

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

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

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### **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 <sup>1,2,3</sup>.

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 <sup>4</sup>. 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 <sup>4</sup>.

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) <sup>5</sup>.

*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 <sup>6</sup>, 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* <sup>3,6,7,8</sup>.

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 <sup>5</sup>.

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 <sup>9,10,11</sup>. 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) <sup>12</sup>. 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 <sup>13</sup> 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) <sup>8</sup>.

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 <sup>14,15,16,17</sup>.

In the State of Piauí, visceral leishmaniasis has been reported since 1934 <sup>14</sup>. In 1980, as the disease spread, the urban area of the State capital Teresina recorded a large number of human cases <sup>15</sup>, subsequently confirming the concentration of the disease inside the city limits <sup>16</sup>. 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 <sup>15</sup>. In 1994, naturally infected specimens of *Lu. longipalpis* were captured in Teresina, thus corroborating the vector's infection in the urban setting <sup>17</sup>. Later (2001), *Lu. longipalpis* continued to be captured in human dwellings in Piauí <sup>18</sup>, 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* <sup>19</sup>. 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 <sup>20,21</sup>. According to recent studies on the island of São Luís, *Lu. longipalpis* adapts easily to the human environment <sup>22,23</sup>.

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<sup>24,25</sup>. 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 species<sup>26</sup>. *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 region<sup>27</sup>. 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 cases<sup>28</sup>. In 2000, *Lu. longipalpis* had already been detected in the urban area of this municipality<sup>29</sup>. Recently, in 2006<sup>25</sup>, 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 Grande<sup>28</sup> 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.

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