

## ORIGINAL ARTICLE

# Retrospective study of the epidemiological overview of the transmission of Chagas disease in the State of Acre, South-Western Amazonia, from 2009 to 2016.



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## Abstract

**Introduction:** Chagas disease (CD), also known as American Trypanosomiasis, is an infectious parasitic disease caused by the etiologic agent *Trypanosoma cruzi*. It is considered endemic in the low-income population and is classified by the WHO as a neglected tropical disease. In the state of Acre, there is almost no scientific data regarding the epidemiology of CD, even though the first autochthonous case was registered in the 1980s.

**Objective:** To analyze the epidemiological panorama of the transmission of Chagas disease in the State of Acre, Brazil, from 2009 to 2016.

**Methods:** A survey of the occurrence of Chagas disease in the State of Acre was performed using public domain secondary data from the Brazil's Notifiable Diseases Information System of SUS (publicly funded health care system), and from the SUS Database of the Health Surveillance Foundation of the State of Acre. Data were collected from the following variables: gender, age group, form of contagion, distribution by region and municipality, perimeter and seasonality.

**Result:** Forty-two cases of CD were confirmed, with an increase of more than 300% from 2015 to 2016 and a frequency coefficient of 3.06 cases per 100,000 people, and in the Tarauacá/Envira region, the probability of a person contracting CD was 600% higher than the state mean.

**Conclusion:** We found that in the state of Acre, in the period from 2009 to 2016, most cases of CD occurred in 2016, in the Tarauacá/Envira region, mainly in the municipality of Feijó, in the rural zone, from July to October, in the age group of 0 to 30 years, being the oral form the main route of transmission and presenting no statistical difference between men and women.

**Keywords:** neglected diseases, American *Trypanosomiasis*, Amazon

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## INTRODUCTION

Chagas disease (CD), also known as American Trypanosomiasis, is an infectious parasitic disease caused by the etiologic agent *Trypanosoma cruzi*<sup>1</sup>. This disease is widely disseminated in Latin America, being surpassed in numbers of cases by malaria alone<sup>2,3</sup>.

CD is considered endemic in the low-income population and is classified by the World Health Organization (WHO) as a neglected tropical disease, due to low investments in research, production of medication and prophylaxis<sup>1,4</sup>.

In the world, there is an estimation of approximately 6 and 7 million people infected with CD, especially in Latin America, whose expansion gradually affects more than 12 million individuals, reaching non-endemic countries in North America (United States and Canada), Europe (in particular Spain), Asia (Japan) and Oceania (Australia), increasing the number of people with Chagas disease living in non-endemic countries<sup>5</sup>.

The II Brazilian Consensus on CD estimated<sup>5</sup>, for 21 Latin American countries, based on 2010 data, that 5,742,167 people were infected by *T. cruzi*, of which 3,581,423 (62.4%) were residents of the countries of the Southern Cone Initiative, highlighting Argentina (1,505,235), Brazil (1,156,821), Mexico (876,458) and Bolivia (607,186)<sup>5,6</sup>.

In the Brazilian Amazon region, an increasing number of cases of acute and chronic CD have become evident in recent years, showing that CD is endemic throughout the Amazon region<sup>7-10</sup>, with a great variety of vectors<sup>11-18</sup> and wild reservoirs<sup>19-22</sup>, providing a greater circulation of the etiological agent of the disease<sup>7-10</sup>.

In the Amazon region, the states with the highest number of CD case registers are Pará and Amazonas, with the main reasons for *T. cruzi* transmission being the construction of houses in rural locations near palm trees infested with triatomines and infected marsupials, associated with deforestation, which transforms the landscape and the biotope of the triatomines, allowing their invasion into the households<sup>23,24</sup>. The most frequent form of transmission is oral, mainly by the consumption of fruit juices and pulps, such as açaí and others from palm trees<sup>9,10,25-28</sup>.

In the state of Acre, there are almost no scientific data regarding the epidemiology of CD; however, the first autochthonous case was already registered in the 80s<sup>29</sup>, showing the potential for the occurrence of this disease in the state, which justified conducting this study, which aimed at analyzing the epidemiological panorama of the transmission of CD in the State of Acre, South-Western Amazonia, from 2009 to 2016.

