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ANALYSIS OF HOSPITAL MORBIDITY RATES AND EXPENDITURES ASSOCIATED WITH LEISHMANIASIS IN MINAS GERAIS, BRAZIL (2013-2023)

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ABSTRACT

Introduction: Leishmaniasis is a vector-borne parasitic disease, with diverse clinical forms and a significant impact on global public health. In Brazil, especially in the state of Minas Gerais, there is a growing concern about hospital morbidity and associated costs. These diseases, caused by protozoa of the genus Leishmania, manifest themselves in different ways, from skin lesions to severe visceral infections. Objective: To evaluate the relationship between hospital morbidity rates due to leishmaniasis and spending on this disease in the state of Minas Gerais, Brazil, between 2013 and 2023. This study aims to provide a detailed understanding of the economic and public health burden of leishmaniasis in the region. Method: Ecological and retrospective study with analysis of secondary data obtained from DataSus. Hospital morbidity rates due to leishmaniasis and expenditures were normalized to 100 thousand inhabitants. Spearman's correlation analyses and comparisons of annual fluctuations with the paired T-test were performed. Results: Hospital morbidity rates and leishmaniasis expenditures in Minas Gerais showed notable peaks, especially in 2017, followed by declines and subsequent increases. There was a significant positive correlation (rho = 0.64; $p<0.05$) between hospital morbidity rates and expenditures, evidencing a direct relationship between the increase in cases and costs. These results suggest that leishmaniasis outbreaks are associated with substantial increases in public health costs. Conclusion: The study reveals the impact of leishmaniasis on public health in Minas Gerais, highlighting the need for more effective strategies to control the disease and reduce associated costs. Continuous monitoring and efficient resource allocation are crucial to improving the bottom line.

Keywords: Leishmaniasis. Hospital morbidity. Health Expenditures. Minas Gerais. Brazil.

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INTRODUCTION

Leishmaniasis is a vector-borne parasitic disease with three predominant clinical forms: visceral leishmaniasis (VL), cutaneous or tegumentary leishmaniasis (TL) and mucocutaneous leishmaniasis (HANDLER, 2015). This disease can be caused by protozoa of more than 20 species of Leishmania (MARC, 2015). Given this, different species cause different clinical manifestations, which vary in intensity, ranging from skin lesions, which can heal spontaneously, to visceral diseases that can be fatal (BURZA, 2018).

TL is characterized by lesions on the skin or mucous membranes, and is mainly caused by *Leishmania (Leishmania) amazonensis, Leishmania (Viannia) braziliensis, and Leishmania (Viannia) guyanensis*. On the other hand, VL represents the most severe form of the disease, affecting internal organs, especially the spleen and liver. *Leishmania (Leishmania) chagasi* is the main cause of VL cases in Latin America (LAINSON & SHAW, 1972; DANTAS-TORRES, 2006; RODRIGUES et al., 2021).

Mucocutaneous leishmaniasis, on the other hand, is a condition that can be fatal and cause serious deformities due to the late destruction of the nasopharyngeal oral mucosa and cartilage. The impact can extend to the larynx, resulting in aspiration pneumonia, which is an aggravated form of the disease. There is also post-kala-azar leishmaniasis, which is a skin disease that occurs after the treatment of visceral leishmaniasis caused by *L. donovani* (BURZA, 2018).

This disease is recognized as a significant public health problem and is widely distributed globally, spanning regions in Europe, Asia, Africa, South America, and Central America. However, in the Americas, leishmaniasis is a vector-borne zoonotic disease with a complex transmission cycle, which involves a great diversity of parasites, reservoirs, and vectors (QUINNELL and COURTENAY, 2009).

Over the 19 years of records (1984-2002), diagnoses of American Visceral Leishmaniasis (AVL) totaled 48,455 occurrences, of which about 66% were recorded in the states of Bahia, Ceará, Maranhão and Piauí. In the last decade, the average annual incidence in the country was 3,156 cases, with a rate of two cases per 100,000 inhabitants.

