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ORIGINAL ARTICLE

Temporal analysis of notified cases of American cutaneous leishmaniasis in the state of Piauí, Brazil (2007-2022)

Análise temporal dos casos notificados de leishmaniose tegumentar americana no estado do Piauí, Brasil (2007-2022)

Análisis temporal de casos notificados de leishmaniasis cutánea americana en el estado de Piauí, Brasil (2007-2022)

Daniela Soares Leite[1] ORCID 0000-0002-3412-1375
Jamileh Marinho de Carvalho[2] ORCID 0009-0006-9450-2096
Maura de Souza Pereira Portilho[3] ORCID 0009-0009-3438-2645
Marcela Bezerra Dias[4] ORCID 0000-0002-3344-9627
Kleberson de Oliveira[5] ORCID 0000-0002-2822-7958
Henrique Rafael Pontes Ferreira[6] ORCID 0000-0002-7444-2085

[1]Universidade do Estado do Pará (UEPA), Belém, Pará, Brasil.
[2]Universidade Estadual de Mato Grosso do Sul (UEMS), Dourados, Mato Grosso do Sul, Brasil.
[3]Faculdade Gamaliel, Tucuruí, Pará, Brasil.
[4]Universidade Estadual Paulista (UNESP), São Paulo, São Paulo, Brasil.
[5]Universidade Federal do Triângulo Mineiro (UFTM), Uberaba, Minas Gerais. Brasil.
[6]Universidade Federal de Pernambuco (UFPE), Recife, Pernambuco, Brasil.

Endereço: Av. Reitor Joaquim Amazonas, Cidade Universitária, 50740600 - Recife, PE – Brasil.
E-mail: henrique.pontes@ufpe.br

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ABSTRACT

Background and Objectives: American tegumentary leishmaniasis (ATL) is a public health concern, and its control remains a challenge in territories with significant social vulnerability. Piauí is one of the most socially vulnerable states in Brazil, and knowing the profile of notifications can serve as support in the implementation of more efficient interventions. Thus, this study aimed to analyze the temporal trend of ATL cases in the state of Piauí between 2007 and 2022. **Methods:** this is a quantitative and retrospective study, carried out using secondary data on ATL cases notified in the Notifiable Diseases Information System (SINAN)/Ministry of Health/Department of Health and Environmental Surveillance, available in DATASUS. The variables analyzed were year/month of notification, municipality of residence and notification, education, race, sex, age, confirmation criteria, evolution, clinical form and type of entry. **Results:** 1,407 cases were notified in the state, with an incidence of 3.88 and 2.75 at the beginning and end of the period. There was a predominance of males (61.42%), aged between 40 and 59 years old (33.12%), incomplete elementary school (54.86%) and race/skin color brown (69,08%). The cutaneous form was predominant (90.3%), with 59.4% of cases having a clinical-laboratory diagnosis. Of the total, 58.1% cases progressed to cure. **Conclusion:** ATL has emerged as a frequently notified condition, posing a significant challenge to local public health, affecting a specific social profile that requires actions at different levels of care, with a positive impact on the prevention and control of the disease in the state.

Keywords: *Neglected Diseases. Health Information Systems. Epidemiological Time Series Studies. Compulsory Notification. Epidemiological Monitoring.*

