CHAGAS DISEASE - RISK ASSESSMENT BY AN ENVIRONMENTAL APPROACH IN NORTHERN ARGENTINA

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ABSTRACT

Chagas' disease vector control has been based almost exclusively on the use of insecticides. A complementary control strategy highlighting environmental management has been developed based on analysis of field data from an endemic community in Santiago del Estero, Argentina. High and low risk factors for human *Trypanosoma cruzi* infection were identified using the Grade of Membership (GOM) model. The characterization of especially low and high-risk habitats given a highly heterogeneous endemic setting where several environmental and host-related indicators were possible determinants of seropositivity rate. Number of peridomestic structures, and the household number of dogs or cats were identified and the benefit of such an approach is that its control can be carried out at the household level. The seropositivity rate among children ages 5-14 in high-risk habitats was 36.4%, whereas in low risk habitat it was 7.7%. This difference is striking for an endemic community with no prior experience of Chagas' disease control interventions.

KEYWORDS: Triatominae. Vector transmission. Modeling Risk. Epidemiology. Chagas disease. Insecticides. Environmental approach. *Triatoma infestans.*

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INTRODUCTION

Chagas' disease, or American Trypanosomiasis, is caused by the flagellate *Trypanosoma cruzi* (Kinestoplastida, Trypanosomatidae), which is transmitted in the feces of blood-sucking insects of the subfamily Triatominae. These bugs commonly infest poor-quality houses, usually hiding during the daytime in the cracks and crevices of the walls and roof and emerging at night to feed on the blood of people and domestic animals sleeping in the house. The transmission of *T. cruzi* in the household environment is favored by the susceptibility of human beings and domestic mammals to *T. cruzi* infection, and the provision of a secure environment with a stable and abundant host (blood) supply (1, 30).

Of the nearly 120 species of Triatominae now recognized, *Triatoma infestans* is the most important vector of *T. cruzi*. This insect has a wide geographic distribution in the southern part of South America (Argentina, Bolivia, Brazil, Chile, Paraguay, Uruguay and southern Peru) and has the capacity to attain high domestic densities (31).Many authors have associated the geographical distribution of triatomine species with the climatic and physical characteristics of each region (2, 3, 5, 8). At a household level, however, the distribution of *Triatoma infestans* is affected more by the availability of refuges and abundance of hosts (human beings, dogs, cats, chickens, etc.) than by the climatic and physical characteristics of the region.

Bug distribution evaluated via detailed home assessments in endemic regions revealed a correlation between the prevalence of houses infested and various physical characteristics of a dwelling, such as cracked, unplastered mud walls or thick roofs of thatch, and dark, poorly ventilated interiors (10, 18). In general, triatomine bug density (12) varies according to: (a) the vector species involved, (b) the existence of peridomestic structures (22), dirt floors and outdoor firewood stacks (29), (c) the number of available blood sources (17, 20, 23), and (d) the domestic use of insecticides by household members (26). (Cecere et al. in press). The household prevalence of infection with *T. cruzi* has been reported to increase with triatomine bug density (18). (Piesman et al. 1985)

Most of the existing literature about the relationship between house structure and domestic bug infestation considers a single feature at a time (e.g., quality of walls, or nature of the interior roof) and focuses on very coarse indicators of bug populations, such as presence or absence of bugs or the number of bugs collected at a habitat per person-hour of effort. A more advanced understanding of the risk of *T. cruzi* infection requires concurrent consideration of available host numbers, its distribution in the habitat, and the diverse features of houses and peridomestic structures that serve as refuges for bugs.

The objective of the project was to develop an effective technology to be integrated into the regular health promoting activities of the Primary Health Care system through the efforts of community health workers, and carry out an intervention program to assess its effectiveness (7, 19, 25).This study proposes to characterize the interrelationships between multiple human, house, and other reservoir factors in order to specify gradients of risk for seropositivity to *T. cruzi* among children in a rural community using data collected in the baseline survey. Its secondary objective is to describe the role of risk profiles in guiding targeted environmental management for the control of *T. cruzi* transmission.

