

Epidemiological profile of leprosy in the Marajó I region, Pará, Brazil

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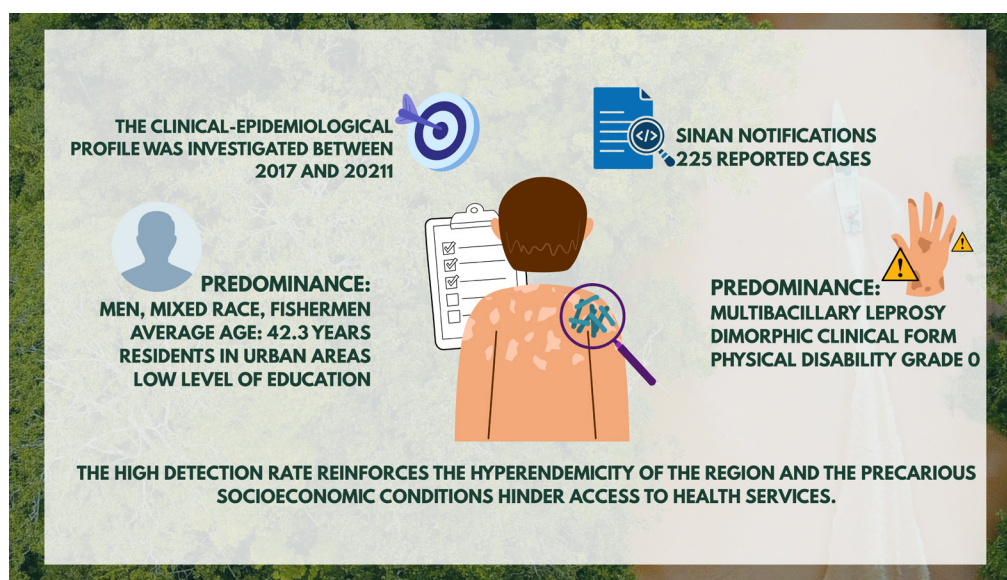
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Highlights

- A total of 225 leprosy cases were analyzed in the Marajó I region (PA) between 2017 and 2021.
- Most cases occurred among mixed-race men, with a mean age of 42.3 years.
- Multibacillary and dimorphous clinical forms predominated, with grade 0 disability.
- The region remains hyperendemic, with evidence of active leprosy transmission.
- Low educational levels and poverty hinder access to information and health services.
- These conditions contribute to delayed diagnosis and inadequate disease management.

Graphical Abstract



Abstract

Leprosy still represents a major public health problem in Brazil and, as it predominantly affects socioeconomically disadvantaged populations, it is considered a neglected disease with multiple barriers to control and elimination. The objective of this study was to investigate the sociodemographic and clinical-epidemiological profile of leprosy cases in the Marajó-I region, Pará. This is an ecological epidemiological study conducted using data from the Notifiable Diseases Information System (SINAN), accessed through its official database. Data were collected from leprosy patients of both sexes, residing in one of the nine municipalities of the Marajó-I region, regardless of treatment completion status, who had records in SINAN. Between 2017 and 2021, a total of 225 cases of leprosy were reported in the region under study. Most cases occurred among mixed-race men, with a mean age of 42.3 years (± 19.01), living in urban areas, with incomplete primary education, and working as fishermen. Regarding the clinical and epidemiological characteristics, there was a predominance of multibacillary cases, mainly of the dimorphous clinical form, with grade 0 physical disability, followed by grade I at diagnosis. The results indicate that the detection rate of new leprosy cases in the Marajó region remains high, suggesting that the disease continues to be a significant public health issue in this area. These findings highlight the importance of strategies aimed at expanding timely diagnosis and strengthening leprosy control actions.

Keywords: Leprosy. Epidemiological Profile. Health Assessment. Diagnosis. Amazon.

