



Phlebotomine fauna in the urban area of Timóteo, State of Minas Gerais, Brazil



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ARTICLE INFO

Article history:

Received 29 October 2013

Received in revised form 19 February 2014

Accepted 23 February 2014

Available online 5 March 2014

Keywords:

Seasonality

Lutzomyia whitmani

Leishmaniasis

Urban transmission

ABSTRACT

This work is characterized by an entomological research and an investigation on whether seasonal behaviours can be associated to the phlebotomine fauna found in the urban area of Timóteo-MG – an endemic focus of tegumentary leishmaniasis (TL). The analysis of the seasonal behaviour of sand flies has taken into account the following climatic variables: rainfall, relative humidity and temperature. Automatic light traps were installed in households between 2009 and 2010. The sand fly species with the highest number captured was *Lutzomyia whitmani* (66.5%), a TL vector species, whose abundance has provided strong evidences that this species is the main vector of TL in the municipality of Timóteo, with its cycle of transmission developing in its urban area. Amongst the results observed in the analyses of seasonal behaviour, only temperature conveyed particular association between seasonal occurrence of sand flies and climate variables. The findings of this study may assist the local epidemiological surveillance agency in defining strategies and directing efforts for controlling these insects.

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1. Introduction

Phlebotomine are insects of the order Diptera, family Psychodidae and contained within the subfamily Phlebotominae; some species of this group of insects transmit leishmaniasis which is associated with infectious forms of *Leishmania* spp. The first descriptions of phlebotomine sand flies in the Americas date back to 1907, and by 1940 around 33 species had been documented. With the indictment of some species of sand flies as vectors of *Leishmania* spp., researches focused on this insect have deepened, thus taking the extent of identified species and subspecies of sand flies in the Americas to approximately 500. Brazil records many species of phlebotomine sand flies, about 229 species and subspecies have already been identified nationwide (Aguilar and Medeiros, 2003).

Not surprisingly, such variety of phlebotomine sand flies is one of the main factors behind Brazil's high incidence of tegumentary leishmaniasis (TL). It is estimated that predominantly Brazil along with Iran, Peru, Saudi Arabia and Syria, account for 90% of all cases leishmaniasis reported worldwide (Alvar et al., 2012). Cases of TL in Brazil are on the rise; in the early 1980s autochthonous cases were reported in 19 of the Brazilian federal units, and by 2003 autochthonous cases of tegumentary leishmaniasis had been documented in all Brazilian states (Brasil, 2011).

The increasing incidence of TL over the years, directly coincides with migration and human occupation; often disorderly, they can be associated with the dilapidation of the native flora, construction of inadequate dwellings in inappropriate sites, poor sanitation, and allocation of animal shelters in peridomestic environments. Such actions have a direct impact upon the behaviour of, and in the habitat of both vectors and reservoir species for leishmaniasis, which conversely have allowed species selection and their adaptation to anthropic environments; thus partially explaining both occurrence and persistence of leishmaniasis in domestic and peridomestic spaces (Teodoro, 1996; Teodoro et al., 2001; Lima et al., 2002).

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Over the past decades, several areas of the Brazilian territory have been affected by the urbanization of leishmaniasis with growing new records of this disease being reported in humans. According to the Brazilian Ministry of Health (Brasil, 2011), in the state of Minas Gerais alone, outbreaks of TL between 2001 and 2010 have pushed the number of reported cases from 1116 to 1887. Greater understanding of the phlebotomine fauna in surroundings with recorded cases of human leishmaniasis is vital to identifying likely vectors, and to understand changes in the diversity of this fauna. Such knowledge, in turn, allows the identification of species unknown as to existing in areas affected by Leishmaniasis.

As a result of the adaptation likelihood of phlebotomine sand flies to urban environments, advanced studies on the potential variations of this fauna, could equally foretell changes in the behaviour patterns of the disease, as well as its associated risks to human habitations and peridomestic environments; thus allowing measures to curb population exposure. Moreover, analysis on the seasonal occurrence of sand flies is another key factor that has been receiving greater scholarly attention. The main climatic variables often associated with the occurrence of phlebotomine sand flies are temperature (Andrade Filho et al., 1998; Dias et al., 2007; Gomes et al., 1980; Mayo et al., 1998; Salomon et al., 2002; Saraiva et al., 2006), rainfall (Dias et al., 2007; Salomon et al., 2002), and relative humidity (Andrade Filho et al., 1998; Dias et al., 2007; Gomes et al., 1980; Saraiva et al., 2006). These variables have been applied to elucidating the behaviour of sand flies and, consequently, possible variants in cases of leishmaniasis affecting humans. Information of this nature contributes to the development of more effective controlling and deterrent measures to prevent TL from dispersing into areas at risk.

