

# EPIDEMIOLOGICAL PROFILE AND SPATIAL DISTRIBUTION OF LEPROSY IN PAULO AFONSO, BAHIA

## PERFIL EPIDEMIOLÓGICO E DISTRIBUIÇÃO ESPACIAL DA HANSENÍASE EM PAULO AFONSO, BAHIA

## PERFIL EPIDEMIOLÓGICO Y DISTRIBUCION ESPACIAL DE LA LEPRO EN PAULO AFONSO, BAHÍA

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**Objectives:** to analyze the epidemiological characteristics and distribution of new leprosy cases in the population of Paulo Afonso, Bahia, Brazil, between 2000 and 2015. **Method:** descriptive study with all new cases of leprosy reported at the Notifiable Diseases Information System. Sociodemographic and clinical variables were used and annual detection coefficients were calculated. Population estimates were obtained from the Brazilian Institute of Geography and Statistics. **Results:** most of the 1,069 new reported cases were female (57.2%), living in the urban area (92%), brown race/color (66.92%), elementary school (67.6%), over fifteen years of age (92.5%), tuberculoid clinical form (48.26%), paucibacillary (62.3%), degree of physical disability at diagnosis (45.93%) and cure (29.75%). **Conclusion:** the epidemiological profile of leprosy in Paulo Afonso is similar to the national one, with variations in leprosy detection coefficients between years and spatial analysis showing heterogeneous distribution, with a higher concentration of cases in peripheral neighborhoods.

**Descriptors:** Communicable Diseases. Public Health. Leprosy. Descriptive Epidemiology. Spatial Analysis.

*Objetivos: analisar as características epidemiológicas e distribuição dos casos novos de hanseníase na população de Paulo Afonso, Bahia, Brasil, entre 2000 e 2015. Método: estudo descritivo com todos os casos novos de hanseníase notificados no Sistema de Informações de Agravos de Notificação. Foram utilizadas variáveis sociodemográficas e clínicas e calculados os coeficientes de detecção anuais. Estimativas populacionais foram obtidas no Instituto Brasileiro de Geografia e Estatística. Resultados: a maioria dos 1.069 casos novos notificados foi do sexo feminino (57,2%), residiam na zona urbana (92%), raça/cor parda (66,92%), ensino fundamental (67,6%), maiores de quinze anos (92,5%), forma clínica tuberculóide (48,26%), paucibacilares (62,3%), grau de incapacidade física no diagnóstico (45,93%) e na cura (29,75%). Conclusão: o perfil epidemiológico da hanseníase em Paulo Afonso é*

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*similar ao nacional, houve variações nos coeficientes de detecção da hanseníase entre os anos e a análise espacial evidenciou distribuição heterogênea, com maior concentração de casos nos bairros periféricos.*

*Descritores: Doenças Transmissíveis. Saúde Pública. Hanseníase. Epidemiologia Descritiva. Análise Espacial.*

*Objetivos: analizar las características epidemiológicas y la distribución de nuevos casos de lepra en la población de Paulo Afonso, Bahía, Brasil, entre 2000 y 2015. Método: estudio descriptivo con todos los nuevos casos de lepra reportados en el Sistema de Información de Enfermedades Notificables. Se utilizaron variables sociodemográficas y clínicas y se calcularon los coeficientes anuales de detección. Las estimaciones de población se obtuvieron del Instituto Brasileño de Geografía y Estadística. Resultados: la mayoría de los 1.069 nuevos casos notificados fueron mujeres (57,2%), que viven en el área urbana (92%), raza/color parda (66,92%), escuela primaria (67,6%), con más de quince años (92,5%), forma clínica de tuberculoide (48,26%), paucibacilar (62,3%), grado de discapacidad física al diagnóstico (45,93%) y en la cura (29,75%). Conclusión: el perfil epidemiológico de la lepra en Paulo Afonso es similar al nacional, hubo variaciones en los coeficientes de detección de lepra entre años y el análisis espacial mostró una distribución heterogénea, con una mayor concentración de casos en barrios periféricos.*

*Descriptorios: Enfermedades transmisibles. Salud Pública. Lepra. Epidemiología descriptiva. Análisis espacial.*

## Introduction

Leprosy is a chronic, curable infectious disease with compulsory notification that affects the skin, mucous membranes and nerves<sup>(1)</sup>. It manifests neurodermatologically through skin lesions with degrees of change in sensitivity<sup>(2)</sup>. The progression of neuropathy can trigger disabilities and physical deformities<sup>(1)</sup> due to late diagnosis and treatment<sup>(3)</sup>.

