Revista O Mundo da Saúde

Tuberculosis - HIV Coinfection: Spatial Analysis and Epidemiological Profile in Rio Grande do Norte

Dayvison Nascimento de Oliveira*
Bárbara Coeli Oliveira da Silva**
Ana Angélica Rêgo de Queiroz***
Rafaela Cavalcanti de Albuquerque Nascimento****
Vanessa Pinheiro Barreto*****
Alexsandra Rodrigues Feijão*****

Abstract

Given the epidemiological relevance of tuberculosis and human immunodeficiency virus (TB-HIV) coinfection and the scarcity of recent data analysis provided by the Notifiable Diseases Information System, it is essential to analyze the spatial distribution of TB-HIV coinfection in the state of Rio Grande do Norte. Thus, this study aimed to analyze the spatial distribution and epidemiological profile of TB-HIV co-infection cases between 2001 and 2018 in the state of Rio Grande do Norte, Brazil. This is an ecological study whose population was of confirmed cases of TB-HIV co-infection between the years 2001 to 2018 in the state of Rio Grande do Norte. Data were obtained from the Informatics Department of the Unified Health System, from the Notifiable Diseases Information System, which were tabulated in Microsoft Excel and analyzed using descriptive statistics. For the spatial analysis, the TerraView software was used to calculate the Global Moran Index and then the Local Moran Index. Between 2001 and 2018 there were 1,576 confirmed cases of TB-HIV coinfection in the state of Rio Grande do Norte. Of these 1,197 (76%) were males aged between 20 and 39 years (56.47%). The predominant clinical form was pulmonary TB in 1,102 (69.82%) cases. The results obtained showed a positive autocorrelation between the most urbanized cities in the state of Rio Grande do Norte, which are located in health regions I, II, III, and VII. Adult males aged 20-39 years, having an incomplete primary education, and living in urban areas were the most frequent characteristics according to the epidemiological profile of the population. Thus, it is advised that health professionals who serve this population affected by these infections should be trained and have empathy.

Keywords: Spatial Analysis. Coinfection. Tuberculosis. HIV. Health Profile. Epidemiology.

INTRODUCTION

Tuberculosis (TB) is an infection caused by *Mycobacterium tuberculosis* (MTB) or Koch's Bacillus, an opportunistic infectious agent, representing the first major cause of death from an infectious disease in the world[1]. HIV-related tuberculosis has changed the perspectives of tuberculosis surveillance worldwide, resulting in an increase in the incidence of tuberculosis and its morbidity and mortality[2].

In an immunocompetent individual, the risk of Koch's bacillus infection advancing to clinical pathology is approximately 10% throughout life, with the association with

DOI: 10.15343/0104-7809.202145481492

*Universitätsklinikum Schleswig-Holstein. Kiel, Alemanha
**Secretaria do Estado da Saúde Pública do Rio Grande do Norte e Secretaria Municipal de Saúde de Parnamirim. Natal/RN, Brasil.
***Fundação de Apoio à Pesquisa do Rio Grande do Norte - FAPERN. Natal/RN, Brasil.
****Unimed. Natal/RN, Brasil.
*****Universidade Federal do Rio Grande do Norte - UFRN. Natal/RN, Brasil.
E-mail: dayvisonjj@ufrn.edu.br

HIV, this progression is estimated at 10% per year. People with HIV-associated tuberculosis have mortality rates 2.4 to 19.0 times higher than individuals without the association. The development of multi-resistance to antituberculosis drugs is the main cause of the increase in the mortality rate, leading to a worsening situation of the patients, extending the treatment time, and consequent increase in the costs of control actions[2-3].

In 2015, with the end of the Millennium Development Goals and the beginning of the Sustainable Development Goals, the World Health Organization (WHO) reassessed the list of priority countries in the fight against TB for the periods from 2016 to 2020, adopting three lists with countries that have a high burden of TB: the first, referring to TB; the second, Multidrug-Resistant Tuberculosis (TB-MTD); and third, TB-HIV co-infection. Each of these lists is made up of 30 countries, 20 with the highest absolute number of estimated incident cases and the remaining 10 with a high incidence rate per capita[4].

In this sense, Brazil stands out for being the only country in the Americas to integrate two of the three lists, occupying the 20th position in the first list, and the 19th position the third list. According to the Joint United Nations Program on HIV/AIDS (UNAIDS), tuberculosis remains the leading cause of death among people living with HIV, accounting for about one in three deaths from AIDS-related causes[4].

In 2016, around the world, 10.4 million people developed tuberculosis, of which 1.2 million people were living with HIV and in that same year about 374,000 people died of AIDS-related TB. In Brazil, in 2017, 69,000 new cases of tuberculosis were diagnosed, of which 9,571 were people living with HIV, with an average of 4,500 deaths per year from tuberculosis[4-5].

TB-HIV co-infection is a public health problem, especially in Brazil, which entails an increase in health costs, due to the large number of new diagnoses, causing the Ministry of Health (MS) to search for viable strategies to establish intermediate milestones aiming to achieve the goals proposed by the WHO. These goals are to reduce the number of deaths by 35%, 75%, and 90% and the incidence coefficient by 20%, 50%, and 80% for the years 2020, 2025, and 2030, respectively, among priority countries that are on one or more of the three lists. In order to achieve these goals, the strategy provides for the establishment of three pillars, the first focused on patient care, the second on the social component, and the third on research and innovation. However, greater investments in public health will be needed by each country that commits to the campaign[6].

In this context, considering the epidemiological relevance of TB-HIV coinfection and the scarcity of studies on the spatial distribution in the state of Rio Grande do Norte (RN) and Brazil[7], it is essential to analyze the spatial distribution of TB-HIV coinfection in the state of RN. Studies of this nature will help in the planning, monitoring, and evaluating health actions, identifying areas of risk, as well as possibly triggering new actions directed at the referred comorbidity. Moreover, they may demonstrate the progression and geographic locations where the co-infection is more predominant[8].

