

# Epidemiological aspects of Leishmaniasis in the Pantanal region of Mato Grosso

Aspectos epidemiológicos das Leishmanioses na região do Pantanal de Mato Grosso

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Received March 7, 2019

Accepted June 28, 2019

## Abstract

Leishmaniasis is a disease caused by the protozoan *Leishmania* parasite that is disseminated by some species of sandflies and hosted by a variety of reservoirs. The objective of the present study was to evaluate the epidemiological situation of leishmaniasis in the municipalities of the Mato Grosso Pantanal. Human data were obtained from the Information System of Notifiable Diseases, and the canine and vector results from the State Department of Health of Mato Grosso. Between 2007 and 2016, 10 cases of visceral leishmaniasis and 499 cases of tegumentary leishmaniasis were identified in the Pantanal region. The surveillance studies regarding the canine reservoir demonstrated that the parasite was present in six of the seven municipalities. Vectors of visceral leishmaniasis were present in five municipalities and vectors of tegumentary leishmaniasis in six. Enhancement of services aimed at controlling this disease is fundamental to prevent an increase in the number of cases in the region.

**Keywords:** Visceral Leishmaniasis, Cutaneous Leishmaniasis, Reservoir, Phlebotomines.

## Resumo

As leishmanioses são doenças causadas por protozoários do gênero *Leishmania* disseminadas por algumas espécies de flebotomíneos e participação de uma variedade de reservatórios. O objetivo do presente estudo foi avaliar a situação epidemiológica das leishmanioses nos municípios abrangentes do Pantanal de Mato Grosso. Os dados humanos foram obtidos do Sistema de Informações de Agravos de Notificação e os resultados caninos e vetoriais junto à Secretaria de Estado de Saúde de Mato Grosso. A região do Pantanal registrou no período de 2007 a 2016, dez casos da forma visceral e 499 casos da forma tegumentar. As ações de vigilância para o reservatório canino demonstraram a circulação do parasito em seis dos sete municípios. A presença dos vetores de leishmaniose visceral ocorreu em cinco municípios e os da leishmaniose tegumentar em seis. O fortalecimento dos serviços voltados para controle desse agravo é fundamental para evitar o aumento no número de casos da região.

**Palavras chaves:** Leishmaniose Visceral, Leishmaniose Tegumentar, Reservatório, Flebotomíneos.

The leishmaniasis are a group of diseases caused by protozoan parasites from more than 20 *Leishmania* species, transmitted to humans by the bites of the infected female phlebotomine sandfly and is hosted by a variety of reservoirs. There are three main forms of leishmaniasis: visceral (VL) or kala-azar, cutaneous and mucocutaneous (the last two classified as tegumentary leishmaniasis - TL) (WHO, 2019).

In Brazil, VL is a zoonotic disease whose etiologic agent is *Leishmania (Leishmania) infantum* and is present in 26 states in the five regions of the country (BRASIL, 2017a). Between 2006 and 2015, an annual average of 3.509 cases was observed, with

Mato Grosso registering an average of 40 cases per year (BRASIL, 2017a). The disease is currently more active in centres of the country and continues to expand due to the urbanization of *Lutzomyia longipalpis* (Lutz & Neiva 1912), the main VL vector in the Americas (OLIVEIRA et al., 2016). Dogs are considered the main reservoirs in the domestic environment, leading to vector infection and consequently, transmission to humans (MORENO & ALVAR, 2002).

Seven species of *Leishmania* are recognized as etiologic agents for TL in the Brazilian territory; the main three are *L. (Leishmania) amazonensis*, *L. (Viannia) guyanensis* and *L. (V.) braziliensis*, which was the third species described and considered as the most prevalent, with wide distribution throughout the country (BRASIL, 2017b; RANGEL et al., 2018). The disease is observed in all Brazilian states, characterized by several transmission patterns, with 21,026

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cases on average annually between 2006 and 2015; in Mato Grosso, during the same period the average number of cases per year was 2,628, representing more than 10% of all cases registered in the country (BRASIL, 2017c). Several species of sandflies are implicated in the transmission of TL, including *L. whitmani*, *L. intermedia*, *L. umbratilis*, *L. wellcomei*, *L. flaviscutellata*, and *L. migonei* (RANGEL & LAINSON, 2009).

