AS&T ACTA SCIENTIAE & TECHNICAE

ISSN: 2317-8957
Volume 1, Number 2, Dec. 2013

ECOLOGICAL AND SOCIAL DETERMINANTS OF LEISHMANIASIS IN THE LEGAL AMAZON, BRAZIL

KAMILA MENDES DE OLIVEIRA[1], RAQUEL LEITE WAINFAS[1], ADRIANO ARNÓBIO[2], RONALDO FIGUEIRÓ[3,4]*

[1] Centro Universitário Estadual da Zona Oeste (UEZO), Rio de Janeiro - RJ, Brasil
[2] Universidade do Estado do Rio de Janeiro (UERJ), Rio de Janeiro – RJ, Brasil
[3] Centro Universitário de Volta Redonda (UNIFOA), Volta Redonda - RJ, Brasil
[4] Laboratório de Biotecnologia Ambiental - Centro Universitário Estadual da Zona Oeste (UEZO), Rio de Janeiro - RJ, Brasil
*ronaldofigueiro@gmail.com

RESUMO

A leishmaniose é uma doença reemergente de distribuição mundial e de grande importância para a saúde pública. É uma doença infecciosa , parasitária e de gravidade clínica que varia desde uma aparência saudável até um estado grave. Existem duas formas principais da doença: a leishmaniose tegumentar (cutânea e mucocutânea) e leishmaniose visceral. Este formulário pode ser mortal para alcançar os órgãos. Os quatro protozoários principal que causam tais manifestações clínicas são *Leishmania chagasi* , *Leishmania braziliensis* , *Leishmania amazonensis* e *Leishmania guyanensis*. O Fatores ambientais, sociais e demográficos são elementos-chave na transmissão da leishmaniose, devido ao seu vetor ser um flebotomíneo - inseto de hábitos hematófagos - e seu principal reservatório os cães. No Brasil, a doença é endêmica e amplamente distribuída. 80 % dos casos notificados são de crianças menores de 10 anos. A Amazônia Legal é uma área de estudo da saúde pública, tendo sofrido ações antrópicas que prejudicam o equilíbrio ecológico do local. Nesta área , a leishmaniose visceral é cada vez mais presente no oeste do Estado do Pará , devido ao seu desenvolvimento econômico , que se reflete na saúde pública. Este estudo tem como objetivo relacionar os fatores ambientais e de saúde com a incidência de leishmaniose na Amazônia Legal e sua através de dados secundários de publicações no Sistema de Informação Nacional de Saúde (DATASUS).

Palavras-Chave: saúde pública, leishmaniose visceral, Amazônia, incidência.

ABSTRACT

Leishmaniasis is a reemerging disease of worldwide distribution and has a public health importance. It is an infectious disease, parasitical and clinical severity ranging from a healthy appearance to a severe stage. Features two major forms, such as cutaneous leishmaniasis (cutaneous and mucocutaneous) and visceral leishmaniasis. This form can be deadly for reaching the organs. The four main protozoa that cause such clinical manifestations are Leishmania chagasi, Leishmania braziliensis, Leishmania amazonensis and Leishmania guyanensis. Environment, social and demographic factors are key for the transmission of leishmaniasis, due to its vector being a sand fly - insect with hematophagous habits - and its main reservoir are dogs. In Brazil, leishmaniasis is endemic and widely distributed. 80% of reported cases are in children under 10 years. The Legal Amazon region is an area of study of public health, having suffered anthropogenic actions that undermine the ecological balance of the site. In this area, visceral leishmaniasis is increasing in western Pará state due to its economic development, which involves the public health. This study aims to relate environmental and health factors with the incidence of leishmaniasis in the Legal Amazon and this relationship through secondary data from publications in the National Health Information System (DATASUS).

Key-Words: public health, visceral leishmaniasis, Amazon, incidence.