The use of geoprocessing and spatial analysis of data on TB-HIV coinfection cases in RN provides a better understanding of the real situation of the disease in the state, considering the heterogeneity and changes in the epidemiological behavior of the coinfection, which call upon the Geographic Information Systems (GIS) for spatial and temporal analyses[9].

Considering all the heterogeneity that surrounds the context of TB-HIV coinfection, which is the cause of a greater repercussion in the mortality of those co-infected individuals, it is essential to understand and analyze the epidemiological situation of this comorbidity in different areas of the RN, thus highlighting the gaps still present in the detection, treatment, and effective monitoring of this population[10-11].

Thus, the present study aimed to analyze the spatial distribution and epidemiological profile of TB-HIV cases of coinfection between the years 2001 to 2018 in the state of Rio Grande do Norte, Brazil.

METHODS

This study is of the ecological type, whose population consisted of confirmed cases of TB-HIV coinfections between the years 2001 to 2018 in the state of Rio Grande do Norte, Brazil.

Brazil is the 5th largest country in the world, located in South America, with a total extension of 8,515,759.09 km², and is divided into 5 cardinal regions, north, northeast, midwest, southeast, and south. Rio Grande do Norte is located in the northeast portion and is the 16th most populous state in Brazil with a territorial extension of 52,811.107 km² [12].

The units of analysis were all 167 municipalities in the state of Rio Grande do Norte. The study area comprises eight Health Regions: Health Region I (São José de Mipibu); Health Region II (Mossoró); Health Region III (João Câmara); Health Region IV (Caicó); Health Region V (Santa Cruz); Health Region VI (Pau dos Ferros); Health Region VII (Metropolitan); and Health Region VIII (Assu) (Figure 1).

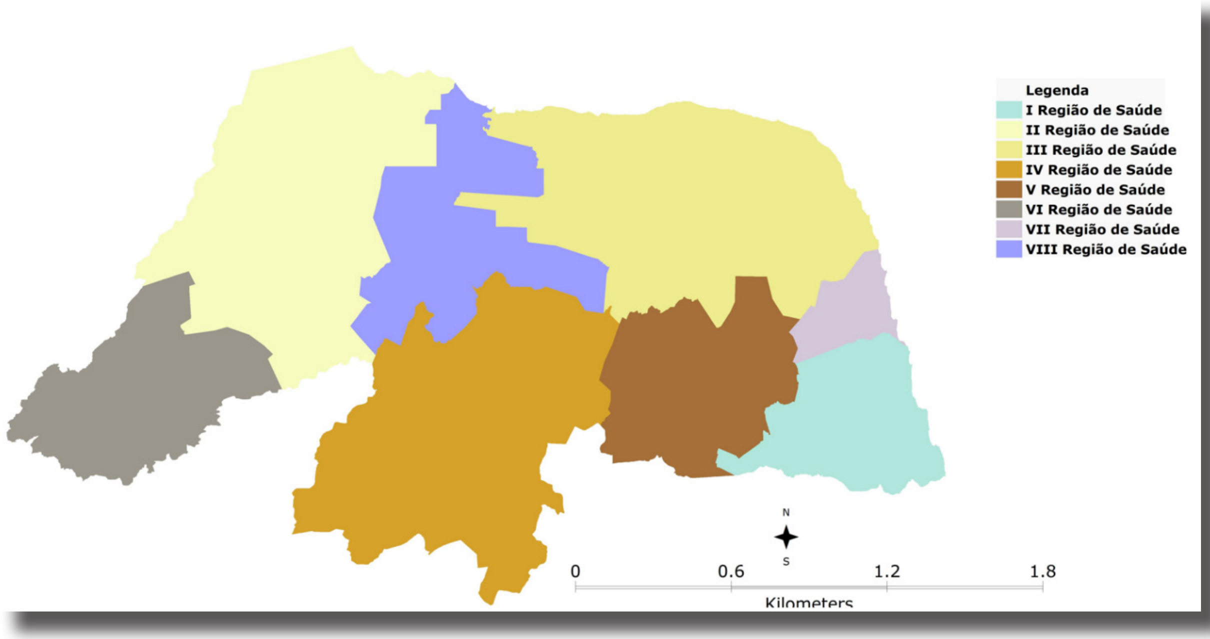

Figure 1 – Health Regions. Rio Grande do Norte, Brazil, 2018.

Data were extracted in August 2019 from the Informatics Department of the Unified Health System (DATASUS), from Notifiable Diseases Information System[13].

The variables that make up the study were organized into sociodemographic characteristics (gender, age group, race/color, education, area of residence, and institutionalized), clinical (form, type of entry, antiretroviral, closure status), and three-year incidence rate per county. Clinical and sociodemographic variable data as well as the incidence rate were tabulated in Microsoft Excel 2016, the first two being analyzed in Microsoft Excel 2016 using descriptive statistics (absolute and relative frequency).

The triennial incidence rate (2001-2003, 2004-2006, 2007-2009, 2010-2012, 2013-2015, 2016-2018) in the municipalities of the state of RN was calculated by dividing the sum of confirmed cases of TB-HIV coinfection in the triennium by the resident population in the triennium, multiplied by 1/3 (triennium) and finally multiplied by 10,000, according to the formula below:

$$\text{RtTB-HIV:} \quad \frac{\sum cases\ TB - HIV\ during\ triennium}{\sum population} \times \frac{1}{3} \times 10{,}000$$

Data referring to the population of the state were taken from the website of the Brazilian Institute of Geography and Statistics[14].

