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ORIGINAL ARTICLE

SPATIAL DISTRIBUTION OF LEPROSY IN MUNICIPALITIES OF THE STATE OF GOIÁS IN THE YEAR 2020

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ABSTRACT

Leprosy is a chronic infectious disease caused by an acid-resistant bacillus called *Mycobacterium leprae* and the disease is characterized by its slow multiplication, with an excessively long incubation period. The objective of the research was to evaluate the spatial distribution of leprosy cases among the municipalities of the State of Goiás in 2020. This is a descriptive study and the data collection took place from the Notifiable Diseases Information System (SINAN) in November, 2021 and it considered the diagnosis´ year and the patient's municipality of residence. The following indicators were adopted in the analysis: a) annual prevalence rate per 10,000 inhabitants; b) annual rate of new cases detection in the general population; and c) annual rate of new cases detection in individuals under 15 years of age, these last two per 100,000 inhabitants. The analysis of the spatial occurrence pattern of leprosy in Goiás State municipalities was carried out in the free software Terraview version 4.2.2. A higher prevalence of distribution of the gross rate of the disease was observed in the Central-North and Central-West macro-regions, with a concentration of cases also in the Northeast region of the State. From the 246 Goiás municipalities, 68.7% (n = 169) had cases of leprosy, 18.3% (n = 45) were in a situation of hyperendemia and 23.2% (n = 57) had a very high detection coefficient. Considering the rate of detection in those people under 15 years of age, only 11 municipalities (4.5%) were in a situation of hyperendemia and 1.2% (n = 3) had a very high detection coefficient (5.00 to 9.99/ 10.000 inhabitants). The current investigation indicates the maintenance of leprosy hyperendemic areas in the State of Goiás, when compared to previous studies. This finding highlights the importance of readjustment of leprosy management and assistance in municipalities at greater risk of leprosy hyperendemicity in order to interrupt the *M. leprae* transmission chain.

KEY WORDS: Leprosy; prevalence; spatial distribution; Goiás State.

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INTRODUCTION

Hansen's disease is a chronic infectious disease caused by an acid-resistant bacillus called *Mycobacterium leprae*. This microorganism is characterized by a slow multiplication, with an excessively long incubation period, which can extend for years and manifest itself in any age range (WHO, 2018, 2021).

Its transmission occurs through the respiratory route. It can happen through close and prolonged contact of the susceptible individual with the untreated carrier. This disease usually occurs in the family and in the social environment, it being known that the vulnerability that conditions some people to develop this illness is influenced by genetics (BRASIL, 2017).

Data show that up to 95% of individuals exposed to the bacillus do not develop the disease. However, even so, prevention and timely treatment are of extreme relevance. Leprosy may affect mainly the skin and the peripheral nerves, which results in neuropathy and long-term sequels, with deformities and disabilities. It triggers various stigmas due to its clinical manifestations (WHO, 2018).

Although it is treatable and curable, it still represents a relevant public health disorder, composing the international agenda of the United Nations (UN) as a goal of sustainable development to combat neglected infectious diseases (BRASIL, 2021). In this context, despite a decrease in the number of notifications in its recent history, Brazil still occupies the second position in the world in absolute number of cases of the disease, only behind India (WHO, 2021). Despite the national trend of decrease in the number of cases in Brazil, still hyperendemic averages are observed in some States of the Central-West, North and Northeast regions, according to Ribeiro et al. (2018) and Schneider & Freitas (2018).

In light of this scenario, the objective of this work is to evaluate the spatial distribution of cases of leprosy among the municipalities of the State of Goiás, in 2020. It was made to identify regions with the need for a better assistance network organization, as well as to provide subsidies to help to develop health promotion strategies.

METHODOLOGY

This is a descriptive study on the spatial distribution of leprosy, targeting the municipalities of the State of Goiás in the year 2020. Data collection occurred in November 2021 and it considered the year of diagnosis and the municipality of residence of the patient.

To create the descriptive sociodemographic tables and clinical data related to the disease, as well as the maps with its spatial distribution, the research collected secondary data in the Notifiable Diseases Information System (SINAN). The information related to the resident population was obtained from the study of population estimates by municipality, sex and age on the period of 2000-2020, from the Brazilian Institute of Geography and Statistics (IBGE), available at the unified health system (BRASIL, 2020) database.

In the analysis, the indicators recommended by the Leprosy Surveillance Guide were adopted: a) annual prevalence rate per 10,000 inhabitants; b) annual rate of detection of new cases in the general population; and c) annual rate of detection of new cases in individuals under 15 years of age, the last two per 100,000 inhabitants (Brasil, 2016a).

