

Mortality from Kaposi's Sarcoma in Brazil and Regions between 1996 and 2023: Temporal Trend Analysis

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Mortalidade por Sarcoma de Kaposi no Brasil e Regiões entre 1996 e 2023: Análise de Tendência Temporal

Mortalidad por Sarcoma de Kaposi en el Brasil y Regiones entre 1996 y 2023: Análisis de Tendencia Temporal

Érika Costa Lopes¹; Rafaella Nascimento da Silva Brito²; Eriksen Alexandre Costa Gonçalves³; Saul Rassy Carneiro⁴

ABSTRACT

Introduction: Kaposi's sarcoma is a multicentric vascular neoplasm, clinically associated with acquired immunodeficiency syndrome (AIDS), which can lead to death. **Objective:** To verify the temporal trend of mortality from Kaposi's sarcoma in Brazilian regions between 1996 and 2023. **Method:** Ecological study of temporal trend analysis using secondary morbidity data available in the Department of Informatics of the National Health System (DATASUS/SIM), in the ICD-10 category (C46-Kaposi's sarcoma). The free software environment R and Prais-Winsten regression were used to analyze the time series. **Results:** A total of 2,226 deaths from Kaposi's sarcoma were reported during the 28 years analyzed, with the Southeast region showing the highest absolute frequency. Among the general population, there was an increasing trend in Kaposi's sarcoma mortality in Brazil, with an APC of 7%, particularly in the Northeast region, which had an APC of 32%, and the South region, with 37.4%. Among women, Brazil showed an increasing trend (7.9%), in addition to increases observed in the Northeast (127.6%) and South (78.5%) regions. Among men, the Northeast region showed a significant increase only from 2010 onwards, with a continuous increasing trend of 36.2%. **Conclusion:** The temporal analysis revealed an increasing trend in mortality from KS in Brazil and in the Northeast, South, and Central-West regions, with emphasis on the Northeast, especially among men. The North and Southeast regions remained stationary. The results emphasize the need for human immunodeficiency virus (HIV) diagnosis and treatment to prevent opportunistic diseases.

Key words: Kaposi's sarcoma/mortality; Mortality/trends; HIV; Brazil.

RESUMO

Introdução: O sarcoma de Kaposi é uma neoplasia vascular multicêntrica, clinicamente associada à síndrome da imunodeficiência adquirida (Aids), que pode acarretar o óbito. **Objetivo:** Verificar a tendência temporal da mortalidade por sarcoma de Kaposi nas Regiões brasileiras entre 1996 e 2023. **Método:** Estudo ecológico de análise da tendência temporal utilizando dados secundários de morbidade disponíveis no Departamento de Informática do Sistema Único de Saúde (DATASUS/SIM), na categoria CID-10 (C46 – sarcoma de Kaposi). Utilizaram-se o ambiente de *software* livre R e a regressão de Prais-Winsten para a análise das séries temporais. **Resultados:** Foram notificados 2.226 óbitos por sarcoma de Kaposi durante os 28 anos analisados, destacando-se a Região Sudeste que apresentou a maior frequência absoluta. Entre a população geral, observou-se tendência crescente da mortalidade por sarcoma de Kaposi no Brasil com VPA de 7%, com destaque para a Região Nordeste que apresentou VPA de 32% e a Sul (37,4%). Entre as mulheres, o Brasil obteve tendência crescente (7,9%), além de elevações observadas no Nordeste (127,6%) e Sul (78,5%). Já entre os homens, o Nordeste mostrou aumento significativo apenas a partir de 2010, com tendência crescente de 36,2% e contínua. **Conclusão:** A análise temporal revelou tendência crescente da mortalidade por sarcoma de Kaposi no Brasil e nas Regiões Nordeste, Sul e Centro-Oeste, com destaque para o Nordeste, especialmente entre os homens. As Regiões Norte e Sudeste mantiveram-se estacionárias. Destaca-se a necessidade do diagnóstico e do tratamento do vírus da imunodeficiência humana (HIV), evitando doenças oportunistas. **Palavras-chave:** Sarcoma de Kaposi/mortalidade; Mortalidade/tendências; HIV; Brasil.