For the spatial analysis of the three-year incidence rate, the TerraView Version 4.2.2 software was used. The Global Moran Index was calculated followed by the Local Moran Index, represented by the Box Map which is classified into four quadrants: Q1 (high-high) and Q2 (low-low), which indicate municipalities with values similar to those of its neighbors, and Q3 (high-low) and Q4 (low-high) with different values from their neighbors. Furthermore, to assess statistical significance, the Local Indicator of Spatial Association (LISA) was applied through the LISA Map and was labeled as significant and with 95% confidence (p = 0.05), 99% (p = 0.01), 99.9% (p = 0.001)15.

At the end, a choropleth map of the LISA Map and Box Map was built using the QGIS software Version 3.14.15 applying the cartographic base of the state of RN provided by IBGE16.

The data used for this study are secondary data provided by DATASUS without identifying the members who provided the data; thus, the study did not need to be analyzed by the Research Ethics Committee.

RESULTS

From 2001 to 2018, there were 1,576 confirmed cases of TB-HIV coinfection in the state of Rio Grande do Norte.

From the evaluation of confirmed cases of TB-HIV coinfection in RN, in the years 2001 to 2018, referring to sociodemographic variables, it was observed that males were the most affected at 76.00%. Concerning the age group that was most affected, 56.47% were adults between 20 and 39 years old. In relation to race, brown skin stood out at 66.62%. With regards to education, 32.99% were marked as ignored/blank. The main area of residence was urban at 90.16%. Regarding the institutionalized variable, the ignored/blank selection prevailed with a total of 51.52%, followed by the non-institutionalized 43.14% (Table 1).

With regards to clinical variables, the pulmonary form reached the highest percentage of cases, 69.92%. The type of entry were new cases at 72.01%. Concerning the use of antiretroviral drugs, 76.77% were of the ignored/blank group. The predominant outcomes were transfers at 32.23%, followed by cures at 32.17% (Table 2).

According to the existence of spatial univariates of the incidence rate in the years 2001 to 2018, there was statistical significance among the trienniums 2007-2009 (0.01), 2013-2015 (0.02), and 2016-2018 (0.01) given that they obtained p-value < 0.05 (Table 3).

The results obtained in the Box Map (Figure 2) allowed us to identify the spatial association of the incidence rate of TB-HIV coinfection. Despite Q1, high-high, there are high incidence rates of TB-HIV coinfection along with neighbors with similar values, this quadrant was the second highest among the municipalities (positive association). From 2001 to 2003, there was a direct autocorrelation (Q1) in the following Health Regions, I, III, VII, and VIII, with a total of 11 municipalities. A direct autocorrelation was as identified between 2004 and 2006 in regions I, II, III, VI, VII, and VIII, with a total of 22 municipalities. Moreover, from 2007 to 2009, regions I, II, III, VI, VII, and VIII, with a total of 23 municipalities and from 2010 to 2012, regions I, II, IV, V, VI, VII, and VIII, with a total of 24 municipalities were also directly autocorrelated. Furthermore, a direct autocorrelation was observed between 2013 and 2015, regions I, II, III, IV, V, VII, and VIII, with a total of 32 municipalities, and from 2016 to 2018 among regions I, II, III, IV, V, and VII, with a total of 29 municipalities.

Regarding Q2, low-high, which was the most representative among the municipalities (positive association) in all three-year periods from 2001 to 2019, was comprised of Health Regions I, II, III, IV, V, VI, and VIII.

Regarding Q3, high-low, there is a high incidence rate of TB-HIV coinfection having neighboring cities with low values (negative association), of which were: Health Regions I, II, IV, V, VI, and VIII, (11 municipalities) from 2001 to 2003; Health Regions I, II, III, IV, V, VI, VII, and VIII, (16 municipalities) from 2004 and 2006; Health Regions I, II, III, IV, V, VI, VII, and VIII, (16 municipalities) from 2007 to 2009; Health Regions I, II, III, IV, V, VI, and VIII (26 municipalities) from 2010 to 2012; Health Regions I, II, III, IV, V, VI, and VIII, (24 municipalities) from 2013 to 2015; and Health Regions I, II, III, IV, V, VI, VII, and VIII, (23 municipalities) from2016 to 2018.

As for Q4, low-high, there is a low incidence rate of TB-HIV coinfection and there were neighbors with high values (negative association) observed from 2001 to 2019 in Health Regions I, II, III, IV, V, VI, and VIII, with the exception of the 2007-2009 triennium, in which were only regions I, II, III, V, VI, and VIII with a total of 36 municipalities.

The LISA Map pointed out clusters of municipalities that diverged from the others, with a statistically significant local spatial dependence reaching levels of 0.1%, 1%, and 5%. Regarding the results obtained in the LISA MAP the Health Regions that reached significance were: regions I, III, IV, VI, and VIII in the 2001 to 2003 period; regions I, II, III, V, and VI from 2004 to 2006; regions I, II, III, IV, V, VI, VII, and VIII from 2007 to 2009; regions I, III, IV, V, VI, VII, and VIII from 2010 to 2012; regions I, II, III, IV, V, VI, VII, and VIII from 2013 to 2015; and finally regions, I, II, III, VI and VII from 2016 to 2019.

Table 1 – Sociodemographic variables of confirmed cases of TB-HIV coinfection. Rio Grande do Norte, Brazil, 2001-2018.

