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ORIGINAL ARTICLE

Spatial analysis of suicide mortality in Espírito Santo state

Análise espacial da mortalidade por suicídio no Espírito Santo

Análisis espacial de la mortalidad por suicidio en el estado de Espírito Santo

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ABSTRACT

Background and Objective: Although there are studies on suicide mortality in Espírito Santo, few assess its spatial distribution, especially in regions with different socio-economic and cultural characteristics, which makes it difficult to identify spatial patterns and limits the planning of preventive actions. Therefore, the aim was to analyze the characteristics and spatial pattern of suicide mortality in the state of Espírito Santo between 2011 and 2020. **Methods:** this was an ecological study of suicide deaths recorded in Espírito Santo state. The characteristics of the deaths were analyzed using descriptive statistics. Spatial analysis indicating emerging areas in the state was performed using the spatial distribution of suicide mortality rates and by applying a spatial association analysis technique called the Getis-Ord Gi*. **Results:** Between 2011 and 2020, 1,987 deaths by suicide were recorded, with the rate rising from 4.62 to 6.17 deaths per 100,000 inhabitants. Deaths by suicide were more frequent among men (n=1,459), in the 30-39 age group (n=408), and of mixed-race/color (brown). The most common method used was hanging (n=1,147), followed by autointoxication (n=371). The application of the Getis-Ord Gi* technique revealed hot spots in the following regions: Midwest, Central Serrana (with the exception of Itarana), Metropolitana, Southwest Serrana, Caparaó, Central Sul and Litoral Sul. Cold spots were observed in the north-east and north-west of the state. **Conclusion:** understanding the profile and spatial distribution of cases in Espírito Santo can serve as a guide for priority actions to prevent suicide in the state.

Keywords: *Epidemiology. Suicide. Spatial Analysis.*

RESUMO

Justificativa e Objetivo: Embora existam estudos sobre mortalidade por suicídio no Espírito Santo, poucos avaliam sua distribuição espacial, principalmente em regiões com características socioeconômicas e culturais distintas, o que dificulta a identificação de padrões espaciais e limita o planejamento de ações preventivas. Assim, objetivou-se analisar as características e o padrão espacial da mortalidade por suicídio no estado do Espírito Santo no período entre 2011 e 2020. **Métodos:** estudo ecológico que avaliou óbitos por suicídio registrados no Espírito Santo. As características dos óbitos foram analisadas por estatística descritiva. A análise espacial indicando áreas emergentes no estado foi realizada com a distribuição espacial das taxas de mortalidade por suicídio e pela análise de associação espacial denominada técnica de Getis-Ord Gi*. **Resultados:** entre 2011 e 2020 foram registrados 1.987 óbitos por suicídio, com a taxa passando de 4,62 para 6,17 óbitos/100 mil habitantes. Predominaram mortes em homens (n=1.459), na faixa etária de 30-39 anos (n=408), e de raça/cor parda. O método mais utilizado foi o enforcamento (n=1.147), seguido por autointoxicações (n=371). A aplicação da técnica Getis-Ord Gi* revelou *hot spots* nas regiões Centro-Oeste, Central Serrana (exceção Itarana), Metropolitana, Sudoeste Serrana, Caparaó, Central Sul e Litoral Sul. *Cold spots* foram observados no Nordeste e Noroeste do estado. **Conclusão:** a compreensão do perfil e da distribuição espacial dos casos no Espírito Santo pode servir como orientação para ações prioritárias de prevenção do suicídio no estado.

