Priority areas for the control of tuberculosis treatment abandonment in Recife, Brazil

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Abstract

Tuberculosis is among the world's high morbidity and mortality infectious diseases. The discontinuity of treatment is a challenge to be faced in order to reduce cases of drug resistance and mortality. The objective of this study was to identify priority areas for the control of cases of tuberculosis (TB) treatment abandonment in the city of Recife. This was an ecological study, carried out with new cases of TB diagnosed in Recife and registered in the Information System for Notifiable Diseases between 2012 and 2014. The outcome variable was the average proportion of the abandonment of TB treatment by census sector. To compose this variable, all addresses of new cases of tuberculosis and those of treatment abandonment in the investigated three-year period were geocoded. Moran's Global Index was used to assess spatial autocorrelation. 641 abandonment cases were recorded and geocoded. The value of the Global Moran Index was 0.0313816 (p=0.03) and, through the Moran Map, 153 sectors with spatial statistical significance were identified, of these 43 were high priority for health interventions distributed in 21 neighborhoods. Priority areas were identified for monitoring adherence to tuberculosis treatment. Due to the lower level of available territorial sectors, similar populations, and socioeconomic dynamics among residents, the use of the census sectors allows health interventions to be carried out to improve the quality of care for patients and to reduce the unfavorable outcomes while considering public resources.

Keywords: Tuberculosis. Patient's refusal of treatment. Spatial analysis. Health education. Primary health care.

INTRODUCTION

Tuberculosis is among the greatest public health problems in the world, requiring multiple facets in the elaboration of strategies to control the disease. The conditions of vulnerability among populations within the context of poverty for contracting TB are widely recognized. To demonstrate the magnitude of the problem, in 2019, 10 million people worldwide developed tuberculosis[1].

In the year 2020, Brazil was in 19th position among the 30 priority countries for the control of tuberculosis referring to the data of 2019[1]. In addition, it demonstrated an incidence coefficient of 35 cases/100

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thousand inhabitants. The data available for the abandonment ratio are from 2018 with 11.6%[2]. The city of Recife stands out in third place among the Brazilian capitals for the incidence coefficient of 80.6 cases/100 thousand inhabitants and the proportion of treatment abandonment at 12.7%[2].

Thus, the increase in adherence to tuberculosis treatment represents a major challenge to control the disease, since discontinuity has an unfavorable effect among populations, which reflects upon the growth of the mortality rates and resistance of the microorganisms to the therapeutic drugs[1,3].

Generally, the most common aspects related to patients are associated with economic factors and other conditions related to health status, side effects of medications, use of legal or illegal drugs, and lack of motivation[4]. Institutional deficiencies in health services also contribute to treatment failure, as they directly interfere with inadequate guidance given to patients and family members[5,6]. The organization of the health service and the best quality of care are identified as the most relevant factors for reducing treatment discontinuity[3].

In view of the above, there are some interfaces in the practice of tuberculosis control, in which the probability of treatment failure has been significantly reduced, if patients and their families receive adequate information about TB, and if there is an identification and empathy with the team that treats tuberculosis[7]. Providing the patient with information on the importance of maintaining the therapeutic procedures required by the infection becomes essential for understanding the severity of the disease and the continuity of its treatment[8].

In this sense, health education is still one of the most important strategies in the fight against tuberculosis. Efforts should be directed to patients to make them more informed and aware of all aspects of tuberculosis, about treatment and the basic rules to prevent the spread of the infection to other people in the community[9]; this being a fundamental role in the actions of health professionals.

In view of the high number of cases of abandonment of tuberculosis treatment, in Recife, it is urgent to know the pattern of spatial distribution of these individuals for the implementation of strategies directed to the areas of highest priority, whether for the professionals who make up the health services or to those of the population, helping to interrupt the epidemiological chain in the places of greatest risk. In view of the above, the objective of this study was to identify priority areas for the control of cases of abandonment of tuberculosis treatment.

METHODOLOGY

This is an ecological study, carried out in the city of Recife, capital of the State of Pernambuco, Northeast Brazil, with a population of 1,633,697 inhabitants (2017) spread over 218.4 km[2], with a heterogeneous occupational density pattern and with distinct geographical spaces between the neighborhoods. The 94 neighborhoods are located in eight health districts and 1848 census setors[10].

