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Risk and transmission of Visceral Leishmaniasis associated with the prevalence of the disease in Teresina-Piauí

Elisa Costa de Sousa*
Ana Paula AVLes Machado*
Adriana Saraiva dos Reis**
Fernando Luiz Lima de Oliveira**

Abstract

The objective of this study is to identify the risk of transmission of Visceral Leishmaniasis (VL) associated with sanitation conditions and the prevalence of the disease in Teresina, Piauí. This was a quantitative, descriptive, documentary research study, with data extracted from the National Notifiable Diseases Information System (SINAN/DATASUS), National Sanitation Information System (NSIS), and the Center for Zoonoses of the city of Teresina. According to data from SINAN/DATASUS, 345 VL cases were registered in the city of Teresina, during the period of 2013 to 2018. The year with the highest number of cases was 2013 (20%) and the lowest in 2018 (10.14%). As for the gender variable, male individuals were the most affected (70.14%), and the highest occurrence was among rural residents (90.72%) and mixed-race individuals (90.43%). Regarding canine VL (CVL) in Teresina, during the study period, the Zoonoses Center collected 42,065 blood samples, 67.07% of which were seroreactive to the Rapid Test and 32.93% were seroreactive to the ELISA Test. In periods with fewer notifications of the disease, a better supply of water, sewage, and waste collection were observed. Thus, it is possible to see that human and canine visceral leishmaniasis are related to health issues, since the lack of adequate sanitation contributes to a greater proliferation of the vector and, consequently, an increase in the number of cases of VL. It is concluded that the number of cases of Human and Canine Visceral Leishmaniasis evolved in a similar way, raising the risk of disease transmission in urban areas.

Keywords: Visceral Leishmaniasis. Sanitation. Epidemiology. Public health.

INTRODUCTION

Leishmaniasis is an infectious disease caused by a trypanosomatid-type protozoa of the Leishmania genus. It is a serious zoonosis that, if left untreated, can be lethal. There are two types of classifications: Visceral Leishmaniasis (VL) and Tegumentary Leishmaniasis (TL)[1]. VL popularly known as black fever, is caused by Leishmania (L.) *infantum chagasi*, while TL is an infectious, non-contagious disease that affects the skin and mucous membranes[2].

The main reservoirs of VL are dogs, in the urban environment, while in the wild foxes, marsupials, and wild rodents cultivate these protozoa. The control measures in accordance with the Ministry of Health are the euthanasia of seroreactive dogs, the reduction in the proliferation of sandflies, and the carrying out of health education activities[3].

Given the above, we can affirm that this pathology has some determinants for its occurrence, such as poverty, migration, unplanned urban occupation, environmental destruction, poor sanitation and housing

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*Centro Universitário UNINOVAFAPI. Teresina, Piauí, Brasil.
**Universidade Federal do Piauí. Teresina, Piauí, Brasil.
E-mail: elisaaraujocs7@gmail.com

conditions, and malnutrition[4]. Currently, basic sanitation in Brazil has received more governmental attention. Therefore, these investments should generate benefits in improving water and public health rates, in addition to meeting the minimum quality standards, defined by the specific legislation of the sector, with the aim of ensuring their sustainability[5].

The disease presents symptoms such as: long-lasting fever, splenomegaly, hepatomegaly, weight loss, weakness, reduced muscle strength, anemia. Thus, for the control of VL in Brazil it is necessary to carry out an early diagnosis and treatment in humans, in addition to reducing the number of vectors, euthanizing positively diagnosed dogs, and providing health education[6].

Furthermore, this disease is found in 69 countries, with 500,000 new cases being notified per year, with a predominance in India, Nepal, Sudan, Bangladesh, Ethiopia, and Brazil. It is considered a neglected disease, since the largest number of cases occurs in low-income populations. In the 1990s, cases were present in large numbers in the Northeast region of Brazil, but over the years, there was an expansion to the North, Southeast, and Midwest regions[7].

