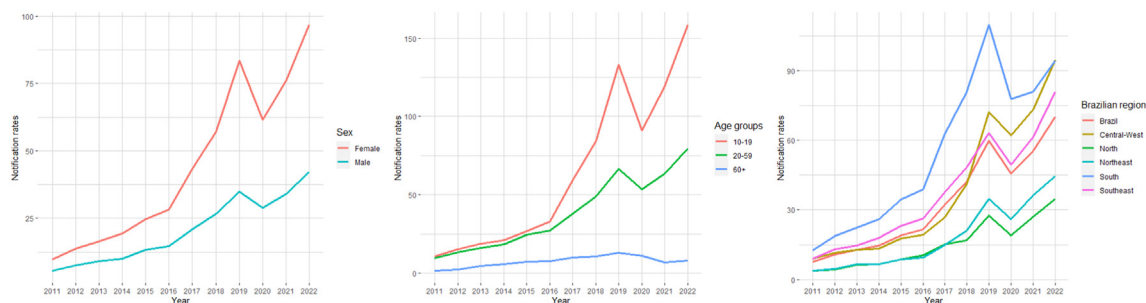


Fig. 1: Self-harm notifications rates by age, sex, and Brazilian regions. Brazil. 2011–2022.

Race/Color	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	% Difference
<b>Suicide</b>													
White	5.41	5.57	5.47	5.52	5.75	5.80	6.32	6.31	6.60	6.53	7.27	7.62	40.85%
Black	3.95	3.83	3.48	3.65	3.64	3.81	4.28	4.09	4.30	4.88	6.32	5.60	41.77%
Asian descendants	2.21	1.92	1.58	2.14	2.26	1.85	2.44	2.00	1.34	2.27	2.17	2.41	9.05%
Brown/mixed race	4.45	4.79	4.80	4.79	5.05	5.21	5.75	6.00	6.44	6.67	7.79	7.93	78.20%
Indigenous	11.59	10.54	17.12	17.70	19.77	17.93	22.04	19.93	19.61	17.71	20.46	16.58	43.05%
<b>Total</b>	<b>4.97</b>	<b>5.16</b>	<b>5.24</b>	<b>5.25</b>	<b>5.46</b>	<b>5.54</b>	<b>6.02</b>	<b>6.07</b>	<b>6.41</b>	<b>6.51</b>	<b>7.55</b>	<b>7.27</b>	<b>46.28%</b>
<b>Self-harm hospitalizations</b>													
White	3.17	2.46	2.48	2.73	3.12	2.82	3.07	3.43	4.1	3.09	3.22	3.71	17.03%
Black	3.04	2.71	1.82	2.18	2.37	1.9	2.05	2.43	2.83	2.44	2.48	3.09	1.64%
Asian descendants	1.74	1.49	1.26	1.79	2.61	3.91	7.68	9.65	12.98	8.39	5.14	4.91	182.18%
Brown/mixed race	2.69	2.65	2.61	2.83	2.7	2.49	2.75	3.15	3.84	3.02	3.86	4.20	56.13%
Indigenous	0.24	0.48	0.35	0.34	0.45	1.13	1.68	1.23	1.55	0.55	1.31	1.14	375%
<b>Total</b>	<b>4.14</b>	<b>3.72</b>	<b>4.18</b>	<b>4.30</b>	<b>4.29</b>	<b>3.96</b>	<b>4.13</b>	<b>4.32</b>	<b>4.76</b>	<b>4.02</b>	<b>4.20</b>	<b>4.69</b>	<b>13.29%</b>
<b>Notifications of self-inflicted violence</b>													
White	8.22	11.78	13.34	15.33	19.26	22.08	33.99	44.07	59.36	44.02	50.56	66.36	702.30%
Black	6.59	10.19	10.99	12.87	16.29	17.89	26.16	34.67	48.98	40.84	48.35	66.52	909.41%
Asian descendants	5.56	7.61	6.4	8.89	10.24	12.44	20.51	25.77	40.31	30.04	48.68	66.44	1094.964%
Brown/mixed race	4.55	7.26	8.6	9.99	13.3	15.43	24.5	33.18	50.03	39.72	50.20	70.45	1448.35%
Indigenous	6.28	9.46	33.16	33.56	39.24	42.57	55.48	72.1	102.67	89.55	86.10	103.72	1551.59%
<b>Total</b>	<b>7.60</b>	<b>10.67</b>	<b>12.73</b>	<b>14.71</b>	<b>19.14</b>	<b>21.61</b>	<b>32.25</b>	<b>42.27</b>	<b>59.73</b>	<b>45.53</b>	<b>55.37</b>	<b>70.06</b>	<b>821.84%</b>

The rate per 100 million inhabitants is calculated based on annual and stratified Brazilian populations obtained from the Brazilian Institute of Geography and Statistics-IBGE (<https://www.ibge.gov.br/>). % Difference: 100% (2022 rate—2011 rate)/2011 rate—represents the increase (or decrease) in the 2022 rate, compared to the series' first year. Brazil. 2011–2022.