Using secondary data, the collection form was the notification of cases of tuberculosis

registered in the Information System for Notifiable Diseases (SINAN). The database was provided by the Executive Health Surveillance Secretariat of Recife.

The study population consisted of new TB cases of all clinical forms registered with SINAN that abandoned the treatment of the disease. Exclusion criteria were adopted for all other forms of entry: transfer, relapse, and post-abandonment reentry. The outcome variable was the average number of cases of abandonment of tuberculosis treatment, residing in the city of Recife, in the three-year period from 2012 to 2014 by census sector. This indicator reflects the percentage of the proportion of new cases of tuberculosis (all forms) terminated due to abandonment, in relation to the total of new cases of tuberculosis diagnosed, in a given place and period[11]. The following is the calculation method for the proportion of TB treatment abandonment: Number of tuberculosis cases closed due to treatment abandonment of all clinical forms within the three-year period divided by the number of tuberculosis cases reported by date of diagnosis, times 100. The thematic map of the dropout proportion was classified in the Quantil function of four classes, where the color gradient goes from the lightest to the darkest in an increasing way according to the percentage value.

The three-year average was chosen to reduce the bias in the analysis of the census sector, as it represents the smallest available area of analysis, where the events are rarer, which could cause random fluctuation of the indicators. To compose this variable, all addresses of cases of tuberculosis incidence and treatment abandonment in the three-year period investigated by the QGIS 2.14.0 program were geocoded.

To check for the existence of spatial autocorrelation of cases, the Global Moran Index[12] was calculated, and to analyze the pattern of spatial distribution of the agglomerates of abandonments by census sector, the local Moran Index was used considering a statistical significance of α ≤0.05. The calculation of the Moran Index directs the formation of clusters with similar risks for the event under study, with results between -1 and +1. The outcome is null between the analyzed areas when the result is zero. When the result is positive the regions are similar, and negative values conclude that there are no similarities. The occurrence of clusters and determination of their significance patterns were demonstrated by the Moran Map. In this map, the LISA function, representing the local autocorrelation, was applied to better understand the degree of similarity between neighboring sectors[13]. The Moran Map was built in four classifications: in the first quadrant (Q1 +/+) there were high priority sectors with high rates and positive neighbors (red); second quadrant (Q2 -/-) low priority sectors with low rates and neighbors with negative values (green color); third quadrant (Q3 +/-) sectors with high rates and neighbors with negative values (yellow color); fourth quadrant (Q4 -/+) sectors with low rates and neighbors with positive (blue) values, the latter two were intermediate sectors.

The priority areas map was considered by the Moran Map in which the census sectors displayed statistically significant (p ≤0.05) high values with positive neighbors. Cluster areas where more than one sector was adjacent with neighbors were ordered as a single area, as they have common borders. Each received a number for coding their health district, neighborhood, and description of the number of census sectors.

The spreadsheet and the database were organized using the Microsoft Excel program with double typing. For the Global and local Moran Index, Terraview 4.2.2 software (National Research Institute - INPE, São Paulo, Brazil) was used, and QGIS 2.14.0 was used for address geocoding and map elaboration.

The cartographic base of street addresses and the digital meshes used can be found on the Recife City Hall website (http://www.recife.pe.gov.br/ESIG/documentos/Informacao/InformacaoManualArquivos.htm) with the coordinate reference system Sirgas 2000/UTM, zone 25S.

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RESULTS

4,722 new TB cases were registered in the city of Recife between 2012 and 2014. Of these, 33 cases were excluded due to the lack of addresses and 4048 because they had an outcome of cure, transfer, death and failure. Thus, 641 cases with an "abandonment" outcome were eligible for the study.

It was found that the proportion of abandonment during the three-year period analyzed by census sector was 33%, heterogeneous, with a variation of 0, being a null case. Among the sectors that showed the highest number of cases of abandonment of tuberculosis treatment, the fourth quartile with values between 17% and 33% were identified (Figure 1). In the analysis of this dependent variable, the Global Moran Index was 0.0313816 (p=0.03). Which shows a spatial correlation between neighbors (census sectors).