There are a few studies regarding leishmaniasis in the Pantanal region, performed in the area of Mato Grosso do Sul, mainly in Corumbá and Aquidauana (CASARIL et al., 2014), and in Mato Grosso in the municipalities of Cáceres (ALVES et al., 2012) and Barão de Melgaço (DIAS et al., 2017). Because Pantanal is a region of great touristic potential and due to the expansion of VL and the prevalence of tegumentary leishmaniasis for the State, a study regarding the epidemiological aspects of VL and LT is necessary.

The objective of the present study was to evaluate the epidemiological situation of leishmaniasis in the municipalities of Mato Grosso Pantanal.

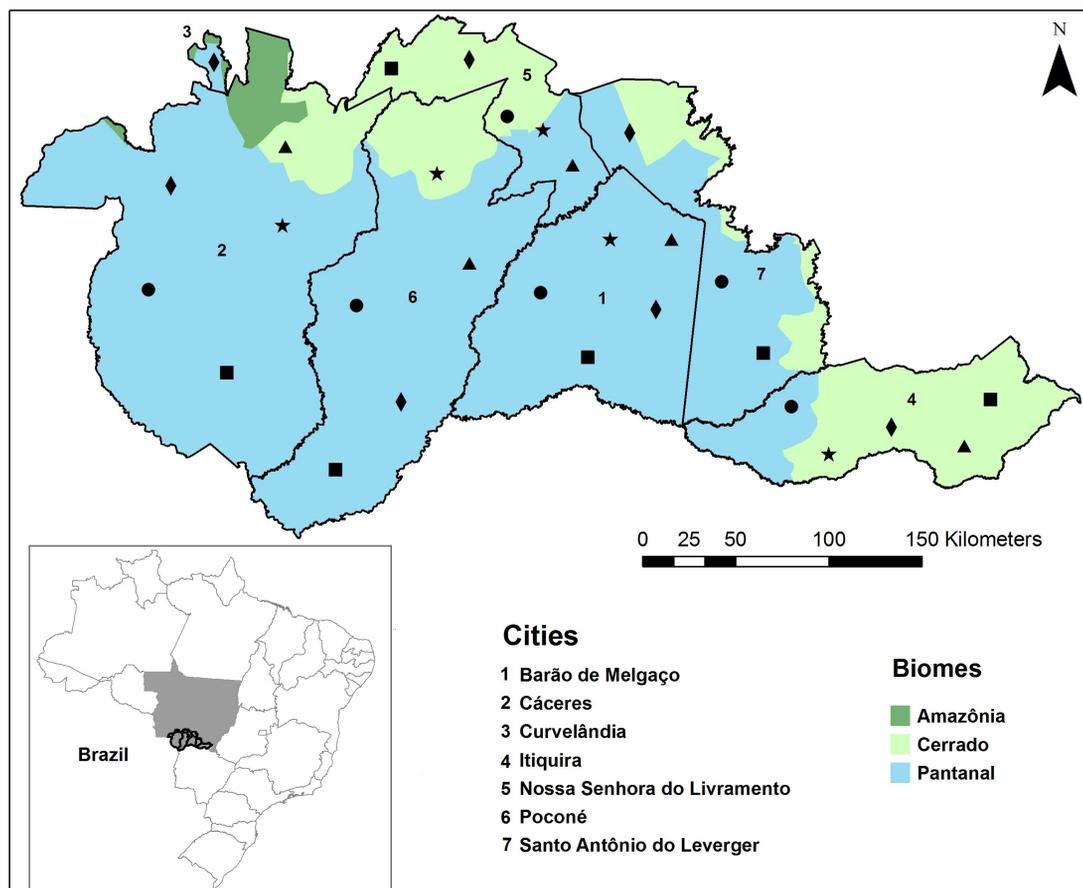
The population of the municipalities of Barão de Melgaço, Cáceres, Curvelândia, Itiquira, Nossa Senhora do Livramento, Poconé and Santo Antônio do Leverger belong to the Mato Grosso Pantanal totals 173,728 inhabitants. The economic base consists of cattle raising, agriculture, fishing tourism and mineral extractivism. The climate in the region is hot and humid tropical (IBGE, 2010).

