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AIDS mortality in Brazil, 2012–2022: a time series study

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Abstract

Background Human immunodeficiency virus (HIV) infection is a health problem in Brazil and worldwide. Without treatment, the infection can progress to Acquired Immunodeficiency Syndrome (AIDS), with a high mortality potential. The objective of this study was to analyze the time trend of AIDS mortality in Brazil, macro-regions, federal units and their respective capitals, from 2012 to 2022.

Methods This is a time-series study of all AIDS deaths in Brazil from 2012 to 2022. The study included the annual number of deaths and the crude and standardized mortality rates. The Joinpoint regression model was used for the time analysis of the standardized rates. Annual percentage change (APC) and average annual percentage change (AAPC) were calculated. A 95% confidence interval (CI) and a 5% significance level were used.

Results During the period analyzed, 128,678 AIDS deaths were recorded in Brazil, with a crude mortality rate of 6.3/100,000 and a standardized mortality rate of 5.3/100,000. From 2012 to 2020, three regions showed a declining trend in AIDS mortality: Central-West (AAPC − 2.3%; 95%CI -4.3 to -0.21; $p = 0.03$), Southeast (AAPC − 5.6%; 95%CI -6.8 to -4.0; $p < 0.001$), and South (AAPC − 4.4%; 95%CI -5.27 to -3.6; $p < 0.001$). There was also a downward trend in 10 states and 10 capitals. There was an increase in the number of deaths from 2020 onwards in the North, Northeast and Southeast regions compared to 2019.

Conclusion There was a downward trend in AIDS mortality from 2012 to 2020 and an upward trend from 2020 to 2022. The regional differences observed could reflect the social disparities that exist in Brazil. In addition, the Covid-19 pandemic has had an impact on the process of dealing with HIV in Brazil.

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Introduction

Acquired Immunodeficiency Syndrome (AIDS) is the most advanced stage of Human Immunodeficiency Virus (HIV) infection [1, 2]. Worldwide, between 2012 and 2022, it is estimated that 17.4 million new cases of HIV will be detected, of which around 163,000 will be in Brazil [3]. In 2019, there were approximately 789,700 deaths from HIV/AIDS-related causes worldwide. In Latin America and the Caribbean, there were about 40,600 deaths in the same year, of which 14,800 occurred in Brazil [4]. HIV/AIDS-related deaths are mainly due to opportunistic diseases that occur as the immune system weakens, such as tuberculosis and other serious opportunistic infections, such as cryptococcal meningitis [1] and neurotoxoplasmosis [5].

According to the report "Global Health Sector Strategies on, respectively, HIV, viral hepatitis and sexually transmitted infections for the period 2022–2030", the World Health Organization (WHO) aims to reduce the annual number of new HIV infections from 1.5 million to 335,000 and the number of HIV/AIDS-related deaths from 680,000 to less than 240,000 between 2022 and 2030 [6]. To this end, the detection of newly infected people through the provision of testing throughout the health care network, unrestricted and early access to antiretroviral drugs, pre-exposure prophylaxis (PrEP) and post-exposure prophylaxis (PEP), as well as the establishment and strengthening of HIV/AIDS information systems, are among the measures stipulated by the entity to achieve these goals [6].

In Brazil, the National STD/AIDS Program was established in 1986 [7] and has become a world reference in the treatment of sexually transmitted infections. Currently, the objectives are coordinated with the states and municipalities through the Multi-Year Action Plan and the National Health Plan. From 2020 to 2023, the standardized AIDS mortality rate should be reduced to 3.9 per 100,000 population [8]. In 2022, the reported standardized mortality rate was 4.1 per 100,000 [9]. The country is also moving towards achieving the UNAIDS 95-95-95 targets (95% of people living with HIV [PLHIV] knowing their serologic status, 95% on treatment, and 95% virally suppressed, respectively), as Brazil registered 91-81-95 in 2023 [10].

Considering the necessity of updated insights on regional disparities in HIV mortality, which have not been comprehensively explored in previous studies on HIV mortality trends in Brazil, especially over a 10-year period, the aim of this study was to analyze the time trend of AIDS mortality in Brazil, macro-regions, federal units and their respective capitals, from 2012 to 2022.

Methods

Study design

This is a time-series study of all AIDS deaths in Brazil from 2012 to 2022.

Study area

Brazil is a country in South America with a population of around 203 million people and a surface area of 8.5 million Km^2 [11]. Brazil is divided in five regions: North, Northeast, South, Southeast and Central-West, inside of which are the 26 states, each one with one state capital, and the Federal District that compose its territory. The country has 5570 municipalities [12] (Fig. 1).

