

Scientific Electronic Archives

Issue ID: Sci. Elec. Arch. Vol. 16 (10)

October 2023

DOI: <http://dx.doi.org/10.36560/161020231790>

Article link: <https://sea.ufr.edu.br/SEA/article/view/1790>



Comparison of epidemiological profile of leprosy from 2010 to 2020 in the city of Alfenas, state of Minas Gerais, with Brazil

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Abstract. Introduction: Leprosy is an infectious disease caused by *Mycobacterium leprae*, a mycobacterium that affects skin cells and peripheral nerves and, when not treated properly, can cause skin lesions with loss of local sensitivity. Its study is still of great importance, as it is a stigmatizing disease, with impacts on public health in emerging countries such as Brazil, and prevalent cities such as the Alfenas city in Minas Gerais. **Objective:** To compare the epidemiological profile of patients affected by leprosy from 2010 to 2020 in Alfenas city, state of Minas Gerais, with Brazil. **Method:** This is a transversal and descriptive study with collected data for the period of 2010 to 2020 available in the DATASUS system. **Result:** The observed profile was characterized by men, aged over 15 years, incomplete Elementary School I and multibacillary type of the disease, however there was divergence in relation to the race/color of individuals affected by leprosy comparing the national scope with the municipal scope of Alfenas. This difference in data is due to the socioeconomic development process in the city of Alfenas since its population composition is similar to that of west Paulista by virtue of the coffee labor in the colonial period. The statistical analysis indicated a varied prevalence coefficients for Brazil and Alfenas, and a dependence between both variables, although relatively weak. **Conclusion:** With the high prevalence of leprosy cases and its consequences, such as skin lesions, it is of great importance to understand this disease, as well as its epidemiological patterns.

Keywords: Leprosy, Epidemiology, Health promotion.

Introduction

Considered one of the oldest diseases of humanity, leprosy is a chronic infectious infirmity

caused by *Mycobacterium leprae*, an obligate intracellular mycobacterium with low pathogenicity and high infectivity. When inside the organism, this

microorganism shows a predilection for skin cells and peripheral nerves, since its growth rate is higher at temperatures below 30°C (Romão; Mazzoni, 2013). This illness development is slow, taking an average of 11 to 16 days for the bacillus to spread, and its evolution is variable, whereas it depends on the immune response of the host against the microorganism (Velooso et al., 2018). This specific immunity is the cause responsible for the expression of Leprosy most different clinical forms. The bacillus is transmitted through inter-human contact, with the upper airways being the main entry point and, also, the elimination route of the pathogen (Romão; Mazzoni, 2013).

The diagnosis of leprosy consists of identifying decreased sensitivity in skin lesions, and the presence of *M. leprae* in histological analyses. According to the Madrid classification, it is possible to define two leprosy unstable groups (Indeterminate and Dimorphous), also considered Paucibacillary (PB) when they present five skin injuries or less, and two stable poles (Tuberculoid and Virchowian), which correspond to Multibacillary forms (MB) when there are six or more skin lesions (Souza, 1997). Dermatological and neurological wounds can cause disability conditions, compromising body functioning and limiting daily activities, as the disease advances. In addition, infected individuals are still targets of social stigma due to their appearance, which can trigger psychological disorders (Oliveira et al., 2021).

Although its incidence has reduced in several countries, owing to the global strategy to fight Leprosy launched by the World Health Organization (WHO), this malady is still considered endemic in some nations nowadays. India, Brazil and Indonesia are part, respectively, of the territories with the highest numbers of registered cases of the disease, corresponding to 74% of Leprosy notifications in the world in 2020, according to the 2022 Brazilian Epidemiological Bulletin (Brasil, 2021). The reason for such geographical distribution is still uncertain, however, it is believed to be related, mainly at the national level, to natural factors such as climate, relief and ecosystems, and social factors too, highlighting the unfavorable living conditions, the expansion of agricultural frontiers, the disinformation, and the migratory movements that have occurred in recent decades. Due to the historical character of regional inequalities related to the urbanization process and economic development, Brazil also presents an irregular distribution of Hansen's disease in its territory (Magalhães; Rojas, 2007). This, added to the natural factor, allows some municipalities to have higher leprosy detection rates than other cities, as occurs, in agreement with the 2022 Epidemiological Bulletin, in the Midwest, North and Northeast regions (Brasil, 2022).

