

ORIGINAL ARTICLE

Spatial-temporal trends and risk of suicide in Central Brazil: an ecological study contrasting indigenous and non-indigenous populations

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Objective: To examine spatial-temporal distribution and risk of suicide, as well as trends in suicide mortality rates, in the indigenous and non-indigenous population of the state of Mato Grosso do Sul, Brazil.

Methods: Data were obtained from the Information Department of the Brazilian Unified Health System. Deaths recorded as voluntary self-inflicted injuries (ICD-10 codes X60.0 to X84.9) were considered suicide. Suicide rates were estimated and adjusted by age in the population > 9 years of age. Kernel analysis was used to assess the spatial distribution of suicide cases, while trend analysis was carried out using a non-parametric test (Mann-Kendall).

Results: The suicide risk among the indigenous population was 8.1 (95%CI 7.2-9.0) times higher than in the non-indigenous population. For indigenous residents in the 15-24 age group, the risk was 18.5 (95%CI 17.5-19.6) times higher than in the non-indigenous population. The majority of indigenous cases were concentrated in a few villages in reservation areas, mainly occupied by Guarani-Kaiowá and Guarani-Nandeva groups. Rate patterns remained stable over time in both groups.

Conclusion: Suicide is a serious public health problem in Mato Grosso do Sul, and has had an alarming and disproportionate impact on the indigenous population for more than a decade.

Keywords: Suicide; minority issues and cross-cultural psychiatry; interdisciplinary relations; epidemiology; social anthropology

Introduction

Different studies have pointed out that Brazil presents low suicide mortality rates^{1,2} in contrast with developed countries. Nevertheless, wide variability in suicide mortality rates among the states of Brazil has been reported. Evidence also points to ethnic inequality in suicide in Brazil, with notable excess suicide mortality in the indigenous population. This is similar to observations from around the world, notably in Canada,³ Norway,⁴ the United States,⁵ Russia,⁶ and Australia.⁷

The state of Mato Grosso do Sul, Brazil, has the highest suicide mortality rate among indigenous people in the country.² According to Silviken,⁴ knowledge of the history of contact with non-indigenous society is considered a starting point for understanding suicide patterns among indigenous people. The societies of the indigenous peoples of Mato Grosso do Sul were broken up by Jesuit missionaries. Menial labor was imposed upon them by the Portuguese colonizers, and, in modern times, they have suffered the impact of the expansion of agriculture and cattle ranching in the region.⁸ Between 1920 and 1930, they were forced by the Brazilian

government to live in small areas near newly created towns so that, once "civilized," they could serve as cheap unskilled labor for the emerging regional agricultural economy.⁹

However, the overall population of Mato Grosso do Sul, both indigenous and non-indigenous, has Brazil's second highest suicide mortality rate.¹ Authors tend to attribute the high suicide mortality rate in the general population of Mato Grosso do Sul to high suicide rates among its indigenous residents, but a thorough analysis of the ethnic inequalities of suicide in this state has not been carried out. Thus, considering that suicide is a phenomenon that varies widely in space and time and is influenced by psychological, biological, economic, sociocultural, and historical factors,¹ this study set out to analyze the spatial distribution and trends of suicide mortality rates among the indigenous and non-indigenous population of Mato Grosso do Sul, Brazil.

Methods

Study area and population

The state of Mato Grosso do Sul is located in the Central-West region of Brazil, and covers an area of 357,146 km². The state consists of 78 municipalities grouped into 11 healthcare micro-regions. According to the 2010 Brazilian census, the state population is 2,449,024 individuals, of which

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around 3.0% are indigenous (self-reported).¹⁰ The indigenous population is approximately 64% Guarani-Kaiowá and Guarani-Ñandeva and 32% Terena, with the remaining 4% representing a less expressive population set, consisting of six other ethnic groups.^{11,12} The 46 Indigenous Territories (IT) in the state occupy 2.3% of its total area and are distributed into 27 municipalities. The Guarani areas are concentrated in the central and southern areas of the state, and approximately 97% of the Guarani population lives in the healthcare micro-regions of Ponta Porã, Dourados, and Naviraí in the south.

