Chapter 5

Identification of basic health unit territories and their correlation with leprosy cases through spatial analysis

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ABSTRACT
The objective of this study was to correlate the geographic scope of the Basic Health Units with the spatial distribution of leprosy cases in the hyperendemic municipality of Santarém, the western region of the state of Pará. The methodology used for this study was the mapping of the territorial coverage of the UBS, its scope, that is, the area of action of the Community Health Agents (ACS), and the cases of leprosy from the period 2003 to 2013, for this was used a Geographic Information System (GIS) to visualize the spatial distribution of leprosy cases about the coverage and coverage of the UBS in the municipality. We have resulted in shapefiles developments in coverage and coverage of UBS and the distribution of leprosy cases. Through the use of spatial analysis, the areas discovered by the UBS were identified, as well as the spatial distribution of leprosy cases.

Keywords: Leprosy, Basic Health Unit, Spatial Analysis

1 INTRODUCTION

Leprosy is one of the oldest diseases that affect man, evidence of the disease has already been found in Egyptian mummies dating back to around 200 BC. however, even today there is no consensus on whether its origin would be African or Asian (AMARAL, 2008). The disease must have arrived in Latin America during the colonization period, between the 16th and 17th centuries. Its expansion was favored by the slave trade, mainly during the 18th century and by the arrival of immigrants from the Old World (AMADOR, 2004).

The first cases of the disease in Brazil were registered in 1600, in Rio de Janeiro, where, later, the first Brazilian leper colony would be created. Migration flows resulting from colonization were the main responsible for the spread of leprosy in the country, departing from Rio de Janeiro, Recife, and Bahia, where the main ports of the colony were located – gateways for Europeans and Africans. The endemic initially settled in the provinces of Bahia, Minas Gerais, Pará, Pernambuco, Rio de Janeiro, and São Paulo, places where agriculture was more developed and, consequently, there was a greater concentration of slaves. The first measures to combat the disease were only instituted by the colonial government more than a century later, in 1740, by order of Emperor D. João VI, who ordered the creation of a plan to contain the disease in the country (EIDT, 2004).

The distribution of leprosy in Brazil is not uniform, with the formation of clusters of cases in some specific regions of the country. More than 80,000 cases of leprosy were diagnosed in the last 20 years in Pará and, even today, with an annual detection rate of 50/100,000 inhabitants (three times higher than the national average), the disease remains a serious public health problem in this state. , where it is also hyperendemic among children and adolescents (CARVALHO, 2016).

The disease is considered a serious public health problem in developing countries, where more than 1 billion people still live in areas considered endemic. In addition to being an infection with aggravating factors inherent to diseases of socioeconomic and cultural origin, it is also marked by the psychological repercussions generated by deformities and physical disabilities resulting from the illness process (BRASIL, 2011).

This disease exists on all continents but is under control in developed countries. However, Brazil, with 31,064 new cases detected in 2014, has still not managed to reach the disease control target, established by the World Health Organization (WHO), of <1 case/per 10,000 inhabitants (CARVALHO, 2016).

Leprosy is a chronic granulomatous infectious disease caused by the obligate intracellular organism that mainly affects the skin and peripheral nerves, which can lead to serious physical disabilities and deformities if not diagnosed and properly treated with multidrug therapy (MDT), in its early stages (BARRETO et al 2014, DA COSTA, 2020).

The etiological agent that causes leprosy is the bacillus Mycobacterium leprae, which causes this disease, also known as Hansen's disease. It has the shape of a straight or slightly curved rod, 1.5 to 8 microns long by 0.2 to 0.5 microns wide (TALHARI, 2006).

It mainly affects the skin and peripheral nerves, but it also manifests as a systemic disease involving joints, eyes, testicles, ganglia, and other organs. The high disabling potential of leprosy is directly related to the ability of Mycobacterium leprae to penetrate nerve cells and its immunogenic power (BRASIL, 2008)

In addition to being an infection with aggravating factors inherent to diseases, it has a socioeconomic and cultural origin, which is also marked by the psychological repercussions generated by deformities and physical disabilities, resulting from the illness process. These deformities and physical disabilities are one of the causes of stigma and isolation of the individual in society (BRASIL, 2011).

