Original article

Social deprivation index and leprosy in Pará State, Brazil, in 2013: spatial analysis

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Emanuele Cordeiro Chaves[1]
Samara Viana Costa[2]
Rute Leila dos Reis Flores[3]
Eula Oliveira Santos das Neves[3]

[1]Secretaria Municipal de Saúde de Belém, Núcleo de Promoção à Saúde, Belém-PA, Brasil
[2]Secretaria Municipal de Saúde de Belém, Núcleo de Planejamento, Belém-PA, Brasil
[3]Secretaria Municipal de Saúde de Belém, Departamento de Vigilância em Saúde, Belém-PA, Brasil

Abstract

Objective: to analyze the ecological association between the condition of social deprivation and leprosy detection rate in Pará State, Brazil. **Methods**: cross-sectional ecological study with data from the Information System for Notifiable Diseases (Sinan); global and local bivariate Moran's factor analysis and autocorrelation were used to identify spatial patterns associated with the distribution of the social deprivation index (SDI) and leprosy detection rate (LDR). **Results**: in 2013, 3,358 new cases of leprosy were reported in Pará, with LDR of 41.98 cases/100,000 inhabitants; higher rates were observed in the municipalities of the Araguaia region; 17.5% of the 143 municipalities of the state were considered hyperendemic (LDR>40.00) and 30.8% presented poor SDI; there was spatial autocorrelation between LDR and SDI ($p<0.05$). **Conclusion**: there was spatial association between SDI and LDR, with higher leprosy detection in the municipalities with higher social deprivation.

Keywords: Leprosy; Social Conditions; Spatial Analysis; Ecological Studies.

Correspondence:
Emanuele Cordeiro Chaves – Av. Conselheiro Furtado, No. 1734, Belém-PA, Brasil. CEP: 66040-100.
E-mail: manu.chaves@hotmail.com

Introduction

Leprosy is an infectious disease, of slow evolution, and its manifestation occurs mostly through dermato-neurological signs and symptoms.[1,2] When leprosy is not timely diagnosed and treated, it may cause physical disabilities in the hands, feet, and eyes, resulting from an impairment of peripheral nerves; in more advanced stages of clinical manifestations, truncal neural impairments may be observed, leading to consequences such as paresthesia and muscle plegias.[3] It is estimated that between 1 and 2 million people worldwide have deformities and disabilities caused by leprosy.[4]

Due to these deformities and disabilities, people with leprosy are often victims of stigma and discrimination. Stigma, an important factor related to delayed diagnosis, facilitates transmission of the infection within families and communities, that is why it was introduced in the 'Global Leprosy Strategy 2016-2020' as an indicator to monitoring discrimination against individuals affected by this disease.[5]

> *The distribution and dissemination of endemic leprosy are closely related to socioeconomic and cultural conditions.*

Despite being an ancient disease, leprosy remains a public health issue, once its transmission control is hard to be achieved in some countries, including Brazil. In 2015, 210,758 new cases were diagnosed in 136 countries. This constitutes a worldwide detection rate of 3.2 per 100 thousand inhabitants. Southeast Asia was the region with the highest number of new cases (156,118), followed by the Americas (28,808) and Africa (20,004).[6]

In 2015, Brazil presented a prevalence of 1.01/10 thousand inhabitants and a detection rate of new cases of 14.07 per 100 thousand inhabitants. In the same year, Pará State had a general detection rate of 35.34 cases per 100 thousand inhabitants, which was considered 'very high', being only behind the states of Mato Grosso, Tocantins, and Maranhão, in the national scenario. Pará also had a high detection rate of new cases among individuals under the age of 15 (13.32/100 thousand inhabitants),[7] indicating the existence of active transmission circuits.[2]

It is important to highlight that, in addition to the high value of indicators presented by Pará State, 67.8% of the cases detected were of multibacilar operational classification[7] and 5.7% presented degree of physical impairment (DPI) 2,[7] an indicator of prolonged illness and of higher possibility of disease transmission within the community, which increases the risk of illness, especially among household contacts of multibacilar patients. These contacts have 6 to 10 times more chances of contracting leprosy, when compared with the general population.[8] The distribution and dissemination of endemic leprosy are closely related to socioeconomic and cultural conditions due to poor housing, low education level, and also migratory movements that facilitate the transmission of the disease. In endemic countries, there are differences concerning the prevalence of the disease among regions; with regard to large cities, these differences appear in intra-urban spaces and concentrate on areas of greater poverty.[9]

Thus, the study on spatial distribution of leprosy allows the identification of groups that live in areas of higher risk of illness, in order to subsidize the planning, implementation, monitoring, and assessment of actions focused on the prevention and control of the disease.[9]

This study aimed to analyze the ecological association between the condition of social deprivation and leprosy detection rate in Pará State, Brazil, in 2013.

