



Article/Artigo

Occurrence of synanthropic triatomines (Hemiptera: Reduviidae) in the Federal District of Brazil

Ocorrência de triatomíneos sinantrópicos (Hemiptera: Reduviidae) no Distrito Federal, Brasil

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ABSTRACT

Introduction: Entomological surveillance of Chagas disease in the Federal District of Brazil (DF), has recorded the following triatomine species: *Panstrongylus megistus*, *P. geniculatus*, *P. diasi*, *Rhodnius neglectus*, *Triatoma pseudomaculata*, and *T. sordida*. We aimed to analyze the spatial and temporal occurrence of triatomine species collected in DF, and their indices of natural infection with trypanosomes. **Methods:** The Health State Secretariat of DF recorded triatomines between 2002 and 2010 in 20 administrative regions. This retrospective analysis considered the number of adults and nymphs of each species collected and infected in both intradomicile and peridomicile. **Results:** A total of 754 triatomines were collected in 252 reported domiciles. *Panstrongylus megistus* was the most frequent species (65%), followed by *T. pseudomaculata* (14%). Of the 309 examined insects, only 3 (1%) specimens of *P. megistus* were infected with flagellates morphologically similar to *Trypanosoma cruzi*. The spatial occurrence indicated a higher diversity of triatomines and frequency of *T. sordida* in rural areas. Moreover, there was a predominance of *P. megistus* in urban areas. The number of records of *P. megistus* in the rainy season was two times higher than that during the dry season. The largest number of triatomines was collected in November. **Conclusions:** The presence of *P. megistus* specimens infected with trypanosomes in domiciles, shows the potential risk of human infection in DF. Thus, it is essential to continue entomological surveillance, intensifying it in the rainy season and in regions of greater occurrence.

Keywords: Chagas disease control. Entomological surveillance. Synanthropic triatomines. Federal District. Brazil.

RESUMO

Introdução: As espécies de triatomíneos registradas pela vigilância entomológica da doença de Chagas no Distrito Federal (DF), Brasil, são *Panstrongylus megistus*, *Panstrongylus geniculatus*, *Panstrongylus diasi*, *Rhodnius neglectus*, *Triatoma pseudomaculata* e *Triatoma sordida*. Nosso objetivo foi analisar a ocorrência espacial e temporal das espécies de triatomíneos coletadas no DF, assim como seus índices de infecção natural por tripanosomatídeos. **Métodos:** Os triatomíneos foram registrados pela Secretaria de Saúde do DF, entre 2002 e 2010, em 20 regiões administrativas. Esta análise retrospectiva considerou o número de adultos e ninfas coletados e infectados de cada espécie no intra e peridomicílio. **Resultados:** Ao todo, foram coletados 754 triatomíneos em 252 unidades domiciliares notificadas. *Panstrongylus megistus* foi a espécie mais frequente (65%), seguida de *T. pseudomaculata* (14%). Dos 309 triatomíneos examinados, somente 3 (1%) espécimes de *P. megistus* estavam infectados por flagelados morfológicamente similares a *Trypanosoma cruzi*. A ocorrência espacial mostrou que houve maior diversidade de triatomíneos e maior frequência de *T. sordida* em áreas rurais. Além disso, houve predominância de *P. megistus* nas áreas urbanas. O número de registros de *P. megistus* no período chuvoso foi duas vezes maior que no período seco, sendo o maior número de coletas observado no mês de novembro. **Conclusões:** A presença de espécimes de *P. megistus* infectados por tripanosomatídeos em domicílios evidencia o potencial risco de infecção humana no DF. Dessa forma, é fundamental que continue a vigilância entomológica, intensificando-a no período chuvoso e nas regiões onde há maior ocorrência.

Palavras-chaves: Controle da doença de Chagas. Vigilância entomológica. Triatomíneos sinantrópicos. Distrito Federal. Brasil.