Alfenas is a city located in the southern region of Minas Gerais, it has an estimated population of 80,973 inhabitants in 2021. The town has an economy based on agriculture, with emphasis on coffee cultivation and the industrial sector. Alfenas also has two universities, which provides a

renewable and fluctuating flow of people over the years. The choice of this location as the study object is relevant because, despite being located in a region with a low prevalence of cases, this city deviates from the standard, by detecting, in 2019, 11 new cases of leprosy, a fair number of notifications within 2010 to 2020 (Brasil, 2021).

As several aspects of the infirmity, including its epidemiology, remain ambiguous in general, and there is a need for extensive research to better understand it (Sarode et al., 2020), this study aims to draw an epidemiological profile of Alfenas, comparing it with the national leprosy parameter, thus seeking to improve knowledge of the clinical entity's profile. This will help to properly direct health professionals so that they can have even more support to guide the general population and provide them with a better quality of life.

Methods

This is a cross-sectional and descriptive study. The data from DATASUS between 2010 and 2020 were analyzed, and the selected period is due to the beginning of the implementation of the Integrated Plan of Strategic Actions, which was structured from the Pan American Health Organization of 2009 (OPA) (Brasil, 2012).

Collect data

The study population was considered to be all live births with a positive diagnosis for leprosy of both sexes between zero and fourteen years old and fifteen years old or more, notified in Alfenas city, totaling 61 cases. The age division was established based on the DATASUS data system on the TABNET platform. The same database was also used to collect the absolute number of individuals affected by leprosy in Brazil.

All data were tabulated and analyzed by a spreadsheet software program, that is, a spreadsheet editor. The selected variables were number of cases, education, age group, clinical form, notified city, race and sex of the patients, which were categorized according to the clinical and sociodemographic axes, and classified numerically and categorically. The data were analyzed descriptively, obtaining frequencies and percentages for categorized variables. Ethical aspects followed the Resolution of the National Health Council number 510/2016, since these are the public data available on the Internet, without the need for an statement from the research ethics committee.

Statistical analysis

The prevalence coefficients of leprosy cases in Brazil and in Alfenas represent the relation of new and old cases of the target population in a specific period. Thus, the ratio between the number of cases of Hansen's disease presented in the years 2010 to 2020 and the current national and municipal population was calculated, multiplying the values obtained in each year by 10^4 inhabitants. This statistical measure was used in detriment of other

parameters on account of the long duration or chronicity of the evaluated period, thus being able to indicate the exposure risk for susceptible individuals.

Through Pearson's correlation coefficient (r), it is possible to measure the degree of linear association between the prevalence coefficients obtained and evaluate them on an absolute scale that varies within the interval $[-1, + 1]$ (Filho; Júnior, 2009). This dimensionless measure was chosen because it measures the intensity and direction of the relationships between the prevalence coefficients in Alfenas and in Brazil, and thus evaluates whether the variables are dependent.

Result and Discussion

In the analyzed period, the number of cases reported in Brazil was 398,600, while in Alfenas city it was 61 cases, which corresponds to approximately 0.015% of the total number of cases. In the country, 2010 was the year with the highest number of notifications, with 42,509 cases, while in Alfenas, the year with the highest number of cases was 2019. On the other hand, the years with the lowest registered numbers were in 2020, with 21,981 cases in Brazil, and in 2014, with 2 cases in Alfenas (Table 1).

Regarding the sex variable, both in Brazil and in Alfenas, there was a predominance of males as the most affected by leprosy.

With respect to the education variable, Brazil has higher rates of people with incomplete Elementary School I (1st to 4th grades), totalizing 85,247 records. In Alfenas, the highest indicators were those of people with Incomplete Elementary School and Complete 4th grade of Elementary School, with 12 cases each.