This disease persists as a public health problem in the world with strong social determination, because spatial distribution has an intimate association with the socioeconomic conditions of the affected populations, with a trend to concentrate cases in less favored social strata<sup>(3)</sup>. The spread of the disease seems to be influenced by individual and collective factors, such as gender, age, genetic susceptibility, socioeconomic and geographic conditions; despite the efforts made, there are still numerous cases of leprosy in some underdeveloped countries<sup>(4)</sup>.

Since the 1990s, the World Health Organization (WHO) has proposed the integration of leprosy control actions<sup>(5)</sup>. In the same period, Brazil began this process, with the consolidation of the Unified Health System (UHS) and with primary health care as a strategy to reorient health care models and cope with social inequalities in health<sup>(6)</sup>. However, in 2000, there was an expansion of

the scope of actions and competencies at the municipal level for leprosy control<sup>(7)</sup>.

Brazil is currently the second most endemic country in the world, and has presented a high detection coefficient (12.2 cases per 100 thousand inhabitants)<sup>(4)</sup>, a regular percentage of cure among new cases between 2012 and 2016<sup>(8)</sup>, and the highest number of new cases occurred in men, brown, illiterate or with incomplete secondary education<sup>(4)</sup>. The Northeast region, as well as the North and Midwest regions, has the highest concentration of cases throughout the country<sup>(4)</sup>. Thus, the regions with the highest risk of contracting the disease<sup>(4)</sup> reach an incidence five to eight times higher than the Southeast and South regions<sup>(8)</sup>.

As in Brazil, the socioeconomic profile of cases in the state of Bahia, considered an endemic area and the largest state in the Northeast, is similar to the profile of cases throughout Brazil. In 2017, the detection coefficient was classified as high (14.5 cases per 100 thousand inhabitants) and 79.4% of the cases evolved to cure<sup>(9)</sup>. Furthermore, the largest number of new cases of leprosy in this state occurs in male people, brown, illiterate or with incomplete elementary school, aged between 30 and 44 years<sup>(10)</sup>.

Paulo Afonso stands out as one of the 20 priority municipalities for leprosy surveillance

and control actions in the state<sup>(11)</sup>. It is considered one of the high-risk clusters for the detection of new cases<sup>(12)</sup>. There is a lack of studies addressing the situation of the disease in the municipality. Thus, the epidemiological characterization of leprosy in the city of Paulo Afonso for a period of 15 years is of great importance to evaluate the diagnostic approach, the effectiveness of treatment and the degree of disabilities detected in a pole city of the Mesoregion of the São Francisco Valley.

The aim of this study was to analyze the epidemiological characteristics and distribution of new leprosy cases in the population of Paulo Afonso, Bahia, Brasil, between 2000 and 2015.

## Method

This is a descriptive epidemiological study based on secondary data from the Notifiable Diseases Information System (SINAN). All new cases of leprosy diagnosed and reported between 2000 and 2015 of residents in the city of Paulo Afonso were analyzed.

Paulo Afonso is a city located in the São Francisco Valley, Bahia, Brazil, with an area of 1,579,723 km<sup>2</sup> and a population of approximately 120 thousand inhabitants<sup>(13)</sup>. This city is the second largest in the São Francisco Valley, Bahia, and the largest in the micro-region of which it is part.

Considering the notification form referring to the municipality of residence and mode of entry, cases of transfer from the same municipality (another unit), transfer from another municipality (same federative unit), transfer from another state, transfer from another country, recurrence, other readmission and ignored were excluded from this study.