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INTRODUCTION

Leprosy is a slow-progressing infectious and contagious disease that primarily manifests through dermatoneurological signs and symptoms, such as skin lesions and peripheral nerve involvement, particularly affecting the eyes, hands, and feet. Peripheral nerve impairment is the main feature of the disease, giving it a high potential to cause physical disabilities that may progress to deformities¹.

The etiological agent of leprosy is *Mycobacterium leprae*, which exhibits tropism for the peripheral nervous system and the dermis, potentially leading to sensory loss, muscle weakness, paralysis, and skin lesions². The diagnosis is established based on these clinical manifestations. Transmission occurs through direct and prolonged contact between infected patients and susceptible individuals, mainly via the upper respiratory tract (nasal and oropharyngeal mucosa), which constitutes the principal route of contagion and elimination of the bacillus²⁻⁴.

Populations most predisposed to infection are those with limited access to sanitation and health information, resulting in social stigma toward affected individuals and creating barriers to case detection, diagnosis, treatment planning, and disease cure⁵⁻⁶. In 2016, the Brazilian Ministry of Health implemented strategies to reduce the number of new leprosy cases; however, the disease remains a concern in developing countries such as Brazil, which ranks second globally in the number of new cases reported⁷⁻⁸.

In 2023, 182,815 new leprosy cases were reported worldwide, with 13.6% occurring in the Americas (24,773 new cases), of which 22,773 (approximately 92%) were in Brazil. The country's detection rate was 10.68 new cases per 100,000 inhabitants, classifying it as a high-burden country

for the disease and a priority target within the Ministry of Health's elimination program⁷⁻⁹.

The Northern region of Brazil recorded, in 2018, the third highest detection rate of new cases—30.44 per 100,000 inhabitants—followed by a subsequent decline, likely due to the COVID-19 pandemic. In 2023, the state of Pará presented the seventh highest detection rate of new cases, with 17.61 per 100,000 inhabitants, still considered high⁹.

Assessment of physical disability at the time of diagnosis serves as an indicator of the quality of health services and the timeliness of case detection. In 2023, both the Northern region and the state of Pará showed a high proportion of physical disability assessments at diagnosis (92.8% and 93.7%, respectively). The proportion of patients presenting with grade 2 physical disability was 10.2%, slightly below the national rate (11.2%), yet still indicating a considerable burden⁹.

Detection of new cases in 2023 showed a slight increase compared to previous years, and the persistence of cases in children indicates ongoing active transmission and deficiencies in public health strategies for disease surveillance and control—particularly regarding coverage and data quality²⁻⁹.

Moreover, according to operational classification, multibacillary cases remain predominant throughout the state of Pará, reflecting delayed diagnosis caused by a shortage of trained professionals and limited community access to primary healthcare units^{2,10}. Thus, the analysis of epidemiological data in endemic regions is crucial to understanding the occurrence and factors contributing to the persistence and spread of the disease. Therefore, this study aims to investigate the sociodemographic and clinical-epidemiological profile of leprosy cases in the Marajó-I region, Pará.

METHODOLOGY

This is an epidemiological, exploratory, and descriptive study with a quantitative approach, retrospective design, and ecological nature. The research field comprised the microregions of Marajó I, located in the northern part of the state of Pará, including the municipalities of Afuá, Chaves, Cachoeira do Arari, Muaná, Salvaterra, São Sebastião da Boa Vista, Santa Cruz do Arari, Soure, and Ponta de Pedras, with a total population of approximately 577,790 inhabitants. The study includ-

ed data covering the period from 2017 to 2021. Data collection, organization, and tabulation were conducted between September and October 2022 to support the analysis of the temporal evolution of the disease during the study period.

Upon approval of the Research site, sociodemographic and epidemiological data of patients diagnosed with leprosy in the study region were obtained from the Notifiable Diseases Information System (SINAN), made available by the 7th Region-

al Health Center (CRS), located in Belém, Pará. Data were selected from leprosy patients of both sexes, residing in one of the nine municipalities of the Marajó I region, regardless of treatment com-

pletion status, who were registered in SINAN. Data from patients with other associated diseases were excluded. The variables collected are presented in Table 1.