Descritores: *Epidemiologia. Suicídio. Análise Espacial.*

RESUMEN

Justificación y Objetivo: aunque existen estudios sobre la mortalidad por suicidio en Espírito Santo, pocos analizan su distribución espacial, especialmente en regiones con características socioeconómicas y culturales diversas, lo que dificulta la identificación de patrones espaciales y limita la planificación de acciones preventivas. Por lo tanto, el objetivo fue analizar las características y el patrón de distribución espacial de la mortalidad por suicidio en el estado de Espírito Santo entre 2011 y 2020. **Métodos:** estudio ecológico que evaluó los suicidios registrados en Espírito Santo. Las características de los fallecimientos se investigaron mediante estadísticas descriptivas. El análisis espacial, que identifica áreas emergentes en el estado, se realizó con la distribución espacial de las tasas de mortalidad por suicidio y mediante la técnica de asociación espacial conocida como Getis-Ord Gi*. **Resultados:** entre 2011 y 2020, se registraron 1.987 suicidios, con una tasa que aumentó de 4,62 a 6,17 muertes por 100.000 habitantes. Predominaron los hombres (n = 1.459), con edad entre 30 y 39 años (n = 408), y de raza/color pardo. El método más utilizado fue el ahorcamiento (n = 1.147), seguido de autointoxicaciones (n = 371). La técnica Getis-Ord Gi* reveló *hot spots* en las regiones: Centro-Oeste, Serrana Central (excepto Itarana), Metropolitana, Serrana Sudoeste, Caparaó, Central Sur y Litoral Sur. *Cold spots* se observaron en el Nordeste y Noroeste. **Conclusión:** comprender el perfil y la distribución espacial de los casos en Espírito Santo puede orientar las acciones prioritarias para para la prevención del suicidio en el estado.

Palabras Clave: *Epidemiología. Suicidio. Análisis Espacial.*

INTRODUCTION

Suicide is a complex and multicausal phenomenon that represents a serious public health problem globally. In the year 2019 it was the fourth main cause of death among teenagers and young adults aged 15 to 29 years old; and for each adult that materializes self-inflicted

death, at least another 20 attempt to take their own lives.[1] Thus, it is considered a type of violent death with one of the highest incidences in the world. Suicide is a phenomenon with a cascade effect, which affects not only the individuals, but also their families, communities and the society as a whole. It is related to risk factors that include those of sociologic, economic, political nature, passing through psychological and psychopathological, biological and the barriers to the access to healthcare.

Besides that, other factors are cited: social inequality, low income, unemployment, schooling, gender, age, previous suicide attempts – which predispose to a progressive lethality of the method – mental health issues, licit or illicit drug use, lack of social support, family history of suicide, strong suicide will, and stressing events.[2] Therefore, although this is a phenomenon that occurs globally, considering the social and economic factors, 77% of the suicide cases were concentrated in low- and middle-income countries in 2019.[1]

Despite the global mortality by suicide has declined 36% between 2000 and 2019, data show that the Americas was the only region where the rate increased in that period, reaching nine deaths per 100,000 population in 2019. In the region, Brazil is the country with the second highest absolute number of deaths by suicide, presenting 14,540 deaths in the year 2019, behind only the United States.[1]

Brazil is also among the 10 countries with the highest number of suicides in the whole world, being the Southern, Midwestern and Northern regions the ones presenting the highest mortality rates by this cause. From 2010 to 2019, there was an increase of 43% in the yearly number of deaths by suicide in the country, and the analysis of the adjusted mortality rates in this period showed an increase in the risk of death by suicide in all regions of Brazil.[3]

However, the country still faces a scarcity in governmental programs that effectively work with suicide prevention,[4] and this situation gets even more overwhelming when we consider the heterogeneity of the phenomenon in the different regions of the country, highlighting the importance of not only think of national public policies, but also regional/local policies that encompass the singularities of each region.

In the Southeastern region, the states of Minas Gerais and Espírito Santo are at the top of the rank of death rates by suicide, and reported 8.2 and 6.5 deaths per 100,000 population, respectively, in the year 2019.[3] From 2003 to 2016, the mortality rate by suicide presented stability, ranging from 3.9 to 4.4 deaths per 100,000 population. From 2017, the number of deaths increases and ranges from 5.2 to 5.82 in the years 2017 and 2018.[5] On the other hand, a study by Tavares and collaborators[6] shows that the mortality rate by self-inflicted injuries in the year 2016 was 6.2 per 100,000 population, with an increase of 30.3% in the deaths by

suicide during the period from 2012 to 2016.

