DOI 10.18471/rbe.v34.37902
Original Article

SPATIAL ANALYSIS OF THE RISK OF LEPROSY DISEASE IN A NORTHEASTERN BRAZILIAN STATE

ANÁLISE ESPACIAL DO RISCO DE ADOECIMENTO DA HANSENÍASE EM UM ESTADO DO NORDESTE BRASILEIRO

ANÁLISIS ESPACIAL DEL RIESGO DE ENFERMEDAD DE LA LEPRA EN UN ESTADO DEL NORESTE BRASILEÑO

Kleane Maria da Fonseca Azevedo Araújo[1]
Lidiane Cristina Félix Gomes[2]
Francisco Carlos Félix Lana[3]

How to cite this article: Araújo KMFA, Gomes LCF, Lana FCF. Spatial analysis of the risk of leprosy disease in a northeastern Brazilian state. Rev baiana enferm. 2020;34:e37902.

Objective: to analyze the spatial distribution of the risk for leprosy disease in the municipalities of the state of Paraíba, Brazil. Method: this is an ecological study of spatial analysis. New cases of leprosy living in Paraíba, registered in the Notifiable Diseases Information System from 2001 to 2016, were included. Descriptive spatial analysis was performed in the periods of 2001-2008 and 2009-2016 of the composite index of epidemiological indicators and spatial dependence analysis through the global and local Moran indices. Results: 12,134 new cases were recorded in the period studied. Clusters with high/high classification in the east, west and northwest regions were identified in the first period. In the second period, clusters are concentrated in the east and southeast regions and decreased in the west and northwest. Conclusion: the risk for leprosy disease is present in the municipalities of Paraíba. Spatial distribution is dissimilar in the state. Surveillance actions should be a priority for the control of the endemic disease.

Descriptors: Leprosy. Epidemiology. Spatial analysis. Primary Health Care.

Objetivo: analisar a distribuição espacial do risco para o adoecimento de hanseníase nos municípios do estado da Paraíba, Brasil. Método: trata-se de estudo ecológico de análise espacial. Foram incluídos casos novos de hanseníase residentes na Paraíba, registrados no Sistema de Informação de Agravos de Notificação de 2001 a 2016. Foi realizada análise espacial descritiva nos períodos de 2001-2008 e 2009-2016 do índice composto de indicadores epidemiológico e análise de dependência espacial por meio dos índices de Moran global e local. Resultados: foram registrados 12.134 casos novos no período estudado. Identificou-se no primeiro período clusters com classificação alto/alto nas regiões leste, oeste e noroeste. No segundo período, os clusters concentram-se nas regiões leste e sudeste e decresceu no oeste e noroeste. Conclusão: o risco para o adoecimento de hanseníase está presente nos municípios da Paraíba. A distribuição espacial é dessemelhante no estado. Ações de vigilância devem ser prioritárias para o controle da endemia.

Descritores: Hanseníase. Epidemiologia. Análise Espacial. Atenção Primária à Saúde.

Objetivo: analizar la distribución espacial del riesgo de enfermedad de la lepra en los municipios del estado de Paraíba, Brasil. Método: este es un estudio ecológico del análisis espacial. Se incluyeron nuevos casos de lepra que

[1] Nurse. PhD in Nursing. Professor at the Universidade Federal de Campina Grande. Campina Grande, Paraíba, Brazil. kleanemaria@yahoo.com.br. http://orcid.org/0000-0001-8033-7305.
[2] Graduation in Geoprocessing Technology. Licentiate in Geography. PhD in Geography. Professor at the Instituto Federal de Educação, Ciência e Tecnologia da Paraíba. Picuí, Paraíba, Brazil.http://orcid.org/0000-0001-5215-6208.
[3] Nurse and Obstetrician. PhD in Interunit Nursing. Main Professor at the Universidade Federal de Minas Gerais. Belo Horizonte, Minas Gerais, Brazil. http://orcid.org/0000-0001-9043-3181.

viven en Paraíba, inscritos en el Sistema de Información sobre Enfermedades Notificabbles de 2001 a 2016. El análisis espacial descriptivo se realizó en los períodos 2001-2008 y 2009-2016 del índice compuesto de indicadores epidemiológicos y análisis de dependencia espacial a través de los índices globales y locales de Moran. Resultados: se registraron 12.134 nuevos casos en el período estudiado. En el primer período se identificaron los clusters con clasificación alta/alta en las regiones este, oeste y noroeste. En el segundo período, los clusters se concentran en las regiones este y sureste y disminuyen en el oeste y noroeste. Conclusión: el riesgo de enfermedad de la lepra está presente en los municipios de Paraíba. La distribución espacial es diferente en el estado. Las acciones de vigilancia deben ser una prioridad para el control de la enfermedad endémica.

