ORIGINAL ARTICLE

Epidemiological profile of leptospirosis in Minas Gerais State, Brazil 2012-2022
Perfil epidemiológico da leptospirose em Minas Gerais, 2012-2022
Perfil epidemiológico de la leptospirosis en el estado de *Minas Gerais, Brasil 2012-2022*

Letícia Lima da Silva[1] ORCID 0000-0001-7401-6097
Fernanda Carvalho Camargos Vieira[1] ORCID 0000-0001-8880-0640
Karina Raasch Jacobsen[2] ORCID 0009-0000-4697-1003
Leonardo Augusto Ferraz[1] ORCID 0009-0007-6773-3056
Nathany Martello Eich[1] ORCID 0000-0002-0290-7939
Yanca Cristina Parreira[3] ORCID 0009-0007-8042-5031
Guilherme de Andrade Ruela[4] ORCID 0000-0001-6976-8710

[1]Universidade Nove de Julho, São Bernardo do Campo, São Paulo, Brasil.
[2]Universitário do Espírito Santo, Colatina, Espírito Santo, Brasil.
[3]Centro De Ensino Superior De Palmas (CESUP), Palmas, Tocantins, Brasil.
[4]Universidade Federal de Juiz de Fora (UFJF), Governador Valadares, Minas Gerais, Brasil.

Endereço: Av. Dom Jaime de Barros Câmara, 90 - Planalto, São Bernardo do Campo, São Paulo, 09895-400.
E-mail: ticia.limasilva2@gmail.com

ABSTRACT

Background and Objectives: Leptospirosis is an infectious disease caused by the bacterium *Leptospira spp*. and its epidemiology is not well known in Minas Gerais State, which makes its prevention and control more difficult. The objective of this study is to outline the epidemiological profile of leptospirosis in the State of Minas Gerais from 2012 to 2022. **Methods:** An ecological epidemiological study was carried out by collecting data from the Information System for Notifiable Diseases, the secondary database was made available by the Department of Informatics of the Unified Health System. Data regarding the disease cases notified in the selected place and period were collected and descriptive statistical analyses were carried out based on sociodemographic and clinico-epidemiological variables. **Results:** 1,728 cases of leptospirosis were reported. The highest number of notifications was in 2020 and the lowest in 2015. There is a higher occurrence of the disease in the white population (46.30%), in males (81.66%) and in the age group 40 to 59 years (38.77 %). As for education, the highest number of registered cases was ignored/blank, with 814 (47.11%). Observing the evolution of the disease, from 2012 to 2022, the aggravation of leptospirosis leading to death occurred in 9.29% of the cases. Cure was the most frequent outcome: 1,415 discharges in that decade (81.89%). **Conclusion:** Based on the results obtained, we concluded that there is a predominance of male patients, white, aged between 40 and 59 years, in relation to education, the largest number of registered cases was ignored/blank and more than 80% of the cases notified resulted in the recovery of the patient's health.

Keywords: *Leptospirosis. Epidemiology. Public health.*

RESUMO

Justificativa e Objetivos: A leptospirose, doença infecciosa causada pela bactéria *Leptospira spp.*, tem a epidemiologia pouco conhecida em Minas Gerais, o que dificulta sua prevenção e controle. O objetivo deste estudo é traçar o perfil epidemiológico da leptospirose no estado de Minas Gerais no período de 2012 a 2022. **Métodos:** Estudo epidemiológico ecológico, realizado pela coleta de dados no Sistema de Informações de Agravos de Notificações, disponibilizado pelo banco de dados secundários do Departamento de Informática do Sistema Único de Saúde. Foram coletados dados referentes aos casos da doença notificados no local e período selecionados e realizadas análises estatísticas descritivas a partir das variáveis sociodemográficas e clínico-epidemiológicas. **Resultados:** Foram notificados 1.728 casos de leptospirose. O maior número de notificações foi em 2020 e menor em 2015. Há maior ocorrência da doença na população branca (46,30%), no sexo masculino (81,66%) e na faixa etária de 40 a 59 anos (38,77%). Observando a evolução da doença, nota-se que, de 2012 a 2022, foram registrados óbitos pelo agravo da leptospirose em 9,29% dos casos. A cura se manteve com maior ocorrência: 1,415 altas nessa década (81,89%). **Conclusão:** Com base nos resultados obtidos conclui-se que há predomínio de pacientes do sexo masculino, raça branca, faixa etária entre 40 e 59 anos e mais de 80% dos casos notificados resultaram na recuperação do quadro de saúde do paciente.

