

## Chagas Disease Awareness among Latin American Immigrants Living in Los Angeles, California

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**Abstract.** Approximately 300,000 persons have Chagas disease in the United States, although almost all persons acquired the disease in Latin America. We examined awareness of Chagas disease among Latin American immigrants living in Los Angeles, California. We surveyed 2,677 persons (age range = 18–60 years) in Los Angeles who resided in Latin America for at least six months. A total of 62% of the participants recalled seeing triatomines in Latin America, and 27% of the participants reported triatomine bites at least once per year while living abroad. A total of 86% of the participants had never heard of Chagas disease. Of persons who had heard of Chagas disease, 81% believed that it was not serious. More than 95% of those who had heard of Chagas disease would want to be tested and treated. Most Latin American immigrants living in Los Angeles recalled exposure to vectors of Chagas disease. However, they have little knowledge of this disease. Increasing awareness of Chagas disease is needed in this high-risk population.

### INTRODUCTION

Chagas disease, also known as American trypanosomiasis, was first described in 1909 by the Brazilian physician Carlos Chagas.<sup>1</sup> The disease is caused by the protozoan parasite *Trypanosoma cruzi* and is classically transmitted to humans via triatomine insects, also known as kissing bugs. However, *T. cruzi* can also be transmitted to humans through blood transfusion, solid organ or bone marrow transplantation, oral transmission, laboratory accidents, intravenous drug use, and vertically from mother to fetus.<sup>2</sup> These non-vector mechanisms represent the primary mode of transmission in non-endemic countries such as the United States.<sup>3,4</sup>

Once infected, the majority of individuals progress to the indeterminate phase of Chagas disease. Although largely asymptomatic, it is important to diagnose patients in this phase given some evidence for reducing further progression of the disease if treated with antitrypanosomal therapy.<sup>5</sup> If left untreated, approximately one-third of patients show development of serious and potentially fatal cardiac manifestations ranging from conduction abnormalities and dysrhythmias to apical aneurysms and cardiomyopathy.<sup>6</sup>

The World Health Organization estimates that more than 10 million persons worldwide are infected with *T. cruzi* and most live in Latin America, an area to which disease is endemic. However, immigration patterns have made Chagas disease an important health issue in the United States, Canada, Europe, and the western Pacific.<sup>7</sup> According to the 2010 U.S. Census, the United States is home to more than 17 million persons born in countries to which Chagas disease is endemic.<sup>8,9</sup> Because of this immigration, it is estimated that more than 300,000 persons are infected with *T. cruzi* in the United States.<sup>10</sup>

California has more than 10 million foreign-born residents, more than any other state in the United States. Of these foreign-born residents, 53% are from Latin America.<sup>8,11</sup> Los Angeles County alone has more than two million residents born in countries to which Chagas disease is endemic. *Trypanosoma cruzi* has been detected in Los Angeles since 1984,<sup>12</sup> and Los Angeles blood banks have estimated seroprevalence rates among blood donors to be as high as

1/2,000.<sup>13–16</sup> Furthermore, two case reports of *T. cruzi* transmitted during heart transplantation in Los Angeles were reported in 2006.<sup>17,18</sup>

Although there is a growing concern for Chagas disease in the United States, relatively little original research has been published on the subject. The present study aims to examine awareness of Chagas disease among immigrants from countries to which Chagas disease is endemic who reside in Los Angeles County. To our knowledge, no previous study has quantitatively assessed the Chagas disease-related health education of this at-risk population in the United States. Based on our experience working with Latin American immigrants at a Los Angeles County hospital, we believed that knowledge of Chagas disease would be poor.

### MATERIALS AND METHODS

**Ethics statement.** This study was approved by the Institutional Review Board of the Olive View-UCLA Education and Research Institute. All participants provided written, informed consent before study enrollment.

**Study population.** This study was a cross-sectional survey in which study participants were recruited from health fairs conducted at 20 local churches and community health centers in Los Angeles County. The study population was a convenience sample of Latin American immigrants, and no personal invitations were sent. We sought 3,000 study participants. Inclusion criteria were any person currently residing in Los Angeles County age 18–60 years who was born and previously resided in Mexico, Central America, or South America for at least six months. Persons who did not meet the inclusion criteria were excluded. Participants were asked to complete a questionnaire that assessed medical and sociodemographic information, as well as awareness of Chagas disease. The questionnaire was administered in English and Spanish by trained, Spanish-speaking personnel, and no education on Chagas disease was given to the participants before questionnaire completion. There was no compensation for participation. No information was collected on persons who refused to participate.

