

Entomological surveillance of Chagas disease vectors in the municipalities of the VIII Regional Health Management of Pernambuco State, Brazil, from 2012 to 2017

Vigilância entomológica dos vetores da doença de Chagas nos municípios da VIII Gerência Regional de Saúde do estado de Pernambuco, Brasil, de 2012 a 2017

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ABSTRACT

OBJECTIVES: To register the distribution of triatomine species found in the home environment, from 2012 to 2017, in the VIII Regional Health Management (GERES) of Pernambuco State, Brazil, and identify the natural infection rate by flagellates morphologically similar to *Trypanosoma cruzi* on these insects. **MATERIALS AND METHODS:** Information from the Pernambuco Chagas Disease Control Program database was used, referring to triatomines collected in the homes of the municipalities, identified, and examined in the laboratory of the VIII GERES. Only insects with data of origin and natural infection were considered. The natural infection rate was calculated using entomological indicators. **RESULTS:** A total of 9,738 triatomines of six species were collected: *Triatoma brasiliensis* (8,251), *Triatoma pseudomaculata* (1,323), *Panstrongylus lutzi* (100), *Triatoma sordida* (56), *Panstrongylus megistus* (seven), and *Rhodnius neglectus* (one). The infection rate for flagellates morphologically similar to *T. cruzi* it was 2%. Petrolina, the largest municipality in the VIII GERES, had the biggest number of specimens (3,420) and Dormentes had the highest rate of infected triatomines (3.3%). Only *T. brasiliensis* was positive for the infection in all municipalities, while *P. lutzi* had the highest infection rate (38.0%). In 2014, the biggest number of triatomines (3,186) was found, while 2012 had the most infected insects (67) with the etiological agent of Chagas disease (5.0%). **CONCLUSION:** This study contributes to health surveillance, since positive species were found in all municipalities of the VIII GERES, signaling the risk of vector transmission.

Keywords: Triatomines; *Trypanosoma cruzi*; Natural Infection.

RESUMO

OBJETIVOS: Registrar a distribuição das espécies de triatomíneos encontradas no ambiente domiciliar, de 2012 a 2017, na VIII Gerência Regional de Saúde (GERES) do estado de Pernambuco, Brasil, e identificar a taxa de infecção natural por flagelados morfologicamente semelhantes a *Trypanosoma cruzi* nesses insetos. **MATERIAIS E MÉTODOS:** Foram utilizadas informações do banco de dados do Programa de Controle da Doença de Chagas de Pernambuco, referentes aos triatomíneos coletados nos domicílios dos municípios, identificados e examinados no laboratório da VIII GERES. Apenas os insetos com dados de origem e de infecção natural foram considerados. A taxa de infecção natural foi calculada utilizando indicadores entomológicos. **RESULTADOS:** Foram coletados 9.738 triatomíneos de seis espécies: *Triatoma brasiliensis* (8.251), *Triatoma pseudomaculata* (1.323), *Panstrongylus lutzi* (100), *Triatoma sordida* (56), *Panstrongylus megistus* (sete) e *Rhodnius neglectus* (um). A taxa de infecção para flagelados morfologicamente semelhantes a *T. cruzi* foi 2%. Petrolina, maior município da VIII GERES, apresentou o maior número de espécimes (3.420) e Dormentes apresentou a maior taxa de triatomíneos infectados (3,3%). Apenas *T. brasiliensis* foi positiva para a infecção em todos os municípios, enquanto *P. lutzi* apresentou a maior taxa de infecção (38,0%). Em 2014, foi encontrado o maior número de triatomíneos (3.186), enquanto, em 2012, a maior quantidade de insetos infectados (67), com o agente etiológico da doença de Chagas (5,0%). **CONCLUSÃO:** O presente estudo contribui com a vigilância em saúde, uma vez que foram encontradas espécies positivas em todos os municípios da VIII GERES, sinalizando o risco de transmissão vetorial.

Palavras-chave: Triatomíneos; *Trypanosoma cruzi*; Infecção Natural.

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INTRODUCTION

Chagas disease, also known as American trypanosomiasis, has the flagellate protozoan *Trypanosoma cruzi* as its etiological agent¹, which is transmitted primarily by vector insects, the triatomines, which are hematophagous insects, belonging to the order Hemiptera, suborder Heteroptera, family Reduviidae, subfamily Triatominae^{2,3,4}.

