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Original Article

Leprosy in a semi-arid region of Bahia: an analysis from 2001 to 2017

Hanseníase em uma região semiárida da Bahia: uma análise de 2001 a 2017

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ABSTRACT: Objective**:** To evaluate the clinical-epidemiological profile of leprosy cases in a semi-arid region of Bahia. Method**:** This is a cross-sectional study carried out using data from 167 records of leprosy patients diagnosed and assisted at the Family Health Unit in Paulo Afonso, Bahia, from 2001 to 2017. Results**:** The annual new case detection rate was 9 per 100,000 inhabitants. Out of 167 patients, 111 (66.5%) were female; 49 (29.3%) were aged between 31 and 45 years. The proportion of cases under the age of 15 was 10.8%. Tuberculoid leprosy was the most common form (55.1%), and the proportion of paucibacillary leprosy was 64.1%. Clinical form demonstrated 94.9% accuracy and an almost perfect agreement ($\kappa = 0.888$) compared to operational classification. Adverse effects were reported in 25 (15%) leprosy patients. Conclusion**:** Leprosy cases have been reported in Paulo Afonso, making the municipality an area of medium endemicity. Strengthening of leprosy control measures should be prioritized to eliminate the disease in this region.

Keywords: Leprosy; Diagnosis; Epidemiology; Health profile.

RESUMO: Objetivo: Avaliar o perfil clínico-epidemiológico dos casos de hanseníase em uma região semiárida da Bahia. Método: Trata-se de um estudo corte transversal, realizado a partir de dados de 167 prontuários de pacientes diagnosticados com hanseníase e atendidos em uma Unidade de Saúde da Família em Paulo Afonso, Bahia, no período de 2001 a 2017. Resultados: A taxa anual de detecção de casos novos foi 9 por 100 mil habitantes. Dos 167 pacientes, 111 (66,5%) eram do sexo feminino; 49 (29,3%) tinham entre de 31 e 45 anos. A proporção de casos com menos de 15 anos foi de 10,8%. A hanseníase tuberculóide foi a forma mais comum (55,1%) e a proporção de hanseníase paucibacilar foi de 64,1%. Comparada à classificação operacional, a forma clínica demonstrou 94,9% de acerto e uma concordância quase perfeita ($\kappa = 0,888$). Efeitos adversos foram relatados em 25 (15%) pacientes com hanseníase. Conclusão: Casos de hanseníase têm sido notificados em Paulo Afonso, tornando o município uma área de média endemicidade. O fortalecimento das medidas de controle da hanseníase deve ser priorizado para eliminar a doença nesta região.

Palavras-chave: Hanseníase; Diagnóstico; Epidemiologia; Perfil de saúde.

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INTRODUCTION

Leprosy is a chronic infectious disease caused by *Mycobacterium leprae,* mainly affecting the skin and peripheral nerves[1,2]. Its transmission happens from person to person by close and prolonged contact with multibacillary (MB) patients without treatment[3]. The morbidity is associated with reactional states and neural involvement, which can cause permanent physical incapacities and deformities that lead to social stigma[4].

Although it has treatment and is curable, leprosy remains a public health problem in several countries. India, Brazil, and Indonesia accounted for approximately 80% of all new cases detected globally. Furthermore, Brazil contributed 93% of new leprosy cases in the Americas[5]. The country's leprosy cases were concentrated in the Midwest, the North, and the Northeast macroregions, respectively. In 2020, 1,405 of the 17,979 reported cases were in Bahia, which ranks fourth in the Northeast in the number of cases[6]. In this scenario, Paulo Afonso, a municipality located in the semiarid northeast region, is one of the priority cities in Bahia for fighting leprosy due to the high number of cases reported in the region.

Interestingly, there is no specific vaccine for leprosy due partly to the impossibility of cultivating *M. leprae* in the laboratory and, therefore, the need for solid experimental models. Thus, its prevention depends on early diagnosis and timely treatment of patients with the disease. Such measures help to reduce the incidence of leprosy as well as the risks related to physical disabilities and deformities. Diagnosis is based on clinical and epidemiological history, bacilloscopy of intradermal scrapings, and histopathology of skin lesion biopsies[7]. However, in practice, the diagnosis is essentially clinical and based on dermato-neurological findings. Furthermore, the histopathological examination of skin lesions is rarely performed in the field, even where such services exist, as they are not always available in the primary care network[8].

