CHAPTER
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Community health agents as facilitators in the suspicion of leprosy in risk areas identified through spatial analysis

https://doi.org/10.56238/alookdevelopv1-091

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ABSTRACT
Objective: to evaluate community health agents in the identification of individuals suspected of leprosy in their coverage areas through spatial analysis. Methods: a cross-sectional, descriptive, and quantitative study. We used the cases reported in the Information System of Notifiable Diseases, 2006-2014. We included 24 agents from basic health units located in areas of a low, medium, and high degree of leprosy detection. Results: 83% of the agents recognized leprosy as an infectious-contagious disease. However, in the transmission and surveillance of contact, only 50% demonstrated to know. During the home visit, 19 suspected cases had spots on the skin, 13 with neurological changes such as pain, numbness, and tingling. Conclusion: limited knowledge can hinder the approach of the agent with the individual with suspicion of the disease, reflecting in actions for the control of leprosy, since this agent greatly amplifies the capillarity of the health system in the active search for new cases of the disease.

Keywords: Leprosy, community health agent, health centers, health attitudes and practice, spatial analysis.

1 INTRODUCTION

Leprosy is a neurodermato-infectious disease caused by *Mycobacterium leprae,* of slow development that affects mainly the cutaneous and peripheral nerves [(1)].

The consequences presented by patients may result in disfiguring skin lesions, progressive nerve damage, and physical disability, causing stigma and social isolation [(2).]

In the last 10 years, more than 200,000 new cases of leprosy have been diagnosed annually worldwide [(3).]

It is still a public health problem in some endemic areas, mainly in India, Brazil, and Indonesia, where 80% of all cases were reported in 2017[4]. The global hidden prevalence is estimated at 3 million cases, but it may be six times higher than the prevalence recorded in some areas [5-6].

Currently, Brazil has not yet reached the WHO target of <1 new case per 10,000 inhabitants, with 26,875 new cases detected in 2017 (an increase of 6% over the previous year), about 1.3/10,000 nationally, according to the National System of Notifiable Diseases in Brazil (SINAN) [7].

In addition, the distribution of leprosy in Brazil is not uniform. The trend of detection of new cases is decreasing in the country, but there is still a high incidence in the states of the North, Midwest, and Northeast regions when compared to those of the South and Southeast regions [8].

More than 80,000 cases of leprosy have been diagnosed in the last 20 years in Pará (9), where the disease continues to advance, given that the current annual detection coefficient of this state is 50/100,000 inhabitants (three times higher than the national average), making the disease a serious public health problem in the state of Pará(10-13).

Since 1991, the Ministry of Health (MH) has been encouraging the insertion of Community Health Agents (CHA) in the primary care network to collaborate in health promotion and disease prevention actions.

The action of the CHAs has been directed to strengthen the bond between the community and the health system, assuming that it can contribute to greater effectiveness of health promotion actions, disease prevention, and individual care [14].

The Community Health Agent is in charge of registering a certain number of families enrolled on a "geographical basis" under his care, around 150 families or 750 people, where the problems must be identified through a mapping of their area of coverage, highlighting the micro-areas of risk.

All CHAs should belong to the community where they perform their work, strengthening the ties between the population and the health services, and creating an informal health network [15-16].

In health education activities, the performance of the CHAs can, through the transmission of information and knowledge, contribute to strengthening the population's capacity to cope with health problems.

Still, its performance can: increase the domain of health information and knowledge by the population; contribute to increasing their skills in the control of health determinants; to help the other professionals of the team in identifying the most vulnerable families that need more specific actions and to improve access to and use of basic health services to avoid late care and reduce the need for emergency consultation [15].

Several difficulties are pointed out in the process of eliminating leprosy in Brazil. To exemplify some of these difficulties, we can mention the complexity of some administrative procedures related

to diagnosis and treatment, information systems that are not reliable, negative perception of the disease by the community, and late diagnosis of the disease, leading patients to states of physical disability [13]. In this context, the recognition of the disease and the mapping of suspected cases of leprosy by the CHAs can facilitate the identification of new cases that require diagnosis and treatment, seeking to mitigate damage to health and reduce the spread of the disease by breaking the chain of transmission.

This study seeks to evaluate the efficiency of the use of the CHA in the identification of individuals suspected of leprosy with the help of spatial analysis techniques as a decision-support tool in this process in the municipality of Santarém-PA.