**Table 1: Suicide, self-harm hospitalizations and notification rates by race/color.**

self-harm hospitalisations among men (AAPC: 3.86%, CI: 1.76–6.01) and for the 10–24 age group (AAPC: 5.43%, CI: 0.64–11.55) (Fig. 2, Table 1, Table 2, Table S1, and Figures S6 and S7). Analysing by race/ethnicity, in 2022, the highest self-harm hospitalisation rate occurred among those declared Asian (4.9 per 100,000). The highest average annual percent increase was recorded among Indigenous people (AAPC: 14.1%; 95% CI: 6.27–22.41). Notably, a statistically significant decreasing turning point was observed among individuals of Asian descent from 2019 to 2022, with a decrease of –32.17% (95% CI: –38.16 to –25.19) (Table 2, Table S1, and Figure S9). The majority of self-harm hospitalisations were due to self-poisoning (X60–X69), corresponding to 66% (n = 68,899) of cases in the period between 2011 and 2022. Among the types of self-poisoning, there was a higher frequency of self-intoxication by drugs (39%, n = 40,743), followed by alcohol (11%, n = 11,488) (Table 3).

### Suicide

Between 2011 and 2022, 147,698 suicides were registered on SIM. There was an increase in suicide rates during the period, with an average annual percentage change (AAPC) of 3.70%. The rates rose from 5.0 per 100,000 population to 7.3 in 2022. Joinpoint regression analysis identified two significant turning points over this period, with an annual Percentage Change (APC) of

2.22% (95% CI: –1.31 to 3.48) in 2011–2016, and 4.95% (95% CI: 3.98–8.41) in 2016–2022 (Fig. 3, Table 1, Table 2, Table S1, and Figure S1).

Suicide rates increased in all regions of Brazil, with annual average percentage changes of 5.76% (95% CI: 3.02–8.57) for the Central-West, 3.67% (95% CI: 1.34–6.08) for the Southeast, 3.61% (95% CI: 1.35–5.98) for the North, 3.48% (95% CI: 2.50–4.48) for the Northeast, and 2.62% (95% CI: 0.49–4.82) for the South, respectively. Notably, the South region had the highest rates, reaching 11.53 per 100,000 in 2022 (Fig. 3, Table 1, Table 2, Table S1, and Figure S4).

In relation to sex, suicide among men was almost four times more frequent than women in 2022 (11.68/100,000 and 3.06, respectively). Higher suicide rates occurred in the 25–59 age range (9.59/100,000), followed by the over-60 population (8.60/100,000). There was an increase in suicide rates in all of the age groups studied: AAPC of 6.14% (CI: 4.57–7.88) in the 10–24 age group; AAPC of 3.08% (CI: 2.21–3.71) in the 25–59 age group; and AAPC of 2.21% (CI: 1.04–3.42) among people aged 60 and over. Turning points were identified in the trend, especially in the period 2019–2022 for the 25–59 age group (APC: 6.47%, CI: 2.89–11.37) (Fig. 3, Table 1, Table 2, Table S1, and Figures S2 and S3).

When analysing by race/ethnicity, the highest suicide rates were found among those declared Indigenous, with 16.58 per 100,000, and the highest annual