Methods

This is a cross-sectional ecological study which analyzed the Integration Regions of Pará State.

Pará is composed of 144 municipalities. When this study was carried out, it had 143 municipalities. Its territory is the 2nd largest Federative Unit of Brazil, with a total area of 1,247,955,381 km^2,[10] moreover, Pará stands out for its geographical features, composed of riverside areas, which makes it difficult for health care professionals to move around and access these places. Pará is the 9th most populous state of Brazil and the most populous in the North region, with an estimated population of 8,272,724 inhabitants in 2016. The monthly household income per capita of its population was of BRL708.00 in 2016.[10]

This study is based on a territorial cutout of the 12 Integration Regions of Pará State. This division, approved by State Decree No. 1,066, dated June 19th,

2008, was created in order to better visualize the state as a whole, enable the application and monitoring of government actions, and economic and social policies, either at state, federal, or municipal level, in addition to bringing several communities of the territory closer, given its geographic dimension.[12]

The number of new leprosy cases was obtained from the database of the Information System for Notifiable Diseases (Sinan) for the year 2013. With regard to population estimates in the municipalities of Pará, information from the Brazilian Institute of Geography and Statistics (IBGE) were used also for 2013.

The leprosy detection rate (LDR) was calculated by dividing the number of new cases of leprosy confirmed in residents in the municipality by the total population in the same municipality and period per 100 thousand inhabitants.[9] Based on LDR, the municipalities were classified according to the endemicity of the disease: low (<2.00); medium (2.00 to 9.99); high (10.00 to 19.99); very high (20.00 to 39.99); or hyperendemic (≥40.00).[13]

Concerning socioeconomic characteristics of the municipalities, variables taken from the 2010 Demographic Census were used. They are available at IBGE website.[14] Variables were selected within two dimensions:

(i) sanitation

- percentage of households without piped water;
- percentage of households without regular garbage collection;
- percentage of households without sewer system;
- percentage of households without bathroom; and

(ii) socioeconomic

- demographic density (inhabitants/km^2);
- percentage of people responsible for the household with monthly income up to 1 minimum wage or with no income; and
- percentage of householders who are illiterate and/or with up to one year of schooling.

Based on these variables, the social deprivation index (SDI) was calculated through a multivariate technique of factorial analysis (FA), using the Statistical Package for Social Sciences (SPSS) software, version 20.0 (United States of America [USA], 2012), aiming at creating an index that would reflect the population's living conditions in each municipality of Pará.

Factorial analysis (FA) is a set of statistical methods which, in certain situations, explain the behavior of a quite large number of variables observed in terms of a quite small number of latent or factor variables. This analysis may be understood as an exploratory statistical technique aimed at summing up information – within a set of variables – in a set of factors – in which the number of factors is usually much smaller than the number of variables observed.[15] FA seeks to reduce data and create indicators that represent original variables.[16] In order to verify the adequacy of the FA model, the Kaiser-Meyer-Olkin statistical measure (KMO) was applied. Its values range from 0 to 1: the closer the value is to 1, the more adequate the technique is.[17] Then, the complete correlation matrix was analyzed through Bartlett's sphericity test, in order to assess if the correlation matrix could be the identity matrix. At last, the anti-image correlation matrix was analyzed. It provides measure of sampling adequacy (MSA): the closer the MSA value is to 1, the more adequate the use of the technique is.[16]

The varimax criterion, in general terms, aims at seeking the orthogonal matrix, which is based on the attempt to find factors with great variability. That is, to find a group of variability highly correlated with a fixed factor. Communality is the variance proportion of a variable which is shared with common factors in the factor analysis.

First, the model was formed with eight variables, regarding the two dimensions: sanitation and socioeconomic. The variables 'demographic density' and 'household without sewer system' were excluded from the model because of their low MSA value and communality. A model with the other information was built; from the main components method, two factors were obtained, and after that, it was possible to calculate the factorial scores by multiplying each of the values of original variables by the respective factorial weights; thus, SDI was obtained considering the scores of factors 1 and 2.[18]

From SDI, it was possible to characterize the municipalities: the lower its number, the better the population's living condition. The municipalities were classified from the percentile (P): those with values of the sum of factorial scores below P_{30} were classified as 'good'; values between P_{30} and P_{70} were classified as 'regular'; and those with values higher than P_{70} were classified as 'poor'. This latter stratum represents the worst cluster related to the population's social deprivation.[18]

With regard to the spatial analysis, the global and local bivariate Moran's index[19] for the number of SDI and LDR per municipality were calculated, aiming at

identifying spatial patterns associated with the distribution of two variables (SDI and LDR), expecting that the random spatial variables do not present dependence in relation to their neighbors. This method is different from the univariate global Moran's index, whose goal is to identify patterns associated with the distribution of only one variable. With regard to the visualization of priority areas, we built thematic maps with classifications and a Moran Map for the period.

