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Differential mortality from external causes in Brazil from 2000 to 2022

Mortalidade diferencial por causas externas no Brasil no período de 2000 a 2022

Mortalidad diferencial por las causas externas en Brasil en el período del 2000 al 2022

Mortalité différentielle par causes externes au Brésil de 2000 à 2022

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ABSTRACT

External causes constitute a heterogeneous set, comprising components with distinct determinants, profiles, and trends. This study aims to analyze the sociodemographic characteristics, trends, and spatial distribution of mortality from external causes and its main components in Brazil and its Federative Units from 2000 to 2022. The methodology involves the construction of indicators, the application of methods to assess trends, and the spatial represent. Mortality from external causes ranks fourth among all causes of death. Its main components —homicides, transport accidents, falls, and self-inflicted injuries—exhibit diverse trends. Falls increased by 322.95% over the period; suicides, by 142.80%; transport accidents, by 17.70%; whereas homicides registered a decrease of 2.19%. Given its magnitude and consequences for individuals, families, and society, mortality from external causes represents a significant challenge for public health and policy programs aimed at preventing and reducing these avoidable harms.

KEYWORDS: external causes; sociodemographic characteristics; spatiotemporal analysis; Brazil.

RESUMO

As causas externas compõem um conjunto heterogêneo, formado por componentes que apresentam determinantes, perfis e tendências diferenciados. O

objetivo do trabalho é analisar características sociodemográficas, tendências e distribuição espacial da mortalidade do grupo e principais componentes no Brasil e em suas Unidades Federativas, de 2000 a 2022. Os procedimentos compreendem construção de indicadores, aplicação de método para avaliar tendência e representação espacial dos processos. A mortalidade por causas externas ocupa a quarta posição no total das causas. Seus principais componentes – agressões, acidentes de transporte, quedas e lesões autoprovocadas voluntariamente – apresentam evoluções diversas. As quedas cresceram 322,95% no período; os suicídios, 142,80%; os acidentes, 17,70%; enquanto os homicídios registraram decréscimo de 2,19%. Por sua magnitude e suas consequências para o indivíduo, a família e a sociedade, a mortalidade por causas externas representa importante desafio a ser enfrentado pelos programas de política e saúde pública para prevenção e redução desses agravos evitáveis.
PALAVRAS-CHAVE: causas externas; características sociodemográficas; análise espaçotemporal; Brasil.

RESUMEN

Las causas externas conforman un conjunto heterogéneo, formado por componentes que presentan diferentes causas, perfiles y tendencias. El objetivo de este trabajo es analizar las características sociodemográficas, la evolución, las tendencias y la distribución espacial de la mortalidad por causas externas y los componentes principales en Brasil y en las Unidades Federales, en el periodo del 2000 al 2022. Los procedimientos incluyen la construcción de indicadores de los niveles y características de mortalidad, la aplicación de método para evaluar tendencias y la representación espacial de los procesos. La mortalidad por causas externas ocupa la cuarta posición en el total de las causas. Sus principales componentes: agresiones, accidentes de tránsito, caídas y lesiones autoprovocadas presentan diferentes evoluciones; las caídas crecieron 322.95% en dicho periodo, los suicidios, un 142.80%, los accidentes, un 17.70%, mientras que en los homicidios se registró una disminución de 2.19%. Debido a su magnitud, a sus tendencias y consecuencias para el individuo, la familia y la sociedad, la mortalidad por causas externas representa un desafío importante que debe ser enfrentado por las políticas públicas y los programas de salud pública para prevenir y reducir estos riesgos evitables.
PALABRAS CLAVE: causas externas; características sociodemográficas; análisis espaciotemporal; Brasil.

RÉSUMÉ

Les causes externes constituent un ensemble hétérogène, formé de causes qui présentent des déterminants, des profils et des tendances différentes. L'objectif de ce travail est d'analyser les caractéristiques sociodémographiques, les tendances et la distribution spatiale de la mortalité du groupe et de ses principales composantes au Brésil et dans les unités de la fédération, de 2000 à 2022. Les procédures comprennent la construction d'indicateurs, l'application de méthodes pour évaluer les tendances et la représentation spatiale des processus. La mortalité par causes externes occupe la quatrième place dans le total des causes. Ses principales composantes, les agressions, les accidents de transport, les chutes et les blessures auto-infligées volontairement présentent des évolutions diverses : les chutes ont augmenté de 322,95% sur la période ; les suicides, de 142,80%; les accidents, de 17,70%; tandis que les homicides ont enregistré une baisse de 2,19%. Par son ampleur et ses conséquences pour l'individu, la famille et la société, la mortalité due à des causes externes représente un défi important à relever par les programmes de politiques et de santé publique pour prévenir et réduire ces maladies évitables.

MOTS-CLÉS : causes externes ; caractéristiques sociodémographiques ; analyse spatio-temporelle ; Brésil.

INTRODUCTION

The correlated transformations in demographic structure and health patterns, driven by socioeconomic changes, scientific and medical advancements, and evolving lifestyles, present challenges that must be considered in planning for both current and future health and quality-of-life demands.

Throughout the course of the epidemiological transition—characterized by shifts in health and disease patterns—the morbidity and mortality profile transitions from a scenario of high levels and incidence of infectious diseases to one marked by increased life expectancy and the growing predominance of chronic and neurodegenerative conditions (Omran, 1971; Vallin & Meslé, 2004).

The integrated processes of demographic and epidemiological transition lead to an inversion in the growth of age groups, shifting from the base to the top of the population pyramid, and transferring morbidity and mortality risks from early ages to adult groups—particularly the elderly (Castiglioni, 2012). The world's median age increased from 21.5 years in 1980 to 30.2 years in 2022, while the proportion of the population aged 65 and older rose from 5.9% to 9.8% (United Nations, 2022). According to UN projections, individuals aged 80 and older, who accounted for 2.0% of the global population in 2022, will more than double in the coming decades, reaching 4.7% by 2050.

Simultaneously, non-communicable diseases and injuries are expanding their impact. Global statistics published by the World Health Organization (WHO) indicate that, in 2019, non-communicable diseases accounted for 74% of all recorded deaths worldwide (PAHO, 2020), representing seven of the ten leading causes of mortality. Violence, accidents, and chronic and degenerative diseases play a prominent role in shaping the current health landscape in Brazil and globally. As Minayo (2006, p. 45) states: "This new profile highlights the impact of lifestyle, social and environmental conditions, and increased longevity, demanding new approaches with which the healthcare system is generally unfamiliar".

External causes of morbidity and mortality, classified under Chapter XX of the International Classification of Diseases and Related Health Problems (ICD-10), have shown a steady increase amid transitional processes. This category comprises a heterogeneous set of factors that vary in their causes, characteristics, incidence, and consequences. Specifically, components coded 104 to 113 encompass "accidents and violence (homicides and suicides), which stem from unintentional and intentional unnatural injuries, respectively" (BRASIL, 2024b, p. 16), along with causes associated with population aging.