	Segment 1	APC (95% CI)	Segment 2	APC (95% CI)	Segment 3	APC (95% CI)	AAPC (95% CI-full range)
<b>Suicide</b>							
<b>Sex</b>							
Male	2011–2016	2.37 (–0.61, 3.42)	2016–2022	4.75 <sup>a</sup> (3.94, 7.66)	–	–	3.66 <sup>a</sup> (3.12, 4.23)
Female	2011–2016	1.78 (–4.59, 4.67)	2016–2022	5.72 <sup>a</sup> (3.09, 12.44)	–	–	3.91 <sup>a</sup> (2.80, 5.09)
<b>Age groups</b>							
10–24	2011–2019	10.29 <sup>a</sup> (8.31, 14.08)	2019–2022	–4.19 (–13.88, 3.22)	–	–	6.14 <sup>a</sup> (4.57, 7.88)
25–59	2011–2019	1.84 (–1.61, 2.83)	2019–2022	6.47 <sup>a</sup> (2.89, 11.37)	–	–	3.08 <sup>a</sup> (2.21, 3.71)
60+	2011–2022	2.21 <sup>a</sup> (1.04, 3.42)	–	–	–	–	2.21 <sup>a</sup> (1.04, 3.42)
<b>Region</b>							
Central-West	2011–2022	5.76 <sup>a</sup> (3.02, 8.57)	–	–	–	–	5.76 <sup>a</sup> (3.02, 8.57)
North	2011–2022	3.61 <sup>a</sup> (1.35, 5.98)	–	–	–	–	3.61 <sup>a</sup> (1.35, 5.98)
Northeast	2011–2022	3.48 <sup>a</sup> (2.50, 4.48)	–	–	–	–	3.48 <sup>a</sup> (2.50, 4.48)
South	2011–2022	2.62 <sup>a</sup> (0.49, 4.82)	–	–	–	–	2.62 <sup>a</sup> (0.49, 4.82)
Southeast	2011–2022	3.67 <sup>a</sup> (1.34, 6.08)	–	–	–	–	3.67 <sup>a</sup> (1.34, 6.08)
Brazil	2011–2016	2.22 (–1.31, 3.48)	2016–2022	4.95 <sup>a</sup> (3.98, 8.41)	–	–	3.70 <sup>a</sup> (3.05, 4.38)
<b>Race-color</b>							
Asian descendants	2011–2022	0.76 (–2.69, 4.39)	–	–	–	–	0.76 (–2.69, 4.39)
Black	2011–2015	–2.47 (–13.40, 3.54)	2015–2022	7.54 <sup>a</sup> (4.67, 18.45)	–	–	3.79 <sup>a</sup> (2.14, 5.84)
Brown/mixed race	2011–2016	2.91 <sup>a</sup> (0.14, 4.35)	2016–2022	7.43 <sup>a</sup> (6.29, 9.57)	–	–	5.35 <sup>a</sup> (4.78, 5.94)
Indigenous	2011–2015	17.25 <sup>a</sup> (7.12, 52.38)	2015–2022	–1.74 <sup>a</sup> (–14.73, 2.24)	–	–	4.78 <sup>a</sup> (0.65, 9.01)
White	2011–2014	0.66 (–2.24, 3.81)	2014–2020	3.22 <sup>a</sup> (1.01, 5.13)	2020–2022	6.83 <sup>a</sup> (2.97, 9.53)	3.16 <sup>a</sup> (2.50, 3.75)
<b>Self-harm hospitalization</b>							
<b>Sex</b>							
Male	2011–2016	–0.47 (–10.65, 2.69)	2016–2022	7.60 <sup>a</sup> (5.14, 18.42)	–	–	3.86 <sup>a</sup> (1.76, 6.01)
Female	2011–2014	5.52 (–1.59, 21.51)	2014–2022	–3.17 <sup>a</sup> (–13.78, –0.63)	–	–	–0.87 (–3.27, 1.22)
<b>Age groups</b>							
10–24	2011–2019	10.22 <sup>a</sup> (2.62, 45.85)	2019–2022	–6.36 (–32.04, 9.37)	–	–	5.43 <sup>a</sup> (0.64, 11.55)
25–59	2011–2022	–0.81 (–2.07, 0.51)	–	–	–	–	–0.81 (–2.07, 0.51)
60+	2011–2015	8.90 <sup>a</sup> (2.30, 23.46)	2015–2022	–6.36 <sup>a</sup> (–11.32, –3.55)	–	–	–1.08 (–3.17, 1.15)
<b>Region</b>							
Central-West	2011–2017	–1.34 (–19.96, 6.51)	2017–2022	13.63 <sup>a</sup> (3.48, 41.61)	–	–	5.20 <sup>a</sup> (1.39, 8.87)
North	2011–2016	–18.03 <sup>a</sup> (–31.99, –10.17)	2016–2022	8.39 <sup>a</sup> (1.05, 25.54)	–	–	–4.53 <sup>a</sup> (–7.77, –1.09)
Northeast	2011–2014	28.78 <sup>a</sup> (10.62, 66.14)	2014–2022	–10.90 <sup>a</sup> (–15.47, –7.39)	–	–	–1.48 (–4.34, 1.95)
South	2011–2022	8.25 <sup>a</sup> (5.36, 11.23)	–	–	–	–	8.25 <sup>a</sup> (5.36, 11.23)
Southeast	2011–2022	1.14 (–0.44, 2.74)	–	–	–	–	1.14 (–0.44, 2.74)
Brazil	2011–2022	0.97 (–0.33, 2.32)	–	–	–	–	0.97 (–0.33, 2.32)
<b>Race-color</b>							
Asian descendants	2011–2013	–15.41 (–26.59, 4.35)	2013–2019	48.79 <sup>a</sup> (43.01, 57.68)	2019–2022	–32.17 (–38.16, –25.19)	8.38 <sup>a</sup> (5.61, 11.37)
Black	2011–2013	–21.84 (–32.46, 1.92)	2013–2022	4.40 (–0.34, 21.69)	–	–	–0.96 (–3.43, 3.71)
Brown/mixed race	2011–2016	–0.42 (–7.69, 2.82)	2016–2022	8.05 <sup>a</sup> (5.52, 15.50)	–	–	4.12 <sup>a</sup> (2.66, 5.69)
Indigenous	2011–2017	39.27 <sup>a</sup> (23.05, 80.03)	2017–2022	–10.05 (–35.78, 5.14)	–	–	14.17 <sup>a</sup> (6.27, 22.41)
White	2011–2022	3.03 <sup>a</sup> (0.40, 5.78)	–	–	–	–	3.03 <sup>a</sup> (0.40, 5.78)
<b>Self-harm notification</b>							
<b>Sex</b>							
Male	2011–2019	27.63 <sup>a</sup> (24.10, 43.77)	2019–2022	8.31 (–11.70, 21.00)	–	–	22.05 <sup>a</sup> (18.51, 26.08)
Female	2011–2019	23.89 <sup>a</sup> (20.79, 39.38)	2019–2022	7.42 (–13.01, 18.60)	–	–	19.16 <sup>a</sup> (15.70, 23.12)
<b>Age groups</b>							
10–24	2011–2022	28.82 <sup>a</sup> (23.36, 34.62)	–	–	–	–	28.82 <sup>a</sup> (23.36, 34.62)
25–59	2011–2019	24.64 <sup>a</sup> (21.72, 37.84)	2019–2022	7.66 (–11.91, 18.67)	–	–	19.76 (16.44, 23.41)
60+	2011–2013	92.07 <sup>a</sup> (57.36, 122.03)	2013–2019	17.92 <sup>a</sup> (11.74, 23.26)	2019–2022	–17.79 <sup>a</sup> (–31.53, –7.91)	16.78 <sup>a</sup> (13.62, 19.93)
<b>Region</b>							
Central-West	2011–2016	15.28 (–4.57, 23.03)	2016–2019	48.79 <sup>a</sup> (33.09, 62.03)	2019–2022	11.52 (–12.28, 21.91)	
North	2011–2022	22.47 <sup>a</sup> (18.85, 26.23)	–	–	–	–	22.47 <sup>a</sup> (18.85, 26.23)
Northeast	2011–2022	26.38 <sup>a</sup> (22.47, 30.43)	–	–	–	–	26.38 <sup>a</sup> (22.47, 30.43)