The SINAN-Leprosy database was made available by the Ministry of Health (MH) as Microsoft Excel 2010 spreadsheet. Data of the municipality of Paulo Afonso were collected in December 2017. The sociodemographic variables were: age (<15 years and ≥15 years), gender (male and female), residence area (rural and urban), race/color (white, black, brown, yellow

and indigenous), schooling (illiterate, primary education, secondary education and higher education). The clinical variables consisted of clinical form (indeterminate, tuberculoid, dimorphous, Virchowian and unclassified), operational classification (paucibacillary and multibacillary), degree of physical disability (DPD) in diagnosis (DPD 0, DPD I, DPD II, not evaluated) and DPD in cure (DPD 0, DPD I, DPD II, not evaluated and ignored).

Data analysis was performed in the first half of 2018. For categorical variables, absolute and relative frequencies were calculated. For the continuous variable (age), annual means and standard deviation were also calculated. The calculation of leprosy detection coefficients was based on the number of cases and population estimates for each year of the study. Population estimates were obtained from the Brazilian Institute of Geography and Statistics (IBGE)<sup>(13)</sup>. All parameters for the classification of endemic indicators in the municipality of Paulo Afonso were defined by the Ministry of Health, in Ordinance n. 149, of February 3, 2016<sup>(14)</sup>. In the analysis, the period from 2000 to 2015 was considered, due to the availability and completeness of the data at SINAN, mainly in the variable of the closure of cases. The year 2000 was the milestone for the decentralization of leprosy control actions and improvement of the quality of the recorded data.

The residential addresses contained in the notification sheets allowed identifying geographic locations (latitude and longitude). The coordinates were acquired as .dbf (dBase file) for the construction of thematic maps of leprosy incidence areas during the years from 2000 to 2015. The shape files were extracted from the IBGE website. These maps allowed identifying the patterns of spatial distribution of leprosy in Paulo Afonso (BA), as well as the observation of well-defined clusters.

The generated data were organized in graphs and tables, using Stata (version 13). For mapping, the coordinates were obtained from Google Earth Pro. The construction of thematic maps

with spatial distributions was made possible by the Qgis 2.18.14 program.

This study presents the synthesis of the main results of the scientific initiation project entitled “Epidemiological Situation of Leprosy and Characterization of Cases Occurred in the Municipality of Paulo Afonso – Bahia in the period from 2000 to 2015”, approved by the Research Ethics Committee at the Universidade Federal do Vale do Rio São Francisco (UNIVASF), Opinion n. 2.785.621.

## Results

Between 2000 and 2015, 1,069 cases of the disease were reported in Paulo Afonso. In general, there was a slight reduction in the absolute

number of new leprosy cases in the municipality, comparing the years (39 cases in 2000 and 34 in 2015). There was a higher occurrence of new cases in 2004<sup>(127)</sup> and 2005<sup>(118)</sup>; and smaller in 2014 and 2015, with 34 cases each. The average was 66.8±29.2 cases per year.

Regarding the sociodemographic characteristics of the new cases, there was a higher frequency in females (611/57.16%), brown skin color (609/66.92%), lower educational levels (766/83.70%) and among young people and adults of economically active age (989/92.50%). The age group with the highest number of new cases reported was 21 to 30 years (191/17.86%). While the mean age among new cases was 40.7±18.9 years. Cases predominated in the urban region (983/93.97%) (Table 1).