INTRODUCTION

Leishmaniasis is a zoonosis of public health importance. It is an infectious and parasitic disease, which etiology in Brazil is given by four species of protozoa: *Leishmania chagasi* (causes visceral leishmaniasis), *Leishmania braziliensis* (causes mucocutaneous form), *Leishmania amazonensis* and *Leishmania guyanensis* (causes cutaneous leishmaniasis).

The transmission occurs through the bite of a sand fly, an hematophagus insect belonging to the order Diptera. The blood is required for maturation of the eggs, that's why only female can perform the transmission.

The protozoa of the genus Leishmania causes a range of clinical syndromes through mucocutaneous lesions and can be lethal in its

visceral form. The severity of clinical manifestations is also related to the low immunity of the patient, in other words, the infection becomes more severe due to the fact that the patients have a reduced immune defense. (Silva et al., 2002). Emphasizing, visceral leishmaniasis is a zoo-antroponosis with global distribution, having dogs as an important reservoir of the agent (Marzochi et al., 1985); its clinical characteristics show a healthy appearance or even a severe stage of the disease (Marzochi et al., 1985). It can be classified as a reemerging disease due to its ability to rapidly expand into new areas (Oliveira et al., 2001). In Brazil, this illness remains a major public health concern owing to be getting endemic with wide geographic distribution and its relation to hygiene, social class and sanitation.

In Brazil, this disease occurs not only by the facts mentioned above, but also by nutrition and the concurrent infections. With increasing urbanization in the last 25 years, it is necessary to analyze the major biological, environmental and social issues that are likely to influence spreading this disease (Gontijo & Melo, 2004). Visceral leishmaniasis has a higher risk with urbanization because migration is an important aspect of the disease and, in general, immigrants are low-income people who live in precarious conditions. (Oliveira et al., 2001).

In Brazil, visceral leishmaniasis affects people of all ages, but in most endemic areas 80% of reported cases occur in children under 10 years. The first report of visceral leishmaniasis in Brazil was in 1934, when amastigotes of the protozoan were found on a sectional liver-cut of people who died diagnosed with yellow fever, but only 20 years later was recorded the first outbreak of the disease (Gontijo & Melo, 2004).

The disease was initially restricted to northeastern region, but has expanded to other regions reaching even the outskirts of urban centers (Figueiredo et al., 2010).

The area of the Legal Amazon covers the states of Amazonas, Acre, Roraima, Rondônia, Pará, Mato Grosso, Amapá, Goiás, and this The area of the Legal Amazon covers the states of Amazonas, Acre, Roraima, Rondônia, Pará, Mato Grosso, Amapá, Goiás (Ferreira et al., 2005). The occupation of this area in the last 50 years has occurred because of the establishment of "axes" and "poles" of development, agricultural projects, mining, production and grains exportation (Alves, 2001). With this accelerated process of occupation, a great part of the forest was cleared for human interests (Alves, 2001). Hot spots can also be considered one of the factors for the deforestation of the Amazon, which characterizes Brazil as a country that emits more CO2 in the world, which causes the greenhouse effect (Oliveira, et al, 2011).

The accelerated deforestation due to the factors mentioned causes an expansion of diseases, implying on behavior of public health. Leishmaniasis is found in the group of these diseases because seasonal foci of sand fly population are associated with cluttered deforestation (Rebelo et al., 1999). Then, a program named "Bolsa Floresta" deploys a series of activities that act on benefit of environmental conservation, poverty alleviation and climate change (Viana, 2008), allowing control of deforestation and helping the work of public health, meaning, if deforestation helps in expansion of leishmaniasis, controlling it , there will be a disease control too.