2 GOALS

To evaluate the Community Health Agents in the identification of individuals suspected of leprosy in their coverage areas using spatial analysis in the municipality of Santarém-PA.

3 METHODS

3.1 ETHICAL ASPECTS

The study was approved by the Research Ethics Committee of the University of the State of Pará, and conducted within the standards required by Resolution No. 466/2012 of the National Health Council.

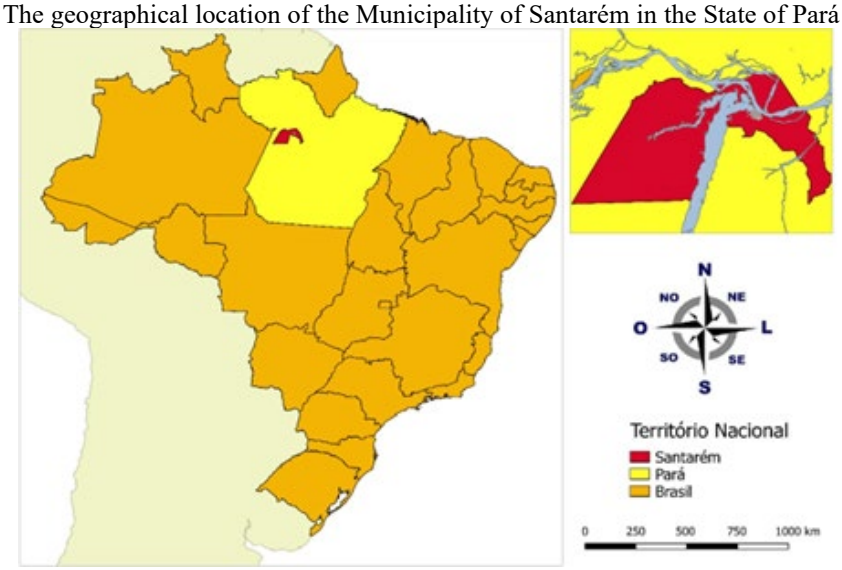
3.2 DESIGN, PERIOD, AND PLACE OF THE STUDY

This is a cross-sectional, descriptive, exploratory, quantitative, correlational study, developed from June to October 2019, in the municipality of Santarém in the State of Pará. The city is located in the north of Brazil in the mesoregion of the Lower Amazon, on the right bank of the Tapajós River, being distant 800 km from the capital Belém.

It is the third largest city in the state of Pará with 294,580 inhabitants and the main socioeconomic center of the Western Region of Pará, due to its offer of better economic and social infrastructure (Figure 1).

Utilizou-se a iniciativa *Strengthening the Reporting of Observational Studies in Epidemiology* (STROBE) para auxiliar na condução metodológica do estudo.

Figure 1. The geographical location of the Municipality of Santarém in the State of Pará and Brazil.



3.3 POPULATION OR SAMPLE; INCLUSION AND EXCLUSION CRITERIA

We selected 24 community health agents from the Basic Health Units (BHU) in areas with detection rates of leprosy cases.

The inclusion criteria in the study were the active CHAs of the BHU selected through spatial analysis and those who accepted and signed the Free and Informed Consent Form (ICF) to participate in training on leprosy. The CHAs of the BHU not selected by the spatial analysis were excluded from the study.

3.4 DATA SOURCE

We used the epidemiological data of patients with leprosy in the municipality of Santarém, notified in the database of the Information System of Notifiable Diseases (SINAN) between the years 2006 and 2014. It was based on the existing information in the SINAN notification forms stored at the Municipal Health Department of Santarém (SEMSA).

A survey was conducted on the information from the 2010 demographic census of the IBGE, with the information base on the census tract (246 sectors) of the urban area of Santarém (IBGE, 2010). The census data were mapped for the analysis of the georeferenced information of the population, correlating them with the data of leprosy patients from SINAN.

To identify and classify the hyperendemic census tracts for leprosy, the patients notified during the study period were geo-referenced. Thus, it was possible to calculate the average detection rates for leprosy in the sectors of the region under study (average detection rate = Number of cases in each census tract / Population of each census tract X 100,000).

