doi: 10.5216/rpt.v53i3.78225

ORIGINAL ARTICLE

THE IMPACT OF COVID-19 ON RECORDS OF AMERICAN TEGUMENTARY LEISHMANIASIS IN BRAZIL: AN ECOLOGICAL STUDY

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ABSTRACT

American tegumentary leishmaniasis (ATL) is a chronic infectious disease endemic to Latin America and is a public health problem in Brazil. The control of ATL has become even more challenging in the face of the Covid-19 pandemic. In light of this, this study aims to quantify the impact of the Covid-19 pandemic on ATL records in an area of northeastern Brazil. This is an ecological study that includes the notifications of all confirmed cases of ATL registered in the State of Pernambuco, reported in the Notifiable Diseases Information System (SINAN) from 2015 to 2022. The period 2015-2019 was used to calculate the expected value for the pandemic years (2020-2022). The expected values were compared with the observed values. In the three years studied, 883 ATL diagnoses were expected in Pernambuco (294 records/ year). However, 646 cases were reported, indicating an underreporting of at least 237 individuals (26.8% reduction). The impact observed in 2022 was the largest of the years evaluated: 111 individuals were no longer diagnosed (37.8% reduction). The Covid-19 pandemic had an impact on the control of ATL in Pernambuco. Actions are needed to reduce the underdiagnosis of the disease caused by the Covid-19 pandemic.

KEY WORDS: American tegumentary leishmaniasis; epidemiology; leishmania; neglected tropical diseases; SARS-CoV-2.

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Received for publication: 09/01/2024. Reviewed: 17/07/2024. Accepted: 21/07/2024.

INTRODUCTION

American tegumentary leishmaniasis (ATL) is an infectious, non-contagious, chronic disease whose clinical manifestations may be limited to the skin or may involve the mucous membranes (Burza et al., 2018). It is caused by seven species in Brazil, such as *Leishmania braziliensis*, *L. amazonensis*, and *L. guyanensis*, each with its own spectrum of manifestations (Burza et al., 2018). The natural reservoir consists of small rodents, and transmission to the human host is via a vector, the infected female phlebotomine (*Lutzomyia* sp.) (Ghassemi et al., 2023).

According to the Pan American Health Organization (PAHO), 1.1 million cases of cutaneous (CL) and mucosal (ML) leishmaniasis were reported in Latin America between 2001 and 2021, making it a major public health problem. Brazil and the Andean countries (Bolivia, Chile, Colombia, Ecuador, Peru, and Venezuela) recorded 896,000 cases, representing 40.8% and 37.6%, respectively, of total notifications (OPAS, 2022a; OPAS, 2022b).

In 2021 alone, 221,790 new cases of CL were reported worldwide. In the same year, Brazil ranked fourth in the world in terms of the absolute number of reported cases, with 14,800, or 6.67% of the global total, which is lower than Syria (35.27%), Afghanistan (17.83%), and Pakistan (7.67%). Together, these countries accounted for about two-thirds of all cases in 2021 (WHO, 2022).

In Brazil, ATL occurs unevenly, although it is present in all regions of the country. The North and Northeast regions have the highest number of cases, accounting for almost two-thirds of patients. In the Northeast, the States of Maranhão, Bahia, Ceará, and Pernambuco are responsible for more than 90% of cases (Brasil, 2023).

The control of ATL has become even more challenging in light of the pandemic caused by the SARS-CoV-2 virus, the first cases of which were reported in China on December 31, 2019 (Huang et al., 2020). The spread of this virus has reached global levels, with the World Health Organization (WHO) declaring an international public health emergency on January 30, 2020, and a pandemic on March 11, 2020 (WHO, 2020; Cucinotta &Vanelli, 2020).

Since the first confirmed case in Brazil (February 26, 2020) (De Souza et al., 2021) and in Pernambuco (March 12, 2020) (Do Carmo et al., 2020; Silva et al., 2021), there have been changes in the behavior of the population and in the dynamics of health services. In this context, the measures adopted, such as isolation, quarantine, mobility restrictions, and readjustment of health services, have had an impact on the management of infectious diseases in the country (De Souza et al., 2020a; Da Paz et al., 2022; Do Carmo & Souza, 2022; Dantas et al., 2023).