In this context, it is imperative to implement regional descriptive studies to better understand the distribution of leprosy at the local level, identifying priority groups and areas within the municipality. Thus, this study aimed to evaluate the clinical and epidemiological profile of leprosy cases in Paulo Afonso, Bahia, from 2001 to 2017.

METHOD

Study design and setting

The present study is a cross-sectional observational study carried out at the Family Health Unit (USF) named Santa Inês, located in the Paulo Afonso municipality, the northeastern region of Bahia, Brazil. In addition, according to the Brazilian Institute of Geography and Statistics (IBGE), in 2021, a population of 119,213 inhabitants was estimated, with a total of 28 USF. However, despite the decentralization of services, *Santa Inês* USF is popularly known for being a reference for diagnosing and treating leprosy patients due to the professional quality and doctor-patient relationship. Ethics and Deontology previously approved the study in the Study and Research Committee of the Federal University of Vale do São Francisco (protocol No. 2,608,850).

Study population

The medical records of patients with leprosy registered at the Santa Inês USF from 2001 to 2017 and residents of the municipality of *Paulo Afonso, Bahia*, were analyzed. The diagnosis of leprosy was based on the epidemiological history and dermato-neurological examination and, when available, on the bacilloscopic index (BI) of the skin lesions, according to the criteria of the World Health Organization (WHO) and the Ministry of Health[9,10]. Two (1.2%) leprosy patients were excluded from the study because the year of diagnosis was unavailable. Thus, the final study population comprised 167 (98.8%) adult patients diagnosed with leprosy.

Data collection

The study used a structured questionnaire as a data collection instrument, containing demographic and clinical variables including race, sex, age, place of residence (rural or urban), number of household contacts, number of skin lesions, clinical form by classification of Madri[8] in indeterminate leprosy (IL), tuberculoid leprosy (TL), dimorphic or borderline leprosy (BL) and lepromatous leprosy (LL), operational classification, degree of inability to diagnose, IB, the occurrence of reaction states, type reaction 1 or reverse reaction (RR) and type 2 reaction or erythema nodosum leprosum (ENL), and adverse effects.

Statistical analysis

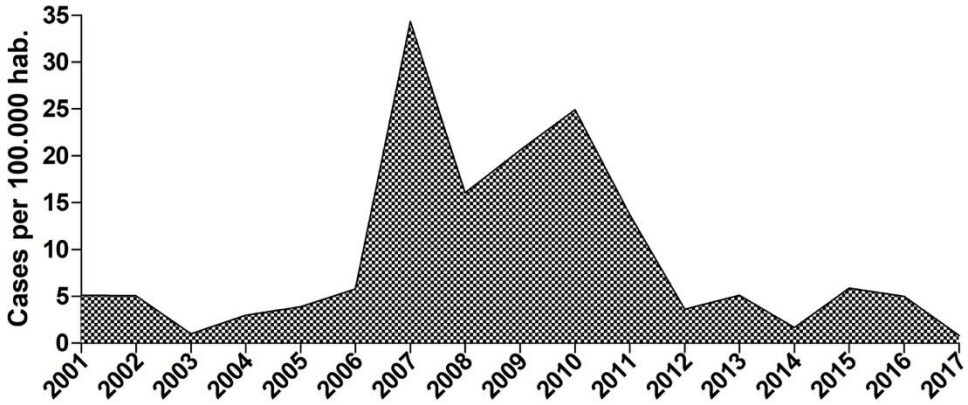
To calculate the new case detection rate (NCDR), the number of leprosy patients registered at the Santa Inês USF was divided by the population of *Paulo Afonso* and multiplied by 100,000. The generated coefficient allowed analyzing the magnitude and trend of leprosy in Paulo Afonso.