In the training, a closed questionnaire was used, containing 9 questions, covering topics on general aspects, diagnosis, transmission, treatment, and surveillance of contacts about leprosy.

For the active search for suspected cases of leprosy, the CHAs used as an instrument of application a questionnaire of suspicion for leprosy with sixteen closed questions about the main signs and symptoms of leprosy [26].

3.5 STUDY PROTOCOL

For the selection of the CHA, the BHU located in areas of high, medium, and low degrees of leprosy detection were identified through spatial analysis. First, the process of georeferencing and spatial analysis of the distribution of leprosy cases was carried out, using the free software QUANTUM GIS (QGIS) which allows to compose maps from data in vector and *raster* formats (images that contain the description of each point of the map). All the variables under the analysis of both SINAN and census were exported to QGIS and visualized on top of the map of the urban area of Santarém, acquired through *Google Maps*.

After mapping the leprosy cases, the BHU were georeferenced and their areas of coverage were spatially mapped according to the information provided by the Municipal Planning Secretariat of the Municipality of Santarém (SEMSA).

With the spatial design of the area of the urban area of Santarém, the UBS with their areas of coverage, and the data of the census tracts, it was possible to gather all this information in a single map for analysis of the dynamics of the distribution of leprosy cases and identification of the UBS located in areas with detection rates ranging from low, medium and high.

For the evaluation of the training on leprosy for the CHA, the pre-test was applied at the beginning of the training and on the last day as a post-test, without access to means that would allow assistance in the resolution of the questions and under the supervision of previously trained monitors. The training was carried out in five days, in the morning and afternoon shifts, with a total workload of 40 hours. The training took place on the premises of the University of the State of Pará on the Santarém campus and had the participation of 24 community health agents from the selected UBS.

After the training, the CHAs returned to their respective BHU for the development of routine activities, including home visits (HV). The active search for suspected cases of leprosy occurred in thirty days during the HV performed by the CHAs of the BHU selected in the areas of low, medium, and high detection. During the HV, the CHAs had as an instrument of application the questionnaire of suspicion for leprosy. For each individual who presented spot and/or alteration of nerves, the leprosy suspicion questionnaire was filled out.

3.6 ANALYSIS OF THE RESULTS

The statistical analysis used was of the descriptive type, using mean and standard deviation, based on the reading of the percentages of categorical and numerical variables. The data were tabulated in tables in the *Microsoft Excel* 2019® program. For the spatial analysis, the distributions of the detection rates of leprosy cases by census tract and according to the areas covered by the BHU were used.

4 FINDINGS

The municipality of Santarém has 48 neighborhoods and 26 UBS with 43 FHS. Considering the urban population of the 2010 census, of 215,790 inhabitants, only 59.78% of the population is covered by the FHS.

In the map of Figure 2, it is possible to visualize the spatial distribution of the cases notified by SINAN, in the period of the study, by urban census tracts of the municipality. A total of 311 cases of the disease were georeferenced, which corresponds to 83% of the leprosy cases living in the urban area of Santarém, with a loss of 66 total cases due to inconsistency of addresses, which represents 17% of the cases in the urban area.

To identify and classify the hyperendemic census tracts, the average detection rates (mean detection rate = Number of cases in each census tract / Population of each census tract X 100,000) per sector were calculated. From this result, we identified the BHU that are located in the zones of high, medium, and low degree of detection of leprosy and it was possible to select a BHU in each detection zone to apply the training, as can be seen in the map of Figure 3.

Figure 2. Spatial distribution of leprosy cases by census tracts and in the circle the location of the basic health units selected for the training of community health agents, in the Municipality of Santarém-Pará, Brazil, 2019.

