



# Comprehensive epidemiological analysis of Kaposi's Sarcoma in Brazilian states: exploring incidence and year of diagnosis

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## ABSTRACT

### OBJECTIVE

To analyze the epidemiology of Kaposi's Sarcoma (KS) in Brazilian states between 2015 and 2024, correlating it with AIDS cases and identifying regional disparities.

### METHOD

Observational study based on DATASUS/Tabnet data. Data on KS and HIV/AIDS were collected by state, year, and demographic variables, with analyses including standardized incidence rates, Spearman correlation, and linear regression, using IBGE (2024) population data as the denominator.

### RESULTS

There were 2,466 KS cases, with the highest incidence in the Southeast (1,166 cases), particularly in São Paulo (530). Adjusted rates were highest in the Federal District (1.84/100,000) and Espírito Santo (1.77/100,000). The most affected age group was 25-29 years (303 cases), with male predominance (71.2%). Between 2015 and 2021, AIDS cases decreased by 14.3%, while KS cases increased by 24.5%, with no significant correlation ( $r_s = -0.21$ ;  $p = 0.62$ ). Temporal regression indicated an annual increase in KS ( $B_1 = 8.3$ ;  $p = 0.01$ ), suggesting factors beyond AIDS, such as treatment failure or inadequate antiretroviral therapy (ART) adherence. Regional disparities may reflect differences in diagnostic capacity and healthcare access.

### CONCLUSION

There is a dissociation between KS and AIDS trends in post-ART Brazil, requiring investigation into determinants such as viral resistance and socioeconomic inequalities.

### KEYWORDS

Sarcoma Kaposi; Epidemiology; Herpesvirus 8; Human; Acquired Immunodeficiency Syndrome.

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**INTRODUCTION**

Kaposi's Sarcoma (KS) is a lymphoproliferative malignant neoplasm associated with human herpesvirus 8 (HHV-8), characterized by cutaneous lesions in the form of nodules or plaques of variable color, which can progress to visceral involvement.<sup>1,2</sup> While classically manifesting in the skin and subcutaneous tissues, it can also involve the mucous membranes, gastrointestinal tract, and lungs.<sup>2-4</sup> Its progression is directly related to immunosuppression, and it is common in patients with AIDS, individuals taking immunosuppressants, and transplant recipients.<sup>5</sup>

Four clinical forms of KS are recognized: the classic form (predominant in elderly men from Eastern Europe),<sup>6,7</sup> the endemic (African) form (independent of HIV infection, with both pediatric and adult variants),<sup>8</sup> the iatrogenic (transplant-associated) form (resulting from post-transplant immunosuppression)<sup>9</sup> and the epidemic form, which is related to HIV infection. The latter emerged as a hallmark manifestation during the AIDS epidemic of the 1980s and 1990s, becoming one of the first and most prevalent neoplasms associated with acquired immunodeficiency.<sup>10,11</sup>

The epidemic form of KS has a more aggressive clinical course, with disseminated lesions and potential for systemic involvement.<sup>9,11</sup> According to UNAIDS data, in 2021, approximately 1.5 million people were newly infected with HIV, and more than 52,000 young people developed AIDS between 2013 and 2023, reinforcing the relevance of investigating opportunistic diseases like KS. The high prevalence of HHV-8 and coinfection with HIV increase the risk of this neoplasm in vulnerable populations.<sup>12,13</sup> Therefore, early detection and knowledge of the immunological and virological factors associated with the disease are essential for improving prognosis and guiding prevention strategies.

Given the public health impact of KS, especially among people living with HIV/AIDS, it is necessary to broaden the understanding of its epidemiology, clinical forms, and association with immunosuppression. The diversity of clinical manifestations and their relationship with different immunological contexts reinforce the importance of updated studies that contribute to early detection, clinical management, and the development of public health policies.

This article aims to analyze the different clinical forms of KS, with an emphasis on the AIDS-related variant, discussing its pathogenesis, clinical manifestations, risk factors, and relevance in the current epidemiological scenario.

**METHODS**

This was a descriptive epidemiological study with a quantitative approach, based on secondary data from the DATASUS system (TABNET platform). The target population included individuals diagnosed with KS in Brazil between 2015 and 2024, regardless of sex or age group. Cases registered within this time frame were included, while other HIV/AIDS-related neoplasms, data from outside Brazil, or data not originating from DATASUS were excluded. The study began with a literature review on KS, followed by data extraction organized by state and year of diagnosis. The statistical and descriptive analysis involved temporal and geographical comparisons of incidence.

