Abstract. Scarce information on the seroprevalence of Trypanosoma cruzi among Amerindians is available, and the distribution of this disease in Mexican Indian populations is unknown. In this study, the prevalence of specific antibodies against T. cruzi among Teenek Amerindians in nine different communities located in San Luis Potosi State was analyzed. An average seroprevalence of 6.5% was found in these populations, suggesting that active transmission of disease occurs in this relatively isolated population in Mexico, and therefore, further studies should be conducted to identify risk factors associated to Chagas disease in other isolated populations across the country to determine the prevalence of Chagas disease in Mexican Amerindians.

Chagas disease is a serious health problem caused by infection with Trypanosoma cruzi, a vector-borne protozoan, which uses different mammals as reservoirs. The disease is transmitted to humans by hematophagous Hymenoptera insects belonging to the subfamily Triatominae, which commonly defecate on the host while feeding, allowing parasites present in the feces to penetrate the damaged skin or to be passed to eyes, nose, and mouth mucosa, leading to infection. It is important to mention that other common mechanisms of transmission include blood transfusion, vertical transmission, and organ transplantation. Housing invasion by infected triatomines has been found to be a key component for disease transmission to humans, being associated with poverty and lack of socioeconomic development, although infection may also occur in people living in well-developed settings and good-quality residences. Therefore, it is important to implement efficient vector control programs in regions where T. cruzi has been reported. Furthermore, adequate control measures depend on accurate and opportune diagnosis of the disease, because chronic disease is difficult to treat and can potentially lead to death, usually because of heart failure.

Trypanosoma cruzi affects ~16–18 million people in the Americas and ~100 million are at risk of infection. Chagas disease has a large geographical distribution extending from the southern part of the Unites States to Argentina, including Mexico, where active transmission of human Chagas disease and triatomine infestation have been reported. Nevertheless, limited information on the prevalence of infection in Amerindians is available, and T. cruzi seroprevalence in Mexican Indian populations is largely unknown. In this paper, a T. cruzi seroprevalence study was conducted among Teenek Indians (also known as Huastecos), an ethnic group living in northeast Mexico in the Huasteca region. This Amerindian population, whose spoken language is a Mayan dialect, lives as relatively isolated groups that still preserve many of their own pre-Hispanic cultural and social characteristics. Minimal migration and interaction with other ethnic groups have resulted in a limited polymorphism, as seen in their representative human leukocyte antigens (HLA) genes.

La Huasteca is a region in the northeastern part of Mexico between the mountainous terrain of the Sierra Madre Oriental and the Panuco River that includes parts of Veracruz, Tamaulipas, San Luis Potosi, and Hidalgo (Figure 1). This area is characterized by a rainy, humid, tropical climate, with altitudes ranging between 107 and 215 m above sea level, with an average annual temperature around 25.5°C. These conditions favor the breeding of different triatomine species (Triatoma dimidiata, Triatoma gestaeckeri, and Triatoma mexicana). The number of inhabitants in this area is ~335,000 and ~48% belong to the Teenek group. This land is shared with other Huasteca-Nahuatl language speaking ethnic groups, which also remain relatively isolated.

Nine communities located in the Huasteca region of San Luis Potosi State (Coaxinquila, 98°51′57″ W, 21°33′18″ N, 200 m above sea level [MASL]; Colonia Altamira, 98°52′22″ W, 21°35′56″ N, 200 MASL; Coxcatlan, 98°54′29″ W, 21°32′26″ N, 160 MASL; Cruce San Antonio, 98°54′10″ W, 21°37′10″ N, 200 MASL; Tamarindo, 98°56′18″ W, 21°39′30″ N, 160 MASL; Tamazunchale, 98°47′45″ W, 21°15′56″ N, 140 MASL; Tencaxapa, 98°47′14″ W, 21°42′25″ N, 160 MASL; El Tom, 98°53′02″ W, 21°35′53″ N, 200 MASL, and Zacatipa 99°03′15″ W, 21°21′44″ N, 900 MASL) belonging to the Tamazunchale Sanitary Jurisdiction were included in this study. As part of the routine screening of the National Vector Borne Disease Control Program, randomization by household was performed, and blood samples were collected from 999 donors representing 0.62% of the Teenek population in the region. Both sexes and all age groups were equally represented based on the information available from the census conducted in Mexico in 2005 (http://www.inegi.gob.mx/inegi/default.aspx). All subjects enrolled were born in Teenek territory and spoke Teenek as the maternal language.