The disease generates many socioeconomic disorders in several countries of the world, mainly in developing countries, including Brazil, given that in these countries there are many socioeconomic and cultural situations and deficiency of health teams that contribute significantly to the maintenance and proliferation of this disease, as it is an endemic disease that preferentially affects the poorest population, lacking a water supply system, basic sanitation, and housing that provides minimum conditions of quality and hygiene.

To strengthen actions to combat leprosy, the Ministry of Health (MS) has identified the municipalities with the highest number of cases, searching for indicators that effectively map the spread

and advancement of leprosy. This has become a challenge for the Ministry of Health, together with the health departments of the most affected states, such as the state of Pará.

Aiming at the reorganization of primary care in Brazil and aiming at preventing and combating diseases such as leprosy, the Ministry of Health (MOH), following the precepts of the Unified Health System (SUS), created in 1994 the Family Health Strategy (ESF) former Family Health Program, through the implementation of multidisciplinary teams of Community Health Agents (ACS) and Basic Health Units (UBS), which are responsible for monitoring a defined number of families, located in a geographic area determined.

Despite this organizational effort, the FHS territories are still registered through manually prepared maps, limiting the ability to analyze and manage information on the occurrence of health problems and their respective risk factors in different areas of the municipality (CARVALHO, 2016).

The use of spatial analysis tools has been very useful in several branches such as public safety, forestry, and public health, and according to Amaral (2008) until recently the collection of information on the geographic distribution of certain elements was done only in documents and paper maps, which prevented an analysis that combined several maps and data.

For Braga (2001), undoubtedly a field for the application of these new resources is the study of the distribution and epidemiological characterization of the occurrence of diseases, with

the objective of guiding the formulation of new prevention and control strategies.

The spatial distribution of leprosy cases does not occur randomly, occurrences are more concentrated in poorer areas. The use of spatial analysis techniques makes it possible to verify the great similarity of existing characteristics between these risk areas.

The study and analysis of spatial behavior, associated with socioeconomic conditions, become a tool of fundamental importance for the development of strategies to combat this and other diseases.

The application of GIS in health research contributes to the identification of geographic areas and population groups that are at greater risk of becoming ill or dying prematurely and, therefore, need greater attention, whether preventive, curative, or health promotion. This implies the reorganization of health services that respond not only to demands for care but also fundamentally to unmet health needs (HINO et al, 2011)

Because of this, the use of computational tools for digital mapping allows the ESF to have a better view of its coverage. Among these tools, spatial epidemiology describes and analyzes geographic variations in the health and disease status of populations correlated with demographic, environmental, behavioral, socioeconomic, genetic, and infectious risk factors (CARVALHO, 2016).

Spatial analysis techniques are presented as a new way of assessing the context and its risk factors, improving the planning of interventions and selective monitoring according to the real needs of small areas (RODRIGUES, 2008).

Through technological advances in the area of georeferencing, the application of spatial analysis in several areas has become more effective, especially in health, with the purpose of understanding and managing the health problems of the population. These analyzes are carried out through Geographic Information Systems (GIS), which are a set of computational tools used to capture, store, manage and present geographic information, which allows aggregating and analyzing a large volume of information for complex analyzes without presenting great difficulties.

Given this scenario, this paper presents an analysis of the spatial distribution of leprosy cases, diagnosed by SINAN during the period from 2003 to 2013, correlated with the mapping of the coverage of the Basic and Health Units and with the Scope carried out by the Community Health Agents in Santarém, a hyperendemic municipality in the western region of the State of Pará.

2 METHODS

To carry out the study, it was first verified the need to create shapefiles (.shp extension), which contain the geographic data of the object under study, in this case, the information corresponding to the street layout and boundaries of the neighborhoods that make up the area. city of Santarém.