The explanatory causes of these trends include behaviors related to socioeconomic, cultural, psychological, and structural determinants, as well as vulnerabilities resulting from aging and society's lifestyles, which affect population groups differently and are unequal in the national context. The consequences resulting from these injuries, in addition to deaths, include psychological, social, and economic problems that affect the individual, families, and communities (Mesquita Filho; Jorge, 2007; Gagné *et al.*, 2013).

This study aims to analyze the levels, sociodemographic characteristics, trends, and spatial distribution of mortality from external causes and its main components in Brazil and its federative units between 2000 and 2022.

Brazil exhibits aging indicators that exceed the global average. Between 2000 and 2022, the country's median age rose from 20.2 to 35.0 years, while the proportion of individuals aged 65 and older increased from 4.0% to 10.9% (IBGE, 2024).

In mortality composition indices, external causes have shown a declining share, decreasing from 12.51% to 9.90% of total deaths between 2000 and 2022 (BRASIL, 2024a). However, they still rank fourth among the leading causes of mortality, following circulatory diseases, neoplasms, and respiratory diseases.

This study utilizes data from Datasus – the Brazilian Mortality Information System (BRASIL, 2024a) to assess deaths by place of residence, alongside population data from the Brazilian Institute of Geography and Statistics (IBGE, 2024). The analysis focuses on the overarching category of external causes and, more specifically, on its primary components.

Methodologically, the study involves calculating annual mortality indicators to assess trends over time, alongside demographic characteristics of deceased individuals classified by age group and sex. Trend evaluation applies to the Prais-Winsten method, a generalized linear regression technique that estimates parameters to categorize the temporal evolution of indicators as increasing, decreasing, or stable (Prais; Winsten, 1954; Antunes; Cardoso, 2015). Spatial differentiation is examined through the construction and cartographic representation of mortality rates for external cause components across Brazil's 27 federative units for the year 2022.

Understanding the characteristics and trends of these complex, multifactorial health conditions is crucial. External causes disproportionately affect young adults but also include those linked to increased longevity, with projections indicating a rising incidence in the coming decades. Medical and hospital care for these conditions requires specialized services over prolonged

periods, generating high hospitalization costs (Mesquita Filho & Jorge, 2007). In this context, health indicators serve as critical tools for planning, implementing, and evaluating health policies and investments, aiming to prioritize preventive measures, surveillance, and treatment of accidents, violence, and their consequences in high-risk settings and vulnerable populations (Laurenti, Mello-Jorge & Gotlieb, 2008; Celino *et al*., 2021; Fauveau, 2002).

EXTERNAL CAUSES OF MORBIDITY AND MORTALITY AND THEIR MAIN COMPONENTS

Deaths from *external causes encompass* accidents and violence, with the most prevalent categories—including homicides, transport accidents, falls, and self-inflicted injuries—standing out due to their frequency.

Assaults

Homicide is defined under Article 121 of the Brazilian Penal Code as: **"**Killing someone" —that is, the deliberate act of taking another person's life. This act, classified as "simple homicide", may occur under aggravating circumstances that constitute "qualified homicide", which carries a more severe penalty (TJDFT, 2024).

According to the Global Study on Homicide 2023, conducted by the United Nations, an estimated 458,000 homicides occurred worldwide in 2021. Africa accounted for 38% of these deaths, while the Americas represented 34% (United Nations, 2023). Brazil led the *world* in absolute homicide numbers, contributing nearly 10% of the global total in 2021, followed by India and Mexico.

Globally, the homicide rate was 5.8 deaths per 100,000 inhabitants in 2021. The highest rates were concentrated in the Americas, particularly in Honduras and Jamaica, with Brazil ranking seventh, reporting a homicide rate 3.7 times higher than the global average (United Nations, 2023).

Homicides exhibit significant demographic selectivity, particularly by sex and age group. Both victims and perpetrators of violent crime are predominantly young men living in areas with poor infrastructure and heightened socioeconomic vulnerability (Lira, 2019). According to the World Health Organization (WHO), 81% of global homicide victims are male, with the highest concentration in the 20–24 age group, where the worldwide rate reaches 12.7 deaths per 100,000 people. The Americas record the highest rates, peaking at 40.6 deaths per 100,000 young people (WHO, 2024).

Traffic Accidents

An accident is "understood as an unintentional and preventable event that causes physical and/or emotional injuries" (Brasil, 2000). Given the high and rising number of such incidents, the United Nations set targets to reduce road traffic fatalities between 2010 and 2020 as part of the UN Road Safety initiative. Global traffic-related mortality rates declined by 5.9% from 2010 to 2021, reaching 1.18 million deaths in the latter year. However, the global mortality rate from road traffic accidents during the same period only decreased from 17.9 to 14.9 deaths per 100,000 inhabitants (WHO, 2024). Although reductions were observed across various regions, the proposed targets were not fully achieved.

Risk factors associated with morbidity and mortality from traffic accidents encompass a wide range of structural and individual determinants. Poor road infrastructure—characterized by inadequate lighting, signage, maintenance, legislation, and traffic enforcement—contributes significantly to accident occurrences (Souza *et al.,* 2007). Additionally, driver behaviors, including alcohol and drug consumption, excessive speed, failure to use safety equipment, noncompliance with traffic regulations, and lack of vehicle maintenance, represent another major causal dimension.

The highest traffic accident mortality rates are recorded in Africa. According to the Pan American Health Organization (PAHO), 90% of all traffic-related deaths occur in low- and middle-income countries (PAHO, 2020). These nations report mortality rates of 21.3 deaths per 100,000 inhabitants, whereas high-income countries have a significantly lower rate of 7.6 (WHO, 2024). In 2022, Brazil's traffic accident mortality rate was 17.18, exceeding the global average by 15.3%.

Falls

Falls are defined as events in which an individual "inadvertently comes to rest on the ground or at a lower level, excluding intentional position changes to support themselves on furniture, walls, or other objects" (SES-SP, 2010, p. 9). They result from the interplay of multiple risk factors, classified into four main dimensions: biological, behavioral, environmental, and socioeconomic.

Falls rank as the second leading cause of mortality worldwide among unintentional injury-related deaths, second only to traffic accidents. According to WHO estimates (2024), approximately 684,000 people die annually due to falls. A significant majority (80%) of these deaths occur in low- and middle-in-

come countries. In Brazil, falls have exhibited the most significant increase among the major components of external causes of mortality.

The rising number of fatal falls is strongly linked to aging and the increased frailty associated with the aging process (SES-SP, 2010). Beyond mortality, falls represent a serious public health concern due to their potential long-term consequences, leading to severe physical, psychological, and social repercussions, including costly treatments and prolonged hospitalization.