According to the World Health Organization (WHO)⁵, about 6 to 7 million people are infected with *T. cruzi* worldwide, with Chagas disease found in endemic areas of 21 Latin American countries; however, it does not occur on the islands of the Caribbean. In Brazil, 4,287 deaths from this disease were recorded in 2019, with 1,937 only in the Southeast Region⁶. According to the Brazilian Ministry of Health⁷, from 2012 to 2016, 1,190 acute cases of Chagas disease were confirmed, and the North Region presented the highest number of cases, 97.1%.

In the world, 155 species of triatomines have been described, grouped into 18 genera and five tribes, with 68 species known in Brazil^{7,8,9}.

The Brazilian Northeast Region is considered of epidemiological importance¹⁰, as it presents large foci of transmission¹¹ and is divided into distinct physiographic regions that involve a diversity of 29 triatomine species^{8,10}. *Triatoma brasiliensis* and *Triatoma pseudomaculata* are considered native species of the region¹². In several municipalities in this region, the population has a high prevalence of infection by *T. cruzi*¹¹.

In Pernambuco State, 14 species of triatomines have already been found: *Panstrongylus lutzi* Neiva & Pinto, 1923; *Panstrongylus megistus* Burmeister, 1835; *Rhodnius nasutus* Stål, 1859; *Rhodnius neglectus* Lent, 1954; *T. brasiliensis* Neiva, 1911; *Triatoma melanocephala* Neiva & Pinto, 1923; *Triatoma petrochiae* Pinto & Barreto, 1925; *T. pseudomaculata* Correa & Espínola, 1964; *Triatoma rubrofasciata* (De Geer, 1773); *Triatoma sordida* (Stål, 1859); *Triatoma tibiamaculata* (Pinto, 1926); *Rhodnius tertius* (Lent & Jurberg, 1966); *Panstrongylus geniculatus* (Latreille, 1811); and *Triatoma infestans* (Klug, 1834). This last species was eliminated from the State after intense control activities, culminating in the certification of the interruption of vector transmission in Brazil^{12,13,14,15}. The species *T. brasiliensis* and *T. pseudomaculata* currently stand out as the main vectors of Chagas disease in the State, along with *P. lutzi*, which is also naturally infected by *T. cruzi*¹².

Recently, in Ibimirim, Pernambuco State, one of the most significant outbreaks of acute Chagas disease in Brazil was recorded, preliminarily associated with the ingestion of contaminated food, which resulted in 30 individuals being treated¹⁶.

Studies on the geographic distribution of triatomines are essential for understanding epidemiological aspects related to the transmission of *T. cruzi* and should be used to guide surveillance and control actions regarding Chagas disease¹³.

Therefore, the present study aimed to record the distribution of species of triatomines found in the home environment, between 2012 and 2017, in the VIII Regional Health Management (*Gerência Regional de Saúde – GERES*) of Pernambuco, which is constituted by priority municipalities for the control of Chagas disease in Pernambuco, and to identify the natural infection rate by flagellates morphologically similar to *T. cruzi* of the respective insects.

MATERIALS AND METHODS

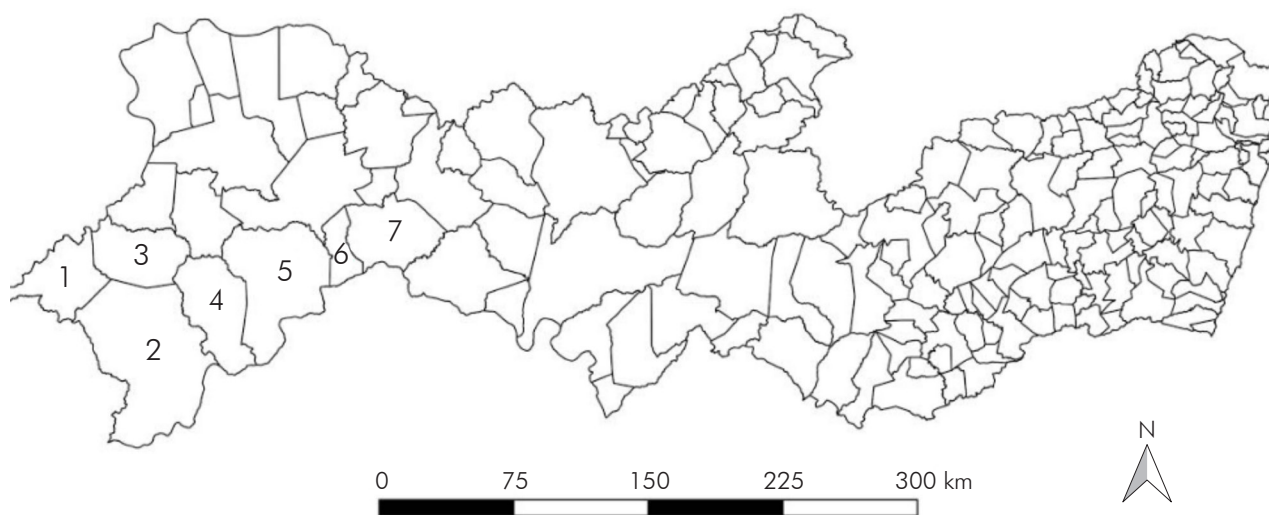
This is a descriptive, quantitative, and retrospective study, with entomological data on triatomines collected from 2012 to 2017 at VIII GERES in Pernambuco.

