

***Lutzomyia longipalpis* (Diptera, Psychodidae, Phlebotominae) and urbanization of visceral leishmaniasis in Brazil**

Lutzomyia longipalpis (Diptera, Psychodidae, Phlebotominae) e urbanização da leishmaniose visceral no Brasil

Elizabeth F. Rangel ¹
Maurício L. Vilela ¹

¹ Instituto Oswaldo Cruz,
Fundação Oswaldo Cruz,
Rio de Janeiro, Brasil.

Correspondence
E. F. Rangel
Laboratório de Transmissores
de Leishmanioses, Instituto
Oswaldo Cruz, Fundação
Oswaldo Cruz.
Av. Brasil 4365, Rio de
Janeiro, RJ
21045-900, Brasil.
efrangel@ioc.fiocruz.br

Abstract

*The article discusses habits related to the vectorial competence of *Lutzomyia longipalpis*, along with evidence confirming the importance of this sand fly species in the epidemiological chain of visceral leishmaniasis in Brazil. A new epidemiological profile for visceral leishmaniasis is also postulated, associated with domestic environments and the role of *Lu. longipalpis* in this process, its sylvatic origin, and its capacity to adapt to a wide range of habitats. Another sand fly species, *Lu. cruzi*, is mentioned as a vector of visceral leishmaniasis in some municipalities in Central Brazil, based on studies in endemic areas of the country.*

Psychodidae; Disease Vectors; Visceral Leishmaniasis; Urbanization

The history of visceral leishmaniasis in Brazil was initially associated with the rural environment, based especially on studies in Sobral, Ceará State, from 1954 to 1956, when a serious epidemic led to dozens of deaths. At the time, the logic was that dogs and the vector were links in the epidemiological chain in the domestic setting. *Lutzomyia longipalpis* was identified as the vector, based on consistent evidence from various studies concerning this sand fly's vectorial competence ^{1,2,3}.

Drastic environmental alterations caused by human action have changed the ecology of some sand fly species and leishmanias and thus the epidemiology of the leishmaniases. Therefore, a new transmission profile should be considered, in which humans are no longer accidental hosts, since they now live in close and frequent association with the epidemiological chain ⁴. Continuous deforestation and slashing-and-burning on the expanding agricultural frontiers, extractivism, rural settlements, wildcat mining camps, and dams and hydroelectric plants are factors that can favor outbreaks. Steady migratory flows constitute another socioeconomic component, with poor populations in underdeveloped countries seeking to improve their quality of life by moving to urban areas ⁴.

Transmission of visceral leishmaniasis has been reported in more than 1,600 municipalities in 19 of the 27 Brazilian States and is present to date in all regions of the country except perhaps the South. An epidemiological evaluation of the

last 13 years shows alterations in the transmission profile, originally characterized by a rural pattern (with only occasional cases on the periphery of some cities), but with the current profile associated with large cities like Corumbá (Mato Grosso do Sul) and Araçatuba (São Paulo) and some State capitals, including Campo Grande (Mato Grosso do Sul), Belo Horizonte (Minas Gerais), Palmas (Tocantis), Teresina (Piauí), and São Luís (Maranhão) ⁵.

Lu. longipalpis is the most important visceral leishmaniasis vector in the Americas, and is certainly the only sand fly species (including those associated with transmission of the etiological agents of tegumentary leishmaniasis) that meets all the established criteria for vectorial competence ⁶, highlighting those that are considered essential, like anthropophilia, spatial distribution coinciding with human cases of the disease, and natural infection by *Leishmania (L.) infantum chagasi* ^{3,6,7,8}.

In Brazil, *Lu. longipalpis*, although already displaying extensive geographic distribution, appears to be undergoing further territorial expansion, with Acre, Amazonas, Amapá, Paraná, Santa Catarina, and Rio Grande do Sul as the only States that have still not reported cases ⁵.

Pioneering reports on the sylvatic origin of *Lu. longipalpis* were obtained from studies conducted most consistently in the North, where the species was believed to be participating in the primary transmission chain of *L. (L.) infantum chagasi*. In the State of Pará, the species was shown to be sylvatic, while adapting to human dwellings in impacted areas ^{9,10,11}. It was suggested that the species occurred in forests, far from dwellings, but with particularly eclectic habits and great capacity to adapt to the peridomicile (chicken coops) around houses built along roads, as along the highway that connected Igarapé-Miri to Tucuruí, where *Lu. longipalpis* had invaded residences after just 18 months of highway construction (there was evidence that *Lu. longipalpis* females were feeding on a variety of mammals and invading residences) ¹². Based on research in the Amazon Region, it was also suggested that this sand fly could establish its breeding sites in forest areas.

By 1973, reports ¹³ in the Southeast and Northeast of Brazil already showed the presence of *Lu. longipalpis* inside human dwellings and in outbuildings with domestic and farm animals, including donkey corrals.

