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Seroprevalence of Chagas Disease Among Latin American Children Living in New York

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Introduction

Chagas disease is a parasitic illness caused by *Trypanosoma cruzi*, a vector-borne protozoa endemic to Latin America.[1] Transmission is primarily the result of zoonotic inoculation by triatomine insects (also known as the "kissing bug"), though vertical transmission, ingestion of contaminated food, and acquisition through infected blood products or transplanted organs may also occur. Affected individuals may develop dilated cardiomyopathy, megacolon, or megaesophagus decades after contracting an asymptomatic infection.[1]

Screening for Chagas disease is uncommon in the United States (US). The Centers for Disease Control and Prevention (CDC) estimates that approximately 238 000 to 347 000 individuals in the US are infected.[2] As few seroprevalence studies have been performed in the US, this estimate is an extrapolation of the number of Latin American immigrants living in the US multiplied by the seroprevalence rate of Chagas disease in their country of origin (typically 1%-6%).[3] As large majorities of Latin American immigrants live in New York, California, and Texas, and because autochthonous transmission is believed to occur in the Southern US,[1] these regions are likely home to the largest number of infected individuals.

Chagas disease has unique characteristics among children. As with adults, children born in Latin America at risk are of infection due to typical transmission routes. Unlike adults, however, is the estimated 1% to 5% risk of transplacental infection among children born to mothers with Chagas disease.[3] This leads to chronic infection among children who may never visit an endemic region. Although up to 40% of neonates with congenital Chagas disease have signs of infection,[4] neonatal diagnosis is rare in the US due to limited clinician awareness. Additionally, Chagas disease treatment with benznidazole is highly effective and well-tolerated during childhood,[4] making pediatric diagnosis ideal for reducing future morbidity.

We sought to perform a Chagas disease seroprevalence study and risk factor assessment among Latin American children living in Suffolk County, New York. We are aware of only one other seroprevalence study in the United States that enrolled children,[5] underscoring the tremendous gap in knowledge of pediatric Chagas disease in the US.

Methods

We conducted a cohort study of Latin American children living in Suffolk County, New York who were either first- or second-generation immigrants to the United States. Study participants underwent a serologic screening for Chagas disease, as described below, and provided responses to survey questions regarding the illness. Potential study participants were recruited from either Stony Brook Children's Hospital or an ambulatory pediatric office consisting largely of Latin American families in Southampton, New York. Both sites are located in Suffolk County, New York, a suburb of New York City. The County has a population of approximately 1 476 000 individuals, 20.2% of whom self-describe as Hispanic or Latino.[6]

Study inclusion criteria included: age 1 to 25 years old, primary residence in Suffolk County, New York at the time of enrollment, and birth or long-term residence (minimum 3 years) of the child and/or the child's mother in Latin America, or a child who received a blood transfusion in a Latin American country. The study was

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approved by the Institutional Review Board at Stony Brook University Hospital.

T. cruzi serum IgG was determined using either a Chagatest ELISA (Weiner Lab) or a Chagas Detect Plus Rapid Test (InBios). For those with a positive IgG screen, confirmatory serologic testing was performed at the CDC.[7] Those with positive confirmatory testing subsequently received treatment outside of the study protocol.

Study participants also completed an original survey of Chagas disease risk factors. The survey instrument was written in both English and Spanish, and questions were asked by a native Spanish speaker when preferred by the study participant. Survey topics included basic demographics, the enrolled child's and mother's country of origin, the age at immigration to the Unites States, home construction style and setting in Latin America, known exposures to the Triatomine insect, and previous knowledge of the diagnosis and treatment of Chagas disease.

Paired de-identified laboratory results and survey responses were entered into a Qualtrics® case report form. Data was analyzed using descriptive statistics only. Due to a low seroprevalence rate, associations between seropositivity and potential infection risk factors could not be determined.

Results

We enrolled 93 children in the study (Table). The mean age was 14.5 years old (SD ± 5.1 years; 2-23 years old). About 52% of participants were male. All 93 participants were screened for *T. cruzi* IgG, of which 3 were positive (3.2%). Of those 3, only 1 was seropositive on confirmatory testing (1.1%). That individual was a 17-year-old who had lived in a rural home constructed of adobe in Latin America before moving to the United States at 8 years old. In that instance, treatment with benznidazole was administered without incident.