MATERIALS AND METHODS

Geography and population

The study area is located in the phytogeographic Chaqueña region of Argentina, in the Valley of Rio Dulce, 70 km from the capital city of Santiago del Estero Province. The study area was 40 km long by 11 km wide and included 10 localities. Community health workers carried out assembly of cartographic data and a population census. A total of 611 dwellings and 3,194 people were censused in 1985. A more detailed description of the study area was reported previously (19).

The setting was selected because it exhibits the range of disease prevalence, house construction and human activities typical of rural communities in northern Argentina. In addition, these localities had never been sprayed with insecticides against *Triatoma infestans* prior to our study.

Demographic Information

Personal information about each subject was recorded by trained personnel and included: age (day, month and year of birth as stated in their identity cards), sex (male, female), length of residence in the region, work activities, and migration behavior. Part of the environmental approach involved the drawing of a sketch map of each house, depicting the number and distribution of bedrooms, beds, and peridomestic structures. The materials used for the internal and external walls, internal and external roof, and peridomestic structures were also recorded.

Entomologic methods

A total of 445 of the 611 houses were evaluated for the presence of triatomines by active search. Of the dwellings not evaluated, 3.6% (22 houses) refused the evaluation, 3.4% (21) were public offices (school, health post, police station, water pump), 9.1% (56) were old houses unoccupied and almost destroyed, and 11% (67) were closed during the survey weeks.

A two-person skilled team from the National Chagas Control Agency searched all bedroom areas, household goods and beds for triatomine bugs during a 20 minutes period per house. The team them sprayed the walls and roofs with 0.2% tetramethrin (a flushing-out agent), and the search was extended for 10 minutes (one person-hour of capture effort in bedroom areas). The team then spent 10 minutes searching for triatomine bugs at peridomestic structures.

The bugs collected from different sites were stored separately by place of capture in labeled plastic bags and were later classified by species and stage (nymph I, II, III, IV, V and adult). Adult bugs, fourth and fifth instar nymphs collected from domestic areas were individually examined for *T. cruzi* infection at the field laboratory within two days after capture.

Fecal drops obtained by abdominal pressure were diluted in saline solution, mounted under 22 x 22 mm^2 coverslips, and examined microscopically for active trypanosomes at 400 magnification (21). When the total number of bugs captured in all bedroom areas from a house was less than 50, all were examined for infection; above 50 bugs captured, 30% of the insects collected were examined.

Serological testing

Informed written consent was obtained for blood samples, collected by venopuncture, from all the inhabitants who were present during the study period. Their sera were then examined for antibodies (IgG) against *T. cruzi* antigens by indirect hemagglutination (IHA), indirect immunofluorescence (IFI) and enzyme linked immunosorbent assay (ELISA) as described by Paulone et al. (1991). A blood sample was considered seropositive when two out of the three serologic tests (IFI, IHA, and ELISA tests) had titers above the cut-off.

Titers of 1/32 or greater (for the IHA and IFI) and an optical absorbance of 0.2 or greater (for ELISA) were considered positive for *T. cruzi* infection.

Analytical Strategy

Children aged 5-14 years old were selected for the analysis because: a) positive serology for *T. cruzi* infection as a marker of transmission shows cumulative risk; following initial infection, positive serology is irreversible in the absence of treatment; b) there is sufficient time-exposure to factors that effect the transmission process in the region, and c) children below 5 years of age have a lower prevalence value of *T. cruzi* infection than the older population (6).

Communities endemic for Chagas' disease are very heterogeneous in terms of household composition, physical characteristics of the houses, types of peridomestic structures, and distribution of blood meal sources for triatomine bugs (i.e., chickens, dogs, cats, young children). Thus risk characterization is performed by identifying critical sets of co-occurring conditions from an initially large number of discrete conditions, no combination of which occurs with high frequency. We identify such conditions via a two-step strategy.

First, Grade of Membership (GOM) models were fit to a high dimensional set of potential risk variables in order to identify profiles of co-occurring conditions associated with low (or respectively high) seroprevalence among children aged 5-14 years old. Equally important, we identified the intermediate risk habitats whose characteristics are not strikingly different from the lower and higher risk sites and which have made clear identification of very low and very high risk habitats particularly difficult. Indeed, they act as a form of noisy background from which we want to extract a low-level but extremely important signal. Second, for low and high risk habitats only, we examined odds ratios for the occurrence of conditions identified in the GOM analysis. This led to a highly focussed set of co-occurring conditions (and identification of habitats associated with them) that are ultimately identified with the lowest (respectively highest) sero-prevalence rates in the community.