Briefly, the following requirements are considered for calculation purposes, according to the same Ministry of Health Guide:

1) for the prevalence rate: the numerator will include the cases in current treatment in a certain location on December 31st of the evaluated year, while the denominator will be composed of the total population in the same treatment location and evaluation year;

2) for the detection rate in the general population: in the numerator the new cases residing in a certain location and diagnosed in the evaluation year are used, while in the denominator will be included the total resident population, in the same location and period;

3) for the detection rate in those under 15 years old: the new cases in those under 15 years old residing in a certain location and diagnosed in the evaluation year will be included in the numerator and the denominator will be composed of the population from 0 up to 14 years old, in the same location and period.

For the study, we used the following parameters adopted by the Brazilian Ministry of Health:

A) Annual prevalence: low: <1.0; medium: 1.0 to 4.9; high: 5.0 to 9.9; very high: 10.0 to 19.9; hyperendemic> 20.0;

B) Annual detection in the general population: low: <2.00; medium: 2.00 to 9.99; high: 10.00 to 19.99; very high: 20.00 to 39.99; hyperendemic> 40.00;

C) Annual detection in those under 15: low: <0.50; medium: 0.50 to 2.49; high: 2.50 to 4.99; very high: 5.00 to 9.99; hyperendemic> 10.00 (BRASIL, 2016a).

Therefore, to analyze the spatial pattern of leprosy occurrence in Goiás State municipalities, the free software Terraview version 4.2.2, provided by the National Institute of Space Research (INPE, 2013) was used. The local empirical Bayes model was also employed to smooth the rates of each municipality, as using neighborhood information of each one, this measure reduces the instability of rates in small areas (Assunção et al., 2005).

RESULTS

According to the data collected in the SINAN database, in 2020, 1,150 cases of leprosy were identified, with a predominance of notifications in males (59.6%), of people with degree between incomplete elementary school and incomplete high school (67.7%), of the brown race (62.4%) and age between 40-59 years old (43.7%), as shown in table 1.

In relation to race, in addition to brown, white people represent the second highest notification rate (22.8%), followed by the black population (13.4%). Still addressing the sociodemographic profile of the cases studied, according to the guidelines for Leprosy Surveillance (BRASIL, 2016a), the rate of diagnoses in age groups under 15 years old which, in this research, represented the minority of notifications (2.7%), even though this finding requires attention.

Table 1. Sociodemographic profile of leprosy cases among residents in the State of Goiás in 2020.

Variables	N	%
Gender		
Masculine	685	59.6
Feminine	465	40.4
Education		
Illiterate	67	7.3
Incomplete elementary to incomplete middle school	620	67.7
Complete middle school and incomplete high school	185	20.2
Complete high school	44	4.8
Race		
White	259	22.8
Black	152	13.4
Yellow	9	0.8
Brown	709	62.4
Indigenous	7	0.6
Age group		
1 to 14 years old	31	2.7
15 to 39 years old	311	27.1
40 to 59 years old	503	43.7
≥ 60 years old	305	26.5

Source: SINAN (November 2021); Ignored: education n=234 and race n=14.

In relation to the clinical profile of the diagnosed cases, as shown in Table 2, the Multibacillary operational classification (84.0%) and Dimorphic clinical form (56.9%) prevailed at the time of diagnosis, followed by Virchowian (22.5%). As for the disability assessment, the majority presented grade zero (52.5%) or grade I (27.1%).

Table 2. Clinical profile of leprosy cases among residents of the State of Goiás in 2020.

Variables	N	%
Operational Classification in Diagnosis		
Paucibacillary	184	16.0
Multibacillary	966	84.0
Clinical Form in Diagnosis		
Undetermined	112	10.7
Tuberculoid	104	9.9
Borderline	596	56.9
Virchowian	236	22.5
Assessment of Disability in Notification		
Grade zero	664	62.5
Grade I	288	27.1
Grade II	111	10.4

*Source: SINAN (November 2021); Ignored: Clinical Form n=102 and Assessment of Disability n=87.

The Goiás State is located in the Brazilian Central-West region, it is composed of 246 municipalities and it has a population of more than 6 million people (IBGE, 2010). The municipalities are organized in 5 macro-regions composed by 18 health regions (GOIÁS, 2021): a) Central-West (Central, Rio Vermelho, West I and West II); b) Central-Southeast (Central South, Railway and South); c) Central-North (Pirineus, Saint Patrick I, Saint Patrick II, Serra da Mesa and North); d) Southwest (Southeast I and Southeast II); and e) Northeast (South Entorno, North Entorno, Northeast I and Northeast II) (Supplemental material).