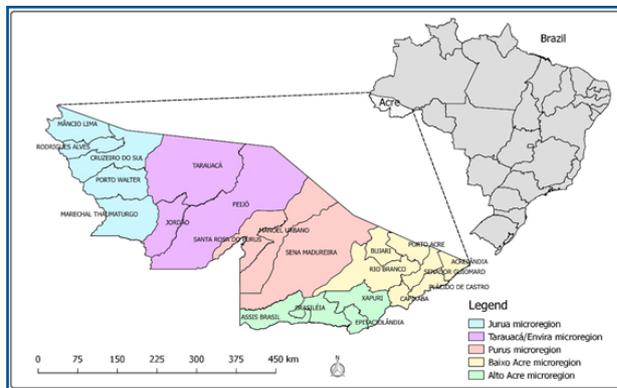
## METHODS

### Study Site

The state of Acre is one of the 27 Federative Units of Brazil, located in the southwest of the North region, bordering the north of Amazonas and the east of Rondônia, in addition to international borders with Peru and Bolivia<sup>30</sup>. The state has approximately

4% of the Brazilian Amazon area and 1.9% of the national territory, with a surface of 164,221.36 km<sup>2</sup>, and it is located at latitude (7°06'56"N) and longitude (68°42'59"S)<sup>30,31</sup>.

Acre is politically constituted by 22 Municipalities and divided into five development regions (Figure 1): Alto Acre, Baixo Acre, Purus, Tarauacá/Envira and Jurua<sup>31,32</sup>.



**Figure 1:** Map of the State of Acre distributed by Microregion

### Epidemiological Survey

This was a retrospective and descriptive population study with the collection and analysis of data referring to the reported cases of *T. cruzi* infection in the state of Acre, secondary data from the Brazil's Notifiable Diseases Information System (SINAN) collected through the Brazil's Single Health System Database (DATASUS). These data were used to determine the frequency of infection and to identify the epidemiological profile of *T. cruzi* carriers.

The inclusion criteria were all the positive cases in years 2009 to 2016, variables such as gender, age and form of contagion (oral, vector and others), distributed by region, city, area (urban, rural and peri-urban), seasonality. The exclusion criteria in this study were the positive cases out of the research period and variables that are out of what was previously described.

### Statistical Analysis

The Frequency Coefficient (number of Cases/Population of the locality in the surveyed year × Base 100,000) was calculated. For the statistical analyses, the following tests were used: Kruskal-Wallis and student's t (GraphPad Prism 6.0 Software); Odds Ratio (Epi Info 7 Software), the data were organized in mean + standard deviation, being significant when (p < 0.05).

## RESULTS

It was possible to observe that from 2009 to 2016, an amount of 139 suspected cases of Chagas disease was registered, of which 97 reports were discarded and 42 were confirmed.

The year with the highest occurrence of CD was 2016, with 25 cases, which represented an increase of 316.67%, compared to 2015, which was the second year with the highest number of cases. Regarding the

frequency coefficient, 2016 also presented the highest result, with 3.06 cases per 100,000 people (Table 1).

The reported cases occurred in three different regions, with the highest occurrence in the Tarauacá/Envira region, followed by Juruá (Table 2).

In Table 2, the Odds Ratio calculation showed that in the Tarauacá/Envira region, the probability of a person contracting CD is 600% higher than the state mean.

In the Tarauacá/Envira region, the municipality

**Table 1:** Frequency Coefficient of Chagas disease in the State of Acre, from 2009 to 2016.

Year	No. of cases	Population <sup>32</sup>	Frequency Coefficient
2009	2	691,132	0.29
2010	5	733,559	0.68
2011	0	746,386	0
2012	0	758,786	0
2013	1	776,463	0.13
2014	3	790,101	0.38
2015	6	803,513	0.75
2016	25	816,687	3.06
Mean	5.25	764,578	0.69

**Table 2:** Number of cases of Chagas disease and Odds ratio, distributed by region of the state of Acre, from 2009 to 2016.

Regions	No. of cases	Odds Ratio (95%CI)
State of Acre	42	1.0 (Reference)
Tarauacá/Envira Region	29	7.10 (4.42-11.39)*
Juruá Region	12	1.60 (0.84-3.05)
Baixo Acre Region	1	0.04 (0.01-0.30)*

\* Significant

of Feijó was the one with the highest number of CD registered in the study period, followed by the municipalities of Rodrigues Alves, Mâncio Lima and Cruzeiro do Sul, belonging to the Juruá region (Table 3). Table 3 also shows seasonality data, and it is possible to observe that the period with the highest occurrence was from July to October of the years under study.

Among the forms of transmission, it was

observed that 32 (76.19%) of the cases occurred orally and 10 (23.81%) by other transmission routes, being that the confirmation that registers related to the vector transmission were not available.

Regarding the distribution of the number of cases per zone, it was observed that the majority occurred in the rural zone, representing 88% of the cases, being this result significantly higher ( $p < 0.05$ ) than the urban and peri-urban zones, as shown in (Table 4).

**Table 3:** Seasonal distribution of the number of Chagas disease cases in the municipalities of the State of Acre, from 2009 to 2016.