The global Moran's index detects the existence of spatial autocorrelation, that is, it assesses how much the value of indicators observed in a municipality is correlated with the values of neighboring municipalities. This index provides a single number, ranging from -1 to 1. The Moran Map is a representation of the local Moran's index and locates where the municipalities are classified, either within the four quadrants or as not statistically significant.[20] For this study, each geographic cluster with statistically significant spatial autocorrelation, identified inside of each quadrant, was called cluster.

The free GeoDa software, version 1.4.1 (Chicago, USA, 2010), was used to carry out the spatial statistical analysis. The maps were created by ArcGis software, version 10.0 (California, USA, 2013).

This study used only secondary data, without identifying the subjects, and was carried out in compliance with the ethical principles of the Resolution No. 510 of the National Health Council (CNS), dated April 7th, 2016.

Results

Table 1 presents the stratification of Pará State by Regions of Integration, according to the intensity of risk of illness based on the assessment of leprosy detection rate, for the year of 2013. According to the risk classification, 25 (17.5%) out of the 143 municipalities presented risk of being hyperendemic; Araguaia's region stood out, since almost half (7/15) of its municipalities presented high risk (Table 1).

Taking into account the information of 143 municipalities, FA was applied through principal components method for the extraction of factors and, then, the orthogonal rotation through varimax method. KMO value of 0.73 indicates the adequacy of the sample to the technique, and the significance level of Bartlett's sphericity test ($p<0.001$) rejects the hypothesis that the variances are equal, which supports the use of FA for the extraction of factors and estimate of factorial scores (Table 2).

Table 1 – Classification of municipalities according to the intensity of risk for developing leprosy, and social deprivation index according to integration regions, Pará, 2013

Integration Region	Population	Classification of intensity of risk for developing leprosy[a,b]					Social deprivation index			Total
		Low	Medium	High	Very High	Hyperendemic	Poor	Regular	Good	
Araguaia	510,370	1	–	3	4	7	2	5	8	15
Baixo Amazonas	700,454	2	7	2	–	1	2	7	3	12
Carajás	615,805	1	–	1	7	3	2	7	3	12
Guamá	643,890	5	5	5	3	-	2	8	8	18
Lago de Tucuruí	387,313	–	–	–	4	3	2	3	2	7
Marajó	517,050	3	4	6	2	1	9	5	2	16
Metropolitan area	2,112,361	–	2	3	–	–	–	–	5	5
Rio Caeté	489,435	4	6	4	1	–	6	7	2	15
Rio Capim	639,192	1	4	4	3	4	6	5	5	16
Tapajós	243,031	–	1	–	3	2	3	1	2	6
Tocantins	789,953	–	2	6	3	–	4	5	2	11
Xingu	350,876	–	1	1	4	4	6	3	1	10
Total	7,999,730	17	32	35	34	25	44	56	43	143

a) Endemicity of the disease: low (<2.00); medium (2.00 to 9.99); high (10.00 to 19.99); very high (20.00 to 39.99); or hyperendemic (≥40.00) per 100,000 inhabitants.
b) Municipalities that did not notify leprosy cases in the period: (i) Bannach (Araguaia); (ii) Faro and Terra Santa (Baixo Amazonas); (iii) Palestina do Pará (Carajás); (iv) Colares, Magalhães Barata, Maracanã, São João da Ponta and Terra Alta (Guamá); (v) Afuá, Melgaço, Santa Cruz do Arari (Marajó); (vi) Bonito, Peixe-Boi, Santa Luzia do Pará, and Santarém Novo (Rio Caeté); and (vii) Irituia (Rio Capim).

Table 2 – Selection of factors through principal components method with varimax rotation, Pará, 2013

Factor	Variable	KMO[a]	Bartlett (p)	% of variance	Factorial load	MSA[b]	Communality
1	% of households without bathroom	0.73	<0.001	54.23	0.86	0.757	0.76
	% of households without garbage collection				0.81	0.706	0.71
	% of people responsible for households with monthly income up to 1 minimum wage or with no income				0.91	0.859	0.86
	% of householders who are illiterate and/or with up to one year of schooling				0.69	0.694	0.69
2	% of households without water supply			24.85	0.97	0.938	0.94

a) KMO: Kaiser-Meyer-Olkin statistical measure.
b) MSA: measure of sampling adequacy.

