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RESEARCH ARTICLE

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TERRITORIAL EVOLUTION OF AIDS CASES IN BRAZILIAN NORTHEAST

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ABSTRACT

HIV/AIDS emerged in Brazil in the 1980s and continues to be a public health problem. Over the years, the virus has evolved and reached different social groups, regardless of their epidemiological profile. **Objective:** To analyze the process of evolution of the internalization of AIDS in the Northeast (NE) of Brazil, throughout its temporality. **Methodology:** This is an epidemiological study with a quantitative, ecological, descriptive, and exploratory approach, made at the Brazilian Northeast. It was conducted with data obtained from the Department of Informatics of the Unified Health System (DATASUS), referring to the years 1982, 1992, 2002, 2012 and 2018, using TabWin and R software for analysis. **Results:** The number of diagnoses in NE states was: Alagoas (7,910); Bahia (35,058); Ceará (23,259); Maranhão (20,033); Paraíba (8,972); Pernambuco (35,039); Piauí (7,255); Rio Grande do Norte (8,283) and Sergipe (5,601). In these, all had their first records in the capital city and, shortly after, cases appeared in cities in the countryside. **Conclusion:** It was observed that in the distribution of the virus in the region Northeast, the population of large cities is more vulnerable. Therefore, health actions are essential to improve support for prevention and health and public policies to combat the pandemic.

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INTRODUCTION

From an economic perspective, the 1980s became known in Latin America as "the lost decade". The exponential growth of foreign debt and inflation, the destruction of social rights and the further impoverishment of the population structured the Brazilian economic scenario. In the area of social policies, Brazil was going through a post-authoritarian regime, based on the triad of neoliberalism: decentralization, focus and privatization. The State sought the disengagement of social assistance actions, transferring them to the spheres of civil society and the private sector (Freitas et al., 2014; Siqueira, 2019).

Faced with a scenario of crisis and socioeconomic remodeling, there is the emergence of the acquired immunodeficiency syndrome - AIDS in Brazilian territory.

This advent provided a social restructuring, not only in collective health issues, but in the sexual, behavioral, and moral aspects of individuals. The absence of clarifying studies added to the forms of transmission and its first evident victims (homosexuals and injecting drug users - IDU), caused a social conduct of treatment and prevention focused on habits considered immoral, excluding physical-biological aspects of the pathology. Therefore, the prejudice and misinformation were then fundamental to the spread of the virus (Portinari et al., 2017).

"[...] There is no analysis of any present historical phenomenon without a critical look at its past". In light of this statement, one must understand a pathology as a historical occurrence, considering its epidemiological evolution, its social impacts, and the techniques of prevention and combat against its dissemination (Félix et al., 2017).

AIDS was not treated as a priority by the Brazilian health sectors, in its first years in the territory. The Drug assistance for the infected was restricted and expensive. The knowledge of the pathogenesis and the ways of transmission of the HIV virus at the beginning of the pandemic was precarious and limited, contributing to the origin of stigmas. There was, however, a link between the disease and individuals marginalized by society (Leite, 2015; Nunes Júnior et al., 2018).

The epidemiological development of the disease allowed its dissociation from previously risk groups, for a dissemination to the whole society without there being, however, overcoming of the stigma. The concept of risky behavior, has become outdated, therefore, producing spaces for the image of vulnerable subjects. The involvement in the social, programmatic, and individual multiple facets of vulnerability to the virus was founded. Allowing the analysis of social, economic, biological factors and the development of public and governmental actions to prevent and combat the pandemic as determinants of illness (Villela et al., 2015).

Currently, the disease affects various social groups, regardless of their epidemiological profile (Fontes et al., 2017). In Brazil, between 2007 and June 2018, the Ministry of Health notified 247,795 cases. Of the total number of cases, 42,215 (17.0%) belonged to the Northeast region of the country. As for mortality, between 1980 and 2017, 327,655 deaths were recorded. In the Northeastern territory, the deaths represent 13.3% in this period (BRASIL, 2018).