Data regarding the confirmed human cases for TL and VL, covering the period between 2007 and 2016, were obtained from the Notifiable Diseases Information System (SINAN), which was made available from the website of the State Health Secretariat of Mato Grosso (MATO GROSSO, 2017). The incidence rate was based on records of confirmed cases, divided by the estimated population (IBGE, 2010) of each municipality, multiplied by 100,000 and divided by the study period (ten years).

Serological data for the detection of canine VL and the entomological data were provided by reports the Department of Environmental Surveillance of the State Health Department of Mato Grosso. The canine positivity index was calculated based on the ratio of the number of reactive animals to the number of animals examined.

The insects were collected using CDC light traps, installed in peridomestic suggestive for the occurrence vector such as the presence of plants, accumulation of organic matter, the presence of domestic animals (dogs, chickens, pigs and horses); at dusk and gathered in around 12 hours later, on three consecutive days.

The distribution of human cases (VL and TL), canine cases and vectors (VL and TL) are shown in Figure 1 (the marks represent the municipality as a whole). A total of 10 human VL cases were identified in the Pantanal mato-grossense region (Table 1). In all cases, the confirmation criterion was laboratory and with the exception of Barão de Melgaço, all the others were autochthonous



**Figure 1.** Geographic distribution of cases of visceral leishmaniasis (VL) in humans (★), of tegumentary leishmaniasis (TL) in humans (◆), canines (●) and vectors VL (▲) and vectors TL (■) in the municipalities of the Pantanal of Mato Grosso, from 2007 to 2016.

of the municipality of residence. The notifications were recorded in several months, but December was the month with the highest number of cases (three). The highest number of cases was observed in the municipality of Cáceres (four) and no record of the disease was observed in the municipalities of Curvelândia and Santo Antônio do Leverger (Table 1). The disease was more prevalent in males (six cases), and the most affected age group was between 0 and 10 years old (four cases); one death was recorded and there was no information on the outcome of the disease in three cases. As for the occupation, there was no information in the file of half of cases, the other were students (two), construction workers (two) and agriculture (one). The majority of the patients (seven) resided in the urban area, only three in the rural area.

A total of 499 cases of TL were recorded in the municipalities of Pantanal region, between 2007 and 2016 (Table 2). Cases were identified every year of the study with an average of 50 cases per year. The confirmation criterion was the laboratory majority (89%) and 76% of the cases (380) were autochthonous from the municipality of residence. Each month, they reported, with the highest number of cases in September (71) and the lowest number in June (15). Cáceres presented an annual average of 25 cases, representing 50% of the total. In contrast, an average lower than one case per year was observed in Barão de Melgaço (Table 2). A total of 391 (78%) patients were male and 52% of the patients were between 30 and 50 years old. Of note, a significant portion (18%) was older than 60 years old. No deaths were recorded as an outcome of the disease and 80% of the patients were cured. Data for the remaining 20% were not available because the patients either abandoned treatment, moved to another place, or did not

complete the notification form. As well as the labor activities, a great diversity of occupations was observed, with emphasis on field workers (agriculture and livestock) with 22% of the cases, followed by retirees (12%) and students (9%); a considerable number of cases (20%) did not carry this information (blank). The predominant area of residence was urban (59%).

The canine serological investigation in the Pantanal from Mato Grosso area resulted in a total of 8102 collections between 2007 and 2016, with a variable positivity index among the municipalities and throughout the years (Table 3).

From 2007 to 2016, entomological surveys contemplated, at least one time, all the municipalities of the Northern Pantanal, with surveys covering both urban and rural areas. These studies have demonstrated that five sandfly species are involved in the transmission of leishmaniasis; *L. longipalpis* and *L. cruzi* (VL vectors), *L. whitmani*, *L. flaviscutellata* and *L. migonei* (TL vectors) (Table 4).

