

**Epidemiological behavior of leprosy in the state of Mato Grosso: a geospatial approach***Comportamento epidemiológico da hanseníase no estado do Mato Grosso: uma abordagem geoespacial**Comportamiento epidemiológico de la lepra en el estado de Mato Grosso: un enfoque geoespacial*Antônio Marcos Moreira Aguiar<sup>1</sup>, Monia Maia de Lima<sup>1</sup>, Wagner Izidoro de Brito<sup>2</sup>

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**ABSTRACT**

**Objectives:** To analyze the epidemiological pattern of leprosy in the state of Mato Grosso from 2007 to 2011 from a geospatial analysis. **Method:** ecological, descriptive-transversal study, performed from SINAN, TABNET, DATASUS and GEODA software version 0.9.5 Spatial Analysis Laboratory, University of Illinois at Urbana-Champaign, USA. **Results:** Of the 13,648 reports, 6,583 (48.23%) were in the age range of 40 to 69 years. The state surpassed 16 cases/10 000 thousand inhabitants. The indicator younger than 15 years showed positive autocorrelation ( $I = 0.220711$   $p = 0.001$ ). The illiteracy rate ( $p = 0.011$ ) and the Gini Coefficient ( $p = 0.020$ ) were predictive factors in the disease. **Conclusion:** The results demonstrate the endemic character of leprosy in the State of Mato Grosso, which reinforces the importance of prevention actions, timely diagnosis, adequate treatment and continuous monitoring of this disease.

**Descriptors:** Leprosy; Health Information Systems; Spatial Analysis; Public Health Surveillance.

**RESUMO**

**Objetivos:** Analisar o padrão epidemiológico da hanseníase no Estado do Mato Grosso entre os anos de 2007 a 2011 a partir de uma análise geoespacial. **Método:** estudo ecológico, descritivo-transversal, realizado a partir do SINAN, TABNET, DATASUS e do software GEODA versão 0.9.5 *Spatial Analysis Laboratory, University of Illinois at Urbana-Champaign*, Estados Unidos. **Resultados:** das 13.648 notificações, 6.583 (48,23%) foram na faixa etária de 40 a 69 anos. O estado ultrapassou 16 casos/10 000 mil habitantes. O indicador "menores de quinze anos" demonstrou autocorrelação positiva ( $I=0,220711$ ,  $p= 0,001$ ). A taxa de analfabetismo ( $p=0,011$ ) e o Coeficiente de Gini ( $p=0,020$ ), foram fatores preditivos no adoecimento. **Conclusão:** Os resultados demonstram o caráter endêmico da hanseníase no estado do Mato Grosso, o que reforça a importância das ações de prevenção, diagnóstico oportuno, tratamento adequado e monitoramento contínuo deste agravo.

**Descritores:** Hanseníase; Sistemas de Informação em Saúde; Análise Espacial; Vigilância em Saúde Pública.

**RESUMÉN**

**Objetivos:** Analizar el patrón epidemiológico de la hanseníase en el Estado de Mato Grosso entre los años de 2007 a 2011 a partir de un análisis geoespacial. **Método:** estudio ecológico, descriptivo-transversal, realizado a partir del SINAN, TABNET, DATASUS y del software GEODA versión 0.9.5 *Spatial Analysis Laboratory, University of Illinois at Urbana-Champaign*, Estados Unidos. **Resultados:** de las 13.648 notificaciones, 6.583 (48,23%) fueron en el grupo de edad de 40 a 69 años. El estado superó 16 casos/10 000 mil habitantes. El indicador "menores de quince años" demostró autocorrelación positiva ( $I = 0,220711$ ,  $p = 0,001$ ). La tasa de analfabetismo ( $p = 0,011$ ) y el Coeficiente de Gini ( $p = 0,020$ ), fueron factores predictivos en la enfermedad. **Conclusión:** Los resultados demuestran el carácter endémico de la hanseníasis en el estado de Mato Grosso, lo que refuerza la importancia de las acciones de prevención, diagnóstico oportuno, tratamiento adecuado y monitoreo continuo de este agravo.