Concerning race/color, Brazil has the highest number of brown individuals affected, 276,646 (69.4%), which differs from that found in Alfenas. This town presents white individuals as the main group, 42 cases (68.8%). The lowest numbers are found in the yellow race (3,860, 1%, in Brazil and 1.1.6%, in Alfenas) and Indigenous (1,698, 0.4%, in Brazil), being noted that the municipality of Alfenas does not present these last cases in the population.

In terms of age group, it is observed that most patients are 15 years old or older, both in Brazil (373,935, 93.8%) and in Alfenas (59, 96.7%).

As for the clinical presentation, in Brazil as well as in Alfenas, the Dimorphous form is the most prevalent, 178,190 (44.7%) and 49 (80.3%) cases, respectively. The Indeterminate form has a lower occurrence, with 54,578 (13.7%) cases in Brazil and no records in Alfenas.

The prevalence of cases of Hansen's disease in Brazil in 2020 was 1,034/10,000 inhabitants, the lowest rate recorded in the study's time series (Figure 1). The prevalence coefficient ranged between 1.034 and 2.172/10,000 inhabitants, with the years 2010 and 2011 having the highest coefficient and all periods analyzed being classified as medium (from 1.0 to 4.999/10,000 inhabitants).

In Alfenas, the year 2014 registered the lowest rate in the time series of the study, with

0.128/10,000 inhabitants and the highest coefficient was in 2019 (1.375/10,000 inhabitants), despite the national and municipal trend of decreasing prevalence. The cases classification varied from low (from 0 to 0.999/10,000 inhabitants) to medium (from 1.0 to 4.999/10,000 inhabitants).

From the data in Figure 1, it was possible to perform a statistical correlation between Alfenas city and Brazil, based on their prevalence coefficients. By calculating the Pearson correlation coefficient function, a value of 0.306 was obtained, which demonstrates that there is a weak positive correlation ($0.1 \leq |r| < 0.5$) between these prevalence coefficients.

Over the years, the elimination of leprosy has been challenging, as evidenced in this study and in the current literature. Various factors contribute to the difficulty in eradicating this illness, like the lack of access information, stigmatization, and low treatment adherence (Barbosa et al., 2014; Ribeiro; Lana, 2015).

The highest leprosy occurrence rate in Alfenas was in 2019, which may correspond to a greater active search for cases in that year and the implementation of campaigns and tests for early diagnosis. In Brazil, the highest number of cases were concentrated in the years of 2010, 2011 and 2012 (DATASUS), which was due to the Integrated Plan of Strategic Actions implementation, ensured in 2009 by the Pan American Health Organization (OPA). On the other hand, the lowest number of notified cases in the country and in the town were detected in 2020, which supports the reflection of the COVID-19 pandemic that started that year, which might have influenced the search for health care by virtue of the implemented social isolation measures (Batista et al., 2022).

Regarding the sex variable, the number of cases both in Brazil and in Alfenas is in line with the data from the 2020 Ministry of Health Epidemiological Bulletin, which points to a higher prevalence of males among leprosy notifications. Such statistics may be related to lifestyle and sociocultural factors (Brasil, 2020; Moreira et al., 2009).

Analyzing the found data, a higher prevalence of cases was detected among individuals with incomplete 1st to 4th grade of Elementary School nationwide. Low education makes it difficult to understand the epidemiological factors associated with the disease and, consequently, can increase potential transmitters and create an overload on the health system (Lages et al., 2019). In the city under analysis, the largest number of found cases were citizens with incomplete 1st to 4th grade and with complete 4th grade of Elementary School, thus remaining in consonance with the findings in Brazil. Additionally, there was also a high number of individuals in Alfenas who were ignored or left the education variable blank, which indicates failures in disease notification and difficulties in leprosy care (Ribeiro et al., 2018).

Table 1. Number of leprosy cases in Brazil and in Alfenas-MG in the period from 2010 to 2020 according to sex, education, race/color, age group, and clinical presentation.