Two factors that explained 79.2% of the total variance regarding data were obtained. The choice of variables that compose each of the factors is made from factorial loads, so that factor 1 has four significant factorial loads, and factor 2, one. The first factor, called 'infrastructure and income', encompassed the following variables: household without bathroom; household without garbage collection; person responsible for the household with monthly income up to 1 minimum wage or with no income; and householder who is illiterate and/or with up to one year of schooling. The second factor has as defining variable 'water supply', the same name given to the factor (Table 2).

In 2013, according to SDI, 44 municipalities (30.8%) presented poor social deprivation index, 56 (39.2%) were regular, and 43 municipalities (30.1%) had their SDI classified as good.

Marajó region had the highest proportion of municipalities classified as bad (20.5%). Baixo Amazonas and Carajás regions presented 14 municipalities with regular SDI, and the metropolitan region had all municipalities classified with good SDI (Table 1).

Figure 1 shows, through spatial analysis, the classification of the social deprivation index and the new case detection rate of leprosy in Pará State, where the social deprivation index had three types of classification: good, regular, and poor. Marajó region stands out with 9 out of the 16 municipalities classified with 'bad' SDI. It is important to highlight that the metropolitan region was the only one with the social deprivation index classified as 'good'.

When we analyze the map that illustrates detection rates, it is possible to observe that the municipalities classified as hyperendemic are concentrated in the south of Pará State, whilst municipalities in the north present medium or high leprosy detection rate.

The spatial autocorrelation between LDR and SDI in Pará State was significant ($p<0.05$). The Moran's index presented positive autocorrelation, with a value of 0.0631, higher than the expected – of -0.0070 –, indicating that municipalities with high (or low) frequency of social deprivation index, and high (or low) frequency of leprosy cases were spatially associated with other municipalities with the same characteristics. The value $p=0.042$ is lower than the significance level of 5%, which rejects the null hypothesis of spatial independence.

Figure 2 presents the result of the Moran Map for leprosy occurrences and for the social deprivation index in Pará State. The municipalities of Bagre, Capitão Poço, Senador José Porfirio, and Portel were significant for high-high spatial pattern. That is, municipalities that presented high social deprivation index also presented high leprosy detection rate. However, the municipalities of Ananindeua, Bannach, Belém, Benevides, Marituba, Santo Antônio do Tauá, Santa Bárbara, and São Caetano de Odivelas presented low-low pattern. Some municipalities were classified in the low-high pattern, such as Almerim, Afuá, Anajás, Augusto Correa, Breves, Bragança, Capanema, Concórdia do Pará, Curralinho, Gurupá, Garrafão do Norte, Melgaço, Muaná, Nova Esperança do Piriá, Santa Cruz do Arari, Santa Luzia do Pará, São Sebastião da Boa Vista, and Viseu; and other municipalities were in the high-low pattern, such as Água Azul do Norte, Canaã dos Carajás, Curionópolis, Goianésia do Pará, Parauapebas, and Dom Eliseu.

Discussion

This study showed that there is spatial association between leprosy occurrences and social deprivation index, and that the municipalities located in the South of Pará State were classified as hyperendemic for leprosy,