There was a total of 153 spatially autocorrelated sectors represented by the Moran Map (Figure 2). Of these, 43 sectors were in Q1; 09 were classified in Q2; 23 sectors in Q3; followed by 78 sectors in Q4. The 43 census sectors that make up the Q1 areas are located in all eight Health Districts (HD) and in 21 neighborhoods in the city of Recife, PE (Chart 1, Figure 3).

Table 1 - Priority areas due to proximity within the Moran Map, Recife, PE, Brazil. 2012-2014.

Health District	Priority Areas according to proximity*, classification	Neighborhood	Number of sectors
I	12 and 14	São José	03
I	13	Ilha Joana Bezerra	03
I	11	Ilha do Leite	01
II	05	Campo Grande	02
II	04	Bomba do Hemetério	01
II	03 and 04	Água Fria	02
II	01	Dois Unidos	01
II	03	Beberibe	02
II	05	Hipódromo	01
III	06	Espinheiro	01
IV	08	Cordeiro	03
IV	08	Zumbi	03
IV	09	Torrões	02
V	15	Afogados	03
V	17	Caçote	02
V	19	Coqueiral	01
V	10	Mustardinha	01
VI	16	Imbiribeira	03
VII	02	Nova Descoberta	01
VIII	18	Cohab	01

Source: Data bank Sinan - Recife. 2012-2014.
*Census sectors with neighbors with the same priority profile (high proportion of treatment abandonment with neighbors who have positive rates).