Then, the clinical and demographic aspects of leprosy patients were presented by evaluating simple frequencies (n) and percentages (%) for categorical variables. The results were organized in tables; bivariate analyses were performed using the chi-square test for categorical variables. The agreement between clinical or laboratory tests was evaluated using Kappa statistics (κ). Pearson's correlation (determined r-value) was also used to compare the number of lesions and the age of leprosy patients. P values < 0.05 were considered statistically significant. Statistical analysis was performed using GraphPad Prism v.5.0 (GraphPad Inc., San Diego, CA, USA)[11].

RESULTS

Detection rates in the semiarid Northeast region

Between 2001 and 2017, 167 leprosy cases were reported in the *Santa Inês* USF, corresponding to a mean detection coefficient of nine cases per 100,000 inhabitants. Observed NCDR varied between one (2003 and 2014) and 34.3 cases (2007) per 100,000 person-years across the 17 periods considered. Furthermore, it is possible to observe an increase in NCDR from 2007 to 2011 and a decrease since then (Figure 1).



Source: Created by the authors.

Figure 1 - New case detection rate (NCDR) of leprosy from 2001 to 2017 (N=167) at Santa Inês USF, Paulo Afonso, Bahia, Brazil.

Main characteristics of enrolled leprosy patients

Medical records of leprosy patients aged seven to 87 years were reviewed. These cases included 111 females (66.5%), 104 self-declared brown individuals (62.3%), 159 persons residing in urban areas (95.2%), 97 adults of working age (58%) (16–45 years), and 18 individuals under the age of 15 years (10.8%). However, the patients' mean age was 37.2 ± 17.8 years. The mean number of household contacts per leprosy patient was 3.8 ± 2.1, and 80.8% (n = 135) were classified as new cases.

Of the 167 leprosy patients, 118 (70.7%) had ≤ 5 skin lesions, and seven (4.8%) had positive bacilloscopies. Furthermore, there was a positive correlation between the number of lesions and patients' ages (p = 0.001, r = 0.252; Figure 2). Based on the Madrid classification from 1953, the most prevalent clinical form was TL, diagnosed in 92 (55.1%) individuals, followed by BL in 41 (24.5%) individuals. The LL clinical form was less prevalent, with only 10 (6%) individuals. Regarding the assessment of the degree of disability, 85 (50.9%) individuals had no physical disability, and 64 (38.3%) had some degree of disabilities. Furthermore, the reactions were documented in only nine (5.4%) cases, and ENL reactions were the most prevalent, corresponding to 77.8% (7/9). Lastly, 64.1% (n = 107) were paucibacillary (PB) as per operational classification. Details of the characteristics of the study population are shown in Table 1.

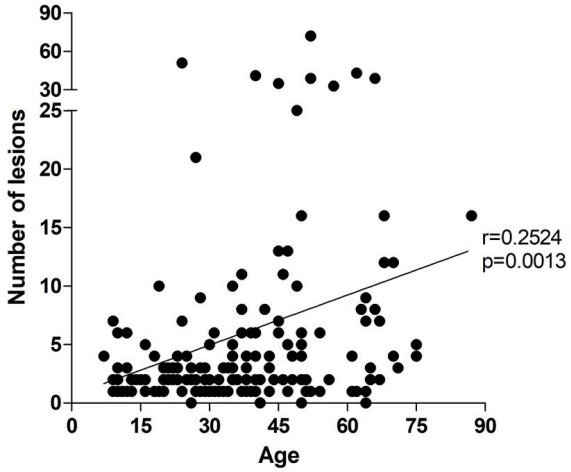


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Figure 2 - Correlation between the number of skin lesions and the age of leprosy patients. Santa Inês USF, Paulo Afonso, Bahia, Brazil, 2001–2017 (N = 167)

Table 1 - Overall clinical and demographic characteristics of the study population. Santa Inês USF, Paulo Afonso, Bahia, Brazil, 2001–2017 (N = 167)