Even though prevention and treatment actions have reduced AIDS mortality, this reduction has not occurred equally among the country's regions. Access to Brazilian health care is not universal and equitable. This hinders early diagnosis and, consequently, treatment (Lins et al., 2019).

The HIV epidemic must be understood in a holistic way, considering its political, social, geographic, and biological factors. The spatial-temporal analysis of geographic groupings makes it possible to detect and evaluate regions of higher incidence, which helps in the direction of public health actions in priority areas and in the knowledge of factors that permeate the expansion of the epidemic to peripheral areas (Pellini et al., 2017).

The evolution of HIV/AIDS in Brazil is characterized by several factors, among them the internalization. The development of the virus points to the interaction of socially vulnerable populations, and the analysis of the spatial advance shows that it is not distributed in a similar way among the Brazilian regions, that is, it does not reach only the large centers, but also the smaller municipalities (Melo et al., 2016).

Even more than three decades after the beginning of HIV/AIDS in Brazil, it is still considered an epidemic and a great difficulty in public health in Brazil, despite studies showing a possible stabilization throughout Latin America (Santos et al., 2019).

Considering the internalization process and the epidemiological evolution of AIDS in the country and especially in the Northeast region, it is essential to analyze this process. In this way, it becomes possible to subsidize surveillance actions and prevention and health promotion policies that are more grounded in the contextual reality. This also makes it possible to understand aspects that favor and permeate the magnitude and spread of the disease.

METHODOLOGY

This is an epidemiological study with a quantitative, ecological, descriptive, and exploratory approach, involving all the counties of Northeastern Brazil, with a longitudinal cut relative to the period from 1982 to 2018. AIDS cases recorded in the Notification Diseases Information System (SINAN) every ten years (1982, 1992, 2002, 2012) and the most recent data available (2018) were analyzed. These

are not prevalence figures, but the absolute numbers reported in that year, which were obtained from the TABNET tool of the Informatics Department of the Brazilian National Health System (DATASUS), available through the link <<http://www2.aids.gov.br/cgi/deftohtm.exe?tabnet/br.def>>.

Regarding the data for 2018, we also obtained the population estimate for that year, through the website of the Brazilian Institute of Geography and Statistics. From this, the incidences of the disease in that year were calculated for each city in the chosen scenario. As inclusion criteria were considered: 1 - cases of AIDS in people aged ≥ 0 years notified in SINAN; 2 - being records from northeastern municipalities in Brazil, in the years of interest (1982, 1992, 2002, 2012 and 2018).

The Brazilian Northeast is composed of 1794 municipalities divided into nine (09) states where 151,410 notifications of the disease were captured. In the end, 23,360 cases made up the sample. Of these data, the absolute frequency for each Federal Unit (UF), the year of notification, and the municipality of residence of the occurrence were configured as variables of interest.

For data analysis were used TabWin *version 4.15* and R *4.0.1*. Both *software* chosen because they are free, available for public and universal use. TabWin is intended to allow quick tabulations on the files that are the basic components of the Unified Health System (SUS) information. The data collected in TabNet were manually inserted in the *software* to generate the maps.

The R uses a versatile programming language that allows everything from data manipulation to statistical analysis. The amount and purpose of R commands or functions can be freely extended by creating new function packages. In this case, the cluster analysis methods with hierarchical method in full connection and Gower metric were used. After the development of the analyses, a dendrogram was generated, aiming at the exploration of the generated groups.

Cluster analysis uses the value of variables to construct a dendrogram that unites them into different classes. In this way, objects with similar characteristics come together in the same class, thus reducing the amount of data. The dendrogram is formed according to the distance calculated between all objects and for the groups that will be formed, in this case it is based on clustering. The analyzed objects are initially alone and are gradually joined together until they are united in only one group (Santos et al., 2017).

Considering resolutions 466/2012 and 510/2016 of the National Research Ethics Committee - CONEP, since these data are freely and openly available to the general public and are not subject to limitations (BRASIL, 2013; BRASIL, 2016). For this reason, the previous analysis of the study by a Research Ethics Committee (CEP) with human beings was not necessary; however, the principles that guide such studies were followed.