Self-Inflicted Injuries

Suicide is defined as "a deliberate act carried out by an individual with the intention of causing their own death, performed consciously and intentionally, even if ambivalently, using a means believed to be fatal" (ABP, 2014, p. 9). It results from multiple and complex factors—psychological, biological, social, cultural, economic, and environmental—and the individual's life history (Brasil, 2017).

The number of suicides worldwide decreased from 762,000 cases in 2000 to 717,000 in 2021, yet it remains among the top twenty causes of death globally. Overall mortality rates declined during this period, from 12.4 per 100,000 people in 2000 to 9.1 in 2021 (WHO, 2024). Europe, which historically has had the highest suicide rates, saw a significant reduction, dropping from 21.3 per 100,000 inhabitants in 2000 to 12.3 in 2021. In contrast, the Americas experienced a rising trend, with suicide rates increasing from 7.2 to 9.8 per 100,000 over the same period (WHO, 2024). The region also exhibits significant gender disparity. While the global male suicide rate in 2021 was 12.3 per 100,000—slightly more than double the female rate of 5.9—in the Americas, this ratio is approximately four to one (WHO, 2024). In Brazil, suicide rates more than doubled between 2000 and 2022, rising from 3.99 to 8.11 per 100,000 people.

The fatal nature of self-inflicted harm profoundly affects families, social circles, and the broader community.

CHARACTERISTCS OF EXTERNAL CAUSES AND THEIR MAIN COMPONENTS IN BRAZIL

External causes in Brazil are notable both for their high mortality burden and the long-term consequences that often require extended treatment, making them a critical public health issue. In 2022, the country recorded 1,544,266 deaths due to external causes, representing a 29.18% increase from 2000. Meanwhile, overall mortality in Brazil rose by 63.12% during the same period (Table 1).

The main components of external causes exhibit distinct trends and prevalence levels. Among the most significant categories, homicides declined by 2.19%, while transport-related fatalities increased by 17.70%, despite a proportional decline within the total number of external cause deaths. Notably, falls exhibited the highest growth rate, surging by 322.95%, followed by suicides, which rose by 142.80%.

Another significant category is classified as "events of undetermined intent", which constituted around 10.00% of all external cause fatalities at both the start and end of the period analyzed (Brasil, 2024a). This substantial proportion primarily results from insufficient information for completing the Death Certificate (Brasil, 2024b). The lack of clarity regarding intent may create challenges in analyzing mortality patterns, especially if the omission of this information is linked to the socioeconomic vulnerability of certain population groups or regions.

Table 1 – External causes of morbidity and mortality in brazil – number of deaths, mortality rates per 100,000 inhabitants, and growth (%) of causes (2000 and 2022)

Causes - CID-BR-10: 104-113	2000		2022		Growth (%)
	Cases	Rates	Cases	Rates	
104 Transport accidents	29,645	17.45	34,892	17.18	17.70
105 Falls	4,258	2.51	18,009	8.87	322.95
106 Accidental drowning and submersion	6,156	3.62	4,760	2.34	-22.68
107 Exposure to smoke, fire, and flames	1,017	0.60	961	0.47	-5.51
108 Poisoning (intoxication) due to exposure to harmful substances	268	0.16	805	0.40	200.37
109 Intentional self-harm	6,780	3.99	16,462	8.11	142.80
110 Assaults	45,360	26.70	44,367	21.85	-2.19
111 Events of undetermined intent	11,934	7.03	15,533	7.65	30.16
112 Legal interventions and war operations	73	0.04	2,042	1.01	2,697.26
113 All other external causes	12,906	7.60	15,114	7.44	17.11
Total: External causes	118,397	69.70	152,945	75.31	29.18
General mortality	946,686		1,544,266		63.12

Source: Prepared with data from Brasil (2024a).

Fatalities classified under X85 to Y09 have declined in absolute numbers and rates over the period studied. However, they remain alarmingly high, securing Brazil's position as the global *leader* in homicide figures. Firearm-related assaults (X93 to X95) were responsible for 31,710 deaths in 2022 (BRASIL, 2024a), accounting for 71.47% of all homicide-related fatalities, a significant portion of which is linked to organized crime and drug trafficking gangs (Lira, 2019). Following assaults, homicides involving sharp or piercing objects represented 15.61% of cases, while blunt force trauma accounted for 4.92%. Notably, assaults involving bodily force saw a staggering 311.91% increase, while homicides caused by sharp objects rose by 24.08% during the period (BRASIL, 2024a).

Transport-related fatalities fall under categories V01 to V99, with the highest number of deaths in 2022 occurring among motorcyclists (V20 to V29), accounting for 34.56% of all cases. Fatalities among automobile occupants (V40 to V49) represented 20.71%, while pedestrian deaths (V01 to V09) constituted 15.44%. Motorcyclist fatalities surged from 2,465 to 12,058 deaths, marking a 389.17% increase over the period analyzed. Meanwhile, automobile occupant deaths rose by 37.22%, and pedestrian fatalities declined, though accidents still claimed 5,387 pedestrian lives in 2022 (BRASIL, 2024a).

The sharp rise in motorcycle-related accidents, injuries, and fatalities has become a growing concern in recent decades (Souza *et al.*, 2007). This escalation is driven by a complex interplay of factors, including vehicle-related risks, such as the inherent instability, reduced structural protection, and lower visibility of motorcycles compared to other motorized vehicles (Mascarenhas *et al.*, 2016). Additionally, socioeconomic factors influence vehicle choice, with motorcycles becoming a preferred mode of transportation for commuting to work and school due to lower costs and greater mobility in congested urban environments.

Other critical transport-related risk factors include poor road infrastructure, inadequate traffic enforcement, and urban congestion—exacerbated by rapid fleet expansion without designated motorcycle lanes. Drivers' behavior, including speeding, substance use, and failure to comply with safety regulations, also contributes significantly to accident rates. Driver behavior, including speeding, substance use, and failure to comply with traffic regulations, further contributes to accident rates.

Falls are categorized under W00 to W19. In 2022, the most frequent fall-related deaths occurred under: W18 – Other same-level falls (46.38%); W01 – Same-level

falls due to slipping, tripping, or missteps (15.12%); and W17 – Falls from one level to another (5.30%). Additional significant categories include W13 – Falls from or off buildings and other structures and W10 – Falls from or on stairs and steps (BRASIL, 2024a).

A noteworthy improvement in data completeness is observed in W19 – Unspecified falls, which decreased from 56.79% to 18.60% over the period. However, these figures remain high, underscoring persistent gaps in mortality records.

Self-inflicted injuries (X60 to X84) are dominated by suicides involving hanging, strangulation, and suffocation (X70)—which increased by 236.73% over the period, accounting for 71.39% of all suicides in 2022. Other significant categories include intentional self-poisoning (X60 to X69), which accounted for 10.94% of cases; self-inflicted firearm injuries (X72 to X74), representing 6.63%; and suicide by jumping from a high place, which grew by 288.82% over the period (BRASIL, 2024a).