Ethical review and informed consent approval was obtained from the Ethical Committee of the Mexican Institute for Epidemiological Diagnosis and Reference (InDRE). Verbal informed consent was obtained from subjects who accepted to participate in the study. All participants were given information, in their own language, about the disease and its vector. The vast majority of the participants have lived in the same community for most part of their life. Interestingly, 60% of the population was familiarized with the vector but only 20% recognized having seen the vector in their residences. Depending on the community, 15–28% of the interviewees

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**Short Report: Seroprevalence of Trypanosoma cruzi Among Teenek Amerindian Residents of the Huasteca Region in San Luis Potosí, Mexico**

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acknowledged being bitten by triatomine insects and only one person reported blood transfusion. Overall, housing and sanitary conditions in all communities studied were poor, lacking basic services such as drinking water, sewage, and electricity. Most dwellings (~90%) were built with palm tree, tree trunks, straw, mud, etc., and domestic animals usually had free access to the household.

Active insect search to determine triatomine infestation after a residual insecticide (K-othrine) spraying program was performed in these communities as part of the National Vector-borne Diseases Control Program. In different communities, household triatomine infestation rate varied from 4% to 38%. Parasite detection in triatomines was performed by light microscopy in fresh feces obtained by abdominal compression. Parasite infection rates in triatomines in the region ranged between 4% and 26% (Table 1).

The presence of specific antibodies against *T. cruzi* in serum samples was determined with two commercial kits: a passive agglutination test (Serodia Fujirebio, Tokyo, Japan) and an ELISA system (Bioschile, Santiago, Chile). Sixty-six samples were positive by either test. Distribution and seroprevalence by age and sex in this population is summarized in Table 2. Confirmatory diagnosis of all 66 positive samples along with 100 serum specimens randomly selected from healthy volunteers living in Chagas disease–free areas was performed by ELISA and indirect immunofluorescence at InDRE as described elsewhere. Definitive diagnosis of *T. cruzi* infection was defined according to WHO recommendations (positive with at least two serologic tests). Sixty-five of 66 samples were serologically confirmed as positive for *T. cruzi* antibodies. The unconfirmed specimen was removed from the analysis and listed as undetermined. None of the control samples tested in this study were anti-*T. cruzi* positive.

*Trypanosoma cruzi* infection is still endemic in Mexico, mostly because of the lack of an official control program in the country. Several reports describing the epidemiology of Chagas disease in Mexico have assessed the prevalence of antibodies in the Mexican population living in geographic regions where the vector is endemic. In this work, the prevalence of antibodies against *T. cruzi* in a relatively isolated Mexican Amerindian population was studied, and a prevalence of 6.5% was found. This figure is significantly higher than the national mean in Mexico, which, according to the national official survey, is 1.6%. The most affected age groups were children younger than 15 years (8%) and adults older than 65 years (14%). Interestingly, no children ≤ 4 years of age had antibodies to *T. cruzi*, which might suggest that disease transmission has stopped quite recently or that these small children are kept in cribs and carried on the back of their mothers and in general are better supervised; thus, they do not have contact with the

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**Figure 1.** Study site. The Huasteca region is composed of municipalities and villages located in the States of San Luis Potosi, Veracruz, Tamaulipas, and Hidalgo in northeast Mexico. This region is located between the Sierra Madre Oriental, the Panuco river, and the Gulf of Mexico. The study site location is indicated on the map.
vector, consequently reducing the possibility of infection during the early years of life. Further studies with a larger number of individuals at early ages and knowledge of their habits, are needed to better understand transmission in this age group.