RESULTS AND DISCUSSION

The distribution by federative unit - FU of HIV/AIDS cases diagnosed in the Notification Diseases Information System (SINAN) in the States of the Northeast region of Brazil, from the first case to the last, specifically, between the years 1982 and 2018 is shown in Table 1. Associated with these, emphasis is given to the year of the first notification.

Of the total number of cases in each state of the Northeastern region of Brazil (Table 1), as well as their percentage in relation to the total number of cases in the region, Bahia presented the highest number of diagnosed cases in the analyzed period (23.16%), followed by Pernambuco (23.14%), Ceará (15.36%), Maranhão (13.23%), Paraíba (5.93%), Rio Grande do Norte (5.47%), Alagoas (5.22%), Piauí (4.79%) and Sergipe (3.70%).

Table 1. AIDS records in the Northeast region of Brazil from 1982 to 2018

State of Residence	Absolute Frequency	Relative Frequency	Year of 1st registration
Alagoas (AL)	7.910	5,22%	1990
Bahia (BA)	35.058	23,16%	1984
Ceará (CE)	23.259	15,36%	1982
Maranhão (MA)	20.033	13,23%	1985
Paraíba (PB)	8.972	5,93%	1985
Pernambuco (PE)	35.039	23,14%	1983
Piauí (PI)	7.255	4,79%	1986
Rio Grande do Norte (RN)	8.283	5,47%	1983
Sergipe (SE)	5.601	3,70%	1987
TOTAL	151.410	100%	-

Source: elaborated by the author

The first city to register cases in each state were Imperatriz - MA (n = 2), Raposa - MA (n = 1) and São Luís - MA (n = 3), Teresina - PI (n = 2), Fortaleza - CE (n = 1), Natal - RN (n = 1), Campina Grande - PB (n = 3) and João Pessoa - PB (n = 3), Recife - PE (n = 1) and Vitória de Santo Antão - PE (n = 1), Arapiraca - AL (n = 3), Coruripe - AL (n = 3), Maceió - AL (n = 21), Palmeiras dos Índios - AL (n = 1), Paripueira - AL (n = 1), Paulo Jacinto - AL (n = 1) and São Miguel dos Campos - AL (n = 1), Aracaju - SE (n = 8) and lastly, Salvador - BA (n = 2). With this, we understand the evolution of HIV/AIDS in the Northeast and in which states and cities the first cases appeared.

Bahia (BA) has the largest number of HIV/AIDS cases (35,058), followed by Pernambuco (PE) (35,039), Ceará (CE) (23,259), Maranhão (MA) (20,033), Paraíba (PB) (8,972), Rio Grande do Norte (RN) (8,283), Alagoas (AL) (7,910), Piauí (PI) (7,255), and lastly, Sergipe (SE) (5,601). In relation to population, the order is the same, but in relation to HDI, the order changes. In relation to HDI, Rio Grande do Norte (RN) has the highest (0.684), followed by Ceará (CE) (0.682), Pernambuco (PE) (0.673), Sergipe (SE) (0, 665), Bahia (BA) (0.660), Paraíba (PB) (0.658), Piauí (PI) (0.646), Maranhão (MA) (0.639), and lastly, Alagoas (AL) (0.631). Through this, it is observed that the most populous states are those with the greatest number of cases.

Despite the decrease in AIDS mortality in Brazil and in the world, it is the fourth main leading cause of death in the country, even with the advances in prevention and the use of antiretroviral therapy (ART). In some regions, such as the Northeast, there has been a steady increase in deaths over the years, despite the reduction in the Southeast, South and Midwest regions, which may be due to the difference in health care provided. The assistance to people with AIDS is not equally distributed in Brazil. Access to diagnosis is slow, and treatment is initiated late. For this reason, it is essential to improve health support and adopt additional preventive strategies (Lins et al., 2019).

According to the Epidemiological Bulletin on HIV/AIDS from the Brazilian Ministry of Health (2018), people between the ages of 15 and 19 continue to show increasing rates of AIDS incidence. There has been a reduction in cases among women in the last 10 years at all ages except 15 to 19. In addition, there is a low presence of condom use among young people, both at first and last intercourse, with no difference between men and women. (Gutierrez et al., 2019).