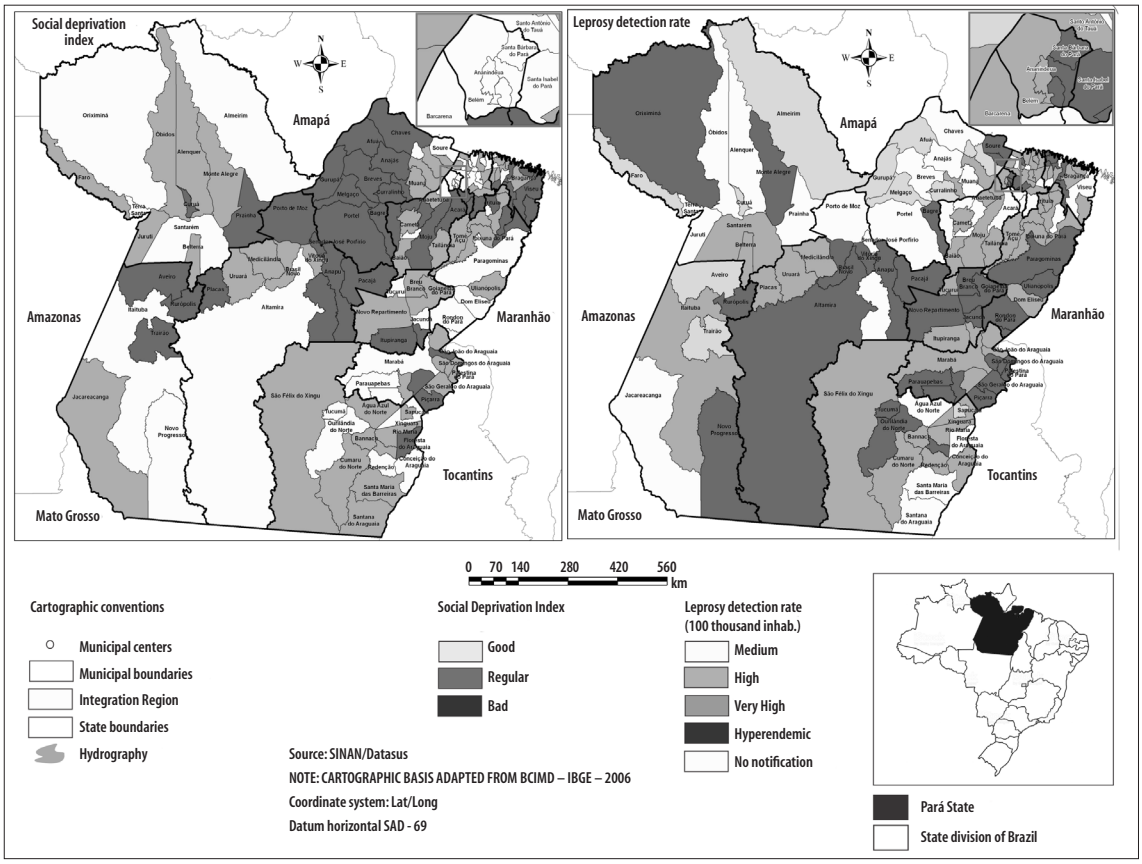


Figure 1 – Distribution of the social deprivation index and leprosy detection rate per integration region, Pará, 2012

whilst in municipalities located in the North, LDR ranged from medium to high. It is important to highlight that no region of the state presented low LDR, confirming the endemicity of leprosy. With regard to social condition, Marajó region stood out for the number of municipalities with 'bad' SDI, and the metropolitan region, for being the only one that presented 'good' SDI.

The distribution of leprosy cases in the region is not homogeneous, once there are four different risk areas concerning leprosy occurrences, graded at medium, high, very high, and hyperendemic detection levels. The spatial heterogeneity was also verified in Brazil,[21,22] where there are regions with basically no transmission of the disease, and others with detection rates extremely high, which led the National Leprosy Eradication Programme to prioritize its interventions in clusters of extremely endemic diseases.[23] Historically, leprosy spread heterogeneously over the Brazilian territory, where socioeconomic and environmental factors are important predictors of the disease.[24]

Another study carried out in Pará State, for the period 2004-2006, also identified that the endemicity is distributed heterogeneously, with greater distribution in the South and Southeast of the state.[25] Thus, Araguaia region (Southeast of Pará) stood out in this study for being predominantly hyperendemic. Nevertheless, there are municipalities with high disease burden in the Northeast and Southeast of Pará State, and in the metropolitan region of Belém, probably due to high migratory flows to the most economically developed region of Pará,[25] as well as by the search for specialized care.[11]

Moreover, it is worth mentioning that Pará State did not present any low risk area of disease detection, which was already expected, given that the state has a history of high leprosy burden. However, there is a prospect of change regarding this indicator in the long term: the current intensification of active search for cases in the state, especially among individuals under the age of 15 and their household contacts, through

the annual National Leprosy and Geo-Helminthiasis Awareness Campaign with Schoolchildren.

