

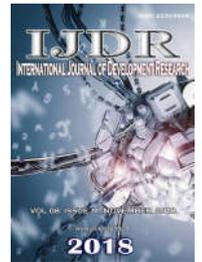


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## SPATIAL ANALYSIS OF HANSEN'S DISEASE AND SOCIAL CONDITIONS: AN INTEGRATIVE REVIEW

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### ABSTRACT

**Objective:** To analyze the scientific production on spatial analysis of Hansen's disease and the relationship with the social conditions, the most prevalent Geographic Information Systems.

**Method:** Integrative review of articles published in English, Portuguese and Spanish in the databases MEDLINE, SCOPUS, WEB OF SCIENCES, CINAHL, CUIDEN, LILACS, IBESC and BDNF. The methodological rigor and the level of evidence were verified by means of the Critical Appraisal Skills Programme (CASP) and evidence-based practice, respectively. **Results:** Eight articles were identified, with prevalence of SIGs Arc Wiew, Arc Gis and Terra View, which showed an association between Hansen's disease and life conditions, migratory movements, and even with low national coefficients, there were hyperendemic municipalities, with newly diagnosed cases in medium-degree incapacity proportion (5-10%). **Conclusion:** Geo processing techniques allow identifying localities with specificities in the context in which exposed populations and those with Hansen's disease are inserted, show ways for more effective advances in control and elimination of the disease by means of inter and trans disciplinary interventions between the different fields of knowledge.

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## INTRODUCTION

Hansen's disease still represents a public health problem worldwide. In the Americas, the disease is not endemic in Canada, Chile and the United States (Penna and Penna, 2012), (Truman et al., 2011), (Sharma et al., 2015), (Lombardi et al., 2015). In the USA, it is limited to the central coast of the gulf. In current Europe, Portugal has treated imported Hansen's disease cases, mostly of Brazilians (Eidt, 2004), (Cruz, 2016). In Latin America, Argentina is one of the countries, besides Brazil, with large load of Hansen's disease that has already achieved the reduction targets at national level, but still has endemic locations (Odriozola et al., 2017). The World Health Organization (WHO), in 2014, recorded 213,899 new cases,

corresponding to a rate of 3.0/100,000 inhabitants, and 94% of these were located in 13 countries, including Brazil (World Health Organization, 2016). To achieve the elimination of Hansen's disease (prevalence < 1 case/10,000 inhabitants), some key issues recommended by the WHO are the strengthening of health surveillance and information systems and inclusion of communities in actions for improvement of Hansen's diseases services (World Health Organization, 2016). Brazil has reduced the coefficients of prevalence and detection of new cases of Hansen's disease, but the North, Northeast and Midwest regions are the most endemic. In 2010, 67% of the new cases occurred in children younger than 15 years. The Northeast region presented the highest number of cases in absolute values, with 12,848 new cases recorded (Ministry of Health, 2008). The use of geo processing in the health area has allowed the digital mapping, organization of spatial data and production of thematic maps. It consists of a set of techniques for collecting, processing, handling and presenting spatial data,

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and uses other areas of knowledge, such as the Cartography, Computing, Geography and Statistics. With it, the exact location of Hansen's disease cases can direct the decision-making in the health context, for the implementation of actions that can positively affect disease control. The Geographic Information Systems (GIS) are indicated as instruments for integrating environmental and social data with health data, allowing better characterization and quantification of the exposure, its possible determinants and effects on health (Ministry of Health, 2006). Considering the current remaining implications on the prevalence and incidence of Hansen's disease and socioeconomic factors, this review aimed to analyze the scientific production techniques of spatial analysis of Hansen's disease and its relationship with social conditions.

**MATERIALS AND METHODS**

This is an integrative review study, whose guiding question of the research was: Which scientific evidences indicate the GISs that predominate in the spatial analysis of the distribution of Hansen's disease by associating it with the social conditions? The literature search process was guided by the research question, with a view to ensuring the greatest number of scientific evidence.

The online survey was carried out by means of the *Portal de Periódicos da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)* (Coordination for Higher Level Personnel Improvement Portal of Journals). The searches were conducted in databases: Medline, Scopus, Web of Science, Cinahl, Cuiden, Lilacs, Ibecs and Bdenf, using the keywords "Hansen's disease" and "geographic information systems" "Hansen's disease" and "social conditions" and "Hansen's disease" and "geographic information systems" and "social conditions" standardized by the MESH (Medical Subject Heading) and DeCS (Health Sciences Descriptors) and their equivalents in Spanish and Portuguese.