The culture of having relationships with multiple people is also dangerous. There is a significant difference between individuals who have sex with several partners compared to those who have fixed partners. Compared to women, men have more sex with different people, as well as more anal sex (Pereira et al., 2016).

Individuals that are homeless are also a cause for concern, they are constantly growing, and they are largely men. They live between social exclusion and lack of integration and are marginalized because of their condition. Several factors, such as lack of access to health

services and lack of knowledge, increase their vulnerability to various diseases, among them AIDS (Silva et al., 2019).

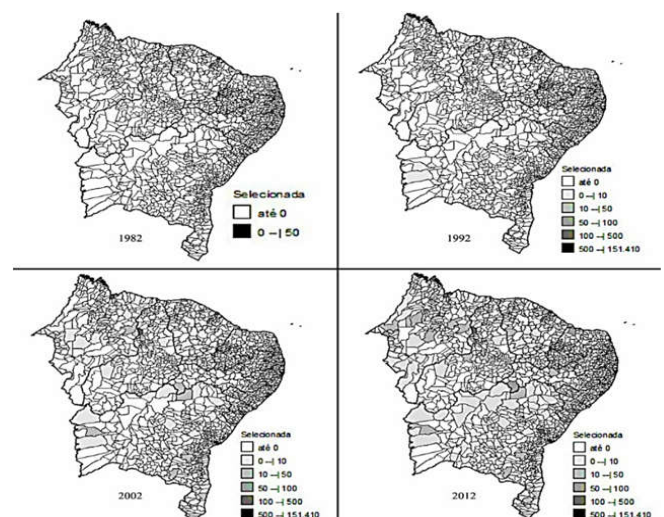
In addition, the patriarchal, capitalist, and racist system performs routine practices where women are dominated and exploited, producing exclusions and inequities that mainly affect those living with HIV/AIDS. However, according to Brillhante (2016), this issue is still little explored in the literature and exponentially influences the internalization of HIV in the territory. The stigma that women who freely use their sexuality deserve to be affected by diseases, the sexist and patriarchal ideas that affirm that the control of the couple's intimacy and the use of condoms belongs to the man, and the moralistic discourse that the woman should aim only at motherhood and satisfying her spouse have contributed, over time, to the feminization of the virus, especially in the countryside of the Northeastern states. Furthermore, women in stable marital relationships tend to neglect their vulnerability to HIV, since they associate it with immoral practices and extramarital relations (Lourenço et al., 2018).

Married women consider married life a protective shell, assigning to their partners the responsibility for decisions involving sexuality and adopting preventive practices delegated by them. In this way, many women are surprised with the diagnosis of seropositivity, adopting a speech of victimization (Lourenço et al., 2018).

The prostitution is another factor that also contributes to the spread of HIV. Many sex workers use condoms in their professional life, but not in their personal life with steady partners (husband, boyfriend, affair, lover). In addition, the decision to test or for HIV is more linked to the subjective construction of who the partner is, fixed or not, than to the risk of having a relationship without using a condom (Sousa et al., 2017).

The university context is also configured as an important situation of vulnerability to HIV, contributing to the internalization of the disease. At this stage in juvenile life, in general, it is often necessary to migrate to large centers and capitals, significant changes in the social and family context take place. Part of the university students tend to adopt sexual behavior without adequate knowledge about their own body and about sexually transmitted infections - STIs, they avoid using contraceptive methods or condoms, and have facilitated contact with alcohol and illicit drugs (Wohlgemuth et al., 2020).

The presentation of the spatial distribution of diagnosed cases released in SINAN, over time, since the beginning of the HIV/AIDS pandemic in the Northeast region of Brazil (Fig. 1), in ten-year intervals (1982, 1992, 2002 and 2012), shows the process of dissemination of the problem throughout the regional territory.



