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# TEMPORAL DISTRIBUTION OF LEPROSY NOTIFICATION RATES IN GOIÂNIA

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## ABSTRACT

**Introduction:** Introduction: Leprosy is a chronic infectious disease that remains a public health challenge in Brazil, with high prevalence in vulnerable regions. The COVID-19 pandemic has worsened underreporting and access to diagnosis. Objective: To describe the temporal and sociodemographic distribution of leprosy notifications in the city of Goiânia. **Method:** Descriptive and observational study with secondary data on leprosy notifications, from 2014 to 2023. The data were obtained from the SINAN public domain website. All notifications from the period were considered. Population data were extracted from IBGE, and the variables used are gender, age group, education and race. Results: 2,188 cases of leprosy were recorded in the period, with a prevalence reduced from 25.63 to 8.71 per 100 thousand inhabitants. Men (59.8%) and mixed race (55.7%) had the highest number of cases. The COVID-19 pandemic negatively impacted the diagnosis of the disease, with partial recovery starting in 2022. **Conclusion:** Despite the reduction in cases, underreporting and inequality in access to health services remain challenges for the population. Inclusive and intersectoral strategies are needed for effective leprosy control.

**Keywords: Leprosy, Goiânia, Public health, Social inequality, Epidemiology.**

## INTRODUCTION

Leprosy is one of the oldest recorded diseases, with evidence of its presence dating back to ancient civilizations such as Egypt and India. Caused by Mycobacterium leprae, the disease spread across various parts of the world and became strongly associated with social stigma. During medieval Europe, those affected were isolated in leper colonies, a practice that persisted for centuries as a form of social control.[1] Despite scientific advances and global eradication campaigns, leprosy still persists, particularly in countries in Asia and Latin America.[2]

On the international scene, India, China, and Indonesia remain among the countries with the highest burden of the disease. In the United States, although leprosy is rare, cases are still reported in states such as Texas and Florida due to environmental and migratory factors.[3] In Europe, the disease has been virtually eradicated, with only a few sporadic cases linked to immigration from endemic regions.[4] These data reflect that, despite advancements, leprosy remains a challenge in

different geographical contexts.

In Brazil, leprosy has deep historical roots dating back to the colonial period. For a long time, the response to the disease was the compulsory isolation of patients in leper colonies, a practice that was abandoned in the 1940s with the introduction of drugs such as sulfa.[5] However, Brazil still holds a prominent global position in terms of the number of cases, alongside India and Indonesia, according to data from the World Health Organization.[6] The challenge is particularly significant in the North, Northeast, and Central-West regions, where poor socioeconomic conditions and limited access to healthcare services hinder disease control.[7]

In Brazilian capitals such as Manaus, Fortaleza, and São Luís, leprosy remains prevalent, reflecting a combination of social factors and limitations in early diagnosis.[8] Medium and small-sized cities also face challenges in controlling transmission, demonstrating that the problem is not restricted to large urban centers.[5] Diagnostic campaigns have expanded, but the disease persists, requiring continuous efforts for its control.[2]

Although Brazil follows WHO recommendations, providing free diagnosis and treatment through the Unified Health System (SUS), significant obstacles remain, such as stigma and social discrimination. These factors hinder treatment adherence and the reintegration of patients. The elimination of leprosy as a public health problem depends not only on effective diagnosis and treatment but also on strategies that combat stigma and promote awareness.[4]

The general objective of this article is to describe the temporal distribution of the leprosy notification rate in Goiânia from 2014 to 2023. Specifically, it aims to analyze the sociodemographic profile of patients and describe the leprosy prevalence coefficient in the municipality throughout the analyzed period.

The relevance of this research lies in the need to better understand how leprosy manifests in different population groups and at different times, especially considering the impact of crises, such as the COVID-19 pandemic, on the diagnosis and treatment of the disease. In this way, the analysis will help identify patterns and gaps in leprosy control, contributing to the formulation of more effective public policies.