In the Pantanal region of Mato Grosso, the occurrence of human cases of VL has been sporadic. In 10 years, only ten (10) cases were confirmed. A different situation can be observed in the Pantanal region of Mato Grosso do Sul; in Aquidauana, where VL is being reported since 1998, 162 cases were recorded between 1999 and 2011. In the same region, in the municipality of Corumbá, 260 VL cases were confirmed between 1994 and 2012; these municipalities were classified by the Ministry of Health as intense transmission areas (BRASIL, 2014; CASARIL et al., 2014).

In the Pantanal region we identified an average of 50 TL cases/year between 2007 and 2016, which represents 2% of the cases for the state of Mato Grosso. The highest number of TL cases was observed in the municipality of Cáceres; however, due

**Table 1.** Number of cases of visceral leishmaniasis (VL) and incidence rate in the municipalities of the Pantanal of Mato Grosso, period 2007 to 2016.

Município	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total	Population estimation	Incidence
Barão de Melgaço	-	-	-	-	01	-	-	-	-	-	01	7.591	1.31
Cáceres	01	-	-	01	-	01	01	-	-	-	04	87.942	0.45
Curvelândia	-	-	-	-	-	-	-	-	-	-	-	4.866	-
Itiquira	-	-	-	-	-	-	-	-	01	-	01	11.478	0.87
N <sup>a</sup> Sr <sup>a</sup> do Livramento	01	-	-	-	-	-	01	-	01	-	03	11.609	2.58
Poconé	01	-	-	-	-	-	-	-	-	-	01	31.779	0.31
Sto Ant <sup>o</sup> do Leverger	-	-	-	-	-	-	-	-	-	-	-	18.463	-
Total	03	-	-	01	01	01	02	-	02	-	10	-	-

**Table 2.** Number of cases of tegumentary leishmaniasis (TL) and incidence rate in the municipalities of the Pantanal of Mato Grosso, period 2007 to 2016.

Municipality	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total	Population estimation	Incidence
Barão de Melgaço	01	-	01	01	-	01	02	01	02	-	09	7.591	11.86
Cáceres	20	25	17	25	06	20	37	36	51	14	251	87.942	28.54
Curvelândia	05	05	01	01	01	01	02	-	-	-	16	4.866	32.88
Itiquira	06	06	03	03	03	02	03	02	02	02	32	11.478	27.88
N <sup>a</sup> Sr <sup>a</sup> do Livramento	02	08	05	07	03	02	05	04	07	05	48	11.609	41.34
Poconé	03	07	04	09	04	03	12	11	07	06	66	31.779	20.76
St <sup>o</sup> Antônio do Leverger	09	07	09	07	04	11	07	10	04	09	77	18.463	41.7
Total	46	58	40	53	21	40	68	64	73	36	499	-	-

**Table 3.** Serological survey for canine visceral leishmaniasis (CVL) in the Pantanal region of Mato Grosso from 2007 to 2016.

County	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
	E (%)	E (%)	E (%)	E (%)	E (%)	E (%)	E (%)	E (%)	E (%)	E (%)
B. Melgaço	04 (00)	174 (5.7)	116 (5.2)	116 (1.0)	-	-	-	402* (4.2)	-	-
Cáceres	82 (6.1)	32 (6.2)	-	01 (100)	-	05 (20.0)	-	-	-	-
Curvelândia	-	01 (00)	-	-	-	-	-	-	-	-
Itiquira	-	03 (33)	183 (13.6)	204 (6.4)	252 (4.4)	17 (17.6)	09 (11.1)	-	-	188 (7.4)
N. S. Livramento	391 (14.6)	281 (9.2)	105 (23.8)	312 (17.3)	290 (9.6)	-	-	-	-	-
Poconé	818 (5.0)	793 (9.2)	746 (19.3)	581 (15.8)	875 (24.2)	183 (24.6)	-	136 (33.8)	31 (35.5)	-
S. A. do Leverger	739 (7.0)	07 (14.3)	-	25 (28.0)	-	-	-	-	-	-
Total	2034	1291	1150	1239	1417	205	09	538	31	188

E: sent samples. %: positivity index. \*Survey developed in partnership with UFMT.