Sociodemographic variables	n	%
Sexo		
Male	1197	76.00
Female	379	24.00
Age group		
<1 year	5	0.31
1-9	11	0.69
10-19	40	2.53
20-39	890	56.47
40-59	544	34.51
60-69	64	4.05
70-79	13	0.82
80 and +	5	0.31
Race/Color		
Brown	1050	66.62
White	269	17.06
Black	115	7.29
Yellow	4	0.25
Indigenous	4	0.25
Ignored/Blank	134	8.50
Education		
Incomplete elementary school	630	39.97
Complete primary education	135	9.07
Incomplete high school	70	4.44
Complete high school	141	8.94
Incomplete higher education	21	1.33
Complete higher education	46	2.91
Ignored/Blank	520	32.99
Not applicable	13	0.82
Residencial area		
Urban	1421	90.16
Rural	108	6.85
Suburban	13	0.82
Ignored/Blank	34	2.15
Institutionalized		
No	680	43.14
Prision	33	2.72
Orphanage	4	0.25
Psychiatric hospital	2	0.12
Other	45	2.85
Ignored/Blank	812	51.52
Total	1576	100.00

Source: Notifiable Diseases Information System

Table 2 – Clinical variables of confirmed cases of TB-HIV coinfection. Rio Grande do Norte, Brazil, 2001-2018.

Clinical variables	n	%
Form		
Pulmonary	1102	69.92
Extrapulmonary	364	23.09
Pulmonary + extrapulmonary	109	6.91
Ignored/blank	1	0.06
Type of Entry		
New case	1135	72.01
Re-entry after abandonment	223	14.14
Transfer	121	7.60
Relapse	87	5.52
Post-mortem	6	0.38
Unknown	4	0.25
Antiretroviral		
Yes	260	16.49
No	106	6.72
Ignored/Blank	1210	76.77
Outcome status		
Cured	507	32.17
Abandonment	189	11.99
Death from tuberculosis	122	7.74
Death from other causes	143	9.07
Transfer	508	32.23
MDR-TB	4	0.25
Change of plan	18	1.14
Primary dropout	3	0.19
Ignored/Blank	82	5.20
Total	1576	100.00

Source: Notifiable Diseases Information System. MDR-TB: Multiple Drug-resistent Tuberculoses.

Table 3 – Global Moran Index. Rio Grande do Norte, Brazil, 2001-2018.

Triennium	Global Moran Index	P-value
2001-2003	-0.0076	0.51
2004-2006	0.0029	0.44
2007-2009	0.1412	0.01
2010-2012	0.0332	0.24
2013-2015	0.1026	0.02
2016-2018	0.1613	0.01

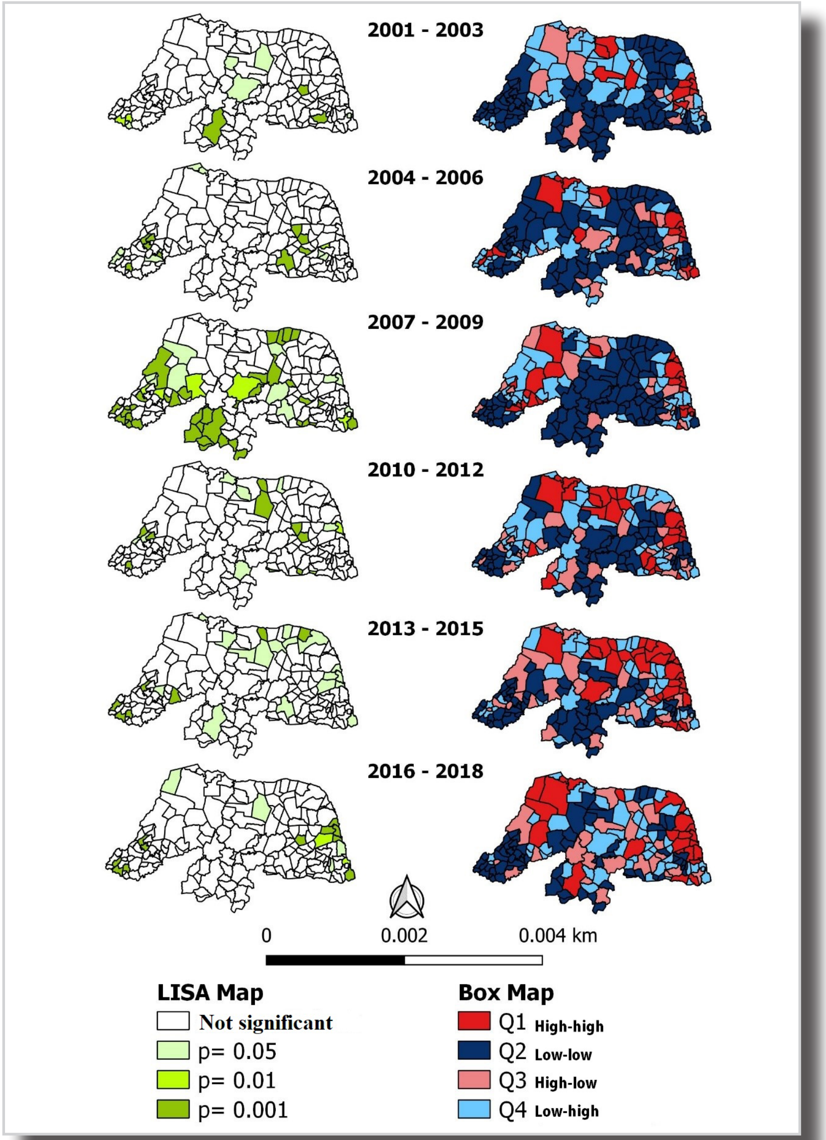

Figure 2 – Analysis of spatial autocorrelation of the incidence rate of TB-HIV coinfection. Rio Grande do Norte, Brazil, 2001-2018.