(Table 2 continues on next page)



	Segment 1	APC (95% CI)	Segment 2	APC (95% CI)	Segment 3	APC (95% CI)	AAPC (95% CI-full range)
(Continued from previous page)							
South	2011–2019	28.25 <sup>a</sup> (23.58, 38.13)	2019–2022	-4.22 (-29.49, 11.35)	-	-	18.44 <sup>a</sup> (13.63, 22.83)
Southeast	2011–2019	24.93 <sup>a</sup> (18.91, 52.76)	2019–2022	8.51 (-15.15, 22.48)	-	-	20.22 <sup>a</sup> (15.99, 25.32)
Brazil	2011–2019	26.42 <sup>a</sup> (23.05, 43.04)	2019–2022	8.06 (-12.82, 20.27)	-	-	21.13 <sup>a</sup> (17.50, 25.33)
<b>Race-color</b>							
Asian descendants	2011–2013	5.26 (-9.21, 29.26)	2013–2022	29.57 <sup>a</sup> (16.42, 48.90)	-	-	24.77 <sup>a</sup> (21.67, 29.63)
Black	2011–2022	22.36 <sup>a</sup> (17.96, 26.99)	-	-	-	-	22.36 <sup>a</sup> (17.96, 26.99)
Brown/mixed race	2011–2022	27.46 <sup>a</sup> (22.61, 32.66)	-	-	-	-	27.46 <sup>a</sup> (22.61, 32.66)
Indigenous	2011–2013	134.97 <sup>a</sup> (65.32, 204.47)	2013–2022	16.02 <sup>a</sup> (9.67, 20.83)	-	-	31.91 <sup>a</sup> (26.36, 37.53)
White	2011–2019	25.18 <sup>a</sup> (17.16, 65.51)	2019–2022	5.13 (-24.51, 23.05)	-	-	19.36 <sup>a</sup> (13.78, 26.44)

