

# Brazilian notifications of Hansen's disease diagnosis: an ecological study (2014-2023)

Bruno Santos Landim <sup>a</sup>,

<sup>a</sup> Universidade Federal Do Vale Do São Francisco, Petrolina, Pernambuco, Brasil, bs6506289@gmail.com

**Abstract.** Hansen's disease (HD), or leprosy, is a sickness state caused by *Mycobacterium leprae*, consisting in a pathogeny that primary attacks directly the skin, causing eruptions, and the peripheral nerves, which if not treated can lead to cases of disabilities, and even death. This study is an ecological study aimed to help the evaluation of the epidemiologic scenario of the disease in Brazil, and raise hypothesis of the data which are provided by Sistema Nacional de Agravos de Notificação (SINAN) at the platform DATASUS, which is directed by the Brazilian Health Ministry, and is a part of the Sistema Único de Saúde (SUS), the country health system, referencing the period of 2014 to 2023, evaluating parameters like gender, age, living city, race, and the multibacillary or paucibacillary infection. A total of 317,944 diagnoses are reported in the period, with a downgrade pattern, but with an upside trend since the COVID-19 pandemic. A higher incidence in males, with a male-to-female ratio of 1.3:1, higher proportions in people with 40 to 59 years old (22.8/100.000 inhabitants) and with 60 or more years old (23.4/100.000 inhabitants). Higher proportions of cases in people that are part of yellow (2.36/100.000 inhabitants), mixed race (1.35/100.000 inhabitants) and black (1.28/100.000 inhabitants) ethnic groups. Also noting that 6 of 9 northeastern capitals are present in the top 20 of cities with most notifications, and 2 of 3 cities with most incidence in the top 20 are part of the state of Mato Grosso. In terms of bacillary pattern, the research found a rising trend of multibacillary, in face over paucibacillary infections, from a 2.26 multibacillary/paucibacillary proportion in 2014 to a 5.4 proportion in 2023. The HD is still a concern in the local and global scenario, with a higher proportion of multibacillary cases being a challenge to the health management and for World Health Organization objectives to combat HD.

**Keywords.** Hansen's Disease, Leprosy, Correlational study, Health Information Systems.

## 1.

## 2. Introduction

Hansen's disease (HD), earlier called leprosy, is classified by the World Health Organization (WHO) as a neglected tropical disease, a criteria which englobes many diseases which hits countries under development and are mainly prevalent among impoverished communities in tropical areas [1].

WHO also estimates that disease affected 184.000 people in 2020, and the main characteristic of this sickness is skin eruptions and damage to nerves, face and skin, if the disease isn't treated, could lead to disabilities and death [1]. In Brazilian territory the disease was introduced with the colonization process, and nowadays HD is a public health concern which led to many politics to help to enhance the disease control, like compulsory notification, and registration of the data involved in the epidemiologic case [2]. With that information, national and local strategies are running to follow the WHO meta to reach zero cases of HD, with Brazil having 75,03% cities of the countries with reported cases of the disease in the period between 2015 to

2019, the initiatives to hit this target need to be assertive, and understand the epidemiological panorama is essential to guarantee the precision and follow the progress of the disease control [3]. The present study is an ecological study created to be a part of the monitoring of this global concern in Brazil, the country who has the second most number of notifications of the disease in the world, and was realized with datas provided by platforms of brazilian health ministry who are free to access, and will correlate social factors like gender, residence city, age, race, and also check the bacillary pattern (multibacillary or paucibacillary) to help to understand how they are related with the ending of being diagnosed with hansen's disease, and the challenges to control the endemic scenario.

## 3. Methods

This research is an ecological study between the Brazil territory at the period between 2014 to 2023 about the diagnosis of Hansen's disease. At an ecological study, or correlation study, the studied factor wasn't the individuals, but the group of

persons. So, the present study will analyze and compare the results only of the groups to try to achieve new discussions about the scenario and their key roles.