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Received in 28/05/2011

Accepted in 05/08/2011

INTRODUCTION

Entomological surveillance of Chagas disease in the Federal District of Brazil (DF), began in the 1980s with the establishment of triatomines information posts (PITs). These insects were sent to laboratory tests and were controlled with insecticides¹. During this period the recorded species were *Panstrongylus megistus* (Burmeister, 1835), *P. geniculatus* (Latreille, 1811), *P. diasi* Pinto & Lent, 1946, *Rhodnius neglectus* Lent, 1954, *Triatoma pseudomaculata* Corrêa & Espinola, 1964, and *T. sordida* (Stål, 1859). In 1999, after the decentralization of health actions at The National Health Foundation (FUNASA), activities involving the research, control, and surveillance of triatomines began to be conducted by the Environmental Surveillance Directory (DIVAL) of the Health State Secretariat of Federal District (SES-DF). The surveillance maintains a community participation strategy with a network of 64 PITs in schools and health care units in the administrative regions of DF.

According to Knox and Oliveira², *P. megistus* is the most widely distributed species in DF, followed by *T. pseudomaculata*, both recorded in intradomiciliary environments, thus drawing attention to a possible vectorial transmission of *Trypanosoma cruzi* to humans in DF, where autochthonous cases of Chagas disease have not been reported.

Studies on triatomines in wild environments have recorded *R. neglectus* and *Psammolestes tertius* Lent & Jurberg, 1965, in *Mauritia flexuosa* palm trees in DF^{3,4}. Other studies have shown enzootic circulation of *T. cruzi* and *T. rangeli* in gallery forests. Indices of natural infection with *T. cruzi* were 33% for mammalian reservoir (*Didelphis albiventris*) and 9% for *R. neglectus*⁵, thus showing the need to maintain entomological surveillance and to monitor the invasion and/or colonization of wild triatomines in domestic environments.

Even without records of vectorial transmission of Chagas disease in DF, there is a possible relation between the human reservoir of *T. cruzi* (71,736 Chagas disease patients in DF, according to the latest serological survey) and synanthropic

triatomines. Furthermore, the invasion and/or colonization of infected triatomines from wild ecotopes may represent the risk of vectorial transmission with the installation of peridomiciliary and domiciliary cycles of *T. cruzi*^{6,7}. In this context, the objective of this paper is to analyze the spatial and temporal occurrence of triatomine species collected in DF, as well as their indices of natural infection with trypanosomes to direct actions of entomological surveillance of Chagas disease coordinated by SES-DF.

METHODS

Study area

The Federal District of Brazil is geographically located between the parallels 15°30' and 16°03' south latitude, and between meridians 47°25' and 48°12' west longitude, in Central Brazil, one of the highest areas of the region, the Central Plateau. According to 2010 Census results, the population comprises 2,563,963 people in an area of 5,787,784km² divided into 30 administrative regions⁸. The area is filled with plateaus over 1,000m in altitude. The average annual rainfall is around 1,600mm, and the average annual temperature ranges between 18°C and 20°C with two distinct seasons, the dry season from May to September and the rainy season from October to April, the latter season with the highest temperature records⁹.

Triatomine collection and natural infection

The insects were collected in intradomiciliary and peridomiciliary environments by residents and then taken to the PITs. Each PIT receives a kit with materials for insect storage, a notepad to keep notes containing the address and location of collection, and tweezers for the handling of specimens.

After notification, the SES-DF public health agents did active searches in these houses and their annexes. The materials used for triatomine collection were metal tweezers and flashlights to inspect cracks and sites deprived of light; when necessary, dislodging liquid (Pirisa 2%) was applied. The insects were placed in polyethylene vials with shredded paper to better preserve them. The vials were properly numbered, tagged, and recorded on special forms of the Program for Chagas disease Control (PCDCh, SES-DF).