Therefore, from the spatial distribution of leprosy among the municipalities of the Goiás State in 2020, as presented in Figure 1, it is possible to observe a higher gross rate in the North-Center (municipalities of São Miguel do Araguaia and Campos Verdes) and West-Center (municipalities of Jussara and Novo Brasil) regions, with a concentration of the cases also in the Northeast region (municipalities of Alvorada do Norte and Buritinópolis) of the State.

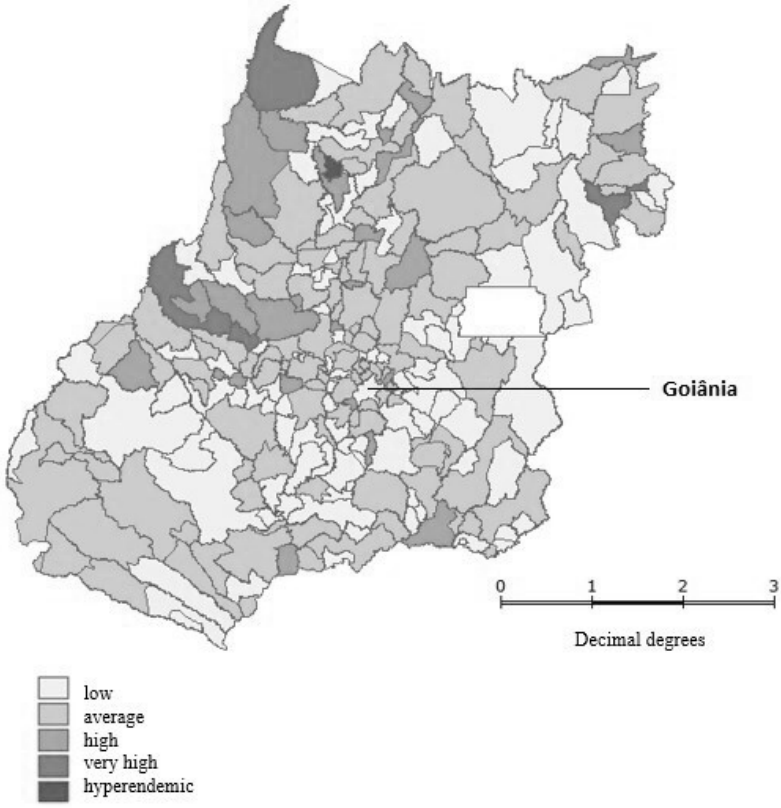

Figure 1. Spatial distribution of the annual prevalence of leprosy in the general population per 10,000 inhabitants (gross rate), in the State of Goiás, 2020.

In a general analysis, among the 246 Goiás municipalities, 68.7% (n = 169) presented cases of leprosy, of which 18.3% (n = 45) are in an hyperendemic (> 40.0/ 100,000 inhabitants) situation (Municipalities of São Miguel do Araguaia, Mundo Novo, Nova Crixás, Mozarlândia, Santa Terezinha de Goiás, Campos Verdes, Nova América, São Luíz do Norte, Rianápolis, Itaguari, Santa Rosa de Goiás, Guaraíta, Goiás, Itapirapuã, Novo Brasil, Córrego do Ouro, Moiporá, Jussara, Santa Fé de Goiás, Aragarças, Piranhas, Turvânia, Avelinópolis, Abadia de Goiás, Goianápolis, Bonfinópolis, Professor Jamil, Acreúna, Aparecida do Rio Doce, Gouvelândia, Corumbaíba, Nova Aurora, Palmelo, Padre Bernardo, Vila Propício, Niquelândia, Campinorte, Estrela do Norte, Formoso, Trombas, Montividiu do Norte, Campos Belos, Guarani de Goiás, Alvorada do Norte and Buritinópolis) and 23.2% (n = 57) have a very high detection coefficient (Figure 2).

