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Original Article

Leptospirosis incidence and associated factors in Chapecó, Santa Catarina, Brazil

Incidência de leptospirose e fatores associados no município de Chapecó, Santa Catarina, Brasil

Incidencia de leptospirosis y factores asociados en el municipio de Chapecó, Santa Catarina, Brasil

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ABSTRACT

Backgrounds and Objectives: The environmental conditions are directly related to the population's quality of life and health, which justifies the evaluation of factors associated with the occurrence of certain diseases. This study aimed to evaluate the incidence of confirmed cases of leptospirosis and associated factors in Chapecó-SC. **Method:** This is a cross-sectional descriptive exploratory study with data obtained from the individual reporting and investigation of records of the Notifiable Diseases Information System database, of the Epidemiological Surveillance Department of the Municipal Health Secretariat, related to all confirmed cases of leptospirosis for the period 2010-2015. **Results:** 24 positive cases were recorded in the period. Of these, 87.5% affected male individuals aged 12-59 years. 8.3% of individuals reported they had contact with floodwater or mud, and in the other cases, the probable contamination occurred in areas with signs of rodents (70.8%) or with the presence of these animals (41.6%), rivers, streams, ponds or dams (37.5%) and livestock breeding facilities (33.3%). The workplace was the main infection source (41.6%). There was no association between the number of leptospirosis cases and rainfall indexes. **Conclusion:** It stands out that the infections occurred mainly through occupational exposure, which emphasizes the importance of health services in continuing education and leptospirosis

prevention campaigns, mainly those aimed at the health of workers exposed to areas of risk.
KEYWORDS: Environment. Zoonotic diseases. Rodents. Health promotion.

RESUMO

Justificativa e Objetivos: As condições socioambientais estão diretamente relacionadas com a qualidade de vida e saúde da população, o que justifica a avaliação de fatores associados com a ocorrência de alguns agravos. O objetivo do estudo foi avaliar a incidência de casos confirmados de leptospirose e fatores associados no município de Chapecó/SC. **Métodos:** Estudo de caráter exploratório descritivo transversal, com dados obtidos nas fichas de notificação e investigação individual no banco de dados do Sistema de Informação de Agravos de Notificação, do departamento de Vigilância Epidemiológica da Secretaria Municipal de Saúde, referente a todos os casos confirmados de leptospirose no período de 2010 a 2015. **Resultados:** Foram registrados 24 casos positivos no período. Destes, 87,5% acometeram indivíduos do sexo masculino com faixa etária de 12 a 59 anos. 8,3% dos indivíduos relataram ter tido contato com água ou lama de enchente e, nos demais casos, a provável contaminação se deu em locais com sinais de roedores (70,8%), ou com a presença desses animais (41,6%), em rios, córregos, lagoas ou represas (37,5%) e criação de animais (33,3%). O principal ambiente de infecção foi o local de trabalho (41,6%). Não foi evidenciada a relação entre o número de casos de leptospirose e os índices pluviométricos. **Conclusão:** Destaca-se que as infecções ocorreram, principalmente, pela exposição ocupacional, o que remete à importância da atuação dos serviços de saúde na educação continuada e campanhas de prevenção à leptospirose, principalmente voltadas à saúde dos trabalhadores expostos a áreas de risco.
DESCRITORES: Meio ambiente. Zoonoses. Roedores. Promoção da saúde.

RESUMEN

Justificativa y Objetivos: las condiciones socio ambientales están directamente relacionadas con la calidad de vida y salud de la población, lo que justifica la evaluación de factores asociados con la ocurrencia de algunos agravios. El objetivo de ese studio fue evaluar la incidencia de casos confirmados de leptospirosis y factores asociados en el municipio de Chapecó/SC. **Métodos:** Estudio de carácter exploratorio descriptive trasversal, con datos del Sistema de Información y Agravios de Notificación, del departamento de Vigilancia Epidemiológica de la Secretaria Municipal de Salud referente a todos los casos confirmados de leptospirosis en el periodo de 2010 al 2015. **Resultados:** Fueron registrados 24 casos positivos en el período. De estos, 87,5% acometieron individuos del sexo masculino con faja etaria de 12 a 59 años. 8,3% de los individuos relataron haber tenido contacto con agua o lodo de inundaciones y, en los demás casos, la probable contaminación se dio en locales con señales de roedores (70,8%) o con la presencia de estos animales (41,6%), en ríos, arroyos, lagunas o represas (37,5%) y creación de animales (33,3%). El principal ambiente de infección fue el local de trabajo (41,6%). No fue evidenciada la relación entre el número de casos de leptospirosis y los índices pluviométricos. **Conclusión:** Se destaca que las infecciones ocurren, principalmente, por la exposición ocupacional, lo que remite a la importancia de actuación de los servicios de salud en la educación de trabajadores expuestos a las áreas de riesgo.
PALABRAS CLAVE: Medio ambiente. Zoonosis. Roedores. Promoción de la salud.