Pernambuco has a territorial area of 98,076.021 km², an estimated population of 9,473,266 people, a population density of 89.62 inhabitants/km², and a Human Development Index of 0.673¹⁷. In all 184 municipalities of Pernambuco and on the island of Fernando de Noronha, 12 GERES, administrative units of the State Health Department, were created, each one responsible for a part of the cities, acting in a more localized way in primary care, in the restructuring of the hospital network, in municipal actions, and in the fight against infant mortality and various endemic diseases.

The VIII GERES is composed of seven municipalities (Figure 1), all belonging to the Sertão do São Francisco: Afrânio (8°30'54"S, 41°00'18"W), with a population of 17,586 inhabitants¹⁸; Cabrobó (8°30'51"S, 39°18'36"W), with a population of 30,873 inhabitants¹⁹; Dormentes (8°26'50"S, 40°46'16"W), with a population of 16,917 inhabitants²⁰; Lagoa Grande (8°59'49"S, 40°16'19"W), with a population of 22,760 inhabitants²¹; Orocó (8°37'06"S, 39°36'02"W), with a population of 13,180 inhabitants²²; Santa Maria da Boa Vista (8°48'28"S, 39°49'32"W), with a population of 39,435 inhabitants²³; and Petrolina (9°23'55"S, 40°30'3"W), a population of 293,962 inhabitants²⁴, where is located the headquarters of VIII GERES^{12,25,26}. These municipalities present the caatinga as primitive vegetation²⁷, with a total area of 14,654.862 km² and a semi-arid climate^{28,29}.

In the municipalities of VIII GERES, triatomine control is carried out by chemical control (use of insecticides), together with active and passive surveillance, both in urban and rural areas. In the active surveillance, municipal agents to combat endemic diseases (ACE) visit the residences and collect the insects without prior notification to the resident, while, in passive surveillance, the residents themselves notify the ACEs to carry out the collection. The dwellings are structured with masonry walls with plaster, masonry without plaster, mud with plaster, mud without plaster, or wood. The roofs are made of tile, straw, wood, or metallic material.

The information used in the present study are from the database of the Chagas Disease Control Program (SISPCDCh) of Pernambuco State and refers to the triatomines collected in the households of the municipalities, identified and examined in the laboratory of VIII GERES, in Petrolina, and registered in the DOS-SISPCDCh System.



1: Afrânio; 2: Petrolina; 3: Dormentes; 4: Lagoa Grande; 5: Santa Maria da Boa Vista; 6: Orocó; 7: Cabrobó.

Figure 1 – Location of the municipalities of VIII GERES, Pernambuco State, Brazil

Insects were collected by municipal ACEs in households in urban and rural areas, using entomological tweezers and flashlights to inspect crevices and places devoid of lighting.

The triatomines were sent to the Regional Entomology Laboratory of VIII GERES for taxonomic identification and parasitological examination of infection by flagellates morphologically similar to *T. cruzi*. Triatomines were identified to species level according to Lent and Wygodzinsky³⁰ and Galvão and Dale³¹. The parasitological examination was performed by abdominal compression of triatomines, and the identification of parasites morphologically similar to *T. cruzi* was performed on slides stained with Giemsa and examined under an optical microscope (400X). The insects that presented incomplete data on the origin and natural infection were considered as exclusion criteria.

The natural infection rate was calculated using entomological indicators recommended by the Pan American Health Organization³²:

$$NI = \frac{\text{Number of triatomines infected by } T. \text{cruzi} \times 100}{\text{Number of triatomines examined}}$$

The maps were made using Microsoft Excel 2010 and QGIS v3.10. The study was approved by the Research Ethics Committee of the University of Pernambuco – CEP-PROPEGI, under number 3,376,395, on June 6, 2019.