RESUMO

Justificativa e Objetivos: a leishmaniose tegumentar americana (LTA) é um problema de saúde pública, e seu controle persiste um desafio em territórios com expressiva vulnerabilidade social. O Piauí é um dos estados do Brasil mais vulneráveis socialmente, e conhecer o perfil das notificações pode servir de apoio na implementação de intervenções mais eficientes. Assim, este trabalho teve como objetivo analisar a tendência temporal dos casos de LTA no estado do Piauí entre os anos de 2007 e 2022. **Métodos:** trata-se de estudo quantitativo e retrospectivo, realizado a partir de dados secundários, de casos de LTA, notificados no Sistema de Informação de Agravos de Notificação (SINAN)/Ministério da Saúde/Secretaria de Vigilância em Saúde e Ambiente, disponibilizados no DATASUS. As variáveis analisadas foram ano/mês de notificação, município de residência e de notificação, escolaridade, raça, sexo, idade, critérios de confirmação, evolução, forma clínica e tipo de entrada. **Resultados:** foram notificados 1.407 casos no estado, com incidência de 3,88 e 2,75 no início e fim do período. Houve predominância do sexo masculino (61,42%), idade entre 40 e 59 anos (33,12%), ensino fundamental incompleto (54,86%) e raça/cor parda (69,08%). A forma cutânea foi predominante (90,3%), com 59,4% dos casos com diagnóstico clínico-laboratorial. Do total, 58,1% casos evoluíram para cura. **Conclusão:** a LTA emergiu como uma condição frequentemente notificada, configurando-se um desafio significativo para a saúde pública local, atingindo um perfil social específico que necessita de ações nos diversos níveis de atenção, com impacto positivo na prevenção e controle da doença no estado.

Descritores: *Doenças Negligenciadas. Sistemas de Informação em Saúde. Estudos de Séries Temporais. Notificação Compulsória. Vigilância Epidemiológica.*

RESUMEN

Justificación y Objetivos: la leishmaniasis cutánea americana (LCA) es un problema de salud pública y su control sigue siendo un desafío en territorios con importante vulnerabilidad social. Piauí es uno de los estados socialmente más vulnerables de Brasil, y conocer el perfil de las notificaciones puede apoyar la implementación de intervenciones más eficientes. Por tanto, este trabajo tuvo como objetivo analizar la tendencia temporal de los casos de LCA en el estado de Piauí entre los años 2007 y 2022. **Métodos:** se trata de un estudio cuantitativo y retrospectivo, realizado a partir de datos secundarios, de casos de LCA, reportados en el Sistema de Información de Enfermedades de Declaración Obligatoria (SINAN)/Ministerio de Salud/Secretaría de Vigilancia de Salud y Ambiente, disponible en DATASUS. Las variables analizadas fueron año/mes de notificación, municipio de residencia y notificación, escolaridad, raza, sexo, edad, criterios de confirmación, evolución, forma clínica y tipo de ingreso. **Resultados:** se reportaron 1,407 casos en el estado, con una incidencia de 3.88 y 2.75 al inicio y al final del período. Hubo predominio del sexo masculino (61,42%), con edades entre 40 y 59 años (33,12%), educación primaria incompleta (54,86%) y color de piel/raza parda (69,08%). La forma cutánea fue predominante (90,3%), teniendo el 59,4% de los casos diagnóstico clínico-laboratorio. Del total, el 58,1% de los casos progresaron hasta la curación. **Conclusión:** la LTA ha surgido como una patología reportada con frecuencia, planteando un importante desafío para la salud pública local, alcanzando un perfil social específico que requiere acciones en los diferentes niveles de atención, con un impacto positivo en la prevención y control de la enfermedad en el estado.

Palabras Clave: *Enfermedades Desatendidas. Sistemas de Información en Salud. Estudios de Series Temporales Epidemiológicas. Notificación Obligatoria. Vigilancia Epidemiológica.*

INTRODUCTION

Neglected tropical diseases are a diverse group of diseases caused by protozoa, helminths, parasites, bacteria, viruses, and fungi. It is estimated that two billion people are at risk of acquiring these diseases, primarily due to their prevalence in tropical and subtropical regions of Asia, Africa, and the Americas. These diseases predominantly affect impoverished and underserved populations with limited access to basic sanitation, clean water, and healthcare services.[1,2]

American tegumentary leishmaniasis (ATL) is a zoonotic disease with mandatory notification. It typically presents in two common clinical forms: cutaneous (CL) and mucocutaneous (MCL). ATL is non-contagious and has a low mortality rate. It is caused by several species of intracellular protozoa from the *Leishmania* genus and is transmitted by the bite of infected female sandflies belonging to the *Diptera* order, specifically the *Lutzomyia* genus. In Brazil, there are seven pathogenic species responsible for the disease, with *L. (Viannia) guyanensis*, *L. (V.) braziliensis*, and *L. (Leishmania) amazonensis* being the most prominent.[3–5] The cutaneous form of ATL is characterized by papular lesions that develop into nodules and ulcers at the insect bite sites. In contrast, the mucosal or mucocutaneous form of ATL involves progressive damage to the oral, nasal, and pharyngeal cavities.[6,7]

