

Suicide among Indigenous peoples in Brazil from 2000 to 2020: a descriptive study



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Summary

Background Previous studies in Australia, Canada, and Brazil, found that suicide among ethnic minority groups is higher than in the general population. Indigenous peoples in Brazil have been reported to have a high suicide rate, with reports of suicide clusters occurring in several communities. The objective of this study was to report trends in countrywide suicide rates among Indigenous peoples in Brazil between 2000 and 2020, and to compare these with the non-Indigenous population.

Methods This ecological study used Indigenous suicide data collected from all regions of Brazil during a 21-year period, between 2000 and 2020. We used suicide estimates from the Mortality Information System (SIM), available at the Brazilian Health Ministry website (DATASUS). Suicide mortality rates by state and region were calculated using the estimated Indigenous population from the 2010 census, and estimated population proportions for the other years. We performed a trend analysis and compared trends in suicide between the Indigenous and non-Indigenous population during the period studied.

Findings Suicide rates among Indigenous Brazilians have reached more than two and a half times the levels for the overall Brazilian population in 2020 (17.57 suicide deaths versus 6.35 suicide deaths per 100,000 inhabitants, respectively). The Central-West region of Brazil had the highest suicide rates among Indigenous Brazilians over the study period, reaching 58.8 deaths/100,000 inhabitants in 2008. The younger age group (10–24 years old) had the highest suicide rates for all the years studied. Time-series analyses showed a trend of statistically significant increases in suicide rates in Brazil for both the Indigenous and non-Indigenous population during the study period. The North region, and specifically Amazonas state, has shown a decisive increase in suicide rates among the Indigenous populations. The suicide rate for Indigenous people in Brazil, excluding cases in Amazonas and Mato Grosso do Sul states, were similar to those for the entire Brazilian population, showing that the Indigenous peoples who are the most vulnerable to suicide reside in these locations.

Interpretation While there were statistically significant increases in suicide rates for all Brazilians over the study period, they remained alarmingly high among Indigenous people, compared to their non-Indigenous counterparts. The high suicide rates among Indigenous people, and younger individuals in particular (aged between 10 and 24), reinforces the need for specific prevention strategies for these populations. Further studies should be concentrated on determining risk factors in distinct ethnic groups, specifically within regions experiencing an elevated risk, such as the states of Amazonas and Mato Grosso do Sul.

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Research in context

Evidence before this study

The first author searched relevant articles using PubMed (from 1990) up to 2020. The search strategy included MeSH terms and free text. Terms included "Indigenous", "suicide rates", "Brazil", "Suicide". Articles were not restricted by language or publication type. Relevant studies were screened and selected. Studies were restricted to the period of the study (2000–2020). There was no study about suicide rates of countrywide indigenous peoples in Brazil on the period we selected. There were studies on the subject between 1990 and 2000 and studies restricted to specific indigenous peoples or specific States or cities or specific age groups. We found studies focussed on suicide rates of the whole Brazilian population. Those studies showed that the Indigenous Brazilian peoples had the highest rates when stratified by race/ethnicity.

Added value of this study

This study is the first to report rates of suicide among the whole Indigenous peoples of Brazil in the years 2000–2020 and compare the rates by sex, age, and region to the non-indigenous Brazilian population.

Implications of all the available evidence

The rates reported in the study, as well as the time-series, show a trend of increasing suicide rates among Indigenous and non-indigenous Brazilians between 2000 and 2020. Indigenous peoples in Brazil endure several public health challenges including high child mortality, high rates of alcohol use disorder and suicide. This study reports an alarming high rate of suicide among younger indigenous men and higher rates in specific regions and States of Brazil. Studies focused on ethnic groups living in those high suicide rate areas that include variables on cultural and religious aspects are needed to understand the risk factors of suicide among this population.

Introduction

Suicide is a major public health problem worldwide. The World Health Organization reports that, globally, one person dies from suicide every 45 s.¹ There are previous reports of high suicide rates among ethnic minorities in South American countries and among Indigenous peoples in particular.² Similar trends of higher suicide rates among Indigenous peoples were also found among Australian aboriginals and Indigenous peoples in New Zealand, Canada, and the United States.³

Brazil has a relatively low suicide rate, compared to other countries (5.7/100,000 inhabitants in 2019), such as the United States (13.9/100,000 inhabitants in 2019), or Austria (14.6/100,000).^{4,5} However, recent studies have found that these rates are increasing.^{6,7} From 1990 to 2019, the overall mortality rate, due to suicide, increased by 46% (95% UI: 37.2–59.9).⁸ The ethnic group (race/colour is the term that the Brazilian government uses) experiencing the highest suicide rates in Brazil is the Indigenous population.⁶

Brazil has the largest absolute number of Indigenous peoples, compared to other countries in Latin America (approximately 896,917 individuals in 2010), although they correspond to only 0.4% of the total Brazilian population, according to the Brazilian Institute of Statistics and Geography (<https://indigenas.ibge.gov.br/graficos-e-tabelas-2.html>). The 2010 demographic census identified 305 ethnic groups that speak 274 different languages, representing one of the most ethnically diverse Indigenous populations in Latin America.² Most of Brazil's Indigenous population lives in the North and