**Descriptorios:** Lepra; Sistemas de Informação em Saúde; Análise Espacial; Vigilância em Saúde Pública.

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## INTRODUCTION

At the end of the nineteenth century, Armanuer Hansen discovered that leprosy was a disease of infectious contagious character, which was important to begin a new vision about this disease, which until then had a mystical and religious character involved. Thus, a new moment begins that has allowed over the years to reduce the impacts of this disease in the daily lives of patients in the physical and psychological field.<sup>1</sup>

Regarding epidemiology, 301,322 cases of leprosy were reported throughout the country between 2008 and 2016, of which 21,666 (7.2%) were under 15 years of age. During this same period, the overall annual detection rate of new cases was reduced by 43.0%, from 21.5 to 12.3/100 thousand inhabitants; and, in the under-15 age group, the reduction was 50.7%, from 2.1 to 1.1/100 thousand inhabitants.<sup>2</sup> According to the epidemiological bulletins of the Ministry of Health, leprosy still presents an endemic pattern more prevalent in some units of the federation, although the prevalence coefficients begin to present declining lines in recent years.<sup>3</sup>

Leprosy is a chronic, infectious disease caused by *Mycobacterium leprae* bacillus of high infectivity but low pathogenicity. It has great repercussion for public health by the magnitude of incapacitating power, reaching mainly the economically active age group. In this context, control of leprosy is based on early diagnosis and timely treatment, aiming at eliminating as early as possible the sources of transmission and division, the state is made up of 141 municipalities.<sup>8</sup>

reducing the hidden prevalence of infectious cases in the community, thus minimizing the current risk of infection.<sup>4-5</sup>

The Ministry of Health (MS) defines as a case of leprosy in situations where the patient presents hypochromic, brownish and reddish skin lesions with altered thermal, painful and tactile sensitivity. This is added to the peripheral neurological changes such as pain, shock, tingling and reduction of motor power in the upper and lower limbs.<sup>6</sup>

The clinical diagnosis is made through anamnesis of the clinical and epidemiological history and physical examination of the patient, through a dermato-neurological evaluation, to identify clinical signs of the disease.<sup>7</sup>

The problem of this study has relevance in the public health level, considering that this aggravation still presents itself as a serious problem throughout the national territory, as it had the objective of analyzing the epidemiology of leprosy in the State of Mato Grosso between the years 2007 to 2011, using techniques of geospatial approach.

## METHODS

This is an ecological, descriptive, cross-sectional study with secondary data from 2007 to 2011, using spatial data analysis techniques to analyze cases of leprosy in the state of Mato Grosso. Mato Grosso, a Brazilian state whose capital is Cuiabá, has an estimated population of 3,035,122 inhabitants, distributed over an area of 903,366,192 km and with a population density of 3.36 (hab/km<sup>2</sup>). Regarding its geographical

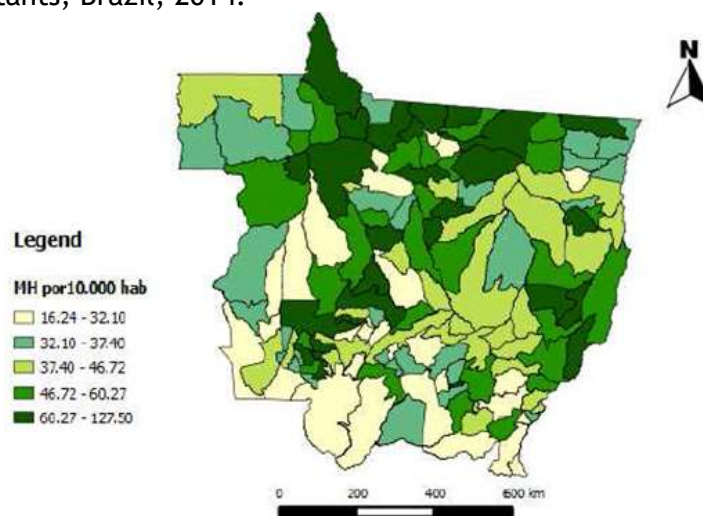
The information was extracted in a secondary way, considering that they are in the

public domain and without prejudice to third parties. We analyzed the database of DATASUS, TABNET and SINAN.

In order to establish the desired morbidity, the variables used to elaborate the clusters were: demographic, socioeconomic indicators, operational classification, new cases in children under fifteen, general detection coefficient and degree of incapacity in diagnosis. For the first step, the data were collected, organized and synthesized in an Excel® worksheet and then analyzed in descriptive form using absolute numbers, percentages and proportions. In the second stage, the cases were spatialized at the state level. As in the descriptive analysis, a statistical significance level of 5%.

To calculate spatial autocorrelation rates for morbidity, socioeconomic factors and demographic indicators for each city, the Moran Global Index was used for univariate and bivariate analysis. Spatial Empirical Bayes was used to smooth population population rates. The

**Map 1:** Spatial Distribution of Leprosy in the Population of the State of Mato Grosso, between 2007 and 2011, per 10,000 inhabitants, Brazil, 2014.