The spread of the disease has been documented in several municipalities, covering all regions of Brazil, except for the South Region. Significant changes are observed in the mode of propagation of the disease, initially predominant in rural and peri-urban environments and, more recently, manifesting itself in urban centers such as Rio de Janeiro

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(RJ), Corumbá (MS), Belo Horizonte (MG), Araçatuba (SP), Palmas (TO), Três Lagoas (MS), Campo Grande (MS), among others (BRASIL, 2006).

Socioeconomic and environmental aspects and living standards are relevant factors in the epidemiology of visceral leishmaniasis in endemic regions. Such circumstances may lead to the persistence of visceral leishmaniasis in rural and peri-urban areas, affecting human groups with low socioeconomic status who live in precarious housing conditions (NASCIMENTO et al., 2005). The persistence of endemic epidemic diseases in developing nations, such as Brazil, results from environmental changes, population displacements, disorderly urban expansion, and other socioeconomic aspects that affect large areas (BENCHIMOL et al., 2019).

In addition, it is extremely important to evaluate the cases of leishmaniasis and their relationship with costs for the State, in order to verify how this tropical disease is growing and afflicting regions where there is a lack of endemic records, such as Minas Gerais. This is essential to develop indicators that guide public health policies. Thus, the objective of this study was to evaluate the relationship with hospital morbidity rates due to leishmaniasis and spending on this disease of great impact in the State of Minas Gerais, southeastern region of Brazil.

METHODS

ETHICAL ASPECTS OF RESEARCH

This study was conducted in accordance with the ethical principles established by the Declaration of Helsinki and with the guidelines of the National Health Council of Brazil. As this is a study that uses secondary data in the public domain, it was not necessary to submit it to the Research Ethics Committee. The information was obtained from public databases, ensuring the anonymity and privacy of individuals.

STUDY DESIGN AND TYPE OF STUDY

This is an ecological, retrospective study that analyzed hospital morbidity rates due to leishmaniasis and related expenditures in the state of Minas Gerais, Brazil, from 2013 to 2023. The study aims to identify trends and correlations between these variables over time, providing a comprehensive view on the evolution of the disease and the associated economic impacts.

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DATA COLLECTION

Data on hospital morbidity rates due to leishmaniasis and associated expenses were obtained from the database of the Hospital Information System (SIH) of DataSus, linked to the Brazilian Ministry of Health. The rates were calculated based on the population of Minas Gerais, being normalized to 100 thousand inhabitants per year. Data were extracted for the years 2013 to 2023, including both cases of Visceral and Integumentary Leishmaniasis.

DATA ANALYSIS

The data were statistically analyzed using the R software, version 4.0.3. Morbidity rates and expenditures were described throughout the study period and compared with the national averages. To evaluate the correlation between hospital morbidity rates and expenditures, Spearman's correlation coefficient was used, with statistical significance set at $p<0.05$.

Annual fluctuations were analyzed using the paired t-test to verify significant differences between variations in morbidity rates and expenditures over the years. Morbidity rates and expenditures were normalized to 100 thousand inhabitants, allowing direct comparison between the years and with the national average.

Graphs were generated to visualize the temporal trends and correlations between the variables studied. All analyses were performed with a significance level of 5%.

STUDY LIMITATIONS

This study is limited by the use of secondary data, which may introduce biases related to the quality and completeness of the available records. In addition, the ecological approach used does not allow causal inferences to be made, limiting itself to identifying associations between the variables studied.

RESULTS

Initially, the distributions for leishmaniasis rates per 100 thousand inhabitants in the State of Minas Gerais between 2013 and 2023 were evaluated (Figure 1). It was possible to emphasize the emergence of the disease in the State of Minas Gerais when compared to the average observed for the country, the average for Brazil of the hospital morbidity rate due to leishmaniasis in Brazil was 1.56 ± 0.34 / 100 thousand inhabitants and the State of Minas Gerais from the first year of analysis of the Study, that is, from 2014 onwards it