Data source

All deaths diagnosed with AIDS as the primary cause among residents of the study area were included in the study. Three variables were analyzed: the number of deaths, the crude mortality rate and the standardized mortality rate. These data were extracted from the basic data and information pannel of the Departamento de HIV/Aids, Tuberculose, Hepatites Virais e Infecções Sexualmente Transmissíveis (DATHI), which uses data from the Mortality System Information (Sistema de Informação sobre Mortalidade/SIM, in portuguese) and Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística/IBGE, in Portuguese). SIM was set up in 1975 and is a health information system that aims to standardize the collection and processing of data on deaths in Brazil, the death certificate is the document used by all municipalities and states to feed the SIM [13].

The underlying cause of death is defined as the disease or injury that initiated the chain of pathological events leading directly to death, or the circumstances of the accident or violence that caused the fatal injury [14]. The standardized mortality rate is used to mitigate the effect of unequal age composition between countries or federated units and allows a more appropriate comparison of this indicator [15]. The standardization of the AIDS mortality rate in Brazil is based on age-group information from the 2000 census [16].

Data processing

After collecting and structuring the database, the statistical treatment was carried out. First, a descriptive analysis was performed. For the temporal analysis of the standardized rates, the joinpoint log-linear regression model was used. This model examines whether a line with multiple segments is statistically better at describing the temporal evolution of a data set than a straight line or a line with fewer segments [17]. In this way, the model makes it possible to identify the trend of the indicator (whether stationary, increasing or decreasing) and the points at which there is a change in this trend (joins), making it

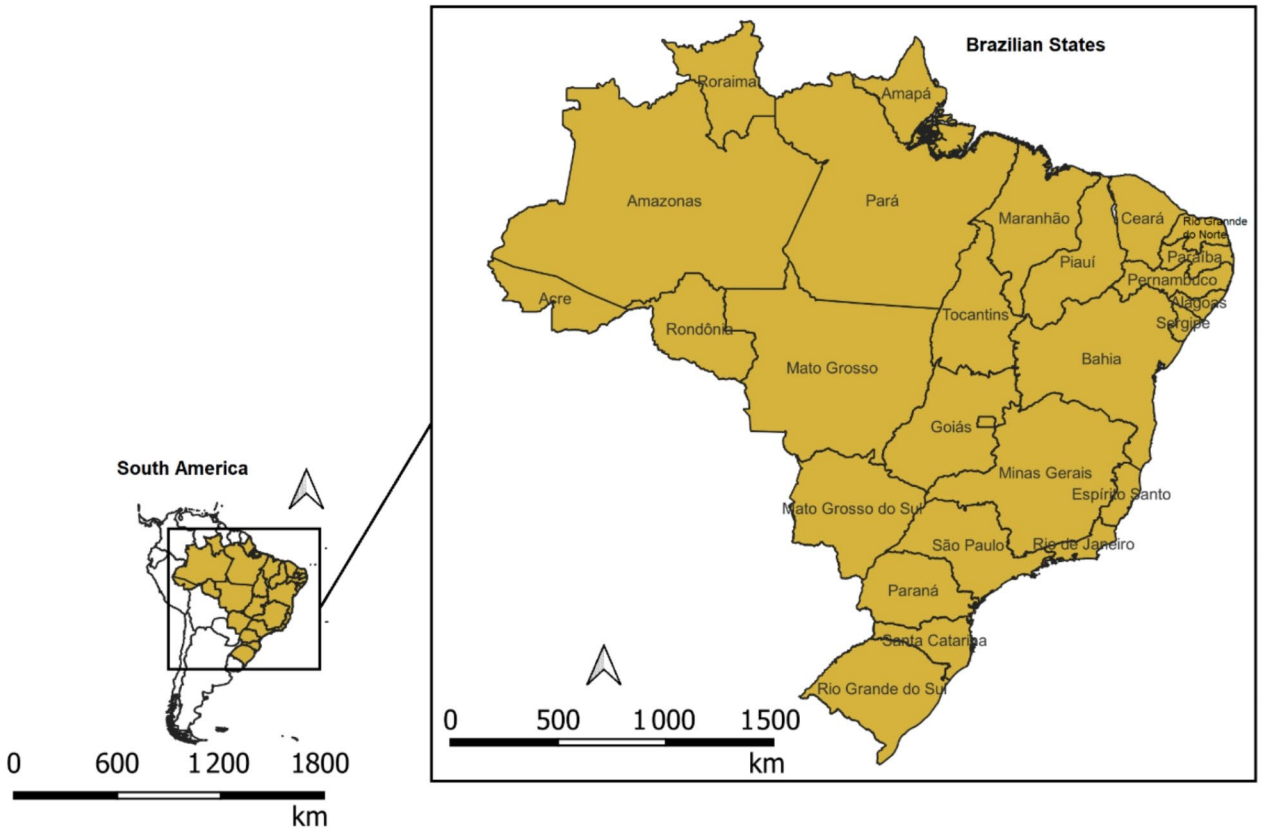

Fig. 1 Study area. Brazilian States, 2024

possible to identify the annual percentage change (APC) and the average change over the entire period (average annual percentage change; AAPC). For each trend identified, a 95% confidence interval (CI) and a 5% significance level were considered. Analyses were performed in the Joinpoint Regression Program, version 4.5.0.1 (National Cancer Institute, Bethesda, MD, USA).