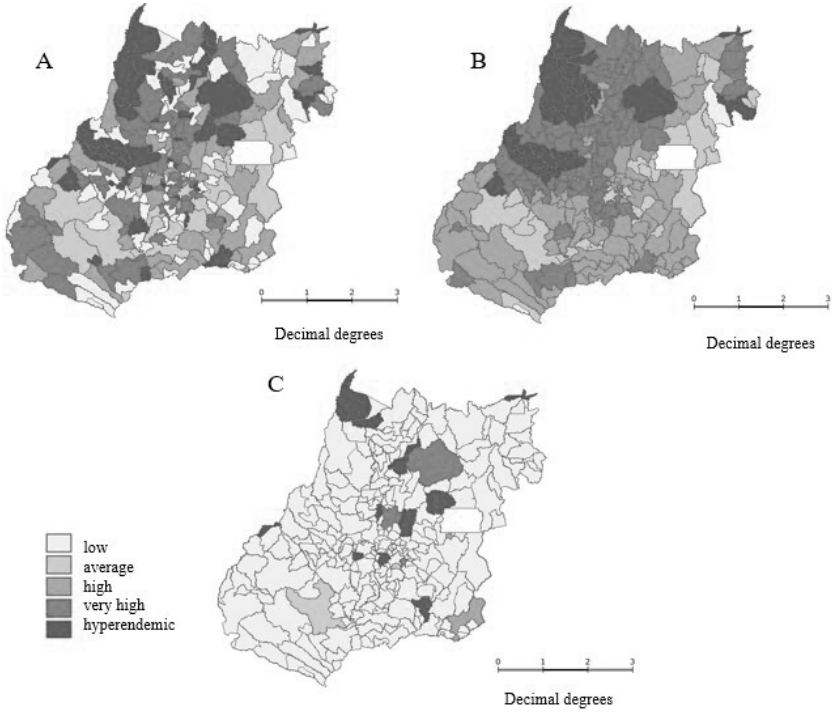

Figure 2. Spatial distribution of the detection coefficients of new cases of leprosy in the general population per 100 thousand inhabitants (A = crude rate and B = local empirical Bayesian rate) and in the population from 0 to 14 years old (C = crude rate), in the State of Goiás, 2020.

The empirical local Bayesian method, by smoothing the influence of small populations on the final statistics, generated corrected indicators, pointing 9.8% of the municipalities (n = 24) in an hyperendemic situation (municipalities of São Miguel do Araguaia, Nova Crixás, Mozarlândia, Mundo Novo, Bonópolis, Uirapuru, Crixás, Santa Terezinha de Goiás, Campos Verdes, Guarinos, Niquelândia, Jussara, Santa Fé de Goiás, Itapirapuã, Fazenda Nova, Novo Brasil, Buriti de Goiás, Goiás, Guaraíta, Piranhas, Alvorada do Norte, Sítio D'abadia, Buritinópolis and Campos Belos) and 41.7% (n = 101) with a very high detection coefficient (20.00 to 39.99/ 100.000 inhabitants) (Figure 2-B).

Considering the detection rate in those under 15 years old, only 11 municipalities (4.5%) were in a state of hyperendemia (municipalities of São Miguel do Araguaia, Bonópolis, Uruaçu, Aragarças, Uruana, Turvânia, Trindade, Pirenópolis, Padre Bernardo, Campos Belos and Caldas Novas) and 1.2% (n = 3) had a very high detection coefficient (Figure 2-C).

Thus, observing the map with the spatial distribution of new cases of leprosy in the general population (Figure 2-A), it is possible to affirm that the highest concentration of cases is also found in the Central-West and Central-North macro-regions (similar to that identified in the prevalence rate distribution), with small foci with high concentrations of cases in other macro-regions. In the map produced with the local empirical Bayesian rate (Figure 2-B), we confirm the Central-West and Central-North macro-regions as the regions with a hyperendemic or very high concentration of cases, while the Northeast macro-region also has municipalities with high and very high concentration foci, in addition to hyperendemic cases.

As for the detection rate in the population under 15 years old (Figure 2-C), there is a greater concentration of cases in the same macro-regions of map B (Central-West and Central-North), with records of cases still in the Northeast macro-region and a new region with a very high detection focus that was not observed in the previous maps, the Central-Southeast macro-region.

DISCUSSION

According to a study by Schreuder et al. (2016), Brazil is the country with the highest number of leprosy notifications in the Americas (94% of new cases) and the Central-West region is one of the most endemic, sharing space with the North and Northeast regions (Schneider & Freitas, 2018). Therefore, this study respects the guidelines of the last Special Epidemiological Bulletin of Leprosy (BRASIL, 2021) which is essential to use official databases as a source of investigation for the construction of occurrence profiles, vulnerability and elaboration of management subsidies and decision making.