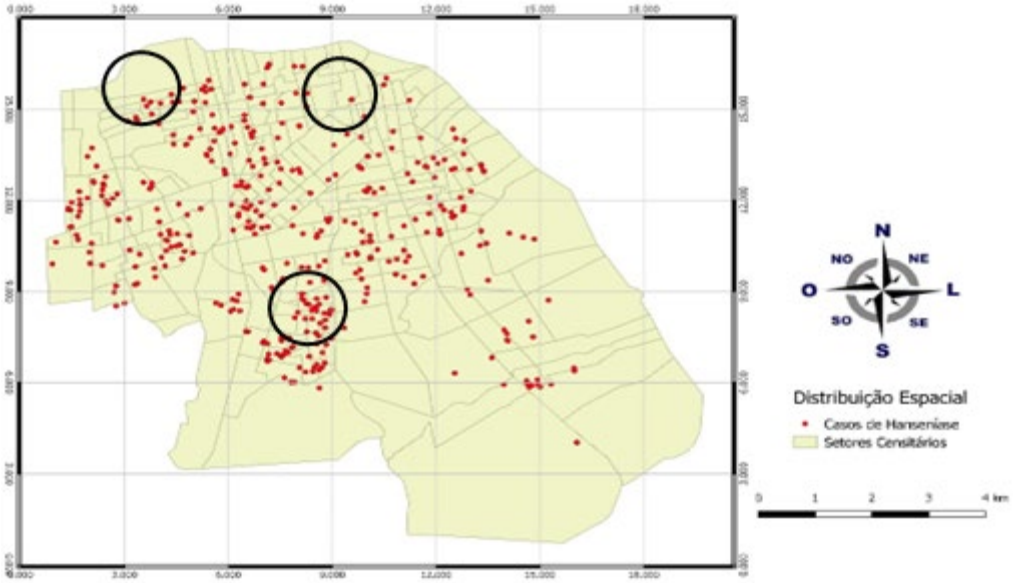
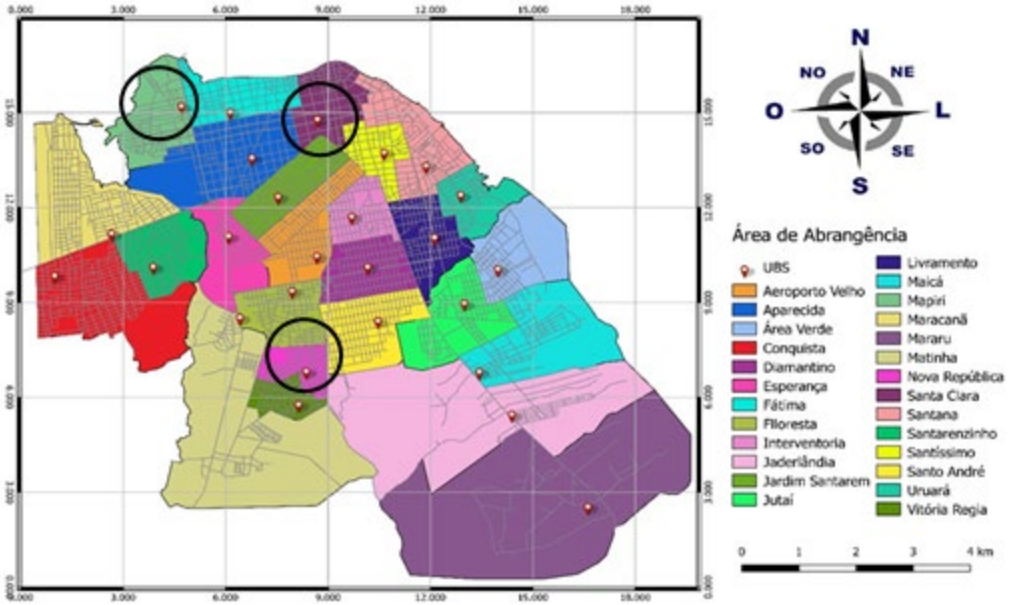


Figure 3 shows the urban area of Santarém and the distribution of the 26 BHUs with their respective areas of coverage. The circles show the identification of BHU located in zones of high, medium, and low degrees of leprosy detection. The UBS of Nova República is in a high-risk area, the Mapiri/Liberdade unit in the medium area and the Santa Clara unit in an area of low risk for leprosy.

Figure 3. Distribution of basic health units (BHU) in the urban area according to their areas of coverage and location and in the circle of BHUs selected for the training of community health agents, in the Municipality of Santarém-Pará, Brazil, 2019.



After the identification and selection of the BHU (Figure 3), training on the disease studied was conducted for the CHAs of the BHU of Santa Clara (ESF I), Mapiri/Liberdade (ESF I/II) and Nova República (ESF I/II). The profile of the CHAs selected for the training identified that of the 24 (100%) participants of the study, 22 (92%) were female.