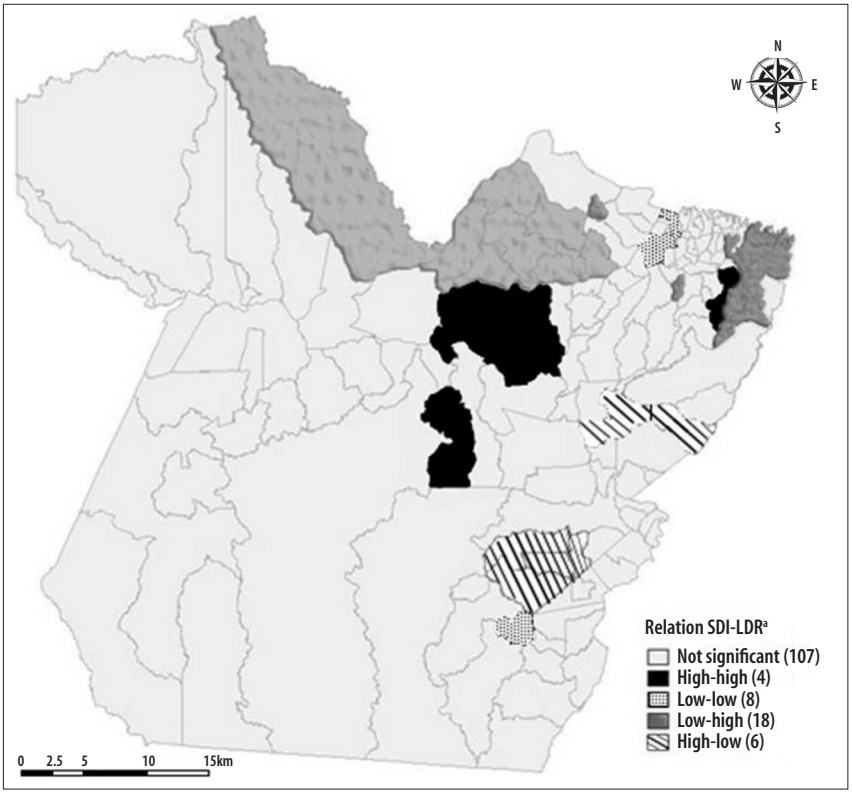
Amazon region has the lowest population density (4.12 individuals/km²) of Brazil; however it presents the highest number of individuals per household. This reality is deeply related to poverty, which compels relatives and other people to live together for long a time, usually in poor sanitation conditions. A study carried out in the municipality of Castanhal, located in Pará State as well, for the period 2004-2010, found that the average density of a family unit was even higher in households which presented a leprosy case, suggesting that improvements on socioeconomic conditions should be part of the global leprosy strategy.[26]

The control of this endemicity offers challenges to sanitary entities responsible for tackling and controlling leprosy at the different levels of government.

Marajó region stood out because most of its municipalities presented 'bad' social deprivation index. This region has a history strongly marked by popular resistance to advances of exploration processes of the population and natural resources, and by an economic development that did not provide improvements to the living conditions of the poor population.[27] The metropolitan region of Belém stood out for presenting SDI predominantly 'good', which may be due to the capital and adjacent region having the highest concentration of goods and services in the state.

In this study, Moran's index showed a relation of dependence between SDI and LDR, which was already expected. Although leprosy may strike individuals of any social class, its incidence is higher in the poorest segments of society, given the presence of adverse socioeconomic conditions and, therefore, poor living and health conditions that facilitate the contamination and spread of the bacillus that causes the disease.[28]

A study carried out in the municipality of Fernandópolis, São Paulo, in the period 2009-2010, also verified the existence of a statically significant link between leprosy and the Human Development Index (HDI), attributed to the organization of local health services and to the presence of factors that enable the endemicity



a) SDI = social deprivation index; LDR = leprosy detection rate.

Figure 2 – Moran Map of the social deprivation index and leprosy detection rate per integration region, Pará, 2013

associated with the social exclusion situation to which the individuals are exposed.[29]

In order to obtain control and possible eradication of leprosy, Pará State must focus on actions to assist municipalities with higher social deprivation index, planning activities that can really address people's health needs. These needs may be different, depending on socioeconomic, environmental, political, cultural, and epidemiological contexts of the territories. The National Policy on Health Promotion aims at promoting quality of life and reducing vulnerability as well as health risks concerning their determinants and conditioners.[30]

As this is a cross-sectional ecological study, there are some limitations in the verification of occurrence of events in a single moment in time, besides the impossibility of translating associations, identified at a collective level, individually. Likewise, the use of secondary data source may also generate limitations with regard to quantity, quality, and information processing. There is also a limitation concerning the technique used (global Moran's index), which expresses the spatial autocorrelation considering only the first neighbor. Nevertheless, LDR and SDI may be influenced by other forms of association, such as lifestyle, living conditions, and lack of information on this kind of endemic disease. Besides, it is important to highlight that there was no notification in 17 municipalities of Pará State in 2013, which may have compromised the assessment carried out in this study.

Thus, new studies on this subject are necessary, using a prospective approach, in which these limitations may be minimized. Leprosy control is not a task addressed only to the Health sector. It should be managed in an integrated way with Social Assistance, as suggested by the results of this study, according to which poor living conditions also make an individual vulnerable to infections and, therefore, illness.

These findings contribute to enhance the knowledge currently available on leprosy, mostly because it is a study carried out in Pará State, where, despite the endemicity observed, there is not enough research on the subject. There are also little regional scientific production that verifies the relation between social conditions and the detection rate of this disease.