Grade of Membership model

Grade of Membership (9, 13, 14, 15, 27, 28) analysis may be seen as a discrete variable analogue of factor analysis (15, 16). Populations defined by multiple characteristics are represented in terms of ideal profiles of co-occurring conditions, and grade of membership (GOM scores) are assigned to each individual. The GOM scores represent the degree of similarity (or proximity) of the characteristics of a given individual (habitat in the present analysis) to a set of co-occurring conditions. If crisp classifications of all habitats into a few clearly defined categories were feasible, then all habitats would have the characteristics of exactly one of the ideal profiles. In practice, the substantial habitat heterogeneity is characterized, via GOM scores, by a sharing of conditions from two or more profiles. In the present application, habitats are described by characteristics associated with two distinct but interrelated conceptual domains: "Host (or blood source) availability" and "Physical environment characteristics". Each domain is associated with a set of ideal pure-type profiles and has a separate set of GOM-scores for each domain. The interrelationship of domains is represented by the joint distribution of GOM-scores. Technical details about estimation strategies for these models were given previously (15, 16). The variables used in each domain are specified in Table 1.

Table 1. Variables and coded used in the GOM score Model

Variables and description		Codes and description
Blood index		
Dogsnum	number of dogs	0 ≤ 2 dogs ; 1 > 2 dogs
catsnum	number of cats	0 ≤ 2 cats; 1 > 2 cats
people	number of persons	0 ≤ 2 persons; 1 > 2 persons
peopleroom	persons / room	0 ≤ 2 ; 1 > 2
peoplebeds	people / bed	0 ≤ 2 ; 1 > 2
peoplestruc	people / structures in the house	0 ≤ 2 ; 1 > 2
totalblodd	sum of person + dogs + cats	0 > 8, 1= 6-8 ; 2 ≤ 5
bloodroom	persons + dogs + cats / room	0 ≤ 6 ; 1 > 6
bloodbed	persons + dogs + cats / bed	0 ≤ 4 ; 1 > 4
bloodstruc	persons + dogs + cats / structure	0 ≤ 3; 1 > 3
Environmental variables:		
Seasonal migration	0 = No; 1 = Yes	
inroof	0 = Good (cement, zinc, fibrocement, well conserved); 1 = Bad (straw, jarilla, discard)	
inwalls	0 = Good (cement, well plastered, mud with no cracks); 1 = Bad (mud or brick unplastered with cracks)	
Galleryroof	0 = Good; 1 = Bad	
rooms	0 ≤ 1 ; 1 > 1	
beds	0 ≤ 3; 1 > 3	
cornstorage	0 = No; 1 = Yes	
kitchen	0 = No; 1 = Yes	
storeroom	0 = No; 1 = Yes	
corral	0 = No; 1 = Yes	
penforpigs	0 = No; 1 = Yes	
pileofbricks	0 = No; 1 = Yes	

RESULTS

Infestation

The community-wide results have been published before (Paulone et al. 1991). Nearly 100% (443/445) of the houses were infested by *Triatoma infestans* in either domestic or peridomestic areas. *Triatoma infestans* was collected from bedroom areas of 390 (88%) houses and from peridomestic structures of 280 (63%) houses. Timed manual collections with a flushing-out agent did not yield live bugs inside 55 domiciles; however, all had fecal streaks on the walls and external surfaces, indicating previous or current triatomine infestation. A total of 6,518 *Triatoma infestans* were captured in the 390 infested bedrooms areas. Of the 2,249 (34%) bugs examined for infection, 697 (31%) were infected with *T. cruzi*.

A total of 2,153 (69%) of the 3,194 inhabitants of the study region were serologically examined (at the beginning of the study). The prevalence of seropositivity against *T. cruzi* infection was 29.2% (630/2,153). Age-specific seropositivity rates increased from 9.6% in children below 5 years of age to 57.7% in persons aged 70 years or greater.