To monitor the disease, notification is necessary, thus, it is possible to identify cases of human leishmaniasis through the Notifiable Diseases Information System (SINANNet), a system linked to the information technology department of the Unified Health System of Brazil (DATASUS)[8]. The combat and investigation of canine leishmaniasis are carried out through the Center for Zoonoses. Information on the city's sanitation conditions were taken from the National Sanitation Information System (NSIS), which is characterized as an essential system in the field of basic sanitation, as it has institutional, administrative, operational, managerial, and economic financial information[9].

One of the urban centers that stand out in the expansion of VL cases in Brazil is Teresina, capital of the State of Piauí, located in the central-northern region of the state and in the mid-northern region of the northeast of the country. According to IBGE, the estimated population in 2018 was 861,442 people and the demographic density in 2010 was 584.94 inhabitants/km²10.

Considering that the municipality of Teresina has low levels of sanitation and a growing number of notifications of cases of Visceral Leishmaniasis in humans and dogs, it is important to review these indices, aiming to identify the risk of VL transmission associated with sanitation conditions and the prevalence of the disease in the capital of Piauí.

METHODS

A quantitative, descriptive, documentary study was carried out from which a more detailed study was elaborated including a review, observation, and interpretation of data. The study site was the city of Teresina, capital of the state of Piauí, which is located at the confluence of the Parnaíba and Poti rivers, and has a hot and humid climate, and an estimated population in 2019 of 814,230 people.

This study was carried out in 2020 through information collected and obtained from the databases of the National Notifiable Diseases Information System (SINAN/DATASUS), National Sanitation Information System (NSIS), and the city's Center for Zoonoses of Teresina.

To obtain data regarding Human Visceral Leishmaniasis (HVL) in the city, the SINAN/DATASUS system was used. The data on human VL cases taken from SINANNet,

included the variables concerning years (2013; 2014; 2015; 2016; 2017; 2018), sex (male, female), residential area (urban, rural), and ethnicity (white; black; brown) were observed. Data were accessed as shown in the diagram below:

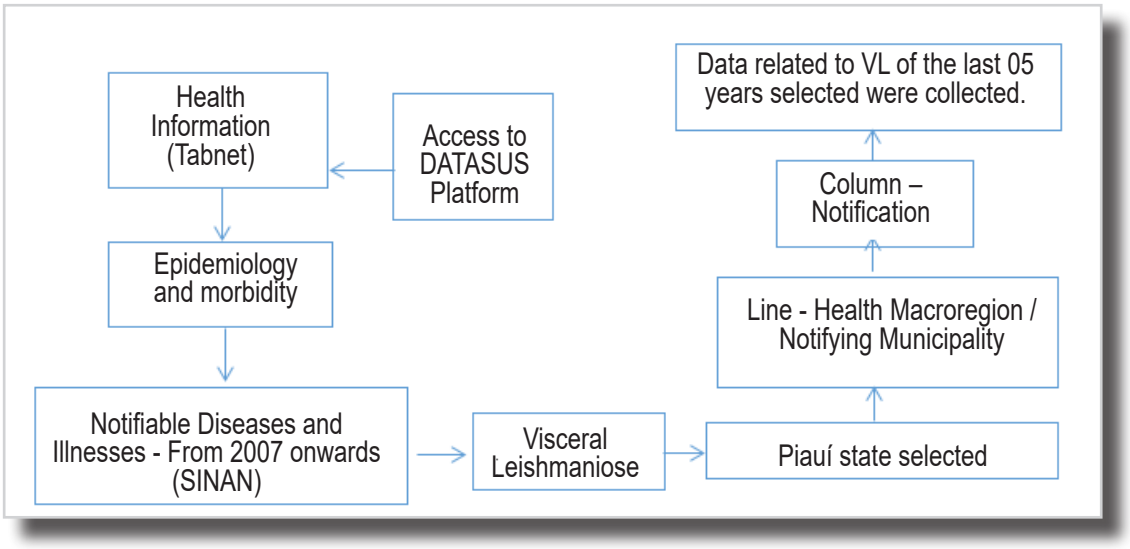

Figure 1 – Access guide to the SINAN/DATASUS website

Data from the National Sanitation Information System (NSIS) were obtained by searching the codes IN055_AE, IN056_AE, and IN015_RS in the auxiliary spreadsheets of the annual diagnoses of water, sewage, and solid waste. The information collected from the NSIS as follows:

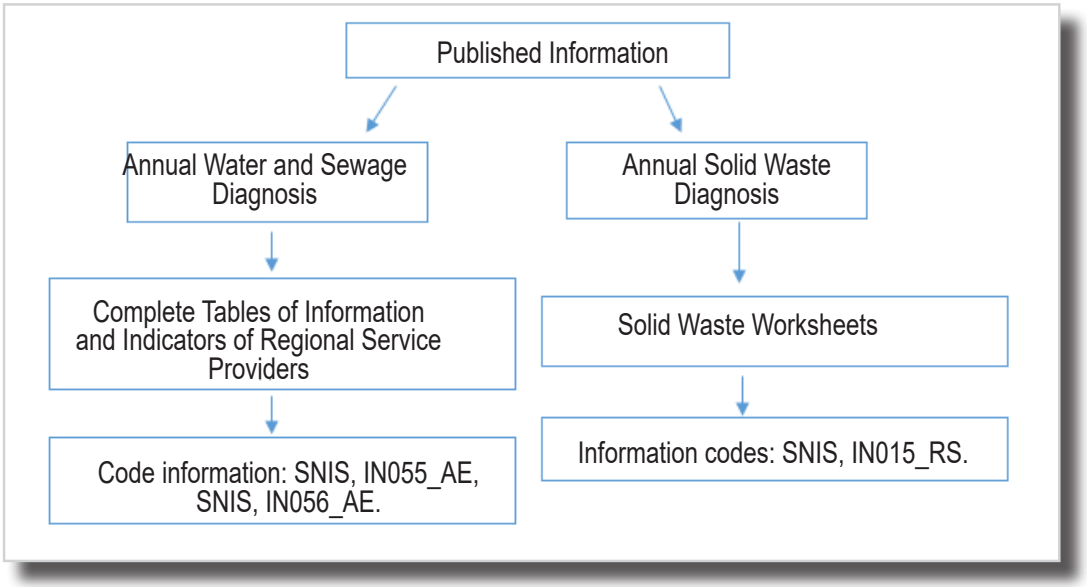

Figure 2 – NSIS website access guide. Source: Authors

Regarding the NSIS data on basic sanitation, the codes IN055 (Index of service to the total population with a water network), IN056 (Index of service to the total population with a sewage network), and IN015 (Index of service to the total population with a solid waste network) were used. These indicators show the percentages of the urban and rural population effectively served by the water supply, sewage, and solid waste networks.

The information related to the dogs was provided by the Teresina Center for the Control of Zoonoses, a veterinary public health agency linked to the Municipal Health Foundation. The following variables were investigated through the annual reports: number of canine blood samples collected, seroreactive samples, and the number of euthanized animals, as well as the administrative zones where the samples were collected during the study period.

At the end of the data collection, a correlation was made between the variables involved in the study, in an attempt to verify whether the number of human cases of the disease correlated with the number of canine cases and the basic sanitation actions studied.

RESULTS

According to data collected from SINAN/DATASUS, 345 human cases of VL were reported in the study period, between 2013 and 2018, in which males were the most affected, especially among those had brown skin and were urban residents (Table 1).

According to data obtained by the NSIS, it was noted that there were divergences between the three variables of basic sanitation. In relation to water supply, there was a gradual improvement and at the end of the period there was a sharp decrease. Solid waste collection was stabilized throughout most of the period, with a slight increase at the end of it. With regards to sewage, a similar phenomenon as that with the water supply occurred, with a decrease in the last three years, as can be seen in figure 3.

Regarding canine VL in Teresina, during the period studied, the Zoonoses Center collected 42,065 blood samples, 67.07% of which were seroreactive to the Rapid Test, which is a screening test. These reactive animals were then tested by the ELISA Test, the definitive test for diagnosis, and 32.93% confirmed the initial result. Following this test, these dogs were euthanized (9.43%) (Figure 4).

The control of CVL in Teresina is carried out in two ways: Block and Investigate. Blocking is when the Municipal Health Foundation (MHF) is informed by the Hospital for Tropical Diseases in the city that there are cases of HVL in certain areas and, thus, an investigation is carried out on dogs in these locations.