Source: Notification of Injury Information System

Concerning the geospatial context, it can be observed that approximately twenty-eight

spatialization was performed using the GEODA software. The present study was approved by the Ethics Committee of the State University of the West of Paraná, under the opinion n° 322.290.

## RESULTS

Based on data from DATASUS/TABNET/SINAN, between 2007 and 2011, the state of Mato Grosso registered a total of 13,648 cases of leprosy, with a reduction in the number of patients over the analyzed period. The age group most affected was 40 to 69 years, with 6,583 notifications (48.23%).

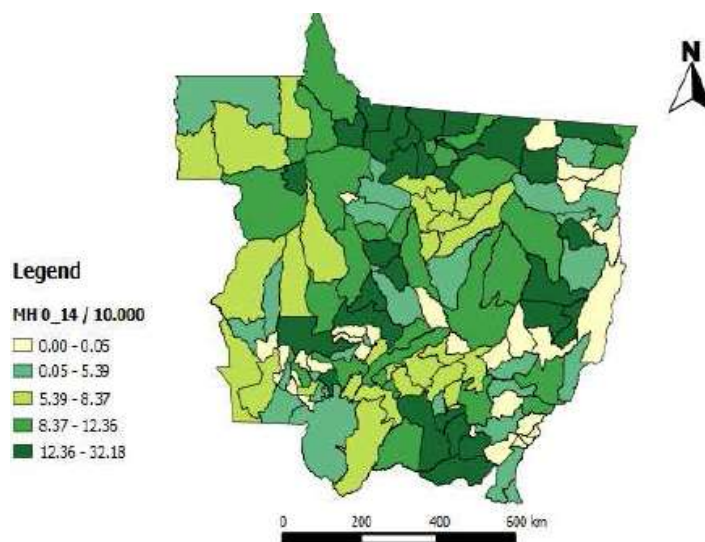
Through the spatial analysis of leprosy in the population of the state of Mato Grosso, it was possible to observe its endemic behavior. Areas with indices higher than those recommended by the Ministry of Health, the World Health Organization and the Pan American Health Organization were found to be less than 1 case per 10,000,000 inhabitants (Map 1).

municipalities (19.9%) have rates ranging from 46.72 to 60.27 per 10 thousand inhabitants. The

demographic characteristics of borders that the state of Mato Grosso makes with the states considered hyperendemic is highlighted, which potentiates a migratory influx of a population contingent into the 141 municipalities of the state.

Leprosy in children under fifteen is one of the main health indicators used by the technical teams of the Ministry of Health to monitor the progression of this disease nationwide. In the present study it was possible to visualize the endemic character of leprosy in this age group (Map 2).

**Map 2:** Geospatial distribution of leprosy in children under fifteen years of age, between 2007 and 2011, with an adjusted rate of 10 thousand inhabitants, Brazil, 2014.



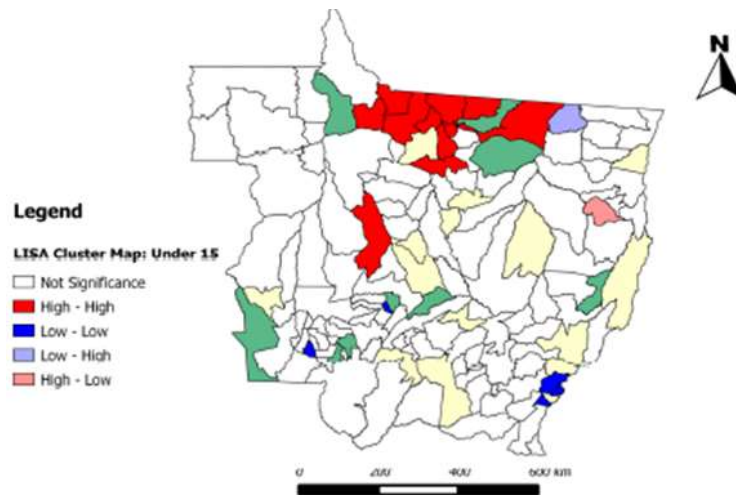
Source: Notification of Injury Information System

Nevertheless, it was possible to evidence the presence of epidemiological clusters of leprosy in the state of Mato Grosso. This instrument allows demonstrating the behavior of this aggravation in our state, as well as the geodemographic delimitation of the main areas of risk. Therefore, it is possible to classify these city groups using the following categories: (1) high-high, that is, cities with high morbidity by MH with surrounding neighbors also with high

morbidity by MH, (2) low-low, or (3) low - high, ie cities with low MH indices with neighbors with high morbidity by MH, and (4) high - low, that is, cities with high morbidity per MH, with neighbors with indices.