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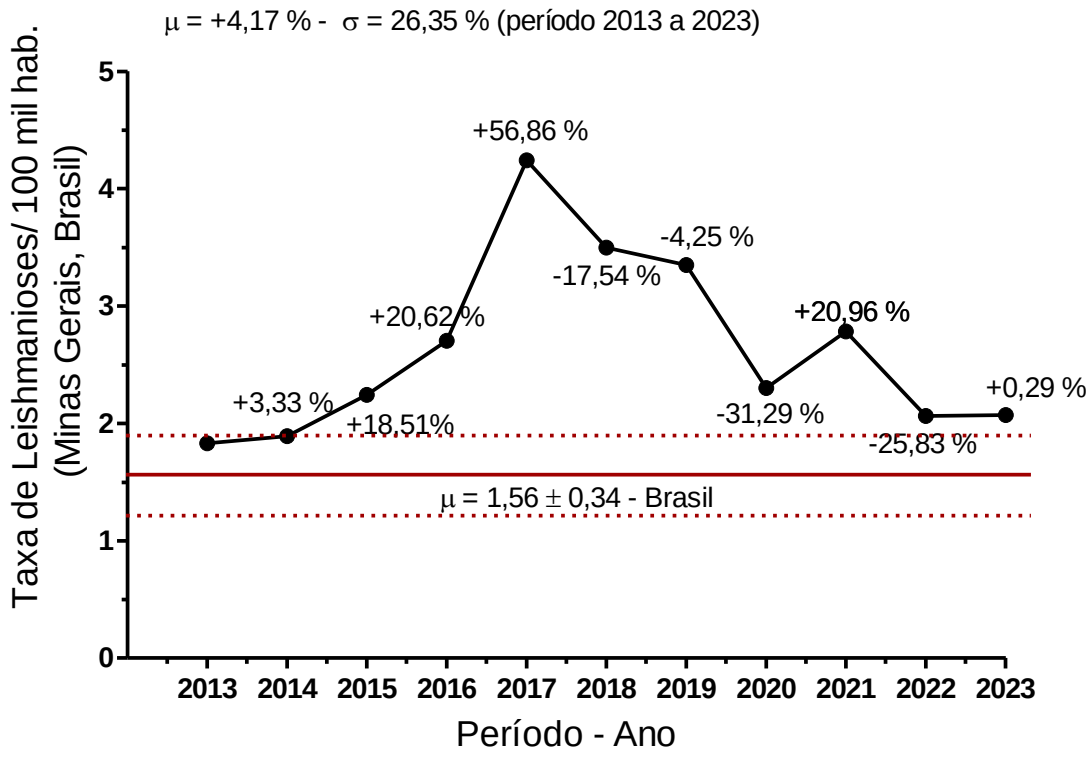
remained above 1 standard deviation observed for Brazil (Figure 1). In 2017 there was a peak in cases, with a growth of 56.86% compared to the previous year (2016), after 2017, there was a decline for the next 3 years and from 2022 to 2023 there was a slight increase of 0.29% for the hospital morbidity rate (figure 1).

Figure 1. Distribution for hospital morbidity rates due to Leishmaniasis in the State of Minas Gerais for the period from 2013 to 2023. Values for hospital morbidity were obtained from the DataSus database associated with the Ministry of Health, Brazil. The rates were obtained after annual normalizations for 100 thousand inhabitants. The data for the distributions in Brazil were also obtained and "plotted" represented by the mean (solid red line) and standard deviation of the mean (dashed red lines).



After reporting the temporal distributions for leishmaniasis in the State of Minas Gerais between 2013 and 2023, the study surveyed the expenses for causes related to hospital morbidities due to leishmaniasis (Figure 2). Similarly, morbidity rates were shown to show a heterogeneous distribution for leishmaniasis expenditures, with a peak for the year 2017. However, the percentage increase for spending compared to the previous year (2016) was 94%. There was also a decline in spending until 2021, with an increase in costs of 21.83% in 2022 and a drop of 30.02% in 2023 (figure 2).