Central-West regions (Table 1), concentrated in the states of Amazonas (183,514 individuals) and Mato Grosso do Sul (77,025 individuals)⁹ (Table 1). The 2010 Brazilian national census estimated that 61.47% of Indigenous peoples in Brazil live in rural areas, while 57.7% live on Indigenous lands, which are legally designated territories owned by them (Table 1). Previous studies have reported that suicide rates among Indigenous peoples in Brazil are double those of the non-Indigenous populations and can reach rates seven times higher than the non-Indigenous population in the Central-West region.^{10,11} A number of Indigenous ethnicities are experiencing clusters of suicide deaths, with reports of six suicides in just one week in a small community of Guarani-Kaiwá from Dourados, in Mato Grosso do Sul state.¹² Repeated household suicide deaths have also been reported among young people in the same Indigenous group.¹³

There has been an increasing awareness of the impact that suicide has on public health.¹ In order to inform efforts to mitigate the dramatic disparities in suicide deaths among Indigenous peoples in Brazil, we need to characterise patterns of suicide deaths over time. Therefore, the purpose of this study was to report and describe the suicide rates among Indigenous people from all regions of Brazil between 2000 and 2020, and investigate differences by demographic characteristics and region. Current knowledge of Brazilian Indigenous suicide rates is restricted to specific states and regions, and over shorter time periods. Detailed information on suicide rates and their changes over time in Brazilian territory is essential, to

Regions and states	Indigenous population		
	Total	Percentage in Indigenous lands	Percentage not in Indigenous lands
Brazil	896,917	517,383 (57.68)	379,534 (42.32)
North	342,836	251,891 (73.47)	90,945 (26.53)
Rondônia	13,076	9217 (70.49)	3859 (29.51)
Acre	17,578	13,308 (75.71)	4270 (24.29)
Amazonas	183,514	129,529 (70.58)	53,985 (29.42)
Roraima	55,922	46,505 (83.16)	9417 (16.84)
Pará	51,217	35,816 (69.93)	15,401 (30.07)
Amapá	7411	5956 (80.37)	1455 (19.63)
Tocantins	14,118	11,560 (81.88)	2558 (18.12)
Northeast	232,739	106,142 (45.61)	126,597 (54.39)
Maranhão	38,831	29,621 (76.28)	9210 (23.72)
Piauí	2944	0	2944 (100)
Ceará	20,697	2988 (14.44)	17,709 (85.56)
Rio Grande do Norte	2597	0	2597 (100)
Paraíba	25,043	18,296 (73.06)	6747 (26.94)
Pernambuco	60,995	31,836 (52.19)	29,159 (47.81)
Alagoas	16,291	6268 (38.48)	10,023 (61.52)
Sergipe	5221	316 (6.05)	4905 (93.95)
Bahia	60,120	16,817 (27.97)	43,303 (72.03)
Southeast	99,137	15,904 (16.04)	82,233 (82.95)
Minas Gerais	31,677	9682 (30.56)	21,995 (69.44)
Espírito Santo	9585	3005 (31.35)	6580 (68.65)
Rio de Janeiro	15,894	450 (2.83)	19,444 (122.34)
São Paulo	41,981	2767 (6.59)	39,214 (93.41)
South	78,773	33,427 (42.43)	39,346 (49.95)
Paraná	26,559	11,934 (44.93)	14,625 (55.07)
Santa Catarina	18,213	9227 (50.66)	8986 (49.34)
Rio Grande do Sul	34,001	18,266 (53.72)	19,735 (58.04)
Central-West	143,432	104,019 (72.52)	39,413 (27.48)
Mato Grosso do Sul	77,025	61,158 (79.4)	15,867 (20.6)
Mato Grosso	51,696	42,525 (82.26)	9171 (17.74)
Goiás	8583	336 (3.91)	8247 (96.09)
Distrito Federal	6128	0	6128 (100)

Table 1: Indigenous population, by household location and proportion living in indigenous lands, stratified by states and regions according to the 2010 Population Census.

better understand any possible risk factors. This data will also assist policymakers with allocating resources to areas and populations of higher need, and to inform prevention efforts for population groups at the greatest risk of suicide.

Methods

Study design

This ecological study used Brazilian Mortality Information System (SIM) data, collected between 2000 and 2020. The mortality data was collected through SIM and is available through the IT Department of the Unified National Health System (DATASUS), provided by the Brazilian Health Ministry (<https://datasus.saude.gov.br/>). Population data was retrieved from the Brazilian Institute of Geography and Statistics (IBGE)/demographic census.

Numerator

All rates were calculated using the numerator as causes of death coded for intentional self-harm X60-X84, from ICD-10 (International Statistical Classification of Diseases and Related Health Problems, 10th version), taken from the Mortality Information System (SIM), provided by the Brazilian Ministry of Health (<https://datasus.saude.gov.br/>). Codes X60 to X84 include all intentional self-injuries and intentional self-intoxication causes of death. Suicide deaths in Brazil are determined by medical-legal doctors (“médico legista”) through autopsy performed in Medical-legal institutes (IML), if there are no Medical-legal institutes available in the region, a judge may assign a local doctor to perform the autopsy. This procedure may include laboratory and imaging tests, as well as interviews with the family. Medical-legal doctors are professionals that represent the police in the

public security system and are skilled in the use of medical knowledge applied to the needs of Justice.