This study may contribute to the planning of health policies in the state. The identification of regions with a population at greater risk of illness provides scientific evidence to intensify surveillance actions in those places, enabling cost reduction through actions addressed to different epidemiological realities in the state, in addition to aiming at an articulation between Health and Social Assistance, with actions focused on leprosy control in Pará State.

Authors' Contributions

Chaves EC, Costa SV, Flores RLR, and Neves EOS contributed to the conception and design of the study, data collection, analysis, and interpretation, discussion of results, and draft of the manuscript. All authors approved the final version of the manuscript and declared to be responsible for all aspects of the study, ensuring its accuracy and integrity.

References

1. Ministério da Saúde (BR). Secretaria de Vigilância em Saúde. Departamento de Vigilância das Doenças Transmissíveis. Eliminar a hanseníase é possível: um guia para os municípios [Internet]. Brasília: Ministério da Saúde; 2015 [citado 2017 jul 10]. 12 p. Disponível em: http://bvsms.saude.gov.br/bvs/publicacoes/eliminar_hanseniase_possivel_versao_preliminar.pdf
2. Ministério da Saúde (BR). Secretaria de Vigilância em Saúde. Guia prático para operacionalização da campanha nacional de hanseníase, verminoses, tracoma e esquistossomose 2016 [Internet]. Brasília: Ministério da Saúde; 2016 [citado 2016 nov 03]. 50 p. Disponível em: http://portalsaude.saude.gov.br/images/pdf/2016/julho/05/guia-operacional-campanha-16-03-2016.pdf
3. Araújo AERA, Aquino DMC, Goulart IMB, Pereira SRF, Figueiredo IA, Serra HO, et al. Complicações neurais e incapacidades em hanseníase em capital do nordeste brasileiro com alta endemicidade. Rev Bras Epidemiol. 2014 out-dez;17(4):899-910.
4. Freitas LRS, Duarte EC, Garcia LP. Trends of main indicators of leprosy in Brazilian municipalities with high risk of leprosy transmission, 2011-2012. BMC Infect Dis. 2016 Sep;16(1):472.
5. Organização Mundial da Saúde. Estratégia mundial de eliminação da lepra 2016-2020: acelerar a ação para um mundo sem lepra [Internet]. Genebra: Organização Mundial da Saúde; 2016 [citado 2017 mar 17]. 36 p. Disponível em: http://apps.who.int/iris/bitstream/10665/208824/8/9789290225201-Portuguese.pdf

6. World Health Organization. Global leprosy update, 2015: time for action, accountability and inclusion [Internet]. Genebra: World Health Organization; 2016 [cited 2017 Mar 17]. 16 p. Available in: http://www.who.int/lep/resources/who_wer9135/en/

7. Ministério da Saúde (BR). Secretaria de Vigilância em Saúde. Registro ativo: número e percentual; casos novos de hanseníase: número, coeficiente e percentual, faixa etária, classificação operacional, sexo, grau de incapacidade, contatos examinados, por estados e regiões, Brasil, 2015 [citado 2016 jul 7]. Disponível em: http://portalsaude.saude.gov.br/images/pdf/2016/julho/07/tabela-geral-2015.pdf

8. Vieira GD, Aragoso I, Carvalho RMB, Sousa CM. Hanseníase em Rondônia: incidência e característica dos casos notificados, 2001 a 2012. Epidemiol Serv Saúde. 2014 abr-jun;23(2):269-75.

9. Amaral EP, Lana FCF. Análise espacial da Hanseníase na microrregião de Almenara, Minas Gerais. Rev Bras Enferm. 2008 nov;61(esp):701-7.

10. Fundação Instituto Brasileiro de Geografia e Estatística. Pará [Internet]. 2017 [citado 2017 mar 17]. Disponível em: http://www.ibge.gov.br/estadosat/perfil.php?sigla=pa

11. Albuquerque NC, Portal LC, Nogueira LMV, Rodrigues ILA. Busca ativa de hanseníase por meio de educação em saúde entre populações ribeirinhas. Rev Enferm UFPE. 2016 jul;10(7):2634-40.

12. Pará. Casa Civil. Decreto Estadual nº1.066, de 19 de junho de 2008. Dispõe sobre a regionalização do Estado do Pará e dá outras providências. Diário Oficial do Estado do Pará, Belém (PA), 2008 jun 20; nº 31.194.