Descriptores: Lepra. Epidemiología. Análisis espacial. Atención Primaria de Salud.

Introduction

Leprosy is a communicable disease of chronic evolution that causes deformities and disabilities if not diagnosed and treated in a timely manner. Due to its transcendence and magnitude, it is a public health problem of social and epidemiological relevance in several countries. In 2018, 208,619 new cases of the disease were reported in 159 countries. Southeast Asia and the Americas had the highest detection rates: 7.49 and 3.08 new cases per 100,000 inhabitants, respectively. In 2018, 208,619 new cases of the disease were reported in 159 countries. Southeast Asia and the Americas had the highest detection rates: 7.49 and 3.08 new cases per 100,000 inhabitants, respectively. The three countries that concentrate high burden of the disease are India, Brazil and Indonesia[1].

The continuity of disease transmission, in addition to biological, genetic and immunological causes[2-3], is related to multiple exposure factors, migratory processes[4], inaccessibility to basic health services and unfavorable socioeconomic conditions[5-6].

In Brazil, although there is a decreasing trend of leprosy nationwide, a study that analyzed the disease from 2001 to 2015 revealed the focal and unequal behavior among the regions of Brazil. The North, Midwest and Northeast regions present a high burden of the disease[7].

In the Northeast Region, the state of Paraíba has a decreasing trend; however, it is still in high endemicity according to the parameters of the Ministry of Health (MH). Transmission remains active in view of the incidence of cases in the adult population and in children under 15 years of age, a fact that presupposes the presence of sick adults without diagnosis and/or without treatment[8-9]. In addition, cases with grade 2 of physical disability are reported, that is, with deformities and disabilities installed, a fact that predicts late diagnosis, points to low efficiency of early detection by health professionals and contributes to occult prevalence (undiagnosed cases)[8,10].

In Brazil, leprosy control actions, timely detection of new cases, treatment with the polychemotherapeutic regimen, contact surveillance, disability prevention and rehabilitation are decentralized to Primary Health Care (PHC), which is anchored in the Family Health Strategy (ESF), composed of an interdisciplinary team[9]. The nurse, as an integral part of the team, assumes a decisive and proactive role in leprosy control actions, such as: active search for cases, contact surveillance, health education, prevention and treatment of disabilities, epidemiological surveillance, besides contributing to researches[11].

The elimination goals are proportionally more viable the better the quality of health services. In this sense, the study of disease monitoring indicators has been used by health and management professionals to monitor the progress of the elimination of leprosy as a public health problem. The World Health Organization (WHO) recommends the use of geoprocessing to analyze the spatial distribution of areas with a higher risk of illness to support the planning of health actions[12]. It is noteworthy the limited number of studies that point to areas of risk for

leprosy through spatial analysis in the state of Paraíba, Brazil.

Thus, the accomplishment of this study is justified by the relevance of knowing the distribut

Method

This is an ecological study with spatial analysis. The 223 municipalities of the state of Paraíba were used as an analysis unit, with an estimated population of 4,018,127 inhabitants[13].

The population was composed of new cases of leprosy living in Paraíba, registered in the Notifiable Diseases Information System (SINAN), from 2001 to 2016, made available by the State Health Bureau of Paraíba.

The annual estimates of the general population and categorized by age (<15 years), used to calculate the indicators, were obtained by the Brazilian Institute of Geography and Statistics (IBGE) and the Informatics Department of the Unified Health System, respectively[14].

Time was divided into two periods (2001 to 2008 and 2009 to 2016). This division aimed to evaluate the oscillations of the indicators, through the implementation of health policies, social policies and strategies for mobilizing and intensifying actions to control leprosy in the municipalities.

Data processing and analysis occurred between February and June 2018. Consistency analysis was performed using Office Excel 2010. Among the 13,603 cases of leprosy registered, new cases were included in the study as a mode of entry and excluding diagnostic errors, cases of residents in other states or countries and those reported outside the study period, totaling 12,134 new cases of leprosy.

The indicators of leprosy evaluation and monitoring recommended by the MH were calculated: the detection rate of new leprosy cases in the general population/100,000 inhabitants (which measures the power of morbidity, magnitude and trend of the endemic disease); detection rate of new leprosy cases in children under 15 years/100,000 inhabitants (which measures the power of recent transmission and trend of endemic disease); rate of new cases of leprosy with grade 2 of physical disability at the time of diagnosis/100,000 inhabitants (which evaluates the deformities caused by leprosy in the population and monitors the trend of timely detection of new leprosy cases)[9].