RESUMEN

Introducción: El sarcoma de Kaposi es una neoplasia vascular multicéntrica, clínicamente asociada al síndrome de inmunodeficiencia adquirida (sida), que puede ocasionar la muerte. **Objetivo:** Verificar la tendencia temporal de la mortalidad por sarcoma de Kaposi en las regiones brasileñas entre 1996 y 2023. **Método:** Estudio ecológico de análisis de tendencia temporal utilizando datos secundarios de morbilidad disponibles en el Departamento de Informática del Sistema Único de Salud (DATASUS/SIM), en la categoría CIE-10 (C46–sarcoma de Kaposi). Se utilizó el *software* libre R y la regresión de Prais-Winsten para el análisis de las series de tiempo. **Resultados:** Se notificaron 2226 muertes por sarcoma de Kaposi durante los 28 años analizados, destacando la región Sudeste, que presentó la mayor frecuencia absoluta. Entre la población general, se observó una tendencia creciente de la mortalidad por sarcoma de Kaposi en el Brasil con una VPA del 7%, destacando la región Nordeste, que presentó una VPA del 32%, y la región Sur del 37,4%. Entre las mujeres, Brasil obtuvo una tendencia creciente (7,9%), además de aumentos observados en el Nordeste (127,6%) y el Sur (78,5%). Entre los hombres, el Nordeste mostró un aumento significativo solo a partir de 2010, con una tendencia creciente del 36,2% y continua. **Conclusión:** El análisis temporal reveló una tendencia creciente de la mortalidad por sarcoma de Kaposi en el Brasil y en las regiones Nordeste, Sur y Centro-Oeste, destacándose el Nordeste, especialmente entre los hombres. Las regiones Norte y Sudeste se mantuvieron estacionarias. Se resalta la necesidad del diagnóstico y tratamiento del virus de inmunodeficiencia humana (VIH) para evitar enfermedades oportunistas.

Palabras clave: Sarcoma de Kaposi/mortalidade; Mortalidad/tendencias; VIH; Brasil.

^{1,2,4}Universidade Federal do Pará (UFPA). Belém (PA), Brasil. E-mails: erikacostalopes340@gmail.com; rafaellabrito16@gmail.com; saul.carneiro@ebserh.gov.br. Orcid: <https://orcid.org/0009-0005-3294-6532>; Orcid ID: <https://orcid.org/0009-0008-2729-6231>; Orcid ID: <https://orcid.org/0000-0002-6825-0239>

³Empresa Brasileira de Serviços Hospitalares (Ebserh). Belém (PA), Brasil. E-mail: eriksongon@yahoo.com.br. Orcid ID: <https://orcid.org/0009-0001-3269-1673>

Corresponding author: Érika Costa Lopes. Avenida Generalíssimo Deodoro, 01 – Umarizal. Belém (PA), Brasil. CEP 66050-160. E-mail: erikacostalopes340@gmail.com



INTRODUCTION

Described for the first time in 1872 by Moritz Kaposi, Kaposi's sarcoma is a multicentric vascular neoplasm which, over the last few years, has been studied for its association with acquired immunodeficiency syndrome (AIDS). It is clinically characterized by the presence of nodular red-blue and brown-red colored lesions, with slow, painless growth. The lesions are usually more frequent in the lower limbs and target mainly the cutaneous tissue, but they can cause visceral compromise in some cases¹.

Over the last few years, Kaposi's sarcoma has been drawing the attention of researchers for presenting an extremely specific epidemiological profile². Epidemic Kaposi's sarcoma occurs in 95% of cases in male young adults/adults who are homosexual and bisexual and carry the HIV, or in women who have relations with bisexual men. In addition to the epidemic form, Kaposi's sarcoma has three more clinical presentations: the classic one, common in elderly men of Mediterranean-origin; endemic, in Black African men; and iatrogenic, common in transplanted and immunosuppressed patients³.

It is worth underscoring the significant difference in AIDS distribution and deaths from Kaposi's sarcoma within highly developed Regions, like the South and Southeast, and the North and Northeast Regions, which, in turn, present development levels lower than the national average. Multiple factors contribute to this disproportion, like access to diagnosis, ineffective or incomplete treatment, and life habits. This is expected to lead to an increase in death rates from Kaposi's sarcoma in several regions by 2030⁴.

After the introduction of antiretroviral therapy (ART), the incidence of Kaposi's sarcoma had a stark drop, but since it is an AIDS-defining neoplasm, it still presents an unfavorable prognosis for the patient. Moreover, the geographic, racial, and social disparity within Brazilian Regions is officially known, mainly regarding health and education axes^{5,6}.