The methodology adopted is based on a quantitative analysis of epidemiological data provided by the surveillance system of the municipality of Goiânia. The data used is publicly available, extracted from the Notification Disease Information System (SINAN), provided by DATASUS, which centralizes information collected by the Municipal Health Department (SMS). Additionally, estimated population data was obtained from the Brazilian Institute of Geography and Statistics (IBGE), ensuring greater accuracy in the analysis of prevalence coefficients.

As the data is public and already consolidated, it was not necessary to seek approval from the Research Ethics Committee involving Human Beings. Secondary data on notifications registered between 2014 and 2023 will be considered, allowing for a detailed description of the disease's evolution and identifying relevant patterns for the formulation of public policies.

## METHODS

This is a descriptive and observational study that used a quantitative approach based on publicly available epidemiological data provided by the Notification Disease Information System (SINAN), made available by DATASUS. Population information was obtained from the Brazilian Institute of

Geography and Statistics (IBGE) from the 2022 census, ensuring greater accuracy in the calculation of prevalence coefficients.

Leprosy notification data was directly extracted from SINAN for the period from 2014 to 2023, covering information such as the number of reported cases, sociodemographic profile (gender, age group, education level, and race), and prevalence coefficients. Additional information on population estimates was obtained from the official IBGE website.

The collected data was organized into tables and analyzed using descriptive statistics. The prevalence coefficient was calculated considering the number of reported cases per 100,000 inhabitants each year, based on population estimates. The interpretation of the results was grounded in current scientific literature, allowing for discussions that align with the local, national, and global epidemiological context.

The study is limited to the analysis of secondary data, which may restrict the scope of the conclusions due to the possibility of underreporting, especially during the COVID-19 pandemic. Additionally, the lack of more detailed socioeconomic variables makes it difficult to assess some social determinants related to leprosy.

Since the data is public, consolidated, and anonymized, the study was exempt from ethical review by the Research Ethics Committee with Human Beings, in accordance with Resolution No. 510/2016 of the National Health Council.

## RESULTS AND DISCUSSION

General analysis of reported leprosy cases in goiânia (2014-2023)

**Table 1 – Temporal Distribution of Leprosy in the City of Goiânia, from 2014 to 2023.**

| Year of Diagnosis | Frequency |
|---|---|
| 2014 | 362 |
| 2015 | 322 |
| 2016 | 265 |
| 2017 | 275 |
| 2018 | 228 |
| 2019 | 222 |
| 2020 | 122 |
| 2021 | 149 |
| 2022 | 117 |
| 2023 | 126 |
| Total | 2.188 |

**Source: Brazil - Ministério da Saúde [9]**

Between 2014 and 2023, 2,188 cases of leprosy were reported in the city of Goiânia. The distribution over these years reveals important patterns that reflect both epidemiological and contextual factors, such as the influence of the COVID-19 pandemic on healthcare services.

### Evolution Over the Period

There was a progressive reduction in the number of cases over the years, decreasing

from 362 notifications in 2014 to 126 in 2023. This decline may indicate advances in leprosy control, but it could also be associated with underreporting and reduced access to healthcare services at certain times.

• Year with the Highest Record: 2014 had the highest number of notifications, with 362 cases.

• Year with the Lowest Number of Notifications: 2020 recorded 122 cases, reflecting the direct impact of the pandemic.

• Gradual Recovery: After the decline during the pandemic, an increase in cases was observed starting in 2021, with 149 notifications, signaling the resumption of diagnosis and care.

**Impact of the COVID-19 Pandemic on Leprosy Patients**

COVID-19 brought restrictions to access healthcare services, redirecting the focus of public systems towards controlling the pandemic. As a result, there was a sharp decline in diagnoses in 2020 and 2021. This does not necessarily indicate a real decrease in leprosy cases, but rather a temporary interruption in surveillance and diagnostic activities.

**Post-Pandemic Distribution and Recovery**

Starting in 2022, the numbers began to stabilize, with 117 cases in 2022 and 126 in 2023, indicating a partial recovery in notifications. This suggests that the resumption of healthcare services and the increase in diagnostic activities helped bring back some cases that may have gone unnoticed during the pandemic.