According to the Pan American Health Organization (PAHO),[1] ATL occurs in 21 South American countries, being endemic in 19 of them, with cases concentrated mainly in Brazil, Colombia, and Peru. From 2001 to 2021, 17 countries in the region notified more than one million cases of cutaneous ATL, with the mucosal form affecting an average of over 50,000 people per year.[1] In Brazil, particularly in the state of Piauí, more than 800 cases were notified between 2007 and 2017.[8,9]

ATL is primarily diagnosed based on clinical characteristics, with various available methods differing in accuracy and availability in healthcare services. Key diagnostic methods include parasitological, molecular, and immunological tests. A clinical diagnosis can be established through a detailed medical history and physical examination, focusing on cutaneous and mucosal lesions.[10]

Treatment for cutaneous leishmaniasis typically involves pentavalent antimonials; however, depending on the identified species, other effective medications like miltefosine may be used, especially for infections caused by *L. guyanensis* and *L. panamensis*. For mucocutaneous leishmaniasis, while antimonials have low evidence, they are strongly recommended. They can also be combined with pentoxifylline, amphotericin B, or miltefosine in cases of therapeutic failure or special circumstances.[11]

In general, neglected diseases are the target of specific actions aimed at gradually reducing their prevalence worldwide, with a strong association with modern epidemiological categories such as poverty and the marginalization of populations in at-risk areas.[2] Leishmaniasis follows this same pattern, posing a significant challenge in regions or territories with high social vulnerability, such as Brazil. There is a direct relationship between its occurrence and the Human Development Index.

This study is justified by the importance of understanding the notification profile and the distribution of cases in a region to support the implementation of more effective interventions as well as guiding public policies for controlling and preventing the disease in the state. Therefore, this work aimed to analyze the temporal trend of ATL cases in the state of Piauí from 2007 to 2022.

METHODS

This is a quantitative and retrospective study aimed at analyzing the time series of notified ATL cases in Piauí between 2007 and 2022. Data were collected in December 2023 from the Information System for Notifiable Diseases (SINAN - *Sistema de Informação de Agravos de Notificação*) of the Unified Health System Department of Informatics (DATASUS - *Departamento de Informática do Sistema Único de Saúde*).

Piauí, located in northeastern Brazil, lies between 2°44'49" and 10°55'05", south latitude, and 40°22'12" and 45°59'42", west longitude. It comprises 224 municipalities and covers an area of 251,611,929 km². The state is divided into four mesoregions, such as North, Center-North, Southeast, and Southwest. The region has a semi-arid climate, characterized by long dry periods and regular rainfall at the beginning of the year, with precipitation ranging from 600 mm to 1,200 mm.[12] In 2020, the population of Piauí was estimated at 3,281,480 inhabitants, resulting in a population density of 12.40 inhabitants per km².[13]

The platform was used with various filters applied to create a database for collecting information on different types of variables that can better characterize the prevalence of ATL in the state of Piauí. The study focused on temporal (year and month of notification), clinical (outcome, confirmation criteria, clinical form, and type of entry), geographic (municipality of notification and residence) and sociodemographic variables (age, sex, race, and education level).

In addition to presenting the absolute number of notified cases per year, the relative percentage of notified cases for each variable was measured, along with the incidence rate per 100,000 inhabitants for the state population and the capital, Teresina. For municipalities with

fewer than 100,000 inhabitants, the incidence rate was calculated per 10,000 inhabitants using the formula: (number of notified cases / population) X 100,000 or 10,000.

Comparisons between categories within variables were used to identify statistical differences, primarily related to the municipality of notification, year of notification, age group, and education level. For a population of 10,000 inhabitants, contingency tables were constructed, and Pearson's chi-square test was performed with a significance level of $P<0.05$.