Descritores: *Leptospirose. Epidemiologia. Saúde pública.*

RESUMEN

Justificación y Objetivos: La leptospirosis, una enfermedad infecciosa causada por la bacteria *Leptospira spp.*, tiene su epidemiología poco conocida en el estado de Minas Gerais, lo que dificulta su prevención y control. El objetivo de este estudio es delinear el perfil epidemiológico de la leptospirosis en el estado de Minas Gerais del 2012 al 2022. **Métodos:** Estudio epidemiológico ecológico, realizado a partir de la recolección de datos del Sistema de Información de Enfermedades de Declaración Obligatoria, disponibles en la base de datos secundaria. del Departamento de Informática del Sistema Único de Salud. Se recolectaron datos sobre los casos de la enfermedad notificados en el lugar y período seleccionado y se realizaron análisis estadísticos descriptivos con base en variables sociodemográficas y clínico-epidemiológicas. **Resultados:** Se reportaron 1.728 casos de leptospirosis. El mayor número de notificaciones fue en el 2020 y el menor en el 2015. Hay una mayor ocurrencia de la enfermedad en la población blanca (46,30 %), en el sexo masculino (81,66 %) y en el grupo de edad de 40 a 59 años (38,77 %). En cuanto a la educación, el mayor número de casos registrados fue ignorado/blanco, con 814 (47,11%). Al observar la evolución de la enfermedad, se destaca que, de 2012 a 2022, se registraron 9,29% de muertes por agravamiento de la leptospirosis. La cura quedó con la mayor ocurrencia: 1.415 altas en esa década (81,89%). **Conclusión:** Con base en los resultados obtenidos se concluye que existe predominio de pacientes masculinos, blancos, con edades entre 40 y 59 años, con relación a la escolaridad, el mayor número de casos registrados fue ignorado/blanco y más del 80% de los casos notificados resultó en la recuperación de la salud del paciente.

Palabras Clave: *Leptospirosis. Epidemiología. Salud pública.*

INTRODUCTION

Leptospirosis is an infectious disease caused by *Leptospira spp*. It occurs all over the world, however, it is more common in tropical and subtropical areas.[1] Usually it is transmitted by the urine of infected animals, such as rats, dogs, cattle, and other rodents, which contaminate the water, soil or foods.[2]

Brazil is the country with the highest number of cases in Latin America.[2] Leptospirosis is an important public health problem in Brazil because it finds in the country a favorable environment for its spread, due to geographical factors as well as the population characteristics, in urban and rural areas, and it presents a high epidemic potential.[3] For this reason, leptospirosis is a mandatory notification disease in Brazil since the year 2000 and the surveillance is carried out in the whole country by the Ministry of Health.[2]

But, despite its mandatory notification, the disease is still neglected. It mainly affects vulnerable populations such as rural and urban workers, people living in slums, people who do not have full access to drinking water and basic sanitation. On top of that, there are those cases that occur because of the high volumes of rain during the rainy season, which floods the urban centers and contributes to the transmission of the bacteria.[4]

Low-resource populations in tropical regions, especially in low and middle-income countries, present the highest burden of diseases.[5] Globally, it is estimated that leptospirosis is responsible for 1.03 million cases and 58,900 deaths yearly. In the Americas region, it is estimated that 10,000 cases occur every year, the majority (95%) occurring in Latin America, and Brazil accounts for 40% of the cases notified.[2]

Clinical manifestations of leptospirosis can vary from mild to severe, depending on the inoculum, serovar or strain, as well as the age and the health condition of the individual.[6] The initial symptoms of the disease such as fever, muscle aches and pain, and headache may be unspecific and similar to other diseases. In more severe cases, leptospirosis may cause jaundice, kidney or liver failure, in addition to pulmonary and neurological complications.[7]

Early diagnosis is important to prevent severe complications and even death. The diagnosis is based on laboratory tests such as blood tests for the detection of antibodies against *Leptospira spp*., and blood or urine cultures for the identification of the bacteria.[3] Leptospirosis treatment entails the use of antibiotics and other types of support care such as hydration and symptoms control. In severe cases, hospital admission may be necessary.[6]

Despite of the several studies on leptospirosis in Brazil, yet there are gaps about the disease epidemiology focusing specifically determined locations of the country, namely Minas Gerais State, and its behavior over the years. Understanding the dynamics of the disease makes it possible to implement public policies for prevention and control that take into account factors

such as population characteristics and socioeconomic conditions from the location, the presence of host animals, and the disease behavior, with the objective of developing effective strategies against leptospirosis.[8]

Therefore, the aim of the present study is to analyze the epidemiological profile of leptospirosis in Minas Gerais State, from 2012 to 2022.