Source: elaborated by the author

Image 1. Mapping of HIV/AIDS cases in Northeastern Brazil from 1982 to 2012

The capital of the state of Ceará, Fortaleza, was the first city in the Northeast to register a case of AIDS, in 1982. Soon after, there was an explosion with more than 50 cases in some cities, such as Fortaleza, Salvador, Recife, and São Luís. As the years went by, the number of people and cities with AIDS cases increased considerably in the Northeast Brazilian states. In the maps, one can see the cities in each state that stand out for the largest records of diagnosed cases, respectively, in 1982, 1992, 2002 and 2012.

The relative frequency of the cases reported in the northeastern capitals in each year studied were as follows: Fortaleza - CE (100%), (92.49%), (59.01%) and (57.34%), Aracaju - SE (0.0%), (69.05%), (47.69%) and (46.49%), João Pessoa - PB (0, 0%), (31,75%), (30,74%) and (37,30%), Maceió - AL (0,0%), (70,69%), (71,85%) and (65,00%), Natal - RN (0,0%), (66,67%), (49,11%) and (39,46%), Recife - PE (0.0%), (62.20%), (35.11%) and (32.18%), Salvador - BA (0.0%), (75.36%), (51.73%) and (45, 36%), São Luís - MA (0,0%), (63,75%), (43,54%) and (39,87%), and lastly, Teresina - PI (0,0%), (67,86%), (59,38%) and (59,04%).

Note that the cases are not migrating only from the capitals, other regions of the country have contributed to the spread of HIV in the Northeast. The internalization of HIV/AIDS, at first, took place in coastal cities and/or large urban centers, but over the years it spread to small cities in the countryside and from border regions. The state of Maranhão, for example, borders Pará and Tocantins, which in 2018 had, respectively, the first and fifth highest frequency of cases in the North Region with 2,261 and 233 cases.

Bahia is bordered by four states in three different regions. Minas Gerais and Espírito Santo of the Southeast Region, being the third and fourth with the highest numbers in their region, with 2,440 and 655 cases. Goiás, from the Midwest Region, being the largest in number of cases, with 1,008 and, Tocantins, from the Northern Region. In addition, the structure of the state can influence the increase in the absolute value of cases. Where, Maranhão has the second lowest HDI in the Northeast Region and Bahia has the fifth.

Over the past 15 years, the major advances in the response to AIDS have inspired new commitments and goals. The great expansion of antiretroviral therapy has put the world on track to meet the goals of reducing disease-related deaths. However, the decrease in new HIV infections has been very slow and the global targets are far from being reached (UNAIDS, 2017).

In 1987, throughout Brazil, there was the creation and structuring of Serology Orientation and Support Centers (COAS), with the objective of offering testing to the entire population. As of 1989, the COAS was renamed Testing and Counseling Centers (CTA), and began to focus not only on testing, but also on counseling (actions aimed at reducing risks and promoting safer practices) (BRASIL, 2017).

Condoms are the most effective means of prevention of STIs, such as HIV. Condoms are distributed by the Ministry of Health on a monthly, bimonthly, or quarterly basis, depending on the storage capacity of each location (BRASIL, 2020).

Many people with AIDS do not have access to appropriate treatment. In Latin America, about 63% of people with AIDS have access to treatment, but several factors can affect accessibility and familiarity with treatment, such as costs in general, travel distance, especially for people living in rural areas, opening hours of health services, and social stigmas (UNAIDS, 2018).

Based on this process of increasing internalization in northeastern Brazil, figure 2 presents the spatial distribution of AIDS cases diagnosed and recorded in SINAN in 2018 in the Northeast region of Brazil, compared to the incidences in the same year. It can be noted, from them, the importance of the problem and in relation to the population and, representativeness of the municipalities.