**RESULTS**

The review traveled stages of preparation that contemplated identification of research question, establishment of inclusion and exclusion criteria, search in databases; categorization of studies and data extraction; assessment of studies included in the review, discussion and interpretation of results; synthesis of the information highlighted in articles (Mendes *et al.*, 2008).

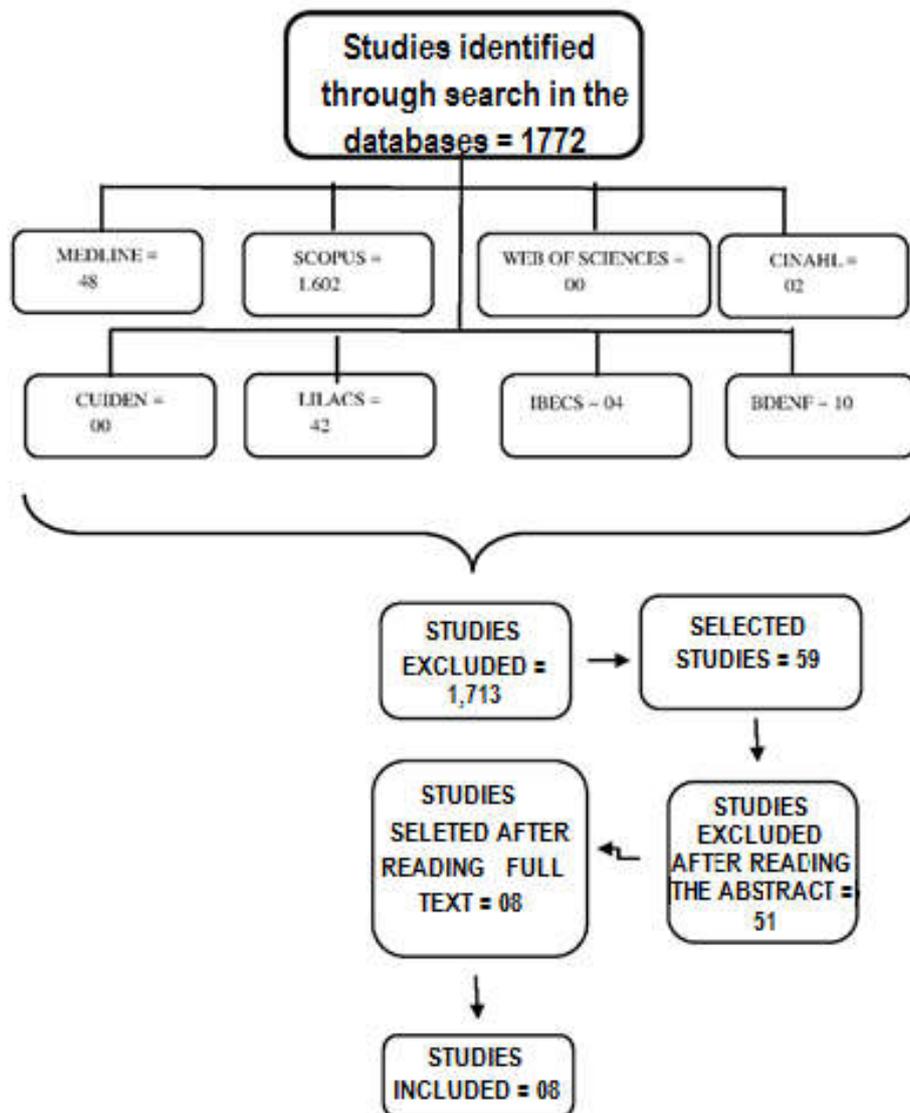


Figure 1. Data collection flowchart

Table 1. Description of articles that used GISs to relate Hansen's disease to social conditions. Recife, 2017