The case rates per Brazilian region and state were calculated per 100,000 inhabitants using the following formula:

$$\text{Case Rate} = \frac{\text{Number of cases per region/ state from 2015 to 2024}}{\text{Total estimated population in the region/state in 2024 (IBGE)}} \times 100,000$$

To investigate the relationship with AIDS, the proportion of KS per 1,000 AIDS cases was calculated (Proportion = KS Cases / AIDS Cases × 1,000), and Spearman's correlation was used to assess monotonic associations, according to the formula (Figure 1). Two simple linear regression models were also applied: one to test the association between KS and AIDS (KS Cases = B0 + B1 × AIDS Cases + ε), and another between KS and time (KS Cases = B0 + B1 × Year + ε), using a significance level of 5%.

Analyses were conducted using R software (v4.3.1) with the *ggplot2* and *stats* packages. The results were subsequently

organized into graphs and tables using Microsoft Excel 2016, allowing for the study's reproducibility and the identification of trends in the incidence of KS in Brazil.

Figure 1 - Spearman's correlation

$$\rho = 1 - \frac{6 \sum_{i=1}^n d^2}{n(n^2 - 1)}$$

Source: Authors (2025)

It is important to highlight some limitations inherent to the data used. The main one relates to the unavailability of information on AIDS after the year 2021 on the consulted platforms, which restricts a more up-to-date analysis of the association with KS cases. Furthermore, the possibility of underreporting must be considered, especially in states with less developed epidemiological surveillance infrastructure, which could impact the accuracy of regional comparisons. These limitations were acknowledged and taken into account in the interpretation of the results.

**RESULTS**

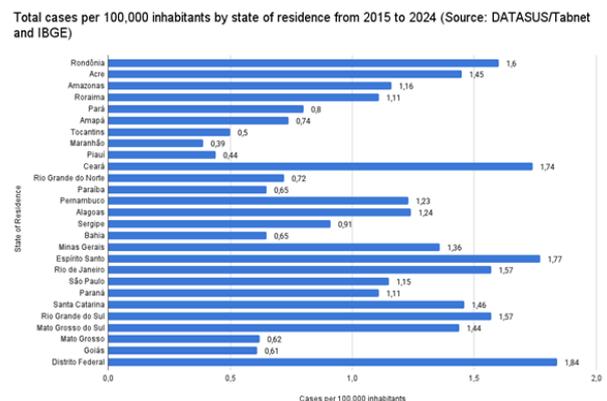
Between 2015 and 2024, a total of 2,466 cases of KS were registered in Brazil. The annual distribution shows a general upward trend, starting with 200 cases in 2015 and reaching a peak of 338 in 2023. There was relative stability until 2019 (236 cases), followed by successive increases from 2020 onward, with notable peaks in 2022 (296 cases) and 2023 (338 cases). In 2024, a significant drop to 238 cases was observed, representing a 29.6% reduction compared to the previous year.

The distribution by sex revealed a predominance of males, with 1,755 cases (71.2%), compared to 711 cases in females (28.8%). Regarding age, the highest incidence was concentrated in the 25-29 age group (303 cases), followed by the 30-34 (275 cases) and 20-24 age groups (128 cases). After the age of 35, a progressive decline was observed, with the exception of peaks in the 50-54 age group (218 cases) and among individuals aged 80 and over (117 cases).

In the geographical analysis, São Paulo had the highest absolute number of cases (530), followed by Minas Gerais (291) and Rio de Janeiro (272). In contrast, Amapá (6 cases), Acre (8), and Rondônia (28) registered the lowest numbers.

The incidence rate, adjusted per 100,000 inhabitants, revealed the highest rates in the Federal District (1.84), Espírito Santo (1.77), and Ceará (1.74). Although São Paulo had the highest number of absolute cases, its rate was moderate (1.15) due to its high population density. In contrast, less populous states like Rondônia (1.6) showed proportionally high rates. The South Region had the highest regional rate (1.37), followed by the Southeast (1.31), while the lowest rates occurred in the North and Northeast Regions (0.93 each) [Graph 1].

Graph 1 - Cases per 100,000 inhabitants by place of residence



Source: Authors (2025)

The results demonstrate a divergent trend between cases of AIDS and Kaposi's Sarcoma (KS) in Brazil from 2015 to 2021 (AIDS data after 2021 were unavailable). While AIDS cases decreased by 14.3% (from 41,323 to 35,424), KS cases increased by 24.5% (from 200 to 249), peaking in 2020 with 275 cases. The proportion of KS per 1,000 AIDS cases nearly doubled during this period (from 4.84 to 7.03), reaching 9.00 in 2020, a figure possibly associated with underreporting during the COVID-19 pandemic (Table 1).