When we analyzed the victims' sociodemographic profile, we noticed that most of the cases are adult males and point to the difference between male and female when it comes to methods used. Among male, hanging was the most prevalent method, while among female poisoning and jumping from a height were more common. As for the region, from 2018, we observed an increase in the mortality rates in the Greater Vitória Metropolitan Region (Região Metropolitana da Grande Vitória/RMGV).[6]

Given this scenario, it is important to emphasize the need for investments in research that increases the availability of information regarding the population's health situation and for the planning of actions targeting the prevention of suicide, and interventions in risk areas and vulnerable populations, aiming to modify the impact of this phenomenon and the mortality in the future. Considering this situation, spatial analysis is an important tool to perform the situational diagnosis of a region, enabling the assessment of results according to the socioeconomic, cultural and environmental reality.[7]

It is noteworthy that, although there are studies addressing the mortality by suicide in Espírito Santo state, studies using spatial analysis methods are scarce, mainly in regions with distinct socioeconomic and cultural characteristics. If there is no understanding of how this phenomenon is distributed in space, it is not possible to direct the actions to vulnerable groups and areas, making suicide prevention actions ineffective. In light of this, the present study has the objective of analysing the characteristics and the spatial distribution pattern of mortality by suicide in the state of Espírito Santo from 2011 to 2020. We expect that the data generated will contribute to the planning, consolidation and assessment of health policies, as well as the strengthening of actions in mental health.

METHODS

Study Type

Ecological study assessing deaths due to suicide reported in Espírito Santo state from 2011 to 2020. The study period was chosen taking into consideration the possibility of analyzing the phenomenon broadly during a decade of important social and technological changes,

Study Location

With Regard to the study setting, the state of Espírito Santo is situated in the

Southeastern region of Brazil, with a residing population of 3,833,486 people in 2022. It is the 14th largest State population in the country, with a territory of 46,074.448 km² and demographic density of 83.21 people/km², divided in 78 municipalities. In this context, Espírito Santo state has a Human Development Index (HDI) of 0.771; the municipalities with the highest HDI are Vitória (0.845) and Vila Velha (0.800), while Santa Leopoldina (0.626) and Ibitirama (0.622) present the lowest HDI, values considered as a medium HDI. [8-9]

Among the main cities in the state is the capital Vitória, as well as the municipalities of Vila Velha, Serra, Cariacica, Guarapari, Fundão and Viana, which are part of the Greater Vitória Metropolitan Region. Besides the Metropolitan Region, it is importante to point out the municipalities of Cachoeiro de Itapemirim, Linhares, São Mateus, Colatina and Aracruz.

The Greater Vitória Metropolitan Region has the highest percentage (49.1%) of urbanization of the state.[9] As for the health regions, the regional boundaries that established in the territory of Espírito Santo state three Health Regions (Central/North, Metropolitan and South), serving as an organizational foundation for the health sector, were approved through the Resolution 153/2020 of the Bipartite Inter-managerial Committee (CIB/SUS-ES),[10] in December 18th, 2020. According to this document, the Metropolitan health region covers the largest population, the equivalent to 2,410,051 people in the year 2020, corresponding to more than half of the state's population.

In light of this, only deaths resulting from intentionally self-inflicted injuries, as classified in Chapter XX of the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10)[11], were selected and tabulated by ICD-10 category according to the codes for each injury (X60–X84).

Data on suicide deaths were obtained from death certificates registered in the Mortality Information System (SIM) of the Department of Informatics of the Unified Health System (DATASUS) of the Ministry of Health. Data collection was conducted between March and April 2023.

The population data by municipality, for each year of the study, used to calculate the mortality rate, were obtained from the mid-year population estimates calculated by the Brazilian Institute of Geography and Statistics (IBGE) and provided to the Federal Court of Accounts (TCU).

Data Analysis

In the first stage, the exploratory data analysis covered the dimensions of sociodemographic characteristics (gender, age, race/color, marital status, education level,

occupation). In accordance with this information, the items were evaluated for consistency and completeness, followed by descriptive analysis, with calculation of absolute and relative frequencies using SPSS software, version 29.0.