With the development of public health, the Amazon has become an area of interest for studies because it has relevant characteristics to epidemiological determination and implications for healthcare assistance. This follows up the fact that the region has a great biodiversity and is suffering human actions which can ultimately lead to environmental imbalances and trophic level of the site (Confalonieri, 2005). In the Legal Amazon region, visceral leishmaniasis is expanding in the state of Pará, owing to urbanization trend and some areas of intense transmission occur in the western state. This expansion of the disease is related to the mining enterprise of bauxite where the economic breakthrough of the region has caused environmental changes affecting public health (Garcez et al., 2010). But that does not mean that the illness occurs only

in the state of Pará. In the state of Roraima, for example, Indians had an epidemiological profile of visceral leishmaniasis in cases observed between 1989 and 1993. There was a prevalence of 69.5% for males (Guerra et al., 2004).

Deforestation is a huge problem in this area because several factors are influencing this situation such as political development in the region, land speculation along highways, growth of cities, the dramatic increase in cattle ranching, timber exploitation and household farming (Ferreira et al., 2005).

Public health and the incidence of some diseases have a direct relationship with society and the environment. The environmental issue has been seen with more importance in recent times due to global warming, greenhouse effect, air pollution, the hole in the ozone layer and also by regional environmental problems such as deforestation, soil degradation, water pollution, among other things. One area that discusses these issues is the Environmental Health, which analyzes environmental factors to diseases and gravities on population health, that is exposed to precarious circumstances of survival and certain physical-chemical factors.

Through the World Health Organization (WHO), models of Environmental Monitoring were proposed to be used where there are several factors considered that may affect people's health, such as poverty, population growth, industrialization, urbanization, technological and economic development, soil contamination, water and air; these factors that establish a direct link with environmental hazards and risks to health of the people exposed to such factors, subjecting them to infections, poisoning, morbidity and mortality (Pignatti, 2004).

Understanding how environmental factors can influence urban and demographic dynamics of pathological leishmaniasis contributes to the understanding of the complexity of the phenomenon of the disease , in this way, the present study aims to determine the main environmental factors related to the incidence of the disease and generate information that foster control programs in the Amazon.

MATERIALS AND METHODS

Geographical coverage

The research comprises the Legal Amazon in a time range of 18 years (1992-2010).

Epidemiological design

The epidemiological method used is a longitudinal study, time series, which can be understood as the epidemiological study that uses aggregate population as the unit of analysis.

Information base

The information base is composed of secondary data from the publication of the National Health Information System (DATASUS) from 2000 to 2010 and the Brazilian Institute of Geography and Statistics (IBGE) – Synopsis Sector.

Statistical design

The secondary data collected through the DATASUS were arranged on a spreadsheet in Bioestat 5.3 © software and analyzed for adherence to a normal distribution by the Shapiro-Wilk test. The variables considered potentially related to the incidence of leishmaniasis were used in curve fitting as independent variables, and regressions were performed with better adjustment after a debris analysis that excluded outliers data.

RESULTS AND DISCUSSION

Deforestation of the Legal Amazon is a threat to the biodiversity of the site and this can be the occurrence of certain factors such as agricultural expansion, accelerated industrialization since the 50s and an adaptation to economic globalization (Vieira et al., 2008). The table and figure below (Table I, Figure 1) show a relationship between the rate of deforestation in the Legal Amazon and the incidence of leishmaniasis in the region:

Table I: Relative deforestation data and relative incidence of leishmaniasis in the Legal Amazon basin in the period 1992-2010

Years	Relative deforestation	Leishmaniasis incidence
1992	0.27	16.59
1994	0.59	18.11
1995	0.57	22.83
1996	0.36	22.94
1997	0.26	19.12
1998	0.34	19.61
1999	0.34	13.47
2000	0.36	19.79
2001	0.36	19.86
2002	0.43	16.18
2003	0.5	15.97
2004	0.55	17.24
2005	0.37	15.6
2006	0.28	14.22
2007	0.23	11.58
2008	0.25	11.45
2009	0.15	10.63
2010	0.13	11.37

Source: Brazilian Institute of Geography and Statistics (IBGE)