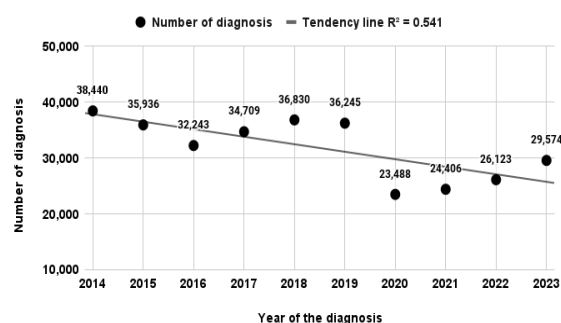
The study analyzed the possible association of factors, like gender, age, race, living city, and paucibacillary or multibacillary pattern, with the year of the diagnosis, to check if these factors contributes or not for the studied ending, who in this case is being diagnosed with HD, and also check the pattern of transmissibility of the disease (paucibacillary or multibacillary). With that in mind, for the realization of this study, it is important that the information who are endeeped by this study was freely available to be checked. With that, the database of this paper was provided by Sistema de Informação de Agravos de Notificação (Sinan)/Ministério da saúde, who is the brazilian government system who registers the notifications of many diseases, like HD, tuberculosis, etc. These datas are available on the Departamento de Informática do Sistema Único de Saúde (Datasus) (<https://datasus.saude.gov.br/informacoes-de-saude-tabnet/>), and was also used the populational datas provided by Instituto Brasileiro de Geografia e Estatística (IBGE), who realizes the brazilian population census. The statistical analysis and data treatment was realized with the help of Google Sheets and Microsoft Excel.

All numbers contained in this study were collected on 28 of September of 2024, which could have slim changes if they were checked after that day, predominantly the data of the years 2021,2022 and 2023, which could be reviewed by the system at any time.

#### 4. Results

A total of 317,944 diagnosis of Hansen's disease were reported in brazil between 2014 and 2023, this period pattern of cases shows a descendant of the number of reported cases, which could be helped by the COVID-19 pandemic, social distancing procedures and the difficulties on the tracking of the disease by the organs, it could've be manifested in the upside of the notifications from 2020 to 2023, as could be viewed in the GRAPH present on the figure 1. This scenario is manifested in a tendency line which shows the tendency of a downgrade of reports, but has a  $R^2$  number far from 1.0 ( $R^2=0,541$ ), which is a situation that shows an inconsistent tendency pattern on the period.

**Figure 2** - Number of Diagnosis per year of HD



There was a higher number of male than female individuals committed by HD, as shown in the table1, manifested in a male-to-female ratio of 1.3:1 in the studied period. The disease also has a correlation with the age, as reported in the incidence of people with 60 or over being 23.4/100,000 inhabitants at the period, whilst in people between 20 to 39 years old reporting an incidence of 13.7/100,000 inhabitants.

**Tab. 1** - Total cases, gender and age of the diganoses

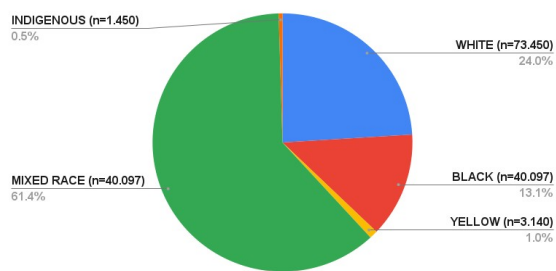
Characteristics	N	%	Average anual incidence (per 100,000 inhabitants)
<b>Total of diagnosed cases (2014-2023)<sup>a</sup></b>	317,994	-	15.7/100,000
<b>Gender<sup>a b</sup></b>			
Male	181,038	56.9	18.4/100,000
Female	136,993	43.1	13.1/100,000
<b>Age<sup>a b</sup></b>			
<9 years old	5,730	1.8	2.2/100,000
10 to 19	24,759	7.8	8.8/100,000
20 to 39	85,694	27.0	13.7/100,000
40 to 59	122,896	38.6	22.8/100,000
60 or more	78,906	24.8	23.4/100,000

<sup>a</sup> The ratio per 100,000 inhabitants is calculated considering the population of 2022

<sup>b</sup> Totals could diverge because of existing cases where the gender or age are not related.