**Sociodemographic variables.** Age was categorized into 10-year age groups. Responses for highest level of education completed were collapsed into three categories: less than high school, high school (or equivalent), or more than high school. Countries of birth with less than 50 persons

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FIGURE 1. *Triatoma sanguisuga*. Photograph courtesy of the Centers for Disease Control and Prevention.

were collapsed into a category renamed other. The location of the respondent's Latin American home was collapsed into two categories based on the type of location (rural versus urban) and size of the location's population. The responses to the questions regarding whether the participant lived or stayed in a Latin American house with a thatched roof, and mud walls, adobe brick walls, or roof were collapsed such that definitely no and probably no became one category and definitely yes and probably yes became one category.

**Variables regarding Chagas disease.** Responses to the questions regarding Chagas disease were collapsed such that definitely no and probably no became one category and definitely yes and probably yes became one category. Answer categories for the question "When you were living in Latin America, how often were you bitten by this bug?" (Figure 1) were collapsed based on the frequency of bites. For the question "Do you think Chagas disease is a disease that is...", responses were collapsed into not serious and serious.

**Statistical analysis.** Descriptive statistics were used to describe the sociodemographic variables. Chi-square tests for independence were used to test for an association between sociodemographic variables and the questions regarding Chagas disease. All analyses were conducted with SPSS 20 software (SPSS Inc., Chicago, IL).

## RESULTS

### Sociodemographic characteristics of the study population.

During April 2008–October 2011, 2,677 persons were recruited into the study. Overall, 65% of the study population was more than 40 years of age and 64% of the study population was female (Table 1). Two-thirds of the participants had less than a high school education. Most participants were originally from Mexico (69%); an additional 25% were from either El Salvador or Guatemala. Within their country of birth, 49% of the participants came from a location described as rural, a farm, or a small city. While living in Latin America, 14% of participants lived under a thatched roof, 35% of participants lived in a home with mud walls, and 79% of participants lived in a house with adobe bricks, walls, or roof.

**Awareness of Chagas disease by country of birth.** Overall, 62% of the study participants recall seeing triatomine insects (Figure 1) in Latin America; corresponding prevalences for

TABLE 1  
Sociodemographic characteristics of the study population

Variable	No. (%)
Age, years	
18–30	271 (10)
31–40	667 (25)
41–50	972 (37)
51–60	749 (28)
Sex	
M	962 (36)
F	2,663 (64)
Education	
< High school	1,792 (67)
High school	588 (22)
> High school	281 (11)
Country of birth	
Mexico	1,857 (69)
El Salvador	428 (16)
Guatemala	239 (9)
Other	153 (6)
Location of Latin American home	
Suburbs/large city (> 50,000 population)	1,346 (51)
Rural/farm/small city (< 50,000 population)	1,274 (49)
Lived/stayed in Latin American house with thatched roof?	
Definitely/probably no	2,270 (86)
Maybe/not sure	13 (1)
Definitely/probably yes	357 (14)
Lived/stayed in Latin American house with mud walls?	
Definitely/probably no	1,674 (64)
Maybe/not sure	37 (1)
Definitely/probably yes	920 (35)
Lived/stayed in Latin American house with adobe brick/walls/roof?	
Definitely/probably no	510 (20)
Maybe/not sure	34 (1)
Definitely/probably yes	2,048 (79)

those born in Mexico, El Salvador, Guatemala, or elsewhere were 62%, 72%, 57%, and 49%, respectively ( $P < 0.001$ ) (Table 2). Twenty-seven percent of participants reported being bitten by triatomine insects (Figure 1) at least once per year while living in Latin America; corresponding prevalences for those born in Mexico, El Salvador, Guatemala, or elsewhere were 30%, 21%, 25%, and 13%, respectively ( $P < 0.001$ ). Eighty-six percent of participants had never heard of Chagas disease; corresponding prevalences for those born in Mexico, El Salvador, Guatemala, or elsewhere were 89%, 81%, 83%, and 70%, respectively ( $P < 0.001$ ).

**Opinion of Chagas disease by country of birth (participants who have heard of Chagas disease).** Of the 13% of participants who had heard of Chagas disease, 62% believed that Chagas disease was a problem in their native country, 55% believed that Chagas disease was a problem in the United States, and 81% believed that Chagas disease was not serious (Table 3). These results were not affected by country of birth. More than 95% of participants who had heard of Chagas disease would want to be tested and treated for it.