After fulfilling these parameters, a composite indicator called "Leprosy Illness Risk Index" was constructed. This methodology was chosen by allowing the evaluation of the risk of illness in an enlarged way, not limiting to the analysis of an isolated indicator.

The indicators fulfillment occurred as follows: the average of epidemiological indicators for the periods 2001 to 2008 and 2009 to 2016 was calculated by municipality, and the indicators' scores were applied by municipality, using the ratio: = [(observed value/maximum value)] = scores of the indicators.

Then, the scores of the indicators were summed and divided by three, and the values transformed into indices: Index = Sum of the scores of leprosy indicators divided by the number of indicators. The index values varied between 0 and 1, considering "best" the lowest value (0), and "worst", the highest value (1).

The spatial presentation of the Leprosy illness risk index was performed through quartiles of distributions. In the first period (2001 to 2008), the values were classified as very low risk (<0.02); low risk (0.02|--0.04); medium risk (0.04|--0.12); and high risk (> 0.12). For the second period (2009 to 2016), the values were categorized as very low risk (<0.02); low risk (0.02|--0.07); medium risk (0.07|--0.15); and high risk (> 0.15).

In order to verify the global spatial autocorrelation, the global and local Moran index and Local Index of Spatial Association (LISA) were used as statistical tool through the local Moran Index, which allows verifying the level of dependence of the analyzed value of the index in a given municipality on the values evaluated of that same index in neighboring municipalities[15].

The results of the Leprosy Illness Risk Index are presented in coroplethic (thematic)

maps that represent data from an area in color. Regarding the presentation of the results of the Local Moran Index, the Box Map was chosen, in which each municipality is classified according to its position in relation to the quadrants of the Moran scattering chart.

The quadrants generated in this technique are interpreted as follows: Q1 - high/high (positive values, positive means) shows municipalities with high rates, surrounded by other municipalities also with high rates; Q2 - low/low (negative values, negative means): municipalities with low index value, surrounded by municipalities with low value of the same index; Q3 - high-low (positive values, negative means): municipalities with high index values, surrounded by municipalities with low values of this less index; Q4 - low-high (negative values, positive means): municipalities with low index values, surrounded by municipalities with high values of the same index.

The study was approved by the Research Ethics Committee (REC) of the Federal University of Minas Gerais, CAAE 62339616.9.0000.5149, under Opinion n. 1.873.644.

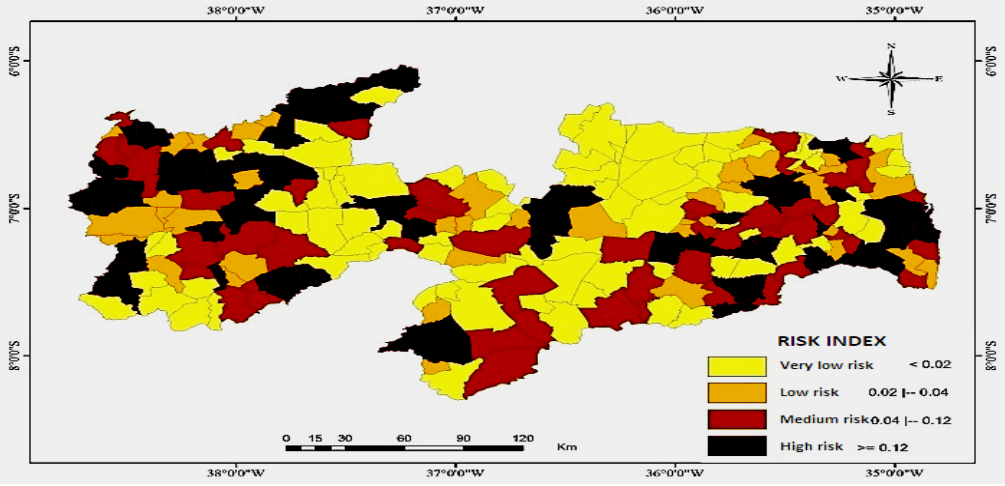
Results

There were 12,134 new leprosy cases recorded in the period studied. Between 2001 and 2008, the mean overall detection rate of leprosy was 15.31 cases/100,000 inhabitants. However, in children under 15 years of age, the average was 3.23 cases/100,000 inhabitants and the grade 2 disability rate was 0.99/100,000 inhabitants.

Considering the period from 2009 to 2016, the leprosy indicators decreased: the average overall detection rate increased to 11.79/100,000 inhabitants; in those under 15 years of age, to 2.34/100,000; and the grade 2 rate of physical disability, to 0.84/100,000 inhabitants.