This study was exempted from assessment by Research Ethics Committee, as it involved the analysis of public domain data, where it was not possible to identify individuals.[14]

RESULTS

From 2007 to 2022, 1,407 cases were notified. Observing ATL notifications over these years, the highest peak occurred between 2007 and 2012, ranging from 91 cases in 2008 to the highest record of 184 cases in 2011, representing an approximate twofold increase in ATL notifications. There is a significant downward trend when comparing 2007-2011 ($\chi 2=103.2$; $P<0.005$). After 2011, a decrease and subsequent stability was observed, with fewer than 100 cases recorded, and 2020 marked the lowest number (29 cases). However, from 2020 onwards, there is a trend of increasing cases, with 90 cases notified in 2022, the last year presented in this study (Figure 1).

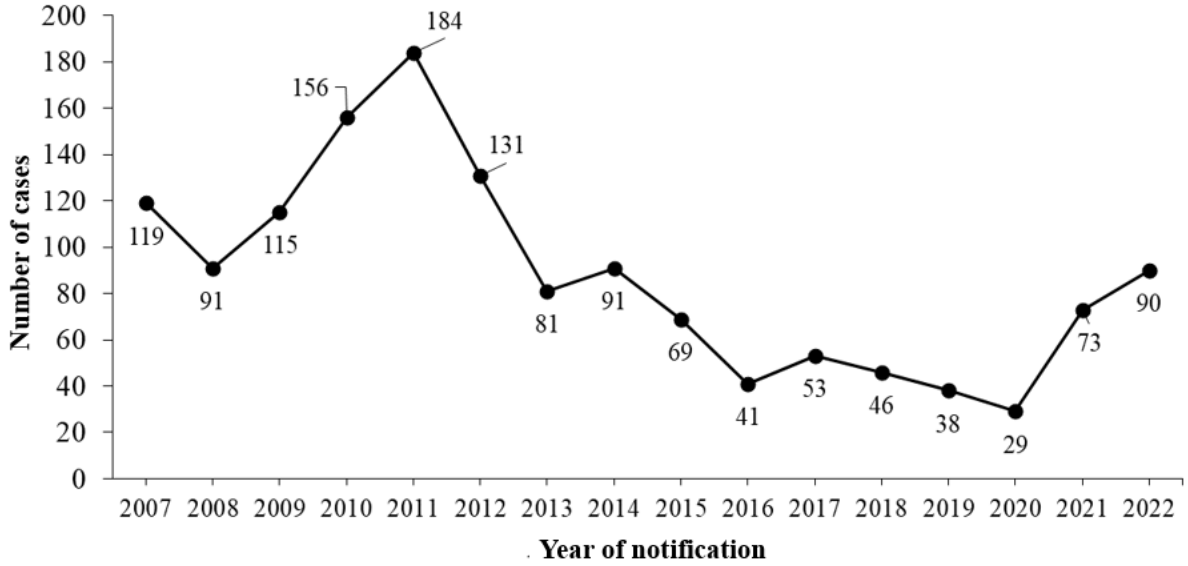

Figure 1. Time series of notified cases in the state of Piauí from 2007 to 2022
Source: Ministry of Health/SVSA - Notifiable Diseases Information System - SINAN (DATASUS).

The majority of cases were of the cutaneous clinical form (90.3%). The clinical-laboratory criterion was the predominant method (60.7%) and was used in the diagnosis of 756 cutaneous cases (53.7%) and 90 mucosal cases (6.4%). The entry type for patients with different clinical manifestations of ATL was above 80% for new cases, with a relapse rate of

5.5%. The progression of these cases was positive, with cure being the most prevalent outcome, accounting for more than 50% of notified cases. Other variables, such as abandonment and change of diagnosis, occurred with low frequency (below 3%), and death due to the disease accounted for only 0.1% of the total notified cases (Table 1)

Table 1. Distribution of American tegumentary leishmaniasis cases according to the diagnosed clinical form, highlighting the confirmation criteria, entry type, and progression of notified cases in the state of Piauí (2007-2022)