We selected the death certificates with suicide deaths reported among people classified as Indigenous. The race/colour of the deceased (terminology used by the Brazilian government) is assigned by medical-legal doctors by visual inspection and interviews with the family of the deceased, the quality of reporting of deaths in the Brazilian Mortality Information System (SIM) was considered of high quality for most of the study period.^{14,15}

Denominator

The denominator was calculated using Brazilian Indigenous population estimates from the 2010 national census.⁹ The Brazilian census comprises two questionnaires: the basic and sample questionnaires. The basic questionnaire is a survey used in all households visited by a census officer, whereas the sample questionnaire is only applied to a selected number of households and has a more extensive list of questions (collected in approximately 11% of households). The 2010 census was used in this study since it is the most up-to-date available source of information on the demographic composition of the Brazilian population, was the first to include the race/colour question in the basic questionnaire, and to include specific questions on ethnicity and spoken languages. Additionally, the 2010 census included not only a race/colour self-declaration item, but also a question addressed at people living on Indigenous lands who did not self-declare as Indigenous. This is decisive since there are reports of people who live on indigenous land and identify with Indigenous cultures and traditions, but do not self-declare as Indigenous. Therefore, we believe that the Brazilian 2010 census more accurately reflects the Indigenous population living in Brazil.¹⁶

The process of calculating the denominator included the following steps: first, we estimated the proportion of Indigenous peoples in the 2010 census, by sex, age group, and region. Next, we obtained the annual estimations of the entire population residing in Brazil, provided by the Brazilian Institute of Geography and Statistics (IBGE). Finally, we calculated the Indigenous population between 2011 and 2020, based on the proportions established in the 2010 census. The same steps were repeated to estimate the Indigenous population between 2001 and 2009, relying on the proportions reported in 2010. For 2000, we used the population estimates for that year. Annual population estimations for the Indigenous population, stratified by age, sex, and regions, are only available in census years; therefore, we were not able to include annual variations in the population in the suicide rate estimation for the Indigenous population, which may influence our results. The option to apply the proportions of Indigenous people from the 2010 census to official estimations of the total Brazilian population derives from the idea that this method appears to be the most conservative. It does not consider

that the Indigenous category may have an unequal population growth rate in relation to other race/colour categories, but incorporates the growth of the general Brazilian population, and prevents distortions in the comparison between different race/colour categories.

Variables

Rates were stratified by sex, age (10–24; 25–59; and 60 and over), region (defined by the Brazilian Institute of Geography and Statistics, according to geographical differences in the Brazilian territory), and state of residence. The most frequent methods of suicide included intentional self-harm injuries, and intentional self-intoxication causes of death (X-60 to X-84 ICD-10 codes), which were estimated by sex for Indigenous and non-Indigenous individuals in this study, all rates were calculated per 100,000 inhabitants.

We calculated the suicide rates for all the Brazilian regions and states, and determined whether there were states with disproportionately high Indigenous suicide rates. Furthermore, we then examined suicide rates for the Brazilian population following removal of any high contributor states, to estimate the relative impact they may have in contributing to national suicide rates.

Statistical analysis

We analysed the trend of suicide rates for Indigenous and non-Indigenous people in Brazil using the Mann–Kendall test (Fig. 1). The purpose of the analysis was to statistically verify whether there was a monotonous trend in the data series over time. The Mann–Kendall test was chosen since it assumes that the sample observations are independent, have the same distribution, and are not correlated over time.¹⁷ The alpha was set at 0.05. This method is non-parametric.

Ethics statement

This study used mortality data publicly available at <https://datasus.saude.gov.br> and population Census data available at <https://ibge.gov.br>. The data was previously anonymised by the Brazilian Health Ministry and the Brazilian Institute of Geography and Statistics (IBGE). No consent or ethics approval was required.

Role of the funding source

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Results

Descriptive data

Suicide rates among Indigenous peoples ranged between 8.53/100,000 in 2001, and 22.04/100,000 in 2017.