The shape is a file created in a GIS environment with vector format and can present characteristics of points, lines, or polygons, as well as in raster format satellite images. The software used to manipulate this information was QGIS (http://www.qgis.org), as it presents a satisfactory performance for the development of the proposed work, in addition to being an open-source alternative (free open-source software).

In the development of the shp files, geographic information contained in Open Street Maps (OSM - https://www.openstreetmap.org) was used, which is a collaborative platform for creating editable maps, in addition to the use of the official map of the city of Santarém, made available by the city hall, with the purpose of delimitation of streets, neighborhoods, and areas. To confirm the locations, Google Earth was also used (https://www.google.com/earth/).

For the elaboration of the vector files, the SIRGAS 2000 Projection System was used throughout the project, UTM 21s zone corresponding to the region in which the municipality of Santarém is located, while for the mapping of leprosy cases and the UBS, the Garmin GPS was used Oregon 550.

The elaboration of the UBS coverage maps and the ACS coverage was carried out using participatory mapping techniques, a method that consists of obtaining and recording spatial data through a partnership with the social actors, in this case, the members that make up the teams of each mapped Basic Health Unit. For the preparation of this shp, a city map and a box of colored pencils were used for each CHA to identify the streets and blocks corresponding to their area of activity, which resulted in the elaboration of a shape of the coverage of the 23 UBS located in the area urban area of Santarém, also identifying the areas covered and uncovered within the scope of these health posts.

The next step was to carry out the mapping of leprosy cases, which had the support of the ACS for the location of patients notified by the Information System for Notifiable Diseases (SINAN) during the study period from 2003 to 2013. These patients had their coordinates (addresses) recorded using a GPS device, which was later added to a database containing individual information on each case of leprosy notified in the SINAN database.

Of the 756 cases diagnosed with leprosy in the municipality of Santarém, 252 cases belonged to the rural area of the municipality, 504 were located in the urban area, of these 416 were georeferenced and the other 88 cases were not located due to failures in filling out the forms regarding the patient's address. It is important to emphasize that not all cases were recorded using GPS, a small part had their location performed using Google Maps (https://www.google.com/maps) due to difficult access or insecurity.

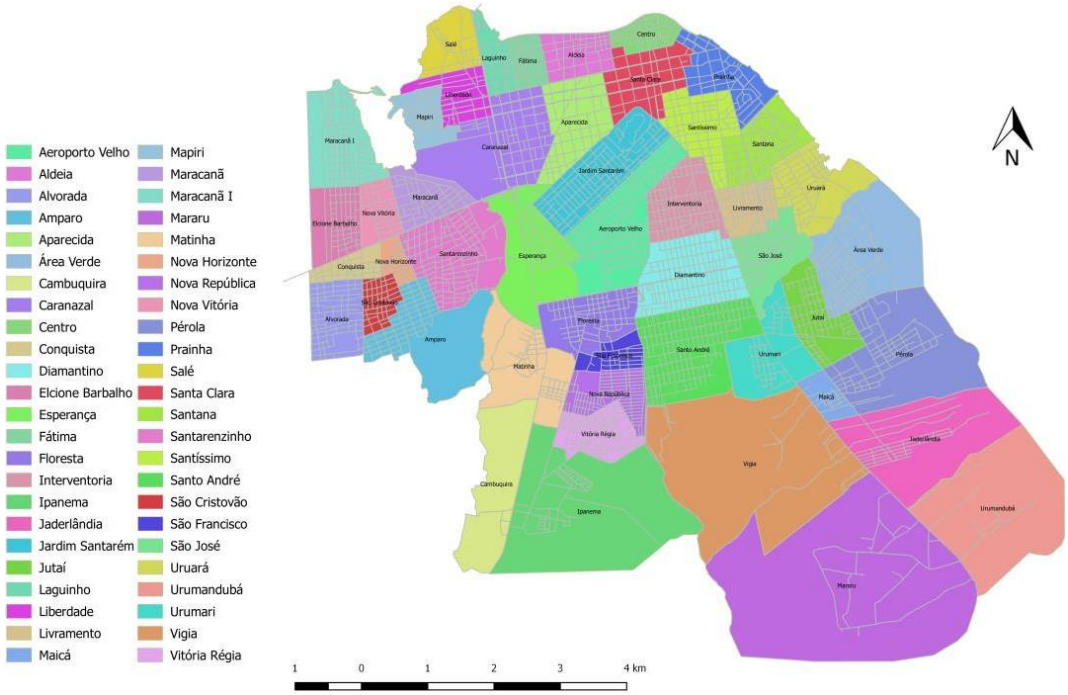
After obtaining the georeferenced information, the basic health units, the leprosy cases, the information from the SINAN database, and data from the census tracts, maps were made and statistical analyzes were carried out on the data obtained.