ANALYSIS OF LEPROSY CASES ACCORDING TO EDUCATION LEVEL, FROM 2014 TO 2023

Leprosy data in Goiânia from 2014 to 2023, collected from the DATASUS website, show a significant distribution across different education levels. The analysis of these figures highlights relevant patterns that reflect how access to education and socioeconomic conditions influence public health.

**Table 2 – Distribution of Leprosy Cases According to Education Level in the City of Goiânia, from 2014 to 2023**

| Education Level | Cases (n) | Percentage (%) |
|---|---|---|
| Illiterate | 94 | 4.3 |
| 1st to 4th Grade Incomplete | 337 | 15.4 |
| 4th Grade Complete | 190 | 8.7 |
| 5th to 8th Grade Incomplete | 390 | 17.8 |
| Complete Elementary School | 213 | 9.7 |
| Incomplete High School | 179 | 8.2 |
| Complete High School | 405 | 18.5 |
| Incomplete Higher Education | 47 | 2.1 |
| Complete Higher Education | 153 | 7.0 |
| Unknown/Blank | 173 | 7.9 |
| Total | 2181 | 100 |

**Source: Brazil - Ministério da Saúde [9]**

• Illiterate: The lowest frequency was recorded in 2023, with only 1 case, while 2017 saw the peak with 18 notifications.

• Incomplete 1st to 4th Grade: One of the groups with high prevalence, although it showed a sharp decrease after 2018.

• Complete 4th Grade: The distribution was relatively stable, with modest fluctuations throughout the period.

• Incomplete 5th to 8th Grade: This group showed high numbers and peaks in years like 2017, suggesting significant vulnerabilities.

• Complete Elementary School: Showed a constant decrease over the years, indicating improvement in diagnosis and treatment at certain points.

• Incomplete High School: Heterogeneous distribution, but with a noticeable reduction in recent years.

• Complete High School: This was the group with the highest number of notifications, especially before the pandemic.

• Incomplete Higher Education: The lowest prevalence among the educational groups, with minimal fluctuation over time.

• Complete Higher Education: The frequency remained stable, suggesting that individuals with higher education may have better access to early diagnosis and treatment.

• Unknown/Blank: Fluctuations throughout the years suggest possible gaps in data collection.

**Observed patterns**

The highest concentration of cases among people with low levels of education (such as incomplete 1st to 4th grade and 5th to 8th grade) highlights the relationship between educational vulnerability and health. Groups with lower educational levels may face difficulties accessing information, early diagnosis, and proper treatment.

On the other hand, the high frequency of notifications among people with completed high school (405 cases) highlights that leprosy does not only affect those in extreme vulnerability. This may reflect social and behavioral factors, such as limited access to the public healthcare system, even among groups with higher education levels.

**Impact of the pandemic**

As in the general analysis, the COVID-19 pandemic significantly impacted the records. Between 2020 and 2021, all education categories showed a sharp decline, with partial recovery starting in 2022. This reinforces that the interruption of healthcare services hindered both the diagnosis and treatment of leprosy.

ANALYSIS OF LEPROUS CASES BY GENDER (2014-2023)

The distribution of leprosy cases in Goiânia between 2014 and 2023, collected from the DATASUS website, reveals that men were more frequently diagnosed than women throughout the period. This difference may indicate both behavioral and social factors, as well as access barriers that affect the two groups in distinct ways.

**Table 3 - Distribution of leprosy cases (female) by year of diagnosis, Goiânia municipality 2014-2023**

| Year of Diagnosis | Frequency |
|---|---|
| 2014 | 145 |
| 2015 | 128 |
| 2016 | 111 |
| 2017 | 101 |
| 2018 | 93 |
| 2019 | 95 |
| 2020 | 52 |
| 2021 | 60 |
| 2022 | 43 |
| 2023 | 51 |
| Total | 779 |

**Source: Brazil - Ministério da Saúde** [9]

**Table 4 - Distribution of leprosy cases (male) by year of diagnosis, Goiânia municipality 2014-2023**

| Year of Diagnosis | Frequency |
|---|---|
| 2013 | 2 |
| 2014 | 217 |
| 2015 | 194 |
| 2016 | 154 |
| 2017 | 174 |
| 2018 | 135 |
| 2019 | 127 |
| 2020 | 70 |
| 2021 | 89 |
| 2022 | 74 |
| 2023 | 75 |
| Total | 1.311 |

**Source: Brazil - Ministério da Saúde** [9]

The highest number of diagnosed cases in females occurred in 2014, with 145 cases, while the lowest number was in 2022, with 43 cases. The recovery was slower among women over the years, with numbers remaining below the levels observed at the beginning of the period.