Collection of canine blood samples for diagnosis is done in three modalities: 1) in routine serological surveys carried out in neighborhoods where the transmission of the human disease had occurred in the previous three years; 2) during the blocking, that is, in the surroundings of the residence where there was a notification of a human case in a neighborhood not included in the Canine Serological Survey; and 3) by voluntary demand of animal owners at the Zoonoses Control Center (ZCC), which can be from any neighborhood in the city not covered by the household canine serological survey. The collections are performed by Endemic Agents, who send the samples daily

to the ZCC Laboratory for diagnosis. After diagnosis, seroreactive dogs are collected for euthanasia in cases where the owner approves.

As observed in figures 5 and 6, the northern and southern regions had more notified cases both through the Blocking and through the Investigation. In 2013, the largest number of notifications occurred in the southern region through the Blocking. Through the notification by Investigation, in the same year, the Northern zone presented a greater number of cases. It is noteworthy that in 2017 there was no control by MHF in the east/southeastern regions.

Table 1 – Cases of human visceral leishmaniasis according to the variables: gender, ethnicity, and residential area of the affected individual, in Teresina, PI, from 2013 to 2018.

Variable	Frequência	%
Year		
2013	69	20.00
2014	67	19.42
2015	68	19.71
2016	45	13.04
2017	61	17.68
2018	35	10.14
Sex		
Male	242	70.14
Female	95	27.54
Ethnicity		
White	6	1.74
Black	12	3.48
Brown	312	90.43
Ing/Branco	15	4.35
Residential Zone		
Urban	313	90.72
Rural	25	7.25

Fonte: SINAN/DATASUS

The evolution of canine and human VL cases can be observed in figure 7. Here, both canine and human cases have been clearly decreasing over the years.

There was no correlation between human and canine cases of Visceral Leishmaniasis (p=0.6228), as well as water supply (p=0.704). However, there was a correlation between human cases and solid waste collection (p=0.0051) as well as human cases in relation to the presence of a sewage system (p=0.0723), as seen in table 2.

Table 2 – Spearman's correlation between the number of human cases of Visceral Leishmaniasis in relation to those of Canine Leishmaniasis, solid waste, water, and sewage systems, in Teresina, PI in the period from 2013 to 2018.

Correlation	Spearman's Coefficient	P value
Human cases vs. canine cases	0.2571	0.6228
Human cases x solid waste	-0.9411	0.0051
human cases x water	-0.2	0.704
Human cases vs sewage	-0.7714	0.0723

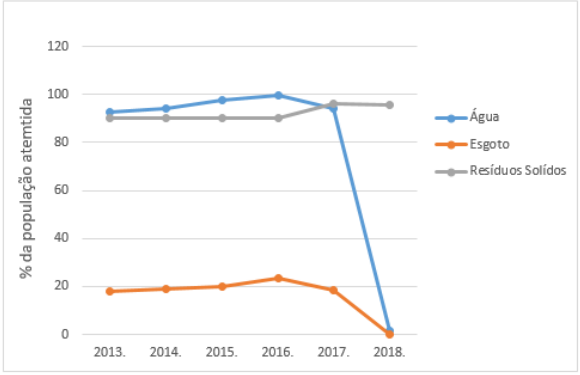

Figure 3 – Service rate of the total population with water, sewage, and solid waste networks between the years 2013 and 2018 in the municipality of Teresina, PI.