RESULTS

In the period from 2012 to 2017, 9,738 specimens of triatomines from six species were collected: *T. brasiliensis* (8,251), *T. pseudomaculata* (1,323), *P. lutzi* (100), *T. sordida* (56), *P. megistus* (seven) e *R. neglectus* (one). *P. lutzi*, *T. brasiliensis*, and *T. pseudomaculata* were found in all municipalities in the Sertão de São Francisco. The infection rate for flagellates morphologically similar to *T. cruzi* in the examined triatomines was 2%. Of the six species collected, four

were positive: *P. lutzi*, *T. brasiliensis*, *T. pseudomaculata*, and *T. sordida* (Table 1).

In Afrânio, specimens of five species of triatomines were collected, and it was the only municipality with a record of the *R. neglectus* species. Attention is drawn to the high rate of infection of *P. lutzi* (59.3%) by flagellates morphologically similar to *T. cruzi* in that municipality. Dormentes presented four species of triatomines, and *P. lutzi* had the highest infection rate (44.4%). In Lagoa Grande, the same species collected in Dormentes were found; however, the total infection rates differed: 1.0% and 3.3%, respectively. In Petrolina, five species of triatomines were collected, highlighting, once again, the high infection rate of *P. lutzi* (46.7%). Regarding the municipality of Santa Maria da Boa Vista, five species were identified, the same amount found in Petrolina, the greatest diversity of species. *P. lutzi* was also the species with the highest infection rate (20.6%) in Santa Maria da Boa Vista. Cabrobó and Orocó had three species each (Table 1).

T. brasiliensis was the only species that showed infection by flagellates morphologically similar to *T. cruzi* in all municipalities studied, while *T. pseudomaculata* was not infected only in Cabrobó. Overall, the highest infection rate was recorded for *P. lutzi* (38.0%) (Table 1).

The municipality of Petrolina had the highest amount of triatomines collected (3,420) and naturally infected insects (83). However, Dormentes had the highest infection rate (3.3%). Orocó had the lowest number of triatomines collected (182), while Cabrobó had the lowest infection rate by flagellates morphologically similar to *T. cruzi* (0.2%). The number of insects naturally infected by flagellates morphologically similar to *T. cruzi* by the municipality is shown in Table 1 and Figure 2.

The year 2014 had the highest amount of triatomines collected (3,186). However, the year with the highest number of positive triatomines (67) and the highest infection rate for flagellates morphologically similar to *T. cruzi* (5.0%) was 2012 (Table 2).

In every year, *T. brasiliensis* was the most collected species: 2012 (357), in Afrânio; 2014 (707), in Lagoa Grande; and 2013 (605), 2015 (299), 2016 (496), and 2017 (496), in Petrolina. *T. brasiliensis* showed the highest positivity in Petrolina in the years 2012 (19), 2013 (13), 2014 (11), 2015 (18), and 2017 (10) (Table 2).

P. lutzi had the highest infection rates for five years: in 2012, 100.0% in Dormentes; in 2013 and 2014, in Afrânio, with 100.0% and 60.0%, respectively; and in 2015 and 2017, 100.0% in Petrolina. In 2013,

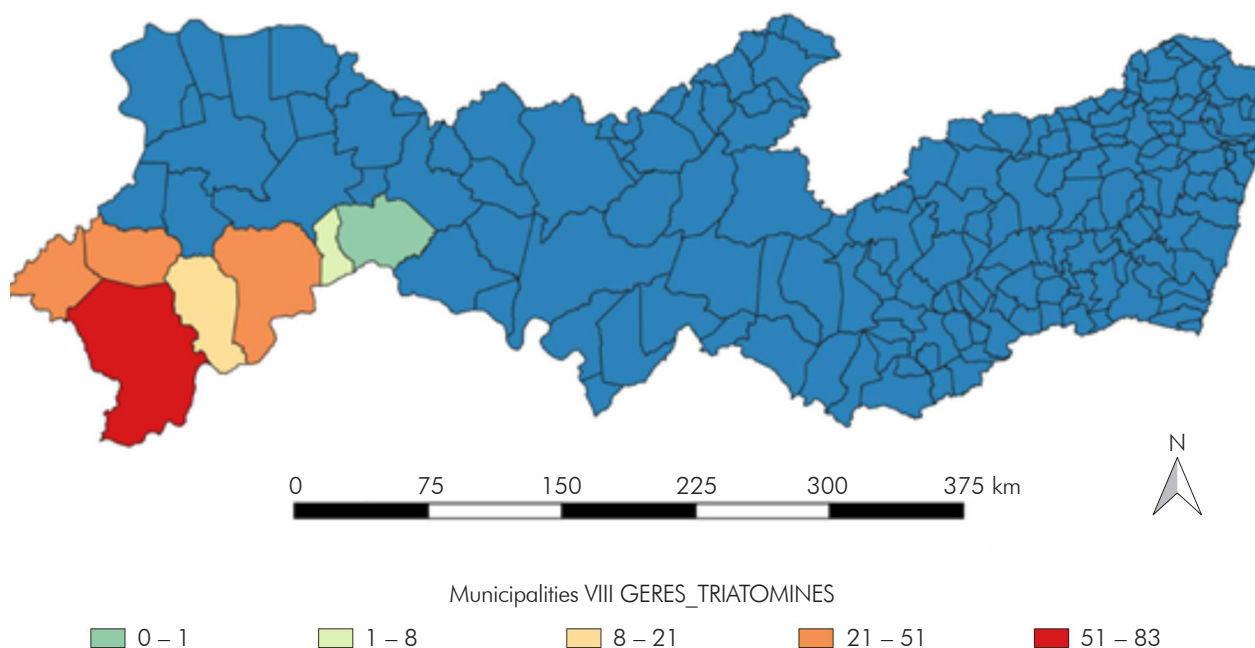
T. pseudomaculata showed the highest infection rate for flagellates morphologically similar to *T. cruzi* in Orocó (100.0%). In 2016, the highest infection rate (12.5%) was detected in *T. sordida* in Petrolina, where the species was not found until 2012 (Table 2).