DISCUSSION

With regards to the total number of TB-HIV coinfection cases in the state of Rio Grande do Norte between 2001 and 2018, there was a growing number in this period, which corroborates a study carried out in northeastern Brazil. This situation that may be explained by the changes concerning the Tuberculosis control strategy, such as its integration with primary health care. This change has led to a reduction in the period between appointments and the simplification of treatment, which has led to access to diagnoses and therapies by the most affected population, generating an increase in population coverage[3].

Thus, it is important to identify PHC actions such as: the offer of rapid tests for HIV; the scheduling of specialized appointments by the team; and meeting spontaneous demand. These actions are directly linked to the detection rate of TB-HIV coinfection, leading to an increase in the sensitivity of the surveillance system, making it possible to actively search for TB cases in the general population and mycobacteria cultures. This demonstrates how detection associated with notification can foster strategies to cover the population (PELISSARI)[17].

Regarding sociodemographic characterization, the male population was the most affected. Research[18] has shown that, due to their behavioral characteristics, they have greater contact with the pathogen, they possess immunological and genetic factors, they less frequently seek to use health services, and they have a greater difficulty in adhering to treatment. Women pay better attention to their health and seek health services earlier than men[19].

The most affected area was the urban zone, which demonstrates the spread of infection through places with a large flow of people and urban agglomerations. This is due to new social and economic habits which can lead to an increase in the number of cases[20].

The predominant age group was between 20 and 39 years old. These young adults make up a considerable part of the economically active population, which may be related to a greater exposure to risk factors[21].

Regarding skin color, most of the individuals reported being brown/mixed, which is in line with the study carried out in the interior of Maranhão22 which shows the Afro-descendant population, which includes blacks and browns, as the most affected by the coinfection as is in most of the Brazilian population[23].

As for the education, most of them are individuals with an incomplete primary education. The lack of adherence to treatment is a problem linked to the low level of education and is associated with lack of knowledge about the means of dissemination of both the HIV virus and the tuberculosis bacillus, as well as the reluctance to seek health services[24-25].

A study on the sociodemographic profile of TB-HIV coinfection in Brazil[11] shows that the majority of coinfected people have an incomplete elementary education. This data is reflected in the current situation of Brazilian education, which is described by illiteracy as a result of the high dropout rates of schools[26]. Thus, it can be highlighted that social vulnerability is one of the contributing factors for low education and, therefore, a greater risk for TB-HIV coinfection.

About 5% of reported cases were from people that are institutionalized, in prisons, psychiatric hospitals, orphanages, or other places that are characterized as institutions. Due to confinement, tuberculosis becomes an even more serious public health problem, causing greater transmission of the pathogen, as the environmental conditions provide for both transmission and the favoring the disease[3,27].

Regarding clinical variables, the most frequent clinical form was pulmonary tuberculosis, this is because the pathogen prefers the lung parenchyma, since it consists of an aerobic bacillus, therefore, it depends on oxygen for its metabolism. However, the extrapulmonary form or the combination of the two forms is more commonly found in cases of coinfected individuals, which demonstrates the immunological vulnerability of these people and the ease that the bacillus has for entering the bloodstream and spread to other parts of the body[28-29].

Regarding the type of data entry that had the highest number of records were new cases. However, cases of re-entry after abandonment were also high, as re-entry after abandonment indicates previous treatment failure, thus, it is considered a major risk factor for the development of MDR-TB and the transmission of this pathogen to the population. The lack of adherence to treatment and the various previous hospitalizations are the factors that are associated with MDR-TB, which makes the treatment more complex and requires recurrent hospitalizations[9,28,30-31].

With regards to antiretroviral therapy (ART), a large percentage of ignored and blank cases was seen. For there to be a good therapeutic response to tuberculosis, the individual with HIV needs to be treated for the virus accordingly. There is also the fact that the patient may not know he/she has HIV, as well as those who know and do not receive antiretroviral therapy due to lack of knowledge about the benefits or embarrassment[9,32].

This variable shows that there are several aspects to be studied and one of them is the work limitations that refer to the attitude, behavior, and posture of the professional at the time of data collection about ART, in addition to requesting an Anti-HIV exam for all patients with tuberculosis since it is a highly underreported variable[9,32-33].

Knowing the importance of ART, the Ministry of Health recommends that patients with TB-HIV coinfection should start therapy, regardless of the TB stage, since HIV directly affects the progression of TB6. Corroborating this fact analyzed by the authors,34 of the 54 coinfected patients who died before finishing TB treatment analyzed in the study, only two of them had access to ART for at least 3 months, demonstrating the high mortality rate for patients without treatment[34].

Concerning the outcomes found in the study, a transfer was predominant, which may be related to the greater complexity of TB-HIV coinfection cases, requiring transfers to specialized and suitable units to carry out the treatment[34]. However, cures were obtained at a relatively low percentage, compared to the average for Brazil in 2017, which was higher than 50%, and in relation to other studies[19,35]. This shows that the cure rate of TB in patients with HIV is still not enough to comply with the MS protocol[9].

These lower cure rates among TB-HIV coinfections are justified by the fact that the evolution of both infections reveals complications of the clinical profile, conferring atypical presentations of TB and the development of other opportunistic diseases. Moreover, the use of various medications (accompanied by their adverse effects) and the difficulty of health services in dealing with the respective pathologies become obstacles to the treatment of diseases[36-37].

In the present study, there was an outstanding frequency of ignored data in patients coinfected with TB-HIV in the following variables: institutionalized and antiretroviral therapy. Notifications in these two criteria are of paramount importance for a reliable assessment of the epidemiological profile of this population. The Notifiable Diseases Information System needs updates regarding mandatory data to be filled in when reporting cases so that there are no gaps in relevant data and, thus, an adequate follow-up of each case may be performed[34].