There is a perceptible gap in the national scientific literature, since few studies address the temporal follow-up of deaths from Kaposi's sarcoma, especially when it comes to long temporal series on the theme, both in Brazil and worldwide, let alone a more detailed analysis, per geographic Region, state, or continent⁷. Several factors can be inferred to explain such a scenario, among which we highlight: lack of systematic clinical records and underreporting of cases in several contexts, and methodological challenges, such as difficulty accessing reliable historical data, regional variations to the epidemiological profile, and limited information on prognostic factors and patient evolution. Another crucial

factor is that most studies focus on specific populations, like people living with HIV, which impairs the comparison between subgroups and reduces the representativeness of the findings in broader scenarios⁸.

Time series studies substantially contribute to analyzing the trends of Kaposi's sarcoma evolution in the Brazilian population and its Regions, allowing us to draw strategies to create public health policies for controlling this disease. Given the lack of knowledge on the theme, this study aims to describe the temporal trend of mortality from Kaposi's sarcoma in Brazil and Regions, from 1996 to 2023.

METHOD

Ecological, quantitative study of temporal series analysis using secondary morbidity data available in the Department of Informatics of the National Health System (DATASUS/SUS), referring to the 1966-2023 period. The data was obtained directly from SUS' Mortality Information System (SIM)⁹, in which the following options were selected: TABNET, vital statistics, deaths per residence, ICD-10 category¹⁰ (C46 – Kaposi's sarcoma) in the Federative Unit, as well as resident population in the same units during the analyzed period, filtered by sex and age group starting at 20 years old. The collected and extracted data was processed in a specific spreadsheet using Microsoft Excel software to calculate crude mortality based on the ratio between the total number of recorded deaths from the disease in the period and the total population at risk, multiplied by 100 thousand. The free software environment R version R 4.3.3¹¹ was used, using the Forecast¹² pack version 8.23 and Prais-Winsten regression¹³ to analyze the time series. For the annual percentage change (APC) and its respective confidence interval, we used the formula¹³:

$$APC = [-1 + 10^{b1}] * 100\%$$

$$95\%CI = [-1 + 10^{b1min.}] * 100\%; [-1 + 10^{b1max.}] * 100\%$$

Moreover, for comparison and interpretation of the results, we used the literature repositories PubMed, SciELO, and Embase. The present study was not submitted to a Research Ethics Committee, since the data used is in the public domain and has a national coverage, according to the National Health Council Resolution N. 466/2012¹⁴.

RESULTS

In the distribution of Kaposi's sarcoma mortality rates during the 1996-2023 period, there is a variability throughout 28 years in all Brazilian Regions.

Regarding the general population, Figure 1 shows that the Southeast Region presented a relatively linear growth throughout the years, with a peak at the end of 2020. Among the female population, observed in Figure 2, the Brazil graph is highlighted, with an expressive elevation and rate growth from 2000 onwards, including more evident peaks around 2010 and 2015, similar to the Southeast and South Regions in 2015. Among the male sex, observed in Figure 3, in the Northeast Region, there was a significant increase from 2010 onwards, revealing a continuous growing characteristic in the number of deaths from Kaposi's sarcoma, like the Brazil graph from that period onwards.

During the period, a total of 2,226 deaths from Kaposi's sarcoma were recorded in Brazil. As shown in Figure 4, the highest mortality absolute frequency was recorded for the Southeast Region, representing a total of 541 cases during the 28 analyzed years, followed by the Northeast (286), South (234), and North (102) Regions. The Central-West Region, in turn, presented the lowest frequency of notifications during the studied period, with about 63 cases.

Regarding the temporal series analysis according to APC, it was possible to observe that, among the general population (Table 1), the Kaposi's sarcoma mortality rate presented an upward trend in four of the six analyzed Regions in the period, with an increase of 32.02%, 37.44%, 135.82%, and 7.00% per year, in the Northeast, South, Central-West Regions, and Brazil, respectively. The trend is stationary in the other Regions.

In the analysis of the mortality rate trend for Kaposi's sarcoma in the female sex shown in Table 1, an annual increase in the death rate is observed: 127.56%, 78.56%, 88.06%, and 7.93%, in the Northeast, South, Central-

West Regions, and Brazil as a whole, respectively. There was no variation in the mortality rate trends for the North and Southeast Regions.