## DISCUSSION

We examined awareness of Chagas disease among 2,677 immigrants from countries to which Chagas disease is endemic who resided in Los Angeles, California, during April 2008–October 2011. Most participants were more than 40 years of age, female, and had less than a high school education. The

TABLE 2  
Chagas disease awareness by country of birth

Variable	No. (%)					P†
	Mexico (n = 1,857)*	El Salvador (n = 428)	Guatemala (n = 239)	Other (n = 153)	Total (n = 2,677)	
Have you ever seen this insect in Latin America before?						< 0.001
Definitely/probably no	634 (35)	109 (26)	98 (42)	72 (47)	913 (35)	
Maybe/not sure	67 (4)	9 (2)	4 (2)	6 (4)	86 (3)	
Definitely/probably yes	1,122 (62)	304 (72)	133 (57)	75 (49)	1,634 (62)	
When you were living in Latin America, how often were you bitten by this bug?						< 0.001
Never	1,276 (71)	333 (79)	174 (75)	132 (87)	1,915 (73)	
About 1 time/year	231 (13)	38 (9)	22 (10)	12 (8)	303 (12)	
About 3 times/year or more	297 (17)	53 (13)	35 (15)	8 (5)	393 (15)	
Have you ever heard of Chagas disease?						< 0.001
Definitely/probably no	1,636 (89)	345 (81)	197 (83)	106 (70)	2,284 (86)	
Maybe/not sure	17 (1)	0 (0)	3 (1)	0 (0)	20 (1)	
Definitely/probably yes	188 (10)	81 (19)	38 (16)	45 (30)	352 (13)	

\* Subtotal affected by missing data for each response.  
† By chi-square test for independence.

lack of formal education observed accurately reflects previous reports of the educational status of the Latin American immigrant population in California.<sup>19</sup> More than 90% of the study participants were born in Mexico, El Salvador, or Guatemala, which is consistent with the Latin American immigrant population nationwide.<sup>20</sup>

Our study population has many high-risk features for the development of Chagas disease. Nearly half of the participants came from an area in Latin America described as rural, a farm, or a small city with a population less than 50,000 persons. While living in Latin America, 14% of participants lived under a thatched roof, 35% of participants lived in a home with mud walls, and 79% of participants lived in a house with adobe bricks, walls, or roof. All of these living conditions have been associated with increased rates of transmission of Chagas disease.<sup>2,7,10</sup> More than 60% of those sur-

veyed recall seeing the triatomine insect (Figure 1) in Latin America, and more than 25% of the participants recall being bitten by the insect responsible for transmitting Chagas disease at least once per year while living in Latin America. More than 10% of immigrants from Mexico, El Salvador, and Guatemala recalled being bitten at least three times per year. Because *T. cruzi* is transmitted through the feces of the triatomine insect entering the bloodstream through a bite, a history of triatomine bites is a strong proxy for exposure to Chagas disease.<sup>2</sup>

Despite this significant exposure to the vector responsible for transmitting Chagas disease in countries to which Chagas disease is endemic, 86% of the study population had never heard of Chagas disease. This finding may be partially explained by the fact that 69% of the participants were from Mexico, and participants born in Mexico were less likely to

TABLE 3  
Opinion of Chagas disease by country of birth (participants who have heard of Chagas disease)\*

Variable	No. (%)					P‡
	Mexico (n = 188)†	El Salvador (n = 81)	Guatemala (n = 38)	Other (n = 45)	Total (n = 352)	
Do you think Chagas disease is a problem in your country of origin?						0.15
Definitely/probably no	36 (20)	13 (16)	2 (5)	8 (18)	59 (17)	
Maybe/not sure	42 (23)	17 (21)	4 (11)	9 (20)	72 (21)	
Definitely/probably yes	105 (57)	50 (63)	31 (84)	28 (62)	214 (62)	
Do you think Chagas disease is a problem in the Latino community in the USA?						0.55
Definitely/probably no	43 (23)	13 (16)	10 (26)	13 (29)	79 (22)	
Maybe/not sure	46 (25)	16 (20)	8 (21)	10 (22)	80 (23)	
Definitely/probably yes	99 (53)	52 (64)	20 (53)	22 (49)	193 (55)	
If you could get tested for Chagas disease by a doctor, would you get tested?						NA
Definitely/probably no	7 (4)	2 (3)	0 (0)	0 (0)	9 (3)	
Maybe/not sure	1 (1)	1 (1)	0 (0)	0 (0)	2 (1)	
Definitely/probably yes	178 (96)	78 (96)	38 (100)	43 (100)	337 (97)	
If you had Chagas disease, would you take the medication for it?						NA
Definitely/probably no	0 (0)	0 (0)	1 (3)	0 (0)	1 (0)	
Maybe/not sure	2 (1)	0 (0)	1 (3)	0 (0)	3 (1)	
Definitely/probably yes	184 (99)	81 (100)	36 (95)	45 (100)	346 (99)	
Do you think Chagas disease is a disease that is: _____						0.35
Not serious	152 (82)	59 (76)	30 (79)	38 (88)	279 (81)	
Serious	33 (18)	19 (24)	8 (21)	5 (12)	65 (19)	