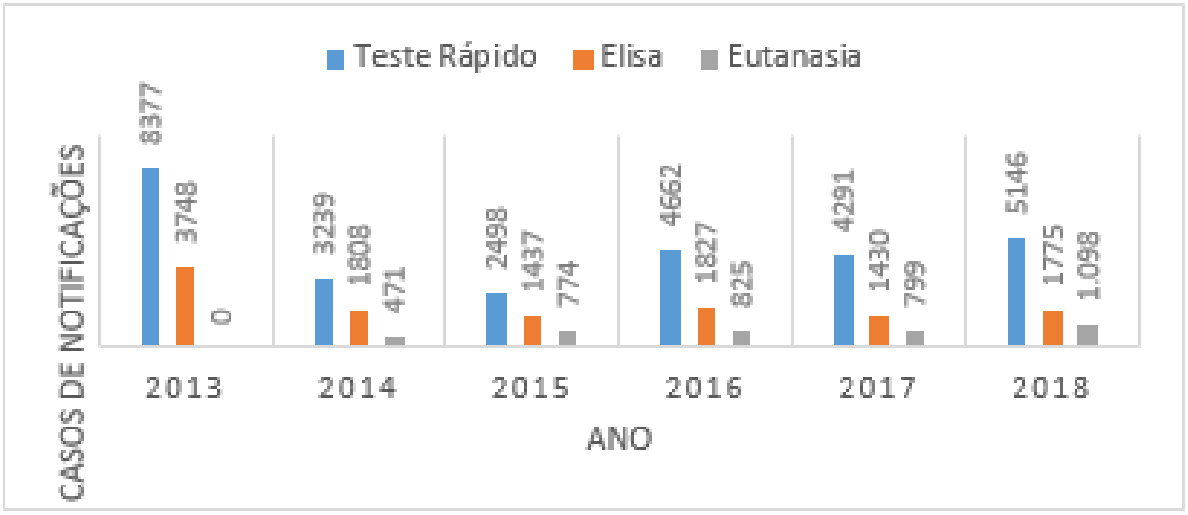

Figure 4 – Tests performed by year of notification, and euthanasia of dogs with suspected CVL in the years 2013 to 2018.

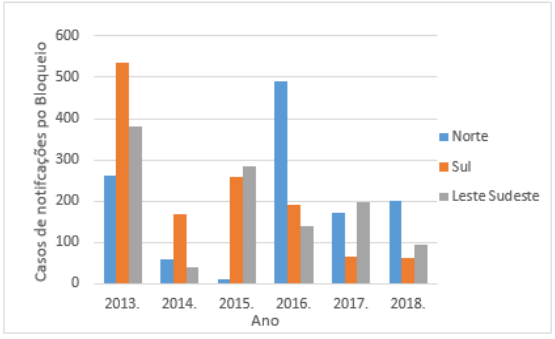

Figure 5 – Cases notified through blocking for CVL in Teresina, according to residential area in the period from 2013 to 2018.

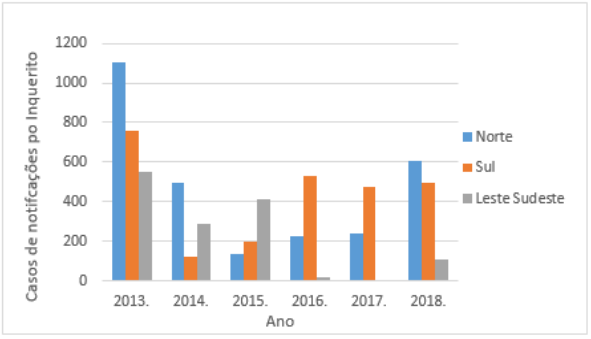

Figure 6 – Cases notified through a serological Investigation for CVL in Teresina, according to the residential area in the period from 2013 to 2018.

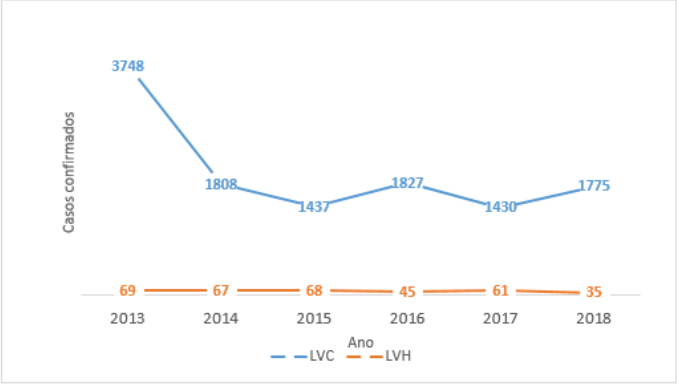

Figure 7 – Number of confirmed cases of Canine (CVL) and Human (HVL) Visceral Leishmaniasis. Teresina, 2013 to 2018.