Another characteristic of the reports is the large number of reports coming from mixed race people, representing 61.4% of the diagnosis, as shown on FIGURE 2 even if the population of this group is related as being around 45.3% by IBGE [4].

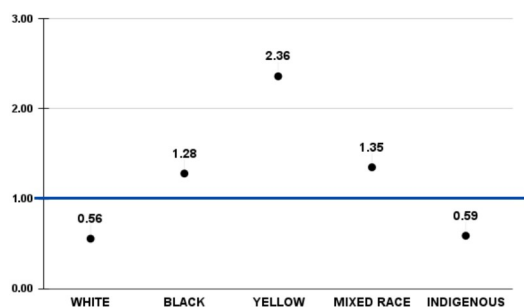
**Figure. 2** - Ethnical distribution of HD diagnosis



<sup>a</sup> The term "yellow" is designated to people who consider themselves as part of an asian origin.

After exploring these results, the research opted to normalize the ethnic groups reports per the population who are part of the group, like is shown on Figure 3 setting 1.0 as the reference to an equal incidence than the general population, the results shows lower incidence of the disease in people who belongs to the "white" or "indigenous" ethnic group. And a greater incidence in people who is a part of the "black", "yellow or "mixed race" ethnical groups.

**Fig. 3** - Ethnical groups compared with population proportion.



Another characteristic returned by the study is that in the cases where the education grade was informed, 10.57% of the people are part of the illiterate people of Brazil. This group represents close to 5.4% of the Brazilian population.

The study also reported a pattern of forming endemic regions, observed in the fact that 20 cities represents 24.2% of the reports and numbers which reach even 565 cases per 100,000 inhabitants, during the period, in the city of Juina at the state of Mato grosso, as could be check in the table 2. Other situations visible in these cities are the numbers on Cuiaba, Petrolina, Várzea Grande and Juína, which are showing tendencies of uprise numbers even if compared to the pre-covid-19 numbers, were the general scenario was a downgrade or stationery, except per Juína.

**Tab. 1** - top 20 cities in HD reports

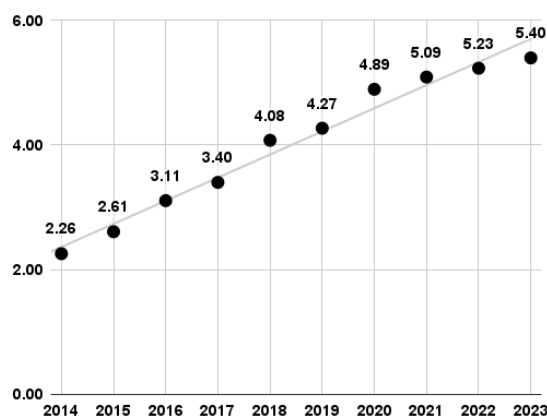
City	State Region	HD diagnoses (2014-2023)	Average anual Incidence (per 100,000 inhabitants)
São Luís	MA NE	7,449	72/100,000
Fortaleza	CE NE	7,330	30/100,000
Recife	PE NE	6,076	41/100,000
Palmas	TO N	5,213	172/100,000
Cuiabá	MT CO	4,825	74/100,000
Sinop	MT CO	4,379	223/100,000
Teresina	PI NE	4,180	48/100,000
Salvador	BA NE	4,120	17/100,000
Rio de Janeiro	RJ SE	4,021	6/100,000
Marituba	PA N	3,862	345/100,000
Petrolina	PE NE	3,330	86/100,000
Várzea Grande	MT CO	3,099	103/100,000
Brasília	DF CO	2,926	10/100,000
Goiânia	GO CO	2,781	19/100,000
Juína	MT CO	2,595	565/100,000
João Pessoa	PB NE	2,297	28/100,000
Belém	PA N	2,207	17/100,000
Manaus	AM N	2,199	11/100,000
Jaboatão dos Guararapes	PE NE	2,038	32/100,000
São Paulo	SP SE	2,030	2/100,000

