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ORIGINAL ARTICLE

SPATIAL ANALYSIS AND EPIDEMIOLOGICAL CHARACTERISTICS OF CASES OF LEPROSY IN AN ENDEMIC AREA

ANÁLISE ESPACIAL E CARACTERÍSTICAS EPIDEMIOLÓGICAS DOS CASOS DE HANSENÍASE EM ÁREA ENDÊMICA

ANÁLISIS ESPACIAL Y CARACTERÍSTICAS EPIDEMIOLÓGICAS DE CASOS DE LEPRA EN ÁREA ENDÉMICA

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ABSTRACT

Objective: to analyze the spatial distribution and the clinical and epidemiological characteristics of leprosy cases in endemic areas. ***Method:*** a descriptive, cross-sectional, retrospective study with a quantitative approach, using secondary data from a Notification of Grievance Information System (SINAN) 2002 and 2012 in the municipality of Tucano/BA, Brasil. The cases of leprosy were geo-referenced using a GPS receiver for location of households and spatial analysis through Terra View 4.2.2 software. ***Results:*** the mean detection rate was 15.53 cases per 100 thousand inhabitants. An increased frequency of cases with age and occurrence of six cases in children under 15 years. The spatial analysis found concentration of cases in the peri-urban area of the municipality. ***Conclusion:*** there is a growing trend of leprosy cases concentrated in the urban area of the municipality, it is important to intensify control interventions focused on an active search for cases of difficult access to health service locations. ***Descriptors:*** Leprosy; Spatial Analysis; Epidemiology.

RESUMO

Objetivo: analisar a distribuição espacial e as características clínico-epidemiológicas dos casos de hanseníase em área endêmica. ***Método*:** estudo descritivo, transversal, retrospectivo, com abordagem quantitativa, utilizando dados secundários do Sistema de Informação de Agravo de Notificação (SINAN) de 2002 a 2012 no município de Tucano/BA, Brasil. Os casos de hanseníase foram georreferenciados utilizando um receptor GPS para a localização dos domicílios e a análise espacial, realizada através do software TerraView. 4.2.2. ***Resultados***: a taxa média de detecção foi de 15,53 casos para cada 100 mil habitantes. Ocorreu um aumento da frequência dos casos com a idade e ocorrência de seis casos em menores de 15 anos. A análise espacial constatou concentração de casos em área periurbana do município. ***Conclusão*:** há uma tendência crescente de casos de hanseníase concentrados na área urbana do município, sendo importante intensificar as intervenções de controle focadas na busca ativa de casos em localidades de difícil acesso aos serviços de saúde. ***Descritores***: Hanseníase; Análise espacial; Epidemiologia.

RESUMEN

Objetivo: analizar la distribución espacial y características clínicas y epidemiológicas de casos de lepra en área endémica. ***Método:*** estudio descriptivo, transversal, retrospectivo, con un enfoque cuantitativo, utilizando datos secundarios del Sistema de Información de Agravio de Notificación (SINAN) de 2002 y 2012 en Tucano, Bahia, Brasil. Los casos de lepra fueron georeferenciados utilizando un receptor GPS para la ubicación de los hogares y el análisis espacial realizado a través del software TerraView 4.2.2. ***Resultados:*** el promedio fue de 15,53 casos de detección por cada 100 mil habitantes. Hubo un aumento en la frecuencia de casos con la edad y aparición de seis casos en niños menores de 15 años. El análisis espacial encontró que la concentración de casos en zona peri urbana del municipio. ***Conclusión:*** existe una tendencia creciente de casos de lepra que se concentró en el área urbana del municipio, y es importante intensificar las intervenciones de control centradas en la búsqueda activa de casos en lugares de difícil acceso a servicios de salud. ***Descriptores:*** Lepra; Análisis Espacial; Epidemiología.