Indigenous healthcare assistance

The health of the indigenous population in Brazil is currently the responsibility of the Special Secretariat for Indigenous Health, under the Brazilian Ministry of Health (Secretaria Especial de Saúde Indígena, SESAI/MS). Healthcare actions are developed by means of the Indigenous Healthcare Subsystem (Subsistema de Atenção à Saúde Indígena, SASI) within the framework of the Brazilian Unified Health System (Sistema Único de Saúde, SUS), and are delivered by the Special Indigenous Health Districts (Distritos Sanitários Especiais Indígenas, DSEI), which are spread out across the national territory. The area of interest to the present study is served by DSEI Mato Grosso do Sul (DSEI/MS), which is responsible for delivering healthcare to approximately 75,000 indigenous Brazilians residing in 46 ITs. Vital statistics and healthcare data produced by DSEI health teams are registered in the Indigenous Healthcare Information System (Sistema de Informação da Atenção à Saúde Indígena, SIASI).

Study design

From a series of suicide cases, a descriptive ecological study with a spatial-temporal focus was performed.

Data source

Mortality data were extracted from the Information Department of the Brazilian Unified Health System (Sistema de Informação sobre Mortalidade, Departamento de Informática do Sistema Único de Saúde, SIM/DATASUS).

Population estimates were derived from 2000 and 2010 census data from the Brazilian Institute of Geography and Statistics (IBGE). Intercensal and postcensal population estimates were obtained by annual geometric interpolation. The classification used by IBGE for the skin color or race variable was based on self-reporting.

Municipal vector data and the geographic location of the ITs were obtained from the IBGE¹⁰ and the National Indian Foundation (Fundação Nacional do Índio, FUNAI),¹³ respectively.

Operational classifications

All records coded as intentional self-harm according to ICD-10 (codes X60.0 to X84.9)¹⁴ were classified as suicide.

Inclusion and exclusion criteria

The 2009-2011 period was selected for examination of the rates and characteristics of subjects aged > 9 years because it offered the greatest compatibility between the frequency of death notifications¹⁵ from SIM/DATASUS and from the SIASI.¹⁶

Analysis of the time series was based on cases reported from 2000 to 2012, as the Brazilian Ministry of Health only made registration of skin color or race compulsory on death certificates, through heteroclassification, from 1999 onward. On average, during the period 2000-2012, the percentage of suicide reports from Mato Grosso do Sul with the skin color or race field ignored or blank was 2.1%.

Variables

The following variables were evaluated: sex, marital status, skin color or race, age range, year of death, place of death, cause of death, municipality where death occurred, and day of the week in which suicide occurred. Monday through Thursday were weekdays, while Friday through Sunday were counted as weekend days.¹⁷

Analysis

Due to the importance of skin color or race data for grouping of suicide cases into indigenous and non-indigenous categories, we decided to use hot deck imputation,¹⁸ a strategy in which each missing value is replaced with an observed response from a similar unit.

The rates were adjusted for age by the method of directly standardized rates with exact confidence intervals,¹⁹ using the World Health Organization (WHO) standard population as a reference.²⁰ The rate ratio was adopted as the risk estimate with 95% confidence intervals (95%CI). For graphic visualization of municipal suicide rates, the following categorization was adopted: null; low (0.1 to 4.9); medium (5.0 to 14.9); high (15.0 to 29.9); and very high (30.0 or more), in accordance with the criteria formulated by Diekstra & Gulbinat.²¹

Adjusted suicide mortality rates (ASMRs) in the municipalities (2009-2011) were geocoded and presented in thematic maps. Due to the widespread presence of Guarani-Kaiowá and Guarani-Ñandeva populations in the south of the state, each of the suicides occurred among indigenous people in the healthcare micro-regions of Ponta Porã, Dourados, and Naviraí were geographically distributed as a Guarani-Kaiowá and Guarani-Ñandeva case. Therefore, despite not knowing exact ethnic affiliation, spatial analysis was used as a proxy to locate the Guarani-Kaiowá and Guarani-Ñandeva in this area.

A kernel analysis was applied to evaluate the spatial pattern of these data,²² considering a radius of influence (\hat{r}) of 15 km and the k-function = quartic. Because SIM/DATASUS does not provide the exact geographic position of suicide cases within a given municipality, an empirical geographic location for each case was generated using the following criteria: in municipalities that had an IT, the cases were distributed at random within the municipality, as suicide can occur outside the IT as well.

In municipalities with more than one IT, the cases were divided according to the population size of the ITs and then distributed randomly and proportionally. In municipalities without an IT, the cases were distributed proportionately between urban and rural areas according to the percentage of self-reported indigenous people residing in the municipality in the 2010 census, and then positioned at random in the urban and rural areas. We believe that the number of accidental positioning errors of geographic coordinates was minimal and controlled, as the ITs are relatively small areas, analyzed on a regional scale, where errors of position would be insufficient to interfere with the results. Furthermore, the influence radius used in the geostatistical analysis fits the error of positioning, controlling the degree of smoothing on the surface.