The main age group of these CHAs was from 31 to 60 years with 19 (79%) CHAs compared to the age group of 20 to 30 years with 3 (13%) CHAs and older than 60 years, 2 (8%) CHAs. Regarding education, 9 (38%) attended complete high school, 2 (8%) completed elementary school, 8 (33%) incomplete university and 4 (17%) already had completed higher education. Regarding the length of service, it was found that 6 (25%) worked as CHAs for a period of up to five years and 18 (75%) were more than five years in the FHS. During the training of the 24 CHAs, it was found that 20 (83%) reported having received training on leprosy and 4 (17%) did not.

Table 1 refers to the application of the pre-and post-test during the training of the CHAs regarding general aspects (the disease), diagnosis, transmission, treatment and surveillance of contacts. It can be seen that in the general aspects of leprosy, the CHA recognized the disease as infectious, of slow evolution, chronic and transmitted by *Mycobacterium Leprae,* 66% in the pre-test and 83% in the post-test. Regarding the signs and symptoms, most of them were recognized as whitish, reddish spots,

and thickening of peripheral nerves with changes in sensitivity and muscle strength, totaling 91% in the pre-test and 100% in the post-test. Regarding the clinical forms of leprosy, 56% in the pre-test and 100% in the post-test recognized the forms as being indeterminate, tuberculoid, dimorphic and virchowian of the disease and that the patients classified as multibacillary present the disseminating forms of the disease.

Regarding transmission, 54% of the CHA in the pre-test and 91% in the post-test recognized that the main route of transmission of leprosy is the upper airway. In the case of the main diagnostic methods, in the pre-test 75% and in the post-test 95% recognized the clinical examination of the lesions and nerves, sputum smear microscopy and biopsy as being diagnostic of the disease.

Regarding the treatment, almost all the CHA in the pre-test 95% and 100% in the post-test recognized the treatment being performed with the use of oral drugs (Polychemotherapy - PQT) in a supervised way. Regarding contact surveillance, 50% of the CHAs in the pre-test and 50% in the post-test recognized the home as the most likely place of infection and the components of contact surveillance as being: dermatoneurological examination, recommendation of BCG vaccine and health education actions.

Table 1- Knowledge about leprosy by Community Health Agents (CHA) in Santarém-Pará, Brazil, 2019.

Knowledge about leprosy	Pretest *n* (24) %	Test *n* (24) %
What is Leprosy	66	83
Signs and symptoms of leprosy	91	100
Clinical forms of leprosy	56	100
Route of transmission of leprosy	54	91
Diagnostic methods for leprosy	75	95
Treatment of leprosy	95	100
Contact Surveillance	50	50

Table 2 shows the result of the active search, performed by the CHAs after the training, for the discovery of suspected cases of leprosy with the application of the suspicion questionnaire in their coverage areas during the Home Visit (HV). Of the 19 suspected cases, distributed by FHS, there was a predominance of the presence of skin stain in 18 of the completed questionnaires, 13 also reported neurological changes such as pain, numbness, tingling, etc., and two cases were discarded from suspicion for informing that the spot was from birth, resulting in a total of 17 suspected cases.

Table 2- Number of suspected cases by Family Health Strategy (FHS) of the Basic Health Units (BHU) Mapiri/Liberdade, Nova República and Santa Clara, after application of the questionnaire of suspicion by community health agents during the home visit (HV), in the period from September to October 2019 in Santarém-Pará, Brazil, 2019.

Signs and Symptoms	Family Health Strategy Basic Health Unit		
	Mapiri/ Freedom	New Republic	Santa Clara
Do you feel numbness in your hands and/or feet?			
Tingling?		1	
The sensation of needles?			
Cramps?		2	
Dormant areas on the skin?			1
Skin blemishes?	3	10	
Loss of eyelashes or eyebrows?			
Alteration is from birth?			2
Total Suspects	3	13	1

5 DISCUSSION

The results showed that the knowledge of the CHAs who participated in the study revealed an erroneous understanding of the disease since they related the virus as a transmitter of the disease. Most of the CHAs stood out regarding the signs and symptoms, evidencing the knowledge about skin lesions (spots), peripheral nerves with altered sensitivity and muscle strength, thus demonstrating the knowledge on the part of the participants of the main characteristics that lead the individual to suspect that he has leprosy.