Annual Percentage Change (APC) and Average Annual Percentage Change (AAPC) estimates by JoinPoint Regression. Brazil. 2011–2022. <sup>a</sup>Indicates that AAPC or APC is significantly different from zero at the alpha = 0.05 level.

**Table 2: Annual percentage changes in suicide and self-harm hospitalizations, and notification rates.**

percentage increase was observed among people declared Brown (AAPC: 5.35% (CI: 4.78–5.94) followed by the Indigenous population (AAPC: 4.78% (CI: 0.65, 9.01) (Table 1, Table 2, Table S1, and Figure S5)).

The main methods of suicide were self-injuries (X70–X84), corresponding to 88.5% (n = 130,701) of cases throughout the period. Among these injuries, hanging was the most frequent method used (69.1%, n = 101,994), followed by firearm injuries (8%, n = 11,745). In the self-poisoning group (X60–X69) (11.5%, n = 16,997), self-poisoning due to use of various drugs (4.6%, n = 6,736) and pesticides (3.6%, n = 5,317) predominated. The frequency of methods used for suicide for males and females followed the same pattern as in the general population, with a higher frequency of self-injuries than self-poisoning (Table 3).

## Discussion

Self-harm notifications and suicide are increasing (21.13%, and 3.70%, respectively). However, the hospitalisation rate did not experience a statistically significant increase. Indigenous people are those most affected by notifications and suicides but have the lowest hospitalisation rate. Women continue to be the most affected by self-harm for both notifications and hospitalisations, and males most affected by suicide. Self-poisonings were the most prevalent methods for self-harm notifications and hospitalisations, while self-injury was most prevalent among suicides.

While the global suicide rate has decreased worldwide, Brazil had an increase in self-harm and suicide rates, following an increase in overall rates in Latin America, and countries such as Uruguay, Argentina, and Mexico.<sup>1,21</sup> Previous studies have shown increased suicide rates in Brazil,<sup>7,19</sup> with relative stability observed during the COVID-19 period (until 2020).<sup>8,9</sup> Our study, with the extension of data to 2022, aligns with these results for the pandemic period, underscoring the

persistent increase in suicide rates over time, and in opposition to some hypothesis that suicide had reduced due to the pandemic.<sup>9,22</sup> Our study also introduces new insights, by revealing a substantial increase in self-harm notifications, a previously unexplored dataset for the entire country, with a specific focus on groups, such as Indigenous people and the younger population. The use of real-world data, as demonstrated in Brazil, can inform research, healthcare, prevention strategies, and clinical practice, to address critical public health concerns, and offer valuable real-world insights for evidence-based interventions and policies.

The rise in suicide and self-harm may suggest offer greater exposure to risk factors, such as an increase in the prevalence of mental disorders, with direct impacts on health services,<sup>23,24</sup> and an association with socio-economic factors, such as increased social inequality and poverty.<sup>23,24</sup> Previous studies demonstrated a reduced suicide rate due to socioeconomic protection.<sup>25,26</sup> These multifactorial risk factors may contribute to differences in suicide rates between the regions. Regional suicide rate variations in Brazil are consistent with the findings of a previous study,<sup>19</sup> reporting higher suicide rates in the South, Central-West, and Southeast, compared to the North and Northeast regions of the country.

Brazil follows the world pattern in terms of differences found for sex, with men being more likely to become victims of suicide, and women generally presenting more self-harm notifications and hospitalisations.<sup>1,6,10</sup> As in the previous study,<sup>19</sup> suicide was almost four times more frequent in men, and notifications were more than twice as frequent in women.