Based on the above, this study aims to quantify the impact of the Covid-19 pandemic on ATL records in an area of northeastern Brazil.

METHODS

Study design, population, and period

This is an ecological study involving the notification of all confirmed cases of ATL registered in the State of Pernambuco and reported to the Notifiable Diseases Information System (SINAN) from 2015 to 2022, with 2015 to 2019 as the pre-pandemic period and 2020-2022 as the pandemic years.

The disease typically manifests in two forms. The CL is characterized by one or more skin lesions that may change in size and appearance over time. In the ML form, lesions may involve the nasal septum, pharynx, and larynx. Patients meeting at least one of the following criteria were considered confirmed cases of ATL (Brasil, 2017): "Residence, origin, or displacement in/ from/ to an area with confirmed transmission and finding of the parasite in direct and/ or indirect parasitological tests; Residence, origin, or displacement to/ from an area with confirmed transmission and positive Montenegro Skin Test (MST); Residence, origin, or displacement in/ from/ to area with confirmed transmission and other positive diagnostic methods."

Also, considering the possibility of difficulties in access to confirmatory laboratory tests, the Brazilian Ministry of Health defines that there is the possibility of confirming cases of CL and/ or ML based on the clinical-epidemiologic criterion, which is "any case of clinical suspicion, without access to laboratory diagnostic methods, and with residence, origin or displacement in/ from/ to an area of confirmed transmission". It should be noted that for the ML of ATL, the presence of skin scarring must be considered as an additional criterion for confirming the diagnosis (Brasil, 2022).

Study area

The study was conducted in Pernambuco, a State in the northeast of Brazil. Pernambuco is the seventh most populous State in Brazil, with an estimated 9.1 million inhabitants and a population density of 92.37 inhabitants per square kilometer (IBGE, 2022). According to the 2021 data from the Atlas of Human Development in Brazil, the Federal Unit ranks 15th in the national ranking of the Municipal Human Development Index (MHDI), with a score of 0.719 (Brasil, 2021).

Pernambuco is divided into 12 Regional Health Administrations (Geres), which are responsible for local action, providing services adapted to the particularities of each region in primary care, restructuring the

hospital network, municipal actions, and combating various endemic diseases (Figure 1) (Pernambuco, 2023).

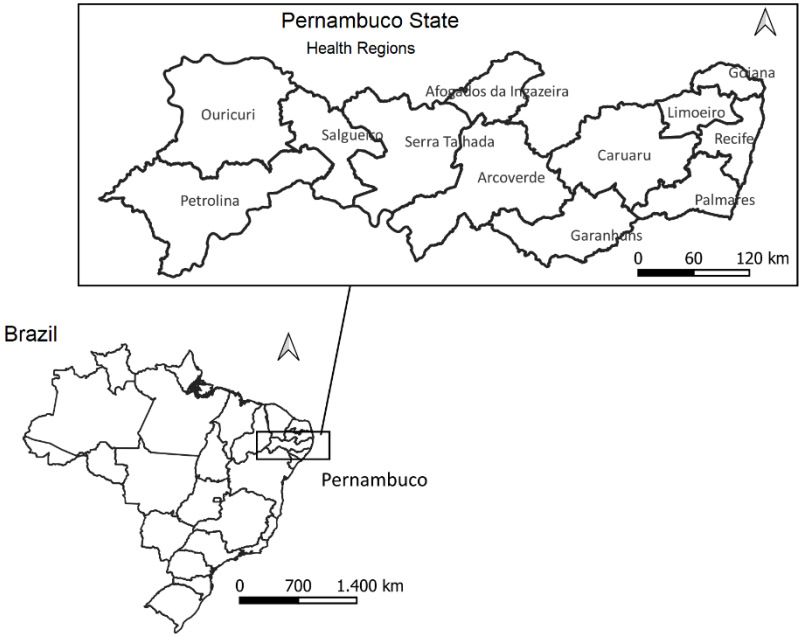

Figure 1. The study area of the State of Pernambuco, Brazil.

