Rev Soc Bras Med Trop 50(6):839-842, November-December, 2017
doi: 10.1590/0037-8682-0512-2016

Short Communication

Seroprevalence of human *Trypanosoma cruzi* infection in the North of Estado de Mexico

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Abstract

Introduction: Chagas disease is a neglected public health problem in Mexico; however, detailed studies to determine the seroprevalence in some states have not been performed. **Methods:** A total 1,504 human serum from thirteen communities in Estado de Mexico, were analyzed with three diagnostics techniques. **Results:** The overall seroprevalence was 9.1%, with high prevalence among people aged 51-60 years, while people aged 0-29 years were seronegative against *T. cruzi*. **Conclusions:** Our data demonstrated the seroprevalence of *T. cruzi* in the North of the Estado de Mexico, an area considered as non-endemic; however, epidemiological conditions necessary for natural transmission were found.

Keywords: *Trypanosoma cruzi*. Diagnostic. Seroprevalence.

Chagas disease is caused by the protozoan parasite *Trypanosoma cruzi*, which has infected at least 6-7 million people in Latin America alone[1]. This infection is primarily transmitted to humans through feces contaminated with the parasite from the insect subfamily Triatominae. However, there are other mechanisms for acquiring the parasite, such as blood transfusions, considered as the second most important mode of *T. cruzi* transmission[2]. Infection rates of *T. cruzi* in the blood banks in some cities in America range from 3 to 53%, while a Mexican study found a seroprevalence of 1.5% in 1992 and 0.4% in 2010[3,4]. However, in Mexico, the infection rates are heterogeneous among the states, e.g., Veracruz State and Puebla had seroprevalence of 0.9% and 7.7%, respectively[5,6]. However, detailed studies to determine the seroprevalence by state have not been established.

Although some programs have been established to control Chagas disease in endemic areas, such as in Puebla, Colima, Jalisco, Chiapas, Veracruz, Yucatan, Guerrero, and Oaxaca; in contrast, in other states, such as Hidalgo and the Estado de Mexico, there is limited knowledge of this parasitosis and the associated insect vectors[7].

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Received 7 December 2016
Accepted 10 August 2017

Velasco-Castrejon[3] conducted the first study in the Estado de Mexico and found *T. cruzi* prevalence of 0.2%, Estrada-Franco *et al*.[8] documented specific antibodies to *T. cruzi* in 7.1% of humans and 21% of dogs from Tejupilco, a rural area of the Estado de Mexico, concluding that dogs may be domestic reservoirs and may contribute to the human transmission of *T. cruzi* in this area. Additionally reported are the following triatomine vector species: *Meccus pallidipennis*, *T. dimidiata,* and *T. barberi*. Furthermore, Barbabosa-Pliego *et al*.[9] also determined the prevalence of *T. cruzi* infection in 24% of dogs and 35% of triatomines collected in the sanitary region located in the Southern part of the Estado de Mexico. In the Toluca Valley, Estado de Mexico, Quijano-Hernández *et al*.[10] performed an epidemiological study in non-domiciliary and domiciliary dogs and found no evidence of *T. cruzi* in local domiciliary dogs or triatomines. In summary, the Estado de Mexico is not considered an endemic area for Chagas disease, hence, few serological and vector studies have been performed in this state, and such studies have only been conducted in the Southern region[10].

The gaps in these studies emphasize the need for epidemiologic surveillance programs throughout the unmonitored areas, including the Northern region of the Estado de Mexico. Moreover, epidemiological studies help define endemic areas of Chagas disease and can help prevent the dispersion of *T. cruzi* in areas where transmission has not been reported or where it was low[11]. In order to contribute to the study on the seroprevalence of

Chagas disease in the Estado de Mexico, Mexico, we analyzed 1,504 samples from thirteen villages distributed in the North of the state, using three diagnostic serological techniques.

An open population study was conducted in thirteen villages of the Hueypoxtla and Tequixquiac municipalities in the Estado de Mexico. Each participant was informed about the protocol by health personnel in each community. All participants signed the letter of informed consent, and they also completed a survey (clinic-based epidemiological data) on personal habits and customs, housing types, clinical manifestations, and recognition of triatomines. Venous blood samples were collected, and centrifuged for 20 minutes each to subsequently obtain serum which was maintained at -20°C until processing. Serological screening was performed using an enzyme-linked immunosorbent assay (ELISA) coupled with chemiluminescence (CHLIA), using the commercially available equipment Architect model I 2000 SR from Abbott according to the manufacturer's instructions and was conducted at the Central Blood Bank of the National Medical Center, *La Raza*. Absorbance was measured spectrophotometrically at 492nm. Optical densities with values greater than that of the negative controls, and generally higher than 0.90 of absorbance were considered as positive; and each positive sample was run in triplicate.

Seropositive samples were confirmed by ELISA and indirect hemagglutination (IHA) techniques, performed in Laboratorio Estatal de Salud Pública of Estado de Mexico according to NORMA Oficial Mexicana NOM-032-SSA2-2002 and NORMA Oficial Mexicana NOM-253-SSA1-2012.