Figure 1 shows the map of the leprosy illness risk index from 2001 to 2008, revealing that 56 (25%) municipalities were classified as very low risk for leprosy illness, 48 (22%), low; 63 (28%), medium; and 56 (25%), at high risk. The municipalities classified as high risk were located mainly in the east, southeast, west and northwest regions of the state.

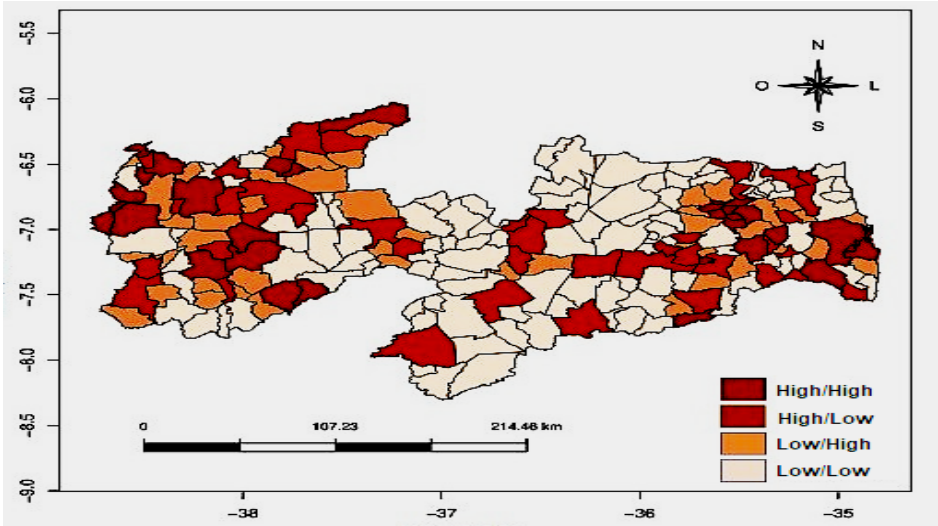
Figure 1 – Spatial distribution map of the leprosy illness risk index. Paraíba, Brazil – 2001-2008



Source: Created by the authors.

The Global Moran Index confirmed the existence of spatial dependence among the municipalities (0.21; p = 0.004). Thus, upon performing the Local Moran Index, there is the presence of clusters in low-risk municipalities located in the mid-north regions of the state, the main cluster on the border with the state of Rio Grande do Norte, and high-risk clusters in the east, west and northwest regions (Figure 2).

Figure 2 – Spatial statistics map of hte leprosy illness risk index. Paraíba, Brazil – 2001-2008

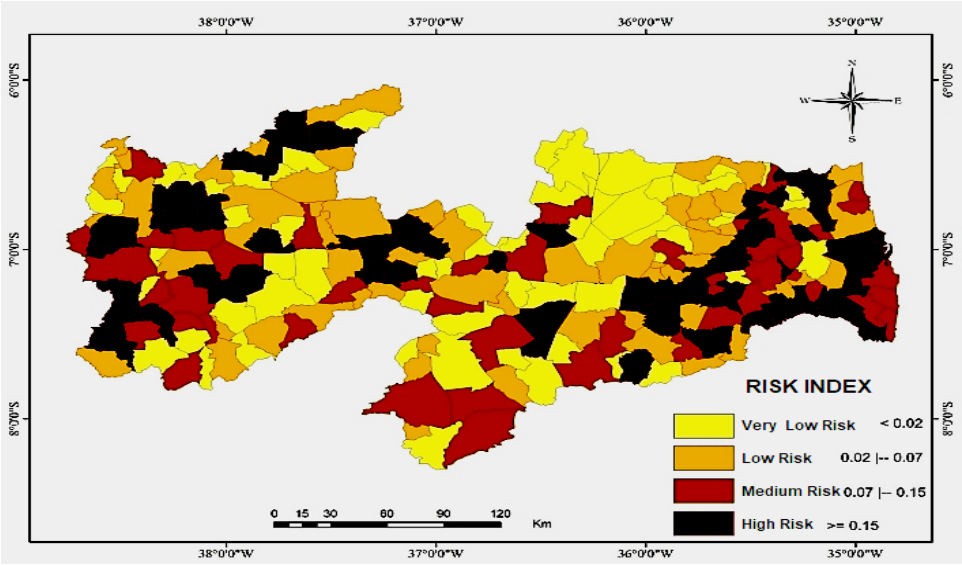


Source: Created by the authors.