Data Source

The data were extracted from SINAN, which was established in the early 1990s to collect and process information on notifiable diseases throughout the country, to provide data for analysis of the morbidity profile and support decisions at the municipal, state, and federal levels (Rocha et al., 2020).

Estimating the impact of the Covid-19 pandemic

To quantify the impact of the Covid-19 pandemic on the number of ATL diagnoses and the incidence rate, the pre-pandemic period (2015-2019) was considered to calculate the expected value for 2020, 2021, and 2022. These expected values were compared with the observed values using the following equations:

Impact in 2020:

$$Percentage\ change\ = \frac{nº\ confirmed\ cases\ (2020) - nº\ expected\ cases\ (2015-2019)}{nº\ expected\ cases\ (2015-2019)} \times 100$$

Impact in 2021:

$$Percentage\ change\ = \frac{nº\ confirmed\ cases\ (2021) - nº\ expected\ cases\ (2015-2019)}{nº\ expected\ cases\ (2015-2019)} \times 100$$

Impact in 2022:

$$Percentage\ change\ = \frac{nº\ confirmed\ cases\ (2022) - nº\ expected\ cases\ (2015-2019)}{nº\ expected\ cases\ (2015-2019)} \times 100$$

In which: 1. The event being analyzed is the number of confirmed cases of ATL; 2. The expected value for the year is calculated considering the last five years before the start of the pandemic. The equations were adjusted to quantify the impact on the incidence rate by replacing "number of cases" with "incidence rate". The results are presented in absolute numbers and percentages.

Analysis were performed using the software JASP (version 0.16.1.0, University of Amsterdam/ Amsterdam, The Netherlands) and Qgis QGis (version 2.14.11, Open-Source Geospatial Foundation (OSGeo), Beaverton, OR, USA).

In addition, to calculate the incidence rate, data were obtained on the resident population according to population estimates for each year, stratified by health region of residence (IBGE, 2022).

The incidence rate was calculated using the following equation:

$$Incidence\ rate = \frac{nº\ of\ confirmed\ cases \in the\ region \in the\ year\ evaluated}{nº\ of\ estimated\ inhabitants\ of\ the\ region \in the\ year\ evaluated} \times 100.000$$

Ethics considerations

The study used secondary data in the public domain, which meant that it did not need to be examined by the Research Ethics Committee.

RESULTS

From 2015 to 2022, there were 2,230 new cases of ATL diagnosed in Pernambuco. The annual average was 318 cases before the pandemic and 213 cases during the pandemic period. The incidence rate in the pandemic period was lower than in the pre-pandemic period (2.2/100,000 and 3.4/100,000,

respectively). In addition, 2020 and 2022 were the years with the fewest recorded cases (*n*= 194 and *n*= 177, respectively) and the lowest incidence rate (2.0/100,000 and 1.8/100,000, respectively) in the entire time series (Figure 2).

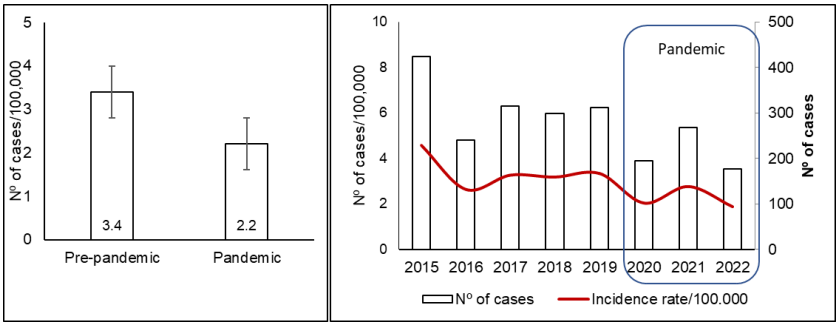

Figure 2. Comparison of American Tegumentary Leishmaniasis incidence before and during the Covid-19 pandemic in the State of Pernambuco, Brazil, from 2015 to 2022.

In the three years evaluated, 883 ATL diagnoses were expected in the study area (294 records/ year). However, 646 cases were reported, which means that at least 237 individuals were underreported - a reduction of 26.82%. Notably, the impact observed in 2022 was the largest of the years evaluated: at least 111 individuals were no longer reported, a reduction of 37.8% compared to what was expected (Table 1).