Self-harm notifications and hospitalisations were more prevalent among younger people (10–24 age range), while suicide rates were higher among the elderly, and adults, in Brazil. However, attention is drawn to the largest percentage increase in all rates among young people over time. In relation to race/

Cause groups	Overall N (%)	Male N (%)	Female N (%)
<b>Suicide</b>	<b>147,698 (100.00)</b>	<b>115,903 (78.47)</b>	<b>31,795 (21.53)</b>
<b>Suicide by Intentional self-poisoning</b>	<b>16,997 (11.51)</b>	<b>9746 (8.41)</b>	<b>7251 (22.81)</b>
X60–X61. X63–X64: Intentional self-poisoning by drugs	6736 (4.6)	2983 (2.6)	3753 (11.8)
X68: Intentional self-poisoning by exposure to pesticides	5317 (3.6)	3480 (3.0)	1837 (5.8)
X69: Intentional self-poisoning by exposure to other unspecified chemicals and noxious substances	2767 (1.9)	1595 (1.4)	1172 (3.7)
X62: Intentional self-poisoning by exposure to narcotics and psychodysleptics [hallucinogens] not classified elsewhere	964 (0.7)	705 (0.6)	259 (0.8)
X65: Intentional self-poisoning by exposure to alcohol	670 (0.5)	561 (0.5)	109 (0.3)
X67: Intentional self-poisoning by exposure to carbon monoxide and other gases and vapors	396 (0.3)	330 (0.3)	66 (0.2)
X66: Intentional self-poisoning by exposure to organic solvents, halogenated hydrocarbons and their vapors	147 (0.1)	92 (0.1)	55 (0.2)
<b>Suicide by intentional self-harm</b>	<b>130,701 (88.49)</b>	<b>106,157 (91.59)</b>	<b>24,544 (77.19)</b>
X70: Intentional self-harm by hanging, strangulation, and suffocation	101,994 (69.1)	84,185 (72.6)	17,809 (56.0)
X72–X74: Intentional self-harm by firearm	11,745 (8.0)	10,579 (9.1)	1166 (3.7)
X80: Intentional self-harm by jumping from a high place	5581 (3.8)	3545 (3.1)	2036 (6.4)
X78–X79: Intentional self-harm by sharp or blunt object	3196 (2.2)	2644 (2.3)	552 (1.7)
X84: Intentional self-harm by unspecified methods	3138 (2.1)	2154 (1.9)	984 (3.1)
X76: Intentional self-harm by smoke, fire, and flames	2100 (1.4)	987 (0.9)	1113 (3.5)
X71: Intentional self-harm by drowning and submersion	1571 (1.1)	1002 (0.9)	569 (1.8)
X82: Intentional self-harm by crashing a motor vehicle	670 (0.5)	514 (0.4)	156 (0.5)
X83: Intentional self-harm by other specified methods	301 (0.2)	237 (0.2)	64 (0.2)
X81: Intentional self-harm by jumping or lying in front of a moving object	263 (0.2)	205 (0.2)	58 (0.2)
X75: Intentional self-harm by explosive material	72 (0.0)	55 (0.0)	17 (0.1)
X77: Intentional self-harm by steam, hot vapors and objects	70 (0.0)	50 (0.0)	20 (0.1)
<b>Hospitalized suicide attempt</b>	<b>104,458 (100)</b>	<b>58,622 (56.12)</b>	<b>45,836 (43.88)</b>
<b>Hospitalization by Intentional self-poisoning</b>	<b>68,899 (65.96)</b>	<b>32,447 (55.35)</b>	<b>36,452 (79.53)</b>
X60–X61. X63–X64: Intentional self-poisoning by drugs	40,743 (39)	14,472 (24.69)	26,271 (57.32)
X65: Intentional self-poisoning by exposure to alcohol	11,488 (11)	9365 (15.98)	2123 (4.63)
X69: Intentional self-poisoning by exposure to other unspecified chemicals and noxious substances	7244 (6.93)	3430 (5.85)	3814 (8.32)
X68: Intentional self-poisoning by exposure to pesticides	6336 (6.07)	3389 (5.78)	2947 (6.43)
X62: Intentional self-poisoning by exposure to narcotics and psychodysleptics [hallucinogens] not classified elsewhere	1666 (1.59)	1043 (1.78)	623 (1.36)
X67: Intentional self-poisoning by exposure to carbon monoxide and other gases and vapors	696 (0.67)	372 (0.63)	324 (0.71)
X66: Intentional self-poisoning by exposure to organic solvents and halogenated hydrocarbons and their vapors	726 (0.7)	376 (0.64)	350 (0.76)
<b>Hospitalization by Intentional self-harm</b>	<b>35,559 (34.04)</b>	<b>26,175 (44.65)</b>	<b>9384 (20.47)</b>
X80: Intentional self-harm by jumping from a high place	8525 (8.16)	6754 (11.52)	1771 (3.86)
X78–X79: Intentional self-harm by sharp or blunt object	10,056 (9.63)	7800 (13.31)	2256 (4.92)
X84: Intentional self-harm by unspecified methods	6267 (6)	4190 (7.15)	2077 (4.53)
X72–X74: Intentional self-harm by firearm	3470 (3.32)	3039 (5.18)	431 (0.94)
X76: Intentional self-harm by smoke, fire, and flames	2549 (2.44)	1092 (1.86)	1457 (3.18)
X83: Intentional self-harm by other specified methods	1916 (1.83)	1379 (2.35)	537 (1.17)
X70: Intentional self-harm by hanging, strangulation, and suffocation	1322 (1.27)	941 (1.61)	381 (0.83)
X82: Intentional self-harm by crashing a motor vehicle	579 (0.55)	412 (0.7)	167 (0.36)
X81: Intentional self-harm by jumping or lying in front of a moving object	390 (0.37)	247 (0.42)	143 (0.31)
X75: Intentional self-harm by explosive material	215 (0.21)	161 (0.27)	54 (0.12)
X77: Intentional self-harm by steam, hot vapors and objects	135 (0.13)	73 (0.12)	62 (0.14)
X71: Intentional self-harm by drowning and submersion	135 (0.13)	87 (0.15)	48 (0.1)
<b>Self-harm notification</b>	<b>720,480 (100.00)</b>	<b>219,234 (30.43)</b>	<b>501,246 (69.57)</b>
Intentional self-poisoning	471,506 (65.44)	122,335 (55.8)	349,171 (69.66)
Other type of self-harm	132,675 (18.41)	40,960 (18.68)	91,715 (18.3)
Intentional self-harm by hanging	55,939 (7.76)	33,121 (15.11)	22,818 (4.55)
Self-injury by bodily force or self-beating	40,338 (5.60)	13,118 (5.98)	27,220 (5.43)
Intentional self-harm by hot objects	9041 (1.25)	3015 (1.38)	6026 (1.2)
Intentional self-harm by firearm	7129 (0.99)	5419 (2.47)	1710 (0.34)
Intentional self-harm by sharp or blunt object	3852 (0.53)	1266 (0.58)	2586 (0.52)