DISCUSSION

Through the data obtained from DATASUS/SINAN it is possible to observe that from the years 2013 to 2018 a total number of 345 cases of VL were reported. The year that was characterized by having the lowest number of notifications was 2018, recording only 10.14% of the cases, and 2016 which had 13.04% of notified cases. The years 2014 (19.71%), 2013 (20%), 2018 (17.68%), and 2015 (19.71%) stand out as the years with the highest incidence of notifications.

In the gender variable, there was a predominance of cases in males (70.14%). This data is similar to the study carried out in the city of Paracatu (MG) in which 128 reported cases were recorded, and it was observed that the majority were in males (56.2%)[11]. It is believed that this gender is more susceptible to illness, possibly due to their occupational and behavioral activities being closer to the source of infection and being more exposed to the vector[12].

Regarding the ethnicity variable, there was a greater predominance among those with brown skin (90.43%). Moreover, another study that analyzed the notifications of VL cases in Brazil between the years 2008 to 2015, resulted in 66.8% of confirmed cases identified in brown individuals[13]. This fact can be explained by the greater concentration of brown people, mainly in the Northeast region. In the city of Teresina, according to the IBGE in 2019, there is a greater number of self-declared brown people, followed by white people[9].

Although VL is considered a rural disease, more recently there has been an observable change in this scenario. Epidemiological data have shown that this disease is becoming more and more urban, and in this study, most reported cases occurred in the city (90.72%). Similar data were described in a study carried out in Araguaína, TO, which reported that outbreaks of the disease progressively affected, starting from 2008, central and suburban areas in the city. This may be related to the increase in population and the disorderly expansion, affecting the economic, social, environmental, and urban areas[14].

Low socioeconomic conditions, deforestation and poor basic sanitation can be factors that contribute to the installation of VL, in addition to population agglomerates without minimal sanitary conditions[15]. According to the IBGE of 2019, in the last population census, Teresina had 814,230 inhabitants, characterizing itself as the most populous municipality in Piauí[9]. Teresina is an expanding city, however, the problem is not just the increase in population, but the disorderly expansion, just like in the city of Araguaína, TO.

Through the data obtained on basic sanitation in the city of Teresina, PI, it is possible to observe that a large portion of the population is receiving proper water supply and solid waste collection, while sewage sanitation is still unsatisfactory. It is important to note that in 2018 the database did not provide population service data for the water and sewage networks.

Over the years analyzed in this study, it is possible to observe that the percentage of the population served with a water supply gradually increased between the years 2013 (92.8%) and 2016 (99.72%). However, in 2017 a decline in these rates occurred, reaching only 94.31%, and in 2018 there were no reports.

It is evident that the population's service rate in relation to the sewage network is unsatisfactory, since between the years 2013 (17.87%) and 2018 (0%) less than 50% of the population did not receive this benefit properly.

In relation to solid waste, it is possible to notice that between the years analyzed, the population service index has been growing progressively and revealing that a good part of the population has access to this resource. Between 2013 and 2016, on average, 90% of residents of Teresina, PI received this service.

Furthermore, as of 2018 the service rate was 95.3%, indicating this sector's effectiveness.

The growth of the basic sanitation sector in Brazil took place successively, through the implementation of public policies from the 70's, with the creation of the National Water and Sanitation Plan – PLANASA. The improvement of basic sanitation generates social and economic benefits that reduce the costs of the health system and generate a greater attendance at work, so that there is no expense with problems related to the lack of sanitation[16].

Basic sanitation influences all factors in a person's physical environment, which effects mental, social, and physical well-being[17]. There are several diseases that are linked to inadequate sanitation, and among these are Visceral and Tegumentary Leishmaniasis[18].

Sites with organic matter originated by domestic animals and poor sanitary conditions lead to the maintenance and proliferation of Lutzomyia longipalpis. A study carried out in the municipality of Parnaíba, PI, from 2010 to 2014, showed that these conditions in the scenarios possess the determining factors needed to maintain the incidence of VL. In this study, 45 cases of HVL and 2787 canine cases were registered[19].

Over the years analyzed, there was a reduction in cases of seroreactive dogs for CVL; however, the number of euthanized dogs is not proportional to seropositive ones. One of the reasons for this is likely due to the population resisting the delivery of their dogs and/or authorizing their euthanasia, which is the strategy used for the control of CVL by the National Program for Surveillance and Control of Visceral Leishmaniasis[20].