Differences between proportions were tested using Pearson's chi-square with continuity correction, and age differences between indigenous and non-indigenous people were tested using the Mann-Whitney *U* test.

The time series analysis considered the ASMR as the response variable (Y) and calendar years as the explanatory variable (X). The rates were represented by non-parametric smoothed curves.²³ The independence of the residuals of the series was evaluated by means of autocorrelation and partial correlation plots and by the Durbin-Watson test. The Mann-Kendall test²⁴ was used to evaluate the trend of these rates.

Structuring of the dataset and data for all analyses was performed using the R statistical software package, version 3.0.3. Cartographic data and spatial analyses were processed using QGIS 2.2.0.

Ethical considerations

As the study was based on publicly available data from the Brazilian Ministry of Health, ethics committee approval was not required.

Results

From 2000 to 2012, there were 2,414 suicides in Mato Grosso do Sul. Of the corresponding records, only 50 (2.0%) were missing skin color or race data. After imputation of the race/skin color variable, 37 (74.0%) cases were reclassified as non-indigenous and 13 (26.0%) as indigenous.

Suicides among the non-indigenous population occurred in all micro-regions of the state, with particular emphasis on Campo Grande (the state capital), where 35.9% of cases were concentrated. The indigenous suicides were concentrated mainly in the micro-regions of Ponta Porã, Dourados, and Naviraí (Table 1).

Suicide occurred primarily among unmarried men, at home, by hanging, with statistically significant differences ($p < 0.05$) between the ratios of these events among indigenous and non-indigenous people. The median age for suicide among indigenous people was 19.2 years, vs. 36.6 years for non-indigenous people ($p = 0.0001$) (Table 1).

From 2009 to 2011, the ASMR in the non-indigenous population was 8.1/100,000 (95%CI 7.4-8.8). In the indigenous population, the rate was 65.2/100,000 (95%CI

53.2-79.5). The 60+ age group presented the highest rate in the non-indigenous population, with 10.5/100,000 (95%CI 8.3-13.2). In the indigenous population, the highest rate was found in the 15-24 age group, with 135.8/100,000 (95%CI 48.2-154.7). However, among indigenous women, the 10-14 age group presented the highest rates, with 38.3/100,000 (95%CI 25.7-56.1).

The relative risk of suicide for the indigenous population compared to the non-indigenous population was 8.1 (95%CI 7.2-9.0). For indigenous men, the risk was 2.4 (95%CI 2.1-2.8) compared to indigenous women, and for non-indigenous men compared to non-indigenous women it was 4.1 (95%CI 3.7-4.6). Among the young indigenous population (15-24 years old), the risk of suicide was 18.5 (95%CI 17.5-19.6) compared to the non-indigenous population of the same age.

In approximately 80% of municipalities, the ASMR for indigenous people was null (Figure 1); in the remainder, the observed rates were either high or very high. Among the non-indigenous population, null rates were observed in five municipalities (6.4%) and low or null rates in 73% (Figure 2).

The three largest densities of suicide occurrence were found in villages within ITs in the municipalities of Dourados, Amambai, and Coronel Sapucaia, territories mainly inhabited by Guarani-Kaiowá and Guarani-Ñandeva. No suicide hot spots were identified in the larger ITs in the micro-regions of Ponta Porã, Dourados, and Naviraí (Figure 3). In general, the hot spots identified overlapped with relatively smaller ITs.

Evaluation of autocorrelation and partial autocorrelation, as well as the Durbin-Watson test, suggest independence of residuals in the indigenous sample (Durbin-Watson = 1.5167; $p = 0.1004$) and in the non-indigenous sample (Durbin-Watson = 2.0543; $p = 0.4043$). As shown in Figure 4, the ASMR was stable over time both for the indigenous ($\tau = -0.426$; $p = 0.051$) and non-indigenous population ($\tau = 0.168$; $p = 0.4633$).

Discussion

In the Brazilian state of Mato Grosso do Sul, the ASMR among indigenous people was very high and the risk disproportionate in relation to the non-indigenous population. Almost all cases were concentrated in a few villages in ITs situated in the center-south region of the state, mainly occupied by the Guarani-Kaiowá and Guarani-Ñandeva. Furthermore, the rates were stable in both subgroups during the study period.