**Table 1** – Sociodemographic and clinical characteristics of new cases of leprosy. Paulo Afonso, Bahia, Brazil – 2000-2015. (N=1.069) (continued)

Variables	n	%
<b>Sex</b>		
Female	611	57.16
Male	458	42.84
<b>Housing area*</b> <sup>(1)</sup>		
Urban	983	93.97
Rural	63	6.02
<b>Race/color*</b> <sup>(2)</sup>		
White	220	24.17
Black	64	7.03
Yellow	10	1.09
Brown	609	66.92
Indigenous	7	0.76
<b>Schooling*</b> <sup>(3)</sup>		
Illiterate	90	9.83
Primary education	676	73.87
Secondary education	142	15.51
Higher education	7	0.76
<b>Age</b>		
<15 years	80	7.48
≥15 years	989	92.50
<b>Clinical Form</b>		
Undetermined	124	11.60
Tuberculoid	516	48.27
Dimorphous	247	23.11
Virchowian	95	8.89
Unclassified	12	1.12
Ignored	75	7.02

**Table 1** – Sociodemographic and clinical characteristics of new cases of leprosy. Paulo Afonso, Bahia, Brazil – 2000-2015. (N=1.069) (conclusion)

Variables	n	%
<b>Operational Classification</b>		
Paucibacillary	666	62.30
Multibacillary	403	37.70
<b>DPD in Diagnosis</b>		
Degree 0	309	28.91
Degree 1	491	45.93
Degree 2	223	20.86
Not Evaluated	46	4.30
<b>DPD in Cure</b>		
Degree 0	310	29.00
Degree 1	318	29.75
Degree 2	126	11.79
Not Evaluated	27	2.53
Ignored	288	26.94

Source: Created by the authors.

\* Percentage calculated considering only the individuals with information for those variables.

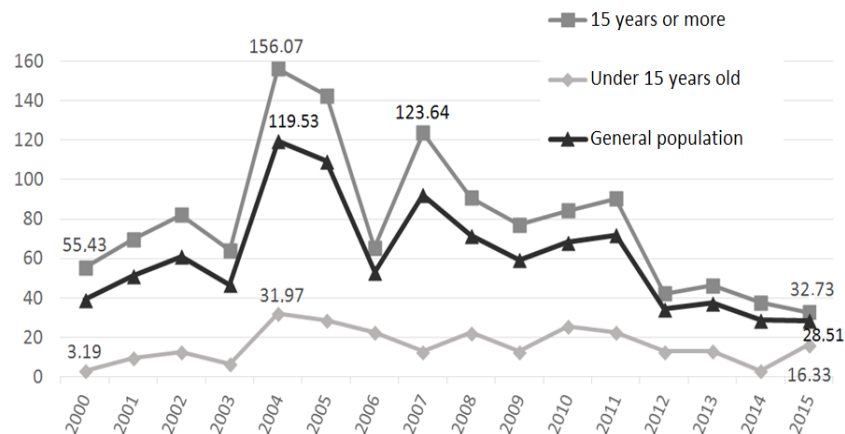
<sup>(1)</sup> In 2.15% (23 people) of the forms, this variable was in blank.

<sup>(2)</sup> In 15.56% (159 people) of the forms, this variable was in blank.

<sup>(3)</sup> In 14.95% (154 people) of the forms, this variable was in blank.

Regarding clinical characteristics, the clinical forms and operational classification (516/48.26%) tuberculoid and paucibacillary (666/62.30%) prevailed, respectively. Concerning the DPD, most cases already had some DPD in diagnosis (714/66.67%) and cure (444/41.54%).

The comparative analysis of the detection coefficients of general leprosy in children under 15 years of age and over 15 years allowed observing that there were variations between years. The highest detection coefficients were recorded in 2004 for all groups (Graph 1).

**Graph 1** – Detection coefficient of leprosy (per 100 thousand inhabitants) in the general population, over 15 years old and under 15 years old. Paulo Afonso, Bahia, Brazil – 2000-2015

Source: Created by the authors.

The initial and final coefficient in the general population was 39.10/100 thousand inhabitants and 28.5/100 thousand inhabitants, respectively. The average for the period from 2000 to 2015 was 60.80/100 thousand inhabitants. In 2015, the lowest detection coefficient was recorded (28.51/100 thousand inhabitants). The fall had its most pronounced moment between 2011 and 2012 and changed the endemic classification in the city for the groups mentioned – from hyperendemic to very high, a parameter previously achieved only in 2000.