In the second stage, a spatial analysis of suicide deaths was conducted in Espírito Santo. For this purpose, suicide mortality rates were calculated for each municipality in the state of Espírito Santo, according to the study period. The calculation was performed by dividing the total number of notified deaths by the standard population (the mid-period study population) for each municipality, then multiplying the result by 100,000, and finally dividing by 10, which corresponds to the number of years covered in the study (2011–2020).

In the next step, the spatial distribution of suicide mortality rates was carried out across the municipalities of Espírito Santo by creating thematic maps using ArcGIS version 10.8.1. This software is specifically designed for the creation, management, sharing, and analysis of spatial data. In the maps, the darker colors represent municipalities with the highest suicide mortality rates.

In the spatial association analysis, the Getis-Ord Gi* technique (pronounced 'G-i star') was used. This Gi* statistic, developed by Getis and Ord,[12] is an indicator of local spatial association. The GI* index is based on analyzing the sum of neighboring values, defined using a neighborhood matrix Wij.[12] For defining the neighborhood, a fixed distance was adopted, defined as the average distance between municipalities, because it allows capturing local clusters without depending on the demographic density of each region. The critical distance was 30 km, which allows the identification of regional patterns. For the spatial weights matrix, the inverse distance matrix was determined, which preserves local influence without dispersing patterns. The FDR (False Discovery Rate) method was applied to reduce the occurrence of false positives and preserve the ability to detect real clusters. The Gi* statistic indicates the extent to which a location is surrounded by a cluster (aggregation) of high values (hot spot) or low values (cold spot) of the analyzed variable. The interpretation of this statistic is based on the sign of Z (z-score) and the values of the significance level (α). A positive and significant z-value for the statistics indicates spatial clustering of high values, while a negative and significant z-value indicates spatial clustering of low values.

Ethical aspects

This research used secondary data obtained from a public domain database, with no subject identification, provided by the Ministry of Health website. Therefore, it is exempt from review by an ethics committee, in accordance with Resolution No. 510 of 2016 of the Brazilian

National Health Council.

RESULTS

From 2011 to 2020, according to the Mortality Information System (SIM) data, 1,987 suicide deaths were recorded in the state of Espírito Santo. According to SIM data, the mortality rate varied from 4.62 deaths per 10,000 population in 2011 to 6.17 deaths per 100,000 population in 2020 (table 1).

Table 1. Number of deaths and suicide mortality rates by study year, Espírito Santo, Brazil, 2011–2020.

Year	No Deaths by Suicide	RT/100,000 pop
2011	164	4.62
2012	177	4.95
2013	159	4.14
2014	173	4.45
2015	189	4.81
2016	175	4.40
2017	208	5.18
2018	239	6.02
2019	252	6.27
2020	251	6.17

*Source: DATASUS, 2023. *RT=number of deaths*

Of the total deaths, 73.4% (n = 1,459) occurred in the male population, and 26.52% (n = 527) in the female population. Regarding age, deaths occurred most frequently (23.05%) in the 30–39 years age group (n = 408), followed by the 40–49 years age group (n = 451; 22.69%). Individuals self-identified as mixed-race (brown) accounted for the highest number of suicide deaths in Espírito Santo during the study period (n = 1,080; 54.35%) (table 2).

Table 2. Sociodemographic characteristics of suicide deaths, Espírito Santo, Brazil, 2011–2020, n = 1,987

Variables	N (%)
Sex	
Female	527 (26.52)
Male	1459 (73.43)
Unknown	1 (0.05)
Age group	
10-14 years	16 (0.81)
15-19 years	99 (4.98)
20-29 years	362 (18.22)
30-39 years	458 (23.05)
40-49 years	451 (22.69)
50-59 years	317 (15.95)
> 60 years	284 (14.30)
Race	
Mixed (brown)	1080 (54.35)
White	646 (32.51)
Black	111 (5.59)
Indigenous	1 (0.05)
Yellow (Asian)	1 (0.05)

Unknown	148 (7.45)
Level of education	
No education	47 (2.37)
1 to 7 years	507 (25.51)
8 to 11 years	295 (14.85)
12 years or more	134 (6.74)
Unknown	1004 (50.53)
Marital Status	
Single	794 (39.96)
Married	591 (29.74)
Legally separated	54 (2.72)
Widowed	157 (7.90)
Other	64 (3.22)
Unknown	327 (16.46)

Source: DATASUS, 2023.