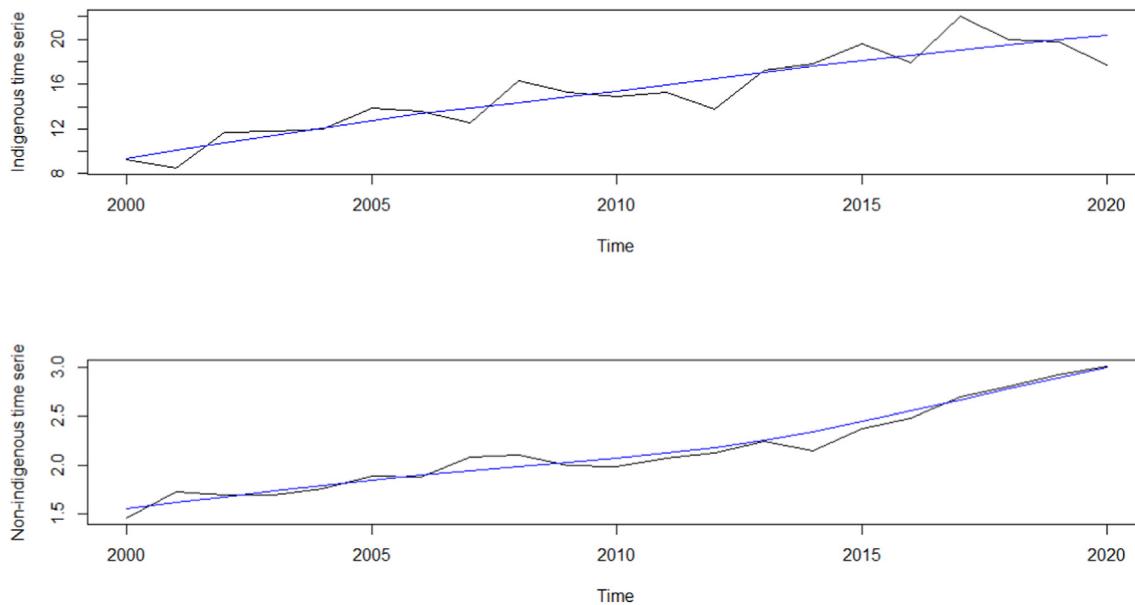


Fig. 1: Time series of suicide rates (per 100,000 inhabitants) for indigenous and non-indigenous populations between 2000 and 2020. The years are displayed horizontally and the respective suicide rates vertically. The black lines are the original suicide rate series, and the blue lines display the series trend over the years. The two populations (indigenous and non-indigenous) demonstrate increasing suicide rates over the years.

The main method for suicide for both sexes was hanging, strangulation, or suffocation (88.3% for men and 90.1% for women) (Table 2). The second most frequent method of suicide among Indigenous women was self-intoxication by pesticides (3%), and use of firearms among Indigenous men (X72-X74) (4.1%) (Table 2). Indigenous peoples in Brazil had higher suicide rates by hanging, compared to non-Indigenous Brazilians, for both men and women (Table 2). Non-Indigenous Brazilians have higher suicide rates by firearm use for both women and men (Table 2).

The region with the highest rates of death by self-harm in all years of the study was the Central-West, ranging between 29.55 in 2013, and 58.8 in 2008, followed by the North region, which exhibited rates ranging between 2.77/100,000 in 2000, and 35.99/100,000 in 2017 (Fig. 2, Fig. S1). More specifically, Mato Grosso do Sul state had the highest suicide rates (ranging from 47.7/100,000 in 2013, to a peak of 105.03/100,000 in 2005), followed by Amazonas (ranging from 0.99/100,000 in 2000, to 44.94/100,000 in 2014), and Roraima (reaching 44.47 in 2017). In the 20-year period of the study, rates show a decrease in suicide among Indigenous peoples in Mato Grosso do Sul, and an increase in Amazonas state (Fig. S3).

The younger age group, comprising individuals aged between 10 and 24, had the highest rate of deaths by suicide, when compared to older age groups, with rates ranging between a low of 12.77/100,000 in 2001, to a high of 33.8/100,000 in 2015 (Fig. 2). The higher rate of suicides in this younger age group, compared to older

age groups, persisted for all years of the study period (Fig. 2). The 25–59 age group experienced the second-highest suicide rates, as reflected in Fig. 2, with an increase in suicides observed between 2016 and 2018, followed by a decrease in subsequent years.

Most of the Indigenous individuals who were suicide victims were male (Fig. 3), single (67.9%) (Table 3) and had an elementary level of education (26.9%) (Table 3). We observed that the two states with the highest suicide rates were Amazonas and Mato Grosso do Sul. For this reason, we also plotted the suicide rates for the Indigenous population without these states, to help gauge the relative weight they had on overall suicide rates among Indigenous peoples (Fig. 4). The rates without Amazonas and Mato Grosso do Sul are lower, and closer to that of the general Brazilian population, suggesting a possible clustering of suicides among Indigenous peoples in these states.

Main results

The trend test showed a statistically significant growth in suicide rates, both in the Brazilian Indigenous (p-value < 0.0001) and non-Indigenous populations (p-value < 0.0001) during the study period. The trend test (Fig. 1) showed an increase in suicide rates in both Brazilian Indigenous and non-Indigenous populations.

Discussion

As observed in many Indigenous populations elsewhere in the world, Indigenous peoples in Brazil showed the