The use of spatial analysis tools provides the recognition of high-risk areas, as the analysis of the correlation of these locations with social indicators can contribute to the effectiveness of strategies and interventions. Furthermore, these tools make it possible to prioritize means that contribute to the reduction of these differentials between areas[38].

Based on the results obtained through spatial and temporal analysis, the presence of the spatial relationship of the TB-HIV coinfection incidence shows that adjacent areas are likely to have similar incidence rates, which tend to share the same characteristics, and this causes the development of clusters. The clustering of cases are the results, above all, of a succession of urban and political elements that contribute to spatial segregation[39].

The health regions identified with the highest incidence rate (Q1) were I, II, III, and VII that had fluctuations due to time. However, the neighboring regions, I, III, and VII are also known as coastal regions, frequently visited by tourists and they are closer to the state capital, Natal, which is a commercial, port, and mostly touristic region. These regions are at high risk for TB-HIV coinfections due to the proximity to the urban center of Natal. This finding corroborates that of another study[39], which demonstrated that the spatial distribution of tuberculosis has a positive autocorrelation, indicating that locations with similar incidence rates tend to be close.

The positive autocorrelation around the Q2 cluster, the low incidence rates occur in cities that are further away from the urbanization pole, such as cities with agro-economic characteristics. The recognition of sectors with high incidence rates of TB-HIV coinfection is of paramount importance to implement better health care in these more incident regions. However, regions with low rates also need to continue monitoring through control actions with the purpose of monitoring new cases[40-42].

In relation to Q3 and Q4, which are areas where there is an epidemiological transition phase, they are spread out among municipalities in all health regions, except for the region VII. This finding is due to the municipalities with different neighboring rates and, therefore, actions to control coinfection and transmission prevention should be strengthened[43].

This study had limitations due to the application of secondary data, considering that the data obtained were based on records of cases notified to Notifiable Diseases Information System, thus, there is a high probability of underreporting, duplication of data, and failures in filling out the information. Despite this limitation, the information obtained is essential to support possible actions regarding TB-HIV coinfection in the state, which may prioritize municipalities with high rates for the implementation of actions to control the coinfection.

CONCLUSION

The spatial analysis made it possible to identify focal municipalities with TB-HIV coinfection cases in the state of Rio Grande do Norte. The distribution of the disease is dissimilar in the state, with the presence of clusters with positive autocorrelation in more urbanized cities in the state of Rio Grande do Norte. It was observed that males, adults aged 20-39 years old, those with an incomplete primary education, and urban residency were the most frequent characteristics according to the epidemiological profile of the population.

These findings provide subsidies for the implementation of actions to combat the disease, based on the specificities of the epidemiological profile of the population and places with the highest concentration of cases.

The study pointed out a large number of ignored or blank data in fundamental variables for a good characterization, such as the use of antiretroviral drugs for HIV suppression and the institutionalization status in which the individual is found. This demonstrates a gap in what should be mandatory at the time of case notification and could delay the development of interventions for each person.

It is advised that the health professionals who serve the population affected with these infections be trained and develop empathy through the presentation of epidemiological data, with prevention procedures such as referral for ART, if necessary, and anti-HIV testing in individuals with TB, aiming at a service that helps to alleviate the growing number of cases.