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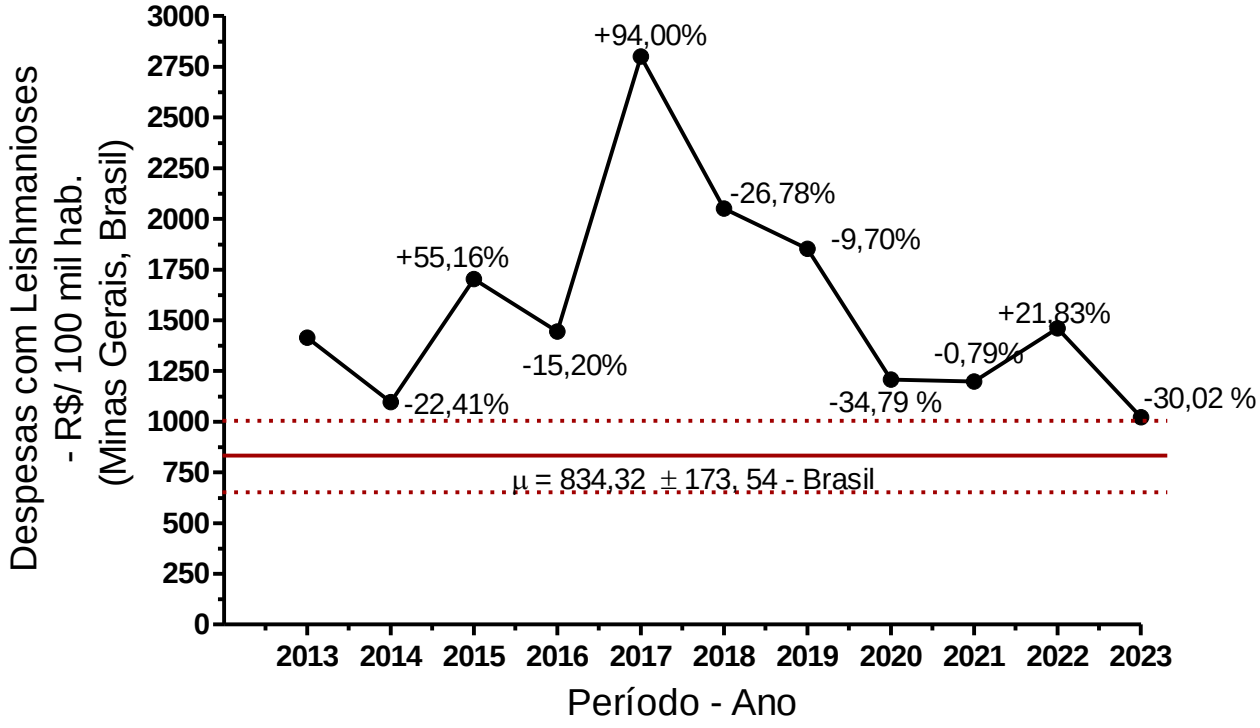
Figure 2. Frequency for Leishmaniasis spending rates in the State of Minas Gerais for the period from 2013 to 2023. The values for expenditures in the country's current currency (real) were obtained from the DataSus database associated with the Ministry of Health, Brazil. Spending rates were obtained after annual normalizations for 100 thousand inhabitants. Data for the frequencies of spending in Brazil were also obtained and "plotted" represented by the mean (continuous red line) and standard deviation of the mean (dashed red lines).



Given some annual counterpoints for hospital morbidity rates due to leishmaniasis and expenses, for a better understanding, an evaluation was carried out by correlation between the two variables, hospital morbidity rates and costs, where it was possible to find a positive and significant correlation (rho = 0.64; $p<0.05$) for the two variables (Figure 3).