Table 1 - Variables and categories used for data collection.

Stage	Variables	Categories / Coding	Description
1st Stage – Sociodemographic and geographic data	Age	Numerical value	Age of the individual in full years.
	Gender	1 = Female; 2 = Male; 3 = Not reported	Gender as declared by the individual.
	Self-reported color/race	1 = White; 2 = Black; 3 = Yellow (Asian descent); 4 = Mixed race (Pardo); 5 = Indigenous	Self-declaration according to IBGE (Brazilian Institute of Geography and Statistics) categories.
	Educational level	0 = Illiterate; 1 = Incomplete 1st–4th grade of elementary school; 2 = Completed 4th grade of elementary school; 3 = Incomplete 5th–8th grade of elementary school; 4 = Completed elementary education; 5 = Incomplete secondary education; 6 = Completed secondary education; 7 = Incomplete higher education; 8 = Completed higher education; 9 = Unknown; 10 = Not applicable	Highest level of education attained.
	Occupation	Free text	Main occupation exercised by the individual.
	Municipality, state, and neighborhood of residence	Free text	Patient's place of residence.
	Area of residence	Rural; Urban; Periurban	Classification of the type of residential area.
	Location of the health unit	Free text	Health facility responsible for diagnosis/notification.
2nd Stage – Clinical and epidemiological data	Operational classification	1 = Paucibacillary (≤ 5 lesions); 2 = Multibacillary (> 5 lesions)	Based on the number of skin lesions.
	Clinical form	1 = Indeterminate; 2 = Tuberculoid; 3 = Dimorphous; 4 = Virchowian; 5 = Unclassified	Clinical classification according to disease presentation.
	Number of affected nerves	Numerical value	Number of thickened nerves identified.
	Degree of physical disability at diagnosis	0 = Grade 0; 1 = Grade I; 2 = Grade II; 3 = Not evaluated	Functional assessment at diagnosis.
3rd Stage – Therapeutic and household data	Treatment start date	dd/mm/yyyy	Beginning of multidrug therapy (MDT).
	Treatment end date	dd/mm/yyyy	Completion of specific treatment.
	Number of people residing with the patient	Numerical value	Number of cohabitants currently or within the past five years.

Following data collection, the information was cleaned, entered, and tabulated in a Microsoft Excel 2007 database for subsequent statistical analysis. Descriptive statistical methods were applied to identify and characterize the data, presenting absolute and relative (percentage) frequencies of the observed results. These analyses were performed using the BioEstat software (version 5.0).

The research project complied with the ethical guidelines established by Resolution No. 196/2012 and Resolution No. 466 of December 12, 2012, of the National Health Council (CNS), and was approved by the Research Ethics Committee of the Universidade da Amazônia (UNAMA) under approval number 5.651.303.

RESULTS

In the present study, data from 225 patients diagnosed with leprosy in the municipalities that comprise the Marajó I region were analyzed, based on notifications registered in SINAN between 2017 and 2021. The distribution of new cases recorded across the nine municipalities of Marajó I is shown in Ta-

ble 2. A higher proportion of cases was observed in Salvaterra (55 cases), Muaná (46 cases), and Soure (29 cases). In 2017, the total number of new cases reported across the nine municipalities reached 80, with notably high figures in Salvaterra (41 cases) and Muaná (12 cases).

Table 2 - Distribution of leprosy cases by municipality in the Marajó I region, Pará, Brazil, 2017–2021 (n = 225).

Variable	Year					
Municipality	2017	2018	2019	2020	2021	Total
Afuá	2	1	5	4	0	12
Cachoeira do Arari	3	3	4	1	1	12
Chaves	1	3	2	3	6	15
Muaná	12	9	9	11	5	46
Ponta de Pedras	4	5	7	7	1	24
Salvaterra	41	6	4	2	2	55
Santa Cruz do Arari	0	1	1	3	2	7
São Sebastião da Boa Vista	9	7	2	2	5	25
Soure	8	3	9	5	4	29
Total	80	38	43	38	26	225

Source: Research data (2022).