Table 1. The impact of the Covid-19 pandemic on the reporting of American Tegumentary Leishmaniasis in the State of Pernambuco, Brazil, 2020-2022.

Indicator	2020	2021	2022	2020-2022
Expected	294	294	294	883
Observed (registered)	195	268	183	646
Nº of underreporting	-99	-26	-111	-237
Impact (percentage change)	-33.7	-8.9	-37.8	-26.82

In the period before the pandemic, Palmares and Goiana had the highest incidence rates (15.7 and 14.7 per 100,000, respectively). The region of Limoeiro took the third position with a rate of 4.1 per 100,000. During this time, these three regions had higher rates than the State.

Goiana had the highest rates in 2020 and 2021 during the pandemic, while Palmares had the highest rate in 2022 (Figure 3).

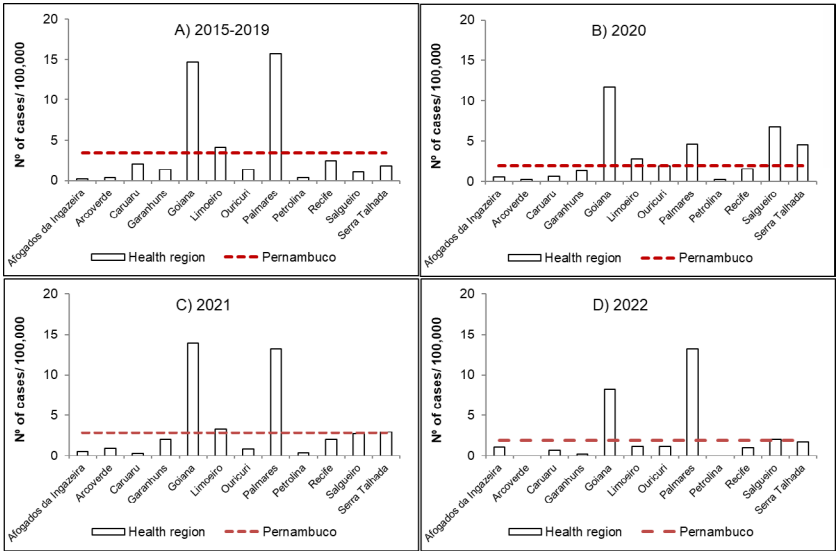

Figure 3. American Tegumentary Leishmaniasis incidence before and during the Covid-19 pandemic by health region in the State of Pernambuco, Brazil, from 2015 to 2022.

Regarding regional impact in 2020, the most significant decreases were seen in Caruaru (-69.2%; -20 records) and Palmares (-63.5%; -50 records). In that year, seven of the twelve regions showed a decrease. On the other hand, Salgueiro and Serra Talhada showed an increase of more than 200% (eight more records than expected in each region/ 2 and 3 cases expected, respectively) (Figure 4A).

In 2021, the regions showed a trend of recovery in reported cases: only four regions diagnosed fewer cases than expected, especially Caruaru (-86.3%; -25 diagnoses). Salgueiro and Serra Talhada, although diagnosing fewer cases than in 2020, still had a higher number of reported cases than expected (2 and 4 more cases, respectively) (Figure 4B).

In 2022, the number of reported cases of the disease decreased again: no records were observed in the regions of Arcoverde and Petrolina. Reductions of more than 50% were also observed in Garanhuns (-82.6%; -5 cases), Caruaru (-69.2%; -20 cases), Limoeiro (-65.0/ -13 cases) and Recife (-55.2%; -54 cases) (Figure 4C).