METHODS

This is an ecological epidemiological study. Data from notified cases of leptospirosis in the State of Minas Gerais, in the period between January 2012 and December 2022, were collected. The State comprises an area of 586,13,983 km² and the population is estimated to be 21,411,923 inhabitants.[9]

Information about the epidemiological profile of patients was obtained from the Information System for Notifiable Diseases (SINAN), made available by the Ministry of Health. Data was obtained from the notification files filled out by the local health service and stored in the software TABNET, a public domain system, made available by the Department of Informatics of the Unified Health System (DATASUS), which was accessed on the 27th of March, 2023.

After data collection, the following variables were analyzed: sociodemographic (sex, race, age group and schooling), and clinico-epidemiological (notification number and the evolving of the disease). Following, descriptive stratified statistical analyses with a quantitative approach were carried out and presented as proportions and variables frequencies, using the software Microsoft Excel Professional Plus 2021.

This study was conducted using secondary data sources from the Health Surveillance Board from Minas Gerais State, which are of public domain and the individual's identities were not displayed. Therefore, it is not required to be submitted to the Research Ethics Committee, according to the resolution nº 510/16 of the Brazilian National Health Council (2016).

RESULTS

In the period between 2012 and 2022, 1,728 cases of leptospirosis were registered in Minas Gerais State. The highest number of cases occurred in 2020, 228 cases, and the lowest number of cases occurred in 2015, 115 cases. From 2012 to 2020 a trend of increase in the cases was observed. After the peak, there was a decrease in the years 2021 and 2022 (figure 1).
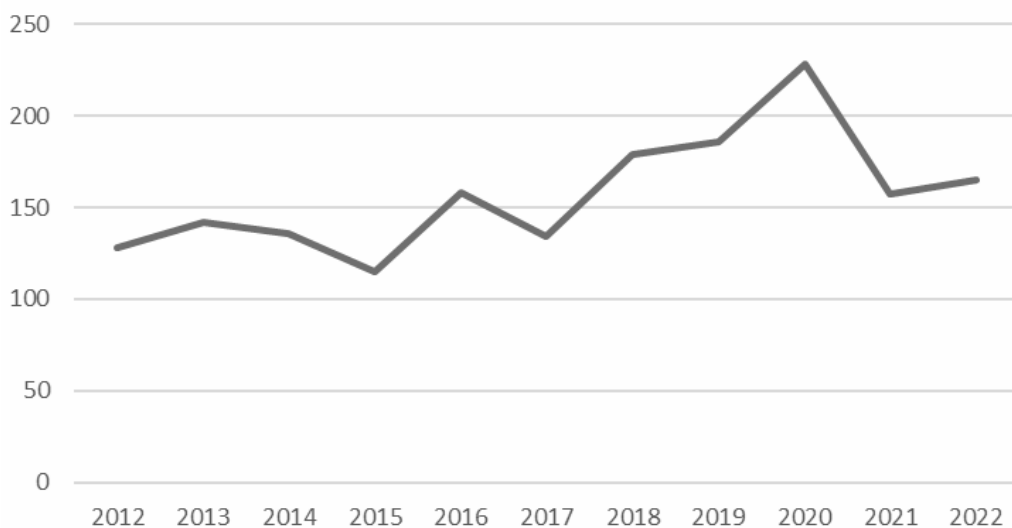
Figure 1 - Cases confirmed in the Information System for Notifiable Diseases (SINAN) in Minas Gerais State, 2012-2022 (n= 1,728).
Source: Ministry of Health/Sanitary Surveillance Secretariat - Information System for Notifiable Diseases - Sinan Net.

The racial profile of the cases notified presented white people as the most affected group, with 800 cases (46.3%). The most frequent occurrence of leptospirosis was among male patients, 1,411 (81.66%) cases, and when we assessed the patients diagnosed with the disease by age group, 40 to 59 years of age was the most frequent group with 670 (38.77%) patients. As for the evolving of the disease, in the majority of the cases, 1,415 (81.89%), the outcome was cure (table 1).

Table 1 – Sociodemographic and clinical characteristics of the confirmed cases of leptospirosis in Minas Gerais State, 2012-2022 (n=1,728)
Source: Ministry of Health/Sanitary Surveillance Secretariat - Information System for Notifiable Diseases - Sinan Net.