	Overall	Both sexes (p-value <0.0001) ¹		Men (p-value < 0.0001) ²		Women (p-value < 0.0001) ³	
		Non-indigenous	Indigenous	Non-indigenous	Indigenous	Non-indigenous	Indigenous
	208,110 (100.0)	197,998 (0.95)	2021 (0.01)	156,170 (0.79)	1481 (0.73)	41,821 (0.21)	538 (0.27)
Intentional self-poisoning	27,885 (0.13)	26,228 (0.13)	111 (0.05)	15,607 (0.1)	72 (0.05)	10,621 (0.25)	39 (0.07)
X68: Intentional self-poisoning by exposure to pesticides	11,366 (5.5)	10,762 (5.4)	40 (2.0)	6990 (4.5)	24 (1.6)	3772 (9.0)	16 (3.0)
X60-X61, X63-X64: Intentional self-poisoning by drugs	7932 (3.8)	7611 (3.8)	11 (0.5)	3396 (2.2)	7 (0.5)	4215 (10.1)	4 (0.7)
X69: Intentional self-poisoning by exposure to other unspecified chemicals, and noxious substances	6235 (3.0)	5587 (2.8)	46 (2.3)	3457 (2.2)	31 (2.1)	2130 (5.1)	15 (2.8)
X62: Intentional self-poisoning by exposure to narcotics and psychedelics [hallucinogens], not classified elsewhere	906 (0.4)	877 (0.4)	1 (0.0)	668 (0.4)	1 (0.1)	209 (0.5)	0 (0.0)
X65: Intentional self-poisoning by exposure to alcohol	732 (0.4)	700 (0.4)	10 (0.5)	568 (0.4)	8 (0.5)	132 (0.3)	2 (0.4)
X67: Intentional self-poisoning by exposure to carbon monoxide and other gases and vapors	471 (0.2)	462 (0.2)	0 (0.0)	377 (0.2)	0 (0.0)	85 (0.2)	0 (0.0)
X66: Intentional self-poisoning by exposure to organic solvents and halogenated hydrocarbons and their vapors	243 (0.1)	229 (0.1)	3 (0.1)	151 (0.1)	1 (0.1)	78 (0.2)	2 (0.4)
Intentional self-harm	175,154 (0.84)	171,770 (0.87)	1910 (0.95)	140,563 (0.9)	1409 (0.95)	31,200 (0.75)	499 (0.93)
X70: Intentional self-harm by hanging, strangulation, and suffocation	131,181 (63.0)	124,648 (63.0)	1794 (88.8)	104,088 (66.7)	1307 (88.3)	20,555 (49.1)	485 (90.1)
X72-X74: Intentional self-harm by firearm	22,966 (11.0)	22,181 (11.2)	65 (3.2)	19,753 (12.6)	60 (4.1)	2427 (5.8)	5 (0.9)
X80: Intentional self-harm by jumping from a high place	7367 (3.5)	7172 (3.6)	5 (0.2)	4570 (2.9)	5 (0.3)	2602 (6.2)	0 (0.0)
X84: Intentional self-harm by unspecified means	5733 (2.8)	5356 (2.7)	14 (0.7)	3737 (2.4)	10 (0.7)	1618 (3.9)	4 (0.7)
X78-X79: Intentional self-harm by a sharp or blunt object	5071 (2.4)	4887 (2.5)	17 (0.8)	4011 (2.6)	15 (1.0)	876 (2.1)	2 (0.4)
X76: Intentional self-harm by smoke, fire, and flames	3583 (1.7)	3387 (1.7)	3 (0.1)	1517 (1.0)	2 (0.1)	1870 (4.5)	1 (0.2)
X71: Intentional self-harm by drowning and submersion	2392 (1.1)	2281 (1.2)	7 (0.3)	1462 (0.9)	5 (0.3)	819 (2.0)	2 (0.4)
X82: Intentional self-harm by crashing a motor vehicle	869 (0.4)	840 (0.4)	2 (0.1)	651 (0.4)	2 (0.1)	189 (0.5)	0 (0.0)
X83: Intentional self-harm by other specified means	483 (0.2)	456 (0.2)	2 (0.1)	361 (0.2)	2 (0.1)	95 (0.2)	0 (0.0)
X81: Intentional self-harm by jumping or lying before a moving object	403 (0.2)	394 (0.2)	1 (0.0)	291 (0.2)	1 (0.1)	103 (0.2)	0 (0.0)
X75: Intentional self-harm by explosive material	95 (0.0)	89 (0.0)	0 (0.0)	72 (0.0)	0 (0.0)	17 (0.0)	0 (0.0)
X77: Intentional self-harm by steam, hot vapors, and hot objects	82 (0.0)	79 (0.0)	0 (0.0)	50 (0.0)	0 (0.0)	29 (0.1)	0 (0.0)

According to the adjusted chi-square test, there is a statistically significant difference between the causes of death in (1) the general indigenous and non-indigenous populations, and (2 and 3) the indigenous and non-indigenous populations stratified by sex. Values are shown as number of cases and percentage.

Table 2: Cause of death stratified by sex and race/color (indigenous and non-indigenous Brazilians).

highest suicide rates, compared to their non-Indigenous counterparts.³ Suicide rates in Indigenous people in Brazil were higher among the younger age group (10–24 years old), and among single men with elementary level education. Similar results were found in previous studies investigating suicide rates among the Indigenous population in Amazonas¹⁸ and Mato Grosso do Sul states.¹³ Older (aged 60 and over) individuals had the highest suicide rates in the Brazilian, general, non-Indigenous population during the study period.^{6,8} However, among Brazilian Indigenous people, the older age group experienced the lowest suicide rates, compared to the younger age groups (highest rate was 12.43/100,000 in 2017). Previous studies have reported that the loss of Indigenous identity and rising occurrence of sexual violence are contributors to the higher number of suicides observed among young people.¹² Income and access to economic opportunities represent important factors associated with risk of suicide. Lazzarini et al., 2018, reported that young Indigenous people from the same ethnic group (Guarani-Kaiowá),

living in two villages in Mato Grosso do Sul State, with different rates of unemployment and educational opportunities, had distinct suicide rates. Increasing alcohol use and alcohol use disorder have also been reported as factors related to high suicide rates among Indigenous youth.¹⁸

The main method of suicide reported among Indigenous peoples was hanging, suffocation, and strangulation for both males and females, followed by the use of firearms among males, and intoxication by pesticides among females. Hanging is also the most prevalent method of suicide in the overall Brazilian population,⁷ although the method of hanging reported in some Indigenous suicides appears to have particularities and symbolic meaning in specific ethnic groups.¹¹ Indigenous Brazilians had higher suicide rates by hanging, compared to non-Indigenous Brazilians, for both men and women, whereas non-Indigenous Brazilians had higher suicide rates by use of firearms for both women and men. While suicide by intoxication with pesticides (X68) was observed as the second most prevalent method of suicide among