INTRODUCTION

Leptospirosis is a febrile infectious zoonosis, caused by the *Leptospira* bacteria, of which microorganism penetration occurs through damaged skin, whole skin immersed for long periods in contaminated water or through mucous membranes, having an average incubation period of 10 days.[1] The main reservoirs are the domestic or wild synanthropic rodents of the species *Rattus rattus* (Linnaeus, 1758), *Mus musculus* (Linnaeus, 1758) and *Rattus norvegicus* (Berkenhout, 1769), carriers of the serovar Icterohaemorrhagiae, one of the most pathogenic to humans.[2]

Among the most vulnerable individuals are people working in the areas of cleaning, sewer cleaning, construction, farmers and veterinarians who are exposed to the risk of occupational contamination, since these professions provide direct contact with *Leptospira*.[3]

In Brazil, leptospirosis is considered an endemic disease, with the first records being made between 1910 and 1940 and reports of several urban outbreaks in the 1960s.[4] During the rainy season, floods and poor sanitation constitute the main risk factors for the occurrence of leptospirosis.[5]

Leptospirosis can be considered a disease of social and economic importance due to its high incidence in certain areas, high hospital costs and loss of working days, as well as its lethality, which can reach up to 40% of the most severe cases.[2] Its geographical distribution is favored by the environmental conditions found in tropical and subtropical regions, where the high temperatures and periods of the year with high rainfall rates favor the emergence of seasonal epidemic outbreaks.[6] The greatest risk of contamination associated with flooding waters is due to population agglomeration, socioeconomic and sanitation conditions that are observed in metropolitan regions.[7]

Currently, there are records of the disease throughout the country, with a higher number of cases in the south and southeast regions. From the beginning of 2010 until December 31, 2015, 25,162 cases of leptospirosis were recorded in the country, of which 8,399 (33.4%) were identified in the southeast region and 7,643 (30.4%) in the southern region. The state of Santa Catarina had 2,790 (11.1%) cases in this period.[7] In this context, we evaluated the incidence of leptospirosis cases and associated factors in the municipality of Chapecó, state of Santa Catarina, occurring in the period from 2010 to 2015.

METHODS

The present investigation is characterized as a descriptive exploratory study, with data obtained from the Notifiable Disease Information System (SINAN), Department of Epidemiological Surveillance of the Health Secretariat of the municipality of Chapecó, related to all confirmed cases of leptospirosis occurring from 2010 to 2015.

The municipality of Chapecó is located in the western region of the state of Santa Catarina (27°05′47″ S, 52°37′05″ W), at approximately 600 km from the capital city of Florianópolis. It has an estimated population of 205,795 inhabitants, with 91.61% located in the urban area. The *per capita* Gross Domestic Product (GDP) is R$ 24,839.97.[8] The climate of the region is humid subtropical mesothermal superhumid type, with no defined dry season, with frequent frosts and regular distribution of rainfall.[9]

Individual notification and investigation forms were used, which are filled out by the municipal epidemiological surveillance service or health unit professionals and comprise the national SINAN database. The history of the confirmed cases according to the main risk situations to which the infected individuals were exposed in the thirty days prior to the first disease symptoms was assessed.

Data were stratified according to the variables: gender, age group, area of residence (urban or rural), risk situations and possible infection environment and occupation.

The study was approved by the Health Secretariat of the municipality, which authorized the use of the database and all ethical norms established in Resolution N. 466 of December 12, 2012 of the National Health Council were followed.

The monthly weather data related to the period of 2010 to 2015 (minimum temperature, mean temperature, maximum temperature, relative average humidity and total rainfall), obtained from the National Institute of Meteorology (INMET), were correlated with the monthly frequency of leptospirosis cases. Pearson's correlation test and PAST statistical software were used to perform the analysis.[10] Only correlations that showed statistical significance were maintained and cited ($p < 0.05$).