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INTRODUCTION

Leprosy constitutes a serious public health problem in many countries due to its magnitude, disabling potential and affects predominantly the economically active age.[1] This is an infectious disease of chronic nature, caused by Mycobacterium leprae, known as Hansen bacillus, which has affinity with peripheral skin and nerves.[2,3] is characterized by having high infectivity and low morbidity. It features an incubation period ranging from 2 to 7 years, reaching more than 10 years. The M. leprae transmission route is air and the male is the main infecting host.[4-6]

Worldwide, in 2011, 228,474 new cases of leprosy were reported, of these, 33,955 in Brazil alone. According to epidemiological bulletin of the WHO, Brazil ranks second in number of cases, second only to Índia.[7] Within the Americas, Brazil concentrates 80% of all cases of the disease, being the only country in the Americas where this pathology is considered endemic.[8] The North, Midwest and Northeast Brazil persist as endemic areas and concentrate the 10 main clusters in the country, with the highest rates of prevalence and concentrating most confirmed cases.[9-11]

With regard to socioeconomic conditions, the disease is more prevalent among people with low educational attainment, lacking primary health care services, social and sanitary assistance.[12] Other factors deserve highlights such as the precariousness home infrastructure, settlements, low investment in prevention, geographical isolation and dependence on services and information, which, in most cases, are scarsce.[13-4] A study shows that the prevalence of the most severe forms is higher in the male population and assumes that behavioral factors and hormones can influence the development of these clinical forms among men.[6]

The municipality of Tucano/BA is becoming an increasing concern of those responsible for epidemiological surveillance of leprosy, to be an active transmission region of the disease and is present in the economic rise related to immigration growth, inadequate occupation of urban spaces, tourism and leisure activities in the region, therefore, at risk of geographical expansion of the endemics. In this municipality, two important operational strategies in combating the disease were carried out: the decentralization of assistance in the diagnosis and treatment of leprosy by extending the network of patient care services and the active search in the population by performing in small area campaigns and involving all basic health units.

Studies of the spatial distribution of infectious diseases are considered important for public health, especially for the planning and execution of control measures.[15] The Geographic Information Systems (GIS) have contributed to the effectiveness of actions by spatial data analysis on the parameters of health, revealing areas of priority for interventions.[16] The use of this tool is useful for the control and monitoring of infectious diseases, such as leprosy, as it allows the identification of risk areas from a spatiotemporal perspective in the geographical regions defined.

In view of the above problems, this paper aims to:

- Analyze the clinical and epidemiological characteristics of leprosy in endemic areas.
- Enclose the geographical risk areas, through spatial analysis.

METHODS

A descriptive, cross-sectional, retrospective study with a quantitative approach, from secondary data of leprosy cases diagnosed from 2002 to 2012 in the municipality of Tucano/BA and reported in the Notifiable Diseases Information System (NDIS).

It conducted the incidence calculation of leprosy per 100,000 inhabitants / year. The digital network and the absolute resident population in the municipality were obtained from the website of the Brazilian Institute of Geography and Statistics Foundation (IBGE) [17], through operations between layers in Geographic Information System (GIS).

The study was conducted in the municipality of Tucano / BA, located in the northeastern state of Bahia, northeastern Brazil. The city has 2799.120 square kilometers in area and is located at -10.96 ° latitude and -38.78 ° longitude from the Greenwich meridian. Its population density is 18.73 inhabitants/km^2, with a predominance of savanna biome and hot, dry climate. It offers a total population of 52 418 inhabitants. The city has an important economic dynamic for the state economy based on agriculture, livestock and turism.[17]

The following variables were used: number of new cases of leprosy, gender, age (0-14anos, 15-29 years, 30-44 years, 45-59 years and 60 years), operational classification (multibacillary - MB, paucibacillar - PB), clinical form (indeterminate - I tuberculoid - T dimorphic - D, Virchowian - V), degree of disability at diagnosis (0, 1 and 2) .[18]

We analyzed the trend for the city by linear regression, where y (annual detection rate of

leprosy) = α + ß1 (x) and the trend was considered significant with p <0.05, and also observed the value of the coefficient of determination (R2) and waste analysis. In a simple linear model, it possessed a data set in which two variables were measured x and y whose correlation indicated a linear behavior, a line was set that best fit these pairs of values by the method of least squares.[19]

The spatial analysis was made from the database of cases and the municipal grid. For the spatial location of the address the absolute method was used for an instantaneous position of a point, with the help of the Global Positioning System navigation receiver (GPS) which captures the geographical coordinates has been performed on a UTM projection system (Universal Transverse Merchant) and ellipsoidal reference Datum SAD 69. The maps were constructed and analyzed in terraView 4.2.2 software, using the intensity estimator Kernel, nonparametric technique which allows to estimate the number of events per unit area in each cell on a regular grid covering the studied region.[20] Because they are using statistical smoothing or rounding a surface density for visual detection of *hotspots* was generated using the bandwidth 200 meters and quartic function.[21] This procedure made it possible to filter the variability of a data set without changing the essential form of their local characteristics, thereby generating a continuous surface from the point data.[16.22]

An Equal Chi-square test was used to compare proportions through the software GraphPad Prism 5.0. Differences were considered statistically significant when ρ <0.05.