Characteristics	Operational classification, n (%)		Total, n (%)	p-value**
	PB (n=107)	MB (n=60)		
Gender				
Male	31 (29)	25 (41.7)	56 (33.5)	0.0955
Female	76 (71)	35 (58.3)	111 (66.5)	
Ethnicity				
White	10 (9.4)	5 (8.3)	15 (9)	0.7420
Black	13 (12.1)	9 (15)	22 (13.2)	
Brown	70 (65.4)	34 (56.7)	104 (62.3)	
Indigenous	2 (1.9)	2 (3.3)	4 (2.3)	
Not informed/ignored	12 (11.2)	10 (16.7)	22 (13.2)	
Age (years)				
0-15	17 (15.9)	1 (1.7)	18 (10.8)	< 0.0001
16-30	38 (35.5)	10 (16.7)	48 (28.7)	
31-45	29 (27.1)	20 (33.3)	49 (29.3)	
46-60	13 (12.1)	12 (20)	25 (15)	
> 61	8 (7.5)	17 (28.3)	25 (15)	
Not informed/ignored	2 (1.9)	-	2 (1.2)	
Skin lesions				
≤ 5 lesions	100 (93.5)	18 (30)	118 (70.7)	< 0.0001
> 5 lesions	6 (5.6)	40 (66.7)	46 (27.5)	
Not informed/ignored	1 (0.9)	2 (3.3)	3 (1.8)	
Bacilloscopy examination				
Negative smear	39 (36.4)	16 (26.7)	55 (32.9)	0.0005
Positive smear	-	7 (11.6)	7 (4.2)	
Not informed/ignored	68 (63.6)	37 (61.7)	105 (62.9)	
Clinical Form*				
IL	13 (12.2)	2 (3.3)	15 (9)	< 0.0001
TL	87 (81.3)	5 (8.3)	92 (55.1)	
BL	1 (0.9)	40 (66.7)	41 (24.5)	
LL	-	10 (16.7)	10 (6)	
Not informed/ignored	6 (5.6)	3 (5)	9 (5.4)	
Reactional episodes				
No	106 (99.1)	52 (86.7)	158 (94.6)	0.0013
Reversal Reaction	1 (0.9)	1 (1.7)	2 (1.2)	
Erythema Nodosum Leprosum	-	7 (11.6)	7 (4.2)	
Degree of disability at diagnosis				
Grade 0	66 (61.7)	19 (31.7)	85 (50.9)	0.0050
Grade 1	29 (27.1)	22 (36.6)	51 (30.5)	
Grade 2	3 (2.8)	8 (13.3)	11 (6.6)	
Not informed/ignored	9 (8.4)	11 (18.4)	20 (12)	

*Madrid Classification (1953). **Chi-square test. PB = paucibacillary; MB = multibacillary; IL = indeterminate leprosy; TL = tuberculoid leprosy; BL = borderline or dimorphic leprosy; LL = lepromatous leprosy.
Source: Created by the authors.

Main characteristics of the leprosy patients stratified according to the operational classification

The clinical and demographic characteristics of leprosy patients grouped according to operational classification in PB and MB groups are summarized in Table 1. The mean age was higher in MB patients (47.1 ± 16.6 versus 31.6 ± 15.9, p<0.0008) than in PB patients. A statistically significant difference was observed between the PB and MB groups in terms of skin lesions (p<0.0001), bacilloscopy examination (p=0.0005), clinical forms (p<0.0001), reaction episodes (p=0.0013) and degree of disability (p=0.0015).

Agreement between operational classification and clinical or laboratory results

However, for the further analysis, we decided to exclude patients who did not have bacilloscopy (n = 105), clinical form (n = 9), and skin lesions (n = 3) results recorded or ignored. Furthermore, we considered the operational classification system the gold standard once the classification of leprosy patients into MB and PB determined their treatment regimen. Data on the agreement between the operational classification and clinical or laboratory results are available in Table 2. The adapted Madrid classification presented the best concordance with operational classification (94.9%, κ = 0.888), followed by the number of skin lesions (85.4%, κ = 0.664).