To curb suicide rates, policies such as firearm access control and restrictions on pesticide and toxic substance sales and use have been recommended (BRASIL, 2017).

MORTALITY PROFILE OF THE MAIN COMPONENTS OF EXTERNAL CAUSES BY SEX AND AGE

The heterogeneity within external causes is strongly reflected in the characteristics of at-risk groups. External causes predominantly affect young males, particularly in cases of violent deaths.

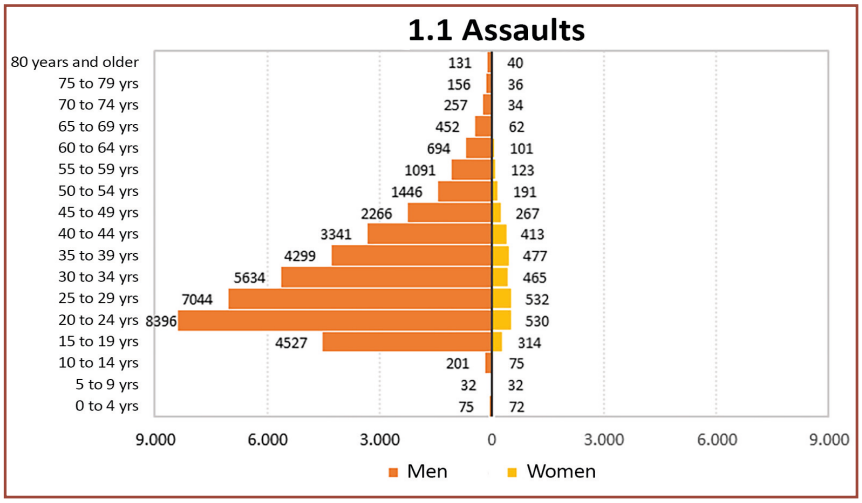
According to United Nations (2023) data, global homicide rates stood at 5.8 per 100,000 inhabitants in 2021, with a male rate of 9.3 compared to 2.2 for females. In Brazil, the overall sex ratio for homicides is 1,063.80 men per 100 women, with a concentration of deaths among young adults, as indicated by median ages around 30 years.

Transport accidents, with a sex ratio of 481.49 men per 100 women in 2022, primarily affect middle-aged adults, with a median age of approximately 40 years. Like homicide patterns, male mortality from accidents occurs at younger ages compared to females. Suicide also exhibits a strong male predominance (sex ratio: 362.65); for this cause, median ages hover around 40 years, though females tend to be affected at slightly younger ages.

Falls, however, differ markedly from other external causes. They are closely linked to age-related frailties, with half of fall-related deaths occurring at ages above 70.85 years for men and 81.10 years for women. While older men ex-

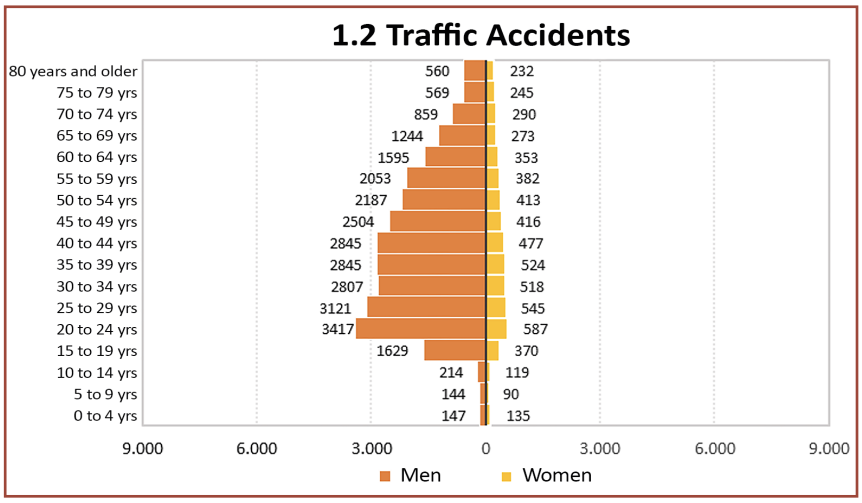
hibit higher mortality rates from falls, the male predominance reverses among individuals aged 80 and older. This shift results from greater female longevity, exposing a larger proportion of elderly women to fall-related risks, as reflected in the sex ratio of 64.91 male deaths per 100 female deaths in 2022.

Figure 1 – Distribution of deaths from external causes by age and sex – Brazil (2022)



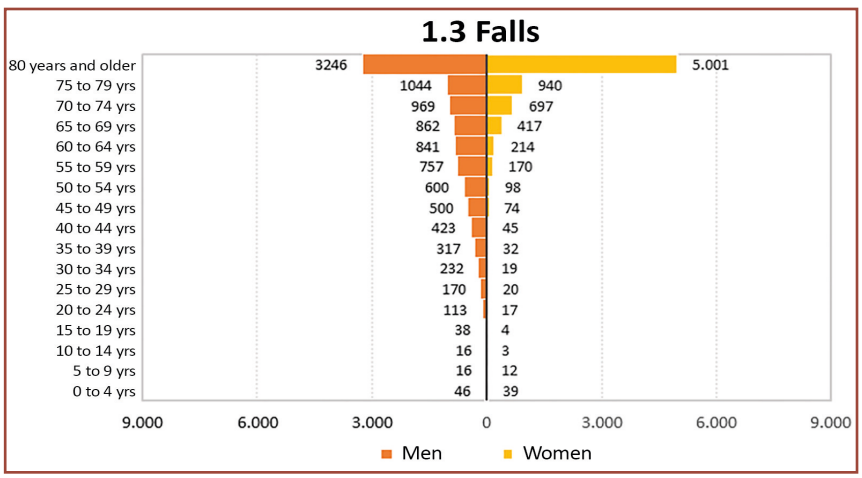
Median ages
Total: 30.06
Men: 29.82
Women: 33.52

Sex ratio
1,063.80



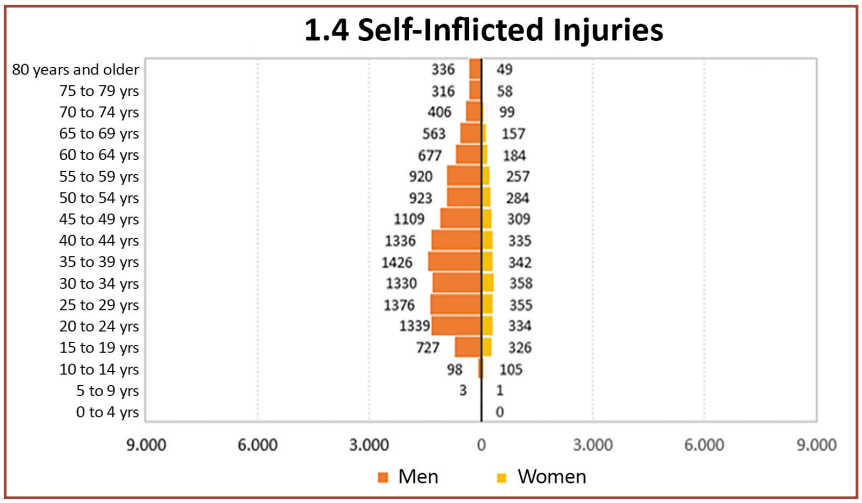
Median ages
Total: 40.21
Men: 40.08
Women: 41.01