This research was conducted exclusively with free access to secondary data, ensuring the preservation of the identity of the subjects, in line with the ethical guidelines established by the National Council of Health NCH No. 466, of December 12, 2012, which deals with research involving human subjects. The authors complied with the ethical principles contained in the Declaration of Helsinki.

RESULTS

The study data shows that in the period between 2002 and 2012 91 cases of leprosy were reported in the municipality of Tucano / BA, with an average of 8.3 cases per year (standard deviation of +6.8 cases). The average detection rate for the period was 15.53 cases per 100 thousand inhabitants. During this period the incidence rate ranged from 3.8 cases (2002) to 41.6 (2012) per 100 thousand inhabitants, the latter being the year in which the highest incidence of the disease was obtained, an increase of 1,094, 7% of the leprosy incidence in the municipality according to data presented in table 1.

Table 1. Number of cases detected, estimated resident population in the municipality of Tucano / Bahia and incidence rate of leprosy patients per year from 2002 to 2012.

Year	Number of Cases	Population	Incidence rates(by 100 thousand inhabitants)
2002	2	51.581	3,8
2003	4	51.907	7,7
2004	1	52.256	1,9
2005	7	52.563	13,3
2006	5	52.895	9,4
2007	3	53.222	5,6
2008	11	47.615	23,1
2009	8	47.371	16,8
2010	9	52.418	17,1
2011	19	52.631	36,1
2012	22	52.866	41,6

The year with the lowest incidence was in 2004 with 1.9 / 100,000 inhabitants. It was noted that the municipality of Tucano showed a significant increasing trend (p = 0.0007) in the incidence of leprosy cases (Figure 1).

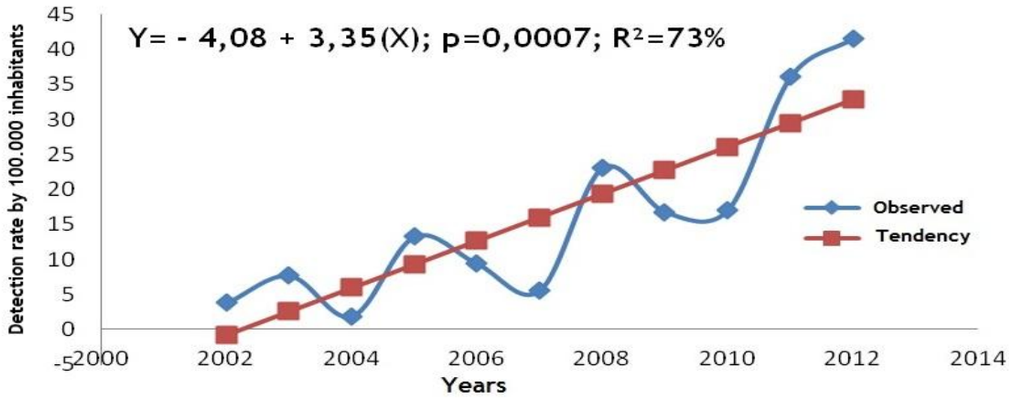

Figure 1. Trend curve of the incidence rate of leprosy cases in the Tucano city, Bahia, 2002-2012

Table 2 shows that the majority of cases were diagnosed among women (65.9%). The age of patients ranged from 2 to 92 years with a mean of 42.02 ± 19.4. The corresponding age group the economically active population was the most affected. The cases in children under 15 years accounted for 06 (6.6%). Most cases (65.9%) showed six to nine years of study. On the merits, 57 (62.6%) were from the peri-urban area, 13 (14.3%) of the rural area and 21 (23.1%) from the center of the city. Clinical examination data shows that 51 patients (56%) were classified as multibacillary (MB) and 38 (41.8%) paucibacillary (PB). In two cases (2.2%) there was no identification of operationally considered being ignored. Regarding the histopathological classificationof clinical forms, it was noted that 42 (46.1%) were the dimorphic way, 21 (23.1%) indeterminate, 17 (18.7%) tuberculoid, 09 (9.9%) Virchowian . It was also observed that 52.7% of cases had leprosy reactions.