**Table 4.** Entomological surveys in the municipalities of the Pantanal of Mato Grosso, period 2007 to 2016.

Municipality*	Researched year	VL vector	TL vector
Barão de Melgaço	2012	<i>L. longipalpis</i>	<i>L. whitmani</i>
	2015	<i>L. longipalpis</i>	<i>L. whitmani</i>
	2016	<i>L. cruzi</i>	<i>L. flaviscutellata</i> ; <i>L. whitmani</i>
Cáceres	2007	<i>L. cruzi</i> , <i>L. longipalpis</i>	<i>L. migonei</i> , <i>L. whitmani</i>
	2008	-	<i>L. migonei</i> <i>L. whitmani</i>
Itiquira	2008	-	<i>L. flaviscutellata</i>
	2010	-	<i>L. whitmani</i>
	2011	<i>L. cruzi</i>	<i>L. whitmani</i>
	2016	<i>L. longipalpis</i>	<i>L. whitmani</i>
Nossa Senhora do Livramento	2008	<i>L. longipalpis</i>	<i>L. whitmani</i>
	2009	<i>L. longipalpis</i>	-
	2010	<i>L. longipalpis</i>	<i>L. whitmani</i>
Poconé	2007	<i>L. longipalpis</i>	<i>L. whitmani</i>
	2008	<i>L. longipalpis</i>	<i>L. whitmani</i>
	2009	<i>L. longipalpis</i>	<i>L. whitmani</i>
	2010	<i>L. longipalpis</i>	-
	2011	<i>L. cruzi</i> , <i>L. longipalpis</i>	<i>L. whitmani</i>
Santo Antônio do Leverger	2008	-	<i>L. whitmani</i>
	2013	-	<i>L. whitmani</i>

\* Some municipalities performed entomological research, but without vector registration: Barão de Melgaço (2008), Curvelândia (2008), Itiquira (2012) and Nossa Senhora do Livramento (2007, 2001, 2013 and 2014).

to the large population, the incidence rate was lower than that of the municipalities of Santo Antônio do Leverger, Nossa Senhora do Livramento and Curvelândia.

In Brazil, TL affects both genders and all age groups, however, it is more prevalent in individuals older than 10 years old (90%) and male (74%) (BRASIL, 2017a). In agreement with these epidemiological characteristics, our data showed that 78% of

TL patients were male and 52% were between 30 and 50 years old. In contrast, only 18% of TL patients were over 60 years old.

In most cases, patients with TL were cured from the disease; however, in 20% of cases, treatment was abandoned or transferred or patients failed to complete the notification form.

Regarding the surveillance for the canine reservoir, it is verified that the municipality of Poconé was consistently sending samples

for analysis (4163) almost every year (2007, 2008, 2009, 2010, 2011, 2012, 2014 and 2015); in contrast, there is no information on the presence of VL positive dogs in Curvelândia, because in the last 10 years only one sample was sent that was not positive for VL. Despite being the largest municipality in the region, in terms of territorial extension and number of inhabitants, Cáceres minimally performed canine surveillance activities; during the years of the study (2007, 2008, 2010 and 2012), only in 2007 the sample collection included more than 50 dogs.

Table 3 shows that the positivity index ranged between 0% and 100%, suggesting situations that do not correspond to the reality in certain municipalities, such as Barão de Melgaço in 2007, Curvelândia in 2008, and Cáceres in 2010 and 2012. In these cases, the number of samples submitted for analysis was extremely low, and probably correspond to spontaneous demand, thus generating a misleading impression of high prevalence of canine leishmaniasis. In urban areas, dogs are the main source for human infection. Therefore, to prevent occurrence of the disease in humans, serological survey actions are recommended by the Ministry of Health, so that infected animals can be identified and removed from the area (BRASIL, 2014).

Previous studies in Mato Grosso have indicated variable prevalence of canine visceral leishmaniasis (CVL): in Jaciara, 35.6% (ranging from 13.6 to 70%) (BRITO et al., 2014a), in Cuiabá, 22.1% (ALMEIDA et al., 2012) and in Barão de Melgaço 4.2% (DIAS et al., 2017).