Among the male sex, as shown in Table 1, an upward trend was observed in the mortality rate from 1996 to 2023 in the North (54.06% increase), Northeast (36.21% increase), and South (58.77% increase) Regions, and a 7.05% increase in Brazil. However, the other Regions did not present significance, remaining stationary.

It is worth underscoring that the Northeast and South Regions had an increase in the three analyzed variables. On the other hand, the North and Southeast Regions presented a stationary trend for the general and female population. Additionally, Brazil kept a growing profile in all the observed analyses.

DISCUSSION

Temporal analysis is an essential tool for epidemiology, given that it allows us to understand how diseases and severities evolve over the years, organizing quantitative information over time. This form of epidemiological approach corroborates the study of pathological components, like the over-year trend, seasonal or cyclical disease behavior, in addition to random variations. Therefore, it becomes valuable to anticipate future scenarios of disease distribution, allowing us to identify factors that contribute to increasing or reducing its occurrence. Thus, it allows for more effective public health interventions in the present, based on past analyzed data, to strengthen more favorable scenarios in the future¹³.

Kaposi's sarcoma is a vascular tumor which, in most cases, presents low malignancy, being considered

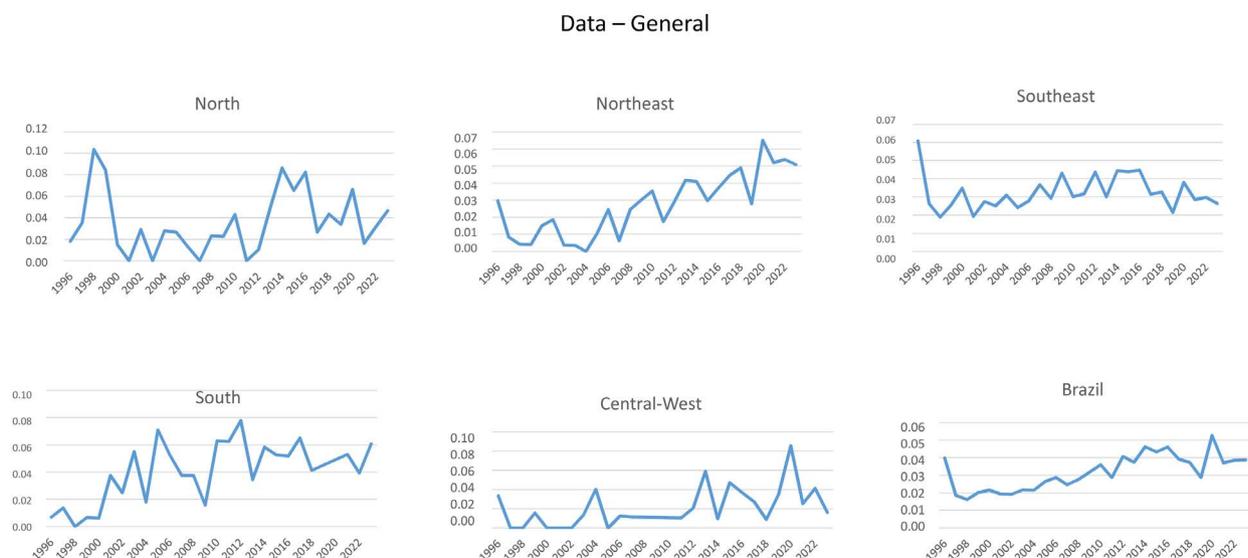


Figure 1. Temporal series of the mortality rate from Kaposi's sarcoma in Brazil and Regions for both sexes