In this way, the sociodemographic data related to the majority of people diagnosed with leprosy in Goiás in the prospect for 2020 (incomplete elementary to incomplete high school and brown race) corroborate the premise that the high detection rates of leprosy in Brazil may be directly linked to inadequate economic, social and environmental conditions (BRASIL, 2019). This group of people represents a portion of the population with low education level and, consequently, they have less access to information and specialized health care, which favors their vulnerability and the spreading of the disease, in a kind of historical and social determination.

The use of spatial distribution maps, including the local empirical Bayesian model to smooth the impact of instability between bordering municipalities population and identify the likelihood between them (Souza et al., 2018), represents an important and accessible tool for identifying needs. That spans access and organization of health services, qualification of professionals involved in surveillance and assistance, fighting poverty, educational improvements, among other factors related to the disease (Araújo et al., 2020; GOIÁS, 2017).

According to an official report, in 2016, the States with highest number of notifications of new cases of leprosy in Brazil were Mato Grosso and Tocantins, respectively (BRASIL, 2016b). The results of the present investigation show hyperendemia in municipalities of the Central-North and Central-West regions of Goiás - bordering the States of Tocantins and Mato Grosso. This correlation supports the argument that urbanization and interstate migration reinforce the transmission pattern of leprosy (Araújo et al., 2020), as well as the idea that social and socio-economic factors condition its maintenance (Monteiro et al., 2015).

It is understood that the hyperendemic picture in some macro regions - pointed out by this study and already identified in previous investigations (GOIÁS, 2017) - may be influenced by the immigration of cases from endemic regions, such as Tocantins, Mato Grosso and Bahia. This idea is supported by the fact that smoothed indicators make it feasible to understand the areas with the greatest risk for leprosy (even in places with small populations), while the long incubation period of the disease may influence the moment of its diagnosis (Souza et al., 2018), and taking into consideration the mobility between States and regions.

Both in Goiás and in Brazil, leprosy is distributed unevenly (GOIÁS, 2017; Silva et al., 2015). The study carried out by Lima et al. (2020), analyzing a time series from 2007 to 2017, observed a trend of decrease in the detection rates of leprosy cases in Goiás (both in the general population, and for those under 15 years of age). Even though the values identified were above the national average and could be compared to the epidemiological situation of the States in the North and Northeast regions of the country.

On the other hand, the detection of cases in minors under 15 years of age in 2020 was 2.7%, a much lower number than that found by Souza et al. (2018) in a study from 2001 to 2012 in Bahia, where the detection in this age group was 4.6%. In the study developed by Schneider & Freitas (2018), the rate of leprosy detection in minors under 15 years of age in Brazil was 5.8% and in the Midwest was 9.6%, for the period from 2001 to 2016. Thus, the results presented indicate a decrease in the detection of cases in minors under 15 years old in the Goiás State, which may be a consequence of a real decrease in cases or failure of detection/notification of the same (GOIÁS, 2017).

In the meantime, the irregular distribution of the prevalence rate among the municipalities of the State, as indicated in the results and already presented in an official bulletin of the SES/GO (GOIÁS, 2017), as well as the hyperendemic regions identified by the Bayesian calculation, in addition to the suspicion of the effectiveness of the surveillance service and the centralized health care model, point to priority focal areas for interventions and understanding of the transmission dynamics. Although it is recognized that, apart from an increase in coverage and articulation of the health care network, it is necessary to sensitize and empower the teams of Primary Care, redefining work and performance processes of Health Units, among other factors (GOIÁS, 2017; Souza et al., 2018).

Compared to previous reports, the current study indicates the maintenance of leprosy hyperendemic areas in the State of Goiás and highlights the importance of the readjustment of leprosy management and assistance in the municipalities at greatest risk of Hansen's disease transmission and hyperendemism. This is especially relevant considering the direct impact of the current Covid-19 pandemic on the active search, diagnosis and notification of silent leprosy in the communities.

The authors recognize the lack of strength of the secondary data analysis, due to the qualitative and quantitative failures of the collection and stratification process. Therefore, new studies are needed to better characterize the form of organization and access to surveillance and health assistance services in the leprosy hyperendemic macro regions, as well as the factors related to the spread and persistence of the health-disease situation.

Thus, extensive investment is needed in the identification of strategies for health promotion, transmission control and disease prevention with a focus on the capacity building of the communities and the professionals involved in Basic Care. These activities represent the basis for expanding active research, early diagnosis and reducing underreporting, as well as promoting greater adherence to established treatment.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests to disclose.

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