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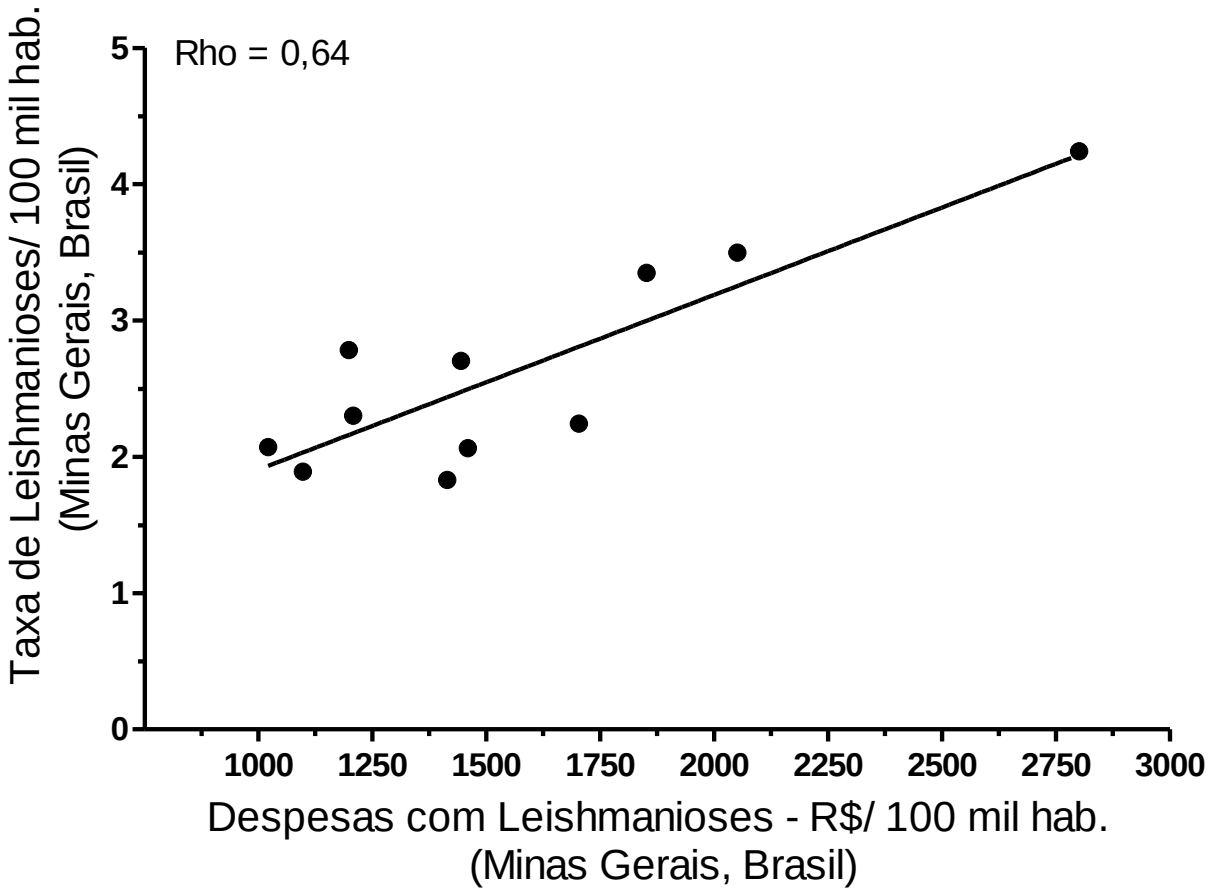
Figure 3. Correlation between hospital morbidity rates and Leishmaniasis expenses for the State of Minas Gerais in the period from 2013 to 2023. Values for hospital morbidity and expenditures were obtained from the DataSus database associated with the Ministry of Health, Brazil. The rates were obtained after annual normalizations for 100 thousand inhabitants. Spearman's test was used to evaluate the effect of correlation. The level of significance used was 5%.



The annual percentage fluctuations for hospital expenses and morbidity due to Leishmaniasis in the State of Minas Gerais for the period from 2013 to 2023 were evaluated on a one-off basis for each year (Figure 4). Given the behavioral heterogeneity for the concordances between costs and hospital morbidity rates, no significant paired differences were observed ($p>0.05$) (Figure 4).