Municipality	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Cruzeiro do Sul	0	0	1	0	0	0	0	1	0	0	1	0	3
Feijó	0	0	0	0	1	0	11	1	6	5	1	0	25
Jordão	0	0	0	0	0	0	0	0	0	2	0	0	2
Mâncio Lima	1	0	0	0	0	0	0	0	1	1	0	0	3
Porto Walter	0	0	0	0	0	0	0	0	0	1	0	0	1
Rio Branco	0	0	0	0	0	0	0	0	0	0	0	1	1
Rodrigues Alves	0	3	1	0	0	0	1	0	0	0	0	0	5
Tarauacá	0	0	0	0	0	1	0	0	0	0	1	0	2
Total	1	3	2	0	1	1	12	2	7	9	3	1	42

**Table 4:** Distribution by zone of the number of Chagas disease cases occurring in the state of Acre, from 2009 to 2016.

Zones	2009	2010	2011	2012	2013	2014	2015	2016	Total (%)	Annual Mean ( $\pm$ SD)
Urban	1	0	0	0	0	0	1	2	4 (9.5%)	0.50 ( $\pm$ 0.70)
Rural	1	5	0	0	1	3	4	23	37 (88.1%)	4.62 ( $\pm$ 7.15)*
Peri-urban	0	0	0	0	0	0	1	0	1 (2.4%)	0.12 ( $\pm$ 0.33)
Total	2	5	0	0	1	3	6	25	42 (100%)	5.25 ( $\pm$ 7.74)

\* Kruskal-Wallis test ( $p < 0.05$ )

The distribution by age group of the number of CD cases was evaluated, and it became evident that more than 80% of the cases occurred in the age range 0-30 years old, with 18 cases being (42.86%) in the age group from 0 to 15 years, 17 (40.48%) from 16 to 30 years, 4 (9.52%) from 31 to 45 years, 1 (2.38%) from 46 to 60 years and 2 (4.76%) 60 years or more.

Regarding the number of cases distributed by gender, there was a higher occurrence in men 25 (59.5% - annual mean  $3.12 \pm 3.98$ ), than in women 17 (40.5% - annual mean  $2.12 \pm 3.82$ ); however, there was no statistical significance between the means ( $p > 0.05$  - Student's T-test) (Table 5).

**Table 5:** Number of Chagas disease cases, distributed by gender in the State of Acre, from 2009 to 2016.

Gender	2009	2010	2011	2012	2013	2014	2015	2016	Total (%)	Annual Mean ( $\pm$ SD)
Men	1	3	0	0	1	3	4	13	25 (59.5%)	3.12 ( $\pm$ 3.98)
Women	1	2	0	0	0	0	2	12	17 (40.5%)	2.12 ( $\pm$ 3.82)
Total	2	5	0	0	1	3	6	25	42 (100%)	5.25 ( $\pm$ 7.74)

Mean: Student's t-test ( $p > 0.05$ )

## DISCUSSION

In the Brazilian Amazonia, in recent years, a growing number of cases of CD have been occurring, reaffirming that this disease is endemic in the region<sup>10</sup>. This characteristic was also observed in the present study, in which it was verified that the years with the highest occurrence of CD were 2015 and 2016, with an increase in the number of cases between these two years of more than 300%. A similar profile was observed by the Ministry of Health of Brazil from 2005 to 2010, where there was an increase of more than 1000 cases of acute CD, of which 879 were concentrated in the Legal Amazon, where the state of the Acre is located<sup>10,33</sup>.

In the state of Acre, 2016 was also the year that presented the highest CD frequency coefficient with 3.06 cases per 100,000 people, which may still be underreported, since according to Teixeira *et al.*<sup>34</sup>, for every acute case detected in Amazonia, from 20 to 100 different cases were not reported, leading to an underestimation, increasing the negligence and severity of this disease in the region.

Even more worrying data were observed in the Tarauacá/Envira region, with an Odds Ratio seven times higher than the state mean, with the city of Feijó presenting the highest number of registers, accounting for 88.2% of CD cases of this region and 59.5% of state cases. The main source of agricultural produce of the municipality of Feijó is açai, being the largest production of the state<sup>35</sup>. These data may be related to the main transmission route occurring in the state during the study period, which was the oral transmission, with 76.2% of the cases. Similar results were observed by Pinto *et al.*<sup>7</sup>, who analyzed 233 cases of Chagas disease in the Amazon region from 1988 to 2005 and found that 78.5% of the cases were probably part of outbreaks caused by oral transmission.