\* NA = not applicable (chi-square test invalid because of low expected counts).  
† Subtotal affected by missing data for each response.  
‡ By chi-square test for independence.

have heard of Chagas disease than participants born elsewhere. These findings may be caused by the heterogeneous geographic distribution of Chagas disease in Mexico, in which disease prevalence is highest in the rural southeastern states.<sup>21,22</sup> However, in the present study participants born in Mexico recall seeing the triatomine in their native country and reported being bitten by the insect at rates similar to participants from other countries. Thus, the lack of knowledge of Chagas disease among Mexican immigrants may reflect a larger problem. Mexico was the last Latin American country to develop a comprehensive national program against Chagas disease.<sup>21</sup> Moreover, although only 50 cases of Chagas disease per year are identified nationally by the Mexican Ministry of Health, other studies have found a prevalence rate of 30% in some Mexican communities.<sup>23</sup> One retrospective analysis of heart failure patients in Chiapas, Mexico, reported a prevalence rate of 82.5% for Chagas disease.<sup>24</sup> Some cite these facts as examples of how Mexico has neglected the evidence of a tremendous epidemic of Chagas disease.<sup>4,21,25–28</sup>

Only 13% of study participants had heard of Chagas disease, and this group as a whole had a poor understanding of the epidemiology and natural course of the disease. Only 62% of this group believed that Chagas disease was a problem in their country of origin, and 55% believed that Chagas disease was a problem in the United States. In reality, Chagas disease is not generally considered to be endemic to the United States and only rare cases of autochthonous *T. cruzi* transmission have been reported.<sup>29</sup> Most (81%) persons also believed that Chagas disease is not serious, when in fact 20–30% of persons with chronic Chagas disease will show development of serious cardiac manifestations, including heart failure, ventricular tachycardia, and even death.<sup>2</sup> Fortunately, more than 95% of this group would want to be tested and treated for Chagas disease. Taken as a whole, these findings highlight one of the most significant barriers to addressing Chagas disease in the United States: lack of knowledge.

The lack of knowledge about Chagas disease is widespread not only among the general population, but also in the medical literature. One small study enrolled 37 Latin American immigrants into focus groups to discuss Chagas disease. Virtually none of the study participants, most from Mexico, had ever heard of Chagas disease. Perhaps more striking, however, was the finding that most of the 28 health care professionals enrolled into the focus groups had also not heard of Chagas disease.<sup>30</sup> A survey of physicians in the United States from various specialties found similar results; 14–47% of respondents had never heard of Chagas disease.<sup>31</sup> Clearly, there is a need for educational outreach towards at-risk Latin American immigrants, as well as physicians in the United States who are likely to care for this population.

This study had several limitations, which should be acknowledged during the interpretation of its findings. Recruitment at local churches and community health centers may have introduced a recruitment bias: a recent Gallup poll found that women are more likely than men to attend church.<sup>32</sup> This finding likely explains the predominance of females in the study population. Because 60–70% of patients with Chagas disease will never show development of clinically apparent disease (the indeterminate phase), persons may not see any physical manifestations of the disease despite coming from areas in which the disease is highly endemic, a fact that may influence recall bias.<sup>2</sup> Lastly, because of the study design,

our convenience sample may limit generalizability and associations drawn by our data may be confounded by unmeasured variables.

In conclusion, Chagas disease is a neglected tropical disease with limited data in the United States. Chagas disease is often unrecognized and underappreciated among the general population and healthcare professionals alike. Our study group has had significant exposure to *T. cruzi*, yet our findings corroborate previous observations that most Latin American immigrants have never heard of Chagas disease. Undoubtedly, this lack of awareness of Chagas disease creates a significant barrier to care. Even those persons who have heard of Chagas disease would benefit from further education. Public health officials should capitalize on this study's findings by training Spanish-speaking Chagas disease advocates to target local churches and community health centers with large populations of Latin American immigrants. These focused efforts to educate, diagnose, and treat Latin American immigrants infected with *T. cruzi* in the United States should prove efficacious because most of our study participants were eager to be tested and treated. By treating Chagas disease in the indeterminate stage, afflicted persons and their children could be spared significant morbidity and mortality, and the healthcare system in the United States could be spared expenses incurred by the progression of Chagas disease in this largely uninsured population.

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