Six high-level clusters were identified involving 10 cities, these are located in the northern region of the state on the border with the state of Amazonas (Map 3).

**Map 3:** Clustering of Epidemiological Clusters of leprosy for its geospatial distribution of cases between 2007 and 2011, Brazil, 2014.



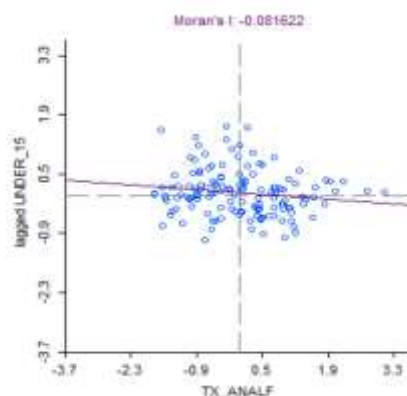
Source: Notification of Injury Information System

The dispersion diagrams of Moran on the socio demographic variables income and population density showed spatial independence. These, at least in the first instance, do not meet the epidemiological outline that may affect and / or predispose a particular population to the development of leprosy. These variables presented negative spatial correlation, which further incites the discussions about the main factors that may be

affecting the state of Mato Grosso to maximize statistics.

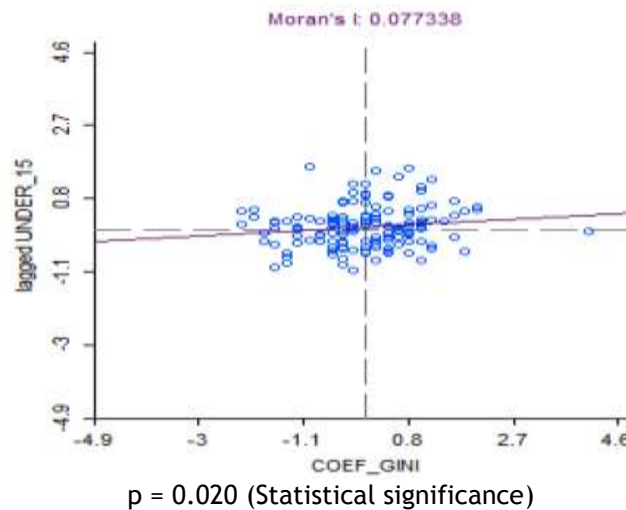
However, the variables of illiteracy rate (Graph 1) and Gini coefficient (Graph 2) showed a positive spatial autocorrelation, indicating that these two factors influence the process of disinformation and social inequality, thus contributing to predispose a given population to the risk of get sick.

**Graph 1:** Moran Dispersion Diagram according to the Spatial Matrix for the variable of illiteracy rate, between the years 2007 to 2011, Brazil, 2014.



p = 0.011 (Statistical significance)

**Graph 2:** Spatialization of leprosy cases according to the variable Gini Coefficient, between the years 2007 to 2011, Brazil, 2014.



## DISCUSSION

Leprosy is a historical grievance, which has had most of its history built upon the mythical and divine perspective. However, it is a fact that before the discovery of its etiologic agent and the advance of medicine thousands of people developed this pathology and its incapacities. In Brazil it assumes a prevalent historical character in all states of the federation. This can be seen from the demonstrations of epidemiological bulletins of the Ministry of Health, which says that the Midwest region presents numbers above the recommended average, with a coefficient of 60.77/100,000 inhabitants.<sup>4</sup>

Regarding the age pattern, this study showed a prevalence among those aged 40 to 69 years, followed by the age range of 15 to 39 years. A study carried out in a city in the state of São Paulo found that 42.9% of the total sample was included in the age group of 20 to 39 years, followed by the age range of 40 to 59 years with 33.68% of the records.<sup>9</sup>

The prevalence of leprosy was identified in other studies conducted in the city of

Fortaleza, CE, where the authors reinforce the endemic character of this disease in all age groups, with a concern of concern in children under fifteen years of age, the main official indicator for monitoring of the disease in the national territory, in addition to strengthening the actions of early diagnosis and prevention.<sup>10</sup>

This condition may be associated with the intrinsic factors of the pathology, such as prolonged incubation period, associated with genetic and environmental factors. Brazil maintains an average detection coefficient in children under 15 years of age of 0.53 new cases per 10,000 inhabitants (absolute number 2,980 new cases).<sup>4</sup>