Ethical aspects

This study used aggregated data from the public domain. Therefore, authorization from the ethics committee was waived.

Results

During the period analyzed, 128,678 AIDS deaths were recorded in Brazil, with a crude mortality rate of 6.3/100,000 and a standardized mortality rate of 5.3/100,000. When considering the entire period (2012–2022), a stationary trend was observed (AAPC −3.6; 95%CI -7.2 to 0.1; $p=0.05$). However, the segmented model showed a period of decline between 2012 and 2020 (APC −4.7%; 95%CI -6.1 to -3.3; $p<0.001$). From 2020, there was an interruption in this trend, accompanied by an increase in the number of deaths (Fig. 2).

The Southeast ($n=53,591$) and the Northeast ($n=27,824$) together accounted for 63.3% of the records. On the other hand, the highest rates were observed in the South (8.7/100,000 for crude mortality and 8.5/100,000 for standardized mortality) and North (7.4/100,000 for crude mortality and 7.3/100,00 for standardized mortality). In addition, in the North, Northeast and Southeast regions, there was an increase in the number of deaths from 2020 compared with 2019 (pre-pandemic). In the other regions (South and Central-West), the increase in deaths began in 2021 (Table 1).

Of the five Brazilian regions, three showed a downward trend in AIDS mortality: Central-West (AAPC −2.3%; 95%CI -4.3 to -0.2; $p=0.03$), Southeast (AAPC −5.6%; 95%CI -6.8 to -4.4; $p<0.001$) and South (AAPC −4.4%; 95%CI -5.3 to -3.6; $p<0.001$). No region showed an upward trend over the study period. Among states, 10 (37%) showed a downward trend, with São Paulo (SP) showing the largest decrease (AAPC −6.5%; 95%CI -7.8 to -5.2; $p<0.001$). No state showed an upward trend in mortality during the study period. Notably, no state in the northern region showed a downward trend (Table 2; Fig. 3).

As for the Brazilian capitals, only eight (29.6%) showed a downward trend. Three of them are located in the

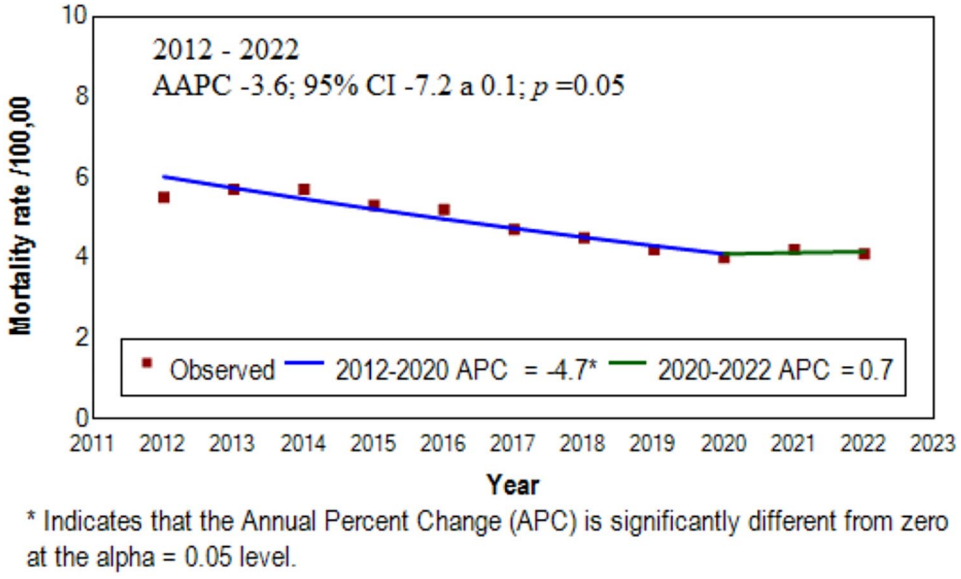

Fig. 2 Time trend of AIDS mortality in Brazil, 2012–2022

Southeast (Vitória - ES, Rio de Janeiro - RJ and São Paulo - SP). Brasília - DF stood out with the largest decrease (AAPC = -6.0; 95%CI -9.0 to -3.0; $p<0.001$). In João Pessoa - PB and Aracaju - SE, there was an upward trend in AIDS mortality from 2012 to 2022 (AAPC=2.9%; 95%CI 0.3 to 5.7; $p=0.033$ and AAPC=2.8%; 95%CI 1.2 to 4.5; $p=0.003$, respectively). In the Northeast, only São Luís - MA showed a decreasing trend (AAPC = -4.6%; 95%CI -6.8 to -2.4; $p=0.001$) (Table 3).