Brazil, 2011–2022.

Table 3: Percentage of suicide and self-harm hospitalizations and notifications by method.



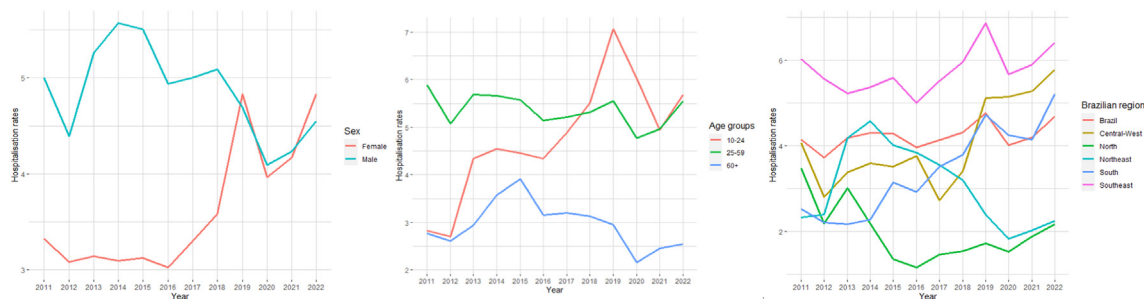


Fig. 2: Self-harm hospitalisations rates by age, sex, and Brazilian regions. Brazil. 2011–2022.

ethnicity, the highest suicide rates and self-harm notifications were found in the Indigenous population, as reported in previous Brazilian literature.<sup>19,27</sup> Despite the overall increase in suicide rates in Brazil, the Indigenous population experienced dramatically lower hospitalisations than the overall population. These results suggest that there may be barriers to accessing urgent and emergency care. The structural inequities between those who need hospital beds and those who successfully access them may result in delayed interventions and inadequate health care provision.