Seroprevalence in men was slightly higher than in women (7% and 6%, respectively). Contrary to our findings, significant differences in sex and age distribution among T. cruzi-seropositive individuals in Mexico have been reported. These discrepancies might be the result of cultural, human behavior, and socio-economic differences among regions. Multivariate regression model (backward stepwise) was performed to assess the relationship between prevalence and all variables (number of dwellings, earth floor, no drinking water, no sewage, triatomine infestation rate, and triatomine infection rate). Matrix scatter plot showed correlation between prevalence and having an earth floor ($P = 0.038$). An earth floor also correlated with no sewage ($P = 0.034$) and no drinking water ($P = 0.003$). To assess the influence of all variables over prevalence, a multivariate linear regression was performed. A model using earth floor as a predictor was the only one that explained prevalence ($R^2 = 0.48$, $P = 0.038$). Earth floor has been previously reported to be associated with presence of triatomine insects in other communities in Mexico where breeding of the vector was reduced by cementing floors. Therefore, “Earth Floor Solidification Programs” should also be considered as a measure to control transmission of T. cruzi by limiting its vector. Interestingly, no association was observed between prevalence and triatomine infestation or infection with T. cruzi; this suggests that other unidentified factors might also play role in disease transmission in these settings.

The communities Tamarindo, Colonia Altamira, Tom, and Coaxinquila showed the highest seroprevalences and also exhibited some of the lowest development indicator levels (Table 1). However, Crucero San Antonio also showed one of the highest seroprevalence (10%), but the development indicators were not as unfavorable as in some of the other communities, and therefore, other factors should also contribute to increase infection rates. Overall, the variability in the seroprevalence among the communities studied in this work might be attributed to poor sanitary infrastructure and housing quality, where less-developed communities tend to present higher seroprevalence, although other factors must play an important role in parasite transmission in well-developed settlements.

High T. cruzi seroprevalence values in several Amerindian communities in other Latin American countries have also been reported and are associated with socio-economic status, educational level, and common practices such as junk piling, breeding small animals such as rabbits, and having large numbers of pets (dogs and cats). All these factors seem to favor breeding of the vector and disease transmission.

Importantly, in 1991, several South American countries agreed to create the Initiative of the Southern Cone Countries for the interruption of transmission of Chagas disease, followed by the Initiatives of the Andean Countries and the Central America countries in 1997. Nonetheless, programs to control this disease in Mexico were not in place until recently, when a pilot exercise in integrated triatomine control carried out in the State of Oaxaca, an endemic area in Mexico, generated promising expectations for Chagas disease prevention. In the Huasteca region, however, very limited information about chronic chagasic cardiomyopathy is available. Epidemiologic surveillance, disease, and vector control programs in endemic areas should be established along with informative campaigns in communities where parasite and vector circulation has been documented.