Table 1 - Descriptive Statistics - Relationship between AIDS and KS Cases

Year	AIDS Cases	KS Cases	KS/AIDS Ratio (per 1.000)
2015	41.323	200	4,84
2016	39.696	199	5,01
2017	38.893	207	5,32
2018	38.501	228	5,92
2019	38.288	236	6,16
2020	30.562	275	9
2021	35.424	249	7,03

Source: Authors (2025)

Statistical analyses confirm that there is no significant correlation between KS and AIDS (Spearman:  $r_s = -0.21$ ;  $p = 0.62$ ) and no linear relationship (regression:  $B_1 = -0.002$ ;  $p = 0.62$ ). However, the temporal regression indicates a significant increase in KS cases over the years ( $B_1 = 8.3$ ;  $p = 0.01$ ) [Table 2].

Table 2 - Statistical Analyses - Relationship between AIDS and Kaposi's Sarcoma Cases

Analysis	Result	p-value	Interpretation
Spearman's Correlation (KS vs. AIDS)	$r_s = -0,21$	0,62	Weak, non-significant correlation
Linear Regression (KS vs. AIDS)	$B_1 = -0,002$	0,62	No significant relationship
Temporal Regression (KS vs. Year)	$B_1 = 8,3$	0,01	Significant increase over time

Source: Authors (2025)

## DISCUSSION

The data from this study reveal important differences in the distribution of KS cases in Brazil between 2015 and 2024. The most populous states, such as São Paulo, Minas Gerais, and Rio de Janeiro, presented the highest absolute numbers, as was expected. However, when the data are adjusted for population, states like the Federal District, Espírito Santo, and Ceará stand out, suggesting that factors such as access to diagnosis, more efficient surveillance, and demographic aspects may influence this incidence.

The upward trend in cases until 2023, followed by a drop in 2024, may be related to several factors. On one hand, improvements in the notification system and the increased survival of people living with HIV could explain the observed growth. On the other hand, the reduction in the last year may be associated with underreporting, changes in healthcare patterns, or even a natural fluctuation.

The higher concentration of cases among young adults, especially those aged 25 to 34, is consistent with the country's observed HIV prevalence.<sup>14</sup> The appearance of peaks in older age groups may be related to patients who have been living with the virus for a longer time or to non-HIV-related forms,

such as classic KS, which primarily affects the elderly.<sup>7</sup>

Another important point is the difference between sexes. Males were the most affected, accounting for over 70% of cases. This may be linked to this group's higher vulnerability to HIV, especially among men who have sex with men (MSM),<sup>12</sup> as well as possible inequalities in access to early diagnosis.

The comparison between KS and AIDS data is noteworthy. Although there was a reduction in the number of AIDS cases between 2015 and 2021, KS registrations increased, and the proportion of KS per 1,000 AIDS cases nearly doubled during the period. Despite this, statistical analyses did not show a significant correlation between the two conditions. This finding suggests that other factors may be influencing this increase, such as therapeutic failure, low adherence to ART, or even non-HIV-related KS cases.

Among these factors, the possibility of viral resistance stands out, even with modern treatment regimens. A national study by Santos-Pereira et al. analyzed over 20,000 people living with HIV between 2008 and 2017 and identified mutations such as K65R and M184V associated with resistance to tenofovir and lamivudine.<sup>15</sup> Furthermore, research published in 2023 in *BMC Infectious Diseases* demonstrated relevant dolutegravir resistance mutations, even when used as a first-line therapy.<sup>16</sup> These data reinforce the hypothesis that despite broad ART coverage, factors like acquired resistance, failures in early viral load detection, and inadequate treatment adherence may contribute to persistent immunosuppression, thereby favoring the emergence of opportunistic diseases like KS.

## CONCLUSION

Based on the findings of this study, it is evident that KS in Brazil remains an underexplored condition, yet it presents relevant regional and demographic patterns. The concentration of cases in specific age groups and the prevalence among men reinforce the need to more closely examine at-risk groups, while regional disparities suggest that local factors—such as access to healthcare, and social and environmental conditions—may directly influence incidence.

Despite limitations, such as the lack of updated AIDS data after 2021, the findings highlight the importance of more integrated prevention and surveillance strategies. The upward trend in KS cases, despite the drop in AIDS incidence, points to a possible shift in the epidemiological profile of KS, which demands new approaches to care. We recommend strengthening KS surveillance in specialized services, adopting regional early screening strategies, especially in high-incidence areas, and including ART resistance monitoring in public policies to prevent comorbidities associated with persistent immunosuppression. Such measures are crucial for improving timely diagnosis and the follow-up of people living with HIV and at risk for KS.

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