One of the Sustainable Development Goals is to reduce suicide rates by one third by 2030. Knowledge of the methods used to attempt suicide explains an important part of the differences in hospitalisation and mortality rates, since the forms used may imply lethality, in addition to helping to guide suicide prevention programs, in order to adopt effective strategies.<sup>28</sup> Injuries continue to be the main cause of suicide in the country, with a highlight on hanging, as found in previous studies.<sup>19,28</sup> Self-poisoning also continues to be an important factor in completed suicide, and is the main cause of hospitalisations and self-harm notifications.

Our study, which links distinct self-harm notifications, hospitalisations, and mortality datasets, enabled us to understand suicide and self-harm trends, and revealed inequalities that would not otherwise be

evidenced when the focus is on a single outcome. However, this study has a number of limitations: (1) as for everywhere in the world for these sensitive outcomes, there is always a possibility of underreporting, despite improvements in system quality over the years in Brazil. (2) Hospitalisations only comprise those after 24 h in public or SUS-affiliated hospitals.<sup>8–10</sup> Self-harm hospitalisations that resulted in less serious physical harm, or were not attended by the SUS, were not included in our study. (3) Additionally, the notifications also refer to self-inflicted violence in all health services, and we were not able to differentiate self-harm notifications from hospitalisations. It is also important to note that self-harm notifications are more recent, and the rate increase may also reflect improvements in the system over time. Therefore, it is important to exercise caution when interpreting the results. Studies conducted in some states and capitals reveal that the system has specific challenges, such as data collection by professionals and standardization of information.<sup>29–31</sup> When assessing the completeness, consistency, and duplicity of the system, these dimensions were rated as moderate, outstanding, and satisfactory, respectively.<sup>31</sup> However, this is one of the few studies that accessed data on self-harm, not only of suicide, in order to understand behaviour among multiple groups, and using a national dataset.

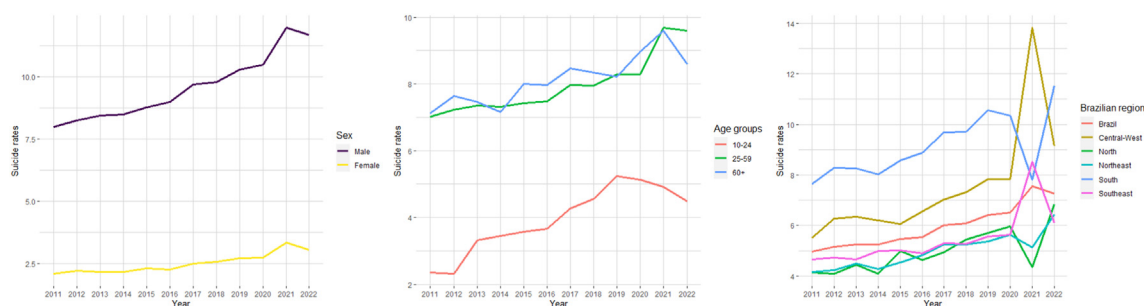


Fig. 3: Suicide rates by age, sex, and Brazilian regions. Brazil. 2011–2022.

## Conclusion

To the best of our knowledge, this is the first study to examine and compare temporal trends, not only for suicide, but also for self-harm notifications and for hospitalisations across sex, age, race/ethnicity, and regions, during 2011–2022, on a national database. Due to the lack of data on self-harm, there are important gaps in studies on this outcome around the world. The observed trend of an increase in self-harm and suicide rates suggests the need for a higher allocation of resources, and planning strategies to reduce risk factors associated with suicide, such as social inequality, and access to mental health care. Suicide is a public health priority, and Brazil provides three distinct databases for self-harm which are not always available in other countries. Although reliable registration and regular monitoring of suicide are some of the strategic foundations for prevention,<sup>28</sup> data access remains a global challenge worldwide. The use of real-world data as an example to facilitate information access and evidence-based planning is an essential prevention strategy.

## Contributors

All authors contributed to the study conception and design. EF had access to raw data and FJOA and EF have accessed and verified the data, performed material preparation, data collection and analysis. The first draft of the manuscript was written by FJOA, EF, DBM and all authors commented on previous versions of the manuscript. JAPA, JN, MB and VP contributed reviewing and editing the final version. All authors read, approved the final manuscript and were responsible for the decision to submit the manuscript. FJOA had the final responsibility to submit the manuscript.

## Data sharing statement

The data used are public and available from the Brazilian Ministry Health (DATASUS), and Brazilian Statistics Institute (IBGE). Websites: <http://www2.datasus.gov.br/DATASUS/index.php>.

## Declaration of interests

Authors report no conflicts of interest.

## Acknowledgements

None.

## Appendix A. Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.j.lana.2024.100691>.

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