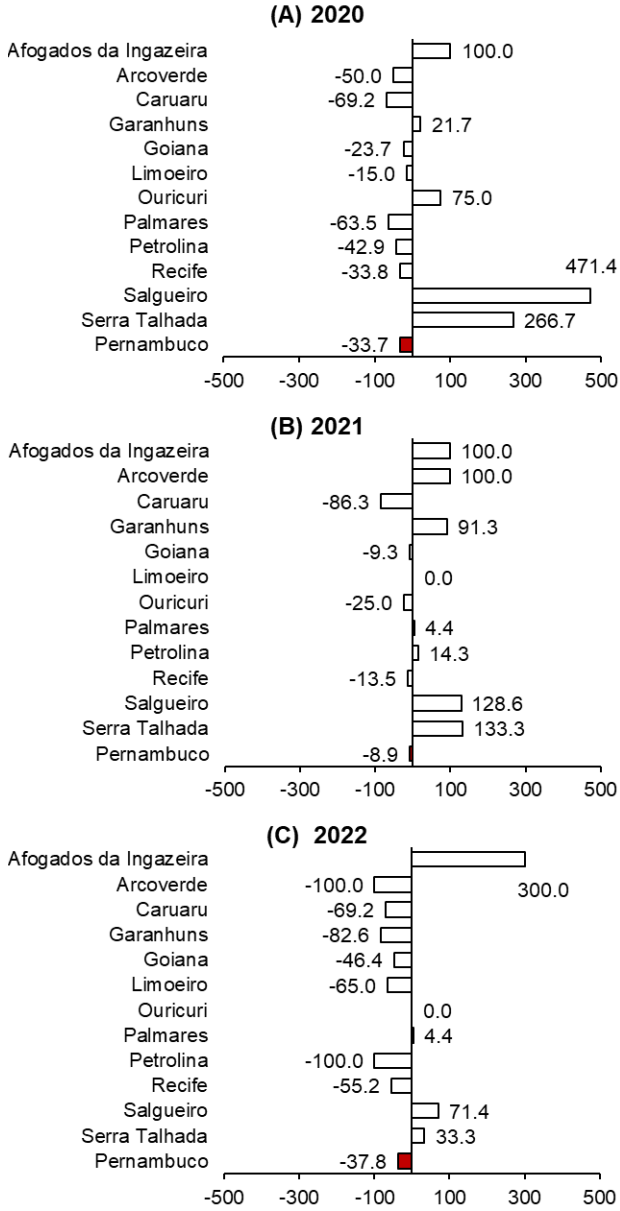

Figure 4. Impact of the Covid-19 pandemic on American Tegumentary Leishmaniasis records by health region in the State of Pernambuco, Brazil, from 2020 to 2022.

DISCUSSION

This study determined the impact of the Covid-19 pandemic on ATL records in the State of Pernambuco. At least 237 individuals were no longer diagnosed and notified in the State, with unequal distribution between health regions. In addition, the impact of the pandemic lasted into the years 2021 and 2022.

The pandemic of the SARS-CoV-2 virus has had multiple consequences, causing impacts in different areas and changing the behavior of society in different dimensions (cultural, economic, and organizational). At this point, the demand for care services and the supply of medical care have decreased, which has been a determining factor in the impact caused by the management of endemic diseases in Brazil (De Souza, 2020; De Souza et al., 2020a; Fundação Oswaldo Cruz, 2021; Da Paz et al., 2022; Do Carmo & Souza, 2022; Dantas et al., 2023).

The strategy of social isolation, although effective in controlling the spread of the new coronavirus, was a significant challenge given the Brazilian social reality, which is characterized by systemic historical social inequalities, such as the proportion of people living in poverty, homelessness, and incarceration (Aquino et al., 2020; De Souza et al., 2020b; De Souza et al., 2021). This context demonstrates that, while it has impacted the battle against Covid-19, it has also influenced policies aimed at endemic diseases in the country (De Souza et al., 2020a; Da Paz et al., 2022; Dantas et al., 2023).

As a result, demand for health services and elective and outpatient care has decreased, affecting the entire chain of care for many neglected tropical diseases (NTDs) (Aquino et al., 2020; Pan American Health Organization, 2022), whether in diagnosis, reporting, treatment, or control. It is important to note that millions of people around the world are still infected and dying from NTDs, especially low-income and socially vulnerable populations, with little investment in new diagnostic techniques, drugs, and control (Vieira, 2023). Leishmaniasis is listed by PAHO among the more than 20 NTDs, which includes Chagas disease and leprosy (OPAS, 2022a).