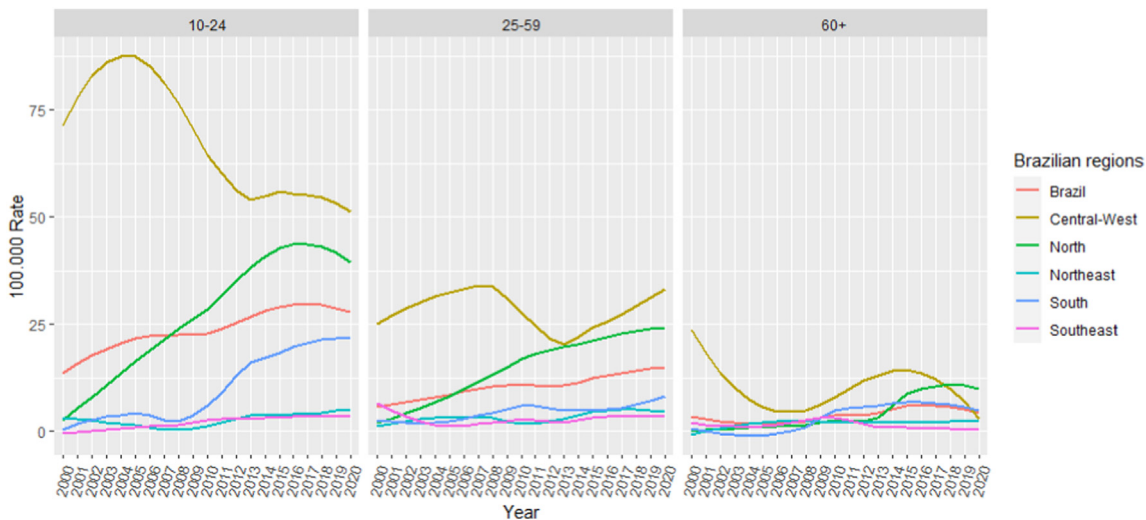


Fig. 2: Suicide rate (per 100,000 inhabitants) by age group of indigenous Brazilians.

Indigenous women (3%), this particular method is more prevalent among non-Indigenous women. Indigenous people's contact with pesticides is likely due to agriculture and cattle breeding on farms near Indigenous lands, and also the high prevalence of a previously available, non-regulated pesticide (aldicarb carbamate), used as rat poison in Brazil.¹⁹

The suicide rates observed among Indigenous women were lower than those for men in all years of the study. These disparities can partly be attributed to differences in the methods of suicide employed. For instance, Indigenous men are more likely to use

firearms as a method of suicide, and they are a highly lethal method, compared to others, such as hanging, or intoxication by pesticides, which are both more frequently used by Indigenous women.

The Mann-Kendall test demonstrated a statistically significant increase in suicide rates in the overall study period in both Brazilian Indigenous and non-Indigenous populations. Suicide rates in Brazil have been increasing in recent decades, and this has been reported in earlier studies.^{6,20} This may be partially explained by improvements in the quality of Brazilian death reporting data over the last 20 years.^{14,21} However,

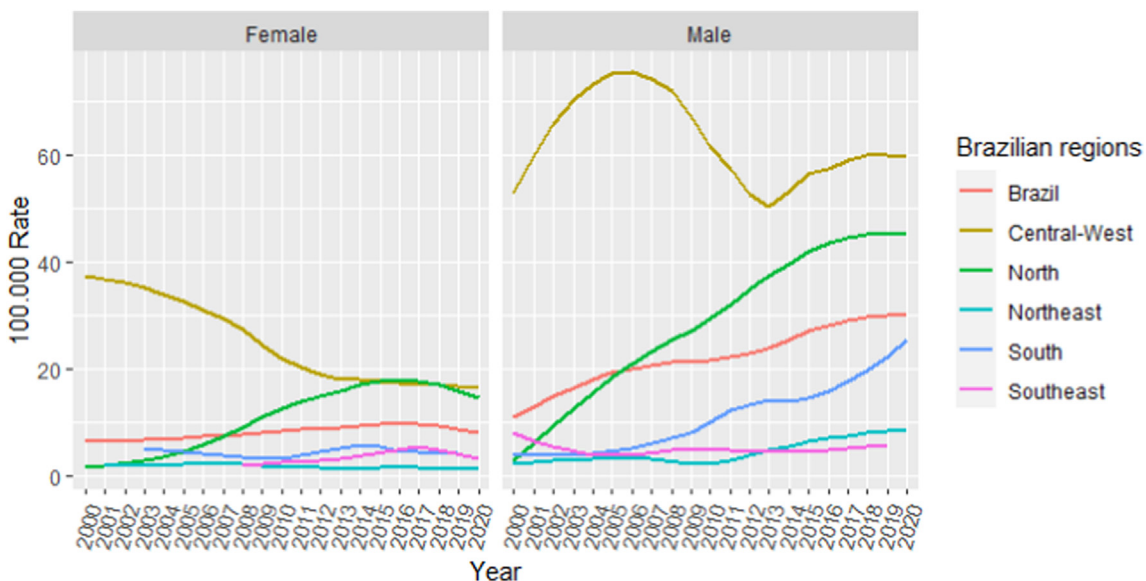


Fig. 3: Suicide rates (per 100,000 inhabitants), stratified by sex and region, of indigenous Brazilians.