The association of leptospirosis cases with the months of the year and the correlation with the six evaluated years, according to the disease occurrence in the municipality, was verified using Principal Component Analysis (PCA). The PAST statistical program was used for the analysis.[10]

RESULTS

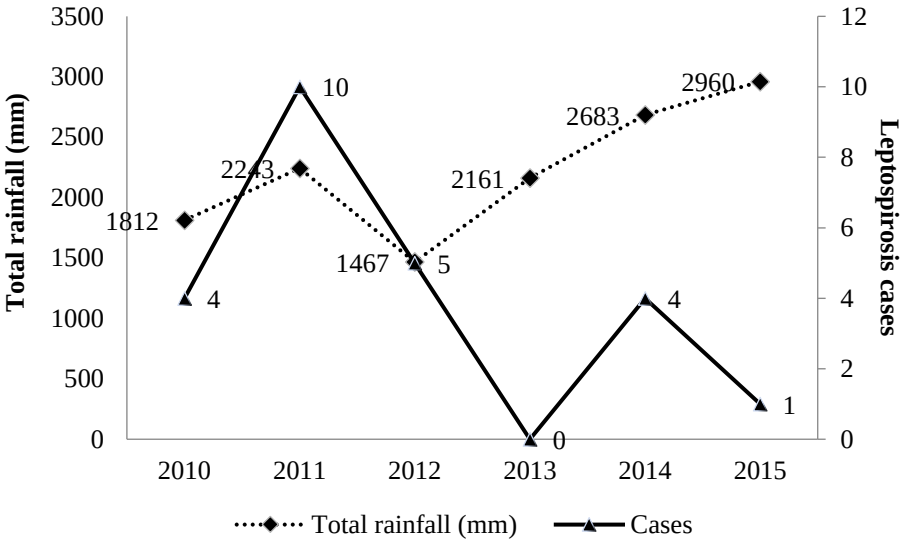
From January 1, 2010 to December 31, 2015, there were 24 positive cases of leptospirosis in the municipality of Chapecó. Of these cases, 83.3% were men aged 12 to 59 years. (Table 1). There were no records of deaths in the period.

Table 1 – Characterization of the confirmed cases of leptospirosis that occurred in the municipality of Chapecó-SC, from 2010 to 2015.

Variables	Cases	%
Gender		
Male	20	83.3
Female	4	16.6
Age range		
10 to 19	8	33.3
20 to 29	4	16.6
30 to 39	5	20.8
40 to 49	5	20.8
50 to 59	2	8.3
> 60	0	0
Area		
Urban	21	87.5
Rural	3	12.5

The year with the highest number of confirmed cases of leptospirosis was 2011 (n = 10, 41.6%). In 2012, five cases (20.8%) were recorded. In 2010 and 2014, four cases (16.6%) were confirmed and, in 2015, there was only one case (4.1%). In 2013 there was no record of the disease. The highest rainfall rates were recorded in 2014 (2683 mm) and 2015 (2,960 mm), whereas the lowest rates were recorded in 2012 (1467 mm) (Figure 1).

Figure 1 – Cases of leptospirosis and relative annual rainfall from 2010 to 2015, in Chapecó – SC.



The epidemiological risk to which individuals reported having been exposed in the 30 days prior to the first symptoms, as well as the possible infection environment that was especially characterized in the locations where the presence of rodents was identified, mainly associated to professional activities, are shown in Table 2.

Table2 – Frequency of leptospirosis cases, according to risk situation and occupation, occurred in the municipality of Chapecó-SC, from 2010 to 2015.