Regarding the method used to complete suicide, more than half of the deaths were by hanging (n = 1,147; 57.7%), followed by self-intoxication (n = 371; 18.7%), which refers to the act of ingesting medication on one's own (table 3).

Table 3. Suicide deaths by type of self-harm according to ICD-10 category and place of occurrence, Espírito Santo, Brazil, 2011–2020.

Variables	N (%)
CID-10 Category	
Self-intoxication	371 (18.67)
Hanging	1147 (57.72)
Drowning	29 (1.46)
Firearms	143 (7.20)
Smoke/fire/flames	51 (2.57)
Steam/water/gas/hot object	2 (0.10)
Sharp/blunt object	49 (2.47)
Jumping from a height /moving object	133 (6.69)
Impact of a motor vehicle	6 (0.30)
Others	56 (2.82)
Place of occurrence	
Home	(1,054)53.05%
Hospital/other healthcare institutions	(472) 23.75%
Public streets	(129) 6.49%
Others	(313) 15.75%
Unknown	(19) 0.96%

Source: DATASUS, 2023

In the spatial analysis of suicide, considering the distribution of crude mortality rates for the study period, the municipalities with the highest suicide mortality rates were Afonso Cláudio (12.02 deaths per 100,000 population), Iúna (11.83 deaths per 100,000 population), and Domingos Martins (10.17 deaths per 100,000 population). The municipalities with the lowest mortality rates during the same period were Ibitirama (1.07 deaths per 100,000 population), Pinheiros (1.5 deaths per 100,000 population), and Boa Esperança (1.96 deaths per 100,000 population). The spatial distribution of crude suicide mortality rates from 2011 to 2020 is presented for each municipality in the state in figure 1.