Of the 93 children who participated, all were either born in Latin America or were born to mothers who had lived in Latin America. Seventy-three children (78%) were born in Latin America, and the remaining 20 children (22%) were born in the US to mothers who were born in Latin America. Of those children born abroad, native countries included Ecuador (32%), Mexico (27%), El Salvador (14%), Colombia (11%), Guatemala (8%), and <5% each from Brazil, Chile, Honduras, Paraguay, and Venezuela. Of those children who immigrated to the United States, the average age at the time of immigration was 9.5 years old (SD ± 4.8 years). Of the 20 children born in the US whose mothers were born in Latin America, 12 (60%) of the mothers were born in El Salvador, 7 (35%) were born in Mexico, and 1 participant did not respond.

Participants were asked to describe the structural material of their family's home in Latin America. Among the 73 participants born in Latin America, homes were described as: brick (55%), adobe (30%), wood (5%), mud (3%), and cement (1%), with some respondents selecting multiple options, and 8 who did not respond to the question. For the same participant subset, 51% had lived in a rural setting in Latin America, 41% had in an urban setting, and 8% in a suburban setting.

Study participants were asked about their past experience with Chagas disease. None of the respondents recalled ever being bitten by a triatomine insect (n = 91) or seeing triatomine insects in their home in Latin America (n = 92).

Among all participants, 27 (29%) reported that their mothers had been tested for Chagas disease, mostly performed at the same medical clinic as the children. Of these 27 children, 13 were born to 3 mothers with confirmed Chagas disease. None of the 13 children were seropositive. An additional 8 participants reported having family members other than a mother diagnosed with Chagas disease; all of these children were also seronegative. Details were not available regarding treatment course for the infected mothers and family members.

Of 92 who responded, 3 participants had received a blood transfusion while in Latin America. None of the 93 respondents had ever received a transplant organ. Four respondents had donated blood while in the United States.

Discussion

We investigated Chagas disease seroprevalence and risk factors among a cohort of Latin American children living in Suffolk County, New York. We are unaware of any prior Chagas disease seroprevalence studies focusing exclusively on children living in the United States. Among this cohort, we found a 1.1% seroprevalence rate. The study's relatively small size prevented an analysis of risk factors, yet the low infection rate is consistent with those reported in endemic Latin American countries and with other seroprevalence studies in the United States. Further, the low seroprevalence rate underscores the difficulty identifying children with Chagas disease. Rather, universal screening of first-generation Latin American immigrants, particularly mothers, likely serves as the best option for identifying children at risk of Chagas disease. Those children diagnosed may then benefit from treatment that is well-tolerated during childhood and that may prevent catastrophic outcomes decades later.

Table. Demographics of 93 Participants Screened for Chagas Disease.

	n (%)
Age (years ± SD)	14.5 ± 5.1
Male	48 (52%)
Country of birth among children born in Latin America	73 (78%)
Colombia	8 (11%)
Brazil	2 (3%)
Chile	1 (1%)
Ecuador	23 (32%)
El Salvador	10 (14%)
Guatemala	6 (8%)
Honduras	1 (1%)
Mexico	20 (27%)
Paraguay	1 (1%)
Venezuela	1 (1%)
Average age of child at time of immigration to the US (years ± SD)	9.5 ± 4.8
Birth country of mothers whose enrolled children were born in the US	20 (22%)
El Salvador	12 (60%)
Mexico	7 (35%)
Not stated	1 (5%)
Home construction material among children born in Latin America (may select multiple options)	
Brick	40 (55%)
Adobe	22 (30%)
Wood	4 (5%)
Mud	2 (3%)
Cement	1 (1%)
No response	8 (11%)
Setting of child's home in Latin America	
Rural	37 (51%)
Urban	30 (41%)
Suburban	6 (8%)

Abbreviations: SD, standard deviation; US, United States.