São Luís	MA	NE	7,449	72/100,000
Fortaleza	CE	NE	7,330	30/100,000
Recife	PE	NE	6,076	41/100,000
Palmas	TO	N	5,213	172/100,000
Cuiabá	MT	CO	4,825	74/100,000
Sinop	MT	CO	4,379	223/100,000
Teresina	PI	NE	4,180	48/100,000
Salvador	BA	NE	4,120	17/100,000
Rio de Janeiro	RJ	SE	4,021	6/100,000
Marituba	PA	N	3,862	345/100,000
Petrolina	PE	NE	3,330	86/100,000
Várzea Grande	MT	CO	3,099	103/100,000
Brasília	DF	CO	2,926	10/100,000
Goiânia	GO	CO	2,781	19/100,000
Juína	MT	CO	2,595	565/100,000
João Pessoa	PB	NE	2,297	28/100,000
Belém	PA	N	2,207	17/100,000
Manaus	AM	N	2,199	11/100,000
Jaboatão dos Guararapes	PE	NE	2,038	32/100,000
São Paulo	SP	SE	2,030	2/100,000

<sup>a</sup> The ratio per 100,000 inhabitants is calculated considering the population of 2022

Another event visible in the study is the tendency of an uprise of multibacillary disease and a downgrade of paucibacillary reports, which could be verified in the Figure 4, with an  $R^2$  of 0.974 for the tendency line.

**Figure. 4** - Multibacillary or Paucibacillary proportion per year



## 5. Discussions

The study analyzed characteristics, the temporal trend and the spatial distribution of Hansen's disease cases and indicators in Brazil in a period of 10 years. These reports shows a higher proportion of males, aged over 40 years old and are mixed race, black or yellow people. The research also found, visualizing the 20 cities with more diagnoses, higher incidence rates at the endemic regions of Juína, Marituba, Fortaleza, Sinop, Palmas, Várzea Grande and Petrolina. With a highlight at the state of Mato Grosso, which presented 4 of 20 cities in the ranking, and the evidence that 6 of 9 northeastern capitals are present in the ranking. Complemented by a temporal trend of a predominance of multibacillary infections over paucibacillary infections.

Even with a downgrade visualized in the general scenario of the 20 cities with most HD diagnoses. It's important to consider that the analyzed period also englobed the COVID-19 Pandemic, which as characteristics who influence the study had the difficulty to track HD because of the social distancing, and also maked people already diagnosed face difficulties to have access to the treatment, possibly leading to a difficulty to cure the sickness[5]. With the data observed in this study, having an uprise trend since 2020, Brazil didn't look to be as part of WHO meta to have 120 countries relating zero HD cases [1]. And also have traced his own metas to control the disease until the year 2030 [3].

The gender ratio and detection rate also shows a higher number of males, a part which could be associated with behavioral and cultural factors, also reinforced by relates of greater occurrence of physical disabilities, higher treatment abandonment rate, which could reflect in the lower cure rate and higher mortality [6] [7].

When we start to evaluate the distribution of the disease, many factors could influence in transmissibility of diseases, like climate, economical activity, and even genetic factors could lead to different responses of HD [8]. With the current uprise of multibacillary, and the downrise of paucibacillary cases directing us to a scenario in which the transmissibility of the disease would be higher because of the presence of more pathogens in the related patients.