This sand fly gradually colonized the rural environment, and in the late 1980s the species began invading the urban environment, especially the periphery of large cities, where it was captured in the intradomiciliary and peridomiciliary

settings (in the latter case in outbuildings with domestic animals) ⁸.

One can logically suppose that some aspects of *Lu. longipalpis* behavior play a determinant role in this context of urbanization of visceral leishmaniasis, especially its flexible eating habits (an eclectic search for blood meal sources) and easy adaptation to domestic conditions, allowing positive captures inside human dwellings and animal pens.

In the 1980s, outbreaks of visceral leishmaniasis in Teresina and São Luís motivated the development of epidemiological studies, including those focusing on the *Lu. Longipalpis* vector ^{14,15,16,17}.

In the State of Piauí, visceral leishmaniasis has been reported since 1934 ¹⁴. In 1980, as the disease spread, the urban area of the State capital Teresina recorded a large number of human cases ¹⁵, subsequently confirming the concentration of the disease inside the city limits ¹⁶. Based on observations, *Lu. longipalpis* was infesting human dwellings, and it was possible to hypothesize a positive correlation between the number of human cases and the household vector infestation rate ¹⁵. In 1994, naturally infected specimens of *Lu. longipalpis* were captured in Teresina, thus corroborating the vector's infection in the urban setting ¹⁷. Later (2001), *Lu. longipalpis* continued to be captured in human dwellings in Piauí ¹⁸, clearly demonstrating the sand fly's adaptation to the urban setting.

The outbreak of visceral leishmaniasis in São Luís, Maranhão, in 1983, led to an increase in research on the vector, showing both the anthropophilia of *Lu. Longipalpis* and specimens naturally infected with suprapylarian promastigotes, suggested as *Leishmania* ¹⁹. Since then, in this same municipality, studies have aimed to expand the knowledge on the sand fly's habits. The species has been shown to live in perfect harmony with humans and domestic animals, and its seasonality and hourly occurrence in the intra and peridomicile have been identified. The species has been found with high density in nearly every month of the year, and has been captured throughout the night, but especially from 8:00 PM to 2:00 AM in the intradomicile and from 6:00 to 10:00 PM in the peridomicile ^{20,21}. According to recent studies on the island of São Luís, *Lu. longipalpis* adapts easily to the human environment ^{22,23}.

More recently, Campo Grande, capital of the Brazilian State of Mato Grosso do Sul, reported the spread of visceral leishmaniasis in the urban environment, leading to more systematic studies on *Lu. longipalpis*.

Mato Grosso do Sul is perhaps the State where the leishmaniasis pose the worst public

health problem, especially visceral leishmaniasis, which has been endemic since 1980 in some cities classified as having intense transmission, particularly Corumbá^{24,25}. Based on reports of human visceral leishmaniasis in Corumbá in the 1980s, studies were done to verify the vector's presence. The most frequent sand fly species included *Lu. cruzi*, showing high density in the intra and peridomicile as an anthropophilic species²⁶. *Lu. cruzi* naturally infected with *L. (L.) infantum chagasi* was later reported, and considering the apparent absence of *Lu. longipalpis*, the former sand fly was suggested as the vector for visceral leishmaniasis in the Corumbá/Ladário region²⁷. While the disease was initially limited to this region, in 1995 it began spreading, and 2002 witnessed the first reports of autochthonous human cases in Campo Grande, with a gradual increase in the number of reported cases²⁸. In 2000, *Lu. longipalpis* had already been detected in the urban area of this municipality²⁹. Recently, in 2006²⁵, studies on the sand fly fauna in the urban area of Campo Grande showed clearly that *Lu. longipalpis* was the most abundant species (92.22%) in the human environment, pointing to a six-fold increase in this sand fly's density as compared to studies from 1999-2000. Based on these data, the authors suggest that the high density of *Lu. longipalpis* is the principal risk factor for visceral

leishmaniasis transmission in the urban area. As a whole, the studies in Campo Grande²⁸ showed that this sand fly is highly anthropophilic, although displaying exceptionally eclectic eating habits.

Clearly, the history of visceral leishmaniasis epidemiology in Brazil has shown a constant role for *Lu. longipalpis* as an essential link in the transmission chain. Its ability to feed frequently on domestic and synanthropic animals, as well as its noteworthy anthropophilia, favor *Lu. longipalpis* in its adaptation to modified environments, meanwhile allowing the maintenance of the visceral leishmaniasis transmission cycle in the rural environment and its spread to urbanized areas, thus leading to differentiated transmission profiles. This sand fly's gradual encroachment from the sylvatic environment into periurban areas and the observation of the evident urbanization process, the result of the vector's competence for colonizing impacted areas, highlight the importance of entomological surveillance and monitoring measures for qualitative and quantitative assessment of the vector. Importantly, there is a need to add new knowledge on *Lu. Longipalpis* biology, especially considering entomological indicators, like the infection rate, with a view towards surveillance measures.