Sex ratio
481.49



Median ages
Total: 78.11
Men: 70.85
Women: 81.10

Sex ratio
130.61



Median ages
Total: 40.20
Men: 40.54
Women: 39.45

Sex ratio
362.65

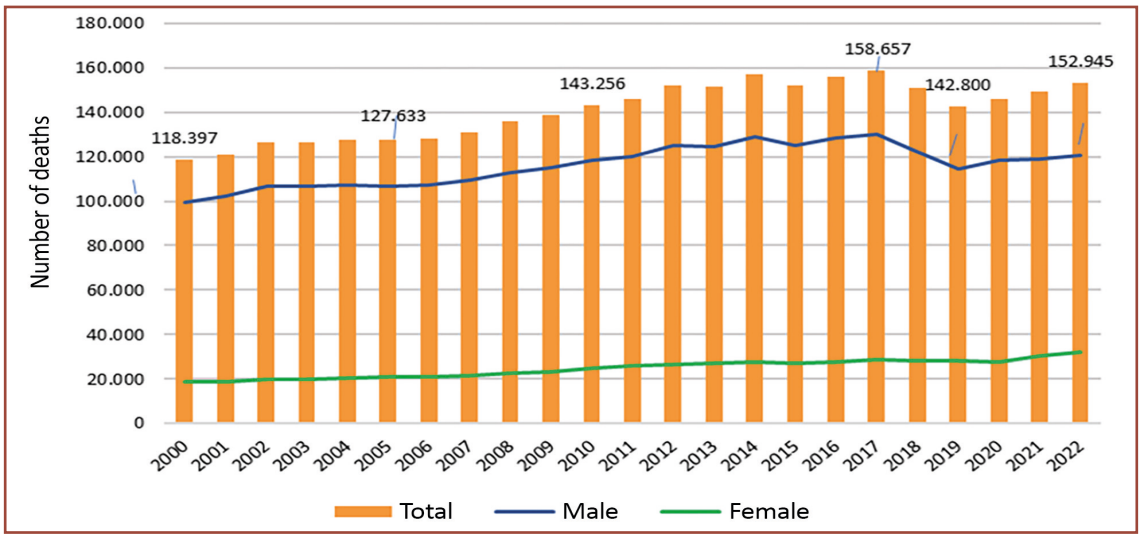
Source: Prepared with data from Brasil (2024a).

ANALYSIS OF TRENDS AND EVOLUTION IN MORTALITY FROM EXTERNAL CAUSES

The evolution of mortality from external causes, illustrated in Figure 2, reveals a steady increase in deaths until 2017. A decline is observed in 2018 and 2019, followed by a further reduction during the COVID-19 pandemic, when confinement measures lowered risks associated with preventable causes. At the end of the study period, mortality rates begin to rise again but remain below pre-pandemic levels.

The sex distribution highlights the predominance of male mortality, particularly in cases of violent deaths. Among women, the most significant trend is the consistent increase, largely driven by the rise in fall-related mortality.

Figure 2 – Figura 2 – Mortalidade por causas externas, total e por sexo, segundo o ano de óbito – Brasil (2000 a 2022)



Source: Prepared with data from Brasil (2024a).

Mortality trend analysis in longitudinal data series may exhibit random fluctuations over time. To accurately assess the series' actual propensity for forecasting, it is essential to employ methods that allow for the evaluation of trends while controlling for the effects of random variables. The Prais-Winsten method (1954) was employed to correct autocorrelation, a phenomenon in which a data point in a time series is influenced by previous values—a common occurrence in population-based datasets that may distort interpretations (Antunes & Cardoso, 2015).

The general analysis covered external causes of mortality from 2000 to 2022, with years of occurrence (classified by place of residence) as independent variables, and overall, male, and female mortality rates as dependent variables. The first step involved a logarithmic transformation of mortality rates, a technique that normalizes data distributions, improving the suitability of the dataset for statistical analysis and interpretation (Antunes & Cardoso, 2015). The regression model was then applied.

The Annual Percent Change (APC), calculated based on the regression coefficient (β), determines the magnitude and trend of the time series: positive variation → increasing trend; negative variation → decreasing trend; non-significant variation → stationary trend The significance level was set at $p < 0.005$, with a 95% Confidence Interval (CI).

Table 2 presents the results of the applied statistical model, highlighting the differential trends in mortality from external causes. The overall findings indicate a statistically significant downward trend for the youngest age group (0–14 years) and an upward trend among the elderly (80 years and older). The highest APC value in the oldest age group further reinforces and statistically confirms the growing impact of fall-related mortality among the aging population. Among men, significant results indicate a declining trend in total external cause mortality but an increasing trend among younger elderly individuals (60–79 years old). For women, the most notable finding is the significant upward trend among those aged 80 and older, which exhibits the highest positive APC rate in the dataset. This trend, also observed in the overall female population, underscores the notable increase in fall-related mortality among women, largely attributed to higher female life expectancy.

Tabela 2 – Tendência das taxas de mortalidade por causas externas, total e específica, por sexo e faixa etária – Brasil (2010 a 2022)