3 RESULTS

After collecting the initial data, we moved on to the next step, the preparation of digital maps in QGIS, at the end of the process X projects were created corresponding to the street layout and boundaries of the neighborhoods, the coverage area of the UBS, the coverage of the ACS, the patients

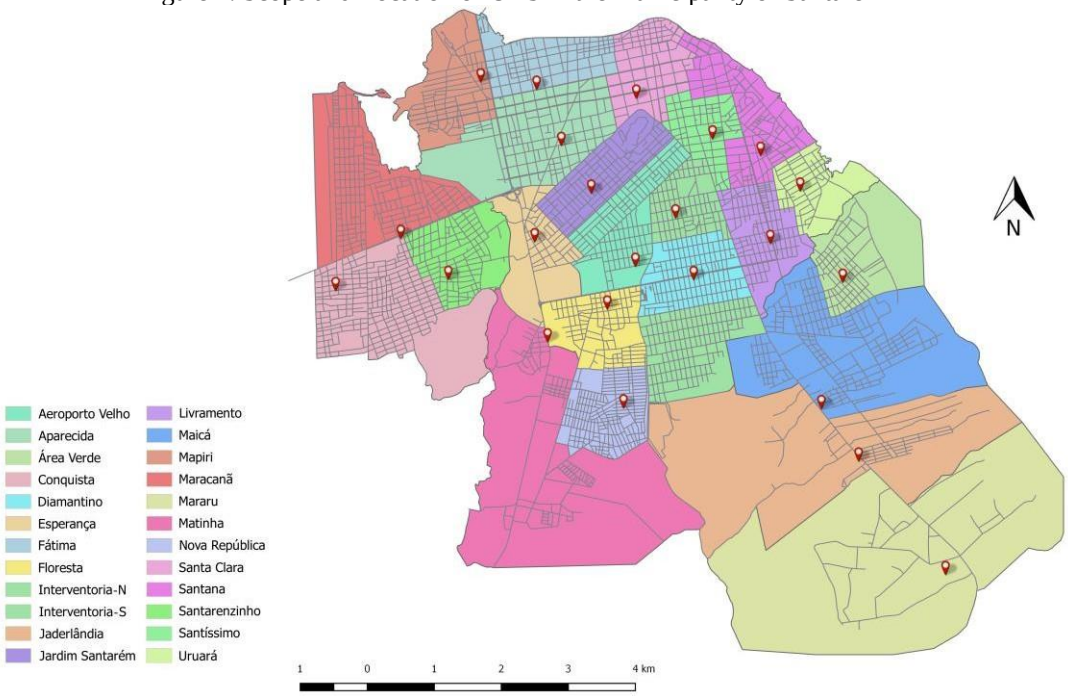
The first map to be elaborated corresponded to the street layout of the municipality of Santarém, as well as the limits of the neighborhoods that make up the city. This map was made by downloading vector files from the Open Street Maps website.