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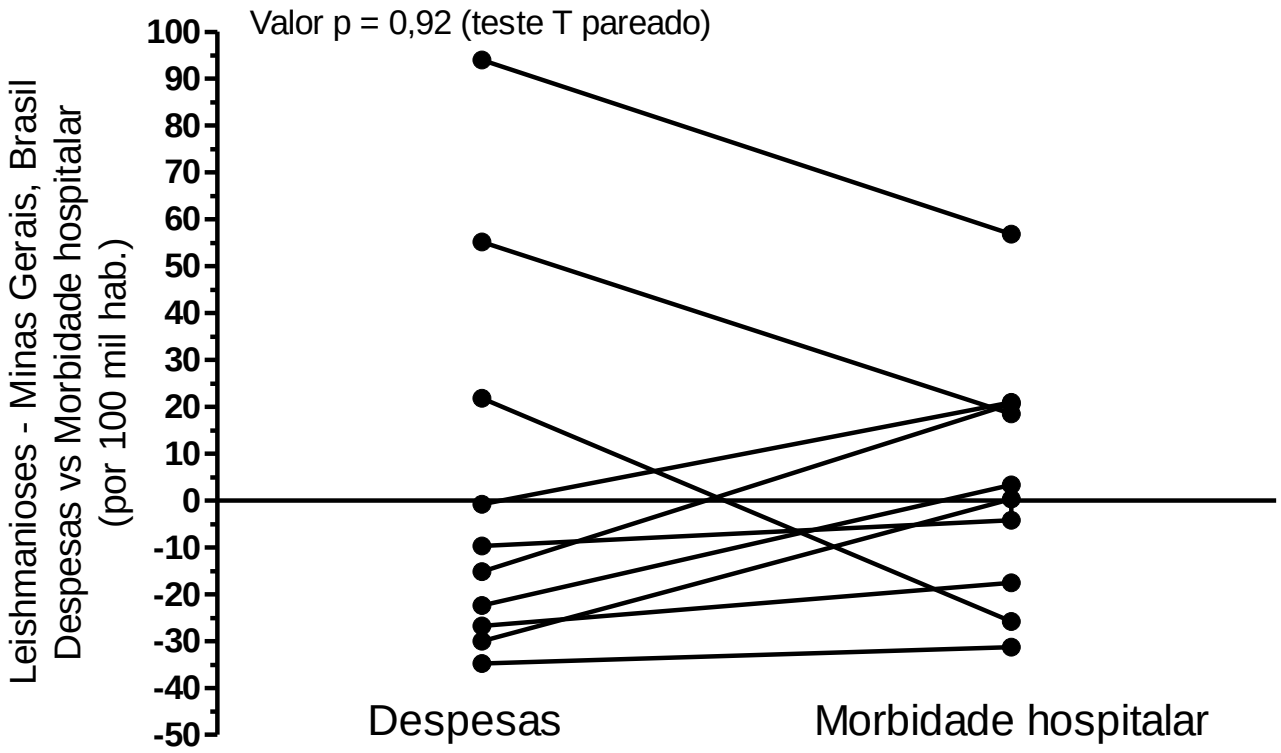
Figure 4. Comparisons for annual percentage fluctuations in hospital expenses and morbidity due to Leishmaniasis in the State of Minas Gerais for the period from 2013 to 2023. Values for hospital morbidity and expenditures were obtained from the DataSus database associated with the Ministry of Health, Brazil. The rates were obtained after annual normalizations for 100 thousand inhabitants. The paired T test was used to evaluate the effect of fluctuations. The level of significance used was 5%.



The percentage differences between morbidity and expense rates for each year of the study were described (Table 1). It is noteworthy that the year 2013 was used as parameters to evaluate the percentage differences for 2014. Of the 10 checkpoints, expenses were below the expected fluctuation in hospital morbidity rates in 6 years, and in 5 years expenses exceeded the percentage variations observed for hospital morbidity rates (Table 1). On average, the expenses with hospital morbidity rates in the State of Minas Gerais were 24.94% lower than expected (Table 1).

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Table 1. Differences between percentage fluctuations for hospital morbidity rates and expenses due to Leishmaniasis in the State of Minas Gerais, Brazil (period from 2023 to 2023).