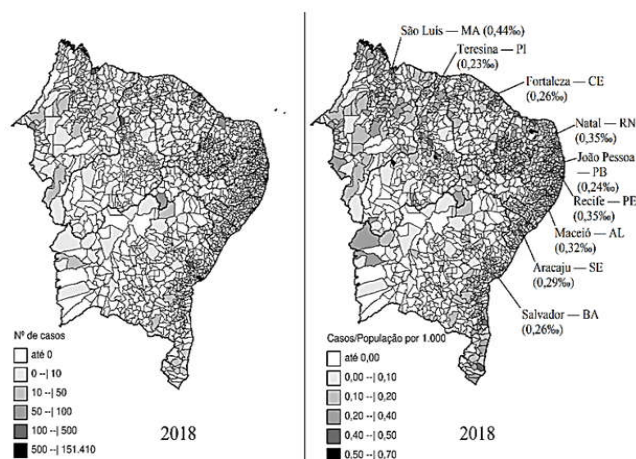


Image 2. Map of diagnosed AIDS cases registered in SINAN and their incidence in Northeast Brazil in 2018

Some cities stand out for the high percentage of cases in relation to the total amount of the state, being the capitals, Maceió - AL (54,72%), Fortaleza - CE (53,00%), Teresina - PI (51,28%), Aracaju - SE (46,85%), Natal - RN (42,03%), Salvador - BA (40,27%), João Pessoa - PB (39,59%), São Luís - MA (34,82%), and Recife - PE (31,35%). This shows that in comparison to the other years (Fig. 1), the percentages of most of these cities decreased as the years went by. This is due to the emergence of cases in more cities.

Showing data in absolute values and incidence is of great importance. It is observed in the cities of the Northeast in 2018 (Fig. 2) the absolute value (total amount of cases in a certain place and time) and the incidence. It is calculated to note the chances of an individual belonging to the population of a given location being affected by the disease of interest in a specified time interval.

The incidence of cases in the Northeast region of Brazil, highlighting the permillage (‰) of the state capitals, shows that they are not the most representative. The cities with the highest rate per state are Barra de Santo Antônio - AL (0.70‰), Antônio Almeida - PI (0.63‰), Extremoz - RN (0.60‰), Cedral - MA (0.56‰), Ilha de Itamaracá - PE (0.54‰), Cedro de São João - SE (0.51‰), Alcobaca - BA (0.49‰), Riachão do Bacamarte - PB (0.44‰), and lastly, Jati - CE (0.38‰). Thus, Barra de Santo Antônio - AL (0.70‰) and Jati - CE (0.38‰), respectively, are the cities with the highest and lowest indexes. Through this, it is possible to notice how frequently new cases appear and that the incidence rates of AIDS increase as the years go by.

According to the Brazilian Interdisciplinary Association of AIDS-ABIA (2016), there is still an increase in the number of cases in Brazil, the country counts more than 40.0% of new infections in Latin America between 2010 and 2015. These numbers increase due to several phenomena, such as feminization, juvenilization, senility and pauperization of the pandemic. Where, in all these phenomena HIV/AIDS reaches a new group of people, thus increasing the number of cases cosmopolitanly.

For the Ministry of Health of Brazil, the AIDS detection rate has been falling in the country in recent years. From 2013 to 2014, the rate fell 3.5%; from 2014 to 2015 the reduction was 4.3%; from 2015 to 2016, 4.6%; and from 2016 para 2017 the fall was 3.4%. With this in view, there are important differences in the proportions of data, thus noting that Brazil is trending towards a decrease in the number of diagnosed AIDS cases, without, however, this showing equality among its regions (BRASIL, 2018).

The lack of information hinders the search for treatment by people living with HIV/AIDS, in order to have a better quality of life. Society's view of them directly influences treatment adherence and self-care practices, as they suffer prejudice for being seen as

'contaminated' or 'condemned' people, limiting their social support (Jesus et al., 2017).

About 15.3% of people have experienced some kind of stigma or discrimination from health professionals just for having HIV/AIDS. Discrimination in attitudes such as avoiding physical contact and breaking secrecy about their seropositivity without the carrier's consent are other verified facts. However, although the reports were made by a minority, it is worth noting that the laws guarantee that no one should experience any kind of embarrassment (UNAIDS, 2019).

These days, with fear of suffering from societal stigma and discrimination, many people living with HIV/AIDS face obstacles in deciding to disclose their HIV or health status to people close to them such as friends, family members, and sexual partners (UNAIDS, 2019). This fear can cause people to give up getting tested for HIV. Women stand out, as there have been reports of being victims of intimate violence, discrimination in sexual and reproductive health services, and forced or coerced sterilization while HIV positive (UNAIDS, 2018).