In the age groups above 30 years there was a predominance of multibacillary, but no statistical difference (p = 0.6558). We also observed a higher prevalence of MB form in males (* p = 0.04). We have not identified significant differences when we analyze the occurrence of leprosy reactions according to the gender of the patient, however, there was a higher occurrence of reaction among patients with the form MB (* p <0.0001).

Table 2. Distribution of socio-demographic and clinical characteristics of leprosy cases in the municipality of Tucano, Bahia, 2002-2012.

Variables	N	%
Gender		
Male	31	34.1
Female	60	65.9
Age group		
< 15	6	6,6
15 ⊢ 30	19	20,8
30 ⊢ 45	29	31,8
45 ⊢ 60	20	21,1
≥ 60	17	18,7
Residence Zone		
Center	21	23.1
Periurban	57	62.6
Rural	13	14.3
Clinical Forms		
Indetermined	21	23.1
Tuberculoid	17	18.7
Dimorfic	42	46.2
Virchowian	9	9.9
Ignored*	2	2.2
Classification Operacional		
Paucibacilary	38	41.8
Multibacilary	51	56.0
Ignored*	2	2.2
Hansenic Reaction		
Yes	48	52.7
No	43	47.3
Degree of Incapacity		
0	60	65.9
1	19	20.9
2 e 3	12	13.2

*Absence of data in the system, recurring from the non filling in of the notification form.

Of the 91 reported cases, 85 (93.4%) were spatially georeferenced and 6 were excluded from spatial analysis due to described mismatch between the address and the map base or due to incomplete filling of the "address" or access difficulties for use GPS receiver.