However, euthanasia has numerous challenges both in its operation and in its maintenance, due to inadequate infrastructure in the municipalities, insufficient or non-existent funding for its development and, mainly, the ethical issues involved, which leads to questions about its effectiveness[21].

For the laboratory diagnosis of CVL cases, the MHF first performs the screening test, the rapid test, where those who react are transferred to an ELISA test for confirmation. It is noticeable that the number of cases of seroreactive dogs in the rapid test (28,213) is higher than the results of the ELISA test (13,852), revealing that the screening test diagnoses may be false positives. Thus, the ELISA test, according to the Ministry of Health, is considered one of the main tests for the diagnosis and confirmation of cases of CVL[22].

According to the PNVCVL, in the municipality of Teresina, dogs with reactive serology for CVL are euthanized after confirmation by the ELISA test; however the number of euthanized dogs (3,967) was much lower than the positive cases (12,025). It is important to note that in 2013 the data on euthanized dogs were lost, and that in 2014, only the first four months of the year had reports of euthanasia. In a survey conducted in Rio Grande do Sul, between 2007 and 2014[24] cases of CVL were reported, thus highlighting the importance of canine reservoirs in the continuity of the disease cycle, as well as the existence of sandflies in the environment[23].

Through the results obtained, it is possible to observed that all residential areas in Teresina are affected by CVL. In the assessment through blocking, the predominance of cases in the southern zone of the city is admissible. In 2015, there was a growing report of notifications in the east-southeastern zone; however, in 2016 most cases occurred in the northern zone. Meanwhile, in 2017 the east-southeastern zone was once again the region with the most notifications, and in 2018 the northern zone registered the highest number of cases.

Concerning the data acquired by the assessment through Investigation, it is noted that the northern and southern zones displayed a greater number of cases, while the cases in the east-southeastern zone considerably decreased over the years. The greater occurrence in these zones may be related, because they have a relevant number

of domestic animals and these zones are close to forests.

In a study carried out in the district of Angelim, in the municipality of Teresina, certain characteristics of the environment were related to the presence of canine VL infections. The research concluded that residences located in areas with greater vegetation more often contained seropositive dogs[24].

It is noticed that the canine and human cases of VL in the analyzed period evolved in a similar way. A study carried out in the Federal District, from 2004 to 2015, recorded 321 confirmed cases of VHL, as well as 6,608 cases of CVL. It was observed that the increase in CVL cases prevailed over the increase in HVL cases, and that the presence of infection in dogs was more frequent than in humans[25].

Despite the fact that the Zoonoses Center actively searches for canine cases in areas of the city with human disease transmission, the lack of correlation between human and canine cases goes against the medical literature, which says that human cases of VL are subsequent to canine cases. Other variables can interfere with the occurrence of fewer human cases than expected, such as municipal control actions and universalized primary care.

It was found that the distribution of channeled water does not correlate with human cases of VL, which also does not confirm the assumption that sanitation actions are essential to reduce the prevalence of the disease. When analyzed separately, the fact of having running water available does not remove the vector and the reservoirs of the disease.

The insufficiency of solid waste collection and sanitary sewage had a greater influence on human cases of VL, confirmed with the calculation of Spearman's correlation coefficient. The vector's survival depends directly on decaying organic matter, a fact that is facilitated by the lack of the variables in question.

CONCLUSION

This study provided the epidemiological assessment of the incidence of VL in Teresina, from 2013 to 2018. The data that supported this research evaluated different characteristics of the target population. Through the results obtained, it is possible to observe the predominance of the emergence of cases in specific groups, such as males, individuals living in rural areas and those of brown skin color.

Moreover, the cases of Canine Visceral Leishmaniasis decreased over the years studied. In view of this fact, it is extremely important that constant monitoring of the surveillance of CVL is carried out, as well as interventions and preventative actions, in order to contain the increasing number of canine cases.

Thus, this research made it possible to observe the factors that influence the occurrence of the disease both in humans and in dogs, and the basic sanitation services can be highlighted. When there is a deficiency of these services, there is an increase in reported cases of CVL and HVL. Therefore, improvements are needed in this sector, along with investments by the responsible bodies, and increased health education measures.

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