Still in the general population, this indicator reached the value of 119.53 cases per 100 thousand inhabitants, a number three times higher than the lower limit for the hyperendemic classification. This was also the year with the highest proportion of diagnoses by collectivity examination (411/38.44%), surpassing even those that occurred through referrals (275/25.64%) and spontaneous demand (24.0%). A similar pattern can be perceived in the following year, 2005, which recorded the second highest detection coefficient of the period (109.5/100 thousand inhabitants in the general population). The main mode of detection was collectivity tests (385/36%

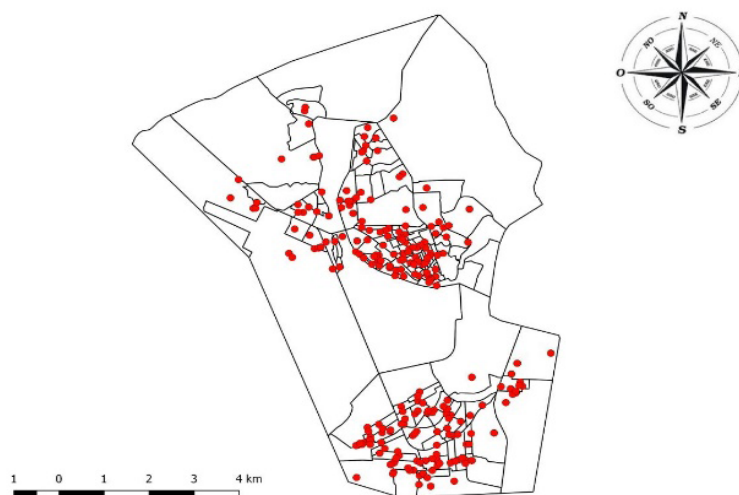
of diagnoses), followed by spontaneous demand (357/33.38%) and referrals (21.0%). In those over 15 years of age, the rates follow a pattern very similar to those of the general population.

Concerning children under 15 years of age, the highest detection coefficient was 31.97 cases/100 thousand inhabitants, considered hyperendemic, as almost all other years studied. There was an increase in the coefficient from 3.19 to 16.3/100 thousand inhabitants between 2014 and 2015, which represented a jump to hyperendemic levels.

Of the total number of new leprosy cases occurring in the municipality, only those living in the urban area were georeferenced (983/91.96%).

In relation to the spatial distribution of the cases, the most affected neighborhoods were those located, respectively, in the southern part of the city, where the neighborhoods Tancredo Neves III (159/14.82%) and Tancredo Neves II (148/13.84%) stand out, in the Center (105/9.82%) and in the neighborhood of Perpétuo Socorro (77/7.20%), located in the Insular (North) part of Paulo Afonso, which assumed the third and fourth positions in number of new cases of leprosy (Figure 1).

**Figure 1** – Distribution of new cases of leprosy residing in the city of Paulo Afonso



Source: Created by the authors.

The distribution of new cases of leprosy in the most endemic neighborhoods evidences the presence of at least two clusters: one located in the Southern part, which has a larger population

and where the detection coefficients are the highest, and another located in the Insular region of the city, affecting mainly the area that corresponded, in the past, to Vila Poty (Figure 2).

**Figure 2** – Spatial clusters of new cases of leprosy residing in the city Paulo Afonso

Source: Created by the authors.

## Discussion

The study revealed that the new cases of leprosy living in Paulo Afonso had the sociodemographic characteristics according to the Brazilian profile in relation to most of the variables analyzed, variation in detection coefficients between years and spatial characteristic with heterogeneous distribution and focused on the most peripheral neighborhoods.

Most new cases of leprosy predominated in females (57.16%), similar to that found in other studies conducted in the state of Bahia<sup>(15)</sup> and in Brazil<sup>(8)</sup>. However, there is a trend of reduction of cases in women in Bahia<sup>(16)</sup>. This higher occurrence in women may be related to the fact that they tend to care more about their own health and are less resistant to seek care with health professionals<sup>(11)</sup>, as well as may also be related to the fact that women are exposing themselves more, upon crossing the home barrier seeking their own space in the labor market<sup>(17)</sup>.