After collection, the insects were sent to the regional laboratory located at DIVAL for taxonomic identification¹⁰ and for a search of natural infection by flagellates morphologically similar to *T. cruzi*. The parasitological search was carried out from abdominal compression and subsequent fecal examination of fresh sample, and from slides stained with Giemsa®, based on the manual of regulations on organization and operation of laboratories for diagnosis of Chagas disease¹¹. The

visited domiciles were sprayed with insecticides by public health agents and were georeferenced by location with the support of geographical coordinates obtained with the Global Positioning System (GPS).

The analysis was based on occurrence data of triatomines between 2002 and 2010 in 20 administrative regions of DF, as supplied by PCDCh–SES-DF. For each recorded species, the total number of adults and nymphs collected and infected with flagellates morphologically similar to *T. cruzi* in intradomicile and peridomicile was analyzed. For statistical analysis, the number of triatomines collected from each identified species was related to the location of collection (administrative regions of DF) and to the month of collection by applying Friedman's nonparametric test ($\alpha = 0.01$). The tests were computed with Statistica®.

RESULTS

According to the reports provided by PCDCh, 754 triatomines were collected in 252 domiciles in DF between 2002 and 2010; on average, 84 triatomines were collected and 28 domiciles were reported per year. Eighty-one triatomines were not identified at species level due to poor preservation of specimens. *Panstrongylus megistus* was the most collected species (65%), followed by *T. pseudomaculata* (14%), *T. sordida* (8%), *P. geniculatus* (7%), *R. neglectus* (5%), and *P. diasi* (1%). In this same report, 117 triatomines did not present records from the environment of sampling and/or stages of development, and are not presented in **Table 1**.

Overall, 46% of triatomines were collected in intradomicile, these being adult insects more frequent in this environment (66%). In peridomicile there was a higher recorded frequency of nymphs (**Table 1**). In the group of 135 houses with a record of intradomiciliary infestation 16% presented triatomine colonization and 86 nymphs were collected, especially from *P. megistus* (66%). Colonies with up to 33 nymphs of *P. megistus* were also found in peridomicile. Among adults, the number of females was higher than that of males in both environments.

Out of 309 triatomines examined, only 3 (1%) specimens of *P. megistus* were infected with flagellates morphologically similar to *T. cruzi* in domiciles from three administrative regions of DF (Sobradinho, Taguatinga, and Águas Claras).

A relation was observed between the number of triatomines of each species that was collected and the location of occurrence (administrative regions of DF) (Friedman = 49.9; $p < 0.01$); the largest number of collections was observed in Planaltina, a predominantly rural region, with the highest diversity of triatomines and frequency of *T. sordida* (**Figure 1**). In most of the other administrative regions

TABLE 1 - Number of triatomines (adults and nymphs) collected in households and infected with flagellates morphologically similar to *Trypanosoma cruzi* in the Federal District, Brazil, from 2002 to 2010.

Species	Intradomicile				Peridomicile			
	Males	Females	Nymphs	Infected	Males	Females	Nymphs	Infected
<i>Panstrongylus megistus</i>	28	56	57	3	41	61	154	0
<i>Triatoma pseudomaculata</i>	14	17	5	0	3	2	7	0
<i>Triatoma sordida</i>	5	16	15	0	0	2	23	0
<i>Panstrongylus geniculatus</i>	10	4	0	0	3	1	0	0
<i>Rhodnius neglectus</i>	8	4	8	0	1	0	5	0
<i>Panstrongylus diasi</i>	1	4	1	0	0	0	0	0
Total	66	101	86	3	48	66	189	0