In the west region (Intermediate Region of Cajazeiras-Sousa), the municipalities of Cajazeiras, Cachoeira dos Índios, Bom Jesus, Santa Helena and Sousa, presented statistical significance, in addition to the municipalities of Coremas, Piancó and Itaporanga (Intermediate Region of Patos). In the east region (Intermediate Region of João Pessoa), João Pessoa, Santa Rita, Bayeux, Alagoinha, Cuitegi, Guarabira, Pilões, Borborema, and in the southeast, the municipality of Pedras de Fogo.

For the period from 2009 to 2016, municipalities classified as very low risk decreased to 47 (21%); low risk increased to 64 (29%); the medium risk decreased to 54 (24%) and the high risk increased to two, totaling 58 (26%). The high-risk municipalities remained in greater number concentrated in the west, east and southeast regions of the state (Figure 3).

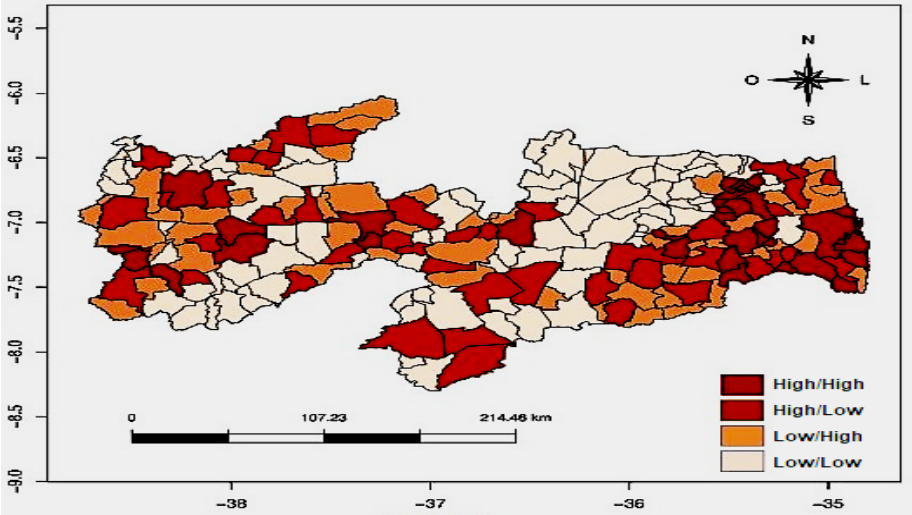
Figure 3 – Spatial distribution map of the leprosy illness risk index. Paraíba, Brazil – 2009-2016



Source: Created by the authors.

The Global Moran Index identified spatial dependence among the areas of the region (0.22; $p < 0.03$), which allowed applying the Local Moran Index. During this period, in the Box Map, there was an increase in the low-risk cluster in the north/northeast of the state, compared to the previous period, and an increase in clusters of high-risk municipalities located in the east and southeast regions and a reduction in the west and northwest (Figure 4).

Figure 4 – Spatial statistics map of the leprosy illness risk index. Paraíba, Brazil – 2009-2016



Source: Created by the authors.

Only the municipality of Sousa, in addition to the municipality of Sousa, was statistically significant in the west (Intermediate Region of Cajazeiras-Sousa), in addition to the permanence of Coremas and Piancó (Intermediate Region of Patos).

In the east region (Intermediate Region of João Pessoa), Bayeux, Alagoinha, Cuitegi, Guarabira remained, with addition of Lucena. In the Southeast, Pedras de Fogo remained, with the addition of the municipality of Juripiranga.

Discussion

In this study, leprosy detection coefficients pointed to the persistence of the disease and a situation of high endemicity in the state of Paraíba. Municipalities classified as high risk were distributed throughout the state; however, the highest concentration was located in the northwest and west regions, bordering the state of Ceará, and in the east and southeast regions, continuous borders with the state of Pernambuco, thus forming clusters in the east and west regions of the state.

The states of Ceará and Pernambuco have high leprosy detection rates[16] and are classified as in "very high endemicity"[9]. Thus, the neighborhood of Paraíba with these states can reinforce the transmissibility of the disease through interstate migrations. A study conducted on the triple border of Latin America (Brazil, Argentina and Paraguay) points to a large flow of people between the three countries, which makes the control of communicable diseases highly complex[17].

In Great Britain and other European countries, although the disease was eliminated, it is confined to immigrants from endemic countries. In Denmark, Canada and Spain, it was proven that the small number of cases registered in ten years was of immigrants from endemic countries[18-19]. Thus, even in countries without cases of the disease, the surveillance system should be active and with health professionals trained to recognize the signs and symptoms.

In the east region, the cluster of high-risk municipalities belongs in part to the metropolitan

region of the state capital, João Pessoa. This region has high population density, high circulation of people, trade and service provision and better Municipal Human Development Index (MHDI) [13]. This fact may be related to better access to reference services, and thus better diagnostic capacity.