The brown race/color (66.92%) was the most frequent in notifications, agreeing with what was presented in other studies<sup>(8,10)</sup>. A study points out that this occurrence results from the predominance of this population in the Northeast region of the country<sup>(15)</sup>, besides being very vulnerable to inequalities in several sociodemographic aspects, due to the historical context of the black population in Brazil.

Regarding education, most new cases of leprosy have only primary education (73.87%), according to other studies<sup>(8,10)</sup>. This characteristic, in addition to other aspects, can be more found by the fact that this population has no knowledge about the prevention methods and clinical signs that arise at the beginning of this disease, and does not have sufficient discernment in relation to self-care<sup>(15)</sup>.

The study showed a higher occurrence of new cases in the urban area (93.97%), similar to that found in other studies conducted in Brazil<sup>(8,15)</sup>. Considering the migration from the rural to the urban area, it is estimated that this population has taken the same precarious socioeconomic characteristics, when moving to poor neighborhoods with population agglomeration. The literature states that this fact may have favored the spread of the disease<sup>(15)</sup>.

In Paulo Afonso, in most new cases of leprosy, the age was above 15 years (92.50%), with an average age of 40.7±18.9 years. In general, these individuals are part of an economically active population, as also presented by other authors<sup>(10,15,17)</sup>. As leprosy has a long incubation period, that is, it takes between 3 to 5 years for the etiological agent to settle in the host's organism and begin to manifest the signs and symptoms characteristic of the disease, this disease receives the name of adult disease<sup>(18)</sup>.

In relation to new cases in Paulo Afonso, the age group of 15 years constituted 8% of the notifications. This result was equivalent to the finding in another municipality of the São Francisco Valley, which recorded 7.94% of all new cases diagnosed<sup>(19)</sup>. Studies show that these young people are increasingly affected due to the high number of cases of the disease in the population. This is, therefore, an indicator of an endemic area, representing a focus of active and recent transmission, since the incubation period is not obeyed due to functional limitation and frailty in this age group<sup>(18)</sup>.

Regarding physical disabilities, the study revealed a higher frequency of new cases that presented some DPD in diagnosis and treatment. Despite the known trend of increase in DPD in Bahia<sup>(10)</sup>, the findings of this study stood out when compared to the literature<sup>(10,15,18)</sup>. Treatment delay may be one of the possibilities of explaining this situation, since the presence of DPD, especially DPD 2, does not occur in the early stages of the disease. Therefore, it can be an indirect marker of the magnitude of the disease, and of the quality and effectiveness of the care provided<sup>(20)</sup>. One fact that draws attention is the reasonable frequency (26.94%) of cases not evaluated at discharge, especially in a scenario of high number of DPD 1 and 2. This evidences the fragility of health teams regarding clinical management and limits knowledge about the conditions of this person during the final course of treatment and after discharge.

The comparison of the detection coefficient of Paulo Afonso (28.73 cases per 100 thousand inhabitants) in 2014 with the coefficients of Bahia (17.4 cases per 100 thousand inhabitants) and Brazil (15.3 cases per 100 thousand inhabitants) in the same year showed that the municipality is classified as very high endemic (between 20.00 and 39.99/100 thousand inhabitants)<sup>(10,14)</sup>.

It is relevant that Paulo Afonso presented an unequal urbanization process since the beginning of its history. If, on the one hand, the former planned "Garden City" camp benefited a selected group of the Plant workers, consisting of engineers and other technical professionals, with

masonry houses and great housing conditions, on the other, it created enormous contrasts with the unhealthy housing conditions of the thousands of immigrants who came seeking work and piled spontaneously around the camp, forming the old Vila Poty. With democratization, there was the fall of the material wall that separated the two regions of the city. Nevertheless, recently, the development of new urban agglomerates in the South and Northwest tend to reproduce, with other nuances, the logic existing in the first years of the city<sup>(21)</sup>.