The main occupations of the participants were agriculture and livestock production. Six villages studied correspond to urban areas while the rest were rural zones. A total of 137 samples were found with positive antibody to *T. cruzi*; with a prevalence of 9.1% which differed by gender. Higher prevalence among the 80 (58.2%) women and 57 (41.8%) men who tested positive were shown, higher than the prevalence reported in 2010 for the country (0.4%) or (0.2%) in 1992 by Velazco-Castrejón *et al*.[4]; while for this State, Estrada-Franco *et al*. reported 7.1%[8]. Compared with other states, the Northern part of the Estado de Mexico had a prevalence ten times higher than that reported for the State of Puebla (0.9%) or Querétaro (0.6%) in 2009[5,12].

The differences in the prevalence in the study area compared with other countries such as Brazil, in which there were blood bank reports of only 0.2% should be noted[13]. In a study of women and children attending a primary health care center in Buenos Aires, Argentina, they showed a prevalence of 4.0%[14]; the previous data therefore suggest the need to modify the status of the State of Mexico as an endemic area for Chagas disease with the implementation of health programs focused on the control of this parasitosis.

The 1,183 (78.6%) samples from Hueypoxtla municipality and 321 (21.5%) from Tequixquiac were analyzed, with a seroprevalence of 104 (8.7%) samples in Hueypoxtla, while the Guadalupe Nopala community had the highest [10 (21.7%)] number of positive cases (**Table 1**). The highest seroprevalence from 33 (10.3%) samples occurred in Tequixquiac, while the

TABLE 1: The positivity percentage in the Hueypoxtla and Tequixquiac municipalities, State of Mexico.

		Total		Positive		
Municipality	**Community**	**n**	**%**	**n**	**%**	**Rate***
Hueypoxtla		1,183	78.7	104	75.9	8.7
	Ajoloapan	229	15.2	26	19.0	11.4
	Casa Blanca	5	0.3	1	1.0	20.0
	Guadalupe Nopala	46	3.2	10	7.3	21.7
	Hueypoxtla	585	38.9	27	19.7	4.6
	Jilotzingo	82	5.5	12	8.8	14.6
	San José Bata	20	1.3	2	1.5	10
	Tezontlalpan	102	6.8	7	5.1	6.9
	Tianguistongo	28	1.9	6	4.4	21.4
	Zacacalco	84	5.6	13	9.5	15.5
Tequixquiac		321	21.3	33	24.1	10.3
	San José	91	6.0	14	10.2	15.4
	San Mateo	99	6.6	9	6.6	9.1
	Tlapanaloya	131	8.7	10	7.3	7.6
Total		**1,504**		**137**		**9.1**

*Rate per each hundred inhabitants

San José community had the highest prevalence of 14 (15.4%) positives.

In this study, three different techniques were used to determine the seroprevalence: the positive samples were analyzed with ELISA and IHA screening tests with 107 and 105 samples, respectively. Although, discrepancies were detected between the two techniques, both have acceptable sensitivity and specificity values. All positive patients were notified of their results, and administered with appropriate treatment under medical supervision; periodic studies were also conducted to determine changes in seropositivity.

Generally, the participant's ages ranged from zero to 98 years, with the majority aged between 20 and 60 years. Positive *T. cruzi* serology was found among people aged 29-91 years and was especially prevalent in individuals aged 40 to 80 years (**Table 2**). Higher rates were observed among people aged 81-90 years, which might suggest a possible correlation between the prevalence and age. It is also important to emphasize that no seropositive cases were identified among people aged 0-28 years (34.3%). This trend could be explained by the improvement in living conditions and the change in housing conditions due to the use of better construction materials and more suitable topcoats, thereby limiting intra- and peridomiciliary vector transmission. However, this does not eliminate the possibility of infection since the conditions favoring natural transmission such as cohabitation with the parasite, insects' vector and potential parasite reservoirs (i.e., cows, goats, pigs, sheep, horses, poultry and other domestic and wild animals) still exist.

A high percentage of participants reported not having traveled to endemic areas, never left their community, and not having received blood transfusions; therefore, further studies are needed to identify the main risk factors.

Unfortunately, no epidemiological data was obtained regarding infestation and infection indexes, since the area was not considered endemic by the health authorities; however, in those places where volunteers were permitted to conduct a search for the bugs, the vector *T. barberi* was located in the barns. In the Northern part of the state, there were no data on the presence of *T. barberi* and there were no records in the literature about the presence of vectors in this area. This specie is mainly characterized by its location in domiciled and peri-domiciled areas with altitudes of up to 2,400 meters above sea level while in neighboring states (surrounding the study region, such as Hidalgo and Mexico City)[15], it has also been reported.

Interestingly, the seronegativity found in patients aged 0 to 28 years does not rule out the active vectorial transmission, as the people reported an awareness of the presence of vector in the area, although it requires further studies to determine the forms of infection.

It is important to note that with the existence of transmitter in the area, and because a higher *T. cruzi* seroprevalence rate was identified in the population, there are undoubtedly latent infections among the population throughout this region.

Our findings demonstrated the seroprevalence of *T. cruzi* in Hueypoxtla and Tequixquiac municipalities, in Estado de Mexico.