Discussion

This study analyzed the time trend of AIDS mortality in Brazil, macro-regions, federal units and their respective capitals from 2012 to 2022. During this period, there was a downward trend in the standardized rate from 2012 to 2020. From 2020, there was an interruption in this trend and an increase in the number of deaths. In addition, the decrease in mortality occurred only in the Central-West, Southeast and South regions, which shows the spatial heterogeneity of AIDS mortality in Brazil.

Regarding the downward trend in AIDS mortality, it is well documented that the introduction of highly active antiretroviral therapy (HAART) [18–20] in 1996 changed the temporal pattern of mortality among PLHIV. A historical series estimating the impact of the antiretroviral therapy (ART) on mortality in Brazil from 1990 to 2017 showed that from 1999, with the implementation of the "National STD/AIDS Policy", there was a downward trend in mortality [21]. Globally, the estimated number of HIV/AIDS-related deaths decreased by 39% in 2019 compared to 2010 [22].

Brazil has adopted the policy of universal treatment since 1996, although its implementation was later achieved through the decentralization of the offer of testing throughout the structure of the Unified Health System and through the updating of the "Clinical Protocol and Therapeutic Guidelines for the Management of HIV/AIDS Infection in Adults" [23], with the adoption of the Treatment as Prevention (TasP) policy in 2013 [21]. The new document brought forward the use of ART for all people diagnosed with the virus, regardless of viral load, CD4 count and the presence of AIDS-defining diseases [24].

In the new 2017 protocol, the first line of treatment was updated to dolutegravir, tenofovir/lamivudine [24]. Several studies have demonstrated a better virologic suppression associated with this protocol when compared to the tenofovir/lamivudine/efavirenz scheme [25–27]. Our study has shown the downward trend in mortality was maintained after the introduction of this new protocol. The experimental TEMPRANO trial showed that early ART reduced the risk of death by 35% compared with delayed ART initiation. Delay was more harmful for individuals with CD4 counts below 500/mm^3, who had a higher cumulative probability of death or serious HIV-associated illness than patients with CD4 counts above or equal to this level [28].

In 2023, the latest version of the document emphasized for the first time that people living with HIV/AIDS with an undetectable viral load are not at risk of transmitting the virus sexually, and included the new option of "dual therapy" (a single tablet of dolutegravir and lamivudine). In addition, speed of treatment initiation was called for, with a recommendation to start on the same day or no later than seven days after diagnosis [24].

Table 1 Deaths by underlying cause of AIDS, crude and standardized mortality ratios for AIDS (per 100 000 population), by year of death

NORTH	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
Deaths from AIDS	903	1,132	1,159	1,172	1,274	1,232	1,225	1,196	1,202	1,359	1,328	13,182
Crude Mortality Rate	5.4	6.7	6.7	6.7	7.2	6.9	6.7	6.5	6.4	7.2	7.7	7.4*
Standardized Mortality Rate	5.5	6.7	6.7	6.7	7.2	6.9	6.8	6.5	6.4	7.1	6.2	7.3*
NORTHEAST												
Deaths from AIDS	2,302	2,490	2,449	2,657	2,679	2,594	2,468	2,455	2,494	2,626	2,610	27,824
Crude Mortality Rate	4.2	4.5	4.4	4.8	4.8	4.6	4.3	4.3	4.3	4.6	4.8	5.0*
Standardized Mortality Rate	4.3	4.5	4.4	4.7	4.7	4.6	4.4	4.3	4.3	4.5	3.7	4.8*
SOUTHEAST												
Deaths from AIDS	5,524	5,512	5,617	5,414	5,279	4,700	4,568	4,205	4,265	4,360	4,147	53,591
Crude Mortality Rate	6.6	6.5	6.6	6.3	6.1	5.4	5.2	4.8	4.8	4.9	4.9	6.2*
Standardized Mortality Rate	6.8	6.6	6.6	6.3	6.2	5.4	5.2	4.8	4.7	4.7	3.5	6.1*
SOUTH												
Deaths from AIDS	2,519	2,634	2,538	2,537	2,430	2,333	2,145	2,039	1,968	2,360	2,132	25,635
Crude Mortality Rate	8.9	9.2	8.8	8.7	8.3	7.9	7.2	6.8	6.5	7.8	7.1	8.7*
Standardized Mortality Rate	9.1	9.2	8.8	8.7	8.3	7.9	7.2	6.8	6.3	7.5	5.2	8.5*
CENTRAL-WEST												
Deaths from AIDS	771	731	744	825	808	804	770	739	667	810	777	8,446
Crude Mortality Rate	5.2	4.9	4.9	5.3	5.2	5.1	4.8	4.5	4	4.8	4.8	5.4*
Standardized Mortality Rate	5.4	4.9	4.9	5.4	5.2	5.1	4.8	4.6	4	4.7	3.7	5.3*