Year of reference	morbidity rates - %	Expenses - %	Differences - %
2014	3,33	-22,41	-19,08
2015	18,51	55,16	36,65
2016	20,62	-15,20	5,42
2017	56,86	94,00	37,14
2018	-17,54	-26,78	-9,24
2019	-4,25	-9,70	-5,45
2020	-31,29	-34,79	-3,50
2021	20,96	-0,79	20,17
2022	-25,83	21,83	-4,00
2023	0,29	-30,02	-29,73
Average	4,17	3,13	2,84
Standard Layout	26,35	42,05	22,28

DISCUSSION

This study analyzed the relationship between in-hospital morbidity rates due to leishmaniasis and associated costs in the state of Minas Gerais, Brazil, over a decade (2013-2023). The results revealed a positive and significant correlation between these variables, indicating that the increase in hospital cases of leishmaniasis is directly related to the increase in public spending on the disease, corroborating the findings of Okwor and Uzonne (2016). This finding reinforces the literature that points to the high economic burden of neglected diseases, especially in endemic regions with limited health infrastructure, as highlighted by Wijerathna (2018) and Alvar et al. (2021).

The observed peak in morbidity rates and spending in 2017 is consistent with epidemiological studies of the disease for that year (CAVALCANTE et al., 2020; GUIMARÃES-E-SILVA et al., 2023). This increase may be associated with environmental and social factors that favored vector proliferation and human exposure, such as changes in land use, population migration, and climatic conditions conducive to transmission, as discussed by Valero et al. (2020).

The subsequent drop in rates, followed by a further increase, highlights the need for more effective and sustainable strategies to control leishmaniasis. Improvements in early diagnosis, treatment, and vector control, as proposed by da Silva Freitas et al. (2023), are crucial to interrupt the transmission cycle and reduce the impact of the disease.

Analysis of annual fluctuations revealed an inconsistency between morbidity rates and expenditures, which may indicate inefficiencies in resource allocation or in the health system's response to variations in disease incidence. This discrepancy underscores the

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importance of continuous epidemiological surveillance and adaptive public policies, which can respond promptly to changes in the epidemiological landscape, optimizing the allocation of resources and maximizing the impact of interventions.

In addition, the prevalence of leishmaniasis in urban areas of Minas Gerais reflects the growing and disorderly urbanization, which facilitates the spread of the disease beyond traditional rural areas (SALOMÓN and WERNECK, 2022). This reality requires interventions aimed at both urban and rural areas, considering the specificities of each context and adopting an integrated approach to disease control.

Finally, the economic relevance of leishmaniasis in Minas Gerais, evidenced by the high hospital costs, reinforces the urgent need for more effective and comprehensive public policies. Health education programs, vector control, and improvements in medical care are essential to reduce the burden of disease and associated costs. In addition, it is crucial to invest in research that explores new methods of prevention and treatment, aiming to improve the management of leishmaniasis and minimize its socioeconomic impact.

CONCLUSION

This study analyzed hospital morbidity rates due to leishmaniasis and associated expenditures in the state of Minas Gerais, Brazil, over the period from 2013 to 2023. The results showed a significant increase in hospital morbidity rates and in expenditures on the disease, highlighting peaks in certain years, such as in 2017, followed by periods of decline and subsequent increases. The positive and significant correlation between morbidity rates and expenditures confirms that the increase in the number of cases leads to a proportional increase in expenditures on treatment and control of the disease.

These findings highlight the importance of continuous and effective monitoring of leishmaniasis in the state of Minas Gerais, as well as the need for public health policies that address not only the control of the disease, but also the reduction of associated costs. The heterogeneity observed in annual percentage fluctuations highlights the complexity of the dynamics between case incidence and allocation of financial resources, indicating that more efficient strategies may be needed to optimize the use of available resources and maximize the impact of interventions.

In summary, the study reinforces the significant impact of leishmaniasis on public health and the economy of Minas Gerais, demanding more targeted, effective, and sustainable interventions to control the spread of the disease, reduce the associated

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economic costs, and promote the health and well-being of the population. In addition, it highlights the need for investments in research and development of new prevention and treatment tools, aiming at a more comprehensive and effective management of leishmaniasis in the state and in the country.

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