P. megistus was recorded in 2012 in Dormentes, Petrolina, and Santa Maria da Boa Vista and in 2014 in Afrânio, Lagoa Grande, and Santa Maria da Boa Vista. *R. neglectus* was recorded only in 2016, in Afrânio (Table 2).

Table 1 – Distribution of species of triatomines, number of positives, and infection rate of protozoa morphologically similar to *T. cruzi*, in the household environment of municipalities of VIII GERES, Pernambuco State, Brazil, between 2012 and 2017

| Municipalities | Species of triatomines | | | | | | | | | | | | | | | | | | Total by municipality | | |
|--------------------------|----------------------------|----|------|-------------------------------|---|----|---------------------------|---|----|------------------------------|-----|-----|--------------------------------|----|-----|-------------------------|---|-----|-----------------------|-----|-----|
| | <i>Panstrongylus lutzi</i> | | | <i>Panstrongylus megistus</i> | | | <i>Rhodnius neglectus</i> | | | <i>Triatoma brasiliensis</i> | | | <i>Triatoma pseudomaculata</i> | | | <i>Triatoma sordida</i> | | | C | P | IN |
| | C | P | IN | C | P | IN | C | P | IN | C | P | IN | C | P | IN | C | P | IN | | | |
| | N | N | % | N | N | % | N | N | % | N | N | % | N | N | % | N | N | % | N | N | % |
| Afrânio | 27 | 16 | 59.3 | 1 | - | - | 1 | - | - | 1,768 | 19 | 1.1 | 284 | 1 | 0.4 | - | - | - | 2,081 | 36 | 1.7 |
| Cabrobó | 3 | - | - | - | - | - | - | - | - | 462 | 1 | 0.2 | 98 | - | - | - | - | - | 563 | 1 | 0.2 |
| Dormentes | 18 | 8 | 44.4 | 1 | - | - | - | - | - | 769 | 22 | 2.9 | 149 | 1 | 0.7 | - | - | - | 937 | 31 | 3.3 |
| Lagoa Grande | 1 | - | - | 2 | - | - | - | - | - | 710 | 7 | 1.0 | 99 | 1 | 1.0 | - | - | - | 812 | 8 | 1.0 |
| Orocó | 2 | - | - | - | - | - | - | - | - | 168 | 2 | 1.2 | 12 | 1 | 8.3 | - | - | - | 182 | 3 | 1.6 |
| Petrolina | 15 | 7 | 46.7 | 1 | - | - | - | - | - | 2,934 | 71 | 2.4 | 418 | 4 | 1.0 | 52 | 1 | 1.9 | 3,420 | 83 | 2.4 |
| Santa Maria da Boa Vista | 34 | 7 | 20.6 | 2 | - | - | - | - | - | 1,440 | 22 | 1.5 | 263 | 4 | 1.5 | 4 | - | - | 1,743 | 33 | 1.9 |
| Total | 100 | 38 | 38.0 | 7 | - | - | 1 | - | - | 8,251 | 144 | 1.7 | 1,323 | 12 | 0.9 | 56 | 1 | 1.8 | 9,738 | 195 | 2.0 |

C: Collected; P: Positives; NI: Natural infection rate; Conventional sign used: - Numeric data equal to zero, not resulting from rounding.



In blue, the municipalities in Pernambuco that are not part of the VIII GERES.