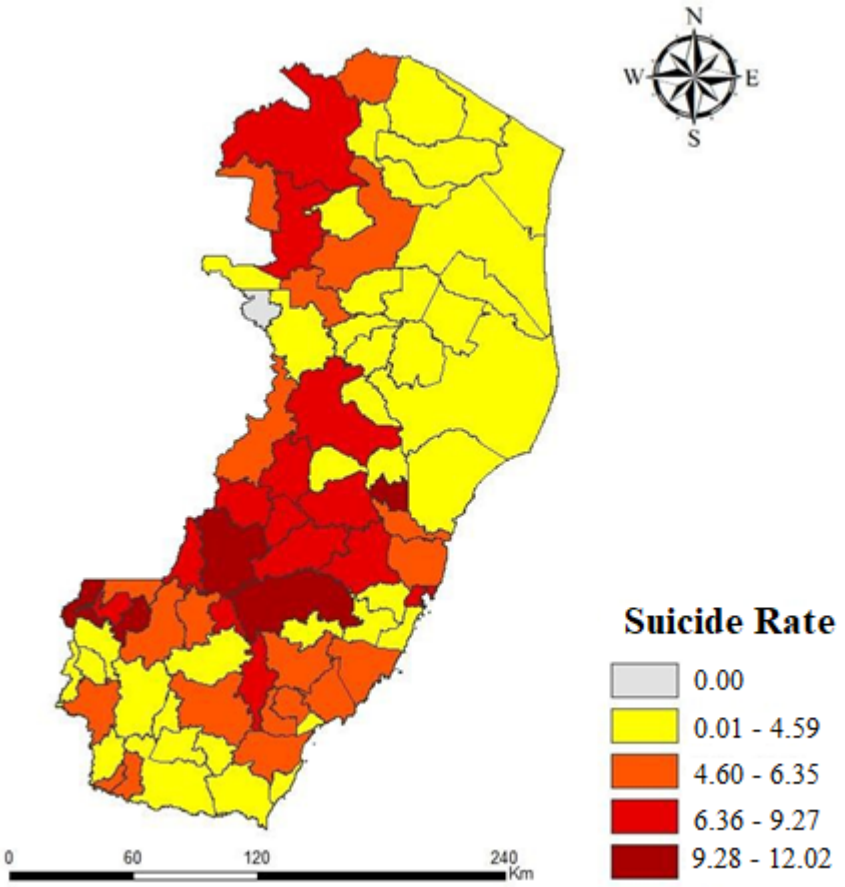

Figure 1. Distribution of suicide mortality rates (per 100,000 population) across municipalities in Espírito Santo, Brazil, 2011–2020.

The results of the local spatial association analysis of suicide rates, using the Getis-Ord Gi* technique, enabled the identification of areas with high occurrence (hot spots) and low occurrence (cold spots) of cases and their distribution during the study period (figure 2).

Between 2011 and 2020, clusters of higher suicide occurrence were observed in municipalities from the following regions: Central-West of the state (Baixo Guandu and São Roque do Canaã), Central Serrana (except Itarana), Metropolitan, Southwest Serrana, Caparaó, Central South, and South Coast of the state. The presence of clusters with lower occurrence (cold spots) was concentrated in the Northeast and Northwest regions, including the municipalities of Sooretama (Rio Doce region), Vila Valério, and São Gabriel da Palha (Central-West). The results found indicated a spatial association with suicide deaths in the state of Espírito Santo.