* Arithmetic average of annual rates

Table 2 Time trend in the standardized AIDS mortality rate (per 100,000 population), by year of death, by state. Brazil, 2012–2022

Spatial unit	Rate[1]		AAPC (IC 95%) *p* value
	2012	2022	
North	5.5	6.2	1.3 (-1.7 to 4.4); $p=0.401$
RO	4.8	3.9	-3.0 (-7.2 to 1.3); $p=0.142$
AC	1.5	1.3	-0.3 (-11.5 to 12.1); $p=0.948$
AM	6.4	6.9	-1.4 (-3.8 to 1.0); $p=0.224$
RR	4.2	6.5	2.1 (-8.9 to 14.5); $p=0.723$
PA	6.7	7.2	0.1 (-1.7 to 2.1); $p=0.863$
AP	4.0	6.1	-0.1 (-4.6 to 4.5); $p=0.942$
TO	2.6	3.8	0.6 (-3.6 to 5.0); $p=0.755$
Northeast	4.3	3.7	-0.6 (-2.1 to 0.8); $p=0.389$
MA	5.2	4.8	-2.2 (-5.6 to 1.2); $p=0.205$
PI	4.2	4.1	-0.4 (-1.2 to 0.4); $p=0.310$
CE	3.6	3.1	-2.1 (-4.5 to 0.4); $p=0.100$
RN	3.1	3.8	1.6 (-2.1 to 5.4); $p=0.350$
PB	3.0	3.4	0.5 (-3.2 to 4.4); $p=0.779$
PE	6.1	4.3	-4.4* (-6.0 to -2.7); $p<0.001$
AL	3.7	4.3	-0.7 (-3.6 to 2.1); $p=0.565$
SE	3.4	3.3	-0.2 (-1.6 to 1.2); $p=0.719$
BA	3.4	3.2	-1.3 (-2.7 to 0.1); $p=0.064$
Central-West	5.4	3.7	-2.3* (-4.3 to -0.2); $p=0.030$
MS	5.6	5.1	-1.7* (-3.3 to -0.1); $p=0.038$
MT	5.5	4.7	-2.8* (-4.9 to -0.7); $p=0.015$
GO	4.5	3.5	-2.6* (-4.3 to -0.9); $p=0.007$
DF	3.6	2.0	-6.0* (-8.9 to -3.0) $p<0.001$
Southeast	6.8	3.5	-5.6* (-6.8 to -4.4); $p<0.001$
MG	3.5	2.3	-4.7 (-6.1 to -3.2); $p=0.001$
ES	6.5	5.0	-3.3* (-5.6 to -0.9); $p<0.001$
RJ	9.3	6.3	-4.2* (-6.2 to -2.2); $p=0.001$
SP	5.3	3.0	-6.5* (-7.8 to -5.2); $p<0.001$
South	9.1	5.2	-4.4* (-5.3 to -3.6); $p<0.001$
PR	5.1	3.5	-3.5 (-7.3 to 0.4); $p=0.077$
SC	6.5	4.5	-5.6* (-7.6 to -3.5); $p<0.001$
RS	11.2	7.3	-4.5* (6.2 to -2.6); $p<0.001$

[1] Standardized AIDS Mortality Rate (per 100,000 inhab.), by year of death. * Statistical significance ($p<0.05$). AAPC: Average Annual Percent Change. AC: Acre; AL: Alagoas; AP: Amapá; AM: Amazonas; BA: Bahia; CE: Ceará; DF: Distrito Federal; ES: Espírito Santo; GO: Goiás; MA: Maranhão; MT: Mato Grosso; MS: Mato Grosso do Sul; MG: Minas Gerais; PA: Pará; PB: Paraíba; PR: Paraná; PE: Pernambuco; PI: Piauí; RJ: Rio de Janeiro; RN: Rio Grande do Norte; RS: Rio Grande do Sul; RO: Rondônia; RR: Roraima; SC: Santa Catarina; SP: São Paulo; SE: Sergipe; TO: Tocantins

Not only advances in antiretroviral therapy, but also prevention measures [29] have been essential in reducing AIDS mortality in Brazil [30]. In people with HIV, unprotected sex is associated with a higher risk of acquiring resistant strains and superinfection, even when using ART [31]. This scenario promotes clinical deterioration [32] by increasing viral load and accelerating disease progression [33, 34].