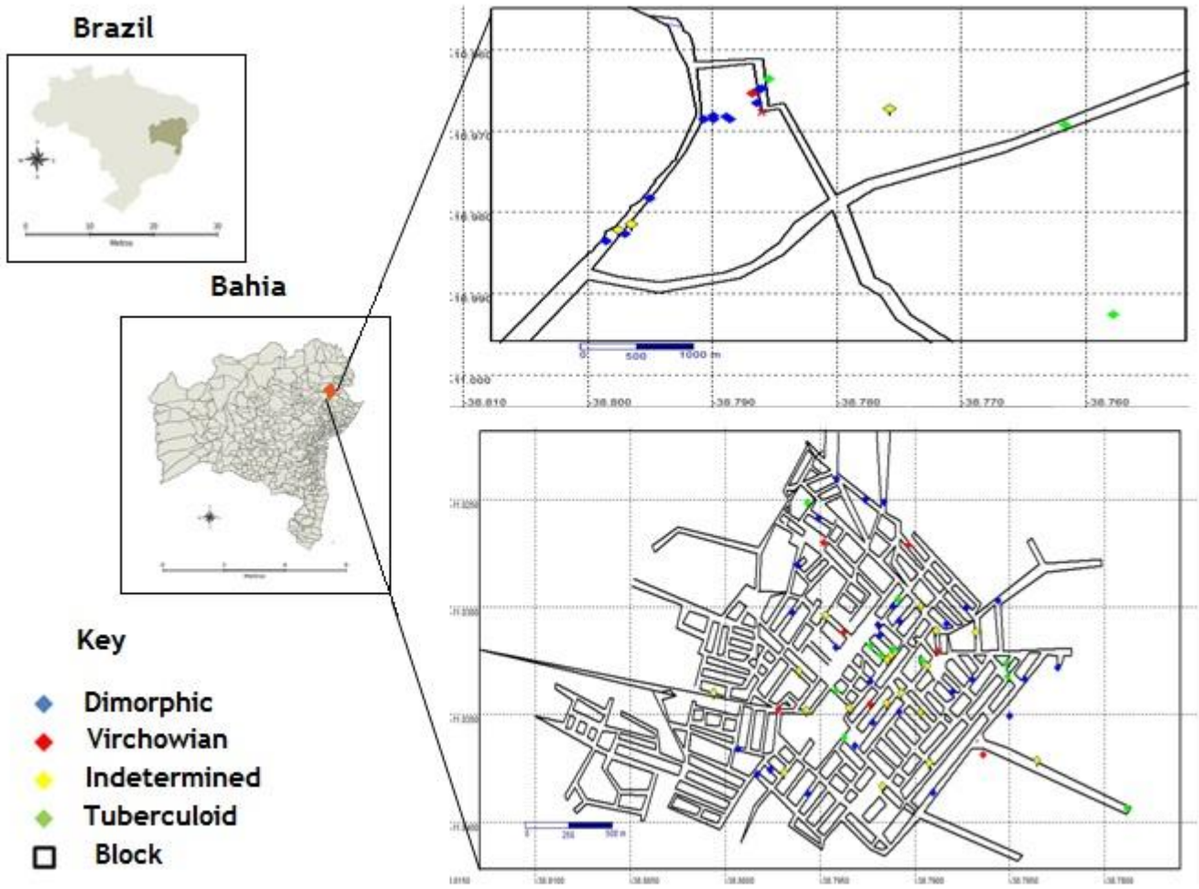

Figura 2. Mapas da distribuição geográfica dos casos de hanseníase segundo formas clínicas no município de Tucano, Bahia, Brasil, 2002 a 2012.

Figure 2 shows the distribution point map obtained by the GPS receiver of leprosy cases reported from 2002 to 2012 according to the clinical classification. Already Figure 3 shows the concentration of human cases obtained through spatial analysis by Kernel quartic, defining the major risk areas. You may notice two clusters of human cases in the period analyzed, represented in the north and center (headquarters) in the city. In these areas, the higher intensities clusters are represented by more intense shades.

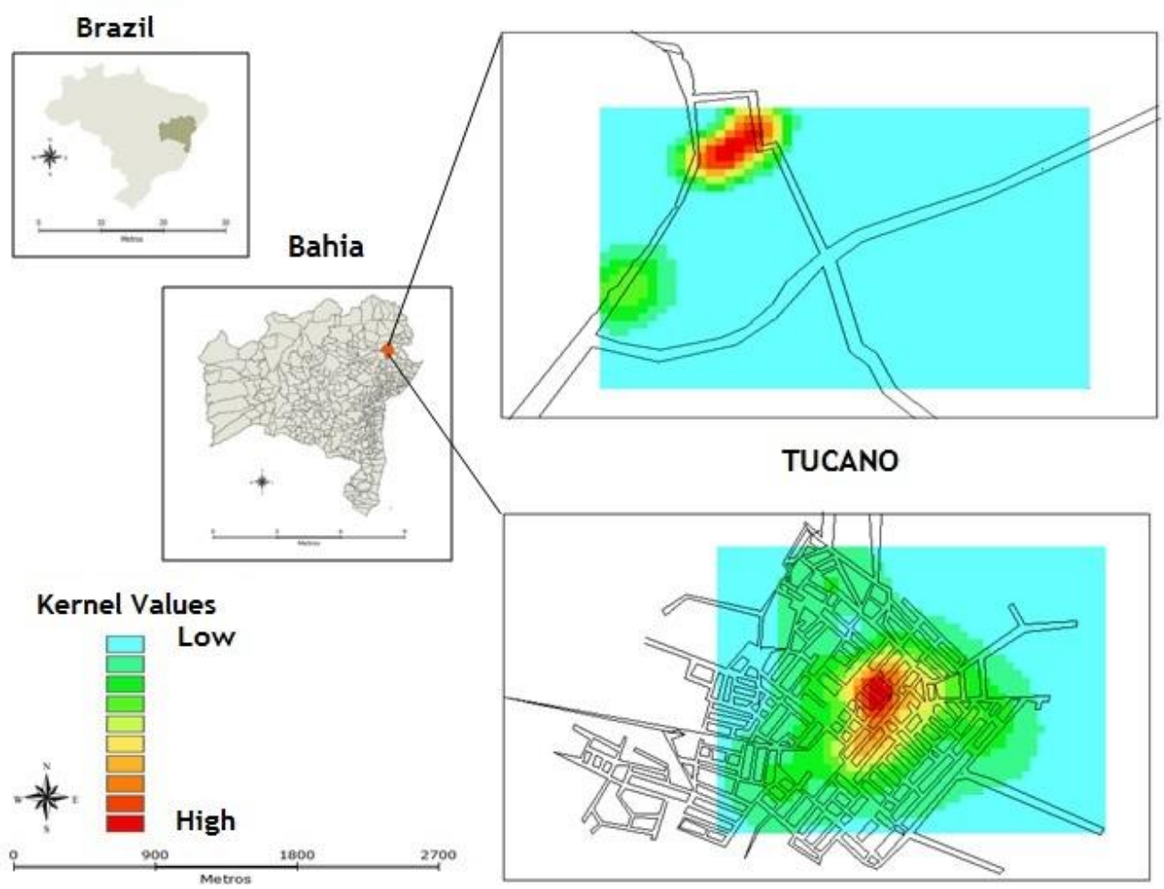

Figura 3. Mapas de Kernel dos casos de hanseníase no município de Tucano, Bahia, Brasil, 2002 a 2012.