The North of Estado de Mexico was previously considered non-endemic, although we found epidemiological conditions (such as the presence of infected vectors, seropositive patients, and potential reservoirs) necessary for the natural transmission of *T. cruzi* (**Figure 1**).

It is important to perform further studies to better understand the epidemiology of Chagas disease in this state, specifically, to understand the entomological indexes and potential reservoirs, and to track positive patients and their contacts.

TABLE 2: Seropositivity by age and gender of the participant from the thirteen communities in the North of Estado de Mexico.

Age group (years)	Women			Men			Total		
	participants	positive	%	participants	positive	%	participants	positive	%
≤10	22	0	0.0	24	0	0.0	46	0	0.0
11 – 20	136	0	0.0	39	0	0.0	175	0	0.0
21 – 30	244	0	0.0	43	2	4.7	287	2	0.7
31 – 40	173	9	5.2	52	6	11.5	225	15	6.7
41 – 50	162	14	8.6	56	9	16.1	218	23	10.6
51 – 60	155	15	9.7	85	18	21.2	240	33	13.8
61 – 70	94	18	19.1	67	14	20.9	161	32	19.9
71 – 80	52	18	34.6	36	4	11.1	88	22	25.0
81 - 90	19	6	31.6	14	3	21.4	33	9	27.3
≥91	0	0	0.0	4	1	25.0	4	1	25.0
Unspecified	19	0	0.0	8	0	0.0	27	0	0.0
Total	**1,076**	**80**	**7.4**	**428**	**57**	**13.3**	**1,504**	**137**	**9.1**

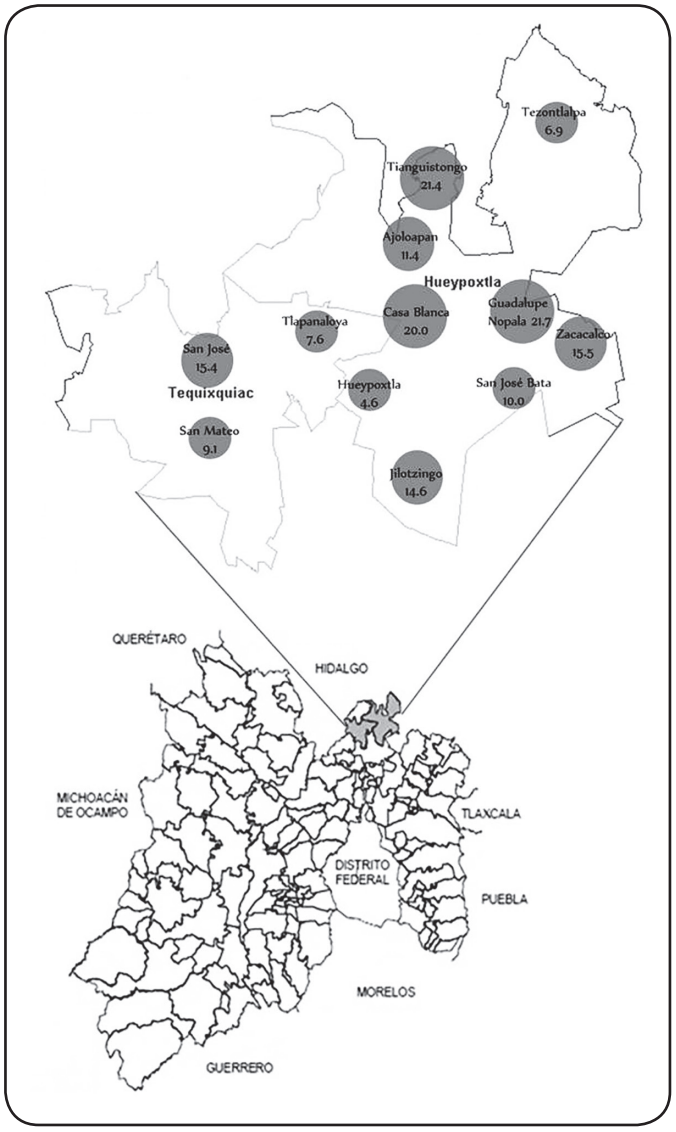

FIGURE 1 - Location of the area of study in the North of Estado de Mexico. The circles on the map indicate the location of the communities where cases occurred; the incidence rates from each community are presented.

Ethical consideration:

The protocol was approved by the Committee of Research Ethics of the "Hospital Regional de Alta Especialidad" from Zumpango, Estado de Mexico, Mexico.

Acknowledgments

We offer our deepest thanks to all of the technicians in the Primary Health Care programs of the various Centros of Salud municipalities of Hueypoxtla, Tequixquiac, and Zumpango for their help in locating patients. We are grateful to the laboratory of the Hospital General of Hueypoxtla for sample collection and storage. We are grateful to Martha Eloisa Velázquez Germán, Jefa Jurisdiccional of Zumpango, for her support in the project facilities. We are grateful to Cesar Florencio Martínez, the Chief of the Hospital General of Hueypoxtla Laboratory.

Conflict of interest

The authors declare that there is no conflict of interest.

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