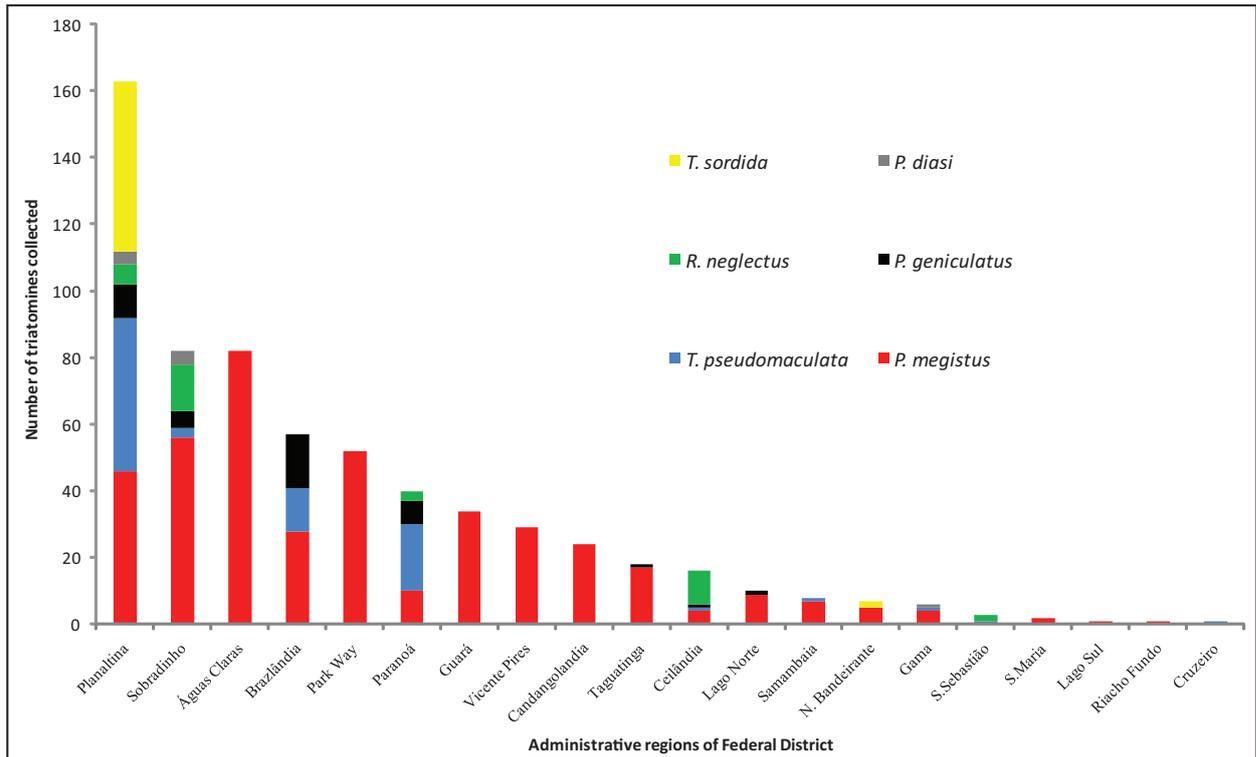


FIGURE 1 - Number of triatomine bugs collected by species in 20 administrative regions of Federal District, Brazil, between 2002 and 2010.

there was predominance of *P. megistus*, this being the only species collected in urban areas like Park Way, Águas Claras, and Guará (Figure 1).

By analyzing monthly data it was possible to observe that the number of triatomine records in the domiciliary environment during the rainy season (n=155) was higher than in the dry season (n=97). Considering only *P. megistus* (the most collected species in DF), the number of records during the rainy season (n=77) was two times higher than that during the dry season (n=38). The highest number of records occurred in November (Figure 2), which coincides with the onset of the rainy season. No significant differences were found between the number of triatomines collected from the other species over the months (Friedman = 11.8; p < 0.37).