	Overall	10-24 years old	25-59 years old	60 and more years old
Education level				
Overall	2021	1285	681	55
Never attended	274 (13.6)	134 (10.4)	114 (16.7)	26 (47.3)
Elementary school I	420 (20.8)	238 (18.5)	170 (25.0)	12 (21.8)
Elementary school II	544 (26.9)	415 (32.3)	125 (18.4)	4 (7.3)
High school	223 (11.0)	148 (11.5)	74 (10.9)	1 (1.8)
Higher Education (Complete or incomplete)	33 (1.6)	16 (1.2)	17 (2.5)	0 (0.0)
Missing/Unknown	527 (26.1)	334 (26.0)	181 (26.6)	12 (21.8)
Marital status				
Overall	2021	1285	681	55
Single	1372 (67.9)	1033 (80.4)	317 (46.5)	22 (40.0)
Married	240 (11.9)	64 (5.0)	159 (23.3)	17 (30.9)
Widower	22 (1.1)	1 (0.1)	13 (1.9)	8 (14.5)
Divorced	5 (0.2)	0 (0.0)	5 (0.7)	0 (0.0)
Stable union	178 (8.8)	81 (6.3)	91 (13.4)	6 (10.9)
Missing/Unknown	204 (10.1)	106 (8.2)	96 (14.1)	2 (3.6)

Table 3: Education level and marital status of the indigenous population, stratified by age groups.

studies suggest that the underreporting of suicide deaths remain a concern in some cities.^{13,21,22} For instance, Matos et al., 2007, reported that 12.9% of suicides in Belo Horizonte (a highly populated city in Southeast Brazil) were misclassified as ‘other causes of death’. Although challenges remain with suicide reporting, there have been extensive improvements in reducing “garbage codes.” These codes do not specify the underlying cause of death, particularly in the North and Northeastern regions. The improvements are a result of expansion of the Brazilian family health

program (focused on primary care teams), and government efforts introduced in 2006 to investigate these codes.²¹

Suicide rates were higher in the Central-West region during the entire period of the study (Figs. 2 and 3). Suicide rates among the Indigenous population in the Central-West reached 58.8/100,000 inhabitants in 2008, which is approximately 10 times the country-wide rate for that year. The Central-West region has a large Indigenous population (143,432), with Mato Grosso do Sul State being home to the highest number (77,025)

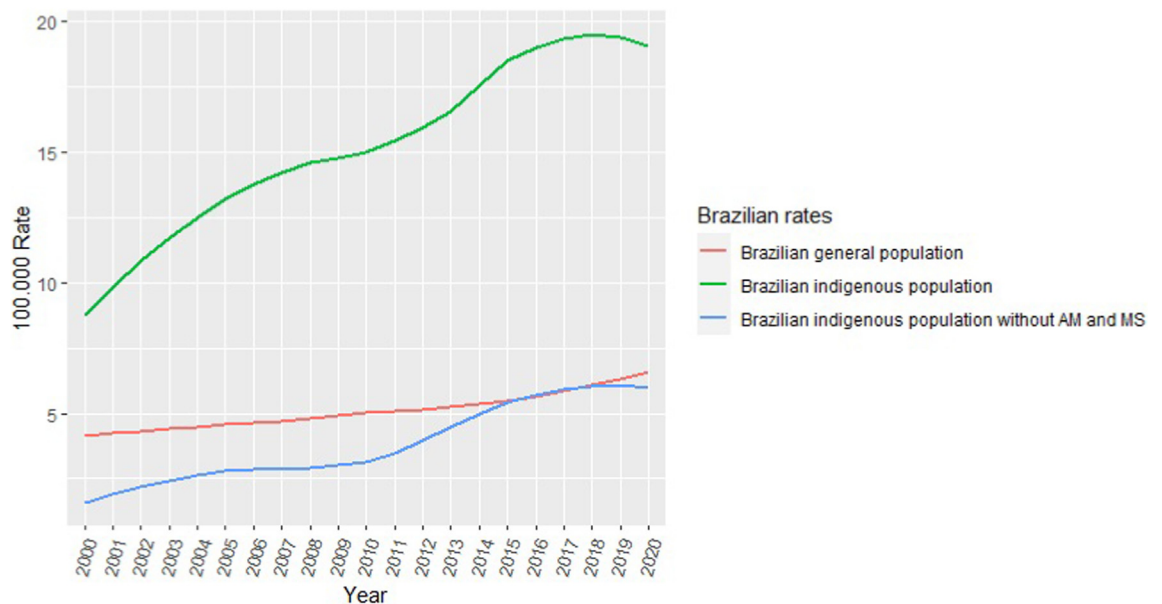


Fig. 4: Suicide rates (per 100,000 inhabitants) of Brazilian indigenous peoples, without Amazonas (AM) and Mato Grosso do Sul (MS) states, and the Brazilian general population.

(IBGE 2010 demographic census) (Table 1). The majority of the Indigenous people in the Central-West region live on Indigenous land (72.5%) (Table 1). In Mato Grosso do Sul, in particular these lands are very close to towns (Dourados, Amabai and Coronel Sapucaia), as part of a previous government strategy to assimilate and integrate Indigenous populations. The state of Mato Grosso do Sul has the highest Indigenous suicide rate in Brazil, reaching 105.3/100,000 in 2005. Mato Grosso do Sul has a history of forced displacement of Indigenous people by Jesuit missions in colonial times in Brazil. This alarming pattern persisted until recently, with the growth of commercial agriculture and cattle breeding in the region.²³ Additionally, the high concentration of extensive, rural properties in the region has resulted in conflict between Indigenous and non-Indigenous populations and has had an extremely detrimental impact on the Guarani-Kaiowá people.¹¹ Lazzarini et al., 2018 report that young Guarani-Kaiowá people have poor access to education and a lower income, compared to other ethnic groups in the same region.