Table 2 - Agreement between operational classification and clinical and laboratory results from leprosy patients. Santa Inês USF, Paulo Afonso, Bahia, Brazil (2001–2017)

	WHO classification, n (%)		Total, n (%)	Concordance, %	Kappa*
	PB	MB			
Clinical Form*					
IL+TL	100 (99)	7 (12.3)	107 (67.7)	94.9	0.888 *Almost perfect agreement*
BL+LL	1 (1)	50 (87.7)	51 (32.3)		
Total	101 (100)	57 (100)	158 (100)		
Skin lesions					
≤ 5 lesions	100 (94.3)	18 (31)	118 (72)	85.4	0.664 *Substantial agreement*
> 5 lesions	6 (5.7)	40 (69)	46 (28)		
Total	106 (100)	58 (100)	164 (100)		
Bacilloscopy					
Negative	38 (97.4)	16 (69.6)	54 (87.1)	72.6	*0.322 Fair agreement*
Positive	1 (2.6)	7 (30.4)	8 (12.9)		
Total	39 (100)	23 (100)	62 (100)		

*Kappa interpretation by Landis & Kock (1977)[11].
PB = paucibacillary; MB = multibacillary; IL = indeterminate leprosy; TL = tuberculoid leprosy; BL = borderline or dimorphic leprosy; LL = lepromatous leprosy; WHO = World Health Organization.
Source: Created by the authors.

Adverse effects of multidrug therapy in leprosy patients

According to the operational classification, patients diagnosed with leprosy received a combination of drugs called multidrug therapy (MDT). Thus, treatment consisted of a monthly supervised dose and a self-administered pack of rifampicin and dapsone for PB patients for six months and rifampicin, dapsone, and clofazimine for MB patients for 12 months. In total, 107 (64.1%) were treated with MDT-BP, and 60 (35.9%) received MDT-MB. Adverse effects were reported for at least one MDT component in 15 (14%) and 10 (16.7%) leprosy patients who received MDT-PB and MB, respectively. The characteristics of patients who experienced adverse effects are shown in Table 3. Of the 107 PB and 60 MB patients, 102 (95.3%) and 44 (73.3%) completed treatment, respectively. Four PB (3.7%) and 11 MB (18.3%) patients did not complete the full course of MDT treatment. Interestingly, one (1%) patient with PB and five (8.4%) patients with MB had no treatment results recorded in their charts.

Table 3 - Adverse effects from MDT in leprosy patients. Santa Inês USF, Paulo Afonso, Bahia, Brazil, 2001–2017 (N = 167)

Adverse effects	Treatment groups, n (%)		Total, n (%)
	MDT-PB	MDT-MB	
Yes	15 (14)	10 (16.7)	25 (15)
No	92 (86)	50 (83.3)	142 (85)
Total	**107 (64.1)**	**60 (35.9)**	**167 (100)**

Chi-square test = 0.2118; p=0.645.
MDT = multidrug therapy; PB = paucibacillary; MB = multibacillary.
Source: Created by the authors.

DISCUSSION

Brazil is the only Latin American country that has yet to achieve the goals proposed by the United Nations for eliminating leprosy, which consists of reaching ten new cases per 100,000 inhabitants[12]. Several control programs have already been created. However, further studies and

effective interventions on the disease are still needed, especially in regions with a higher prevalence and regions that have unfavorable socioeconomic and environmental conditions, such as the municipality of Paulo Afonso, located in the semi-arid backlands of Bahia.

The NCDR identified in the study was nine per 100,000 inhabitants. In Brazil, according to the Ministry of Health, this rate is classified as an area of median endemicity, suggesting the existence of an active disease in the community. On the other hand, the NCDR in Paulo Afonso was lower when compared with other municipalities. According to Gonçalves *et al*. (2018), the NCDR in Belém, Pará, was 11.97 per 100,000 inhabitants[13]. A similar study in Rio Largo, Alagoas, showed that the NCDR was 12.98 per 100,000 inhabitants[14].

It is also observed that, in the years 2003 and 2014, the detection rate in the municipality, although lower, may indicate underreporting or low detection of cases. In addition, it is possible to observe that disease patterns are related to social vulnerabilities. Paulo Afonso is a municipality where, despite the efforts and social programs of the municipal and federal governments, it is still possible to locate families in extreme poverty[15].

In our results, the most affected patients were female, unlike a study carried out in Brazil from 2001 to 2013, which revealed a significantly higher number of men than women[3]. There is no biological evidence to prove greater susceptibility to leprosy. However, it is plausible to consider that endocrine alterations can modulate various aspects of host immunity and may influence the development of infectious diseases among men and women[16,17].