Table 3 presents the proportion of leprosy cases according to sex, age group, educational level, area of residence, and self-reported race/color. Over the analyzed period, all age groups combined showed a higher proportion of cases among male individuals (66.2%), with a mean age of 42.3 years (± 19.01) and predominance in the 30–39-year age group (23.1%). Furthermore, there was a predominance of mixed-race (pardo) individuals (74.2%), with incomplete 1st–4th grade education (26.6%), unreported occupation/profession (34.6%), and residence in urban areas (59.5%).

Table 4 shows a higher proportion of cases classified under the dimorphous clinical form (114 cases), followed by 42 cases of the Virchowian form. The clinical-epidemiological characteristics are presented in

Table 5. Regarding the mode of entry, most patients were classified as new cases (54.1%). Concerning the mode of detection, 64 cases (25%) were identified through spontaneous demand.

As for the operational classification, 185 cases (82.2%) were multibacillary. With respect to the initial therapeutic regimen, 164 patients (64%) were prescribed multibacillary multidrug therapy (MDT-MB) during the study period. In relation to registered contacts, 67.4% of patients had 0 to 5 registered contacts. Regarding the number of affected nerves, 65.8% of patients presented 0 to 4 affected nerves. Finally, concerning the degree of physical disability at diagnosis, 120 individuals (47%) were classified as grade 0 disability (Table 5).

Table 3 - Cociodemographic characteristics of leprosy cases by municipality in the Marajó I region, Pará, Brazil, 2017–2021 (n = 225).

Variable	N	%
Gender		
Female	76	33.7
Male	149	66.2
Age group (years)		
6–19	27	12
20–29	30	13.3
30–39	52	23.1
40–49	35	15.5
50–59	27	12
≥ 60	49	21.7
Not reported	5	2.2
Race/Color		
White	19	8.4
Black	36	16.0
Mixed-race (Pardo)	167	74.2
Yellow (Asian descent)	1	0.4
Indigenous	0	0
Undefined	0	0
Not reported	2	0.8
Educational level		
Illiterate	18	8.0
Incomplete elementary education	122	54.2
Completed elementary education	14	6.2
Incomplete secondary education	13	5.7
Completed secondary education	19	8.4
Incomplete higher education	3	1.3
Completed higher education	2	0.8
Unknown	21	9.3
Not reported	12	5.3
Not applicable	1	0.4
Occupation		
Artisanal fisherman	64	28.4
Homemaker	33	14.6
Student	25	11.1
Others	25	11.1
Not reported	78	34.6
Area of residence		
Rural	88	39.1
Urban	134	59.5
Not reported	3	1.3

Source: Research data (2022).

Table 4 - Distribution of leprosy cases in the Marajó I region, Pará, Brazil, 2017–2021 (n = 225).

Variable	Year					
Clinical form	2017	2018	2019	2020	2021	Total
Dimorphous	49	18	18	22	7	114
Indeterminate	5	2	2	4	4	17
Tuberculoid	6	3	4	2	3	18
Virchowian	9	6	9	8	10	42
Unclassified	8	6	5	1	2	22
Not reported	3	3	5	1	0	12
Total	80	38	43	38	26	225

Source: Research data (2022).

Table 5 - Clinical and epidemiological characteristics at diagnosis of leprosy cases by municipality in the Marajó I region, Pará, Brazil, 2017–2021 (n = 225).