During the pandemic period, ATL was not the only NTD affected (De Souza et al., 2020a; Dias et al., 2020; Da Paz et al., 2022; Do Carmo & Souza, 2022). In schistosomiasis, for example, a study in an endemic area of Brazil showed a 68.4% reduction in the number of cases diagnosed and a 43.5% reduction in the number of Kato-Katz tests performed (Dantas et al., 2023). A similar relationship has been observed in the diagnosis of leprosy. In Brazil, for example, there was a 41.4% reduction in reported leprosy cases in 2020 (n= 16,073) compared with the average number of cases in 2015-2019 (n= 27,430) (Da Paz et al., 2022). For tuberculosis, a study conducted in the State of Bahia showed a 26.4% reduction in new cases when comparing the period January to July 2019 and 2020 (De Souza et al., 2020a).

The results of this study indicate a 26.8% decrease in the incidence of ATL in the State of Pernambuco between 2020 and 2022, compared to the pre-pandemic period (2015 to 2019). Even in the health regions with the highest incidence in 2020 (Goiana, Salgueiro, Serra Talhada, and Palmares), there was a decrease compared to the pre-pandemic period. These inequalities in the distribution of ATL in Pernambuco have been pointed out by Araújo (Araújo, 2020), according to whom the highest risk areas were observed in the eastern part of the State, especially in the municipalities located in the health regions of Palmares and Goiana. It is important to highlight that, historically, the municipalities of Palmares, Goiana, and Limoeiro have the highest records of CL in Pernambuco.

Regarding the decrease in notifications that occurred in 2022 in Pernambuco, it was not possible to attribute this situation to any specific factor. Therefore, there is a need for more in-depth research on this issue in that year. It is only known that this context was not limited to the State of Pernambuco but was also observed in other Brazilian States, such as Ceará, which indicates a decrease in ATL cases in 2022 compared to 2021 (Ceará, 2022).

Diagnosis and treatment of ATL are essential since the progressive tendency of the lesions to develop leads to organic and psychosocial damage that severely impairs the patient's life. This highlights the need for adequate care for ATL at all levels of health care, starting with the basic network/ primary health care (PHC), which, in addition to suspecting and, when indicated, referring patients with suspected ATL to outpatient or hospital referral units, should provide the necessary conditions for the diagnosis and treatment of this disease (Brasil, 2017).

It should be noted that identifying cases reported to national data systems strengthens epidemiological surveillance and provides a better idea of the national epidemiological context. Based on these analysis, public authorities may plan and implement actions to improve the public health system and control and prevent different outbreaks (Brasil, 2022). It should be noted that public health actions are aimed at reducing the morbidity and mortality of ATL (Burza et al., 2018).

Since 2011, Pernambuco has invested efforts and prioritized the fight against seven neglected diseases and other poverty-related diseases through the SANAR Program. The SANAR Program was born to fight neglected diseases in Pernambuco and is a pioneer in Brazil. It was established by Decree No. 39,497 of June 11, 2013. In the last four-year period (2019-2022), 64 municipalities were considered priorities within SANAR's strategies. Although leishmaniasis is included in the list of priority diseases, only the visceral clinical spectrum of the disease is included (Pernambuco, 2019). This is a cause for concern, especially in the post-pandemic context.

It is important to note that this study has methodological limitations that must be considered when interpreting its results. Being an ecological

study, it was based on secondary data, which is subject to bias in terms of both the quantity and quality of information available. As such, the results presented may not faithfully reflect the proper number of disease cases. Nevertheless, the results provide significant evidence of the impact of the pandemic on reporting tegumentary leishmaniasis cases in Pernambuco.

The study demonstrated how the Covid-19 pandemic has affected the diagnosis and reporting of ATL in Pernambuco. Therefore, it is essential to enhance health surveillance activities in the region, which includes adding ATL to the list of priority diseases in the State.

ACKNOWLEDGEMENTS

Fundação de Amparo à Ciência e Tecnologia do Estado de Pernambuco (FACEPE). Programa Estadual de Pesquisa Aplicada ao SUS. Processo nº.: APQ-0692-4.06/22.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest to disclose.

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