Monitoring adherence and efficacy of ART and providing salvage therapy in the event of virologic failure are also necessary to reduce the number of deaths from the disease. One cohort reported an association between viral resistance to drugs (with a dose-response relationship) and mortality in patients with virologic failure, in which 20% died, and it was reported that markers of advanced disease were associated with fatal outcomes. Measures proposed to reverse this scenario include rapid testing, modification of the therapeutic regimen to prevent mortality, and screening and empiric treatment of opportunistic infections. In the weeks following hospital discharge, follow-up and monitoring have also been cited to reduce mortality [35].

Similarly, structural interventions can help to control the epidemic. Interventions that reduce social inequalities, such as promoting equitable access to health services, are important because income and other social indicators play an important role in the social determinants of HIV/AIDS in urban centers [36]. Although not the aim of this study, it is important to highlight this aspect.

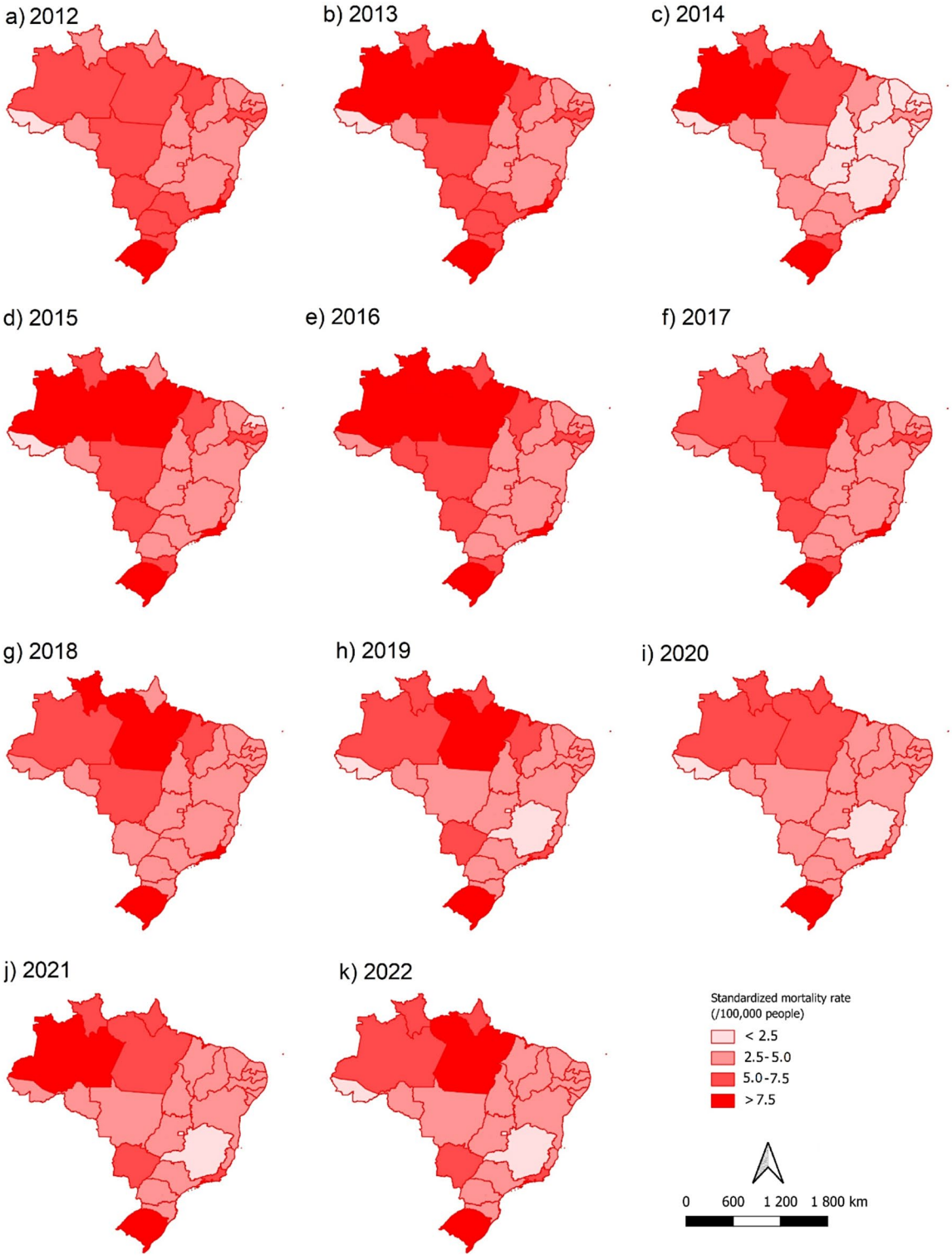

Fig. 3 AIDS mortality rate in Brazilian states, 2012–2022

A study conducted in Brazil among the low-income population of a cohort of 28.3 million Brazilians between 2007 and 2015 showed that socioeconomic status increases the risk of AIDS mortality: low schooling (RR: 2.76; 95% CI: 1.99–3.82), black race (RR: 1.69; 95% CI: 1.57–1.83), and people with lower economic status (RR: 1.99; 95% CI: 1.70–2.34) have a higher risk of dying from the disease [37]. The results of this study are consistent