Bases/Authors/Country	Objective	Method/Level of Evidence*	GIS-Softwares used	Results
CINAHL/Silva D.R. X. <i>et al.</i> / Brazil	To analyze the association between social and environmental indicators and the Hansen's disease detection coefficient (HDDC) in the Brazilian Amazon.	Ecologic/2B	Terra View	There was positive correlation of the Hansen's Disease Detection Coefficients (HDDC) between total deforested area ( $r = 0.50$ ; $P < 0.000$ ) and proportion of households with rudimentary cesspool ( $r = 0.49$ ; $P < 0.000$ ). The HDI presented an inverse behavior to the HDDC - the higher the HDI, the lower the HDDC ( $r = -0.36$ , $P < 0.000$ ). There was no association between proportion of households with well water supply and HDDC when analyzed throughout the region.
Scopus/Queiroz <i>et al.</i> / Brazil	To analyze the spatial distribution of Hansen's disease in a Brazilian endemic area	Ecologic /2B	Arc Map	There was significant association between risk of Hansen's disease and: water availability, garbage collection and the level of poverty; the higher the number of residents in the household, the greater the chance of infection. The average distance between the intradomiciliary and neighbors cases was 2,890 m and a median of 2,841 m; 45% of cases were multibacillary.
Scopus/Sampaio P.B., Rossi T.L., Junior, E.Z. / Brazil	To determine the spatial distribution of coefficients of new cases of Hansen's disease in the state of Espirito Santo (ES.).	Ecologic /2B	Terra View	Of the 78 cities in ES, 25 (32%) were hyperendemic, 21 (26.9%) had very high endemicity and two (2.6%) had low endemicity. Ten (12.8%) cities changed classification according to official parameters: two went from low to average; four changed from medium to high, three changed from high to very high, and one changed from very high to hyperendemic.
Scopus/Cury M.R.C.O. <i>et al.</i> / Brazil	To identify areas with higher occurrence of Hansen's disease cases and associated socioeconomic and demographic factors	Ecologic /2B	Arc Gis	Areas with lower socioeconomic levels coincide with a higher incidence of the disease; identified clusters of greater risk in the poorest areas of the city. The chi-square test showed association between disease and SF ( $X^2 = 180.7$ ; $p < 0.0001$ ). There was no association between the disease and demographic density; nor between the households of most patients and the location of the health services.
Scopus/Moura <i>et al.</i> / Brazil	To use home visits as surveillance tools for Hansen's disease in a Brazilian hyperendemic area	Ecologic /2B	Arc Map	High risk of disease in social contacts. Fifteen new cases occurred in people aged less than 20 years (27%), suggesting early exposure to <i>M. leprae</i> . Of the new cases, 6 (40.0%) resulted from household contacts and nine (60.0%), from neighbors. More than half of the study participants had a family income of <two minimum wages. The residents had low educational attainment, lived in neighborhoods of lower socioeconomic level, as determined by family income, population density and education. A single family presented up to eight cases. Of the 15 new cases, five had some degree of disability
Scopus/Miranda W.C., Neto F.C., Barrozo L. / Brazil	To analyze the spatial clusters and possible associations between relative risks of Hansen's disease and socioeconomic and environmental factors, in cases diagnosed in children under 15 years.	Ecologic /2B	Arc Gis	Overall detection rates reduced from 0.88/10,000 in 2005 to 0.52 in 2011. Space-scanning statistics identified four high-risk and six low-risk clusters. The RRs were associated with higher percentage of water bodies, higher Gini index, higher percentage of urban population, higher average number of residents per residence, and lower percentage of residents born in Bahia.
Web of Sciences/Freitas L.R.S., Duarte E.C., Garcia L.P. / Brazil	To analyze the ecologic association between demographic and socioeconomic characteristics of Brazilian cities and the mean rate of incidence of Hansen's diseases from 2009 through 2011	Ecologic /2B	Arc Gis	The highest median SIR (Smoothed Incidence Rate) occurred in municipalities with a population > 20,000 inhabitants, with urbanization $\geq 65\%$ of the population, with an illiteracy rate between $\geq 13\%$ and $< 24\%$ ; with a poverty rate of $\geq 43\%$ , unemployment rates $\geq 8\%$ , a higher average number of residents per household ( $\geq 3.3$ ) and a significant income inequality (Gini index of family income per capita $\geq 0.55$ ). Municipalities with a higher proportion of men than women had the highest SIR (23.9 per 100 thousand inhabitants).
Scopus/Cunha M.D., Almeida A.S., Cunha G.M., Santos R.S. / Brazil	To discuss the application of the geographically weighted regression (GWR) model to health data to improve the understanding of social and clinical factors especially variable that potentially affect the prevalence of Hansen's disease.	Ecologic /2B	Arc Gis	Running water is a protective factor for new cases in different degrees in the municipality; where patient care is available for a longer period. Decentralization of services has contributed positively to higher detection rates, particularly in areas where decentralization recently; households with $\geq 7$ residents contributed more strongly to a greater detection of the disease. There was association between proportion of households with piped water and higher detection rates, mainly in the Northeast of the municipality. The indeterminate forms were strongly associated with higher detection rates in the south, where access to health services was more established.