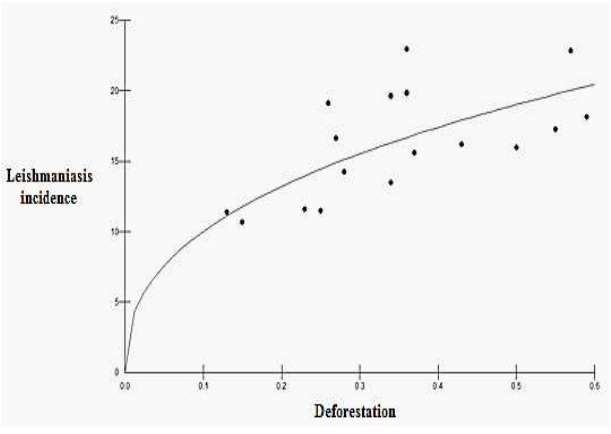

Figure 1: Geometrical regression linking the incidence of leishmaniasis and the Legal Amazon (relative) deforestation in the years 1992-2010. R^2 = 48.14% and p-value <0.01

It can be observed that deforestation has meant an increase in the occurrence of the disease. This pattern may be due to the human being increasingly overlapping with their habitat of the sand fly, thus being more prone to infection and stings. Since the ancient cultures, sanitation is associated with precarious health. Sanitation is a determining and conditioning factor for health, so, both must have an important connection (Teixeira, 2011). Table II and Figure 3 below show a linear relationship between households without sanitation and the incidence of leishmaniasis:

Table II: Index of households without sanitation and incidence of leishmaniasis

Years	Houselholds without sanitation	Leishmaniasis incidence
2001	12.77888889	19.86
2002	11.32111111	16.18
2003	10.36555556	15.97
2004	11.71111111	17.24
2005	10.20777778	15.6
2006	9.992222222	14.22
2007	10.00666667	11.58
2008	7.914444444	11.45
2009	7.364444444	10.63

Source: Brazilian Institute of Geography and Statistics (IBGE)

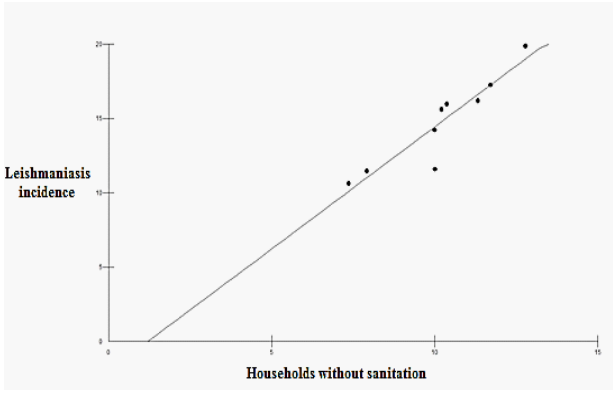

Figure 2: Linear regression linking the incidence of leishmaniasis in the Legal Amazon with the number of households without sanitation in the years 2001-2009. R^2 = 85.03% and p-value <0.01

The regression indicates a positive relationship between sanitation and the incidence of leishmaniasis. This pattern is possibly also related to the precariousness of hospital care and the highest population density in these areas.

The relationship between the absence of schooling and the incidence of leishmaniasis is also positive (Table 3, Figure 3), indicating that the lack of education can be a social factor favoring the incidence of disease due to this portion of the population has little or no knowledge about the disease, its prevention and prophylaxis.

Table III: Test of relationship between absence of school education and incidence of leishmaniasis

Years	Absence of school education	Leishmaniasis incidence
2001	14.73444444	19.86
2002	13.04333333	16.18
2003	13.62777778	15.97
2004	13.97333333	17.24
2005	13.36555556	15.6
2006	12.34333333	14.22
2007	12.07	11.58
2008	11.65222222	11.45
2009	11.03444444	10.63

Source: Brazilian Institute of Geography and Statistics (IBGE)