The study population was mostly made up of young adults of active age (between 16 and 45 years old), predominantly made up of brown people, almost all of whom came from the urban area. According to literature findings, young adults were the most affected by leprosy[18], negatively impacting on the economy since the disease can cause disability, social stigmatization, and segregation. Nery et al.[19] showed that the most deprived groups in Brazil are at the greatest risk of leprosy detection. Individuals residing in the most impoverished regions (Midwest, North, and Northeast) had a five to eight times greater leprosy risk than other individuals[20]. Likewise, self-reported "black" or "brown" skin color was linked to a 40% increase in the risk of developing the disease[21]. Thus, socioeconomic inequalities are strongly influenced by brown and/or black skin color, which, in turn, result from the historical process of slavery and represent social determinants that influence the greater risk of developing the disease in this population segment.

TL was the most common form of the disease, followed by borderline, undetermined, and LL. The higher prevalence of TL cases indicated a lower level of community transmissibility and early diagnosis. The training of health professionals to identify the disease early can favor the strategy to diagnose PB forms. However, borderline and LL cases throughout the period reinforced the need for effective surveillance for more efficient action in the region. The degree of physical disability should be used in conjunction with NCDR and is an indicator that evaluates the effectiveness of early detection. A study conducted in Brazilian municipalities corroborates our findings, demonstrating a higher prevalence of grade 1 disability[22,23]. The lesions' findings were correlated with age. It is possible that this increase in the number of lesions could be related to the higher life expectancy and lower immune response in those with advanced age[3].

In Paulo Afonso municipality, the operational classification of leprosy into PB or MB is simple and feasible in areas of difficult access to the biopsy. The stratification of the patient by bacillary load and number of skin lesions allows adjustment of the drug regimen. However, cases in which the number of lesions was ≤ 5 and/or bacilloscopy negative, but the lesions clinically presented those of dimorphic leprosy, according to the Madrid classification, it was decided to start MDT-MB.

Our results revealed a moderate agreement ($\kappa = 0.888$) between the operational classification and the clinical form. Rodrigues Júnior et al.[24] found a good agreement similar to that reported in this study. This result provides evidence to health managers, especially those in primary care, regarding the evaluation criteria, allowing for better disease transmission.

Twenty-five of the 167 studied patients had at least one side effect attributed to at least one MDT component. Goulart et al.[25] discovered MDT-related side effects in 71 (37.9%). However, no statistically significant difference was observed in the PB or MB treatment. All patients completed the basic or alternative scheme. Together, the data suggest that, regardless of therapeutic regimen, the drug is well tolerated by leprosy patients in the Santa Inês USF.

One of this study's limitations may be the data's inconsistency and incompleteness. Furthermore, it is important to highlight the possibility of underreporting, which may interfere with the quality of the information. Future research is needed to minimize such limitations.

CONCLUSION

In this study, many leprosy cases were reported at the Santa Inês USF; this finding reinforces the importance of increasing knowledge about the disease through health education and improving local public policies. Demographic and clinical characteristics were similar to those reported in the literature. Although PB cases are more prevalent in the region, it is still necessary to intensify surveillance strategies to achieve the goals proposed in

the National Strategy for Confronting Hansen's Disease 2019–2022. Finally, the collaboration of diverse local sectors, including civil society, is essential to accelerating efforts to stop leprosy transmission in the region.

Authors' contribution: *Iara Ferreira de Lima*: Project design, planning, writing and/or critical review, and approval of the final version. *Isaque Oliveira Braga*: Writing and/or critical review and approval of the final version. *Isnaia Firminia de Sousa Almeida Agostinho de Melo*: Writing and/or critical review and approval of the final version. *Joilda Silva Nery*: Data analysis and interpretation, writing and/or critical review, and approval of the final version. *Iukary Takenami*: Data analysis and interpretation, writing and/or critical review, and approval of the final version. *Pedro Pereira* Tenório: Project design and planning, data analysis and interpretation, writing and/or critical review, and approval of the final version.

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