The World Health Organization (WHO) has assumed as strategies for the early diagnosis and adequate treatment of the cases identified for the elimination of leprosy, thus, it is essential to know the epidemiological characteristics of leprosy by the CHA, to enable understanding these professionals of the relationship the bacillus with the individuals in the environment [(4)].

Regarding the knowledge about the clinical forms of leprosy, 56% of the CHA recognized the forms as being indeterminate, tuberculoid, dimorphic and virchowian and that multibacillary patients are those who present the disseminating forms of the disease.

This result reveals that the CHAs have a limited understanding of the clinical manifestations of leprosy, which may hinder their performance in the active search for suspected cases of the disease and consequently the possibility of early identification of cases. Studies verifying the profile of CHAs have also shown a limited understanding of the basic aspects and clinical manifestations of leprosy [(21-22)].

Regarding knowledge about transmission, only 54% of the CHA identified the upper airways as the main route of transmission of the disease. It is known that the disease is transmitted through the airways, through close and prolonged contact with a susceptible person with a leprosy patient who is not being treated [(23).] In this regard, this professional must have adequate knowledge about the characteristics, signs, symptoms and treatment of the most recurrent pathologies [(22).]

Another important point in the process of knowledge of the CHAs was regarding the surveillance of leprosy contacts, the study revealed incomprehension on the part of these professionals about this measure of coping with the endemic.

This limited knowledge can hinder the approach of the CHA with the individual with suspicion or in the follow-up of the disease, reflected in the actions of leprosy control, since it is based on early diagnosis, timely treatment and the active search for cases of the disease, which ends up contributing to an ineffective control and monitoring of cases of the disease in the municipality.

Emphasizing what is recommended by the National Program for Leprosy Control (PNCH), the diagnosis in the initial phase of the disease aims to break the chain of transmission and avoid sequelae resulting from late diagnosis and lack of adequate follow-up [14,22,24].

Thus, it is essential to know the epidemiological characteristics of leprosy in populations and its spatial distribution, to enable the understanding by the CHA of the relationship of the bacillus with individuals and the region where these people live. The CHAs become true protagonists of the health surveillance model because their privileged position in the dialogue between the subjects involved in the health-disease process can function as a facilitator in the mediation between health professionals and the community [14].

Despite the difficulties of the CHAs regarding the knowledge about the etiological agent, transmission and surveillance of contacts, this study revealed a high level of knowledge in the CHAs evaluated regarding the treatment of leprosy with the use of PQT. The importance of informing the CHA professionals about the therapy used may reflect on leprosy control actions, since treatment adherence or abandonment, self-care actions and cases of recurrences or leprosy reactions can often be identified by this FHS member [21], reflecting positively on the performance of this CHA during the orientations given during the HV.

One cannot fail to invest in the education of these CHAs, because the orientation/information conveyed by the CHAs is a primary attribution in their work process and the permanent education of this subject must respect the singularities of the profile of this worker [17,22].

During the study period, it was possible to observe that the time that the CHAs dedicate to other activities, such as the administrative functions performed within the UBS, decreases the time to perform the HV, health education and active search, failing to perform health surveillance and impairing their performance in front of the community.

It is worth mentioning that the collection of information on suspected cases of leprosy did not alter their work routine. Studies that show the daily life of the CHAs identified the problem of function deviation as a serious problem in the development of the work of health agents [25]. This was also observed in this study, where the time of the CHAs in follow-up was impaired due to the administrative

functions that they accumulated, impairing the performance of the HV, and mischaracterizing the role of the health agent.

The knowledge required in the work process of the CHAs is quite complex and diversified and sometimes requires the learning of aspects that are present in the living conditions of the population and that require intersectoral action [16-17].

Another interesting factor about the study was the refusal of some families to answer the questionnaire of suspicion of leprosy applied by the CHA, revealing that there is still prejudice regarding leprosy and that the lack of information about the disease continues to be a barrier for the individual to talk about the disease, as well as the CHA to address this subject in their work routine [21].

Health education about leprosy is still a difficulty that involves issues such as the identification of the signs and symptoms of the disease, treatment actions, contact surveillance, and cure [15,24].

It is known that the late diagnosis of leprosy can have serious consequences for patients and their families, not only because of the injuries that physically incapacitate them but also because of the psychosocial repercussions due to prejudices, fears and rejections by society.