A study conducted in the state of Tocantins, Brazil found that the detection of the disease was significantly higher in municipalities with better MHDI; however, this fact was explained by the coverage of areas with higher demographic density, greater circulation of people and development[20].

In Brazil, leprosy in urban areas has been explained by rapid urbanization and intense population migration[4]. This fact causes greater population density in certain areas, disorganized growth and contributes to intensifying social inequalities, excluding people from social and material opportunities for survival, as well as access to health services.

In western Paraíba, some municipalities found at high risk, although with a population below 60,000 inhabitants, are places with a previous history of leprosy hyperendemicity, such as the municipalities of Cajazeiras, Conceição, Catolé do Rocha and Sousa, pointed out in the clusters in a study conducted in Brazil, from 2005 to 2007[21], and Cuitegi, present in the cluster at high risk of leprosy detection in Brazil from 2001 to 2015[7].

Although leprosy declined in Paraíba[8] and there has been a decrease in high-risk municipalities in the western region of the state, the concentration of municipalities classified as high risk in the east and southeast regions has increased. This fact reinforces the idea of temporal and geographical persistence of the disease. Studies have shown the spatial concentration of leprosy and the persistence of certain geographical areas[7, 20].

The persistence in spatial analysis in the second period of study of municipalities in the eastern region, metropolitan area of João Pessoa, particularly Bayeux, may be associated, in addition to population density, with historical-social determinants, since, in the past, in this municipality, the former leprosarium of Paraíba, Getúlio Vargas Hospital, operated in this municipality. Thus, there is historical-social determinant that marks the present, and that health services are unable to break.

In fact, areas with a history of endemicity may have a hidden prevalence that contributes to the chain of transmission of the disease. In Munger district, Indian state of Bihar, considered endemic for leprosy, after intensive activity of active search for cases, in 2016, 321 new cases of the disease were diagnosed among 85,560 people examined[22].

The explanation for some municipalities increase or remain at high risk between the periods analyzed, as well as for the increase in high-risk clusters, may be associated with some factors: long incubation period of *Mycobacterium leprae*, quality of health services, unfavorable socioeconomic conditions present in certain municipal areas and quality of health information[6,23].

There is evidence that the epidemiological behavior of leprosy is influenced by the quality and operational capacity of PHC health services, and services that detect and treat cases early are more effective, preventing the occurrence of physical disabilities, being attentive to the user's needs, from the prevention of injuries to rehabilitation[24]. In Ethiopia, leprosy control actions were decentralized to basic health services, aiming to approach the population to early diagnosis, timely treatment and follow-up of cases, improving disease indicators[25].

Nevertheless, when leprosy control actions are not developed with quality, they can sometimes explain the persistence of the risk of leprosy illness in certain geographical areas. Therefore, the services must be provided with human resources capable of embracing the user and developing leprosy control actions appropriately[11].

Thus, the importance of nurses' work in leprosy surveillance actions stands out, since this professional assumes several functions of planning, execution and evaluation of control,

management, epidemiological surveillance activities, besides being in conjunction with other professionals to ensure the early diagnosis of the disease, treatment, and monitoring of the user and family[11].

Therefore, leprosy should be approached early in the process of training in the various health areas, especially for those professionals who will work in PHC services. In addition, developing permanent health education activities for FHS professionals and avoiding the turnover of professionals are measures that can contribute to the control of the disease.

Additionally, social vulnerabilities and inequities present in certain areas put the health of the population at risk. Spatial studies show that the distribution of the disease in space is influenced by inequalities, unfavorable socioeconomic conditions and cultural factors[23]. The actions to be developed to better control the disease do not depend only on health services, emphasizing the actions to combat poverty, educational improvements, job and income generation, which, in addition to promoting access to health services, are effective in controlling the disease.

The municipalities that were classified as low risk formed clusters in the first period in the mid-north region, and in the second period, in the north of the state. These should be highlighted and analyzed with caution regarding leprosy illness. This is because these municipalities may actually be free of the disease, but, on the other hand, there may be diagnostic errors, underreports and/or late diagnosis[19].

Municipalities with very low risk, bordering municipalities that present high risk, can also influence the transmission chain through people's displacement. Thus, a surveillance alert is the need to intensify active search actions to detect cases with difficult diagnosis that might contribute, in the near future, to the persistence of leprosy.

This study has limitations, since the data used are secondary, which may present inconsistency in the quality and quantity of information. Nonetheless, the data were treated with methodological rigor and are representative of the epidemiological situation of leprosy in the period studied.

Conclusion

In conclusion, spatial analysis contributed to identify focal areas of leprosy in the state of Paraíba. The distribution of the disease is dissimilar in the state, and high-risk clusters are present in the east and west regions.