Certain groups have impaired access to HIV testing and treatment services. Among them are mainly men, young people, and people included in key populations. These groups have little access to testing services and are less likely to adhere to treatment, resulting in lower viral suppression rates. For people living with HIV/AIDS, several factors limit access to health services, among them are limited household resources and the inability to pay health service fees and other related expenses (UNAIDS, 2018).

Gender inequalities make women more vulnerable to HIV. AIDS is the leading cause of death among women of reproductive age (15 to 49 years old) and about 6,000 young people (15 to 24 years old) are infected with the virus each week. Some critical areas must be addressed, including the elimination of violence against women. In regions with high HIV incidence, partner violence has been found to increase the chances of becoming infected with the virus by 50% (UNAIDS, 2020).

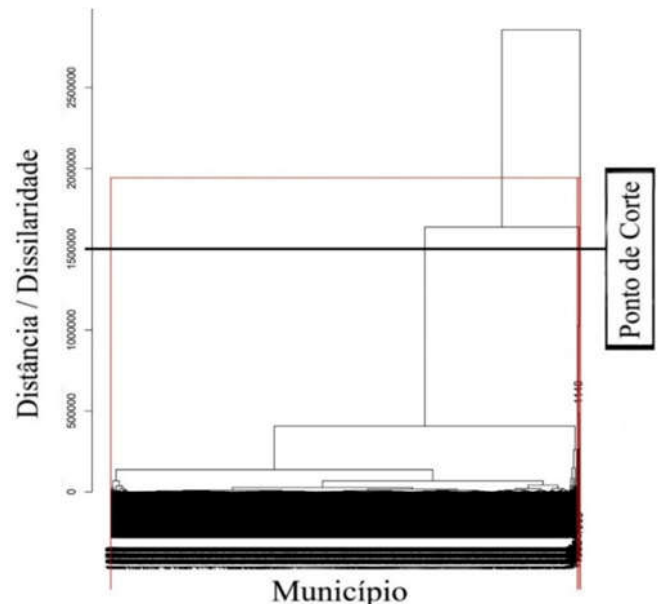
Compared to women, men have lower numbers regarding treatment. About less than half of men living with HIV/AIDS adhere to treatment, while women are around 60%. Men are more likely to start treatment late, stop, or cancel. They also do not seek treatment to the same extent as women (UNAIDS, 2017).

According to Grangeiro (2016), as cited by ABIA, the epidemiological surveillance of HIV/AIDS in Brazil is complex; cases are registered from four national information systems. This causes more than 10.0% of the existing cases to appear in the statistics only one year after their diagnosis was made. With the correction of this delay in records, their rates would not be as low as those diagnosed, thus reversing the officially announced downward trend and being able to practice more effective actions in reality (ABIA, 2016).

In order to identify possible patterns of the process of internalization and dissemination of HIV/AIDS in the Brazilian Northeast, Figure 3 presents the dendrogram of the incidences of diagnosed cases registered in SINAN in 2018. The panorama in which the cities of the region are grouped according to the current incidences of the disease can be observed.

Grouping analysis or cluster analysis is a descriptive procedure for checking patterns. In this case, incidence and population size were used as parameters for the investigations. From this, the presented groups were determined, which are part of a subjective analysis, where a reference point is used in the dendrogram, in this case the midpoint, to observe the distinct groups. After the procedures of the cluster analysis of the northeastern municipalities, the existence of three groups was identified and a clustering coefficient (CA) very close to the ideal (CA = 0.999) was obtained.

The use of the hierarchical method of complete linkage with the Gower metric and, delimiting the midpoint of the dendrogram, it was obtained a first group composed of cities with the lowest incidences of AIDS. About 99.39% of the cities are present in this group. Of the 1,783 cities in this group, 821 are observed with the lowest incidence (0.0%) and Barra de Santo Antônio - AL with the highest (0.70%) with 15,792 inhabitants. Almost all the municipalities in the interior of the Northeast are included in this group. It can be seen that, regardless of population size, the process of internalization occurs with equal incidence in the inland cities, denoting the cosmopolitan nature of the virus.