Table 3 Trend in the standardized AIDS mortality rate (per 100,000 inhabitants), by year of death, by state capital. Brazil, 2012–2022

Spatial unit	Rate[1]		AAPC (IC 95%) *p* value
	2012	2022	
North			
Porto Velho – RO	10.0	7.4	-3.8 (-9.2 to 1.9); $p=0.163$
Rio Branco -AC	2.3	2.7	2.8 (-3.9 to 10.0); $p=0.375$
Manaus – AM	9.5	12.4	-0.2 (-2.6 to 2.2); $p=0.837$
Boa Vista – RR	4.8	9.2	2.8 (-0.8 to 6.5); $p=0.111$
Belém – PA	13	19.7	1.8 (-0.1 to 3.7); $p=0.056$
Macapá – AP	5.5	10.8	2.1 (-1.9 to 6.3); $p=0.269$
Palmas – TO	2.3	5.6	4.6 (-15.8 to 29.9); $p=0.684$
Northeast			
São Luís – MA	9.5	8.7	-4.6* (-6.8 to -2.4); $p=0.001$
Teresina – PI	8.6	7.6	-0.5 (-2.2 to 1.1); $p=0.459$
Fortaleza – CE	6.1	7.0	-0.2 (-3.1 to 2.6); $p=0.836$
Natal – RN	4.1	9.5	4.6 (-1.1 to 10.7); $p=0.102$
João Pessoa – PB	4.6	5.2	2.9* (0.3 to 5.7); $p=0.033$
Recife – PE	10.5	10.5	-1.4 (-3.9 to 1.2); $p=0.243$
Maceió – AL	5.8	8.8	2.4 (-6.7 to 12.4); $p=0.615$
Aracaju – SE	4.8	7.0	2.8* (1.2 to 4.5); $p=0.003$
Salvador – BA	6.8	8.1	0.6 (-3.8 to 5.3); $p=0.780$
Central-West			
Campo Grande – MS	5.6	7.9	0.9 (-3.7 to 5.9); $p=0.687$
Cuiabá – MT	10.2	6.9	-3.7 (-7.4 to 0.1); $p=0.059$
Goiânia – GO	5.9	5.2	-1.4* (-2.6 to -0.1); $p=0.034$
Brasília	3.6	2.0	-6.0* (-8.9 to -3.0) $p<0.001$
Southeast			
Belo Horizonte – MG	4.1	4.2	-2.2 (-4.6 to 0.2); $p=0.066$
Vitória – ES	6.8	5.9	-4.4* (-7.7 to -1.0); $p=0.017$
Rio de Janeiro – RJ	11.9	9.0	-3.2* (-6.1 to -0.2); $p=0.036$
São Paulo – SP	5.7	4.1	-4.8* (-7.9 to -1.6); $p=0.003$
South			
Curitiba – PR	6.6	6.9	-1.5 (-8.9 to 6.5); $p=0.711$
Florianópolis – SC	9.4	9.7	-5.6* (-9.5 to -1.4); $p=0.014$
Porto Alegre – RS	24.5	23.8	-1.5* (-2.9 to -0.1); $p=0.040$

[1] Standardized AIDS Mortality Rate (per 100,000 inhab.), by year of death. * Statistical significance ($p<0.05$). AAPC: Average Annual Percent Change. AC: Acre; AL: Alagoas; AP: Amapá; AM: Amazonas; BA: Bahia; CE: Ceará; DF: Distrito Federal; ES: Espírito Santo; GO: Goiás; MA: Maranhão; MT: Mato Grosso; MS: Mato Grosso do Sul; MG: Minas Gerais; PA: Pará; PB: Paraíba; PR: Paraná; PE: Pernambuco; PI: Piauí; RJ: Rio de Janeiro; RN: Rio Grande do Norte; RS: Rio Grande do Sul; RO: Rondônia; RR: Roraima; SC: Santa Catarina; SP: São Paulo; SE: Sergipe; TO: Tocantins

with another study conducted in a cohort in Uganda that showed higher HIV/AIDS mortality among the unemployed, suggesting that socioeconomic factors influence disease outcomes in different contexts [38].