These areas can be compensated by the organization and structuring of health services, guarantee of equitable access of the population and the integrality of actions to control the endemic disease. It is noteworthy that new research approaches should happen to better understand the conditioning and determining factors of the disease.

The results of this study contribute to promote reflections among health professionals and managers on leprosy control actions, besides contributing to the scientific community, the health education process towards actions to control the disease. Furthermore, there is need for new research approaches to better understand factors that condition and/or determine the maintenance of the disease in several municipalities in the state.

Collaborations:

1 – conception, design, analysis and interpretation of data: Kleane Maria da Fonseca Azevedo Araújo, Lidiane Cristina Félix Gomes and Francisco Carlos Félix Lana;

2 – writing of the article and relevant critical review of the intellectual content: Kleane Maria da Fonseca Azevedo Araújo and Francisco Carlos Félix Lana;

3 – final approval of the version to be published: Kleane Maria da Fonseca Azevedo Araújo, Lidiane Cristina Félix Gomes and Francisco Carlos Félix Lana.

References

1. World Health Organization. Global leprosy update, 2018: moving towards a leprosy-free world.

Weekly Epidemiol Rec [Internet]. 2019 [cited 2019 Dec 10]; 94(35-36):389-412. Available from: https://apps.who.int/iris/bitstream/handle/10665/326775/WER9435-36-en-fr.pdf?ua=1

2. Masaki T, McGlinchey A, Cholewa-Waclaw J, Qu J, Tomlinson SR, Rambukkana A. Innate Immune Response Precedes Mycobacterium Leprae-Induced Reprogramming of Adult Schwann Cells. Cell Reprogram. 2014;16(1):9-17. DOI: 10.1089/cell.2013.0064

3. Benjak A, Avanzi C, Singh P, Loiseau C, Girma S, Busso P, et al. Phylogenomics and Antimicrobial Resistance of the Leprosy Bacillus Mycobacterium Leprae. Nat Commun. 2018;9(1):352-62. DOI: 10.1038/s41467-017-02576-z

4. Murto C, Ariza L, Alencar CH, Chichava OA, Oliveira AR, Kaplan C, et al. Migration among individuals with leprosy: a population-based study in Central Brazil. Cad Saúde Pública. 2014;30(3):487-501. DOI:10.1590/0102-311X00005913

5. Nery JS, Ramond A, Pescarini JM, Alves A, Strina A, Ichiara MY, et al. Socioeconomic determinants of leprosy new case detection in the 100 Million Brazilian Cohort: a population-based linkage study. The Lancet. 2019;7:30260-8. DOI:10.1016/S2214-109X(19)30260-8

6. Leano HAM, Araújo KMFA, Bueno IC, Niitsuma ENA, Lana FCF. Fatores socioeconômicos relacionados à hanseníase: revisão integrativa da literatura. Rev Bras Enferm. 2019;72(5):1405-15. DOI: 10.1590/0034-7167-2017-0651

7. Rodrigues RN, Leano HAM, Bueno IC, Araújo KMFA, Lana FCF. High-risk areas of leprosy in Brazil between 2001-2015. Rev Bras Enferm. 2020;73(3):e20180583. DOI: 10.1590/0034-7167-2018-0583

8. Araújo KMFA, Leano HAM, Rodrigues RN, Bueno IC, Lana FCF. Tendência de indicadores epidemiológicos da hanseníase em um estado endêmico. Rev Rene. 2017;18(6):771-8. DOI: 10.15253/2175-6783.2017000600010

9. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Diretrizes para vigilância, atenção e eliminação da Hanseníase como problema de saúde pública: manual técnico-operacional [Internet]. Brasília (DF); 2016 [cited 2019 Dec 10]. Available from: http://www.saude.gov.br/images/pdf/2016/fevereiro/04/diretrizes-eliminacao-hanseniase-4fev16-web.pdf

10. Souza EA, Ferreira AF, Boigny RN, Alencar CH, Heukelbach J, Martins-Melo FR, et al. Leprosy and gender in Brazil: trends in an endemic area of the Northeast region, 2001–2014. Rev Saude Publica. 2018;52:20. DOI:10.11606/s1518-8787.2018052000335

11. Sousa GS, Silva RLF, Xavier MB. Atributos da atenção primária em saúde no controle da hanseníase: ótica do enfermeiro. Rev baiana enferm. 2017;31(1):e17251. DOI: http://dx.doi.org/10.18471/rbe.v31i1.17251