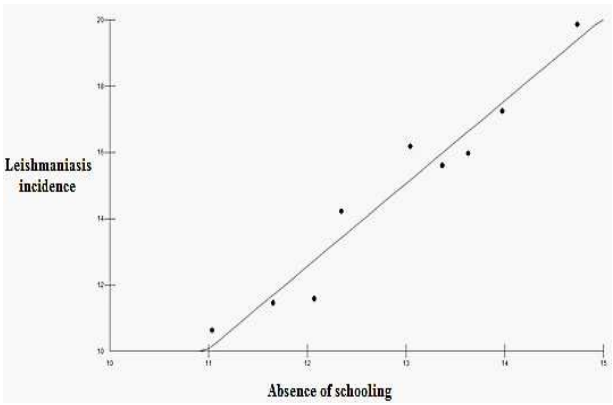

Figure 3: Linear regression linking the incidence of leishmaniasis in the Legal Amazon with people who have no educational level in the years 2001-2009. R^2 = 94.46%

The infectious and parasitic diseases in Brazil reached an expressive underprivileged population, low income, low education level and has no conditions for sanitation and primary health care (Paes et al., 1999), however the analyzes of this study have shown no significant (Table IV, Figure 4), which may suggest that these factors are not correlated in the study area.

Table IV: Test of relationship between incomes less than one minimum wage and incidence of leishmaniasis

Years	Income of less than one minimum wage	Leishmaniasis incidence
2001	12.24777778	19.86
2002	14.03888889	16.18
2003	14.20222222	15.97
2004	14.89555556	17.24
2005	15.86777778	15.6
2006	14.94444444	14.22
2007	16.27222222	11.58
2008	10.04222222	11.45

Source: Brazilian Institute of Geography and Statistics (IBGE)

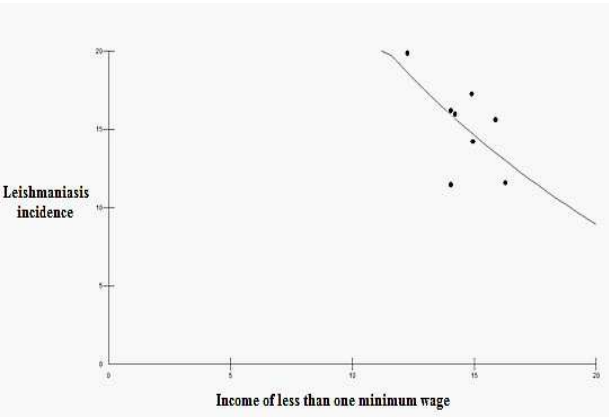

Figure 4: Logarithmic regression linking the incidence of leishmaniasis in the Legal Amazon with people who have incomes less than one minimum wage in the years 2001-2008. R2 = 38.408% and p-value = 0.103

From these results, it is possible to observe that many factors are related to the incidence of leishmaniasis in the Legal Amazon region. Deforestation, sanitation and absence of schooling were positive index rate of leishmaniasis.

Deforestation may influence the spread of the disease due to the fact of being a human action, reflecting the expansion of the spatial distribution of man, which increasingly overlaps with the habitat of the sand fly, forcing insects that once had their habitat in the forest to encroach homes or start to colonize urban environments.

The absence of schooling, in turn, may be related to lack of knowledge about the disease, its transmission, diagnosis and cure, thus increasing the risk, while on the other hand the family income apparently has no direct implications on risk.

Thus, this study reinforces the importance of fighting deforestation of the Legal Amazon, because among the various climatic consequences and threat to biodiversity degradation of this ecosystem features, there are also significant epidemiological implications regarding leishmaniasis.

ACKNOWLEDGMENTS

We appreciate the support of FAPERJ (Carlos Chagas Filho Foundation for Research Support of the State of Rio de Janeiro).