Studies analyzing suicide in indigenous and non-indigenous populations in Brazil usually highlight high rates among indigenous people and low rates among non-indigenous people.^{17,25} However, the case of Mato Grosso do Sul seems peculiar, as it presents both the highest rate of indigenous suicide and the highest relative risk of suicide for indigenous versus non-indigenous people in the country, and, on the other hand, the second highest rate of suicide in the country among the non-indigenous population, approximately 37% higher than the average rate of Brazil, which is 5.9/100,000.¹¹

Table 1 Epidemiological and demographic characteristics of indigenous and non-indigenous suicides in Mato Grosso do Sul, Brazil, 2009-2011

	Indigenous (n=118, 19.7%)	Non-indigenous (n=482, 80.3%)	Pearson χ^2 p-value
Sex			
Male	70.3	79.9	0.0342
Age groups (years)			
10 to 14.9	18.6	0.8	0.0001
15 to 24.9	50.9	19.7	0.0001
25 to 39.9	17.8	36.5	0.0001
40 to 59.9	11.0	27.6	0.0003
60 and older	1.7	15.3	0.0001
Marital status			
Single	76.9	57.3	0.0003
Married/consensual union	21.1	29.8	0.1006
Widowed	1.4	4.1	0.2561
Divorced	-	8.0	-
Place of death			
Home	90.4	75.0	0.0001
Hospital	3.6	17.3	0.0001
Public place	6.0	7.7	0.9999
Weekend			
Yes	58.5	42.7	0.0021
Suicide method			
Hanging	96.6	67.2	0.0001
Poison	3.4	10.4	0.0281
Firearm	-	13.7	-
Others	-	8.7	-
Healthcare micro-regions			
Ponta Porã	56.8	7.0	0.0001
Dourados	26.3	14.1	0.0001
Naviraí	11.9	3.7	0.0001
Jardim	5.1	5.2	0.4677
Campo Grande	-	35.9	-
Aquidauana	-	3.5	-
Corumbá	-	3.7	-
Coxim	-	3.3	-
Nova Andradina	-	4.4	-
Paranaíba	-	12.2	-
Três Lagoas	-	6.6	-

Data presented as percentages.

Source: Information Department of the Brazilian Unified Health System (Sistema de Informação sobre Mortalidade, Departamento de Informática do Sistema Único de Saúde, SIM/DATASUS).

Studies of suicide mortality in the general population of the Central-West region of Brazil¹ and in Mato Grosso do Sul specifically²⁶ have suggested that these rates were being influenced by the excess of indigenous suicides. However, the data presented herein show that suicide is also a relevant problem among non-indigenous people. This indicates that the high rate of suicides in the general population of the state of Mato Grosso do Sul, and possibly in the entire Brazilian Central-West macro-region, cannot be explained exclusively by the excess of suicides in the indigenous population. The simultaneous occurrence of markedly high suicide rates in the indigenous population and rates above those commonly observed in Brazil in the non-indigenous population is analogous to those reported in remote regions of other countries, as in the case of Russia's northeast region⁶ and of Australia's Northern Territory,⁷ where socioeconomic inequality is also a reality.

Very high rates of indigenous suicide were observed in most of the municipalities located in the micro-regions of Ponta Porã, Dourados, and Naviraí, which are home to 97% of the Guarani-Kaiowá and the Guarani-Ñandeva population of Mato Grosso do Sul. It is a fact documented in the literature that not all indigenous groups show high rates of mortality by suicide.⁴ In Mato Grosso do Sul, there is evidence that suicide is an important problem among the Guarani, particularly among the Guarani-Kaiowá,^{17,27} but not among the Terena. Indigenist policies and the history of contact have been pointed out as important factors for understanding the differences in the mortality rates among different indigenous peoples.⁴

The Terena were chosen by the Brazilian indigenist agencies as the indigenous people most adapted to national society. Terena groups, considered the most receptive and open, were displaced to Guarani areas with the objective of