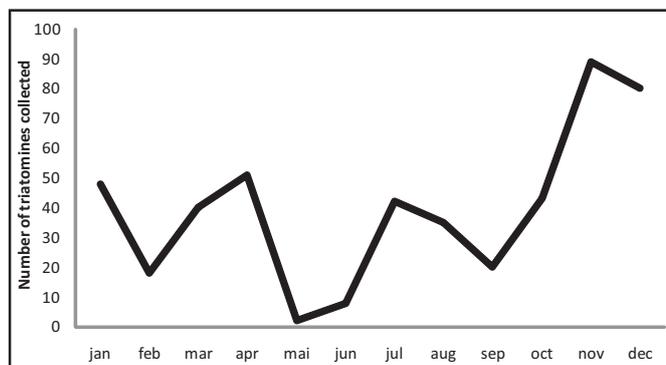


FIGURE 2 - Number of specimens of *Panstrongylus megistus* collected throughout the year in domiciles of Federal District, Brazil, between January 2002 and December 2010.

DISCUSSION

The results show that of the six species of triatomines collected in the domiciliary environment, *P. megistus* is the most important for epidemiological surveillance of Chagas disease in DF. In spite of the low indices for natural infection with trypanosomes for this species in DF, compared with studies in different regions of Brazil¹²⁻¹⁷, it is important to stress that some of the triatomines were found colonizing intradomicile and feeding on human blood according to precipitin tests (unpublished data), thus evidencing the risk of human infection. Our results also show that the spatial occurrence of triatomine species is different in the 20 administrative regions studied in DF, with the highest number of records and species richness observed in Planaltina, a predominantly rural region with the highest frequency of *T. sordida*. In most of the other administrative regions, areas with intense urbanization, a predominance of *P. megistus* was observed. The data also indicate that during the rainy season there are more records of triatomines, especially of *P. megistus* in November.

Between 1981 and 1996, a total of 4,007 specimens were recorded in DF, and the most collected species were *P. megistus*, *T. pseudomaculata*, *R. neglectus*, and *T. sordida*¹². Our data show that *P. megistus* remains the most frequent species, followed by *T. pseudomaculata*, *T. sordida*, *P. geniculatus*, *R. neglectus*, and *P. diasi*. A study on the geographic distribution of synanthropic triatomines in the state of Goiás in the 1990s indicated the existence of five species: *T. sordida*, *T. infestans*, *R. neglectus*, *P. megistus*, and *T. pseudomaculata*¹⁴. The species with highest natural infection rate with trypanosomes

was *P. megistus*, as observed in our study in DF. Between 2000 and 2003 four more species were reported in the State of Goiás: *P. diasi*, *T. costalimai*, *P. geniculatus*, and *T. lenti*¹⁸. As DF is geographically placed inside the State of Goiás, *T. costalimai* and *T. lenti* may also occur in wild environments in DF. *Psammolestes tertius* is found in some administrative regions of DF, in nests of *Phacelodorus ruber* birds, which are present in the crowns of *M. flexuosa* palm trees^{4,19}. Even though natural and experimental infection of *Ps. tertius* with *T. cruzi*²⁰ had already been observed, the former species has strong association with wild birds²¹ and, therefore, has low capacity of domiciliation. These behaviors may explain why *Ps. tertius* was never recorded by entomological surveillance in domiciles of DF^{1,2}. It appears *T. infestans* never occurred in domiciles of DF as it has not been recorded since the beginning of entomological surveillance^{1,2}.

Among the triatomine species found in Brazil, *P. megistus* presents different degrees of adaptation to the domestic environment. In the south of Brazil it occurs mainly in wild ecotopes^{16,22}, unlike in the southeast and northeast regions where *P. megistus* has greater epidemiological importance for occupying artificial ecotopes^{15,17,23-25}. Specimens of *P. megistus* prefer tree hollows in arboreal habitats^{26,27}, and they feed on marsupials (*Didelphis* spp.), which are frequently infected with *T. cruzi*, thus justifying high infection indices when compared with other species of triatomines^{26,28,29}. A study on *T. cruzi* reservoirs in DF showed that specimens of *D. albiventris* are responsible for maintaining enzootic circulation of the parasite in the region, where 33% of these mammals were infected⁵. However, *P. megistus* has varied feeding habits, also feeding on birds, dogs, cats, rodents, cattle, goats, pigs, and humans^{17,27,30}. Compared with other species such as *T. sordida*, *P. megistus* presents higher preferences for human blood, increasing the risk of transmission of *T. cruzi* by this vector³⁰.