Data – Feminine

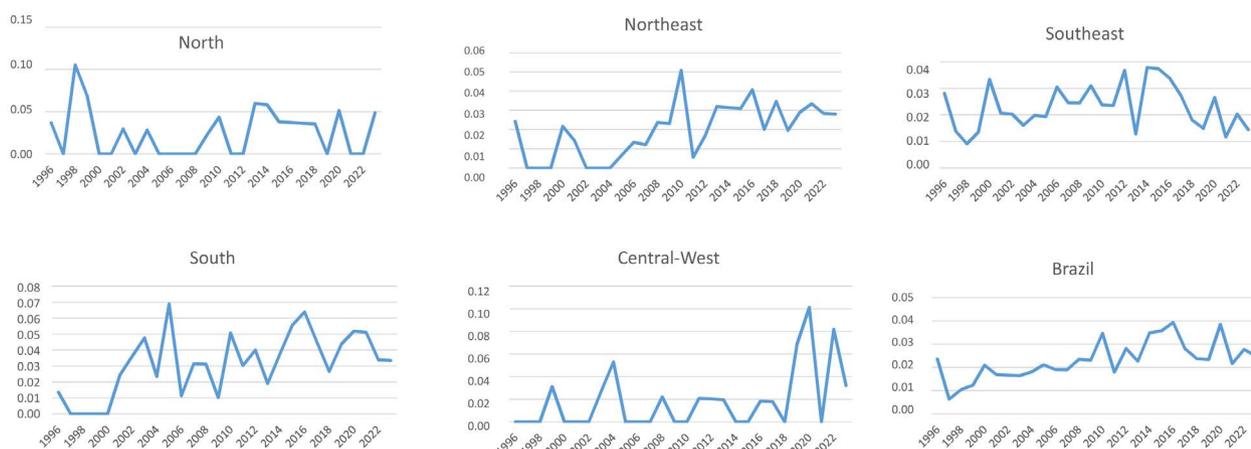


Figure 2. Temporal series of the mortality rate from Kaposi's sarcoma in Brazil and Regions for the female sex

Data – Masculine

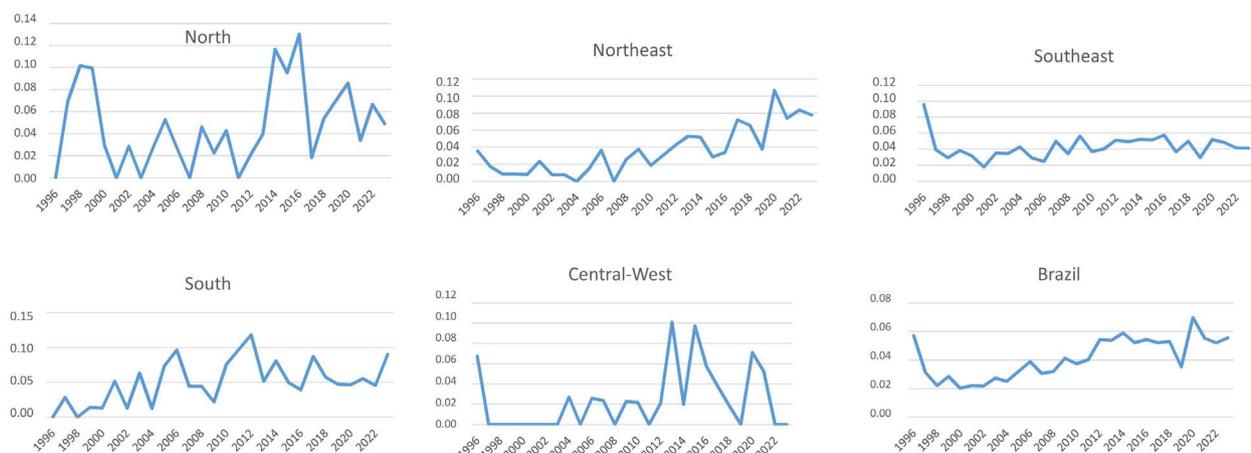


Figure 3. Temporal series of the mortality rate from Kaposi's sarcoma in Brazil and Regions for the male sex

unusual until the 1980's AIDS epidemic in Brazil, which was associated mainly with homosexual men carrying the HIV¹⁵. Historically, it can be observed how, since that period, strong stigmatization and physical and verbal discrimination persist¹⁶, which contribute to low adherence to effective treatment and, consequently, evolution to mortality¹⁷. This study corroborates the current projections that predict an upward trend in deaths from Kaposi's sarcoma for both sexes until 2030⁴.

Kaposi's sarcoma mortality rate analysis for the 1996-2023 period showed that the South and Southeast Regions are highlighted for high standard deviations. Observed in the presented figures, this trend is a result of extreme significance, since these two Regions present conglomerates with Bayesian rates above 31.51 cases/10 thousand inhabitants, which represents the number of

cases of people carrying the HIV in the Southeast and South Regions, 42.7% and 20.9%, respectively, from 2005 to 2020¹⁸. Thus, it demonstrates the persistence of the issue in these areas, since the high prevalence of HIV correlates with mortality by epidemic Kaposi's sarcoma, a neoplasm caused by immunosuppression¹⁹.