Confirmation criterion	Ign./blank	%	Cutaneous	%	Mucosal	%	Total	%
Clinical-laboratory	8	0.6	756	53.7	90	6.4	854	60.7
Clinical-epidemiological	2	0.1	515	36.6	36	2.6	553	39.3
Entry type								
Ign./blank	10	0.7	34	2.4	5	0.4	49	3.5
New case	-	-	1.170	83.2	111	7.9	1,281	91
Relapse	-	-	67	4.8	10	0.7	77	5.5
Progression								
Ign./blank	6	0.4	434	30.8	53	3.8	493	35
Cure	3	0.2	749	53.2	66	4.7	818	58.1
Abandonment	1	0.1	14	1	-	-	15	1.1
Death due to American cutaneous leishmaniasis	-	-	1	0.1	1	0.1	2	0.1
Death due to another cause	-	-	1	0.4	1	0.1	6	0.4
Transfer	-	-	3	2.7	3	0.2	41	2.9
Change of diagnosis	-	-	2	2.1	2	0.1	32	2.3

Source: Ministry of Health/SVSA - Notifiable Diseases Information System - SINAN (DATASUS). Abbreviations: Ign.: Ignored

The incidence of ATL in the state during the historical series was 42.87/100,000 inhabitants. There was a shift in the ranking between the municipalities that notified cases and the municipalities of residence of patients. The differences were concentrated in the municipalities of Inhuma, Barras, Ipiranga, and Palmeira. In the capital, Teresina, 677 cases were notified (48.1%), and, when compared to other municipalities, it concentrated the highest number of cases, with a significant difference ($\chi 2=95.4$; $P<0.05$). The city of Ipiranga Piauí had the lowest prevalence of notified cases, with 19 patients (1.4%). The same pattern was observed in the data related to the municipality of residence, with 396 cases (28.1%) from Teresina, with an incidence rate of 45.61/100,000 inhabitants. While the incidence rates in other municipalities were elevated due to their smaller populations (<100,000 inhabitants), the city of Altos had the highest incidence rate, at 45.31/10,000 inhabitants (Table 2).

Table 2. Ranking of municipalities that notified American tegumentary leishmaniasis cases and municipalities of residence of patients affected by American tegumentary leishmaniasis in the state of Piauí (2007-2022)

N°	Municipality of notification	Total	%	Municipality of residence	Total	%	Inc
1	Teresina	677	48.1	Teresina*	396	28.1	45.61*
2	Altos	161	11.4	Altos	184	13.1	45.31

3	Pedro II	72	5.1	Pedro II	85	6	21.91
4	Luzilândia	31	2.2	Luzilândia	31	2.2	12.15
5	Uruçuí	29	2.1	Uruçuí	31	2.2	12.3
6	Inhuma	26	1.8	Barras	30	2.1	6.35
7	Palmeira Piauí	23	1.6	Ipiranga do Piauí	29	2.1	29.47
8	Ipiranga do Piauí	19	1.4	Inhuma	28	2	18.27

Source: Ministry of Health/SVSA - Notifiable Diseases Information System - SINAN (DATASUS).
*In Teresina, since it has more than 100,000 inhabitants, the incidence was proportional to the population (100,000 inhabitants), and in other cities, the incidence used was based on 10,000 inhabitants.

The monthly reporting of ATL did not show significant variations. In the analysis, more than 80 cases were notified each month, with the highest number in February and the lowest in July (Figure 2).