Characteristics	N=1,728	%
Race/Skin color		
Ignored/Blank	163	9.43%
White	800	46.30%
Black	118	6.83%
Yellow/Asian	7	0.41%
Brown/mixed	638	36.92%
Indigenous	2	0.12%
Sex		
Male	1,411	81.66%

Female	317	18.34%
Age group		
Ignored/blank	1	0.06%
<1 year	4	0.23%
01-4	1	0.06%
05-9	19	1.10%
10-14	44	2.55%
15-19	92	5.32%
20-39	660	38.19%
40-59	670	38.77%
60-64	93	5.38%
65-69	70	4.05%
70-79	65	3.76%
80 e +	9	0.52%
Outcome		
Ignored/blank	128	7.41%
Cure	1,415	81.89%
Death caused by the disease notified	159	9.20%
Death by another cause	26	1.50%

DISCUSSION

From the analysis of DATASUS platform, we observed a total of 1,728 cases of leptospirosis notified between the years 2012 and 2022 in Minas Gerais State. In 2020 there was a peak of notifications, 228 cases of the disease, and in 2015 the lowest number of cases of leptospirosis for the period was notified (115 cases). It was observed that after the increase in the number cases that occurred up until the year 2020, there was a decrease in the period 2021-2022. It can be a result of the sub-notifications that occurred during the COVID-19 pandemic period, and from repeated infection of the most exposed population to the etiologic agent – people living in flooded areas, lack of basic sanitation and/or areas with garbage accumulation – which can acquire immunity to the disease due to milder presentation of the disease.[10]

Leptospirosis is considered a mimetic disease, in other words, this disease, in its milder form, is harder to diagnose because it is similar to other illnesses such as dengue fever, bacterial sepsis and malaria. The signs and symptoms of leptospirosis can vary from a limited and mild fever to many organs malfunction, which can cause death. Most of the cases do not evolve to any complications, only around 10% do. Weil's syndrome is an example of a complication of leptospirosis, which is characterized by acute renal damage, jaundice, and conjunctival suffusion. In addition to that, another common cause of death by this infection is pulmonary haemorrhage.[3]

Leptospirosis is a disease which major risk factor is related to floods and inundation, and because of that, in years with higher volumes of rainfall there is a higher occurrence of epidemic outbreaks of human leptospirosis. The State of Minas Gerais is characterized by these occurrences due to its geographic location.[11] In 2020, the high number of cases detected in the Southeastern region of Brazil can be justified by the intensification of the South Atlantic convergence zone with the sub-tropical cyclone Kurumí above the Atlantic ocean, which boosted the humidity in the whole region[12], demonstrating that there is a need for natural disasters monitoring and alert as a support to the public health management. The drop in the notifications in the years 2021 and 2022 can be explained by the COVID-19 pandemic and the mobilization to tackle it, which prioritized COVID-19 to the detriment of diseases with a lower incidence, such as leptospirosis. This factor impacted on the detection of the disease, caused sub-notification and worsened the clinical outcomes.[13]

Brazil has the highest number of leptospirosis cases among the Latin American countries.[14] That is due to the hot and humid climate of countries located in the tropical and sub-tropical regions, which fosters the survival of the bacteria, as well as the intense rainfall regime found, mainly in the Southeastern region, which favours the transmission of leptospirosis because it causes floods and inundation in the area.[15] For that reason, it is important to outline the epidemiological profile of the disease in the country, mainly in the regions where there are gaps in the tracking of the disease, basic infrastructure and neglect – namely Minas Gerais State – in order to implement public policies to prevent and fight the disease, once it is a highly prevalent disease related to climate, socioenvironmental and socioeconomic factors.[16]

As for the ethnic profile of the population from Minas Gerais State that was affected by the disease, 800 (46.3%) cases occurred in white people, followed by 638 (36.92%) cases that occurred in brown/mixed, 163 (9.43%) were ignored/blank, 118 (6.83%) in black people, 7 (0.40%) in yellow/Asian, and 2 (0.11%) cases in indigenous people.

Regarding gender, a higher number of cases was reported in male, 1,411 (81.66%) cases, whist 317 (18.34%) in females. For this parameter, there is no difference in the susceptibility to the disease, once infection can occur in both genders when they are exposed to the same infectious sources equally. However, men usually are more exposed due to the type of work performed such as work in areas with inundation, plantations and places with garbage accumulation, and consequently, present a higher risk of being affected by leptospirosis.[17]