Figure 1. Street layout and neighborhood boundaries in Santarém-PA



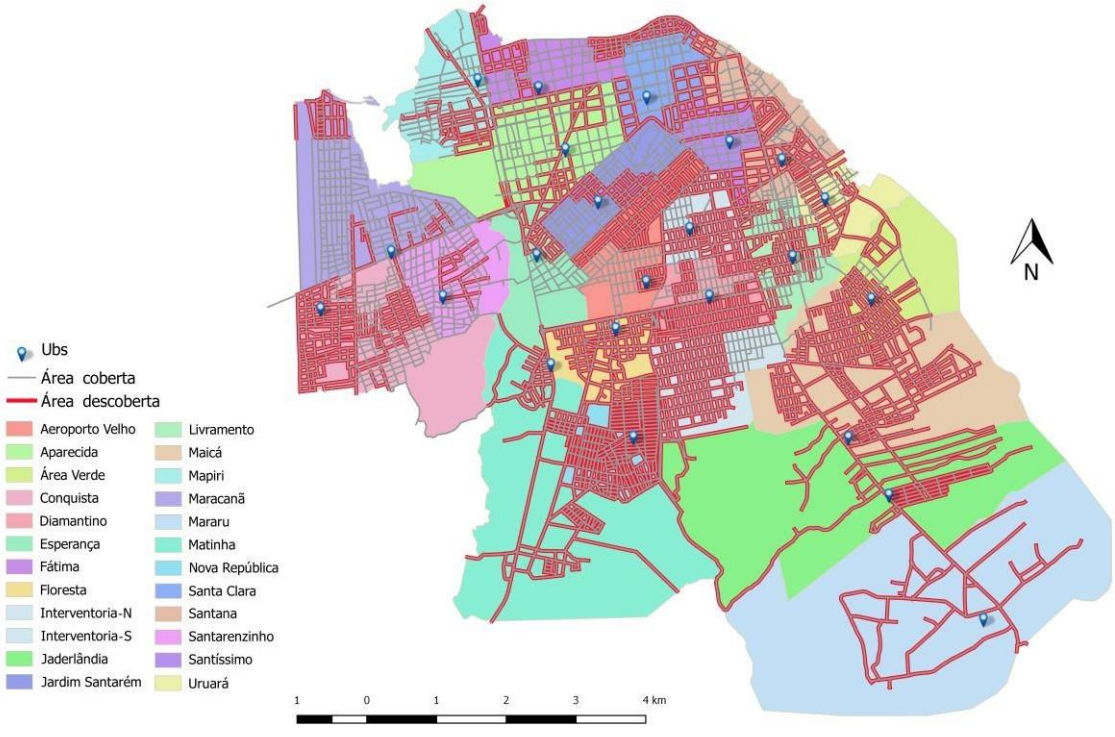
With the information obtained during the visit to the UBS, the next step was to draw up a map with the scope and location of the Basic Health Units.

Figure 2. Scope and Location of UBS in the municipality of Santarém-PA



Using the paper maps that were painted with colored pencils identifying the areas of action of each Community Health Agent, it was possible to draw up a map that the areas covered by the CHAs, thus making it possible to highlight the discovered areas allowing a macro view of these areas.