ALVES, Diógenes S. O processo de desmatamento na Amazônia. Rev. Parc. estrat., n 12, pag. 259-275, Set. 2001;

CONFALONIERI, Ulisses E. C. Saúde na Amazônia: um modelo conceitual para a análise de paisagens e doenças. Estud. av., vol.19, n.53, 2005;

FERREIRA, Leandro V., VENTICINQUE, Eduardo, ALMEIDA, Samuel. O desmatamento na Amazônia e a importância das áreas protegidas. Estud. av., São Paulo, v. 19, n. 53, Apr. 2005;

FIGUEIREDO, Fabiano B. et al . Relato de caso autóctone de leishmaniose visceral canina na zona sul do município do Rio de Janeiro. Rev. Soc. Bras. Med. Trop., Uberaba, v. 43, n. 1, Feb. 2010;

GARCEZ, Lourdes Maria et al. Vigilância da leishmaniose visceral em localidades epidemiologicamente distintas em Juruti, um município minerário do Estado do Pará, Brasil. Rev Pan-Amaz Saúde. vol.1, n.1, 2010;

GONTIJO, Célia Maria F.; MELO, Maria N. Leishmaniose visceral no Brasil: quadro atual, desafios e perspectivas. Rev. bras. epidemiol., São Paulo, v. 7, n. 3, Sept. 2004;

GUERRA, Jorge Augusto O. et al. Leishmaniose visceral entre índios no Estado de Roraima, Brasil: aspectos clínicoepidemiológicos de casos observados no período de 1989 a 1993. Rev. Soc. Bras. Med. Trop., Uberaba, v. 37, n. 4, Aug. 2004;

OLIVEIRA, Cláudia Di Lorenzo et al. Spatial distribution of human and canine visceral leishmaniasis in Belo Horizonte, Minas Gerais State, Brasil, 1994-1997. Cad. Saúde Pública, Rio de Janeiro, v. 17, n. 5, Oct. 2001;

OLIVEIRA, Rejane C. de et al . Desmatamento e crescimento econômico no Brasil: uma análise da curva de Kuznets ambiental para a Amazônia legal. Rev. Econ. Sociol. Rural, Brasí¬lia, v. 49, n. 3, Set. 2011;

PAES, Neir A., SILVA, Lenine Angelo A. Doenças infecciosas e parasitárias no Brasil: uma década de transição. Rev Panam Salud Publica/ Pan Am J Public Health 6(2), 1999;

PIGNATTI, M. G. Saúde e Ambiente: as doenças emergentes no Brasil. Rev. Ambiente & Sociedade, vol.7, n.1, Campinas, Jan./June 2004;

MARZOCHI, Mauro Célio de A. et al . Leishmaniose visceral canina no Rio de Janeiro -

- Brasil. Cad. Saúde Pública, Rio de Janeiro, v. 1, n. 4, Dec. 1985;

REBÊLO, J. M. M. et al. Flebotomíneos (Diptera, Psychodidae) de área endêmica de leishmaniose na região dos cerrados, Estado do Maranhão, Brasil. Cad. Saúde Pública, Rio de Janeiro, jul-set 1999;

SILVA, Eduardo Sérgio da et al. Visceral leishmaniasis caused by Leishmania (Viannia) braziliensis in a patient infected with human immunodeficiency virus. Rev. Inst. Med. trop. S. Paulo, São Paulo, v. 44, n. 3, 2002;

TEIXEIRA, Júlio César, GOMES, Maria Helena R., SOUZA, Janaina A. de. Análise da associação entre saneamento e saúde nos estados Brasileiros: estudo comparativo entre 2001 e 2006. Eng. Sanit. Ambient., Rio de Janeiro, v. 16, n. 2, June 2011;

VIANA, Virgilio M. Bolsa Floresta: um instrumento inovador para a promoção da saúde em comunidades tradicionais na Amazônia. Estud. av., São Paulo, v. 22, n. 64, Dec. 2008;

VIEIRA, I.C.G. et al. Deforestation and threats to the biodiversity of Amazonia. Braz. J. Biol., São Carlos, v. 68, n.4, Nov. 2008;