Variable	N	%
Mode of entry		
New case	138	54.1
Transfers	41	18.2
Relapse	5	1.9
Other re-entries	13	5.09
Unknown	5	1.9
Not reported	23	10.2
Mode of detection		
Referral	28	10.9
Spontaneous demand	64	25.0
Community screening	3	1.17
Contact examination	41	16.0
Other modes	2	0.78
Unknown	33	12.9
Not reported	54	24.0
Operational classification		
Paucibacillary	40	17.7
Multibacillary	185	82.2
Initial therapeutic regimen		
Paucibacillary	38	14.9
Multibacillary	164	64.3
Not reported	23	10.2
Registered contacts		
0–5	172	67.4
10–15	24	9.4
Not reported	29	12.8
Number of affected nerves		
0–4	168	65.8
4–7	13	5.0
Not reported	43	19.1
Degree of physical disability at diagnosis		
Grade 0	120	47.0
Grade I	56	21.9
Grade II	8	3.1
Not reported	41	18.2

Source: Research data (2022).

Table 6 presents the variables related to discharge characteristics. Regarding the type of discharge, the highest proportion corresponded to patients discharged due to cure (60.7%).

Concerning the degree of physical disability at the time of discharge, 83 cases (32.5%) showed no physical disability or demonstrated improvement.

Table 6 - Discharge characteristics of leprosy cases by municipality in the Marajó I region, Pará, Brazil, 2017–2021 (n = 225).

Variable	N	%
Type of discharge		
Cure	155	60.7
Treatment abandonment	25	9.8
Death	4	1.5
Transfers	12	4.6
Not reported	29	12.8
Degree of physical disability at the time of discharge		
Grade 0	83	32.5
Grade I	17	6.6
Grade II	2	0.7
Not evaluated	5	1.96
Not reported	118	52.4

Source: Research data (2022).

DISCUSSION

The present study characterized the sociodemographic and clinical-epidemiological profile of leprosy cases in the Marajó I region between 2017 and 2021, with a total of 225 reported cases across the nine municipalities investigated. In terms of socio-demographic characteristics, most cases occurred among male, mixed-race (pardo) individuals, aged 30–39 years, residing in urban areas, with incomplete elementary education, and engaged mainly as homemakers, students, or fishermen. Regarding the clinical-epidemiological profile, most patients were multibacillary, presenting the dimorphous clinical form, and predominantly exhibited zero to four affected nerves, with grade 0 physical disability, followed by grade I at the time of diagnosis.

The findings of this study are consistent with previous research indicating that the higher prevalence of leprosy among men is associated with sociocultural factors, such as occupational exposure and greater social interaction, which increase the risk of infection and transmission of *Mycobacterium leprae*¹¹⁻¹².

With respect to race/skin color, the highest inci-

dence was among mixed-race individuals, followed by Black individuals, consistent across all study years. These results align with the literature, which associates the higher occurrence of leprosy in these populations with poor health and socioeconomic conditions prevalent in the studied regions. Regarding age group, leprosy was most prevalent among individuals aged 20–60 years, corroborating the findings of Chaquiam *et al.* (2021)¹², who reported higher prevalence among young and middle-aged adults due to greater social activity and reduced access to health services.

As for the area of residence, the majority of cases occurred in urban zones, and the most common educational level was incomplete elementary education. Similar findings were reported by Gonçalves *et al.* (2018)¹³, who identified urban settings as presenting high endemicity for leprosy, given that transmission occurs through prolonged contact, particularly affecting individuals living in precarious socioeconomic and sanitary conditions. These results also corroborate the observations of Basso and Silva (2017)¹⁴, who emphasized that low educational

attainment limits health literacy, hindering understanding of the disease and the importance of early diagnosis, thereby delaying treatment initiation.

This association was also highlighted by Chaves *et al.* (2017)¹⁵, who analyzed the relationship between the social deprivation index and leprosy incidence in the state of Pará, identifying the Marajó region as having one of the worst deprivation indices compared with other regions of the state. The authors attributed this to the population's low socioeconomic conditions, which increase vulnerability to infection and disease progression.

Regarding the clinical forms, the dimorphous form was the most prevalent, followed by the Virchowian and tuberculoid forms. Similar distributions have been reported in other studies^{11,14}, reinforcing the possibility of delayed diagnosis and treatment interruption or abandonment, which contribute to disease progression, continued transmission within communities, and the development of physical disabilities.