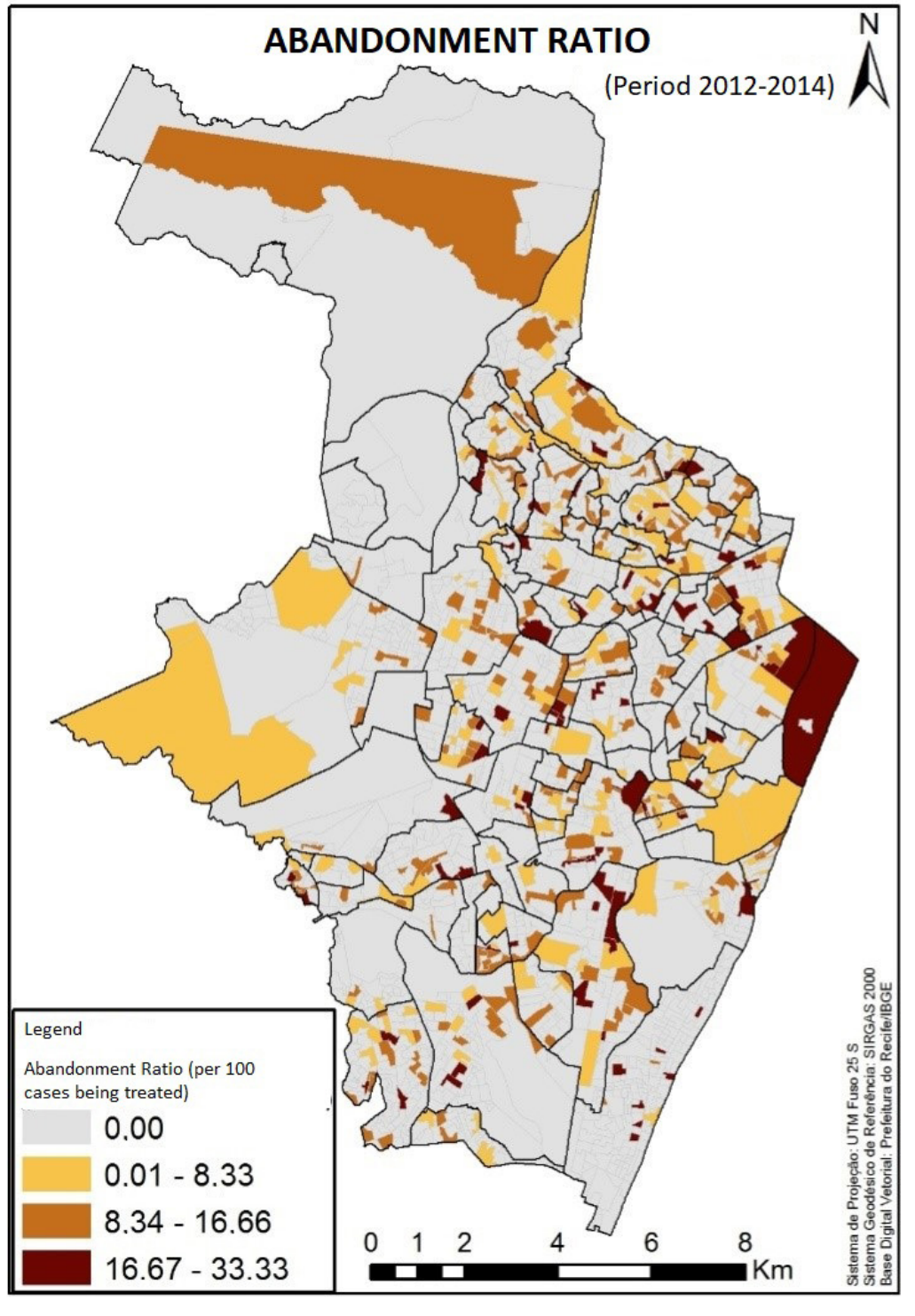
Figure 1- Spatial distribution of the proportion of patients abandoning Tuberculosis treatment from 2012 to 2014. Recife, PE. Brazil.
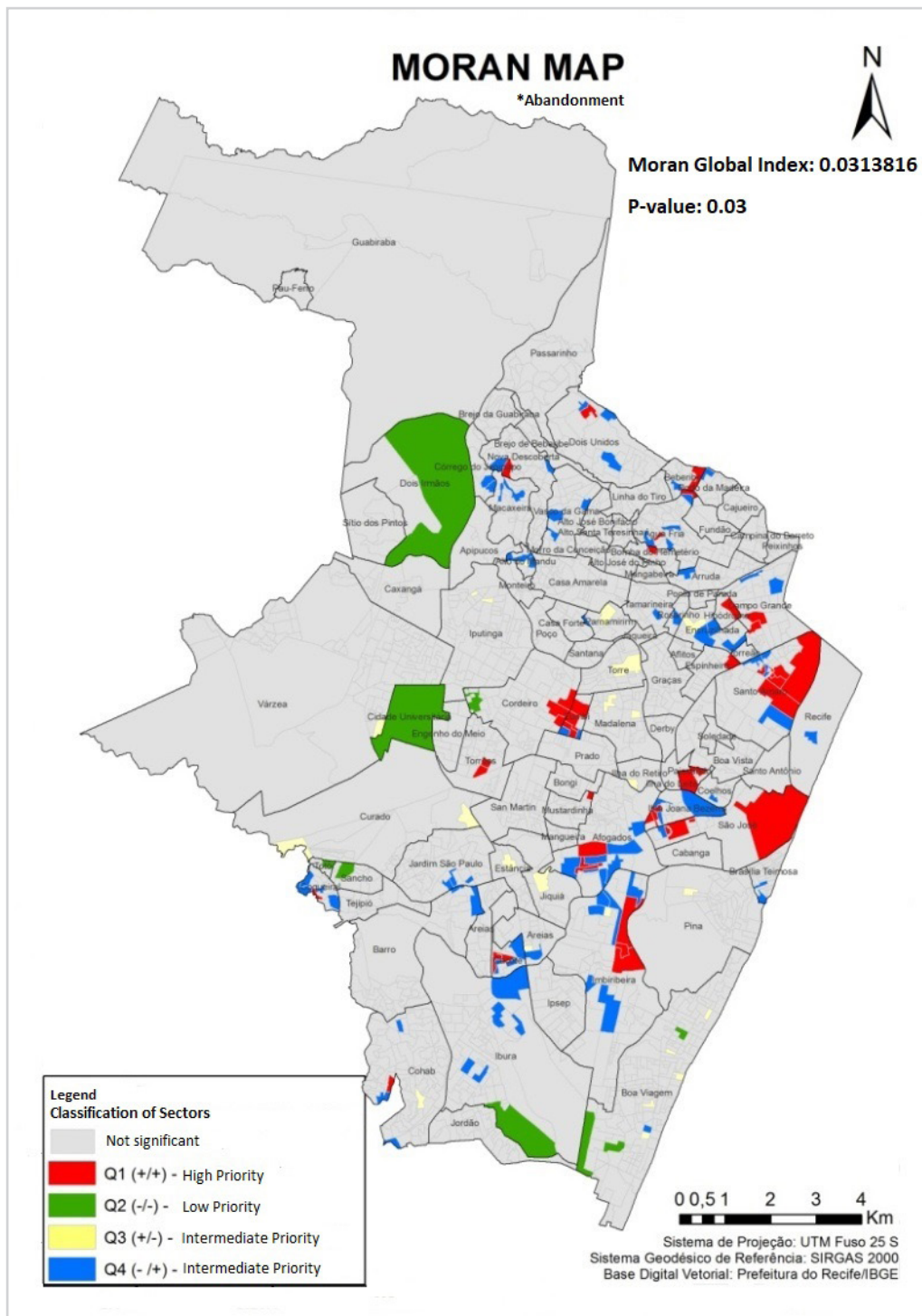
Figure 2- Moran Map indicating the spatial clusters of the abandonment of Tuberculosis treatment in the statistically significant census sectors in Recife, PE, 2012-2014.
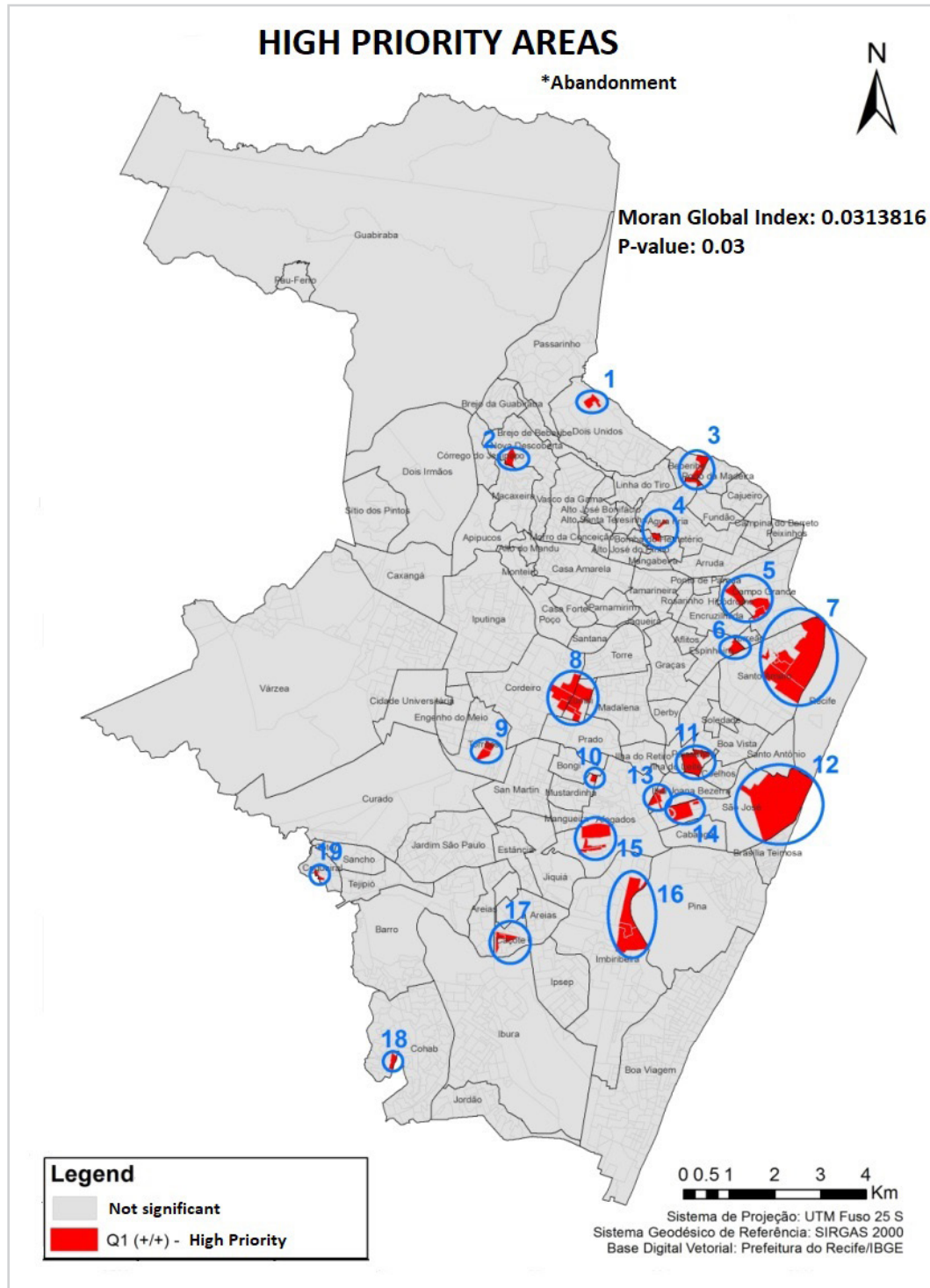
Figure 3- Spatial clusters (Moran Map) of abandoning Tuberculosis treatment in high priority census sectors in Recife, PE, Brazil. 2012-2014.