Environment and human activity

A variety of roofing materials was used throughout the study region (445 houses survey). Thatched roofs included a wide variety of local plants (*Pennisetum* sp., *Larrea* sp., *Cassia aphila*, *Solanum* sp., *Tagetes minuta*), and were the most commonly found (34.1%), followed by zinc roofs (27.4%). The materials used in the walls of houses were a type of cement-brick (block) made by the local people (37.7%), followed by mud, mud-brick and mud-stick (25.9%), and wood (21.7%). Eighty percent of houses had 1-2 bedrooms, and only 7.6% had more than five bedrooms. The most common peridomestic structures associated with houses were corn-storage areas (troja), waste deposit areas (storeroom), and open branch canopies (enramada, used as alternative bedrooms during warm weather), present in 65.8%, 79.1% and 81.6% of houses, respectively. Farming activities were the primary occupation of 54.1% of the families, followed by seasonal migration for sugar cane-collection and craftsman activities.

GOM results

Two-profile GOM models were fit to the "Host (blood) availability". The high risk profile for blood availability was defined by the logical AND statement: [more than 2 dogs] AND [more than 2 cats] AND [6 persons or dogs or cats per room] AND [3 persons or dogs or cats per structure]. Low risk was indicated when no adverse conditions were observed from the full list of host availability variables.

The high risk profile for physical environment characteristics was given by the logical AND statement: [poor interior roof] AND [poor gallery roof] AND [corn storage area present] AND [pig pen present] AND [brick pile present]. Low risk for physical environment characteristics was indicated when no adverse house or peridomestic conditions were observed from the full list of environmental variables.

Each habitat was given a separate GOM score for each domain describing its position relative to the above profiles. GOM scores take values in the interval $0 \leq \text{GOM score} \leq 1$. For each domain we define a habitat to be low risk if $0 \leq$ GOM score ≤ 0.20; intermediate risk if $0.20 >$ GOM score ≤ 0.70, and high risk if GOM score > 0.70.

We cross-classified the habitats according to their GOM scores in both blood availability and environmental variables. Seropositivity rates in each host-environment risk categories are shown in Table 2.

Table 2. Rates of human *Trypanosoma cruzi* infection grouped by age intervals, number of examined (% of population surveyed)

Age group (years)	Studied	(%)	Positive	% of pos.
6mo - 4	364		35	9.6
5 - 9	347	(79.0)	88	25.4
10 - 14	281	(72.4)	71	25.2
15 - 19	205	(65.7)	72	35.1
20 - 24	131	(59.3)	42	32.1
25 - 29	131	(71.2)	39	29.8
30 - 34	76	(65.3)	31	40.8
35 - 39	71	(62.3)	24	33.8
40 - 44	71	(70.3)	27	38.0
45 - 49	85	(75.9)	25	29.4
50 - 54	78	(69.0)	29	37.2
55 - 59	83	(83.8)	34	40.9
60 - 64	77	(85.6)	29	37.2
65 - 69	49	(73.1)	24	49.0
70 +	104		60	57.7
TOTAL	2,153		630	29.2

We would anticipate that seroprevalence rates should increase across each row as one moves from low to high risk categories, and as one moves down each column from low to high risk in terms of host availability. These expectations are essentially realized, with the singular exception of the medium risk (for host availability)-high risk (for physical environment) habitats. Here we find an exceptionally low seroprevalence rate (0.090). Identification of the actual habitats in this category reveals that most of their occupants initiated roof repairs in the 9 years proximal to data collection, thereby likely reducing the presence and abundance of bugs.

The second stage of our analytical strategy required the identification of habitats at low risk for host availability and low or medium risk for environmental variables (Table 3). The two cells of the table associated with these conditions have seroprevalence rates of 16.2% and 18.8%, respectively, both less than the seroprevalence rate (25.9%) in high risk habitats for both sets of conditions. Even this much variation in an endemic community with no prior history of Chagas' disease control is somewhat surprising. What is not obvious at first is the amount of spread between what we ultimately refer to as very low seroprevalence rates versus very high. Prior to this analysis it has been impossible to explicitly identify those habitats in the very low (or very high) risk categories. Intermediate risk habitats, or those not clearly classifiable, were eliminated from further consideration, analogous to signal extraction from background noise.