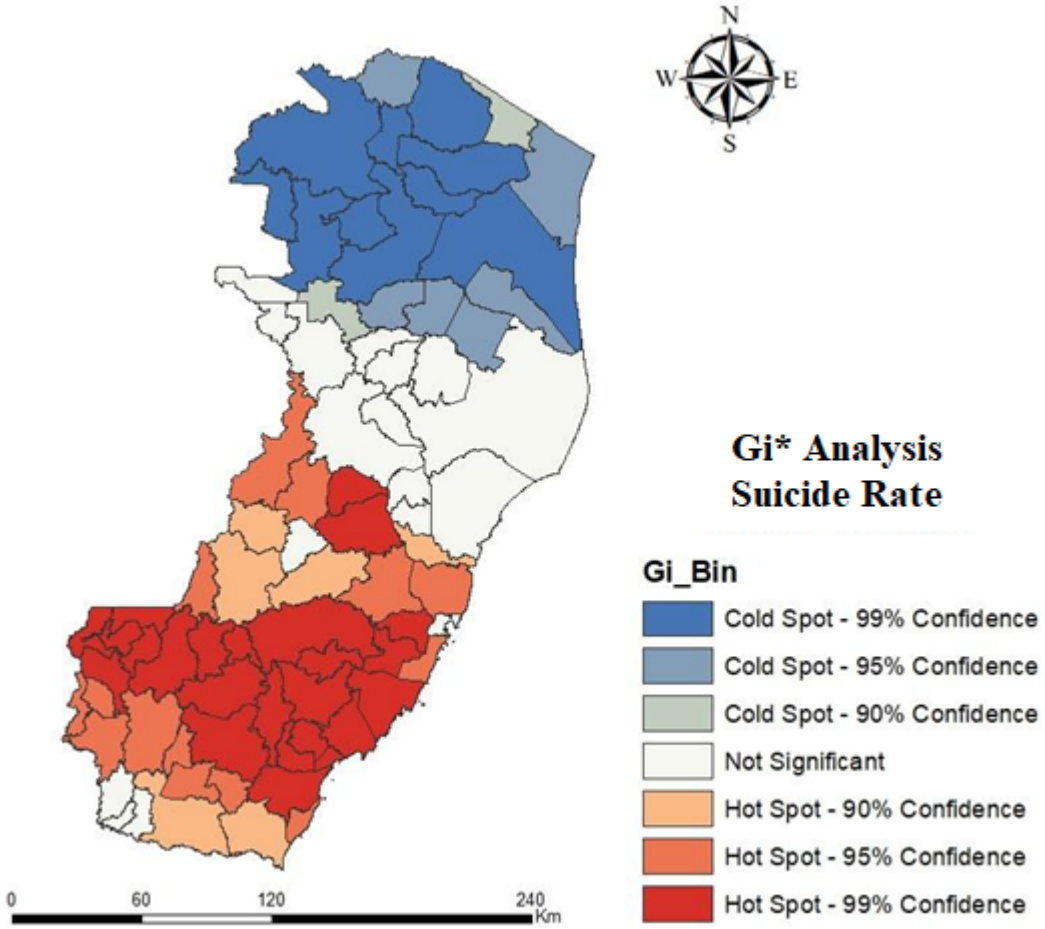

Figure 2. Clusters of high and low suicide mortality rates, distributed across municipalities in Espírito Santo, Brazil – 2011–2020.

DISCUSSION

In Espírito Santo, the highest percentages of suicide deaths have been reported among males, individuals aged 30–39, and those of mixed-race descent. Considering the distribution of the mortality rate, it was observed that between 2011 and 2020, the highest number of suicide deaths occurred outside the Metropolitan Region.

A previous study indicated a growing trend in suicide rates in the Metropolitan, Northwest, and South regions of Espírito Santo state. This difference in the higher number of deaths found outside the Metropolitan Region can be justified, considering the increased identification and classification of suicide as a cause of death, due to the expanded coverage of the Mortality Information System (SIM), as well as the correct completion of death certificates, despite still being a process where underreporting occurs.[6]

An analysis of death records by gender revealed a significantly higher incidence of

suicide among men compared to women. In much of the world, including Brazil, suicide deaths also predominantly affect the male population.[13] According to the Ministry of Health's Epidemiological Bulletin (2021),[3] the risk of death by suicide among men is 3.8 times higher than among women, a finding consistent with studies conducted in different regions of the country. In addition to the choice of more lethal methods, several hypotheses explain the higher suicide rates among men, such as increased consumption of drugs and alcohol, impulsive behaviors, and greater sensitivity to financial instability, including unemployment and poverty.[14] In relation to the female population, maternity and pregnancy are considered protective factors due to the care that will be provided to the child. Additionally, it can be said that the search for professionals for early diagnosis and treatment of mental health issues is more common compared to men, a situation that may explain the lower suicide rate among women.[14]

Although suicide is predominantly male, an increase in suicide rates among women has been observed, as evidenced by research indicating growth between 2007 and 2016.[14-15] These findings reveal that, although suicide mortality among women is lower than among men, it is an increasing event.

Regarding race/color, in general, the mixed-race (brown) population was the most affected, followed by the white population. These findings align with the results of the latest IBGE Census, which indicated that the majority of the state's population is mixed-race.[9] As for the race/color category, there is a noticeable difficulty among professionals in completing declarations in this regard, with completion rates ranging from 3% to 25%. Nevertheless, there has been an improvement in the completion percentages.[15]

The variable 'education level' presents a high number of ignored cases, which was also found in previous studies.[16] The data obtained showed a higher number of deaths among individuals with four to seven years of schooling, that is, those who had completed up to the first stage of elementary education. Similar findings have been observed in other parts of the world, indicating that low education is a risk factor for suicide.[17-18]

Regarding the most commonly used methods, hanging followed by self-poisoning remained the leading causes of suicide, and there is consensus in the literature that hanging is the most frequently used method.[15] Hanging does not require the acquisition of a specific tool, which facilitates the suicidal act, making it more difficult to control access. Therefore, the early identification of individuals at risk is crucial for implementing measures that limit access to this means.[16]

Regarding age, the most affected age groups were 30–39 and 40–49 years, indicating

that older individuals, especially males, committed more suicides. This finding aligns with American epidemiological studies, which reported an increase in suicide rates within this age group.[19] A systematic review on suicide and suicide attempts in adults pointed out that various factors are involved in these cases, such as recent adverse events, a history of mental disorders, and self-harm.[20]