However, early diagnosis favors an adequate treatment, avoiding the evolution of the disease and, consequently, preventing the installation of physical disabilities caused by it.

This study shows the usefulness of spatial analysis techniques in the process of identifying BHU in areas of high, medium, and low degrees of leprosy detection, as well as for the selection of CHAs for training and also the possibility of spatially visualizing the areas discovered by the FHS in the municipality of Santarém.

Another positive point of the application of spatial techniques was the possibility of observing that the location of some of the BHU was not strategically located, that is so that it was possible to cover equally the entire area under its scope.

The location of these UBS in their coverage areas should exert a great influence on the population's search for the health services offered.

It is worth mentioning that one of the problems faced by the local population can be observed in Figure 3, where the UBS Maracanã, Fátima, Matinha, and Maicá are in the limits of their coverage areas, on the border with other neighboring areas, that is, not being strategically located in a way that allows universal and continuous access equitably by all their enrolled population, which ends up causing this population, due to the distance, to move to care in other UBS outside their areas.

According to the guidelines and norms for the organization of Primary Care (Ordinance 2,488/2011) of the Ministry of Health (MH), the delimitation of the coverage area is an important factor in quantitatively identifying the population living in the localities surrounding a given UBS,

seeking to establish territorial limits and obey the parameters of care coverage, primary care and medium complexity [17].

Another curiosity in this study was the cases of leprosy in the municipality, where the mapping of these cases showed a very heterogeneous spatial distribution [9,11].

The use of spatial analysis techniques in the mapped cases identified the presence of areas with high risk and low risk of leprosy infection in the urban area of Santarém.

One of the main strategies of the Ministry of Health is the integration of the actions of diagnosis and treatment of the disease in primary care. Thus, the FHS and CHA teams and all units of the Unified Health System (SUS) become part of the patient care network, facilitating universal access to diagnosis and treatment ([17].

However, to improve the performance of this strategy, the spatialization of cases is a very useful method to analyze the data and allow decision-making to be focused on priority areas for the direction of activities to combat the disease [9,18-19]

5.1 STUDY LIMITATIONS

A limitation found is related to the confirmation or not of the suspected cases of leprosy identified by the CHA by the leprosy physician of the municipality, since there is only one doctor for the care of the entire region of the western state of Pará, causing a very long wait in the evaluation of the suspected patient.

5.2 CONTRIBUTIONS TO THE AREA

The performance of the CHAs involves the definition of a certain area of coverage for each agent, where the mapping and health actions under the responsibility of the CHAs result in the identification of the problems of that area, highlighting the micro-areas of risk.

In this sense, the spatial analysis had a relevant contribution to this study, because as observed, the distribution of leprosy cases in the municipality of Santarém is quite heterogeneous and from the spatial analysis it was possible to identify priority areas for the direction of the activities of the CHAs in their areas of coverage and coverage, thus allowing the more effective fight against the disease in their microregions.

Thus, the use of spatial analysis becomes a powerful tool to analyze data and allows more effective decision-making by the nursing team. In addition, the CHA's approach to the identification of suspected cases of leprosy during their HV further amplifies the capillarity of the health system in society through these professionals and strengthens the relationship of the population with public health services.

6 CONCLUSIONS

The limited knowledge of the CHAs about leprosy and its process of transmission and surveillance of contacts may impair the approach of the CHA to the individual with suspicion or follow-up of leprosy, reflected in the actions of leprosy control.

The visualization of leprosy cases mapped spatially in the urban area of Santarém, showing their distribution and allowing the calculation of the average detection rates by census tracts, as well as the mapping of the UBS and their areas of coverage, allowing the identification of areas of high risk, medium and low risk of leprosy infection associated with the areas of operation of the UBS, thus contributing to a more effective active search for CHAs during HV.

The use of spatial analysis techniques in the health area as a decision support tool is fundamental in the process of identifying the most vulnerable regions for the development of infectious diseases such as leprosy, in addition to being an important tool in the monitoring of the coverage areas of the UBS, enabling the planning of interventions and monitoring according to the real needs of the population assisted.

The use of CHAs in the identification of suspected cases of leprosy can both contribute to the early identification of cases of the disease and also improve the response of the health system to society through the interlocution of the assisted population and public health services.

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