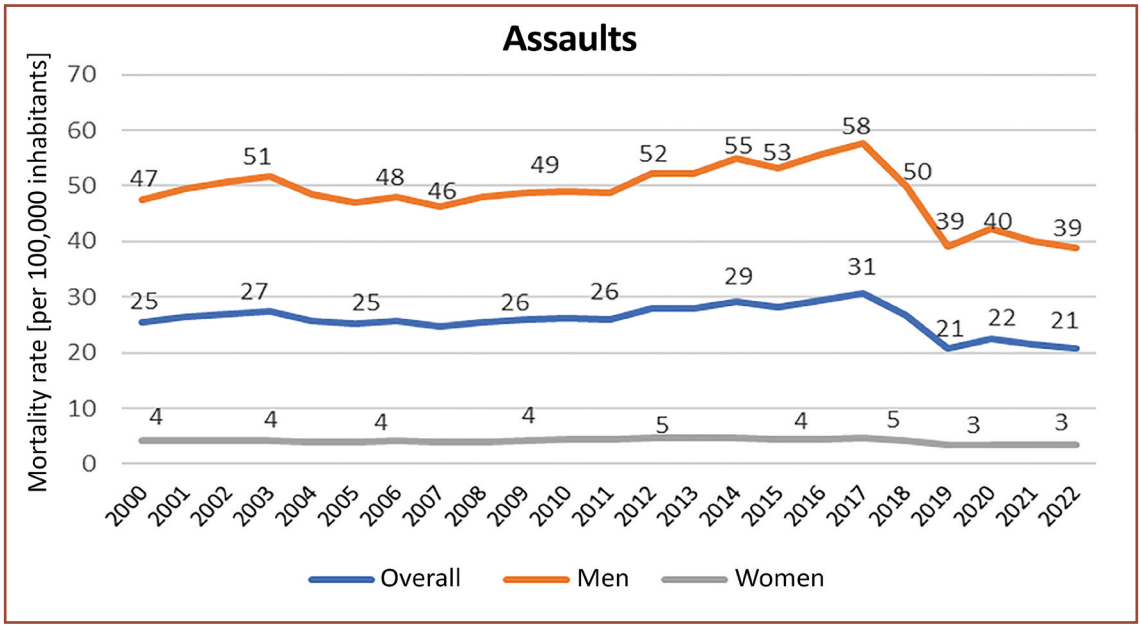
Age group	Prais-Winsten Model Result				Annual Percentage Change Rate (VPA %)			
	β	IC 95%		Sig.	VPA (%)	IC 95%		Trends
		Inf.	Studies			Inf.	Studies	
General								
Total	0.002	-0.001	0.004	0.158	0.36	-0.15	0.88	Stationary
0 – 14	-0.009	-0.011	-0.007	0.000	-2.08	-2.51	-1.64	Decreasing
15 – 39	-0.001	-0.004	0.001	0.305	-0.34	-1.02	0.34	Stationary
40 – 59	-0.002	-0.003	0.000	0.023	-0.43	-0.80	-0.07	Decreasing
60 – 79	0.002	0.000	0.004	0.017	0.47	0.09	0.84	Increasing
80+	0.015	0.012	0.018	0.000	3.47	2.75	4.20	Increasing
Men								
Total	-0.010	-0.013	-0.008	0.000	-2.36	-2.98	-1.75	Decreasing
0 – 14	-0.002	-0.005	0.001	0.233	-0.44	-1.18	0.31	Stationary
15 – 39	-0.002	-0.003	0.000	0.015	-0.44	-0.79	-0.10	Decreasing
40 – 59	0.002	0.000	0.003	0.013	0.39	0.09	0.69	Decreasing
60 – 79	0.013	0.011	0.016	0.000	3.08	2.53	3.64	Increasing
80+	0.000	-0.002	0.003	0.688	0.11	-0.46	0.69	Stationary
Women								
Total	0.007	0.005	0.008	0.000	1.57	1.18	1.96	Increasing
0 – 14	-0.007	-0.009	-0.006	0.000	-1.70	-1.99	-1.41	Decreasing
15 – 39	0.000	-0.002	0.002	0.891	-0.04	-0.57	0.50	Stationary
40 – 59	-0.001	-0.003	0.002	0.619	-0.14	-0.72	0.44	Stationary
60 – 79	0.003	0.001	0.005	0.013	0.68	0.16	1.21	Increasing
80+	0.016	0.012	0.020	0.000	3.78	2.92	4.64	Increasing

Note: β – coefficient of the regression line; 95% CI – Confidence Interval; Sig. – Level of Significance
Source: Compiled from Brasil (2024a) and IBGE (2024).

The trends identified through the Prais-Winsten method reflect the overall behavior of a heterogeneous set of causes that constitute the chapter on external causes. Figures 3 to 6 illustrate the mortality rate trends for the four primary components of external causes over the analyzed period, calculated for the total population and by sex. These figures highlight general distinctions, though age group distributions also present significant variations. The key trends observed are as follows: Figures 3 and 4 illustrate the recent decli-

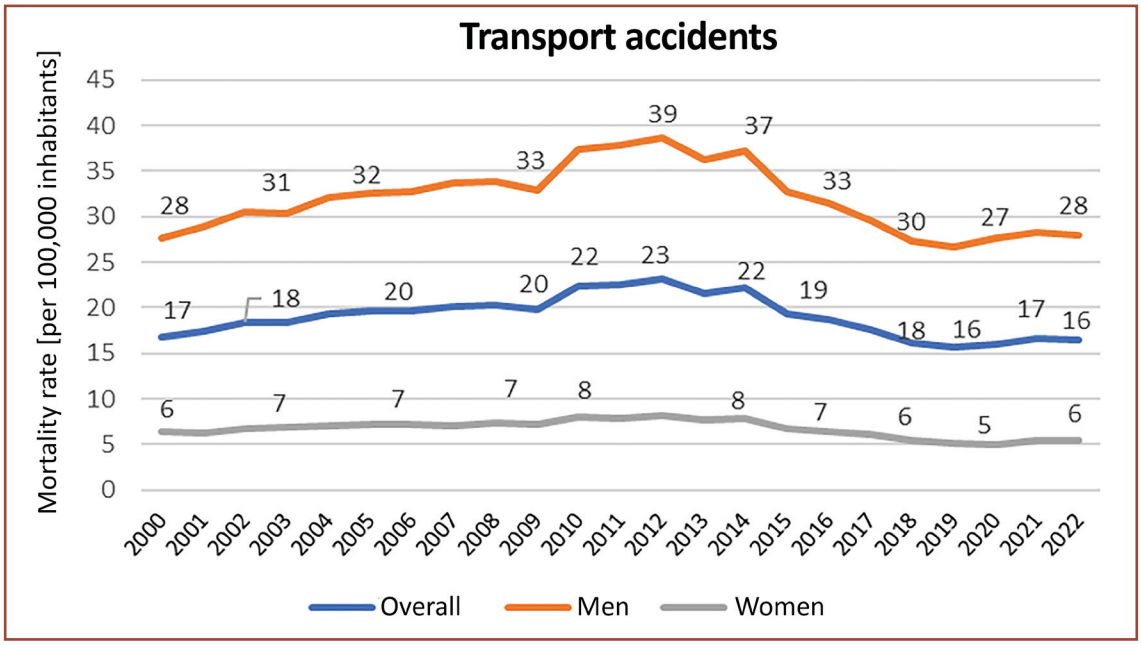
ne in overall mortality rates due to assaults and transport accidents, alongside a pronounced male predominance. In contrast, Figures 5 and 6 highlight the rising mortality rates from falls and suicides throughout the analyzed period, affecting both the total population and both sexes.