Sociodemographic Data		Brazil	Alfenas
Variables	Category	N (%)	N (%)
Reporting year	2010	42509 (10,7)	8 (13,1)
	2011	41392 (10,4)	8 (13,1)
	2012	40650 (10,2)	6 (9,8)
	2013	38093 (9,5)	4 (6,6)
	2014	38422 (9,6)	1 (1,6)
	2015	35913 (9,0)	3 (4,9)
	2016	32216 (8,0)	5 (8,2)
	2017	34636 (8,7)	5 (8,2)
	2018	36765 (9,2)	6 (9,8)
	2019	36023 (9,0)	11 (18,0)
	2020	21981 (5,5)	4 (6,6)
		398600 (100)	61 (100)
Sex	Masculine	226277 (56,8)	37 (61,0)
	Feminine	172295 (43,2)	24 (39,0)
	Ign./White	28 (0,0)	0
		398600 (100)	61 (100)
Age group	≤ 14 years	24653 (6,2)	2 (3,3)
	≥ 15 years	373935 (93,8)	59 (96,7)
	Ign./White	12 (0,0)	0
		398600 (100)	61 (100)
Race/color	Black and Brown	276646 (69,4)	16 (26,2)
	White	100115 (25,1)	42 (68,8)
	Ign./White	16281 (4,1)	2 (3,3)
	Yellow	3860 (1,0)	1 (1,6)
	Indigenous	1698 (0,4)	0
		398600 (100)	61 (100)
Education	1st to 4th incomplete grade of elementary school	85247 (21,4)	12 (19,7)
	Ign/White	71880 (18,0)	13 (21,3)
	5th to 8th incomplete grade of elementary school	60005 (15,1)	6 (9,3)
	Incomplete high school	46055 (11,6)	8 (13,1)
	Illiterate	37365 (9,4)	3 (4,9)
	4th complete grade of elementary school	31269 (7,8)	12 (19,7)
	Incomplete high school	24342 (6,1)	3 (4,9)
	Complete elementary school	23373 (5,9)	1 (1,6)
	Complete higher education	10843 (2,7)	1 (1,6)
	Incomplete higher education	5219 (1,3)	2 (3,3)
	Not applicable	2975 (0,7)	0
		398600 (100)	61 (100)
Clinical presentation	Dimorphous	178190 (44,7)	49 (80,3)
	Virchowian	71646 (17,9)	8 (13,1)
	Tuberculoïd	58677 (14,7)	3 (4,9)
	Indeterminate	54678 (13,7)	0
	Unclassified	22138 (5,6)	0
	Ign./White	13371 (3,4)	1 (1,6)
		398600 (100)	61 (100)

¹ Source: DATASUS 2010 – 2020. Subtitle – Ign.: Ignored.

The incidents related to race/color in Brazil are an indirect demonstration of the country's ethnic-racial profile, since a greater number of cases were observed among self-declared black and brown individuals, remaining in concord with data from the last demographic census, which demonstrate a largest national population of blacks and browns people (IBGE). Alfenas, on the contrary, follows the ethnic-racial profile of the Southeast region which, in agreement with the 2022 Epidemiological Bulletin (Brasil, 2022), has mostly a self-declared white population (41.9%), and, thus, follows the tendency

to present a higher number of leprosy cases amidst these individuals (IBGE). This was the only analyzed variable in which the municipal data differed from the national findings, which could be explained by the fact that the Southeast region, especially the states of São Paulo and the south of Minas Gerais, has a high immigration rate, because of the greater job opportunities or the search for higher education, and having a colonial socioeconomic past (Saes; Castilho, 2013). With an economy supported by agriculture, especially coffee cultivation, Alfenas presents, just like the West Paulista, a coffee trade

legacy, mainly related to the ethnic-racial profile that was formed due to the labor force used for this activity. Initially, this workforce was made up of black African slaves, but with the abolitionist laws of the late 19th century, there was a transition of this manpower, passing, over the years, to be composed mostly of

Italians, who were encouraged by the local coffee growers to migrate to Alfenas and neighboring cities, following the ideals of São Paulo progress, that is, the concept of whitening the population (Castilho, 2011).