A doctoral thesis focusing on the social determinants and endemic areas of leprosy in the states of Mato Grosso and Mato Grosso do Sul evidenced that the gross rate of detection is four times higher in TM, in addition to a larger population in relation to MS in almost half a million people. Narrow differences in sex ratio and age groups were observed, in addition to a



larger proportion of young people under the age of 15 identified in the MT.<sup>11</sup>

Leprosy has become uncommon, so doctors may not recognize early manifestations, as well as pathologists may not include it in differential diagnosis, making it difficult to recognize the early symptoms of the disease, which usually take time to appear.<sup>12</sup>

Mato Grosso presents rates for those under fifteen years old that are worrisome, which place it in the central actions of the Ministry of Health. Once again, the legal Amazon is compromised in relation to leprosy, with the state of Tocantins occupying the first position in the country, with the coefficient of 23.6/100,000 inhabitants, Mato Grosso occupying the second position, with the coefficient of 19.74/100,000.<sup>4</sup>

Spatialisation techniques are interesting epidemiological tools because they allow different diseases to be identified and monitored in different geographic areas, as well as to determine population groups that are more vulnerable to illness within their geographical, economic and socio-cultural context. Considering that leprosy is an infectious, chronic and silent disease, the elaboration of these clusters is relevant, in order to obtain a more reliable reality of the progression of the cases.<sup>4</sup>

The relevance of this research instrument was also evidenced in a study carried out in the city of Rio de Janeiro, which identified critical areas of the endemic disease, including the risk factors related to the social, economic and health conditions of exposed individuals.<sup>13</sup>

The clusters allowed to visualize the geodemographic conditions of the state, which

reinforce that the hyperendemicity of leprosy currently found in the agricultural frontier area, which in contiguity covers several states in the Midwest, North and Northeast of Brazil, suggests some relation of the endemic process of leprosy with the occupation of new places, from where the demographic movement necessary for the clearing of a field, opinion similar to this epidemiological study on social determinants in the endemic spaces of leprosy.<sup>11</sup> Regarding the socioeconomic variables, a study showed that of the sample studied, there was a predominance of the concentration of the less privileged layers of society.<sup>14</sup>

The results show that the level of information and social inequalities are relevant in the development process of leprosy. However, other research continues to foster other factors that may act synergistically in the genesis of this disease, such as nutritional, genetic, associated infections and social variables.<sup>15</sup>

Consistent with the principles and guidelines of the Ministry of Health, it is necessary to articulate continuous and permanent actions using health education as an instrument of social inclusion aimed at health teams, community leaders and the population in general. Empowering the community about basic knowledge and suspicion of possible cases will help health facilities with regard to early diagnosis and prevention of disabilities. In addition, it is necessary to integrate the three spheres of government in the formulation of partnerships with other institutions and entities aimed at the dissemination of information.<sup>16</sup>

One of the limitations of this study was not being able to deepen and raise other

relevant discussions regarding the maintenance of this status in the state. Propositions such as genetic influence, nutrition and migratory flow are some topics that deserve special attention, thus stimulating new lines of research.

Nevertheless, it is expected that the epidemiological reality demonstrated in this study may contribute to the various technicians working in the context of public health, as well as its planning, execution and continuous monitoring of the progress of this disease at the state level and Brazil.

## CONCLUSION

The results show that the state of Mato Grosso is endemic for leprosy. All municipalities analyzed had rates above acceptable international standards - less than one case per 10 thousand inhabitants. The involvement of the age group in children under fifteen is worrisome and should foster discussions among managers, professionals and technical teams regarding the actions of prevention and early diagnosis of bacilliferous without treatment.

The illiteracy rate and the Gini Coefficient have been shown to be relevant in increasing the population's vulnerability to this problem, which further reinforces the need to articulate, plan and plan public and collective actions that reduce this socioeconomic and cultural hole of the communities more exposed. The clusters presented corroborated the endemic state of leprosy in the state, evidencing that municipalities with high disease rates are geographically close to other areas with compatible epidemiology.

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#### **COLLABORATIONS**

AMMA: substantial contribution to the conception, design, collection and analysis of data. MML and WIB: Substantial contributions to the critical review and the final version to be published.

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“In Memoriam”

To Dr. Carlos Alberto Farias Rodrigues. For his valuable scientific contribution to Brazil in the field of leprosy. In addition to mentor, a great friend.

#### **CONFLICTS OF INTEREST**

The authors declare that no have conflicts of interest

#### **AVAILABILITY OF DATA**

Available upon request to the authors

#### **FUDING SOURCE**

Does not apply.

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