In this context, when observing the distribution of new leprosy cases reported in the municipality of Paulo Afonso between 2000 and 2015, their location follows a spatial distribution logic directly related to the socioeconomic conditions of the affected areas<sup>(14)</sup>. Studies conducted in Brazil and other countries indicate that certain contexts, involving housing characteristics, family and social aggregation habits, flow of people encouraged by economy or culture, may contribute to the maintenance of circulating *Mycobacterium leprae*<sup>(22)</sup>.

The identification of clusters mainly involving the Tancredo Neves neighborhoods and the neighborhoods where Vila Poty was once located, as is the case of the Center, seems to signal greater transmission of leprosy in these areas. This highlights the relevance of understanding the organization of the local geographic space in the maintenance of the transmission chain and in the dynamics of leprosy over the years<sup>(23)</sup>. However, the lower number of cases in certain neighborhoods, especially marginal to the most endemic areas, may suggest the need for intensification of actions aimed at earlier diagnosis and treatment of patients<sup>(24-26)</sup>. After all, a study explains that prevention, treatment and better health care in compromised areas contribute to less exposure of the population to the bacillus<sup>(27)</sup>.

The higher concentration of cases involving certain neighborhoods in the South, North and Northwest areas of Paulo Afonso shows that the historical process of social-spatial segregation experienced at the city's headquarters



contributed to a heterogeneous distribution of leprosy between 2000 and 2015, affecting mainly the poorest regions of the city<sup>(28)</sup>.

The limitations found in the present study result from the absence of some data in the notification form. This prevented reliable analysis of the characterization of the disease. As a result, 12.44% could not be georeferenced due to the incompleteness of the information of the fields destined to the addresses in the notification forms. In addition, the use of secondary data restricted the number of sociodemographic variables investigated. If, in this study, a questionnaire were applied, it would be possible to investigate other variables that were not included in the notification form.

## Conclusion

The study showed that Paulo Afonso, despite the decline in the number of cases over the years (2000-2015), still has a marked presence of multibacillary patients with a degree of disability at the time of diagnosis. This situation, by affecting more women and competent individuals, causes various social and economic losses, as it affects mainly adults of economically active age.

This reality draws attention to the maintenance of the transmission chain and to the higher risk of disabilities and deformities due to the late diagnosis and treatment of a significant portion of patients. Despite a downward oscillation in the number of cases over the years (2000-2015), the number of multibacillary patients is still remarkable.

The study, by presenting the neighborhoods with the highest risk of illness and the high frequency of cases that already arrived with some DPD, reinforces the need for better qualification of health professionals, intensification of epidemiological surveillance and decentralization of actions at the municipal level, as well as the guarantee of comprehensive care to people with leprosy and/or its sequelae.

At the same time, the research makes room for future studies, raising questions such as: What is the relationship between the pace of urbanization of Paulo Afonso and the increased

number of leprosy cases? What is the role of the migratory component in maintaining the leprosy transmission chain in the municipality?

In view of the above, the results of this study, associated with other epidemiological studies, are expected to allow a greater understanding of the dynamics of the spatial distribution of leprosy in the city of Paulo Afonso, contributing to education, prevention and control actions towards the areas at higher risk of leprosy infection.

## Collaborations:

1 – 1 – conception, design, analysis and interpretation of data: Yasmin Pereira Azevedo, Vitor Augusto da Silva Bispo, Ronaldo Inácio de Oliveira, Bruno Bezerra Gondim, Sélton Diniz dos Santos, Márcio Santos da Natividade and Joilda Silva Nery;

2 – 2 – writing of the article and relevant critical review of the intellectual content: Yasmin Pereira Azevedo, Vitor Augusto da Silva Bispo, Ronaldo Inácio de Oliveira, Bruno Bezerra Gondim, Sélton Diniz dos Santos, Márcio Santos da Natividade and Joilda Silva Nery;

3 – 3 – final approval of the version to be published: Sélton Diniz dos Santos, Márcio Santos da Natividade and Joilda Silva Nery.

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