Chagas disease presents a tremendous public health challenge in the United States for numerous reasons. In particular, there have been no largescale serologic studies to accurately assess disease prevalence and identify high risk populations, the majority of those with chronic infections were presumably infected prior to arriving in the United States, chronic infections are generally asymptomatic, and commercially available serologic tools are often unreliable. As a result, screening strategies generally lack specificity and focus on risk factors such as prior residence in Latin America or currently living in a region with local transmission, and even those attempts to identify infected individuals are scarce.

The low rate of individuals with Chagas disease has been underscored by the few seroprevalence studies performed in the United States, including both risk factor-targeted and untargeted studies, almost exclusively enrolling adults. Among all blood donors in the United States, 2462 were diagnosed with *T. cruzi* seropositivity between 2007 and 2019, though routine screening is no longer performed due to the low positivity rate.[8] Of 885 hunters screened in Texas, where local transmission may occur, none were seropositive.[9] Among Latin American immigrants living in Los Angeles, 59/4755 (1.24%) serologically screened individuals were diagnosed with Chagas disease.[10] In Boston, of 2183 individuals screened who had lived in Latin America for at least 6 months, 19 (0.9%) were confirmed positive.[5]

Seroprevalence among Latin American children in the United States has been studied even less. The Boston seroprevalence study[5] is the only investigation to include pediatric patients; of those screened, 101 were ≤19 years old, all negative for Chagas disease.

Perinatal seroprevalence studies have been performed in an attempt to target congenital Chagas disease. Edwards et al[11] screened pregnant women in southern Texas and found an infection rate of 0.25%

(10/4000). Di Pentima[12] screened 2107 Hispanic and 1658 non-Hispanic pregnant women in Houston, of whom 9 (0.4%) and 2 (0.1%), respectively, were confirmed to have Chagas disease.

T. cruzi infection rates vary dramatically by geographic region within the endemic countries, with more rural areas often having higher incidence of Chagas disease.[13] Within endemic regions, home construction characteristics play a large role in infections rates. In particular, homes with walls constructed of porous or cracked materials where triatomines may borrow (such as adobe or plaster), dirt floors, ceilings made of cardboard tile, nearby rock piles, and the presence of domestic animals are associated with a greater risk of Chagas disease.[13,14] Although these factors may increase the likelihood of infection, they remain incompletely understood. Many participants in our study reported these risk factors, but the low seropositivity rate precluded an analysis for Chagas disease risk factors among this cohort.

Our study was limited by the small sample size for a seroprevalence study. Future investigations of pediatric Chagas disease seroprevalence will benefit from recruiting a larger study population. Also, by including both first- and second-generation children, our study combines 2 groups of children at different levels of risk for Chagas disease; the risk among individuals living in endemic Latin American countries is approximately 1% to 6%, yet $<$5% of *T. cruzi* infected women will transmit the infection to their children during pregnancy. Larger studies of both populations are needed to better understand strategies for screening and identifying those children at high risk of Chagas disease.

Conclusion

Among a small cohort of first- and second-generation Latin American children living in the United States, we found a seroprevalence rate of approximately 1%, consistent with the seropositivity rate in endemic Latin American countries. Consistent with prior seroprevalence studies, Chagas disease is rare, and identifying those at highest risk of infection remains a challenge. As a result, universal screening of children born in Latin America may be the optimal method for identifying asymptomatic infections. Among those children born in the United States to mothers who lived in Latin America, maternal screening is likely a more cost-efficient approach than testing all second-generation children. Early identification of Chagas disease enables children to receive well-tolerated, highly effective antiparasitic medications, preventing severe morbidity during adulthood.

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Author Contributions

A.S.H. assisted with study conceptualization and design, design of the data collection instruments, wrote and edited the initial draft of the manuscript, and reviewed and revised the manuscript. H.H. assisted with study conceptualization and design, design of the data collection instruments, collected data, and critically reviewed the manuscript for important intellectual content. E.F. assisted with study conceptualization and design, design of the data collection instruments, carried out the initial analyses, and critically reviewed the manuscript for important intellectual content. C.B. assisted with study conceptualization and design, design of the data collection instruments, and reviewed and revised the manuscript. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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