Figure 3 – Mortality rate due to assaults (per 100,000 inhabitants), by sex – Brazil (2000-2022)



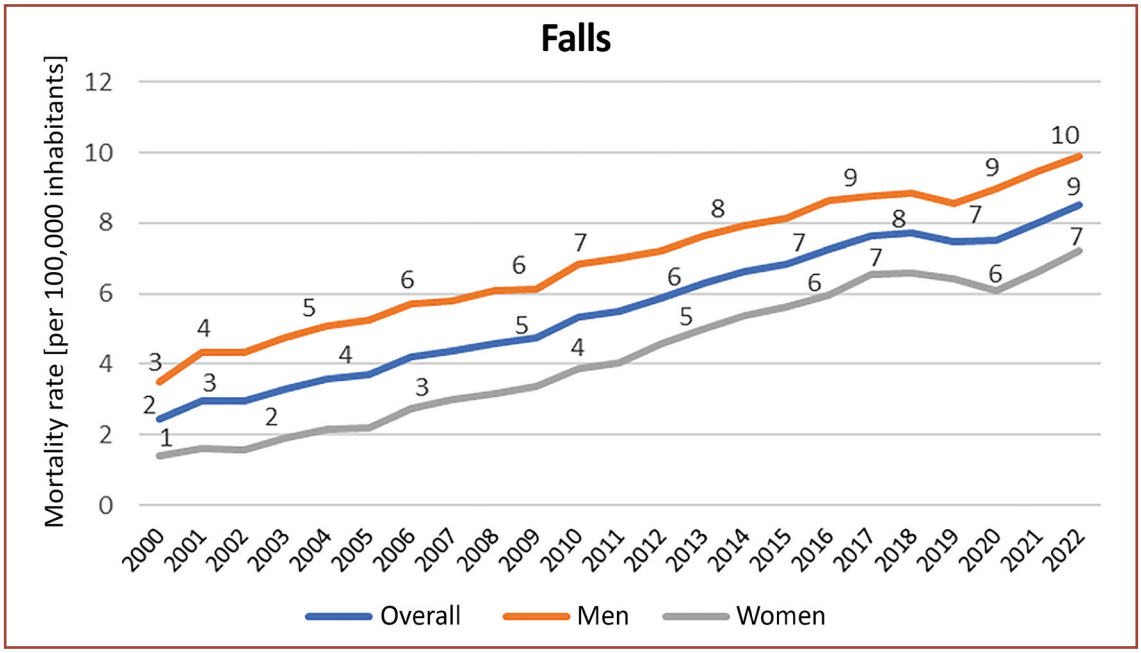
Source: Compiled from Brasil (2024a) and IBGE (2024).

Figure 4 – Mortality rate due to transport accidents (per 100,000 inhabitants), by sex – Brazil (2000-2022)



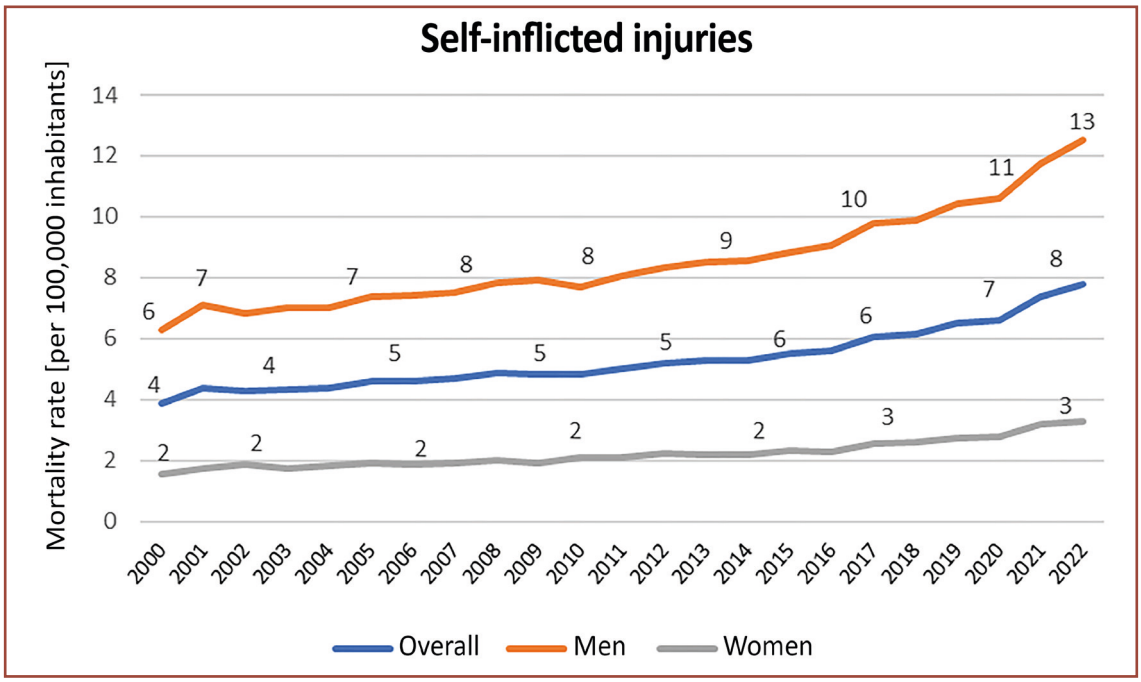
Source: Compiled from Brasil (2024a) and IBGE (2024).

Figure 5 – Mortality rate due to falls (per 100,000 inhabitants), by sex – Brazil (2000-2022)



Source: Compiled from Brasil (2024a) and IBGE (2024).

Figure 6 – Mortality rate due to self-inflicted injuries (per 100,000 inhabitants), by sex – Brazil (2000-2022)



Source: Compiled from Brasil (2024a) and IBGE (2024).