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### Table 1

<table>
<thead>
<tr>
<th>Community</th>
<th>Inhabitants</th>
<th>Sample size N (%)</th>
<th>Positive samples N (% prevalence)</th>
<th>Number of dwellings</th>
<th>Households infested with triatomines (%)</th>
<th>Triatomines infected with T. cruzi (%)</th>
<th>No drinking water N (%)</th>
<th>Earth floor N (%)</th>
<th>No sewage N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coaxinquila</td>
<td>539</td>
<td>218 (40%)</td>
<td>18 (8)</td>
<td>116</td>
<td>38%</td>
<td>26%</td>
<td>115 (99%)</td>
<td>100 (86%)</td>
<td>2 (2%)</td>
</tr>
<tr>
<td>Colonia Altamira</td>
<td>395</td>
<td>123 (31%)</td>
<td>12 (10)</td>
<td>74</td>
<td>8%</td>
<td>25%</td>
<td>41 (55%)</td>
<td>67 (91%)</td>
<td>72 (97%)</td>
</tr>
<tr>
<td>Coaxcatlan</td>
<td>2,454</td>
<td>118 (5%)</td>
<td>6 (4)</td>
<td>582</td>
<td>32%</td>
<td>10%</td>
<td>47 (8%)</td>
<td>111 (19%)</td>
<td>100 (17%)</td>
</tr>
<tr>
<td>Crucero San</td>
<td>479</td>
<td>75 (16%)</td>
<td>4 (3)</td>
<td>127</td>
<td>20%</td>
<td>7%</td>
<td>21 (17%)</td>
<td>39 (31%)</td>
<td>7 (6%)</td>
</tr>
<tr>
<td>Antonio</td>
<td>637</td>
<td>145 (23%)</td>
<td>14 (10)</td>
<td>8</td>
<td>38%</td>
<td>12%</td>
<td>8 (100%)</td>
<td>8 (100%)</td>
<td>8 (100%)</td>
</tr>
<tr>
<td>Tamarindo</td>
<td>50</td>
<td>15 (30%)</td>
<td>2 (13)</td>
<td>5300</td>
<td>18%</td>
<td>7%</td>
<td>948 (18%)</td>
<td>665 (13%)</td>
<td>390 (7%)</td>
</tr>
<tr>
<td>Tamazunchala</td>
<td>21,614</td>
<td>261 (1%)</td>
<td>7 (3)</td>
<td>12</td>
<td>16%</td>
<td>4%</td>
<td>12 (100%)</td>
<td>8 (67%)</td>
<td>11 (92%)</td>
</tr>
<tr>
<td>Tencaxapa</td>
<td>65</td>
<td>26 (40%)</td>
<td>2 (8)</td>
<td>11</td>
<td>27%</td>
<td>16%</td>
<td>11 (100%)</td>
<td>11 (100%)</td>
<td>8 (73%)</td>
</tr>
<tr>
<td>Tom</td>
<td>60</td>
<td>42 (70%)</td>
<td>3 (7)</td>
<td>46</td>
<td>4%</td>
<td>12%</td>
<td>26 (57%)</td>
<td>15 (33%)</td>
<td>13 (28%)</td>
</tr>
<tr>
<td>Zacatipana</td>
<td>193</td>
<td>51 (26%)</td>
<td>1 (2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*At least two positive serologic tests.

### Table 2

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Male [positive/total (%)]</th>
<th>Female [positive/total (%)]</th>
<th>Total [positive/total (%)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 4</td>
<td>0/20</td>
<td>0/15</td>
<td>0/35</td>
</tr>
<tr>
<td>5 to 14</td>
<td>11/119 (9%)</td>
<td>12/154 (8%)</td>
<td>23/273 (8%)</td>
</tr>
<tr>
<td>15 to 24</td>
<td>2/38 (5%)</td>
<td>6/33 (5%)</td>
<td>8/170 (5%)</td>
</tr>
<tr>
<td>25 to 44</td>
<td>4/79 (5%)</td>
<td>6/165 (4%)</td>
<td>10/244 (4%)</td>
</tr>
<tr>
<td>45 to 64</td>
<td>5/84 (6%)</td>
<td>9/208 (8%)</td>
<td>14/204 (7%)</td>
</tr>
<tr>
<td>65 &gt;</td>
<td>5/28 (18%)</td>
<td>5/45 (11%)</td>
<td>10/73 (14%)</td>
</tr>
<tr>
<td>Total</td>
<td>27/368 (7%)</td>
<td>38/631 (6%)</td>
<td>65/999 (6.5%)</td>
</tr>
</tbody>
</table>

*At least two positive serologic tests.
REFERENCES