13. Ministério da Saúde (BR). Secretaria de Vigilância em Saúde. Departamento de Vigilância e Doenças Transmissíveis. Diretrizes para vigilância, atenção e eliminação da hanseníase como problema de saúde pública: manual técnico-operacional [Internet]. Brasília: Ministério da Saúde, 2016 [citado 2017 jul 10]. 60 p. Disponível em: http://portalarquivos.saude.gov.br/images/pdf/2016/fevereiro/04/diretrizes-eliminacao-hanseniase-4fev16-web.pdf

14. Instituto Brasileiro de Geografia e Estatística. Resultado da amostra do censo demográfico 2010 [Internet]. 2010 [citado 2014 mar 22]. Disponível em http://www.ibge.com.gov.br

15. Rezende ML, Fernandes LPS, Silva AMR. Utilização da análise fatorial para determinar o potencial de crescimento econômico em uma região do Sudeste do Brasil. Rev Econ Desenv. 2007;1(19):92-109.

16. Fávero L, Belfiore P, Silva F, Chan BL. Análise dos dados: modelagem multivariada para tomada de decisões. Rio de Janeiro: Campus/Elsevier; 2009. 594 p.

17. Vieira ES, Tavares E, Madruga R. Análise fatorial [internet]. Belém: Universidade Federal do Pará; 2014 [citado 2017 jan 29]. 20 p. Disponível em: http://www.ufpa.br/heliton/arquivos/aplicada/seminarios/M1_Emerson_Analise_Fatorial.pdf

18. Fundação Getúlio Vargas. O índice de condições de vida e o índice de desenvolvimento humano municipal [internet]. Brasília: Fundação Getúlio Vargas; 2012 [citado 2016 out 19]. 2 p. Disponível em: http://www.cps.fgv.br/cps/pesquisas/Politicas_sociais_alunos/2012/Site/BES_IDHMICV_curto.pdf

19. Cliff AD, Ord JK. Spatial processes: models and applications. London: Pion; 1981.

20. Druck S, Carvalho MS, Câmara G, Monteiro AMV. Análise de dados de área: análise espacial de dados geográficos. Brasília: Embrapa; 2004.

21. Matos HJ, Blok DJ, Vlas SJ, Richardus JH. Leprosy new case detection trends and the future effect of preventive interventions in Pará State, Brazil: a modelling study. PloS Negl Trop Dis. 2016 Mar;10(3):1-10.

22. Alencar CH, Ramos Júnior NA, Santos ES, Richter J, Heukelbach J. Clusters of leprosy transmission and of late diagnosis in a highly endemic area in Brazil: focus on different spatial analys approaches. Trop Med Int Health. 2012 Apr;17(4):518-25.

23. Alencar CH, Ramos Júnior AN, Barbosa JC, Kerr LRFS, Oliveira MLW, Heukelbach J. Persisting leprosy transmission despite increased control measures in a endemic cluster in Brazil: the unfinished agenda. Lepr Rev. 2012 Dec;83(1):344-53.

24. Gomes FBF. Indicadores epidemiológicos da hanseníase e sua relação com a cobertura da Estratégia Saúde da Família e o Índice de Desenvolvimento Humano em Minas Gerais – período: 1998-2013 [dissertação]. Belo Horizonte (MG): Escola de Enfermagem da Universidade Federal de Minas Gerais; 2016.

25. Palácios VRCM, Dias RS, Neves DCO. Estudo da situação da hanseníase no estado do Pará. Rev Para Med. 2010 abr-jun;24(2):49-56.

26. Barreto JG, Bisanzio D, Guimarães LS, Spencer JS, Vazquez-Prokopec GM, Kitron U, Salgado CG. Spatial analysis spotlighting early childhood leprosy transmission in an hyperendemic municipality of the Brazilian Amazon Region. PLoS Negl Trop Dis. 2014 Feb;8(2):e2665.

27. Belo RPN. Atuação de psicólogos em centros de referência de assistência social na região amazônica do Marajó [dissertação]. Natal (RN): Universidade Federal do Rio Grande do Norte; 2015.

28. Rangel EM, Lopes VAS. Hanseníase e vulnerabilidade social: uma análise do perfil socioeconômico de usuários em tratamento irregular. Saúde Debate. 2014 out-dez; 103(38):817-29.

29. Baldan SS, Santos BMO. Hanseníase: uma abordagem na perspectiva de promoção de saúde. Hansen Int. 2012 jul-dez;37(2):11-21.

30. Ministério da Saúde (BR). Secretaria de Vigilância em Saúde. Política nacional de promoção da saúde [Internet]. 3 ed. Brasília: Ministério da Saúde; 2010 [citado 2016 jun 30]. (Série B. Textos Básicos de Saúde). 60 p. Disponível em: http://bvsms.saude.gov.br/bvs/publicacoes/politica_nacional_promocao_saude_3ed.pdf

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