DISCUSSION

This study demonstrates municipal relevant aspects related to the use of mobile geo as a tool for leprosy control. The data showed that the overall detection rates of leprosy showed significant increasing trend in Tucano city, interior of Bahia. However, there were different spatial patterns between the evaluated areas. Analysis of the data indicates that there is a persistence of active transmission of the bacillus and a late detection of the disease, with hyperendemicity standards in urban and rural areas of the municipality.

The municipality of Tucano showed an average detection rate in the period 15.53 per 100 thousand inhabitants. These values classify the municipality as highly endemic region, according to the epidemiological parameters of the Ministry of Health (between 10 and 20 cases per 100 thousand inhabitants).[23] It is important to note that in the early years in this study (2002-2007) the detection rate of leprosy cases in the municipality framed it in low parameters and medium endemicity (2 to 10 cases per 100,000 inhabitants), however, a progressive increase in the detection of cases between the years 2008 to 2012 was observed, and in this last year the city had an incidence rate that ranked as a hyperendemic area (over 40 cases per 100 thousand inhabitants).[23] This sharp increase in cases may be associated with the implementation of a referral service for diagnosis and treatment of leprosy cases in the city.

Considered a public health problem in Brazil, leprosy in the municipality of Tucano presented in an incidence greater than the coefficient established by the Ministry of Health to eliminate it. As well as the national level, the city had a high rate of detection of new cases and even hyperendemic periods. In all states of Brazil a significant reduction in the detection of leprosy cases was provided from 2010, based on a national epidemiological profile between the years 1980 to 2004.[23] However, epidemiological indicators presented for the municipality of Tucano, show that the municipality follows against national indicators.

In Brazil, it is necessary to intensify local surveillance activities of leprosy, especially aimed at greater effectiveness in diagnosis and treatment of disease, early on, especially in regions with the highest concentration of cases in the country. Furthermore, it is important for continuous improvement of information systems, critical activity to ensure proper monitoring of the epidemiological situation of leprosy in Brazil and to contribute to the goal of eliminating the disease as a problem of public health.[24]

The implementation of the Family Health Units in the city caused no further significant

impact on reducing new cases of detection rates, although the decentralization of actions to facilitate user access to the unit for diagnosis and treatment. The expansion of the diagnostic network, along with the educational practices and periodic campaigns seem to be the most emerging actions to be put in place so that they can make early diagnosis and therefore provide curative intervention before the facilities of disabilities that can change the dynamics of leprosy patients of life related to activities at work as well as the prejudice that it may face in a society where many are unaware of the disease.

The leprosy detection rate in children under 15 years in 2011 in Tucano was 0.3 per 10,000 inhabitants, indicating the occurrence of new cases of leprosy in the young age group. The detection of cases in children and adolescents indicates that the endemic and early exposure to bacillus.[24] This also reinforces the hypothesis about the persistence of late diagnosis and maintenance bacillus supplies.[23] Given that the incubation period of disease ranges on average from two to seven years, individuals have been exposed to *Mycobacterium leprae* earlier, given the long incubation period of the disease.[23-4]

Related to clinical aspects it is noted, in general, that a greater proportion of multibacillary cases and clinical forms of borderline and lepromatous is in those aged between 15 to 45 years. This data is worrying since it affects the economically active age group, and account for a greater transmission of disease. Thus, the need to intensify health education practices is clear, investigation of contacts and active search of abandonments of treatment to try to break the chain of transmission. There was growth in the proportion of new cases with degree of disability assessed. This trend in the proportion of cases with grade 2 disability signals the constant hidden prevalence and late diagnosis of the disease leading to clinical complications and neurological damage caused by bacillus.[25]