REFERENCES

1. Ministério da Saúde (BR). Manual de recomendações para o controle da tuberculose [base de dados online]. Brasília: Ministério da Saúde; 2019 [acesso 2019 fev 20]. Disponível em: https://www.telelab.aids.gov.br/index.php/bibliotecatelelab/item/download/172_d411f15deeb01f23d9a556619ae965c9.
2. Joint United Nations Programme on HIV/AIDS. Global AIDS update 2016 [base de dados online]. Geneva: Joint United Nations Programme on HIV/AIDS; 2016 [acesso 2019 fev 20]. Disponível em: https://www.unaids.org/sites/default/files/media_asset/global-AIDS-update-2016_en.pdf.
3. Barbosa IR, Costa ÍCC. Estudo epidemiológico da coinfecção Tuberculose-HIV no Nordeste do Brasil. Rev Patol Trop. 2014;43(1):27-38. doi: 10.5216/rpt.v43i1.29369.
4. World Health Organization. Global Tuberculosis Report 2018 [base de dados online]. Geneva: World Health Organization; 2018 [acesso 2019 fev 20]. Disponível em: https://apps.who.int/iris/handle/10665/274453.
5. Programa Conjunto das Nações Unidas sobre HIV/AIDS. Estatísticas Globais Sobre HIV 2017. Brasília: Programa Conjunto das Nações Unidas sobre HIV/AIDS Brasil; 2018 [acesso 2019 fev 20]. Disponível em: https://unaids.org.br/wp-content/uploads/2018/11/Fact-sheet-UNAIDS-novembro-2018-1.pdf.
6. Brasil. Brasil Livre da tuberculose. Brasília: Ministério da Saúde; 2017 [acesso 2019 fev 20]. Disponível em: http://bvsms.saude.gov.br/bvs/publicacoes/brasil_livre_tuberculose_plano_nacional.pdf.
7. Rodrigues-Jr AL, Ruffino-Netto A, Castilho EA. Distribuição espacial da co-infecção M. tuberculosis/HIV no Estado de São Paulo, 1991-2001. Rev Saude Publica. 2006;40(2):265-70. doi: 10.1590/S0034-89102006000200012.
8. Manfré LA, Lourenço RW, Donalísio MR. Distribuição espacial da tuberculose no município de Sorocaba, São Paulo, Brasil, 2000-2007. Rev Caminhos Geografia [Internet]. 2010 [acesso 2020 abr 26]; 11(35):29-43. Disponível em: http://www.seer.ufu.br/index.php/caminhosdegeografia/article/view/16147/9088.
9. Sousa AIA, Pinto VL. Análise espacial e temporal dos casos de aids no Brasil em 1996-2011: áreas de risco aumentado ao longo do tempo. Epidemiol Serv Saúde. 2016;25(3):467–76. doi: 10.5123/S1679-49742016000300003.
10. Bastos SH, Taminato M, Fernandes H, Figueiredo TMRM, Nichiata LYI, Hino P, et al. Perfil Sociodemográfico e de saúde da coinfecção tuberculose/HIV no Brasil: revisão sistemática. Rev Bras Enferm. 2019;72(5):1389–96. doi: 10.1590/0034-7167-2018-0285.
11. Ministério da Saúde. Panorama epidemiológico da coinfecção TB-HIV no Brasil 2019. Brasília: Ministério da Saúde; 2019 [acesso 2019 fev 20]. Disponível em: https://portalarquivos2.saude.gov.br/images/pdf/2019/outubro/01/Boletim-tuberculose-2019.pdf.
12. Instituto Brasileiro de Geografia e Estatística. Brasil em Números [base de dados online]. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; 2018 [acesso 2019 fev 20]. Disponível em: https://biblioteca.ibge.gov.br/visualizacao/periodicos/2/bn_2018_v26.pdf.
13. Ministério da Saúde. Departamento de Informática do Sistema Único de Saúde do Brasil. Sistema de Informação de Agravos de Notificação. Brasília: Ministério da Saúde; 2018 [acesso 2019 fev 20]. Disponível em: http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sinannet/cnv/tubercrn.def.
14. Instituto Brasileiro de Geografia e Estatística. Estimativas da População Brasileira [base de dados online]. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; 2020 [acesso 2019 fev 20]. Disponível em: https://www.ibge.gov.br/estatisticas/sociais/populacao/9103-estimativas-de-populacao.html?=&t=downloads.
15. Marconato R, Larocca APC, Quintanilha JA. Análise do uso de tecnologias em estabelecimentos agropecuários por meio dos índices de Moran global e local. Rev Política Agrícola [Internet]. 2012 [acesso 2020 abr 26]; 20(1):5–21. Disponível em: https://www.alice.cnptia.embrapa.br/bitstream/doc/930788/1/Analisedousodetecnologias.pdf.
16. Instituto Brasileiro de Geografia e Estatística. Base Cartográfica do Estado do RN. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística. 2015 [acesso 2020 mar 25]. Disponível em: ftp://geoftp.ibge.gov.br/organizacao_do_territorio/malhas_territoriais/malhas_municipais/municipio_2015/UFs/RN/.
17. Castrighini CC, Reis RK, Neves LAS, Galvão MTG, Gir E, et al. Prevalência e aspectos epidemiológicos da coinfecção HIV/tuberculose. Rev enferm UERJ. 2017; 25:e17432. doi: 10.12957/reuerj.2017.17432.
18. Gaspar RS, Nunes N, Nunes M, Rodrigues VP. Análise temporal dos casos notificados de tuberculose e de coinfecção tuberculose HIV na população brasileira no período entre 2002 e 2012. J Bras Pneumol. 2016;42(6):416–22. doi: 10.1590/S1806-37562016000000054.
19. Coelho A, Biberg C. Perfil epidemiológico da coinfecção Tuberculose/HIV no município de São Luís, Maranhão, Brasil. Cadernos ESP [Internet]. 2015 [acesso 2020 abr 26]; 9(1):19–26. Disponível em: https://cadernos.esp.ce.gov.br/index.php/cadernos/article/view/88/93.
20. Bosqui LR, Silva SS, Sanfelice RA, Miranda-Sapla MM, Alvarenga DS, Lucas BB, et al. Perfil clínico de pacientes com diagnóstico de tuberculose atendidos no Hospital Universitário de Londrina, Paraná. Semina Cienc Biol Saude. 2017;38(1):89-98. doi: 10.5433/1679-0367.2017v38n1p89
21. Serra LDC, Ross JDR. Estudo clínico-epidemiológico da coinfecção tuberculose-HIV em uma cidade no interior maranhense. J Manag Prim Heal Care 2013;3(2):122–5. doi: 10.14295/jmphc.v3i2.149.
22. Instituto Brasileiro de Geografia e Estatística. Estimativa da população Brasileira. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; 2010 [acesso 2020 abr 26]. Disponível em: https://ibge.gov.br/estatisticas/sociais/populacao/9103-estimativas-de-populacao.html?edicao=17283&t=downloads.
23. Silva RAR, Costa RHS, Braz LCSB, Lucena IA, Ferreira KS, Duarte FHS, et al. Pessoas vivendo com aids: associação entre diagnósticos de enfermagem e características sociodemográficas/clínicas. Rev Bras Enferm. 2018;71(5):2535–42. doi: 10.1590/0034-7167-2017-0420.
24. Menezes EG, Santos SRF, Melo GZS, Torrente G, Pinto AS, Goiabeira YNLA, et al. Fatores associados à não adesão dos antirretrovirais