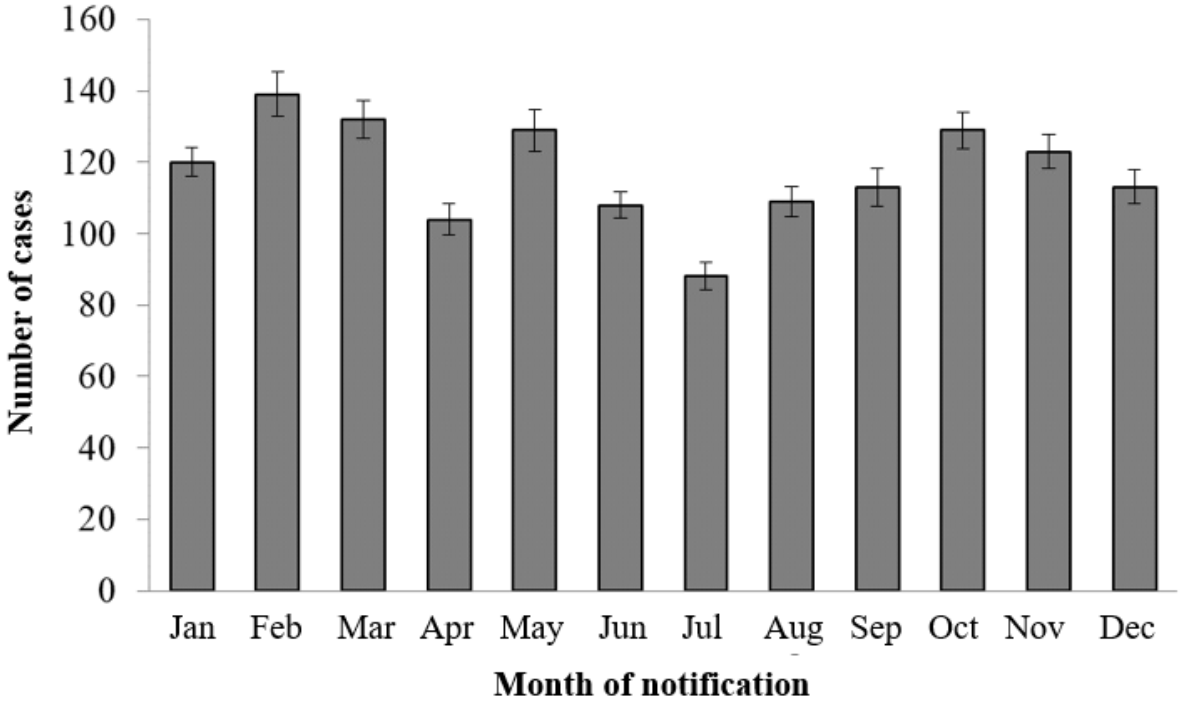

Figure 2. Number of American tegumentary leishmaniasis cases notified per month in the state of Piauí during the historical series from 2007 to 2022
Source: Ministry of Health/SVSA - Notifiable Diseases Information System - SINAN (DATASUS).

According to sociodemographic variables, males were the most affected group, with 858 diagnosed cases (61.42%). Regarding age groups, the highest number of reports was among adults aged 40 to 59 years, with an average of 466 cases (33.12%), making this the highest-risk group for infection. The notification of ATL among adults aged 20 to 59 years (the group with the highest prevalence) was different when compared to adults over 60 years of age ($\chi 2=272.15$; $P<0.005$). Finally, regarding educational level, patients affected by ATL predominantly had a low level of education. Moreover, 54.86% of affected patients had some level of incomplete elementary school (Table 3).

Table 3. Sociodemographic variables of confirmed American tegumentary leishmaniasis cases in residents of the state of Piauí from 2007 to 2022 according to sex, age group, and race/skin color

Variables	Total	%
Sex		
Woman	544	38.66
Man	863	61.34
Age group		
< 1 year	15	1.07
1 – 9	49	3.48
10 – 14	66	4.69
15 – 19	68	4.83
20 – 39	417	29.64
40 – 59	466	33.12
60 – 69	182	12.94
70 – 79	94	6.68
> 80 years	50	3.55
Educational level		
Ign./blank	195	13.86
Illiterate	140	9.95
Incomplete 1st to 4th grade of elementary school	272	19.33
Complete 4th grade of elementary school	150	10.66
Incomplete 5th to 8th grade of elementary school	216	16.35
Complete elementary school	157	11.16
Incomplete high school	78	5.54
Complete high school	92	6.54
Incomplete higher education	19	1.35
Complete higher education	39	2.77
Not applicable	49	3.48
Race/skin color		
Yellow	11	0.78
White	253	17.98
Indigenous	4	0.28
Brown	972	69.08
Black	132	9.38

Source: Ministry of Health/SVSA - Notifiable Diseases Information System - SINAN (DATASUS).
Abbreviations: Ign: ignored.