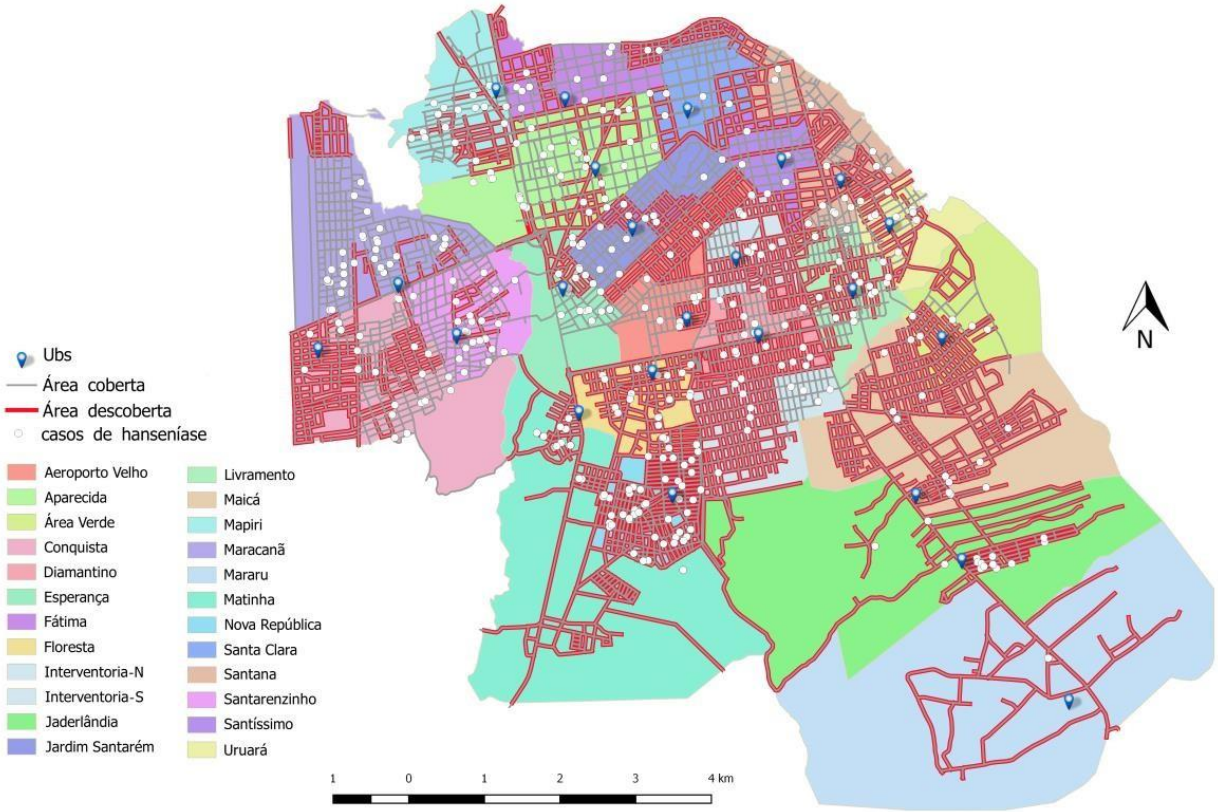
Figure 3. Coverage of Community Health Agents in the Urban Area of Santarém



In the information collection stage, an unusual situation was presented to us, the Basic Health Unit of the Interventoria had its scope extended to the neighborhood of Santo André, the problem is that the area was not continuous, since between the neighborhoods of the Interventoria and Santo André there was the Diamantino neighborhood with its own UBS. In this way, we can see on the map the scope of the UBS of Interventoria divided into North and South, which results in the displacement of people located in Interventoria Sul (neighborhood of Santo André) to the UBS of Interventoria Norte, given that it is responsible for servicing this population.

After locating and mapping the leprosy cases notified by SINAN in the municipality of Santarém, during the period from 2003 to 2013, it was possible to superimpose this information on the previously generated maps, resulting in the map below.