The male sex had the highest number of diagnoses in 2014, with 217 cases, and the lowest number in 2020, with 70 cases. After the drop in cases in 2020, the numbers began to rise again in 2021 and 2022, but they did not return to pre-pandemic levels.

## Patterns and differences between sexes

The higher incidence of leprosy in men can be explained by a combination of factors. Men generally seek healthcare services less often, which may lead to delayed diagnoses and greater disease spread. Additionally, increased exposure to hazardous work or risky environmental conditions can increase their vulnerability to infection.

On the other hand, the lower prevalence among women does not indicate natural immunity but may reflect cultural and social factors, such as women's greater concern with preventive health. However, the impact of family and economic responsibilities can limit some women's access to appropriate treatment, contributing to the silent progression of the disease.

ANALYSIS OF LEPROSY CASES BY RACE (2014-2023)

The distribution of leprosy cases in Goiânia by race between 2014 and 2023, collected from the DATASUS website, reveals distinct patterns among the analyzed groups. The data indicates that, although socioeconomic factors and racial inequality may influence prevalence, the high concentration of cases among mixed-race individuals also reflects the large representation of this group in the population.

**Table 5 - Distribution of leprosy cases (by race) by year of diagnosis, municipality of Goiânia 2014-2023.**

| Year of Diagnosis | White | Black | Asian | Brown | Indigenous |
|---|---|---|---|---|---|
| 2014 | 114 | 36 | 1 | 205 | 1 |
| 2015 | 96 | 37 | 3 | 184 | 0 |
| 2016 | 96 | 29 | 0 | 134 | 0 |
| 2017 | 75 | 41 | 3 | 156 | 0 |
| 2018 | 70 | 22 | 4 | 130 | 1 |
| 2019 | 75 | 27 | 0 | 119 | 0 |
| 2020 | 40 | 9 | 0 | 69 | 1 |
| 2021 | 47 | 7 | 2 | 91 | 0 |
| 2022 | 41 | 9 | 0 | 66 | 0 |
| 2023 | 48 | 13 | 0 | 64 | 1 |
| Total | 702 | 230 | 13 | 1218 | 4 |

**Source: Brazil - Ministério da Saúde** [9]

The total number of diagnoses in brown people was 1,218 cases, which shows a dominant presence compared to the numbers of cases in other races, reflecting both social and demographic factors. The highest number of records in brown people was in 2014, with 205 cases, and the lowest was in 2023, with 64 diagnoses.

White individuals had a total of 702 diagnoses during the analyzed period, with the highest number of records in 2014 (114 cases) and the lowest number in 2020 (40 cases). These data show that leprosy is not limited to historically vulnerable groups but also affects populations with greater access to resources.

The total number of diagnoses in Black individuals was 230 cases, with the highest number of cases in 2017 (41 records) and the lowest number in 2020 (9 cases) and 2021 (7 cases). This group faces additional challenges due to structural inequalities that may hinder diagnosis and treatment.

The Asian ethnic group recorded a total of only 13 cases during the analyzed period, with

a sparse distribution over the years, and absences in several periods. This could indicate underreporting or limited access to healthcare services.

The Indigenous group had only 4 diagnosed cases, making it the group with the lowest incidence, showing a low frequency and irregular records over time.