Other reservoirs, wild and synanthropic, participate in the *Leishmania* transmission cycle. Roque & Jansen (2014), cite different orders of mammals (Didelphimorphia, Pilosa, Cingulata, Rodentia, Carnivora and Primata) infected by several species of *Leishmania* responsible for the integument form; however, they conclude that the reservoirs of these species are still unknown, probably because the researches have concentrated on the search for a specific host as observed for dogs and *Leishmania infantum* and that, however, these species of *Leishmania* can be kept in the wild through a reservoir system. In this region of the Pantanal Norte, data with these species are scarce; however, in Corumbá, in the state of Mato Grosso do Sul, the serological and molecular tests (PCR) with different wild mammals demonstrated the occurrence of *Leishmania* in 50% of the quatis (*Nasua nasua*), 9/18, 56% of the monkeys (*Sapajus cay*), 5/9 and 40% of the foxes (*Cerdocyon thous*), 2/5, but the study did not identify the species of *Leishmania* involved (PORFIRIO et al., 2018).

Information regarding the vectors is fundamental to understand the dynamics of transmission, thus helping to plan preventive and control measures. Activities aimed at entomological surveillance varied at different intervals. The municipalities of Nossa Senhora do Livramento, Itiquira and Poconé performed the greatest number of studies to identify potential vectors. In Curvelândia, the activity was performed in a cavern and there was no record of species of medical importance. Santo Antônio do Leverger performed two surveys with only vectors of TL, however, the presence of *L. cruzi* had already been reported in the municipality in previous years (MISSAWA & LIMA, 2006).

Important species in the transmission of the etiological agent of VL were observed in five out of the seven municipalities that were part of the research (BRASIL, 2014). *Lutzomyia longipalpis*,

the main vector in Brazil, is present in most member states, demonstrating the high adaptability to different types of vegetation, climates, habitats and food availability (LAINSON & RANGEL, 2005; FALCÃO DE OLIVEIRA et al., 2017). *Lutzomyia cruzi* is the *Leishmania infantum* vector in some areas of Mato Grosso do Sul (FALCÃO DE OLIVEIRA et al., 2017) and Mato Grosso (BRITO et al., 2014b). The highest frequency of *L. cruzi* was found in municipalities within Pantanal and Cerrado, indicating that these are the preferred environments of this species (MISSAWA & LIMA, 2006).

The main species involved in the transmission of TL, *L. whitmani*, was identified in all municipalities, except for Curvelândia; is considered a vector for *L. braziliensis* in the northeast, southeast, central-west and south of Brazil, and for *L. shawi* in the north and *L. guianenses* in the Amazon; in the State of Mato Grosso, the distribution of this species in areas of Amazon forest, Cerrado and Pantanal, indicating that this is probably the most well-adapted species of phlebotomine sandflies in the state (MISSAWA et al., 2008). In Barão de Melgaço and Itiquira, *L. flaviscutellata*, an important vector of *Leishmania amazonensis*, was also observed (LAINSON & SHAW, 1968). *Lutzomyia flaviscutellata* is a wild phlebotomine sandfly found at ground level that feeds on a wide variety of animals, including marsupials and birds, but is strongly attracted to rodents (CARVALHO et al., 2015). In Cáceres there was also a record of *L. migonei*, a species mainly related to tegumentary leishmaniasis (RANGEL & LAINSON, 2009), but with evidence of *L. infantum* transmission in La Banda in Argentina, São Vicente Férrer in Pernambuco and Fortaleza in Ceará (SILVA et al., 2014; RODRIGUES et al., 2016).

The activities of Health Surveillance are fundamental to perceive the changes in the environmental context, in order to predict the events and to act in a timely manner, avoiding or reducing the risks of illness. Despite the existence of programs to control leishmaniasis, negligence in relation to these diseases is quite common, with actions aimed at the control of the vector and reservoir developed unsatisfactorily. Although the Pantanal region did not present expressive numbers of cases of leishmaniasis, the presence of vectors in most of the municipalities studied, as well as reagents dogs for VL, demonstrates the need to strengthen services aimed at controlling this disease.

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