12. Word Health Organization. Global leprosy update, 2016: accelerating reduction of disease burden. Weekly Epidemiol Rec [Internet]. 2017 [cited 2019 Dec 15];35(92):501-20. Available from: https://apps.who.int/iris/bitstream/e/10665/258841/9235pdf;jsessionid=A10D667A466A3DAB793B56498C67B373?sequence=1

13. Instituto Brasileiro de Geografia e Estatística. Cidades [Internet] Rio de Janeiro (RJ); 2019 [cited 2020 May 10]. Available from: https://cidades.ibge.gov.br/brasil/pb/panorama

14. Brasil. Ministério da Saúde. Departamento de Informática do SUS-DATASUS. Informações de Saúde, Demográficas e Socioeconômicas [Internet] Brasília (DF); 2018 [cited 2018 Nov 20]. Available from: http://www.datasus.gov.br/DATASUS/index.php?area=0206&id=6942

15. Souza WV, Carvalho MS, Cruz OG, Ragoni V. Análise espacial de dados de área. In: Santos SM, Souza WV, organizadores. Introdução à Estatística Espacial para a Saúde Pública. Brasília: Ministério da Saúde; 2007. p. 63-78.

16. Leano HAM, Araújo KMFA, Rodrigues RN, Bueno IC, Lana FCF. Indicadores relacionados a incapacidade física e diagnóstico de hanseníase. Rev Rene. 2017;18(6):832-9. DOI: 10.15253/2175-6783.2017000600018

17. Assis IS, Arcoverde MAM, Ramos ACV, Alves LS, Berra TZ, Arroyo LH, et al. Social determinants, their relationship with leprosy risk and temporal trends in a tri-border region in Latin America. PLoS Negl Trop Dis. 2018;12(4):e0006407. DOI: 10.1371/journal.pntd.0006407

18. Aftab H, Nielsen SD, Bygbjerg C. Leprosy in Denmark 1980–2010: a review of 15 cases. BMC Res Notes. 2016;9(10):2-9. DOI: 10.1186/s13104-015-1768-6

19. Ramos JM, Romero D, Belinchón I. Epidemiology of Leprosy in Spain: The Role of the International

Migration. PLoS Negl Trop Dis. 2016;10(3):e0004321. DOI: 10.1371/journal.pntd.0004321

20. Monteiro LD, Mota RMS, Martins-Melo FR, Alencar CH, Heukelbach J. Determinantes sociais da hanseníase em um estado hiperendêmico da região Norte do Brasil. Rev Saude Publica. 2017;51(70):1-11. DOI:10.1590/s1518-8787.2017051006655

21. Penna MLF, Oliveira MLV, Penna GO. The epidemiological behaviour of leprosy in Brazil. Lepr Rev [Internet]. 2009 [cited 2019 Dec 20];80(3):332-44. Available from: https://pdfs.semanticscholar.org/9a4c/4c74cc700f0c1b2aac5ebd87ec0234443611.pdf

22. Mangeard-Lourme J, Singh A, Singh RK, Parasa J, Arquer GR. Enhanced active case-finding, identifying leprosy cases missed by recent detection campaigns in Munger District, Bihar, India. Lepr Rev [Internet]. 2017 [cited 2019 Dec 10];88:452-62. Available from: https://pdfs.semanticscholar.org/d8d7/523769d6e457e10aed6b7bdb1ee703250c50.pdf?_

23. Rodrigues RN, Niitsuma ENA, Bueno IC, Baquero OS, Jardim CCG, Lana FCF. Hanseníase e vulnerabilidade da saúde em Belo Horizonte, Minas Gerais. REME rev min enferm. 2017;21:e-997. DOI:10.5935/1415-2762.20170007

24. Lanza FM, Lana FCF. O processo de trabalho em hanseníase: tecnologias e atuação da equipe de saúde da família. Texto contexto - enferm. 2011;20(spe):238-46. DOI:10.1590/S0104-07072011000500030

25. Abeje T, Negera E, Kebede E, Hailu T, Hassen I, Lema T, et al. A. Performance of general health workers in leprosy control activities at public health facilities in Amhara and Oromia States, Ethiopia. BMC Health Serv Res. 2016;7(16):122. DOI: 10.1186/s12913-016-1329-2

Received: July 15, 2020

Approved: August 26, 2020

Published: October 7, 2020

The *Revista Baiana de Enfermagem* use the Creative Commons license – Attribuition -NonComercial 4.0 International.
https://creativecommons.org/licenses/by-nc/4.0/

This article is an Open Access distributed under the terms of the Creative Commons (CC BY-NC).
This license lets others remix, adapt and create upon your work to non-commercial use, and although new works must give its due credit and can not be for comercial purposes, the users do not have to license such derivative works under the same terms.