The high concentration of cases among mixed-race individuals reflects both social vulnerabilities and the greater representation of this group in the population of Goiânia. This suggests that the higher prevalence of the disease among mixed-race individuals cannot be attributed exclusively to racial inequality. On the other hand, the significant number of cases among white individuals demonstrates that leprosy is not limited to marginalized groups, affecting various social segments. The authors suggest the same in a study conducted in the Southeast region of Brazil; according to the authors, about 45.3% of the population identifies as mixed-race, which partly justifies such a high percentage of cases in this population.[10]

Consistently, another study concludes that race, by itself, does not imply a lower risk or greater resistance to leprosy. Instead, underreporting and lack of access to healthcare services emerge as the main factors behind the observed differences.[11] Although the data show lower numbers of cases among Black, Asian, and Indigenous groups, this does not necessarily indicate a reduced risk but may reflect limitations in case reporting and access to proper healthcare.

ANALYSIS OF LEPROSY CASES BY AGE GROUP FROM 2014 TO 2023

The data on the distribution of leprosy cases by age group in Goiânia, from 2014 to 2023, collected from the DATASUS website, reveal significant patterns that reflect the differential vulnerability of each group over the years.

**Distribution of cases by age group**

• Under 1 year: No cases were recorded throughout the period, indicating that exposure to Mycobacterium leprae can be minimized in the first months of life, possibly due to intensive care and reduced social contact.

• 1 to 4 years: Only 2 cases were reported in 2015, suggesting low exposure in this age group. This may be related to the fact that young children have less interaction outside the family environment.

• 5 to 9 years: A total of 20 cases spread over the years, with a peak in 2014 (7 cases), shows sporadic occurrences. This distribution highlights the importance of educational and control programs to prevent early exposure.

• 10 to 14 years: With 31 cases, this age group shows greater vulnerability compared to younger groups. The gradual increase in cases over the years suggests that early adolescence may be a period of higher risk due to increased social interactions and community activities.

• 15 to 19 years: The occurrence of 59 cases reflects that this phase of adolescence is a critical period, with a peak in 2016 (12 cases). Exposure in school and community environments may explain this trend.

• 20 to 29 years: This age group recorded a significant number of cases, with a higher concentration in the pre-pandemic years. High mobility and greater social integration in this group suggest increased vulnerability to infection.

• 30 to 39 years: The progressive decrease in cases over the years, from 75 in 2014 to 10 in

2023, suggests that young adults may have benefited from improvements in diagnostic and prevention programs.

• 40 to 49 years: The 451 cases recorded indicate one of the most affected age groups. Occupational factors and working conditions may explain this high prevalence, especially before the pandemic.

• 50 to 59 years: This group had the highest incidence, with 479 cases throughout the period. The significant presence of cases may be related to comorbidities and difficulty accessing early diagnosis.

• 60 to 69 years: The prevalence in the elderly (351 cases) underscores the need for continuous monitoring, as chronic conditions and limited access to healthcare services negatively impact detection and treatment.

• 70 to 79 years: With 191 cases, this age group shows that leprosy remains a challenge even in advanced ages, highlighting the importance of health policies targeting the elderly.

• 80 years or more: Although fewer in number (58 cases), records in this age group highlight the need for continuous monitoring, especially considering the impact of the pandemic on access to healthcare services.

## Observed Patterns

The analysis reveals that leprosy affects different age groups, but it is more prevalent among adults aged 30 to 59 years, highlighting the vulnerability of this population. The higher incidence in adults suggests that factors such as occupation and lifestyle increase the risk of exposure. In contrast, children and adolescents, although less affected, require attention to ensure early diagnosis and prevent transmission.

**Table 6 – Prevalence Rate of Leprosy in Goiânia, from 2014 to 2023, per 100,000 inhabitants.**

| Year | Estimated Population | Leprosy Cases | Prevalence Rate/100,000 |
|---|---|---|---|
| 2014 | 1,412,364 | 362 | 25.63 |
| 2015 | 1,430,697 | 322 | 22.51 |
| 2016 | 1,446,366 | 265 | 18.32 |
| 2017 | 1,466,105 | 275 | 18.76 |
| 2018 | 1,485,505 | 228 | 15.35 |
| 2019 | 1,503,752 | 222 | 14.76 |
| 2020 | 1,516,113 | 122 | 8.05 |
| 2021 | 1,425,131 | 149 | 10.46 |
| 2022 | 1,437,366 | 117 | 8.14 |
| 2023 | 1,445,932 | 126 | 8.71 |

**Source: IBGE - Brazilian Institute of Geography and Statistics** [12]

Table 6 shows a consistent reduction in the leprosy prevalence rate over the years, dropping from 25.63 per 100,000 inhabitants in 2014 to 8.71 per 100,000 in 2023. This decline may indicate improvements in disease control and prevention, reflecting the efforts of public

policies and awareness campaigns.