Another important aspect to be discussed is that the Tucano municipality of indicators have lagged behind the planned target by the WHO between 2010 and 2015 downward trend in overall detection of new cases, or the goal of reducing the level 2 disability at 35%. 7,26O coefficient degree cases with 2 is an indicator that measures the clinical course of disease in the population within one year, regardless of case detection rates or even prevalence.[26]

The high number of patients with some degree of disability at diagnosis is noteworthy, reflecting a late detection, even before decentralized actions of service to users, which contributes to the permanence of undiagnosed cases (hidden prevalence) and continuity of the chain transmission.[7] The active search for new cases and the provision of treatment, as well as their contacts, home visits and practices developed by USF represent important actions for reducing this agravation.[23,24] Moreover, as leprosy is more significant in the population where socioeconomic conditions are more precarious, and the treatment subjects the individual to a strong antibiotic, it is necessary to the development of actions by the state, as well as a multidisciplinary team to monitor the individual.

One has to recognize the strengthening of the leprosy control program in Tucano, which promoted improvements in active case finding, diagnosis and treatment of disease in the population, justifying the exponential increase in the detection of new cases in those years under study. But this sudden increase in the overall detection rate of the disease cannot be attributed to changes in the epidemiological profile, given that leprosy is not a sensitive infectious disease to elimination strategies, but a chronic stable and long incubation period the pathogen, which has affinity for populations with unfavorable social and economic contexts.[23]

As the incidence allows us to estimate the power transmission of the disease and assess the impacts of the actions that are being implemented to reduce it, the results show the effects of the actions developed over time and the need to intensify them, implementing measures as disclosure about the disease and its diagnosis and treatment network, periodic campaigns for evaluating spots on service users, active search of home by Community Health Agents and the entire Family Health Team and the active participation of users.

The spatial distribution analysis allowed us to view areas of the city with the highest concentration of cases of leprosy. Spatial analysis of leprosy cases in Tucano, together with the local epidemiological research showed a worrying scenario regarding the distribution, transmission and maintenance of the disease in the region. The geoprocessing techniques showed the existence of two regions as key areas of disease transmission in the municipality both rural and downtown. These two large geographical areas of concentration of cases are in the vicinity of the basic units of municipal health, which may be associated with better accessibility of users to health services offered. It should be

noted that although the map shows a distinct spatial pattern, represented by varying the color depth, one sees a potential risk of transmission of leprosy to the fullest extent mainly in urban and peri-urban areas. Thus, the municipality must strengthen the active search for cases, especially in rural and hard to reach areas.

Urbanization of infectious and parasitic diseases, reported that the occurrence of so-called rural endemic diseases, follows both the precarious conditions of life existing on the periphery of cities as the articulation of these areas with the rural environment. They also claim that this social exclusion framework is crucial in economic and social policies that contribute to the shaping of an epidemiological transition, with the transfer characteristic morbidity and mortality profiles of rural to urban environments. These studies demonstrate that the sheltered population, mainly in the outskirts of cities and poor areas suffer greater impact in the incidence of communicable diseases. They then determine which sites interact with the process development conditions, allowing not only the increase in incidence and morbidity but also the geographical expansion and generation of different involvement profiles.[27-8]

A general reflection of the data allows us to infer that in the context of different epidemiological settings of leprosy, even after three decades of implementation of multidrug therapy, there are still discussions about the high rates of case detection, maintenance of transmission of the disease and the occurrence of complications clinics as a degree of physical disability and leprosy reactions. Strategic innovations continue in an attempt to improve the effectiveness to achieve the goal of elimination of leprosy as a public health problem in endemic countries.[7,29]

CONCLUSION

Despite the study's limitations with the use of the information available secondary data may give an idea of the endemicity of the disease in the municipality of Tucano/BA and allowing reformulate more effective control strategies.

This study demonstrated the need for a redefinition of control strategies of integrated leprosy to achieve the desirable results of early detection and cure according to the parameters defined by the Ministry of Health.

The use of spatial analysis of leprosy cases tools to estimate the risk of transmission and occurrence of the disease was effective in defining priority areas for control and deepen the analysis of environment, infections and definition of preventive measures. Increase research related to active case finding, especially in rural areas and difficult access to health services, and evaluation of abandonment reasons of treatment may be useful in order to support the planning of the control actions and monitoring of leprosy.

Thus, understanding the dynamics of disease transmission, as well as the identification of those in at risk of infection areas is essential to facilitate actions of epidemiological surveillance of municipal leprosy.

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