Source: elaborated by the author

Image 3. Dendrogram of the incidence of diagnosed cases of AIDS, registered in SINAN in Northeast Brazil in 2018

Inequalities in health and in access to services are observed within the regions of Brazil. Despite an improvement in access and use of services in the five Brazilian regions, important differences are noted in the North and Northeast in relation to the others. There are low numbers regarding health status assessment and little use of services, even with a large coverage by public programs (Viacava et al., 2019).

The second group is composed of cities with higher incidences than the first.

About 0.5% of the municipalities in Northeast Brazil are present in this group, which in absolute values represents nine municipalities. Among them, cities with a population of more than 500,000 inhabitants predominate, being seven capitals, Aracaju - SE, João Pessoa - PB, Maceió - AL, Natal - RN, Recife - PE, São Luís - MA, and Teresina - PI, and two large state representatives, Feira de Santana - BA, and Jaboatão dos Guararapes - PE. The lowest incidence is associated with Feira de Santana - BA (0.23%) with 609,913 inhabitants and Teresina - PI (0.23%) with 861,462 inhabitants, the highest is in São Luís - MA (0.44%) with 1,094,667 inhabitants.

The third group counts on 0.11% of the northeastern municipalities, which, in absolute value, are only two. Both are large Northeastern capitals and national metropolises, Fortaleza - CE and Salvador - BA. This denotes that, in most cases, the greatest incidences of AIDS still occur in large urban centers and/or in Brazilian capitals. The two cities have the same incidence (0.26%), respectively with 2,643,247 and 2,857,329 inhabitants.

Large urban areas offer better conditions for facing public health problems. This occurs due to their large population, proximity to health services, and more financial resources allocated to them.

However, diseases tend to have a higher incidence in large cities, since they spread faster in more populated places (Segurado et al., 2016).

Relating the dendrogram with the 2018 maps (Fig. 2) one notices the spread of cases throughout the Brazilian Northeast. This event can occur due to several factors, among them the migration of people from inland cities to large cities in search of study and/or work, contact with a new reality, alcohol and drug use, the neglect of condom use, disorderly urbanization, high birth rate of people with HIV, social and programmatic vulnerability, and inequalities of public and health policies.

It is observed that the cities that had the lowest incidences are small cities in the countryside, about more than 50.0% had their incidence below 0.10%. In comparison with small cities, large cities have their incidence higher, especially the capital cities with values above 0.20%.

Cluster analysis was developed in order to solve problems such as the classification of several individuals. Its use together with the dendrogram that contains the individual information divided into different groups, allows the data analysis with great precision (Santos et al., 2017). In this way, it is possible to make specific AIDS decisions for each group, according to their data.

CONCLUSION

The HIV/AIDS epidemic in the Northeast of Brazil began in the large cities and/or capitals. Then, in a few years after its emergence, there was an explosion of cases in other municipalities, including cities in the countryside. Through this, an evident process of interiorization of the disease can be noticed.

Even though the population of the large cities has more access to treatment and prevention, they are still more vulnerable to HIV. Because the number of cases is much more prominent in relation to those of small cities in the interior of the states.

It is possible that, with new theoretical and practical bases and in relation to the field and scenario studied, measures can be taken through public health policies directed at the most vulnerable populations. Health professionals need to make appropriate, more rigorous, and law-governed combat and prevention decisions in those areas most affected. In addition, the public needs to adopt preventive methods and care, in fact. Since the problem shows itself as a serious health crisis sneaking into the eyes of managers.

The use of the chosen analysis methods was sufficient to achieve the proposed goal. Through tools that are easy to access and handle, it is clear that this trial enables fruit in the field of innovation for the combat and prevention, mapping of cases, and easy understanding of the distribution of the virus in the region.

Due to the limited availability of data, this study was limited to the investigation through the absolute number of cases in the region, not using other qualitative aspects such as socio-demographic data (sex, race, education, age group). The nature of the information used is adequate for the referent object, however, it is not adequate for studies that intend more robust justifying elements, of socio-personal motivating aspects for the dissemination. This can be investigated a *posteriori*.

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