It is worth mentioning that the South Region has the second highest concentration of AIDS cases in Brazil (19.6%), only behind the Southeast Region (49.2%)²⁰. This record corroborates the growing trend and elevated standards found in the South Region for all the analyzed variables. Moreover, it is worth mentioning that, between 2000 and 2010, Florianópolis held the highest number of HIV cases among the Brazilian capital cities with high rates of virus infection, and, even after advancements, the city has not yet reached the 90-90-90 goal. This

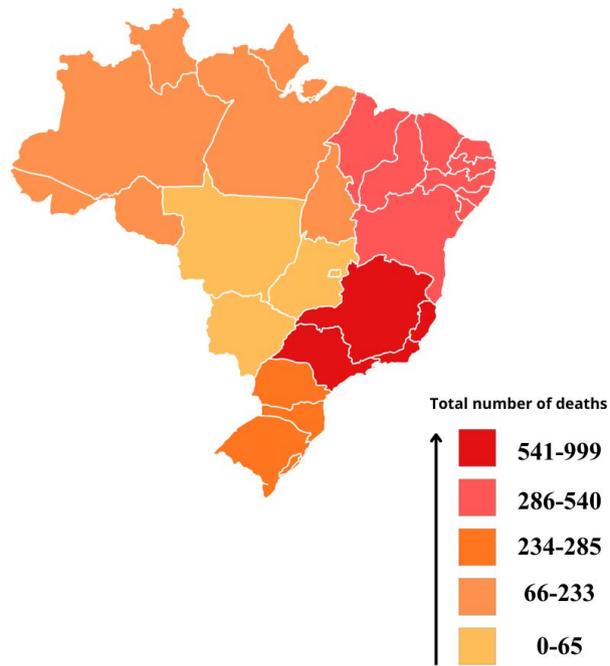


Figure 4. Spatial distribution of the absolute number of deaths from Kaposi's sarcoma per Brazilian Region, from 1996 to 2023
Source: Adapted from SIM⁹.

was proposed by the Joint United Nations Programme on HIV/AIDS (UNAIDS) and provides that 90% of HIV cases must be diagnosed, treated, and reach viral suppression. In 2025, the goal was updated to 95%; thus, the low adherence to ART in a Region of high HIV incidence increases the risk for opportunistic diseases such as Kaposi's sarcoma²¹.

When analyzing the Northeast Region, we notice an increase in mortality from Kaposi's sarcoma, mainly from 2005 onwards, a number in line with the incidence of HIV in Brazil, given that this represents the second Region with the most cases of the virus, according to data from the Notifiable Diseases Information System (SINAN). The process is believed to be a direct consequence of the HIV epidemic's movement towards the interior of Brazil, decentralizing this complex scenario of the urban South-Southeast hub²², associated with the prevalent affliction in low-income and education people²³. It can be observed that this socioeconomic context increases the difficulty in effectively adhering to ART, considering that ART medication introduction must be higher than 95% to ensure viral suppression²⁴.

Table 1. Temporal trends of mortality from Kaposi's sarcoma in Brazil and Regions from 1996 to 2023 for the general population and different sexes

Region	Coefficient	APC	95% CI APC	Trend
General				
North	10.45	31.42	-8.60 to 88.97	Stationary
Northeast	18.52	32.02	3.73 to 68.03	Growing
Southeast	18.11	1.08	-1.50 to 3.75	Stationary
South	15.06	37.44	10.81 to 70.46	Growing
Central-West	13.24	135.82	66.78 to 233.45	Growing
Brazil	87.05	7.00	4.61 to 9.45	Growing
Female				
North	4.82	14.85	-34.13 to 100.30	Stationary
Northeast	11.01	127.56	36.78 to 278.57	Growing
Southeast	75.37	0.80	-3.23 to 5.01	Stationary
South	13.78	78.56	1.80 to 213.21	Growing
Central-West	15.10	88.06	17.61 to 200.71	Growing
Brazil	65.50	7.93	5.05 to 10.90	Growing
Male				
North	11.67	54.09	9.26 to 117.32	Growing
Northeast	27.05	36.21	2.2 to 81.56	Growing
Southeast	14.63	1.94	-1.08 to 5.06	Stationary
South	19.92	58.77	25.17 to 101.41	Growing
Central-West	10.38	63.56	-7.04 to 187.80	Stationary
Brazil	11.69	7.05	3.90 to 10.29	Growing

Captions: APC = annual percentage change; CI = confidence interval.