Figure 2 – Distribution map of triatomines infected by flagellates morphologically similar to *T. cruzi* in the home environment in municipalities of VIII GERES, Pernambuco State, Brazil, between 2012 and 2017

Table 2 – Quantity of species of triatomines collected annually by municipality, number of positives, and infection rate in municipalities of VIII GERES, Pernambuco State, Brazil, between 2012 and 2017

| Species of triatomines | Municipalities | 2012 | | | 2013 | | | 2014 | | | 2015 | | | 2016 | | | 2017 | | |
|--------------------------------|--------------------------|-------|------|-------|-------|------|-------|-------|-----|------|-------|-----|-------|------|-----|------|-------|-------|------|
| | | C | P | IN % | C | P | IN % | C | P | IN % | C | P | IN % | C | P | IN % | C | P | IN % |
| <i>Triatoma brasiliensis</i> | Afrânio | 357 | 7 | 2.0 | 460 | 4 | 0.9 | 505 | 6 | 1.2 | 251 | 2 | 0.8 | 96 | - | - | 99 | - | - |
| | Cabrobó | 21 | - | - | 18 | - | - | 294 | 1 | 0.3 | - | - | - | - | - | - | 129 | - | - |
| | Dormentes | 139 | 11 | 7.9 | 177 | 2 | 1.1 | 205 | 8 | 3.9 | 89 | 1 | 1.1 | 97 | - | - | 62 | - | - |
| | Lagoa Grande | - | - | - | - | - | - | 707 | 7 | 1.0 | - | - | - | - | - | - | 3 | - | - |
| | Orocó | 3 | - | - | 29 | 1 | 3.4 | 26 | - | - | 23 | - | - | 55 | 1 | 1.8 | 32 | - | - |
| | Petrolina | 346 | 19 | 5.5 | 605 | 13 | 2.1 | 692 | 11 | 1.6 | 299 | 18 | 6.0 | 496 | - | - | 496 | 10 | 2.0 |
| Santa Maria da Boa Vista | 273 | 8 | 2.9 | 446 | 10 | 2.2 | 260 | 1 | 0.4 | 229 | 1 | 0.4 | 67 | 1 | 1.5 | 165 | 1 | 0.6 | |
| <i>Triatoma pseudomaculata</i> | Afrânio | 61 | - | - | 68 | 1 | 1.5 | 81 | - | - | 49 | - | - | 16 | - | - | 9 | - | - |
| | Cabrobó | - | - | - | - | - | - | 86 | - | - | - | - | - | - | - | - | 12 | - | - |
| | Dormentes | 16 | 1 | 0.1 | 20 | - | - | 44 | - | - | 15 | - | - | 26 | - | - | 28 | - | - |
| | Lagoa Grande | - | - | - | - | - | - | 99 | 1 | 1.0 | - | - | - | - | - | - | - | - | - |
| | Orocó | - | - | - | 1 | 1 | 100.0 | 1 | - | - | 2 | - | - | 7 | - | - | 1 | - | - |
| | Petrolina | 39 | 3 | 7.7 | 46 | - | - | 111 | - | - | 55 | - | - | 97 | - | - | 70 | 1 | 1.4 |
| Santa Maria da Boa Vista | 53 | 2 | 3.8 | 76 | 1 | 1.3 | 47 | - | - | 41 | 1 | 2.4 | 19 | - | - | 27 | - | - | |
| <i>Panstrongylus lutzi</i> | Afrânio | 8 | 5 | 62.5 | 3 | 3 | 100.0 | 10 | 6 | 60.0 | 4 | 1 | 25.0 | - | - | 2 | 1 | 50.0 | |
| | Cabrobó | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | 1 | - | - | |
| | Dormentes | 6 | 6 | 100.0 | 11 | 2 | 18.2 | - | - | - | - | - | - | 1 | - | - | - | - | |
| | Lagoa Grande | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | |
| | Orocó | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | 1 | - | - | |
| | Petrolina | - | - | - | 6 | 3 | 50.0 | 4 | 1 | 25.0 | 2 | 2 | 100.0 | 2 | - | 1 | 1 | 100.0 | |
| Santa Maria da Boa Vista | 21 | 5 | 23.8 | 8 | 1 | 12.5 | 2 | - | - | 1 | - | - | - | - | 2 | 1 | 50.0 | | |
| <i>Triatoma sordida</i> | Petrolina | - | - | - | 9 | - | - | 5 | - | - | 1 | - | - | 8 | 1 | 12.5 | 29 | - | - |
| | Santa Maria da Boa Vista | - | - | - | 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| <i>Panstrongylus megistus</i> | Afrânio | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | |
| | Dormentes | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| | Lagoa Grande | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - | - | |
| | Petrolina | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| | Santa Maria da Boa Vista | 1 | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | |
| <i>Rhodnius neglectus</i> | Afrânio | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | |
| Total | | 1,346 | 67 | 5.0 | 1,988 | 42 | 2.1 | 3,186 | 42 | 1.3 | 1,061 | 26 | 2.5 | 988 | 3 | 0.3 | 1,169 | 15 | 1.3 |

C: Collected; P: Positives; NI: Natural infection rate; Conventional sign used: - Numeric data equal to zero, not resulting from rounding.