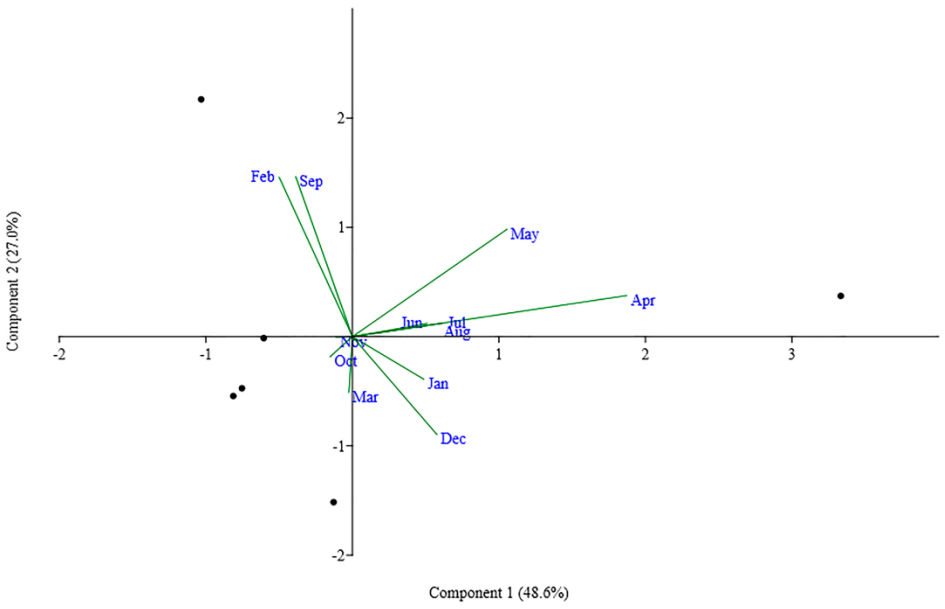
Risk situation	**N**	**%**
Place with signs of rodents	17	70.8
Presence of rodents	10	41.6
River, stream, pond or dam	9	37.5
Livestock breeding facilities	8	33.3
Vacant lots	4	16.6
Planting / harvest (crops)	4	16.6
Garbage / Rubble	4	16.6
Grain/food storage	2	8.3
Floodwater or mud	2	8.3
Place of Infection		
Work	10	41.6
Household	4	16.6
Leisure	4	16.6
Others	6	25
Occupation		
Student	5	20.8
Unemployed	2	8.3
Small farmer	2	8.3
Bricklayer	2	8.3
Not described	2	8.3
Inmate	1	4.1

Physician	1	4.1
Psychologist	1	4.1
Railroad and subway operators	1	4.1
Receptionist	1	4.1
Garbage collector	1	4.1
Re-stocker	1	4.1
Gardener	1	4.1
Electrician	1	4.1
Driver	1	4.1
Slaughterer or Butcher	1	4.1

None of the assessed climatic variables showed a significant correlation ($p < 0.05$) with the monthly reported number of cases of leptospirosis. Overall, 75.6% of the variation in the occurrence of leptospirosis cases as a function of the months of the year was explained by PCA. Case seasonality was observed during the assessed period.

There was an association between the occurrence of cases with the months of January, February, April, May, September and December. The occurrence of cases in the months of February and September was similar, as well as for April and May and for January and December (Figure 2). The occurrence and distribution of cases throughout the year were similar in the years of 2013, 2014 and 2015, whereas 2010, 2011 and 2012 differed from each other and the other analyzed years (Figure 2).

Figure 2 – Association through the Principal Component Analysis (PCA) of leptospirosis cases with the months of disease occurring in the municipality of Chapecó – SC from 2010 to 2015.



DISCUSSION

In the assessed period, 24 cases of leptospirosis were confirmed in the municipality of Chapecó, and most of the infected individuals were residents of the urban area. Considering that the state of Santa Catarina has an index of 3.92 cases of leptospirosis per 100.000 inhabitants and this index is 1.2 in Brazil, the rate of 1.17 found in Chapecó is similar to that of the national scenario, and lower than the one observed in the state.[7]

Of the leptospirosis cases assessed in Chapecó, two had a history of contact with floodwater or mud. However, both reported other concomitant activities during which they were submitted to risk situations such as cleaning of an abandoned house, working in iron frame construction and contact with weir water. The others had no contact with floodwater or mud.

In most of assessed cases, the contamination occurred in places with signs of rodents (feces) or with the presence of these animals, banks of rivers, streams, lagoons or dams, and livestock breeding facilities. The workplace, home and leisure activity places were identified as probable infection environments. Household chores can be considered as being associated with individual risk of infection.[11]

Livestock breeding represents an epidemiological risk and is likely to be the source of contamination at the workplace for the workers in this area, as the infection can occur from contact with diseased or *Leptospira* carrier animals, such as dairy cattle and swine herds.[12,13]

Of the notified cases in Brazil, approximately 28% are related to rural areas, where transmission occurs indirectly, usually associated with the work process of people dealing with grain production.[14] Thus, leptospirosis can be considered a leading zoonosis in human morbidity and mortality, especially in the population working with subsistence farming.[15] However, the Brazilian urban and periurban environments suffer from rodent infestation due to the disorderly process of urbanization, mainly close to brooks and streams. This has been the predominant factor for the incidence of cases of this disease.[16]