It is important to emphasize that various individual and social factors are involved in the array of risk factors related to suicide, including age and adverse life experiences, as well as variables pertinent to each stage of life. Therefore, it is essential that preventive measures be planned not only individually but also collectively, taking into account the specific risk factors of each region.[18]

This leads the World Health Organization to consider suicide a global public health issue,[1] as it has psychosocial and economic impacts. These include diminished personal capacity, loss of interest and pleasure in daily activities, absenteeism from work, and a decline in the quality of life for both the individual and their family members. This impact is underscored by the increasing economic costs associated with mental disorders, including suicide and suicide attempts, which have been rising each year. [21] Therefore, the phenomenon of suicide, in addition to being a serious health problem, can also represent a significant economic, social, and political challenge. This implies that prevention should not be addressed solely through pharmacological or psychotherapeutic methods; it is essential to involve the community by providing social support to vulnerable individuals, as well as to the families and friends of suicide victims.

Regarding the state's microregional situation, the Metropolitan Region recorded lower suicide rates compared to other regions. This can be attributed to certain areas having better overall living conditions. In the case of the Metropolitan Region, the availability of services and goods, along with better access to employment, transportation, and improved quality of life, can directly contribute to this outcome.

On the other hand, areas facing economic vulnerability tend to have higher suicide rates, as social inequality can foster feelings of injustice, tension, anger, and personal failure due to the inability to achieve economic success. Additionally, the stress from ongoing financial difficulties and anxiety, the lack of success in the search for a job, can lead a person to suffering that may develop into suicidal thoughts or giving up on life. Thus, individuals tend to experience less depression and stress when economic activity is expanding. Therefore, more developed regions may exhibit lower suicide rates.[22]

Finally, it is worth noting that the population living in the mountainous region

represents Pomeranian culture, and the self-inflicted violence among this population can be attributed to their hostile, closed-off, and distrustful profile. These factors predispose them to depression and can be exacerbated by excessive alcohol use. This is a population with few leisure options, beyond a life focused solely on rural work - elements that can be considered risk factors for suicide. In other words, the combination of sociocultural and economic variables that have historically been associated with an increased incidence of self-directed violence.[23]

Supporting these analyses, a specific study indicated that, between 2001 and 2007, there was a trend of increasing self-inflicted violence among the Pomeranian population in the state of Espírito Santo. Data such as age, profession, day of the week, time period of incidents, sex, methods used, and motivation for the act were identified to characterize the profile, considering suicide attempts and mortality. Furthermore, the study highlighted that sociodemographic and cultural factors were related to patterns of this type of death, with the predominance of rural activities, associated with low employability and precarious work, as well as the influence of Protestant religion and the strong value placed on marriage within the population.[24] In this regard, the results obtained point to the need for preventive strategies through the development of public policies aligned with the local reality, especially for the most vulnerable groups.

Spatial analyses conducted in international settings, such as in Australia, highlight the importance of identifying geographic and cultural patterns associated with suicide, contributing to the understanding and prevention of this phenomenon across different populations.[25]

In addition to the ecological design, one of the main limitations of this study concerns the use of data from the Mortality Information System (SIM). Underreporting is a frequent problem in suicide statistics, especially in rural areas or regions further from urban centers where access to health services is limited. In this context, many suicide deaths may be recorded under ill-defined or neglected causes due to the lack of accurate diagnosis or inadequate reporting. The lack of proper records can lead to an underestimation of mortality rates, which can distort the analysis of the population's health patterns and impact data quality due to variability in how deaths are notified.

Furthermore, the use of population estimates to calculate mortality rates, which, although based on censuses and projections, may not accurately reflect the actual population during the study period due to migration and changes in the characteristics of the population.

In the state of Espírito Santo, spatial association analysis indicated that the areas with the highest incidence of suicide are located in the regions Central-West, Central Serrana, Metropolitan, Southwest Serrana, Caparaó, Central South, and South Coast, pointing that

suicide occurs heterogeneously in the state.

These results can guide interventions aimed at those territories, with actions to promote mental health and prevent suicide in priority areas, which may impact mortality indicators in the future.

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