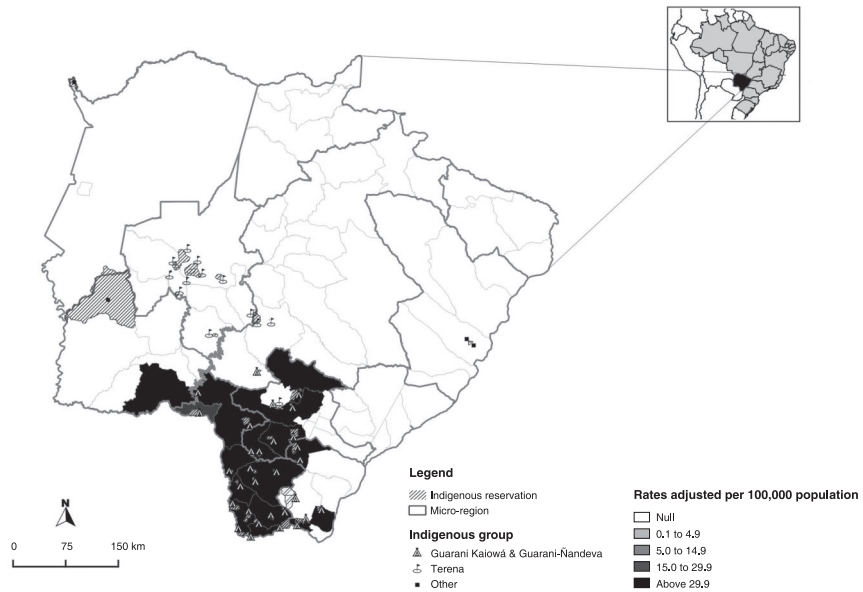


Figure 1 Spatial distribution of adjusted suicide mortality rates among indigenous people in the municipalities of Mato Grosso do Sul, Brazil, 2009-2011.

assisting in the process of civilization and pacification of the Guarani.²⁸ The Terena generally live in urban environments and often no longer speak their native language, being fluent in the Portuguese language instead. Indigenous people from this group have greater access to prestigious political positions in Brazilian society, to education, employment with better pay, and funding for income generation and/or cultural valuation projects.

For the Guarani, the relocation and resettlement process has been particularly harmful, as it failed to take into consideration the complex dynamics of conflicts and alliances that the different groups and extensive families established among themselves. The mixture of different indigenous groups (Guarani and Terena), different Guarani groups (rivals and allies), and with the non-indigenous population, addressed by the Guarani term *jopara*, is associated

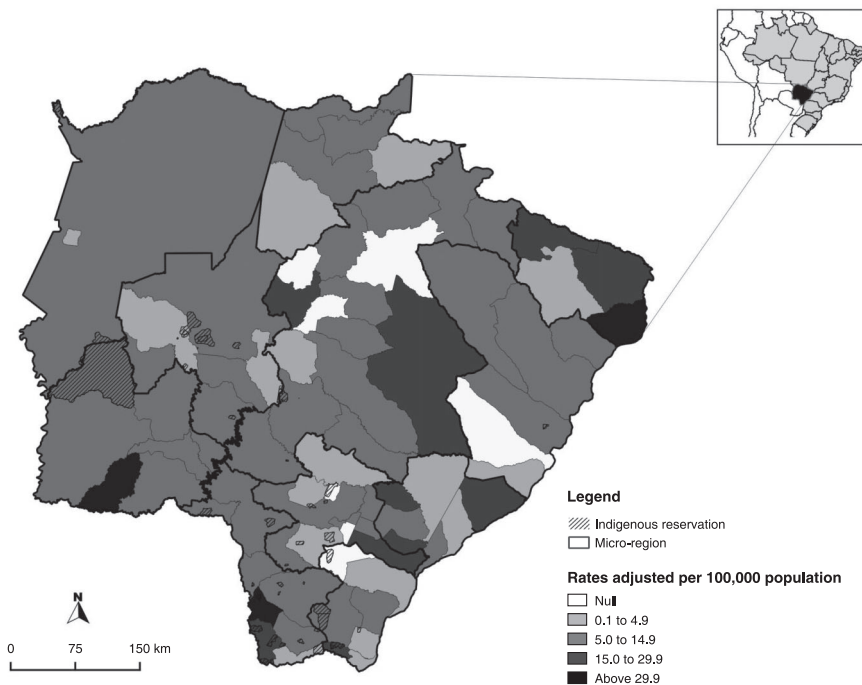


Figure 2 Spatial distribution of adjusted suicide mortality rates among non-indigenous people in the municipalities of Mato Grosso do Sul, Brazil, 2009-2011.