It is important to note that our study did not analyze social determinants. However, the context of greater social vulnerability in the northern and northeastern regions of Brazil may explain the stationary temporal behavior of AIDS mortality. Regional disparities are also important. Of the northern and northeastern regions, only the state of Pernambuco showed a declining trend.

A study that analyzed AIDS mortality trends in Brazil from 1998 to 2008 showed that during this period, the AIDS epidemic expanded in the North and Northeast regions, while it declined in the Southeast. Thus, even with the introduction of HAART, universal access and improved quality of life have not been achieved in all regions of the country [39]. During this period, there was an increase in mortality rates in Brazil from 4.38 to 6.13 deaths/100,000 inhabitants. Our study has shown that during the 2012–2021 period, in contrast, there was a decrease in the mortality rates.

In addition, a study that analyzed the period from 2000 to 2018 showed that the northern and northeastern regions showed increasing trends in HIV prevalence, incidence, and mortality [40]. Another study from 2001 to 2021 showed similar results, while the South and Southeast showed declining trends over the same period [41]. This decline was also observed in an ecological study from 2015 to 2019 [42]. Our investigation has

found similar results, all regions but the Northern and the Northeastern regions have shown downward trends in mortality, suggesting that this regional disparity still exists.

In addition, it is important to highlight the impact of the COVID-19 pandemic on the fight against HIV/AIDS in Brazil. A Brazilian study showed a downward trend in HIV/AIDS diagnoses and an increase in mortality after the start of the COVID-19 pandemic (22.4% and 9.8% reduction in HIV/AIDS diagnoses in 2020 and 2021, respectively). In turn, the number of AIDS deaths increased by 6.9% in 2020 and 13.9% in 2021 [42]. However, this decrease may be related to a decrease in HIV testing and/or underreporting of cases due to the COVID-19 pandemic [10].

The concentration of resources for the control of COVID-19 may have had an impact on diagnosis and ART initiation, increasing the number of infected people who can multiply the transmission chain but are still undiagnosed [43]. Another important fact is that the follow-up of HIV/AIDS patients has been discontinued. In 2020, UNAIDS estimated that interruptions in ART as a result of the pandemic could lead to an additional 500,000 deaths in sub-Saharan Africa between 2020 and 2021 [44]. In addition, the COVID-19 pandemic has exacerbated social and economic inequalities in Brazil, affecting the outreach of target populations such as men who have sex with men, sex workers, transsexuals, and drug users. These have faced increased difficulties in accessing health services to maintain ART during the pandemic [42].

The prevention and control of HIV/AIDS in Brazil in the present and future must focus on adequate funding for both healthcare facilities and human resources, integration of prevention and treatment, reduction of regional disparities to provide universal access, promotion of domestic pharmaceutical manufacturing capacity and creation of international alliances [30]. The present study points out to the persistent regional inequality that affects HIV/AIDS mortality control in the Northern and Northeastern regions, which needs to be addressed by the public health authorities.

Even with methodological care, this study has limitations, the most important of which is that the use of secondary data is strongly influenced by the quality of the surveillance systems. Although the SIM is nationally and internationally recognized as a solid and robust information system [45], inaccurate or incomplete completion of death certificates may lead to underreporting of certain causes of mortality, in the case of this study, HIV/AIDS-related causes [46].

Conclusion

This study showed a downward trend in AIDS mortality from 2012 to 2020. After 2020, this trend was interrupted. The decrease in mortality occurred only in the Central-West, Southeast and South regions and in the state of Pernambuco, which shows the heterogeneity in the control of AIDS mortality in Brazil.

It is recommended that HIV/AIDS policies be strengthened, especially in the North and Northeast. In addition, strategies should be developed to reduce health inequalities, which are closely related to AIDS mortality. This study points to the need for the authorities to take a closer look at these regions.

Abbreviations

AAP	Average annual percentage change
AIDS	Acquired immunodeficiency syndrome
APC	Annual percentage change
CI	Confidence interval
DATHI	Departamento de HIV/Aids, Tuberculose, Hepatites Virais e Infecções Sexualmente Transmissíveis
HIV	Human immunodeficiency virus
IBGE	Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics)
PEP	Post-Exposure Prophylaxis
PLHIV	People Living with HIV
PrEP	Pre-exposure prophylaxis
SIM	Sistema de Informação sobre Mortalidade (Mortality System Information)
WHO	World Health Organization

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CDF, LSL and RFC: Data collection, interpretation of findings, analysis, interpretation, drafting of the manuscript and study supervision. RPSN, PEO, AGSJ, MBS and RJVC: Data collection, interpretation of findings, analysis and drafting of the manuscript.

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Data availability

The data for this study was obtained from https://indicadores.aids.gov.br/.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

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Competing interests

The authors declare no competing interests.

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