Resumo

São apresentados os hábitos que condicionam a competência vetorial de Lutzomyia longipalpis e discutidas as evidências que confirmam a importância deste flebotômíneo na cadeia de transmissão da leishmaniose visceral no Brasil. Discute-se, também, o novo perfil epidemiológico da leishmaniose visceral, associado à ambientes urbanos, e o papel desempenhado por Lu. longipalpis neste processo, sua origem silvestre e capacidade de adaptação. É citado outro flebotômíneo, Lu. cruzi, como transmissor em alguns municípios da região central do Brasil, com base em estudos realizados em áreas endêmicas.

Psychodidae; Vetores de Doenças; Leishmaniose Visceral; Urbanização

Contributors

E. F. Rangel and M. L. Vilela conducted the literature review and wrote the manuscript.

Acknowledgements

The authors wish to thank Simone Miranda da Costa of the Leishmaniasis Vectors Laboratory, Oswaldo Cruz Institute, Oswaldo Cruz Foundation, for her assistance in the literature review.

References

- Deane MP, Deane LM. Infecção natural do *Phlebotomus longipalpis* por leptomonas, provavelmente de *Leishmania donovani*, em foco de calazar, no Ceará. O Hospital 1954; 45:697-702.
- Deane LM, Deane MP. Encontro de leishmânias nas vísceras e na pele de uma raposa, em zona endêmica de calazar, nos arredores de Sobral, Ceará. O Hospital 1954; 45:419-21.
- Deane LM. Leishmaniose visceral no Brasil. Estudos sobre reservatórios e transmissores realizados no Estado do Ceará. Rio de Janeiro: Serviço Nacional de Educação Sanitária; 1956.
- Rangel EF. Transmission of American cutaneous leishmaniasis in peridomestic foci in Rio de Janeiro State and other similar situations compared to the classical epidemiology in Amazon region. In: Proceedings from a Research Seminar on Tropical Diseases, Society and the Environment. v. 2. Geneva: Special Programme for Research and Training in Tropical Diseases/SAREC; 1995. p. 103-10.
- Secretaria de Vigilância em Saúde, Ministério da Saúde. Manual de vigilância e controle da leishmaniose visceral. Brasília: Ministério da Saúde; 2003.
- Killick-Kendrick R. Phlebotomine vectors of the leishmaniasis: a review. Med Vet Entomol 1990; 4:1-24.
- Lainson R, Shaw JJ. New World leishmaniasis – the neotropical *Leishmania* species. In: Collier L, Balows A, Sussman M, editors. Topley & Wilson's Microbiology Infections. 9th Ed. London: Topley & Wilson's; 1998. p. 241-66.
- Lainson R, Rangel EF. *Lutzomyia longipalpis* and the eco-epidemiology of American visceral leishmaniasis, with particular reference to Brazil. Mem Inst Oswaldo Cruz 2005; 100:811-27.
- Lainson R, Shaw JJ, Silveira FT, Braga RR, Ryan L, Povoá MM, et al. *A Leishmania* e as leishmanioses. In: Lainson R, organizador. Instituto Evandro Chagas: 50 anos de contribuição às ciências biológicas e à medicina tropical. v. I. Serviços de saúde pública. Belém: Instituto Evandro Chagas; 1986. p. 83-124.
- Lainson R, Dye C, Shaw JJ, MacDonald DW, Courtenay O, Souza AA, et al. Amazonian visceral leishmaniasis – distribution of the vector *Lutzomyia longipalpis* (Lutz & Neiva) in relation to the fox *Cerdocyon thous* (Linn.) and the efficiency of this reservoir host as a source of infection. Mem Inst Oswaldo Cruz 1990; 85:135-7.
- Ryan L, Lainson R, Shaw JJ, Fraiha H. Ecologia de flebotomíneos (Diptera: Psychodidae: Phlebotominae) na Região Amazônica. In: Lainson R, organizador. Instituto Evandro Chagas: 50 anos de contribuição às ciências biológicas e à medicina tropical. v. I. Serviços de saúde pública. Belém: Instituto Evandro Chagas; 1986. p. 307-20.