em portadores de HIV/AIDS. Acta Paul Enferm. 2018;31(3):299–304. doi: 10.1590/0102-311X00106914.
25. Santos Neto M, Silva FL, Sousa KR, Yamamura M, Popolin MP, Arcêncio RA, et al. Perfil clínico e epidemiológico e prevalência da coinfecção tuberculose/HIV em uma regional de saúde no Maranhão. J Bras Pneumol. 2012; 38(6):724–32. doi: 10.1590/S1806-37132012000600007.
26. Nogueira PA, Abrahão RMCM, Galesi VMN. Infecção tuberculosa latente em profissionais contatos e não contatos de detentos de duas penitenciárias do estado de São Paulo, Brasil, 2008. Rev Bras Epidemiol. 2011;14(3):486–94. doi: 10.1590/S1415-790X2011000300013.
27. Belo EN, Orellana JDY, Levino A, Basta PC. Tuberculose nos municípios amazonenses da fronteira Brasil-Colômbia-Peru-Venezuela: situação epidemiológica e fatores associados ao abandono. Rev Panam Salud Publica [Internet]. 2013 [acesso 2020 abr 26]; 34(5):321–9. Disponível em: https://scielosp.org/pdf/rpsp/2013.v34n5/321-329/pt.
28. Oliveira LB, Costa CRB, Queiroz AAFLN, Araújo TME, Sousa KAA, Reis RK. Análise epidemiológica da coinfecção tuberculose/HIV. Cogitare Enferm. 2018;23(1):e51016. doi: 10.5380/ce.v23i1.51016.
29. Barbosa EL, Levino A. Análise da coinfecção TB/HIV como fator de desenvolvimento da tuberculose multidroga resistente: uma revisão sistemática. Rev Pan-Amazônica Saúde [revista em Internet] 2013;4(4):57–66. doi: 10.5123/S2176-62232013000400007.
30. Pereira LFB, Soares DL, Silva TC, Sousa FVEC, Caldas ADJM. Fatores associados à coinfecção tuberculose/HIV no período 2001-2011. J Res Fundam Care Online. 2018;10(4): 1026-31. doi: 10.9789/ 2175-5361.2018.v10i4.1026-1031.
31. Malhão TA, Oliveira GP, Codennoti S, Moherdaui F. Avaliação da completitude do Sistema de Informação de Agravos de Notificação da Tuberculose, Brasil, 2001-2006. Epidemiol Serv Saúde. 2010;19(3):245-56. doi: 10.5123/S1679-49742010000300007.
32. Rocha MS, Bartholomay P, Cavalcante MV, Medeiros FC, Codenotti SB, Pelissari DM, et al. Sistema de Informação de Agravos de Notificação (Sinan): principais características da notificação e da análise de dados relacionada à tuberculose. Epidemiol Serv Saúde. 2020; 29(1):e2019017. doi: 10.5123/S1679-49742020000100009.
33. Tshitenge S, Ogunbanjo GA, Citeya A. A mortality review of tuberculosis and HIV co-infected patients in Mahalapye, Botswana: Does cotrimoxazole preventive therapy and/or antiretroviral therapy protect against death? African J Prim Health Care Fam Med. 2018;10(1):e1-e5. doi: 10.4102/phcfm.v10i1.1765.
34. Moreira TR, Gonçalves ESM, Colodette RM, Fernandes MS, Prado MRMC, Oliveira DM, et al. Fatores associados a HIV/AIDS em pacientes com tuberculose em minas gerais entre os anos de 2006 e 2015. REME – Rev Min Enferm. 2019;23:e-1211. doi: 10.5935/1415-2762.20190059.
35. Brunello MEF, Chiaravalloti NF, Arcêncio RA, Andrade RLDP, Magnabosco GT, Villa TCS, et al. Áreas de vulnerabilidade para co-infecção HIV-aids/TB em Ribeirão Preto, SP. Rev Saude Publica. 2011;45(3):556–63. doi: 0.1590/S0034-89102011005000018.
36. Magnabosco GT, Andrade RLP, Arakawa T, Monroe AA, Villa TCS. Desfecho dos casos de tuberculose em pessoas com HIV: subsídios para intervenção. Acta Paul Enferm. 2019;32 (5); 554-563. doi: 10.1590/1982-0194201900077.
37. Jamal LF, Moherdaui F. Tuberculose e infecção pelo HIV no Brasil: magnitude do problema e estratégias para o controle. Rev Saúde Pública. 2007;41(Supp.1):104-10. doi: 10.1590/S0034-89102007000800014.
38. Oren E, Narita M, Nolan C, Mayer J. Neighborhood socioeconomic position and tuberculosis transmission: a retrospective cohort study. BMC Infect Dis. 2014;14:227. doi: 10.1186/1471-2334-14-227.
39. Queiroga RPF, Sá LD, Nogueira JA, Lima ERV, Silva ACO, Pinheiro PGOD, et al. Distribuição espacial da tuberculose e a relação com condições de vida na área urbana do município de Campina Grande - 2004 a 2007. Rev Bras Epidemiol. 2012;15(1):222–32. doi: 10.1590/S1415-790X2012000100020.
40. Hargreaves JR, Boccia D, Evans CA, Adato M, Petticrew M, Porter JDH. The Social Determinants of Tuberculosis: From Evidence to Action. Am J Public Health 2011; 101(4):654–62. doi: 10.2105/AJPH.2010.199505.
41. Roza DL, Caccia-Bava MCGG, Martinez EZ. Spatio-temporal patterns of tuberculosis incidence in Ribeirão Preto, State of São Paulo, southeast Brazil, and their relationship with social vulnerability: a Bayesian analysis. Rev Soc Bras Med Trop. 2012;45(5):607–15. doi: 10.1590/S0037-86822012000500013.
42. Baldan SS, Ferraudo AS, Andrade M. Características clínico-epidemiológicas da coinfecção por tuberculose e HIV e sua relação com o Índice de Desenvolvimento Humano no estado do Mato Grosso do Sul, Brasil. Rev. Pan-Amazônica Saúde.2017;8(3):59–67. doi: 10.5123/s2176-62232017000300007.
43. Lima SS, Vallinoto ACR, Machado LFA, Ishak MOG, Ishak R. Análise espacial da tuberculose em Belém, estado do Pará, Brasil. Rev Pan-Amazônica Saúde. 2017;8(2):55–63. doi: 10.5123/s2176-62232017000200007.

Received in april 2021.
Accepted in october 2021.