The identification of rodents in the work environment may be an important predictor of the presence/density of the wild reservoir of *Leptospira*. The work environment was indicated as predisposing factor for leptospirosis in workers of the environmental sanitation service in the city of Pelotas, state of Rio Grande do Sul, identified by a serum-epidemiological survey in which the prevalence of recorded

leptospirosis infection was 10.4%, being among the highest rates recorded in serological surveys carried out in Brazil.[17,18] Likewise, in the municipality of Garanhuns in the state of Pernambuco, the prevalence of anti-*Leptospira spp*. antibodies in occupational groups was 5.19%.[19]

In Chapecó, no association was found between the number of cases of leptospirosis and rainfall indices, and the appearance of the disease does not coincide with periods of increased rainfall and floods. These data coincide with a study carried out between January 1991 and April 1996, which disclosed that the number of requests for leptospirosis testing at the Public Health Central Laboratory of Santa Catarina (LACEN) decreased in 1992 and 1993, when there were no floods, but the rate of positive results was similar to that of years in which flooding occurred, and lethality was higher, since the diagnosis is made and disclosed at a later date or misdiagnosis occurred due to other diseases with similar signs and symptoms.[20]

Regarding this fact, it can be observed that the variation in the incidence of leptospirosis is determined not only by the rainfall index, but by a multiplicity of environmental and social factors, such as lack of basic sanitation and disordered urbanization, which requires skilled professionals and fast diagnosis, as well as responding to the demands that cause the infection.[21]

It was observed that the incidence of leptospirosis in Chapecó has a defined seasonality. The concentration of cases in the months of December, January and February coincides with the school vacation period, when students and other people living in urban areas visit and go camping in rural areas. These months are also characterized by higher temperatures, a condition that causes people to be more exposed to contamination by not wearing closed shoes during work activities, for instance.

The records of cases in September may be associated with rainfall, which is usually higher during this period, although no correlation was found with any of the tested climate variables for the overall occurrence of cases in the assessed period. The cases recorded in April and May might be associated to a greater number of rodents in the urban environment at this time of the year, a situation that has been reported by the Municipal Zoonosis Control Program of the municipality of Chapecó.

Leptospirosis affected mainly male individuals, living in the urban area and in the economically-active age group (70.8%), considering those over 18 years of age, associated with occupational exposure, since these individuals can perform activities that facilitate the contact with sources of infection. This study shows that the

predominant range of the active population in the labor market is the one that has the greatest contact with the *Leptospira* bacterium.

It has been demonstrated that the professional environment is relevant to the disease epidemiology, since it may represent an increased risk of contamination.[22] Professional categories associated with agriculture/farming, veterinary professionals, sanitation workers, among other professions, are more susceptible.[22] In Chapecó, *Leptospira* infections occurred mainly in environments with occupational-related exposure and, principally, in places with signs of the presence of rodents, near rivers, streams or dams, in livestock breeding facilities, vacant lots, crop fields and grain storage sites, garbage and rubble deposit sites.

Contamination cases caused by contact with floodwater or mud were less significant, showing no association with the occurrence of flash floods and floods, not even considering the higher rainfall indices that occurred in the period. Therefore, it is important and necessary to investigate the cases for timely surveillance and effective prevention and control of leptospirosis.[13] Among the prevention actions is the improvement of actions directed at workers' health, together with primary care, in order to detect early risks, establish timely treatment of those affected, and keep surveillance on alert during the periods of greatest exposure.[13]

The knowledge of the determinant causes of leptospirosis, as well as the most vulnerable areas and social groups, contributes to more equitable and effective public intervention policies.[23] In this context, knowledge of infection severity, geographical distribution, involved risk factors and circulating strains is important for the establishment of the regional leptospirosis epidemiology and improvement of preventive measures.[24] It is noteworthy that the work of Environmental Surveillance in environmental health education is of utmost importance as an instrument for zoonosis prevention actions.[25]

Finally, the identification of work environments and areas vulnerable to the occurrence of leptospirosis in the municipality of Chapecó, characterize a challenge for Environmental Surveillance and health teams working together with other sectors of public and private services, aiming to both monitor the control of the vectors and work with the instrumentalization and training of workers for disease prevention and the promotion of the population’s health, as well as the notification and investigation of the cases, thus minimizing the underreporting of the disease, which can be considered a limitation of this study .

The present study demonstrates the importance of health services in continuing education and campaigns to prevent leptospirosis, mainly aimed at the health of workers exposed to areas of risk. It shows relevant information about the seasonality of leptospirosis occurrence in the municipality that can support the planning and implementation of prevention actions. According to this perspective, it is essential to strengthen prophylactic measures aiming to minimize the disease incidence.

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