Another parameter to analyze is the brazilian epidemiologic panorama is the late diagnosis, which could occur in reason of difficulties caused by the symptoms of the disease, that could contributes to polyneuropathy caused by HD, generating loss of muscle contraction capacity and skin lesions, resulting, in the scenario that shows higher incidence at the economically active age, economical losses, which could be even make impossibility to work, especially at the illiterate people, which showed elevated proportions of HD, and are the most fragile economical group in Brazil [9].

Potential limitations of our study are observed in matters of the data analyzed, obtained from secondary sources, which may contain inaccuracies due to inadequate fillings on the platforms, and the notification scheme. Also, an ecological study could not be interpreted as a definition of the individual level, being restricted to be material for raising hypotheses for other different type of studies.

In other aspects, this study enables an understanding of some parameters of the epidemiological Hansen's disease scenario of Brazil, be useful as a support to trace new strategies of research, and even actions to help in the control of the disease. Also permits an observation of some reflections of the COVID-19 pandemic in the overall registers.

## 6. Conclusions

Hansen's disease is still a challenge in Brazil, and the mixed scenario, with cities still experiencing a rise in cases after the pandemics, is a real concern to the public health management, which directs to a situation that not only epidemiological and health strategies can help to end the disease. Starting a necessity to reinforce the investment of the social parameters that have influence in the disease, like social structure, food security, and education, to enhance the dignity, earlier diagnoses, well management of the treatment who is already preconized by WHO and the possibility to achieve the control of this disease that exists over 4,000 years.

## 7. Acknowledgments

8. Institute of Czech-Brazilian Academic Cooperation (INCBAC) and Universidade Federal do Vale do São Francisco (UNIVASF).

## 9. References

[1] Ending the neglect to attain the Sustainable Development Goals: A road map for neglected tropical diseases 2021-2030. Genève (Suisse): World Health Organization, D1; 2021.

[2] Brazil. Ministério da Saúde 2010. [https://bvsms.saude.gov.br/bvs/saudelegis/gm/2010/prt3125\\_07\\_10\\_2010.html](https://bvsms.saude.gov.br/bvs/saudelegis/gm/2010/prt3125_07_10_2010.html).

[3] Brazil. MINISTÉRIO DA SAÚDE Estratégia Nacional para Enfrentamento à Hanseníase. 2024.

**10.** [4] Instituto Brasileiro de Geografia e Estatística. Censo 2022: IBGE; 2022.

**11.** [5] Mahato S, Bhattarai S, Singh R. Inequities towards leprosy-affected people: A challenge during COVID-19 pandemic. *PLOS Neglected Tropical Diseases* 2020;14:e0008537. <https://doi.org/10.1371/journal.pntd.0008537>.

**12.** [6] Amorim De Souza E, Boigny R, Oliveira H, Leide M, De Oliveira D-R, Heukelbach J, et al. endências e padrões espaço-temporais da mortalidade relacionada à hanseníase no Estado da Bahia, Nordeste do Brasil, 1999-2014. *Cadernos Saúde Coletiva* 2018;26(2).

<https://doi.org/10.1590/1414-462X201800020255>.

[7] Martins-Melo FR, Ramos AN, Alencar CH, Heukelbach J. Trends and spatial patterns of mortality related to neglected tropical diseases in Brazil. *Parasite Epidemiology and Control* 2016;1:56–65. <https://doi.org/10.1016/j.parepi.2016.03.002>.

[8] Aquino JS, Ambrosio-Albuquerque EP, Alves HV, Macedo LC, Visentainer L, Sell AM, et al. *IL8* and *IL17A* polymorphisms associated with multibacillary leprosy and reaction type 1 in a mixed population from southern Brazil. *Annals of Human Genetics* 2018;83:110–4. <https://doi.org/10.1111/ahg.12291>.

[9] Instituto de Pesquisa Econômica Aplicada. N° 70 Evolução do analfabetismo e do analfabetismo funcional no Brasil. 2004.

**13.**