- Lainson R, Rangel EF. Ecologia das leishmanioses: *Lutzomyia longipalpis* e a eco-epidemiologia da leishmaniose visceral americana no Brasil. In: Rangel EF, Lainson R, organizadores. Flebotomíneos do Brasil. Rio de Janeiro: Editora Fiocruz; 2003. p. 311-36.
- Forattini OP. Entomologia médica. v. 4. São Paulo: Editora Blücher; 1973.
- Alencar JE, Diniz JO, Pessoa Filho FP, Aragão TC, Correia TA. Alguns focos de calazar no Piauí. In: Anais do 13^o Congresso Brasileiro de Higiene. Fortaleza; 1956.
- Costa CHN, Pereira HF, Araújo MA. Epidemia de leishmaniose visceral no Estado do Piauí, Brasil, 1980-1986. Rev Saúde Pública 1990; 24:361-72.
- Costa CHN. Urbanization of kala-azar in Brazil: kala-azar in Teresina, Piauí, Brazil. In: Research and Control of Leishmaniasis in Brazil, Proceedings of a National Workshop. Rio de Janeiro: Fundação Oswaldo Cruz; 1993. p. 109-24.
- Vexenat JA, Fonseca-de-Castro JA, Cavalcante R, Tavares JP, Da Silva MR, Batista WH, et al. Visceral leishmaniasis in Teresina, State of Piauí, Brazil: preliminary observations on the detection and transmissibility of canine and sandfly infections. Mem Inst Oswaldo Cruz 1994; 89:131-5.
- Andrade-Filho JD, Silva ACL, Falcão AL. Phlebotomine sand flies in the State of Piauí, Brazil (Diptera: Psychodidae: Phlebotominae). Mem Inst Oswaldo Cruz 2001; 96:1085-7.
- Ryan L, Brazil RP. *Leishmania* infections in *Lutzomyia longipalpis* (Diptera: Psychodidae) on the island of São Luís, Maranhão State, Brazil. Mem Inst Oswaldo Cruz 1984; 79:383-4.
- Rebêlo JMM, Araújo JC, Carvalho ML, Barros VLL, Silva FS, Oliveira ST. Flebotomos (*Lutzomyia*, Phlebotominae) da Ilha de São Luís, zona do Golfão Maranhense, Brasil. Rev Soc Bras Med Trop 1999; 32:247-53.
- Rebêlo JMM. Frequência horária e sazonalidade de *Lutzomyia longipalpis* (Diptera: Psychodidae: Phlebotominae) na Ilha de São Luís, Maranhão, Brasil. Cad Saúde Pública 2001; 17:221-7.
- Soares MRA, Rebêlo JMM, Barros VLL, Moraes JLP, Santos LS, Fonteles RS, et al. Flebotomíneos (Diptera: Psychodidae) identificados de duas áreas endêmicas de leishmaniose visceral americana na Ilha de São Luís – MA. Rev Soc Bras Med Trop 2006; 39 Suppl 1:77.
- Penha TA, Abreusilva AL, Oliveira AC, Santos ACG, Moraes JLP, Rebêlo JMM, et al. Flebotomíneos em área endêmica de leishmaniose visceral canina no Município de São Luís Maranhão. Rev Soc Bras Med Trop 2006; 39 Suppl 1:77.
- Nunes VLB, Yamamoto YY, Rego Junior FA, Dorval MEC, Galati EAB, Oshiro ET. Aspectos epidemiológicos da leishmaniose visceral em cães de Corumbá, Mato Grosso do Sul. Pesqui Vet Bras 1988; 8:17-21.
- Oliveira AG, Galati EAB, De Oliveira O, De Oliveira GR, Espindola IA, Dorval ME, et al. Abundance of *Lutzomyia longipalpis* (Diptera: Psychodidae: Phlebotominae) and urban transmission of visceral leishmaniasis in Campo Grande, state of Mato Grosso do Sul, Brazil. Mem Inst Oswaldo Cruz 2006; 101:869-74.
- Galati EAB, Nunes VLB, Rego Jr. FA, Oshiro ET, Chang MR. Estudo de flebotomíneos (Diptera: Psychodidae) em foco de leishmaniose visceral no Estado de Mato Grosso do Sul, Brasil. Rev Saúde Pública 1997; 31:378-90.

27. Santos SO, Arias J, Ribeiro AA, Hoffmann MP, Freitas RA, Malacco MAF. Incrimination of *Lutzomyia cruzi* as a vector of American visceral leishmaniasis. *Med Vet Entomol* 1998; 12:315-7.
28. Oliveira A. Estudos ecológicos de phlebotominae (Diptera: Psychodidae) em área urbana no município de Campo Grande, Estado de Mato Grosso do Sul [Doctoral Dissertation]. Rio de Janeiro: Instituto Oswaldo Cruz, Fundação Oswaldo Cruz; 2006.
29. Oliveira AG, Falcão AL, Brasil RP. Primeiro encontro de *Lutzomyia longipalpis* (Lutz & Neiva, 1912) na área urbana de Campo Grande, MS, Brasil. *Rev Saúde Pública* 2000; 34:654-5.

Submitted on 02/Oct/2008

Approved on 13/Oct/2008