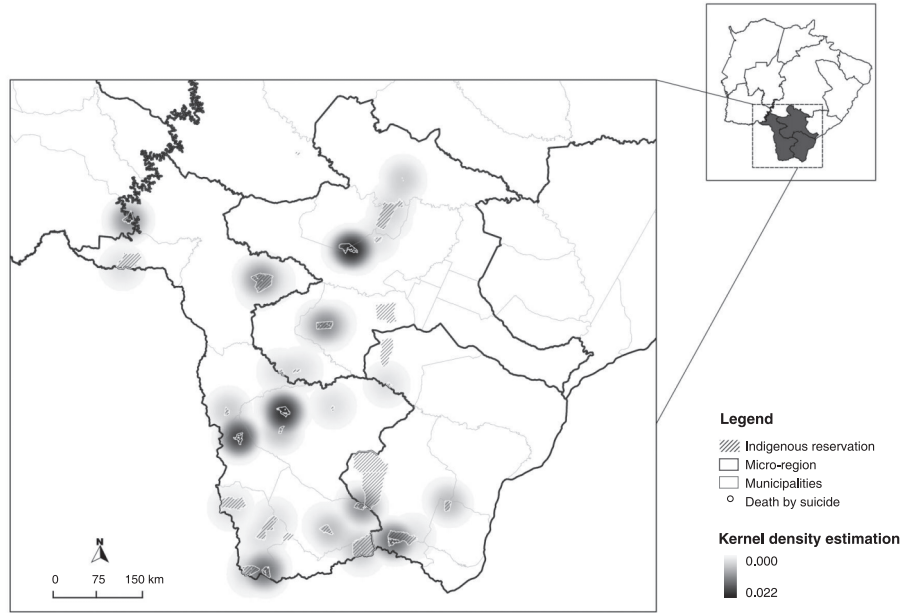


Figure 3 Suicide density among indigenous people in the municipalities of the Ponta Porã, Dourados, and Naviraí micro-regions, Mato Grosso do Sul, Brazil, 2009-2011.

with the escalation of conflicts which are difficult to manage in the context of resettlement, and is an important key for understanding the high ASMR among the Guarani.²⁹ Similar to what has been described in studies on suicide mortality that did not explore ethnic-racial variables,^{1,30} we found that, in Mato Grosso do Sul, the highest ASMR occurred among men, regardless of color or race. In comparison, the ASMR among non-indigenous women was low, only slightly above the national average of 1.8/100,000.¹ Conversely, in indigenous women, the ASMR was approximately 26 times higher than the average national rate.¹¹ The relative risk of suicide for men compared to women was almost twofold in the non-indigenous population in comparison to the indigenous population. In Mato Grosso do Sul, as was observed in other contexts involving native populations,^{17,31} there is a greater importance of suicide among indigenous women.

In the non-indigenous population, the highest ASMR was found in the over-60 age group, replicating findings that point to suicide as an age-dependent outcome that usually afflicts elderly people.³² In the indigenous population, the highest

ASMR was observed in young people aged 15-24 years. Although the young indigenous population of Mato Grosso do Sul corresponds to about 3% of the total population in this age group, around 40% of suicided in this age group occurred among indigenous people. While injuries appeared as the leading cause of death among non-indigenous youth, suicide emerged as the main cause of death for indigenous youth,¹¹ ratifying its relative importance in the mortality profile of the state, as observed in other regions of the country.^{17,27}

Hypotheses have been presented to explain the marked occurrence of suicide among young indigenous people in Mato Grosso do Sul, particularly among the Guarani-Kaiowá and the Guarani-Nandeva. Costa Pereira³³ suggests the possible role of young people as spokespeople of a collective malaise, where suicide would be one form to denounce the historical and contemporary difficulties experienced by their people. Halin & Brym,¹² comparably to what has been proposed by Souza & Orellana,¹⁷ highlight the possible correlation between the abandonment of traditional rites of passage and youth suicide. Pimentel²⁹ presents the

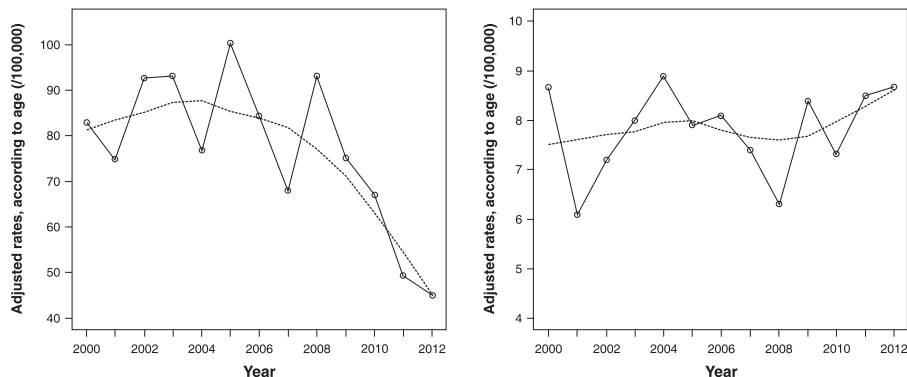


Figure 4 Suicide mortality trends in indigenous and non-indigenous people, Mato Grosso do Sul, Brazil, 2000-2012.

indigenous perception that a supposed emotional instability in young people would render them especially vulnerable to suicide “by contagion,” with shamanic recommendations, little considered today, to avoid any contact with the bodies of suicide victims. Similarly, Australian studies suggest³⁴ that suicide by contagion is considered much more frequent in young aboriginals than in non-aboriginals.