Since 2002, the municipality of Timóteo, in the state of Minas Gerais (BR), has been systematically recording human cases of TL, and up to 2010, 164 cases of tegumentary leishmaniasis have been accounted for. Aiming to better understanding the dynamics of the transmission of TL within the referred township, this research is aimed at studying the existing phlebotomine fauna in the urban area of Timóteo, and at analysing whether the occurrence of seasonality behaviours of sand flies can be associated to the municipality object of this study.

2. Materials and methods

2.1. Study area

This study was undertaken in the municipality of Timóteo, which is located in the metropolitan area of the Vale do Aço, east Minas Gerais; an area of approximately 144,381 km², and population of 81,119 inhabitants, of whom 99.9% live within the urban area (IBGE, 2010).

Timóteo enjoys a high-altitude tropical climate, with droughts in the winter and rains during summer; with the temperature reaching 15 °C in winter and 35 in summer. The terrain is rather uneven and characterized mainly by mountains; the native vegetation is regarded as tropical rainforest typical of the southeast of Brazil, with some riparian and gallery forests, which unfortunately are currently limited to a few scattered spots and confined within the neighbouring State Park of Rio Doce, one of Brazil's largest conservation areas of Atlantic Rainforest (PMT, 2011).

2.2. Choice of capture sites, sample collection and identification of phlebotomines

To investigate the phlebotomine fauna, automatic light traps were placed in some households within the urban area of Timóteo. The primarily target was habitations where human cases of TL had

been reported between January 2002 and July 2009, followed by other residences that in the same period were free from TL. The allocation of sampling points and trap settings was oriented by the municipality's map, taking into account its census subdivisions, which total 95 census district areas (IBGE, 2009). Residences with reported cases of tegumentary leishmaniasis in the aforementioned period were pinpointed on the map, and then a circumference with a radius of 250 metres was drawn with the aid of CorelDraw® Graphics Suite X4. The maximal distance of 250 m was established considering that as one intention was to investigate the presence of sand flies nearby households with and without recorded cases of TL, and consequently the greater or lesser likelihood of transmission of *Leishmania*, so even a small distance would suffice to support the findings. Also, previous investigations carried out in the Americas describe movements within small radius as below 200 m (Alexander and Young, 1992), below 60 m (Casanova et al., 2005), and below 57 m (Chaniotis et al., 1974) and below 180 m (Galati et al., 2009). Moreover, as some households with recorded cases of TL were located very close to each other, defining a large radius would make it difficult to characterize the peridomicile in terms of the presence of sand flies.

After that, all households identified by isolated circumferences were singled out as sampling points, whilst areas identified by overlapping circumferences were considered as one distinct area out of which the residences that better represented the total area, in spatial terms, were visually selected.

In addition to the traps described above, additional trapping devices were also set up at residences located within the census district areas that up to July 2009 had no records of TL. 20% of a grand total of 75 census district areas free of reported cases of TL were randomly chosen, resulting in 15 districts. Then, in an arbitrarily manner, a respective street, avenue or square was elicited from each one of the 15 selected districts, where at the 15 corresponding selected residences, a trap was then set up (Fig. 1).

According to the above criteria, 30 traps, Falcão model (Falcão, 1981) (Fig. 2) were installed at households with recorded cases of TL, and 15 in residences that up to October 2009 were free of TL (Fig. 1). A 'Falcão' (Falcão, 1981) light trap was deployed in each household for two succeeding nights in every month between November 2009 and October 2010. The traps were installed at a maximum distance of 20 m from each residence, and at 150 cm from the ground; totalling 45 trapping devices. Priority was given to resting site of domestic animals and orchards. Traps were activated at 18:00 and collected at 06:00 of the following day. Specimen triage took place at Timóteo's Department of Health with support provided by the staff from the Centre for Zoonosis Control. All captured insects were sacrificed by refrigeration; male and females were separated, slide-mounted and identified following the classification proposed by Young and Duncan (1994).

2.3. Analysis

The data were compiled in tables, based on a calculation of the proportion and prevalence of sand flies according to species, sex, and place of capture. The seasonal behaviour analysis was based upon the proportional distribution of sand flies (by totals and by sex) given their capture within periods aggregated in trimesters; the proportions were compared using the χ^2 test (chi-squared). Both descriptive and Pearson correlation analyses were also carried out on both: proportions of captured sand flies (by totals and by gender), and climatic variables: temperature (°C), rainfall (%) and humidity (mm). The data pursuant to climatic variables contained within the collection period (November 2009 to October 2010) was derived from the National Institute of Meteorology (2009) website; these climatic variables were then examined by descriptive statistics (mean, median, and standard deviation) according to the

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