It is also worth mentioning that, although the North and Central-West Regions have presented a stationary trend in the deaths from Kaposi's sarcoma, the North is usually the Region with higher HIV incidence in Brazil. Among the capitals, higher rates were observed in Manaus (63.6%)²⁰. It must be highlighted that underreporting disguises results and mirrors logistical and structural problems in the operationalization of Municipal Health Secretariats and/or Basic Health Units, impairing data collection for mapping national epidemiological control, which, in turn, disturbs data insertion into SIM⁷.

In addition to factors that could have contributed to the growing mortality from Kaposi's sarcoma in the analyzed period, there is the COVID-19 pandemic, which generated great challenges for SUS. Among them, the overload of health units during the period, either due to overcrowding, lack of medications and/or professionals, and structural and hospital routine changes, given the emergency measures adopted during the pandemic. Additionally, there was an interruption of continuous treatment and follow-up on several oncological diseases. The vulnerability of individuals, added to virus infection and other complications, compromised good prognoses for patients, leading to greater possibilities of case aggravation from metastasis, and even deaths, considering that malignant neoplasms can evolve within a short period²⁵⁻²⁷.

Finally, when comparing the absolute and relative numbers of deaths from Kaposi's sarcoma with deaths from AIDS, we noticed these represent less than 4% of causes. Kaposi's sarcoma is an aggressive neoplasm that presents a low mortality index²⁸. Individuals usually die due to opportunistic infections and not from Kaposi's sarcoma itself, which, in some cases, can be controlled only through proper ART follow-up, with no need for a specific oncological treatment²⁹. However, mortality from Kaposi's sarcoma is directly proportional to the number of HIV infection cases among Regions, that is, Regions with the most notifications of the virus (Southeast, South, and Northeast) also hold the highest number of deaths from Kaposi's sarcoma, corroborating the findings in the literature³⁰. The analysis underscored the limitations regarding the effectiveness of mortality data collection, under-notification sensitivity, and record incompleteness in more unfavorable socioeconomic environments, inherent to studies that use secondary databases, although these are official government records, which influences the precision of epidemiological data³¹.

The present study highlights the temporal evolution of Kaposi's sarcoma mortality, which is strongly associated with HIV, an infection of great epidemiological impact in Brazil. Thus, by mapping patterns of mortality from

Kaposi's sarcoma between 1996 and 2023 in the different Brazilian Regions, it is possible to provide important information to understand regional inequalities, evaluate public HIV prevention and treatment policies throughout the years, in addition to highlighting the persistence of challenges in early diagnosis and access to oncological treatment for Kaposi's sarcoma. Therefore, we contribute to planning more effective health strategies, holding the epidemiological behavior of each Region as standard.

CONCLUSION

The present study demonstrated that the temporal trend of mortality from Kaposi's sarcoma over the 28 years analyzed is different between Regions. Brazil and its Northeast, South, and Central-West Regions presented an upward trend, while the North and Southeast Regions remained stationary throughout the whole studied period. Thus, we reinforce the importance of public policies that promote the efficacy of the health information system, to enforce fundamental SUS principles like universality, integrity, and equity in the access to early HIV diagnosis, proper treatment, and adherence monitoring are crucial to prevent the development of opportunistic diseases, such as Kaposi's sarcoma.

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CONTRIBUTIONS

Érika Costa Lopes and Rafaella Nascimento da Silva Brito have substantially contributed to the study design and planning; data acquisition, analysis, and interpretation; and wording. Eriksen Alexandre Costa Gonçalves has contributed to data acquisition and interpretation, wording, and final review of the article. Saul Rassy Carneiro contributed to statistical analysis and critical review. All the authors approved the final version for publication.

DECLARATION OF CONFLICT OF INTERESTS

There is no conflict of interest to declare.

DATA AVAILABILITY STATEMENT

All the contents associated with the article are included in the manuscript.

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None.

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