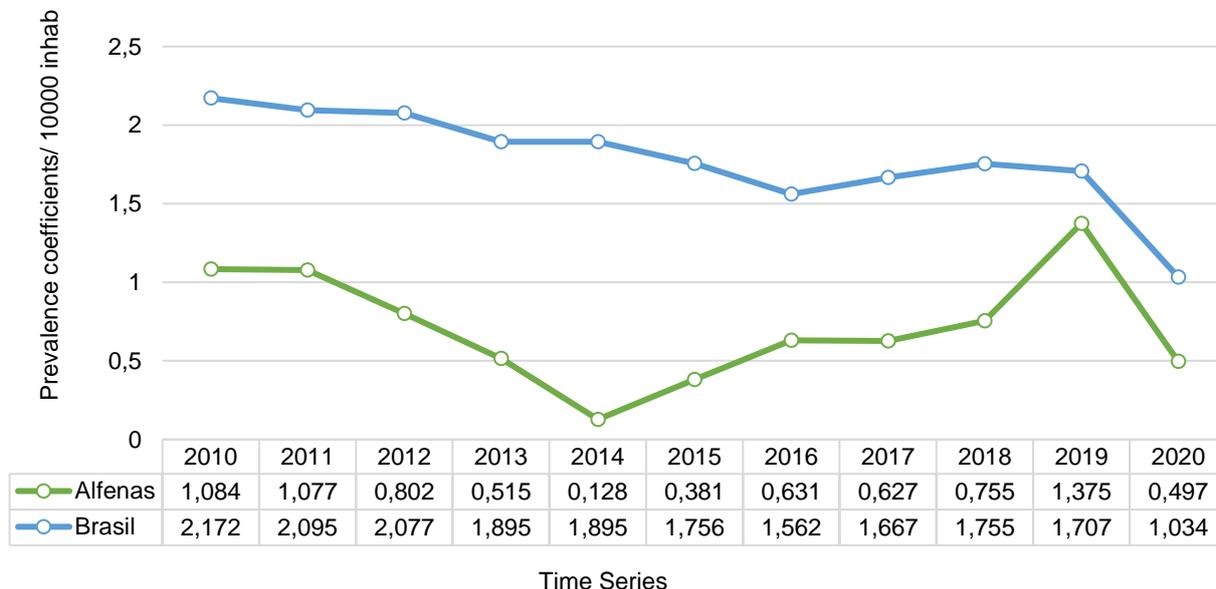


Figure 1. Hansen's disease prevalence coefficients in Brazil and Alfenas, 2010 to 2020¹.

¹ Classification of the leprosy prevalence coefficient in Brazil and in Alfenas: low, 0 to 0.999/10,000 inhabitants; medium, 1.0 to 4.999/10,000 inhabitants; high, 5.0 to 9.999/10,000 inhabitants; very high, 10.0 to 19.999/10000 inhabitants; and hyperendemic, above 20.0/10,000 inhabitants (Ribeiro et al., 2018).

Most Hansen's disease patients in Brazil, including Alfenas, were over 15 years old, as this is an economically active age group, a period in which individuals have greater interpersonal contact, increasing the *Mycobacterium leprae* dissemination (Moreira et al., 2009). The age group category of <15 years old is a relevant data, as the diagnosis of the disease in patients younger than this age indicates an early exposure to the microorganism and the possibility of generating more severe consequences. In addition, it points to the endemic profile of the disease in the region (Moreira et al., 2009).

As for the clinical forms, there was a higher prevalence of the Dimorphic form both in Brazil and in Alfenas, followed by the Virchowian form, which is in agreement with the consulted literature (Cunha et al., 2017). The appearance of the dimorphic form is justified by the longer incubation time of the bacillus, which can take about 10 years or more (Brasil, 2017). In contrast, the Virchowian form is the most contagious, since the production of some antigens by the mycobacterium allows its evasion from the immune system, thus facilitating the microorganism dissemination (Araújo, 2003). The high percentage of these forms can also be explained by the hypothesis that there is an elevate rate of late diagnosis, thus increasing the number of potential transmitters

(Romão; Mazzoni, 2013). The Health Ministry recommends a five-year follow-up or more for individuals with the multibacillary forms (Dimorphic and Virchowian), due to this long incubation period and, consequently, their higher risk of illness. Surveillance, however, should also extend to the paucibacillary forms (Tuberculoid and Indeterminate), but for a shorter period, such as two years, as the contamination risk by these forms is low (Cunha et al., 2017).