DISCUSSION

The consequence of the heterogeneity of the neighborhoods' territorial dynamics, propagate the physical condition and also include the historical and social contexts. The census sectors are the smallest unit of measurement officially available for analysis, which approximates the reality of similar population clusters. They create an image of the collective risk of stratified abandonment in the urban space. One of the findings of the study was the formation of clusters in different sectors in the neighborhoods, but there is a similarity in the unfavorable social and economic aspect of these clusters.

Some geographic aspects pertinent to the territory are areas characterized by the presence of hills with high population density in the neighborhoods: Dois Unidos, Nova Descoberta, Água Fria, Beberibe, Bomba do Hemetério, and Cohab. Another aspect observed is the areas close to streams or mangroves such as Ilha do Leite, São José, Joana Bezerra Island, Coqueiral, and Santo Amaro. In the other areas, a flat topography of high population density is observed such as Afogados, Caçote, Cordeiro, Zumbi, Campo grande, Hipódromo, and Espinheiro.

Referring to territorial dynamics, some neighborhoods are concentrated in planned areas, organized in urban space, and others were formed without planning, referring to irregular settlements classified as subnormal agglomerations (slums) by IBGE[14]. When analyzing census sectors with a high proportion of cases of treatment abandonment, it was observed that among the 19 areas classified by proximity of the sectors (Figure 3), 12 areas are located in these regions of subnormal agglomerates: São José, Joana Bezerra Island, Bomba do Hemetério, Água Fria, Beberibe, Espinheiro, Torrões, Caçote, Mustardinha, Nova Descoberta, Cohab, one of the census sectors in the neighborhood of Imbiribeira, and Santo Amaro.

Some regions presented sectors with the same geographical and urban characteristics, mainly between the border sectors of different neighborhoods such as: Água Fria and Beberibe, Água Fria and Bomba do Hemetério, Campo Grande and Hipódromo, Cordeiro and Zumbi. These areas concentrate characteristics of disordered urbanization due to the agglomeration process, probably due to the inequality of the distribution of government interventions.

In these areas, there are physical and human instruments of health in the sectors themselves, or close to them, mainly in the Primary Care service[10]. The existence of physical instruments does not guarantee the absence of the problem of abandonment, but it reflects the difficulties of adherence to treatment and the need for interventions to help professionals recognize and face the challenges of tuberculosis control, whether directed to the health region or between sectors.

The study allowed the identification of spatial clusters of treatment abandonment cases, recognizing that this pattern did not reach all population groups with the same intensity. There are probably other multi-causal factors in the health-disease process that must have been suppressed, such as strategies for controlling tuberculosis (at the institutional level), which had a good outcome in some areas. However, it was no accident that Brazil reached the "millennium goal[2]" in reducing the cases of disease incidence and

mortality, while the abandonment outcome still needing to be reduced.

The usefulness of census sectors for the generation of maps, brought a visual graphic representation of spatial patterns to improve the understanding of the event and rational decision-making in the public sector. Actions planned equally in directing human, material, and technological resources to the priority areas, can the use of public resources with greater efficiency[15].

It should be noted that, in studies using secondary notification data, in general, there are limitations and problems related to coverage, underreporting, and the quality of the records. In the first two, there was no way to verify by the method used since this research was a study with secondary data. Regarding the quality of the database assigned for this study there was a quality above expectations. However, there was a loss of 33 cases due to the lack of addresses for geocoding representing 0.70% of the total cases. Yet, as compared with some studies using a similar methodology[16-17], the data recorded according to the municipality were significantly better. For new studies, it is advisable to associate multiple indicators that can provide an explanation at a collective level, since there are several processes that can be related to the multi-causality of this disease.