With respect to the age group of patients diagnosed with leptospirosis, we observed that 4 (0.23%) cases reported were under one year of age, 20 (1.16%) were from 1 to 9 years old, 136 (7.87%) cases were from 10 to 19 years old, 660 (38.19%) from 20 to 39 years old, 670 (38.77%) from 40 to 59 years old, 228 (13.19%) from 60 to 79 years old, 9 (0,52%) cases were 80 or older, and ignored/blank 1 (0.06%). The highest number of cases occurred within the age group 40 to 59 years old, which shows that this age group is more likely to be exposed to the disease's risk factors, such as crowded and flooded spaces, than children and the elderly.[18]

As for schooling, in the majority of the cases, 814 (47.11%), the information was ignored/blank, followed by completed high school for 222 (12.85%) cases, and from 5th to incomplete 8th grade of elementary school for 164 (9.49%). The high number of missing information may be related to errors in the filling out of the patient's notification files or the sending of inadequate records in the system, making the information unavailable.[19] In addition, less schooling may contribute to a poor understanding of prevention methods and the adoption of unhealthy practices, such as the inadequate accumulation of materials that should be forwarded to recycling, and garbage.[20]

Regarding the evolving of leptospirosis illness, from 2012 to 2022, 159 (9.29%) deaths by the complications of the disease were registered, and 2016 was the year with the highest number of deaths. Cure was the most frequent outcome with 1,415 (81.89%) patients discharged during the decade. The low number of deaths when compared to the cure occurs due to the early and appropriate diagnosis of the disease in its early stages, slowing down its progression.[21] Furthermore, the appropriate treatment with penicillin G benzathine, ampicillin, and ceftriaxone is another factor that contributes to the high cure rates.[22]

Although the disease presents a low fatality rate due to the early diagnosis and correct treatment, it cause high costs to the public health sector with medication and hospital stays, mainly because it affects the lower income populations more frequently, once they are more exposed to precarious living conditions and sanitation.[23]

Thus, leptospirosis is an endemic infectious and contagious disease, mainly associated to the rainfall regimes, floods and inundation.[24] In addition to that, disease outbreaks are attached to social and living conditions, basic sanitation, rodent infestation, and floods.[25] In this perspective, transmission is boosted by socioenvironmental vulnerability, once the infection occurs by direct or indirect contact with the urine of contaminated animals and is facilitated by the hydric component.[26]

Thus, it is necessary to maintain the disease under control and to increase the effectiveness of early diagnoses, and for that, it is important to adopt preventive and health promotion measures in order to assure the decrease in the transmission and health loss.[27]

The present study outlined the epidemiological profile and mapped leptospirosis in the State of Minas Gerais, from 2012 to 2022, despite of the typical limitations of an ecological study, namely the availability and quality of data.

The study results pointed out that the resources used provided an epidemiological panorama of leptospirosis cases in the State of Minas Gerais, and they can be an useful tool for the healthcare professionals to rethink their practices and direct more investments in this area of knowledge, in addition to create an opportunity to public managers to plan preventive strategies specific to this population.

To delineate the epidemiological profile of leptospirosis cases in the State of Minas Gerais is very important because this is a region with favorable climate and sociogeographic conditions to the disease, also, it is a location where there are gaps in studies about the epidemiology of leptospirosis and its characterization over the years.

Hence, it is necessary to understand the disease dynamics, in order to make possible the implementation of public measures for its prevention and control, taking into account factors such as population characteristics and the socioeconomic conditions of the location, so that more effective strategies against leptospirosis can be developed.

In accordance to the study results, we concluded that among the leptospirosis cases in the State of Minas Gerais, from 2012 to 2022, there is a predominance of male patients, white, from 40 to 59 years old. In the period of the study, 1,728 cases of leptospirosis were notified, and more than 80% resulted in the full recovery of patient's health status.

As demonstrated above, the objective of the study was achieved by the use of quantitative analyses, making possible to follow the number of cases and sociodemographic and clinico-epidemiological variables, which may contribute to the development of public policies for the reduction and prevention of the disease, which requires strategies for health education together with the development of infrastructure.

We highlight that studies using public domain databases can minimize the costs and time, and at the same time constitute reliable sources for research and organization of public services and policies.

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Author's Contribution:

Fernanda Carvalho Camargos Vieira, Yanca Cristina Parreira e Karina Raasch Jacobsen contributed to the conception and design of the study and writing of the manuscript. **Letícia Lima da Silva, Nathany Martello Eich e Leonardo Augusto Ferraz** contributed to the conception of the study, data analysis and interpretation, and writing of the manuscript. **Guilherme de Andrade Ruela** contributed to the planning and design of the study, review and final approval of the manuscript.

All authors approved the final version of the manuscript to be published and are responsible foe all aspects of the study, including the assurance of its precision and integrity.