The prevalence coefficient of a disease indicates the number of present cases (both old and new) of that disease in a given community at a specific time. Prevalence, despite not being a risk measure, is useful for planning healthcare resources (Soares; Andrade, Campos, 2001). In Brazil, leprosy cases have been decreasing since elimination goals were established (Ribeiro; Silva; Oliveira, 2018), and, as can be seen in Figure 1, the prevalence coefficients have been lessening every year. This result can be explained by the increase in public policies adopted to eradicate this illness and by the commitment of the Health Ministry to identify Hansen's disease cases through compulsory notification in health systems (Ribeiro; Silva; Oliveira, 2018). Nevertheless, the rates still required attention, since in the years of 2010 to 2020, Brazil had a

prevalence coefficient classified as medium (from 1.0 to 4.999/10,000 inhabitants), meaning that even though leprosy cases tended to decline, the rates still have a significant number of affected individuals. This reaffirms the importance of continuing and reinforcing the goals for detection, control, and elimination of the infirmity. In Alfenas, the prevalence rate varied between medium (from 1.0 to 4.999/10,000 inhabitants) and low (from 0 to 0.999/10,000 inhabitants), so, despite the small number of cases in certain periods, the city has a potential risk of elevating the number of infected people. This may be related to the epidemiological variations of infectious and contagious diseases, as well as the underreporting of leprosy cases in Alfenas, due, for example, to the presence of rural communities (IBGE), regions where the information and the access to healthcare services are scarcer.

It is possible to establish an association between Brazil and Alfenas city, based on similarities in the distribution of their prevalence coefficients. The Pearson correlation coefficient (r) is a statistical term that can evaluate such a relationship between variables. The value of r obtained in the calculation ($r = 0.306$) demonstrated a weak positive correlation ($0.1 \leq |r| < 0.5$) between the prevalence coefficients (Filho; Júnior, 2009). This means that the association between the prevalence coefficients in Brazil and Alfenas are statistically dependent, although the relationship being relatively weak.

It is important to note that this study has some limitations, such as the dependence on updating the official databases of the Health Ministry. Therefore, some measurement errors may occur, such as the underestimation of national and municipal data, as well as the measure of the prevalence coefficient being affected by cases that emigrate and immigrate (Soares; Andrade, Campos, 2001). In addition, failures in reporting and late diagnosis interfere with the leprosy elimination. Finally, another hindrance is the underreporting cases in 2020, owing to the COVID-19 pandemic (Ribeiro; Silva; Oliveira, 2018), which made it difficult to maintain the supply of services and specialized care.

Conclusion

Leprosy configures a public health problem in the territory, affecting not only the physical integrity of the individual, but also their social life, being observed, in the national territory, a great limitation regarding the access to information and the notification of this disease.

With a relevant prevalence of cases and its subsequent consequences, such as dermatological lesions, it is of immense importance to understand this infirmity, as well as its epidemiological patterns. Therefore, the comparison carried out in this study seeks to contribute identifying the most susceptible groups to the illness, the most prevalent presentation forms, and the possible causes and consequences of the Hansen's disease in Brazil and in Alfenas.

The data obtained between Brazil and Alfenas city are practically aligned, following the same epidemiological trend. There was, however, a single discordant variable in this comparison: race/color. Black and brown individuals are the most affected by leprosy in Brazil, and, although they also represent a considerable number of cases in Alfenas, the city has a greater number of white people with the infirmity. This divergence occurs due to the higher prevalence of white individuals in this region, in line with the local historical and socioeconomic development of Alfenas.

Thus, this subject is considered an important topic to be studied, also noting the relevance of health education for the prevention and for the correct treatment of Hansen's disease.

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