More recently, the state of Amazonas has shown a trend of growing suicide rates (Fig. 4, Fig. S3). Amazonas is home to 183,514 Indigenous people, according to the 2010 census, and approximately 70.6% live on Indigenous land (IBGE 2010 demographic census) (Table 1). Amazonas also contains 42 of the 46 Brazilian Indigenous lands which are larger than 500,000 hectares.²⁴ Although this trend of rising suicide rates may be partially explained by improvements to suicide notifications in the region, other factors may be playing a role in driving these results. For instance, Amazon Indigenous lands have recently become the target of increasing mining activity and approximately 60% of current mining concessions are located in the Amazon rainforest.²⁵ Previous research has demonstrated that 9% of Amazon deforestation between 2005 and 2015 has been attributed to mining, which reaches far beyond any leased land.²⁵ The previous federal government did not conduct any extra demarcations of Indigenous lands, and also took measures to defund the National Indigenous Foundation (FUNAI), responsible for safeguarding Indigenous territory, and thereby escalating the degradation of resources to Indigenous people.²⁴ It has been reported that this hostile environment may be associated with the increase in suicide rates among the Indigenous population of Amazonas. Additionally, studies show an increase in alcohol consumption and poor access to mental health care,¹⁸ which are both important risk factors for suicide.

Limitations

The findings of this study must be considered in the context of a number of limitations. Use of the 2010 census as a reference for the Brazilian Indigenous population, resulted in a possible overestimation of this population between 2001 and 2009. The 2010 census included a question on race/colour in the main

questionnaire (answered by the entire census sample), and not in the sample questionnaire (2000 census), answered by only 10% of the sample. While Indigenous population growth between 2000 and 2010 was observed in a number of regions, such as the North, Northeast, and Central-West, a reduction was observed in the South and Southeast, resulting in a slight total population growth during the period (https://www.ibge.gov.br/indigenas/indigena_censo2010.pdf). This indicates that the estimation strategy for the Indigenous population on a more aggregated scale may not have a greater influence on estimation errors. Additionally, there is evidence that estimation of the Indigenous population may be influenced by the sociopolitical context, since self-declarations can be modified, to avoid stigma. The Indigenous population is small in some regions and, therefore, suicide rates may be vulnerable to slight demographic variations. The race/ethnicity allocated on the suicide mortality declaration in Brazil completed by the medical-legal doctor, typically through visual inspection, and information provided by the family of the deceased, which could, therefore, be subject to reporting errors.²⁶ For instance, there is evidence of the “whitening” of race assigned on Brazilian death certificates, with mixed-race individuals from wealthier backgrounds being more commonly classified as white.²⁶ Differences in suicide rates between specific Indigenous groups, or people, were not calculated, since this data is not available on the Brazilian Mortality Information System. As a consequence, these findings are difficult to interpret at the level of each specific Indigenous group, and certain ethnic groups have different cultural views on suicide and the intention of death.^{11,27} All Brazilian regions have experienced improvements with the reliability of death certificate reports in the last 20 years, but these have occurred unequally in the different regions. Some suicide rate increases may be attributable to these improvements, but not all, since death reports in Brazil were already of a moderate quality in 2000.²¹ Underreporting of suicide deaths is a worldwide challenge. Tøllefsen et al., 2012, report in a systematic review that approximately 10% of suicide deaths are misreported.²⁸ Suicide deaths are frequently classified as accidents and undetermined intent deaths. Additionally, suicide is stigmatising in some cultures and religions. Further research with smaller samples from homogeneous groups, focusing on specific Indigenous identities, supplemented with the collection of in-depth qualitative data, are important, in order to clarify specific risks.

Epidemiological studies among the Brazilian Indigenous peoples must be designed to take into account the particularities of different ethnic groups. Although some factors are common to the entire Brazilian Indigenous population, like unemployment, poor access to mental health services, low income, and conflict related to land ownership and natural resources, they are not applicable to all regions and ethnicities.

Conclusion

The use of routine health records on causes of death is of immediate use to policymakers. They can inform decisions on resource allocation, staff training and prevention measures, and increase awareness in the community of each region's specific needs. Health disparities between different races/ethnicities are a high priority public health issue in Brazil and other countries. Our findings, as in previous studies on child mortality, cancer, and the COVID-19 pandemic, demonstrate that Brazilian Indigenous peoples are a neglected group.^{29–31} The observed trend of an increase in suicide rates for both Indigenous and non-Indigenous Brazilians indicates the need for a higher allocation of resources, and planning strategies to reduce the risk factors associated with suicide, such as social inequality, and access to mental health care. Despite the overall increase in suicide rates in Brazil, the Indigenous population continues to experience dramatically higher rates, compared to their non-Indigenous counterparts. These findings highlight the urgency for government policies which are specially tailored for the Indigenous population, as a means to reduce these alarming disparities.

Contributors

All authors contributed to the study conception and design. EF performed material preparation, data collection and analysis. The first draft of the manuscript was written by JAPA, EF, DBM and all authors commented on previous versions of the manuscript. JN, FJOA, JO, AMC, MB and VP contributed reviewing and editing the final version. All authors read and approved the final manuscript.

Data sharing statement

Data can be provided by corresponding author upon request.

Declaration of interests

Authors report no conflicts of interest.

Appendix A. Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.j.lana.2023.100591>.

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