Several studies show that most outbreaks of acute Chagas disease are associated with açai<sup>36-39</sup>, which is the main food responsible for the increase in the number of cases of Chagas disease in the North region in recent years, whether due to fruit or pulp contamination by means of waste from the infected triatomines in the endemic areas<sup>40</sup>, which have already been registered in the state with the occurrence of the following species: *Rhodnius robustus*<sup>29</sup>, *Rhodnius*

*pictipes*<sup>29</sup>, *Rhodnius montenegrensis*<sup>41</sup>, *Rhodnius stali*<sup>16</sup>, *Rhodnius neglectus*<sup>42</sup>, *Eratyrus mucronatus*<sup>13</sup>, *Panstrongylus geniculatus*<sup>12</sup>, *Panstrongylus megistus*<sup>43</sup> and *Triatoma sordida*<sup>44</sup>.

When the triatomine infected by *T. cruzi* or its waste is ground together with the açai fruit at the time of preparation of the pulp, it favors the survival of the etiologic agent for more than 48 hours at room temperature, 144 hours (6 days) at 4°C and 26 hours at -20°C<sup>45</sup>, with pasteurization being indicated as a safe way to eliminate the parasite<sup>46</sup>. However, pasteurization is not performed in most parts of the state of Acre, especially in the rural area, in which 88% of CD cases occurred, where açai pulp is still handmade. Furthermore, in the rural area, some other aspects are described as facilitators for the occurrence of CD, such as: construction of houses in rural areas near palm trees with the presence of triatomines and marsupials infected with *T. cruzi*; deforestation and proliferation of mammals, such as rodents and marsupials in degraded environments; intrusion of adult triatomines into households attracted by electric lighting or oil lamps<sup>10</sup>, all of which are observed in rural areas of the state of Acre.

When evaluating the seasonal distribution, it was possible to observe a higher occurrence of CD cases in the months of July to October, which represented 71.4% of the cases registered in the present study. This fact confirms the studies carried out in the state of Pará by Pinto *et al.*<sup>7</sup>, where this seasonality coincides with the açai crop that reaches its maximum production between the months of June and December<sup>47</sup>, data that meet with the main route of "oral" transmission.

The açai harvest is carried out mainly by youngsters and adults under 30 years old, due to the difficulty of climbing the palm trees, which is in agreement with the data of the present study, in which the age range from 0 to 30 years old was the one that presented the highest frequency of the disease, with 83.3% of the cases.

This characteristic may have a relation to the work of family subsistence of these localities, since these families depend almost exclusively on the agricultural activity and extractivism, living amid precarious conditions of basic sanitation<sup>48-50</sup>.

Concerning the number of cases distributed by gender, there was no statistical difference between men and women. Studies show that there is no correlation between gender and serology for Chagas disease, since it affects both genders indistinctly<sup>51</sup>.

It was verified that in the state of Acre in the period from 2009 to 2016, the majority of cases of CD occurred in 2016, in the Tarauacá/Envira region, mainly in the municipality of Feijó, in the rural area, from July to October, in the age group of 0 to 30 years old, being the oral form the main route of transmission and presenting no statistical difference between men and women.

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## Resumo

**Introdução:** A doença de Chagas (DC), também conhecida como Tripanossomíase Americana, é uma doença infecciosa e parasitária, causada pelo agente etiológico *Trypanosoma cruzi*, sendo considerada endêmica em população de baixa renda e classificada pela Organização Mundial da Saúde como uma doença tropical negligenciada. No estado do Acre, quase não há dados científicos sobre a epidemiologia da DC, embora o primeiro caso autóctone tenha sido registrado na década de 1980.

**Objetivo:** Analisar o panorama epidemiológico da transmissão da DC no Estado do Acre, no período de 2009 a 2016.

**Método:** O levantamento da ocorrência da DC no Estado do Acre foi realizado utilizando dados secundários de domínio público do Sistema de Informação de Agravos de Notificação do SUS e do Banco de Dados do SUS da Fundação de Vigilância Sanitária do Estado do Acre. Foram coletados dados das seguintes variáveis: sexo, faixa etária, forma de contágio, distribuição por região e município, perímetro e sazonalidade.

**Resultado:** Quarenta e dois casos de DC foram confirmados, com um aumento de mais de 300% de 2015 a 2016 e um coeficiente de frequência de 3,06 casos por 100.000 pessoas, e na região de Tarauacá / Envira, a probabilidade de uma pessoa contrair CD foi de 600% maior que a média do estado.

**Conclusão:** Constatamos que no estado do Acre, no período de 2009 a 2016, a maioria dos casos de DC ocorreu em 2016, na região de Tarauacá/Envira, principalmente no município de Feijó, na zona rural, de julho a outubro, em faixa etária de 0 a 30 anos, sendo a via oral a principal via de transmissão e sem diferença estatística entre homens e mulheres.

**Palavras-chave:** doenças negligenciadas, tripanossomíase americana, Amazônia.