Regarding the mode of entry, the majority of cases were classified as new cases, followed by those transferred from other municipalities, states, or primary healthcare units. Similar results were reported by Gonçalves *et al.* (2018)¹³, who analyzed leprosy distribution in a district of Belém, Pará, and found evidence of active disease transmission among the local population. Additionally, there is evidence that leprosy resistance in Brazil involves genetic determinants¹⁶. Several studies have identified polymorphisms associated both with protection against and increased susceptibility to the disease. These findings suggest that host genetic factors play a crucial role in modulating the immune response to *Mycobacterium leprae*, explaining, at least in part, why some exposed individuals do not develop the disease¹⁷⁻¹⁹. However, when such genetic susceptibility factors coincide with social vulnerability, as observed in the Marajó region, they can further exacerbate the concentration of cases.

CONCLUSION

The epidemiological profile identified in this study was characterized by a higher frequency of male individuals, aged 30 to 39 years, of mixed-race (pardo) and/or Black skin color, and with incomplete elementary education. Additionally, there was a predominance of multibacillary operational classification, particularly the dimorphous

In relation to the mode of detection, most reported cases were identified through spontaneous demand, contact examination, and referral. However, a significant number of cases were recorded as unknown or not reported, suggesting potential deficiencies in the evaluation and reporting processes. These findings differ from those of Gonçalves *et al.* (2018)¹³, who observed that the main detection methods were referral and spontaneous demand, with fewer cases identified through contact examination – highlighting weaknesses in active case-finding networks. According to the Brazilian Ministry of Health, between 2014 and 2023 there was a 5.6% reduction in cases detected by referral and a 2.8% increase in spontaneous demand, making these the most frequent detection modes during that period^{9,10}.

Concerning bacillary load, there was a predominance of multibacillary cases, which is highly significant because only multibacillary cases participate in the transmission and maintenance chain of leprosy, indicating delayed diagnosis^{2,10,20}.

With respect to the degree of physical disability, most reported cases were classified as grade 0, followed by grade I, with grade II being the least frequent and a considerable number of cases not reported. This finding is consistent with **Gonçalves *et al.* (2018)¹³, who also observed that most cases had grade 0 disability, followed by grades I and II. National data from 2023 show that 53.6% of newly reported cases in Brazil presented grade 0 disability, 35.2% grade I, and 11.2% grade II⁹. Other studies, however, have found higher proportions of grades I and II, linking these outcomes to the duration of disease progression and the limited resources and training of primary healthcare professionals for conducting qualified disability assessments at diagnosis. These limitations contribute to late detection, worsening of physical disabilities, and highlight deficiencies in prevention and rehabilitation strategies within the health system^{10,20,21}.

clinical form, with grade 0 physical disability at the time of diagnosis.

Although the study successfully achieved its initial objective, certain limitations must be acknowledged. One such limitation concerns the considerable number of incomplete patient records, particularly regarding variables such as the number

of skin lesions, number of affected nerves, degree of physical disability at diagnosis, and recording of household contacts. These inconsistencies may have resulted from insufficient training of health-care professionals in completing patient data forms during leprosy assessments or in handling the notification system.

Furthermore, the COVID-19 pandemic period may have contributed to a reduction in the number of reported cases during the study period (2017–2021), due to restricted access to primary healthcare units and treatment interruptions. Another limitation stems from the scarcity of previous studies conducted in the

Marajó I region, as existing epidemiological bulletins are generally limited to broader regional or state-level data. This lack of localized research makes it difficult to monitor the evolution of leprosy diagnosis, treatment, and control in the studied area.

In light of these findings, the study encourages further research to strengthen surveillance and control of new cases, as well as to identify the epidemiological factors that favor the persistence and spread of the disease. Such investigations are essential for designing new strategies for monitoring and case detection, particularly in vulnerable and hard-to-reach areas.

CRediT author statement

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All authors have read and agreed to the published version of the manuscript.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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