In a study carried out in São Carlos, SP, Brazil, there were associations with socioeconomic levels of residents of the census sectors, with areas of social vulnerability, and with greater demographic density[18]. At the individual level in the state of Maranhão, there was also a low level of education among the factors associated with treatment abandonment[19]. According to the socioeconomic paradigm, in an ecological study carried out in the municipality of Itaboraí, RJ, Brazil, areas of vulnerability to illness due to tuberculosis and the limitations of health services to deal with social issues were demonstrated[20], a finding that affirms the importance of more vigorous public policies to reduce social inequality.

To reach the international goals of the End TB Strategy by the year 2035, thus extinguishing the tuberculosis endemic by reaching the value of 10 cases for every 100,000 inhabitants[15], there must be an expansion of the controlling protagonists: the professionals of the Strategy Family Health. When institutionally trained for clinical treatment, evaluation of contacts, implementation of directly observed treatment, and carrying out an active search for symptomatic respiratory cases, an adequate number of people can assigned per area while considering the vulnerability of the inhabitants of the territory, their physical structure, and resources to make diagnostic tests accessible to symptomatic and contact persons, then the incidence and proportion of cases of abandonment will be reduced.

When physical and human health instruments are present in these areas, the tendency is to minimize the social inequities present with a reduction in the collective health risk. The health education process is necessary for individuals and their social network to perceive themselves as vulnerable, thus, they will practice self-care and interrupt the transmission chain (mainly of bacilliferous cases) by reducing prejudice and the discrimination of the disease. In the meantime, it is necessary to add studies to this prerogative that corroborate this process, beginning with the reception of people as a strategy to face this disease[21]. For the benefit of the community in different segments of civil society, there must also be a need to integrate knowledge, power, and

intentions to face this disease. Thus, health education strategies regarding the disease and its treatment alleviate erroneous stigmas and concepts, as well as empowering and making the patients and the community co-responsible, motivating them to a greater adherence and a favorable outcome of a cure.

With the distribution of abandonment cases, it is possible to subsidize the reformation of health policies and services; especially for nurses and other Primary Care professionals who work directly in TB cases, where they work as a team in assisting these patients when implementing strategies that reduce the number of cases mainly in these areas.

The unit of analysis through the census sectors aids any strategy aimed at vulnerable populations that abandon TB treatment, while not generalizing the extensive territorial areas which possess their own dynamics that are inherent to the urbanization process itself.

The study carried out in Ribeirão Preto, SP in 2006 to 2017, which was of a temporal tendency and identified areas with spatial association of abandonment by census tracts, was based on the Moran Global Index. It identified an increase in treatment abandonment and areas in central regions that have a high number of homeless people and areas of subnormal agglomerations, coinciding with areas of high concentrations of poverty and intermediate living conditions of the municipality[9]. This is confirmed in a study in Fortaleza, CE, in 2007 to 2014, on the social and programmatic determinants of tuberculosis incidence and treatment abandonment by neighborhoods, which presented positive areas close to the regions of the city center[22]. However, it is emphasized that these data may reflect the improvement in the records in the notification services and ineffective actions for treatment.

This study supports the principle of equity in the Unified Health System, in distributing more to those who need it most, by identifying priority areas for interventions with urgent needs for tuberculosis control and focusing on the health education process, based not restricting this to the health sector alone. Probably, with an empowered and active social control in social spaces, these interventions can become instruments for people's autonomy, as they are a vehicle that allows citizens to claim rights in relevant administrative bodies. Moreover, the biomedical approach is not enough to control tuberculosis, but also there is the need to improve the living conditions in which they are inserted.

CONCLUSION

The use of spatial analysis tools allowed the identification of priority areas for the treatment of tuberculosis. The census sectors were the smallest unit of measurement for analysis available, so it was possible to target groups with greater vulnerability and identify need for health interventions to control the disease. These areas can help the municipal management authorities to carry out improvement actions to assistant patients and to reduce unfavorable outcomes within context of public resources.

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