However, a significant impact from the COVID-19 pandemic is observed in 2020 and 2021, periods in which the prevalence rate showed more pronounced declines. This can be attributed to a reduction in the search for medical care and disruptions in healthcare services, hindering early diagnosis and treatment of leprosy. Starting in 2022, the rate shows a slight recovery, suggesting a gradual resumption of surveillance and diagnostic activities.

The slight fluctuation in the population between 2021 and 2023 may be related to COVID-19 mortality and internal migration, impacting population estimates and, consequently, the calculation of prevalence. Despite these fluctuations, the continuity of surveillance efforts is essential to ensure early detection and prevent underreporting of the disease.

## CONCLUSION

The study highlights a higher incidence among individuals with low education, emphasizing how educational vulnerability is linked to public health. Limited access to information and healthcare services hinders early diagnosis and effective treatment. However, the high frequency of cases in individuals with a complete high school education reinforces that leprosy is not restricted to the most vulnerable groups, also affecting other social strata.

Leprosy had a higher prevalence among men (59.8%), which can be explained by factors such as lower healthcare-seeking behavior and greater exposure to unhealthy working conditions. Although women were affected less frequently, they were still significantly impacted, suggesting the need for specific strategies for both sexes.

The high concentration of cases among mixed-race individuals (55.7%) reflects not only social vulnerabilities but also the demographic representativeness of this group in Goiânia. Leprosy also affects white and black groups, indicating that the disease is not restricted to specific races or socioeconomic conditions. The low frequency of cases among Asians and Indigenous people suggests potential gaps in reporting and access to diagnosis.

The pandemic had a significant effect on the decline in notifications, especially in 2020 and 2021, hindering the continuity of diagnosis and treatment. Starting in 2022, there was a gradual recovery in numbers, but they are still far from the levels seen before the pandemic. This underscores the need for resilience in surveillance systems to ensure that neglected diseases, such as leprosy, are not neglected during times of crisis.

Leprosy in Goiânia between 2014 and 2023 presented a complex scenario involving educational, demographic, and social aspects. Although factors such as social and racial inequality are relevant, the analysis shows that the prevalence of the disease cannot be explained by a single isolated factor. The interaction between living conditions, access to healthcare, education, and social behavior must be considered to develop effective public policies.

## FINAL CONSIDERATIONS

The analysis of leprosy cases in Goiânia between 2014 and 2023 reveals consistent patterns of inequality and socioeconomic impact, reflected in the distribution by education, sex, and race. The data show that although factors such as social inequality influence the prevalence of the disease, a more comprehensive approach is essential to understand the dynamics involved.

It is essential that leprosy prevention and control strategies are comprehensive and targeted, taking into account the specific characteristics of each affected group. Promoting equity in access to diagnosis and treatment, as well as strengthening epidemiological surveillance, are key to reducing the incidence of the disease and mitigating its long-term impacts.

In addition, continuous investment in educational campaigns is necessary to reduce the social stigma associated with the disease and encourage active pursuit of early diagnosis. Partnerships between the public and private sectors can also help expand the reach of control policies and strengthen healthcare actions in areas of greater vulnerability. The implementation of public policies that ensure comprehensive patient care, from diagnosis to social reintegration, is essential to reduce the impact of leprosy on the lives of affected individuals.

Policies that combat structural inequalities are essential to address the root causes of vulnerability to leprosy. Investments in education, healthcare, and social inclusion can not only reduce the incidence of the disease but also improve the quality of life of the most affected populations, consolidating a fairer and more effective healthcare system.

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