Figure 4. Distribution of Leprosy Cases in the municipality of Santarém-PA

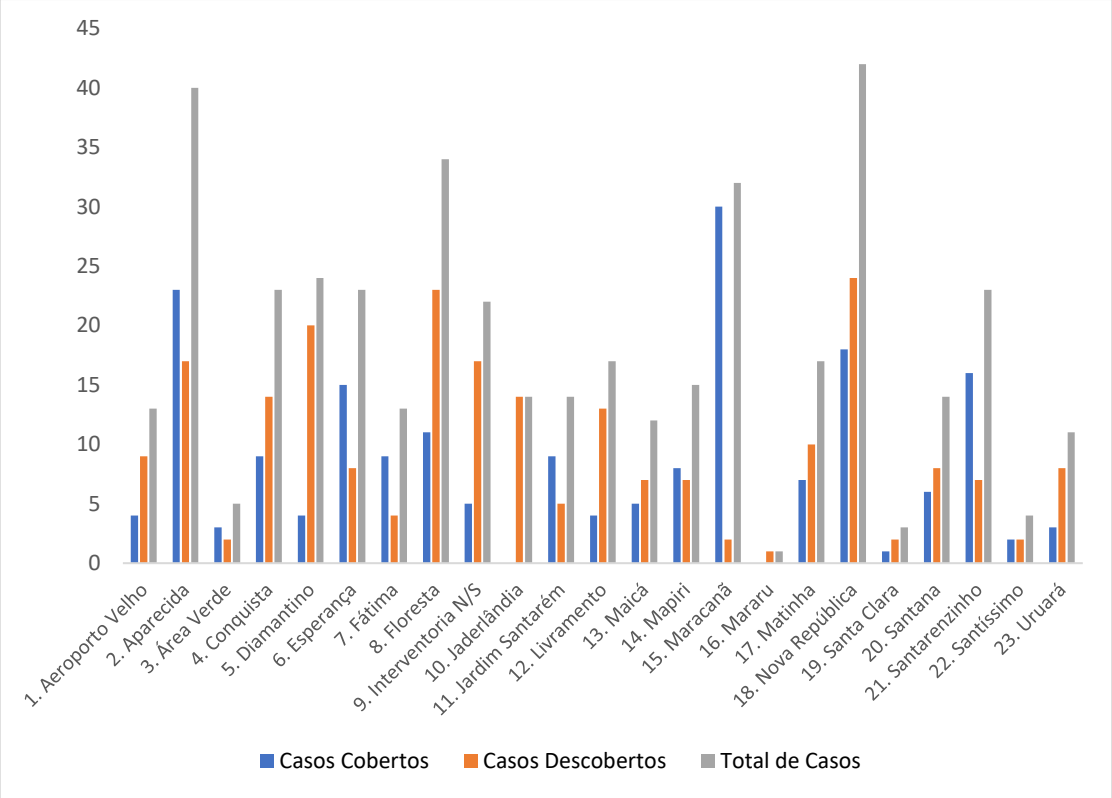


Having information on leprosy cases and covered and uncovered areas, it was possible to carry out a spatial analysis of the number of patients who were in uncovered areas

Table 1. Number of leprosy cases by covered and uncovered area

UBS	Cases Covered	Cases Discovered	Total Number of Cases
1. Aeroporto Velho	04	09	13
2. Aparecida	23	17	40
3. Área Verde	03	02	05
4. Conquista	09	14	23
5. Diamantino	04	20	24
6. Esperança	15	08	23

Figure 5. Number of Leprosy Cases by covered and uncovered area



4 DISCUSSION

Primary health care in Brazil is based on the Family Health Strategy (ESF), which plays a fundamental role in reorienting the care model and universalizing the Unified Health System. leprosy, which can be optimized through the use of Geographic Information Systems to aid decision-making by managers and responsible bodies.

The municipality of Santarém has 48 neighborhoods and only 23 Basic Health Units to meet the entire demand of the urban area of the municipality. In addition to presenting a reduced number of UBS to serve the population, the issue of location and scope have a great influence on the population's search for the health services offered.

As shown through the spatial analysis, a clear example of the problem faced by the population occurs in the situation of UBS Interventoria, which is responsible for assisting the Interventoria North and South area. This situation forces the population to move from Interventoria Sul, passing through the UBS

of Diamantino, which is closest to this population, to the UBS of Interventoria in search of care, the same problem occurs with the ACS who have to move from Interventoria Norte to South to carry out its activities.

According to Ordinance 2488/2011 of the Ministry of Health, which approves the National Policy for Primary Care, establishing the review of guidelines and norms for the organization of Primary Care, the delimitation of the coverage area is an important factor in quantitatively identify the population residing in the locations surrounding a given UBS, seeking to establish territorial limits and obey parameters of care coverage, primary care and medium complexity (BRASIL, 2011).

5 CONCLUSION

In addition to making inferences about the quality of actions and measures taken by Basic Health Units to control endemic diseases.

It was found that the organization, distribution, and number of UBS and professional members of the Health teams are of fundamental importance for changing the current epidemiological situation of leprosy in Santarém. The scope of coverage of these UBS has been reflected in the distribution and number of leprosy cases in Santarém, especially in georeferenced cases in the discovered areas.

This fact may be due to the small number of UBS and ACS that are not enough for the monitoring and health care of the entire population of the urban area of the city, as it could be observed among the patients notified in the years 2003 to 2013 who were georeferenced mostly within these areas.

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