\* Oxford Center for Evidence-based Medicine. Level of Scientific Evidence by Type of Study. Source: the author, 2017

## DISCUSSION

The results of the studies of this review corroborate researches that have shown the association between social conditions and high levels of endemicity of Hansen's disease (Souza, 2015), (Nicchio, 2016), (Magalhães, 2007). Poverty (Queiroz, 2010), (Cury, 2012), (Moura, 2013), (Miranda, 2014), (Freitas, 2014), (Silva, 2010), numerous families (Queiroz, 2010), (Moura, 2013), (Miranda, 2014), (Cunha, 2016), (Freitas, 2014), education deficit (Silva, 2010), (Moura, 2013), (Moura, 2013), (Freitas, 2014), unfavorable health conditions (Souza, 2015), (Queiroz, 2010), (Miranda, 2014), (Cunha, 2016), inequality and social exclusion (Silva, 2010), (Freitas, 2014), are some conditions that act in the maintenance of the nosological framework of some countries. The poverty situation has serious repercussions, including the lack of instruction, determined by the children's need to work to help their families (Pinzane, and Leão, 2017). The higher the level of education of a population, the healthier it is, and being healthy has a higher probability of access to formal and informal education (Casemiro *et al.*, 2014). A study conducted in Brazil showed that up to 2015 about 430 thousand children aged between 6 and 14 years remained outside the school and belonged to poor, black, indigenous families with disabilities and with per capita income lower than ¼ minimum wage. In this same year, 27% of the population remained as functional illiterates; and only 46.9% of teachers in the final years of basic education had college degree in their teaching area (National Education Program Observatory, 2017).

People that cannot read or have difficulties of interpretation can hardly understand and apply in their lives the concepts of health promotion that may act as protective factors for health. The articles included in this study showed other quite relevant information from the epidemiological point of view, such as high percentage (45%) of multibacillary cases among a population studied in the Brazilian northeast region (Queiroz *et al.*, 2010); another study showed that five (33.33%) out of 15 new cases investigated had some degree of incapacity (Moura *et al.*, 2013); another one showed a negative relationship with the residents born in Bahia (Miranda and Neto, 2014); and finally, another study found a higher proportion of households with running water as a protective factor for new cases in different degrees in the municipality (Cunha *et al.*, 2016). Another important contribution of this IR was showing that the Hansen's disease in Brazil still has significant hyperendemic locations (Moura *et al.*, 2013), (Sampaio *et al.*, 2012), despite the reduced indicators published by the Ministry of Health (Ministry of Health, 2008), and "this spatial conformation defines the Brazilian geography of Hansen's disease" (Magalhães, 2007). Recent studies (Assis *et al.*, 2017), (Alencar, 2012), developed in the region of the Brazilian Amazon found a high rate of detection of new cases, especially in children younger than 15 years old, and growth of cases of multibacillary form, which points to a persistent maintenance of the cycle of transmission.

In this direction, not only health authorities need to seek to address the disease biologically, but also multifactorial interventions need to consider the complexity of the determination of Hansen's disease. Even with advances in explanations about exposure to the etiological agent of Hansen's disease and forms of transmission, some gaps still need to be better elucidated, such as the zoonotic transmission

and the role of the environment involving water, soil and vegetation type (Truman, 2010), (Busso, 2011), (Lavaria, 2008). In the United States, the autochthonous cases are rare, however the transmission by armadillos has been studied, suggesting it is a zoonosis in the southern United States (Penna and Penna, 2012), (Truman, 2011). Important aspects regarding the efforts of control programs, which focus on the priority research and interventions on the aspect of transmission between humans, whose results have been configured in impacts little relevant in reducing the detection coefficients. The studies showed that the elimination of Hansen's disease requires multifaceted interventions to overcome the care model still predominantly centered in medical practice, seeking joint action with Education, Housing, Labor and Environmental sectors, among others, reducing effects of inequalities, improving the population's conditions, thus obtaining a positive impact on the disease magnitude (Rodrigues *et al.*, 2017), (Carvalho *et al.*, 2015), (Oliveira *et al.*, 2016). Therefore, investing in approaches as complex as its determination, and reflecting on the Krieger's affirmative (Krieger, 2017), when the author mentions that "the basic point is that the unjust social relations between groups shape the characteristics of these groups, including their health status". An important limitation found in this study was the exclusion of non-Brazilian studies because they did not meet the inclusion criteria, during searches in the databases. The discussions would possibly be richer by comparing realities, extending the contributions of this study for the state of the art.

## Conclusion

Geoprocessing techniques allow identifying localities with specificities in the context in which exposed populations and those with Hansen's disease are inserted, introducing other possibilities related to the disease transmission, such as the zoonotic type, and environmental elements such as water, soil and vegetation type, as well as the ratio of deforestation with the expansion of the disease in the northern regions of the country. Therefore, the results of the present study contribute to broader understanding of determination and spatial distribution of the disease, by incorporating other aspects that may indicate paths to more effective progresses in its control and elimination, and that inter-sectorial and transdisciplinary interventions between the different fields of knowledge can be implemented.

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