Moreover, in the present study, not only was the ASMR high among indigenous girls aged 10-14 years, but the rate found in this age group was approximately 40 times higher than that of non-indigenous age-matched girls in Mato Grosso do Sul. This is an alarming nuance that has been little considered in the specialized literature, which usually directs its concerns to young indigenous males.^{5,17,25} We therefore propose that research be undertaken to understand the influence of different factors on the high suicide mortality rate among indigenous girls in Mato Grosso do Sul. According to Hamlin & Brym,¹² ethnographic studies of Guarani women suggest that the alarming rates of suicide, especially among youths, could also be related to repercussions of the rearrangements of the Guarani family structure in the last few decades, expressed as work overload, exposure to new forms of sexual exploitation, and frustration with the requirement of traditional marriage at early ages.

Another point that warrants special attention is the fact that, in the indigenous population, suicide was more frequent during weekend days than in the non-indigenous population. The high proportion of suicide over the weekend among indigenous people has been used as a proxy for an association with alcohol consumption.^{17,25} A forensic skill-based study in Australia’s Northern Territory showed higher blood alcohol levels in indigenous people who committed suicide compared to non-indigenous people.⁷ A qualitative study conducted in the Amazon region pointed to a strong association between indigenous youth suicide and interpersonal conflicts influenced by alcohol consumption, especially on weekends.³⁵ In turn, Pimentel’s analysis of Guarani-Kaiowá indigenous concepts found that they associated the use of alcohol with suicide because people who drank constantly were seen as more likely to be aggressive, even towards themselves.²⁹ Moreover, the use of alcohol could rouse, even in those who are not regular drinkers, a kind of “courage” to commit suicide or even create a favorable environment “to give life to the idea” of suicide, especially among those dissatisfied or enraged because of interpersonal conflicts.

Although hanging is the most frequently used method of suicide among indigenous and non-indigenous people, it is worth noting that, in this study, hanging was used as a virtually universal mode among indigenous people, and significantly more often than by non-indigenous people. In a qualitative study carried out among survivors of suicide attempts, the preferred use of hanging was associated with representations of hanging as an efficient, fast, and clean method, which does not require much preparation and, at the same time, is easily accessible both in rural and urban contexts.³⁶ The use of this highly lethal method imposes additional challenges to the elaboration and implementation of intervention strategies that aim to reduce of the number of suicides, particularly in indigenous contexts in which health interventions are usually conducted with difficulty.

Although the indigenous population did not use firearms to commit suicide, for the non-indigenous population, this was the second most common method. Such findings are very similar to those observed among natives of Australia’s Northern Territory,⁷ but differs from what has been found in the young indigenous population of the United States and Alaska, where hanging and firearms were the most common methods and used equally frequently.⁵

Various cultural factors have been pointed out in the literature as important for choosing the method of suicide.³⁷ In Guarani, the term *jejuvy*, which could be translated to squeezing the throat, is used to refer to hanging.⁸ It is important to understand the cultural significance of hanging as more than a simple, impulsive method. It is also worth noting that the Guarani believe in having two “souls,” *ã* and *nhe’e*, shadow and speech. By means of *jejuvy*, *nhe’e* is suppressed and “will be lost in space,” thereby losing its way to heaven.²⁹ Characteristic of the *jejuvy* is its private, discrete, active character (hanging without falling into a void), preceded by a psychic state known as *nhemyro* (a mixture of anger, fierceness, desperation, and sadness) that strikes rapidly, especially in youths who find themselves in various difficult situations.^{8,29}

In Mato Grosso do Sul, the home was the most common place for committing suicide in indigenous and non-indigenous people alike. However, only among non-indigenous people did the number of deaths by suicide occurring in hospitals and public places (e.g., the streets) surpass the number of suicides occurring at home. The pattern observed among the indigenous population of Mato Grosso do Sul corresponds to findings both in other indigenous populations^{6,7,25} and in predominantly agricultural non-indigenous populations.³⁰ The frequent occurrence of deaths by suicide in hospitals and public places in the non-indigenous population may reflect the easier access to these structures typical of the urban world.