DISCUSSION

OCCURRENCE OF THE SPECIES OF TRIATOMINES

All species identified in the present study have already been recorded in Pernambuco and are commonly found in semi-arid regions^{8,13,14,15,33,34,35}. The greater diversity of triatomines may favor the transmission of *T. cruzi* by increasing the possibility of species of epidemiological importance³⁶. All species found in this study were also detected in two Ceará municipalities, Caririáçu and Jardim, which have the same climatic and phytogeographic characteristics of the Caatinga biome³⁵.

Silva et al.³³ identified six species of triatomines (*T. brasiliensis*, *T. pseudomaculata*, *P. lutzi*, *Rhodnius nasutus*, *T. sordida*, and *T. infestans*) in the VIII GERES, in 2006 and 2007, and only four of them were detected in this study (*T. brasiliensis*, *T. pseudomaculata*, *P. lutzi*, and *T. sordida*). This finding shows a significant change in the dynamics of Chagas disease transmission and post-control of *T. infestans*, an important vector of the *T. cruzi*.

Specimens of *T. brasiliensis* and *T. pseudomaculata* were found in 2012 by Silva et al.³⁴ only in four municipalities: Afrânio, Petrolina, Dormentes, and Santa Maria da Boa Vista; while, in this study, they were detected in all municipalities of VIII GERES, demonstrating the spread of these species. In this study, *P. lutzi* was collected in all seven municipalities of Sertão de São Francisco, but Silva et al.³⁴ only found it in Afrânio, Dormentes, and Santa Maria da Boa Vista. Likewise, in the present study, there was a record of *P. megistus* in Afrânio, Dormentes, Lagoa Grande, Petrolina, and Santa Maria da Boa Vista, while Silva et al.³⁴ recorded the occurrence of this species only in Petrolina.

Based on Silva et al.^{33,34}, differences can be seen regarding the distribution of the species of triatomines in the VIII GERES. During the 2006–2007 biennium, six species were recorded (*T. brasiliensis*, *T. pseudomaculata*, *P. lutzi*, *R. nasutus*, *T. sordida*, and *T. infestans*)³³; in 2012, three of them were not found (*T. sordida*, *R. nasutus*, and *T. infestans*)³⁴. In the analyzed period of the present research, six species were registered, being three more frequent (*T. brasiliensis*, *T. pseudomaculata*, and *P. lutzi*), followed by *T. sordida*.

Brazil received, in 2006, the certificate of elimination of *T. cruzi* transmission by *T. infestans* after implementing a vector control program³⁷, which had a significant impact on the entomological indicators of this species and may be one of the factors affecting species diversity.

Some species, like *P. lutzi*, *T. brasiliensis*, and *T. pseudomaculata*, were found in all municipalities of VIII GERES, with the most diverse report recorded for Afrânio, Petrolina, and Santa Maria da Boa Vista. *T. brasiliensis* was the most frequent species, followed by *T. pseudomaculata* and *P. lutzi*, which was also confirmed by Silva et al.³³. These species were also collected in the Sertão de São Francisco region, including *P. megistus*, and in the Agreste of the state, in 2013, with *T. brasiliensis* being the most abundant species^{8,27}.

Silva et al.³⁴ did not record the occurrence of *P. megistus* and *R. neglectus* in Afrânio. However, *T. brasiliensis* was the most frequent species, which was also observed in the present study, remaining predominant.

In 2012, Silva et al.³⁴ did not report the presence of triatomines in the municipalities of Cabrobó, Lagoa Grande, and Orocó, differently from the present study, suggesting the hypothesis that there is a dissemination of the species of triatomines in VIII GERES.

In Petrolina, *T. brasiliensis*, *T. pseudomaculata*, *P. megistus*, *T. sordida*, and *P. lutzi* species were collected, and the last two were not recorded by Silva et al.³⁴ in that municipality. Finally, in Santa Maria da Boa Vista, the species *T. brasiliensis*, *T. pseudomaculata*, *P. lutzi*, *T. sordida*, and *P. megistus*, with the last two not found in the municipality by Silva et al.³⁴.