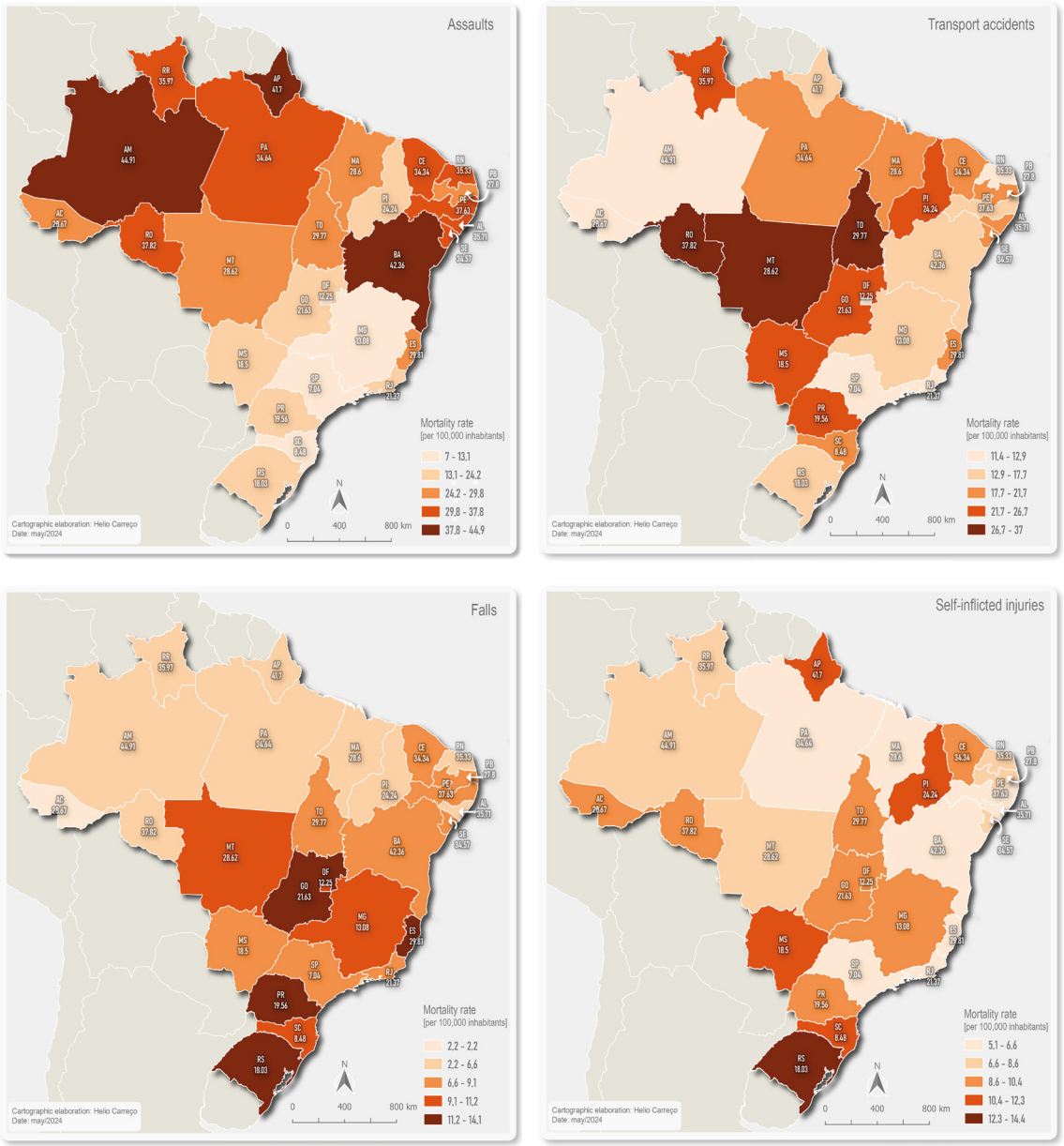
SPATIAL ANALYSIS

Given the heterogeneity among the country's federative units, spatial analysis aims to highlight the disparities in the focal causes, shaped by socio-

-economic, demographic, cultural, structural, and service-related inequalities across these regions (BORGES, 2017). Additionally, it seeks to identify spatial patterns within the dataset.

The methodological approach involves constructing and analyzing mortality indicators for 2022, focusing on four key external causes across all Brazilian states. The mortality rates per 100,000 inhabitants, depicted in Figure 7, emphasize significant regional differences in mortality levels and reveal clusters of contiguous states exhibiting similar trends.

Figure 7 – Mortality rates per 100,000 inhabitants for homicides, transport accidents, falls, and self-inflicted injuries, by Federative Units of Brazil (2022)



Source: Compiled from Brasil (2024a) and IBGE (2024).

Homicide mortality rates are highest in states within the North and Northeast Regions, with rates exceeding 40.00 per 100,000 inhabitants in Amazonas (44.91), Bahia, and Amapá. Conversely, the lowest rates are found in the South, Southeast, and Central-West Regions, with São Paulo (7.04) and Santa Catarina recording rates up to four times lower than the highest figures (BRASIL, 2024a; IBGE, 2024).

Similarly, transport accident mortality rates display significant spatial disparities. The highest rates, surpassing 30.00 per 100,000 inhabitants, are concentrated in a continuous area covering states in the North and Central-West Regions, notably Tocantins (36.98), Mato Grosso, and Rondônia. The lowest rates are observed in São Paulo (11.37) and the Federal District.

In contrast to homicides and transport accidents, fall-related mortality is concentrated in the South, Southeast, and Central-West Regions, correlating with higher proportions of elderly populations. The highest mortality rates are observed in Paraná (14.07), Espírito Santo, and Rio Grande do Sul, states with a significant elderly demographic. Conversely, the lowest rates are recorded in Acre (2.17), Roraima, and Amazonas, predominantly in the North and Northeast Regions.

Regarding suicides, the highest rates are found in the South and Central-West Regions, particularly in Rio Grande do Sul (14.44), Santa Catarina, and Mato Grosso do Sul. However, elevated rates are also recorded in Piauí (Northeast) and Amapá (North). The lowest rates are found in the Southeast and Northeast Regions, with Rio de Janeiro (5.06), Pernambuco, and Maranhão presenting the lowest figures.

CONCLUDING REMARKS

Mortality from external causes, stemming from complex and heterogeneous factors, poses a significant challenge for health policies and services in Brazil. This category encompasses a wide range of determinants and their interactions, affecting diverse risk groups and producing consequences on multiple levels.

Despite an overall trend of stability, external causes still hold a prominent position in the national mortality ranking. The multifactorial nature of these causes is closely linked to the profiles of affected populations and the socio-environmental contexts in which they occur.

While the number of homicides has declined, Brazil remains the global *leader* in this category of deaths. Homicides primarily impact young males,

whereas accidents and suicides are more prevalent among older adult men. Falls, however, stand apart in terms of causes, risk groups, and trends. They exhibit the highest growth rate among all categories analyzed, and their incidence is predominantly concentrated among the elderly, across men and women, and is expected to increase in the coming decades, in line with the country's aging population.

The spatial analysis underscores the diverse mortality patterns across Brazil's federative units, though regional clusters emerge for all four major causes analyzed. Further studies on the socioeconomic, demographic, cultural, and environmental factors that shape these disparities are essential for deepening the explanatory analysis of both the similarities and differences observed.

The availability and quality of health records play a crucial role in understanding public health needs and guiding policy interventions. Although data production on mortality causes has improved and the proportion of deaths with unreported causes has decreased, data completeness and accuracy remain inconsistent across categories, sociodemographic profiles, and geographic regions. These discrepancies can hinder comparisons between indicators.

Given the magnitude of fatalities and severe injuries classified under external causes, further research is crucial to examine the socioeconomic and demographic determinants of at-risk groups, the contexts in which these events occur, and their interrelations. Additionally, targeted intervention strategies must be adopted to mitigate, prevent, and manage these public health burdens. Addressing these challenges and the associated healthcare costs requires comprehensive policies to reduce risk factors, enhance prevention measures, and improve the overall quality of life in Brazilian society. ●

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