Spatial analysis of suicide cases in our series demonstrated that there were no hot spots in the larger ITs. On the contrary, these spots were generally spatially overlapping with relatively small ITs, whose population was mostly concentrated in one or two villages with a high population density and proximity to the urbanized areas of the municipalities of Dourados, Amambai, and Coronel Sapucaia. In Brazil, the proximity of many ITs to urban centers is not due to chance or to intentional migration of the indigenous people, but to a longstanding Brazilian government project designed to assimilate and integrate the indigenous population into national society.³⁸

As a result of the resettlement policies imposed by the Brazilian government throughout the process of contact with national society, the study area (located in the southern part of Mato Grosso do Sul) is now mainly inhabited by the Guarani-Kaiowá and Guarani-Ñandeva. Evidence in the literature points to suicide as a significant phenomenon among the Guarani, but not among the other ethnicities of the state, allowing for the assumption that the great majority of suicides in Mato Grosso do Sul occur among the Guarani-Kaiowá and the Guarani-Ñandeva.

Thus, although ethnically specific information is not available on death certificates in Brazil, it seems reasonable to assume that the geocoding of suicide cases according to

IT and with the ethnic groups predominant in each of them is a useful tool to uncover the density of occurrence and the ethnic profile of indigenous suicide.

To comprehend the spatial distribution of indigenous suicide in Mato Grosso do Sul, one must consider the main economic activities in the state: agriculture and cattle ranching, which, combined, cover 85% of its territory. Of the properties with farming activity, 76.9% are classified as large-sized establishments (10 km² or more), which makes Mato Grosso do Sul the state with the second highest concentration of large rural properties in Brazil.³⁹

While the non-indigenous agricultural sector prospers,³⁹ the indigenous people of Mato Grosso do Sul are in an unfavorable position because of territorial restrictions imposed by the Brazilian government. The Guarani-Kaiowá and Guarani-Nandeva especially have gone through resettlements that force “indigenous families to occupy small territorial spaces, where razed land predominates: wilderness taken over by soybeans and by extensive cattle breeding”⁸ (p. 47-48).

This territorial confinement has left ITs densely populated and vulnerable to a series of problems, including lack of food provisions and high infant mortality rates. This confinement intensifies *jopara* (mixture), inciting disputes for prestige, power, and resources among “chiefs,” which can result in increasing violence towards themselves and others. Furthermore, political divergences with FUNAI are frequent, as are ongoing disputes with local farmers for land ownership.⁹ It is in this historical, socioeconomic, and cultural context that high rates of suicide occur among the Guarani of Mato Grosso do Sul.

A survey conducted in India, a country with one of the world's highest rates of suicide and that opted for economic policies that favored large-scale agriculture in the early 1990s, showed a positive association between the percentage of small farmers and rates of suicide.⁴⁰ A similar pattern may be implicated in indigenous and non-indigenous suicides in Mato Grosso do Sul.

During the study period, the annual trend of ASMRs among the indigenous and non-indigenous populations remained stable, although these rates oscillated at distinct levels. Among the non-indigenous people, the rates were reduced in scale, with only slight variation. Among the indigenous people, these rates, in addition to being very high, alternated between periods of rise and fall during the 2000s, through 2008.

From 2009 onwards, as opposed to what was observed in the non-indigenous population, the ASMR displayed a strong and continuous reduction among the indigenous population. Although it is possible to assume that indigenous suicide in Mato Grosso do Sul has decreased in recent years, recent data from different agencies and institutions in Brazil¹¹ do not support this theory. Additional studies are needed to understand recent trends in suicide mortality rates among the indigenous people of Mato Grosso do Sul.

It must be stressed that suicide mortality rates in small populations are subject to small fluctuations.²⁰ Therefore, caution is required when interpreting the rates presented in this study, especially the suicide mortality rates in the relatively small indigenous population. Although this study was based on secondary data and is thus subject to

problems of reliability and coverage, it is noteworthy that the SIM/DATASUS coverage of Mato Grosso do Sul was > 95% in recent years and that, in 2011, the percentage of deaths with undetermined intent in relation to the total deaths due to ill-defined causes was < 3%, one of the lowest rates in the country.¹¹

In conclusion, the results of this study show that suicide is an important public health problem in Mato Grosso do Sul, with an alarming and disproportionate impact on the indigenous population. The high average suicide mortality rates in the non-indigenous population seen in most municipalities, particularly among people > 60 years of age, is another important finding that identifies suicide as a statewide problem. The perceptible differences between the epidemiology of suicide among indigenous and non-indigenous people compound the challenge of developing and implementing preventive measures that take into account and respect the ethnic, geographic, and cultural differences of each segment of the population.

Disclosure

The authors report no conflicts of interest.

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