In the administrative regions of Park Way, Águas Claras, Sobradinho, Guará, and Taguatinga, areas with high urban densification³¹, *P. megistus* was the predominant species. Knox et al.³² also reported the presence of *P. megistus* in DF in areas with intense anthropic pressure, but with remnants of native vegetation still left in ecological parks and gallery forests close to residences. The development of colonies of *P. megistus* occurs in humid environments^{23,33}, and it is possible that gallery forests may be the natural habitat of populations of this species. With the disorganized growth of administrative regions many domiciles are found close to these areas, and this may favor dispersal by flight and domiciliary invasion of these triatomines, stimulated by environmental changes such as reduction of food sources in the wild environment, presence of food sources in peridomicile, and/or rising temperature^{23,33-38}. In this context, urban areas surrounded by remainder forests and with marked climate change over the year (as in DF) are likely to favor the invasion of *P. megistus* in artificial ecotopes. Future ecological studies of wild populations of *P. megistus* in gallery forests of DF may clarify these questions. At a later time, genetic analysis and morphological comparisons among wild, domestic, and peridomestic populations may contribute towards an understanding of the infestation dynamics of this species in the domiciliary environment of DF.

Our results indicate that the invasion of *P. megistus* specimens (mainly females) in domiciles of DF occurs more often during the rainy season, especially in November. The increased occurrence of adult specimens of *P. megistus* in the domiciliary environment over the last trimester of the year was observed in other studies in different

regions of Brazil^{30,37,39,40}, indicating that these triatomines present a higher potential to colonize domiciles and their annexes in the rainy season. In DF, this period is marked by an increase in temperature as from October⁹, which can stimulate the flight activity of *P. megistus*, as already observed for other species of triatomines^{38,41}. The predominance of females in the domiciliary environment indicates their higher invasive potential in relation to males, which may be related to dispersion processes. A study on synanthropic triatomines in the state of Piauí showed that females of *T. brasiliensis* Neiva, 1911, and *T. sordida* were more frequently captured than males⁴², as observed for *P. megistus* and *T. sordida* in the present study.

Triatoma pseudomaculata was the second most collected species in DF. Unlike *P. megistus*, it lives under the barks of dead trees and in bird nests²⁷, presenting lower indices of natural infection with *T. cruzi*¹⁵. This species was often found in domiciles in Planaltina and Paranoá, and in some of these domiciles nymphs were collected, indicating colonization. Even though *T. pseudomaculata* is more frequent in peridomicile and usually feeds on birds, the colonization in domiciles has been observed in Sobral, Ceará, and Berilo, Minas Gerais, suggesting adaptation of this species in this environment^{25,43}. In the northeast of Brazil *T. pseudomaculata* has great importance for epidemiological surveillance of Chagas disease, its being the most frequent species after *T. brasiliensis*^{15,42}. Some studies have suggested that the increasing presence of *T. pseudomaculata* in the domiciliary environment is related to climate change, deforestation, and cropland expansion^{25,44}, which could explain the higher frequency of this species in the rural areas of Planaltina and Paranoá, observed in the present study.

Regardless of the fact that it has remained the most collected species in cerrado areas of Brazil for the past years^{18,45-47}, *T. sordida* presents a low risk of transmission of *T. cruzi* to humans because of its peridomiciliary behavior and marked ornithophily^{15,34,46-47}. Some studies show that zones of higher occurrence of *T. sordida* correspond to those of higher and older farm exploration³³, which may justify the higher frequency of this species in Planaltina.