Considering the studies carried out in the same region by Silva et al.^{33,34}, density fluctuation can be observed in the different cities studied. One of the causes of the changes in the species occurrence, is the unstable behavior of triatomines, especially regarding the dry and rainy seasons³⁸.

TRYPANOSOMATIDS INFECTION

In the present study, the triatomine infection rate of VIII GERES was 2.0%, lower than the rate of Pernambuco State in the 2006–2007 biennium³³ (9.8%) and in 2012³⁴ (21.3%). *P. lutzi* showed the highest positivity rate for flagellates morphologically similar to *T. cruzi* (38.0%), which is considered high and has already been demonstrated by Silva et al.^{33,34}, Brazilian Ministry of Health³⁹, and Vinhaes and Dias⁴⁰, with infection rates of 17.8%, 35.1%, 29.4%, and 2.6%, respectively. Costa et al.³⁵ also found *P. lutzi* but did not calculate the infection rate. One of the reasons for the high rates of infection presented by *P. lutzi* probably is the wide variety of food sources: rodents, skunks, armadillos, coatis, lizards, frogs, birds, cattle, horses, goats, sheep, pigs, cats, dogs, and humans^{41,42}.

In this study, *T. brasiliensis* was the most abundant triatomine, with a positivity rate of 1.7%. This species was found positive for flagellates morphologically similar to *T. cruzi*, with rates of 6.5%³³, 19.2%³⁴, 2.7%³⁹, 1.44%⁴⁰, and 6.7%⁴³. However, Costa et al.³⁵ did not find *T. brasiliensis* infected in the municipalities of Jardim and Caririáçu, in Ceará.

T. sordida had the third-highest infection rate. This species has already presented infection rates reported in other studies: 0.8%³⁹, 0.85%⁴⁰, 2.3%⁴³, and 5.5%⁴⁴. However, in studies carried out by Silva et al.^{33,34} and Costa et al.³⁵, *T. sordida* was not found infected.

T. pseudomaculata was found infected in 0.9% of the specimens collected, inferior to what was presented by other studies: 8.0%³³, 13.1%³⁴, 2.1%³⁹, 1.29%⁴⁰, and 1.7%⁴³. Costa et al.³⁵ also recorded positive specimens; however, the infection rate was not calculated.

The positivity of *P. megistus* in Silva et al.^{33,34}, Brazilian Ministry of Health³⁹, Vinhaes and Dias⁴⁰, and

Silveira⁴³ contrasts with the negative result found in the present study and Costa et al.³⁵. Similarly, specimens of *R. neglectus* were found infected in studies conducted by Silva et al.³³, Brazilian Ministry of Health³⁹, Vinhaes e Dias⁴⁰, and Silveira⁴³, but this was not the case in this study and Camargo et al.⁴⁴.

Considering that positive triatomines were found in the present study, the population should be informed and made aware of the maintenance of surveillance measures. It is noteworthy that cases of acute Chagas disease in Brazil occur mostly in populations with one to nine years of schooling⁷. As a chronic condition, from an economic and social point of view, morbidity and mortality stand out in the most vulnerable populations⁴⁵.

It is essential to emphasize the need to maintain entomological surveillance in the municipalities through home visits carried out by ACEs, aiming to reduce infestation. Carrying out improvements in the houses, such as replacing palm leaves on roofs, covering gaps, and cracks in walls, are measures that aim to prevent the formation of colonies of triatomines in households. Chemical control and health education actions in communities improve the living conditions of the population in municipalities with the presence of the vector that transmits the disease.

As this was a study with secondary data, it was not possible to monitor the patients diagnosed with Chagas disease in the municipalities of VIII GERES, during the period of the present research, as well as to carry out an interview with the residents who reported the presence of triatomines in their respective households.

CONCLUSION

Most of the species collected in VIII GERES of Pernambuco are common in the Caatinga biome. The present study contributes to health surveillance, as it found positive species in all municipalities in the Sertão de São Francisco, indicating the risk of vector transmission, with emphasis on *P. lutzi*, which had the highest infection rate for *T. cruzi*, and the municipalities of Dormentes and Petrolina that presented the highest positivity rates of the VIII GERES.

CONFLICT OF INTEREST

The authors declare that there was no conflict of interest.

AUTHORS' CONTRIBUTION

All authors cooperated with the research, analysis and interpretation of data, and manuscript writing. They declare themselves responsible for the total content of the article, guaranteeing its accuracy and integrity.



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