DISCUSSION

The present study provides a broader perspective and diagnosis of ATL, highlighting various epidemiological and statistical variables according to clinical manifestations, municipalities with the highest number of notifications, municipalities of residence, and the sociodemographic and temporal status of the disease. As a disease of global public health concern, ATL exhibits diversity in clinical and epidemiological aspects.

Brazil is among the ten countries with the highest number of notified ATL cases worldwide, with 39% of the cases concentrated in the northeast region, making it a focal point for investigating the disease's dynamics. In the state of Piauí, ATL is particularly significant due to the consistent reporting of this condition relative to the size of its population and territory.[1,15]

When examining monthly notifications, no consistent pattern emerged regarding the month with the highest number of reports, indicating that ATL is a recurrently notified disease throughout the year, unlike other vector-borne diseases. In the case of leishmaniasis, despite the fluctuation of insect populations associated with seasonal changes, with an increase in

insects after rainy periods, ATL did not follow this transmission pattern. This may be related to the fact that ATL involves dermatological alterations, where the appearance of lesions may take longer for symptoms to manifest.[16]

An increase in notifications was observed in more populous cities compared to rural areas. The pattern of leishmaniasis occurrence in cities changed over the years, with a higher number of cases in more populous cities in the state. This trend could also be influenced by residents traveling to other municipalities in search of better healthcare services and by the disease's expansion into urban areas. This phenomenon has also been observed in other states in the northeast region.[4,16,17] The high rate of urbanization, loss of natural habitats for insect vectors, human interference in natural habitats, and migratory processes are factors that have contributed to the spread of the disease.[15]

Sociodemographic variables highlight the social groups most affected by ATL, characterized by low-income populations with low educational levels and limited access to disease prevention and control services. Despite the low mortality rate, ATL is considered one of the most concerning dermatological conditions in Brazil due to sequels it causes in patients, including body deformities and mucosal region involvement through hard-to-heal lesions if not properly treated. These issues have a significant psychological impact on patients, leading to stigmas with social and economic consequences, as ATL can be considered an occupational disease.[17,18]

It is important to characterize the social groups most affected for the benefit of the scientific community and health authorities. In this study, the adult population was most affected, with a notable predominance among male patients, those of brown race/color, and individuals with incomplete elementary or high school, similar to results found in other states in the northeast.[4,19,20]. This at-risk group is primarily related to economically active and working individuals. ATL, with its occupational nature, involves jobs in activities such as resource extraction, exposure to forested areas, construction, animal husbandry, residences near forests, and other rural activities.[4,17]

Among the notified cases, the majority progressed to cure, with a low number of deaths, showing good overall case progression. However, more than 30% of cases were notified as "ignored/blank" possibly due to a lack of information about patients after the initial diagnosis. Additionally, the study explored the entry type for patients, with a relapse rate of 5.5% of cases, highlighting the need for health action networks to focus on improving follow-up measures, such as active case finding in endemic areas and health education, to prevent reinfection that could worsen the clinical condition and hinder recovery.[21]

Another relevant finding is the change in diagnosis presented in this study. Although occurring in approximately 2.3% of cases, it is often confused with other diseases that present similar clinical manifestations (body lesions), which may lead to underreporting of ATL. In such cases, the disease may be misdiagnosed and treated as another condition. Therefore, clinical-laboratory diagnosis is the most appropriate, requiring suitable methods for confirmation, especially due to potential confusion with other diseases.[22]

Conversely, the study acknowledges the limitations caused by the high prevalence of cases notified as "ignored/blank" due to the lack of patient follow-up after the initial diagnosis. This gap could make the studied profile more reliable and valuable for public policy development. Nevertheless, the study highlights significant improvements in the quality of information, with easier access and better presentation of results on the platform.

In conclusion, this study contributes to understanding risk areas, clinical aspects, and vulnerable groups, enhancing scientific knowledge and dissemination for disease prevention and control in the state. Addressing stigmas related to lesions, proper treatment, and effective diagnosis can lead to reduced recurrences and new cases. Additionally, expanding awareness and sensitization campaigns by health education teams in various settings is crucial, considering the need to understand ATL in the occupational context, particularly when there is exposure to risk areas and the vector insect during work activities.

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Contribuições dos autores:

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