Rhodnius neglectus is widespread in central Brazil and has an important role in enzootic transmission of *T. cruzi*^{5,7}. Apart from the invasion of adults in domiciles⁴⁸, there is evidence of household infestation of *R. neglectus* (with bugs occasionally establishing breeding colonies) in the States of Minas Gerais, Goiás, and São Paulo^{18,49,50}. *R. neglectus* occurs predominantly in wild environments, inhabiting different species of palm trees in Brazil⁵¹⁻⁵³. In DF it can be found in *M. flexuosa* palm trees^{3,4,19}, and sporadic occurrence in the administrative regions of Planaltina, Sobradinho, Ceilândia, and São Sebastião may be associated with the presence of palm trees in peridomicile. The role of these peridomiciliary palm trees in the maintenance of triatomines in DF should be evaluated in future studies.

Panstrongylus geniculatus occurred especially in Brazlândia, in the northwest region of DF, in agreement with the observations of Knox et al.³². In the wild environment *P. geniculatus* inhabits, preferentially, armadillo burrows (*Dasylops* spp.)^{26,27}, but it has been found in the domiciliary environment in different states of Brazil^{18,54-55}.

Punctual distributions of *P. diasi* in DF were also observed. This species is distributed in areas of cerrado in central Brazil^{18,56} and has been found in the domiciliary environment without description of wild ecotopes²⁶.

In comparing occurrence records in peridomicile and intradomicile, *T. pseudomaculata*, *T. sordida*, *P. geniculatus*, *R. neglectus*, and *P. diasi* occurred more in intradomicile, which cannot be considered a preference for this environment as surveillance occurs when residents notify invasion of these insects in their domiciliary environment, not worrying about insects that may be co-habiting in peridomiciliary environments. Therefore, notifications from PITs are, in general, intradomiciliaries³⁵. Peridomiciliary captures occurred mainly after the research of public health agents in households, as observed by Villela et al.¹⁷. Because secondary data were used, a lot of information, such as sampling location, species, and location (address), was lost due to incorrect completion of forms. Another limitation of this study was the loss of data on natural infection of triatomines. Only 40% of the collected insects were properly examined, as many died and were dry before examination because of problems with transport and logistics. Moreover, parasitological tests of collected insects could have been more efficient, including molecular diagnosis for detection of *T. cruzi*.

After about 30 years of vector surveillance of Chagas disease in DF, *P. megistus* remains the species of highest epidemiological importance. The risk of vectorial transmission of *T. cruzi* to humans in DF may be considered low due to the good living conditions of most inhabitants of the area and the low natural infection rate of triatomines detected in the present study. However, the presence of *P. megistus* specimens infected with flagellates morphologically similar to *T. cruzi* in domiciles shows that the risk of human infection still exists in DF. Thus, it is essential to continue entomological surveillance, intensifying it during the rainy season and in administrative regions of greater occurrence, as shown in the present study. Moreover, we recommend the strengthening of the PIT network and community encouragement, based on educational actions, for active participation in entomological surveillance. In this way, the detection of synanthropic triatomines would be more efficient, thus reducing the chances of colonization of these insects in domiciliary units of DF. Other zoonoses transmitted by vectors in DF, such as visceral leishmaniasis⁵⁷, also in the scope of epidemiological surveillance, call to attention investments in basic and applied research involving vector transmission in the region. In this sense, we bear in mind that American trypanosomiasis cannot be eradicated completely, the more likely scenario being a reduction in human infection risk with *T. cruzi*, especially from strategies of surveillance and vector control.

ACKNOWLEDGMENTS

We are thankful to the technicians of SES/DIVAL, who participated in triatomine sampling in the administrative regions of DF. We are also grateful to César Augusto Cuba Cuba, and Márcio Vinhaes for reviewing the manuscript.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

FINANCIAL SUPPORT

Coordenação de Aperfeiçoamento de Pessoal de Nível Superior and Conselho Nacional de Desenvolvimento Científico e Tecnológico.

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