Table 3. Seropositivity rates by habitat risk

Variable type	Environmental variables			
Blood availability variables	Risk	Low-1	Med-2	High-3
	Low-1	0.188	0.162	0.214
	Med-2	0.205	0.220	0.090
	High-3	0.193	0.228	0.259

Using the variables defining host availability and environmental conditions, we calculated odds ratios comparing the proportion of habitats in the new low-risk group (defined above) with the corresponding proportion in the high risk group. Confidence limits (CL) on the odds ratios were also calculated. We then invoked the following rule to refine our specification of low and high risk habitats: "A negative (or respectively positive) condition is a component of a high (or respectively low) risk profile if the lower boundary of its 95% confidence limit corresponding to its odds ratio exceeds 3.5." Using this rule we obtained a final set of high/low risk profiles delineated in Table 4. Neither the total number of people nor the number of children (OR = 0.42, CL = 0.13-1.32) in the house are useful indicators of risk. Householder activities (migration, craftsman, hunter and farming activities) and gender do not differentiate between high risk and low risk. Both roof and wall quality have small OR (roof, OR = 0.04, CL = 0.01-0.12, and wall, OR = 0.12, CL = 0.01-0.96).

The number of peridomestic structures strongly differentiates between children that are living at high and low risk. The comparison between houses with no peridomestic structures versus those with more than six gives OR = 5.78 (CL = 0.56-91.33), and between as few as 1-2 structures versus more than 6 gives OR = 19.75 (CL = 4.27-91.33). This statement implies that if house structure is important (roof and walls), still more important is the presence of peridomestic structures that are serving as an integral part of the human activities. Among the peridomestic structures, food-storage (OR = 8.06, CL = 3.47-18.69), storeroom (OR = 2.26, CL = 1.04-4.92), corral (OR = 4.91, CL = 2.11-11.37) and pigpen (OR = 4.07, CL = 1.86- 8.87) can be considered places most likely to define risk.

Table 4. Final model to define low risk and high risk houses

Model		
Level of risk	Variables	% of seropositivity
Low	# of Peridomestic structures = 1 (Other than food-storage), no presence of food storage and 1 dog or 1 cat	7.69
High	# of Peridomestic structures >2, presence of food-storage and more than 1 dog or 1 cat or combined	36.36

Dogs are shown to be the most important variable in defining low and high risk. Almost all children in low risk houses live without dogs (67.9%). Low risk, given the presence of dogs, means generally living with less than 1 dog and 1 cat, and high risk, with more than 3 dogs (OR = 11.25, CL = 4.07-31.10). The risk associated with cats parallels that of dogs (OR = 17.22, CL = 1.13- 260.97).

Seropositivity rates are sensitive to perturbations in the risk profiles observed. For example, if the prevalence of *T. cruzi* infection in children in the low-risk profile is adjusted for the presence of 2 or more dogs or cats, the prevalence of infection rises from 7.69 % to 13.75% (11/80). If food-storage is eliminated from the high-risk profile, then the prevalence for *T. cruzi* infection in children drops from 36.36% to 26.42% (14/53).

DISCUSSION

This study emphasizes the role of the peridomestic environment and the household number of dogs or cats as determinants of the risk of being infected with *T. cruzi* for children aged 5-14 years. The prevalence of *T. cruzi* infection in children less than 14 years old clearly indicates active transmission of *T. cruzi* in the region at the baseline survey.

The abundance of *Triatoma infestans* populations appears to be regulated by density-dependent effects of host irritability on vector blood intake, female fecundity, nymph developmental rate, and adult dispersal (24). Therefore, not surprisingly, domestic bug densities have been found associated positively with host availability (17), particularly the number of cohabitating dogs or chickens (4). Domestic *Triatoma infestans* preferred to feed on dogs than on humans in relation to their relative numbers, and moreover, dogs usually showed greater prevalence rates of infection and a higher capacity to infect triatomine bugs than humans in northern Argentina (11). (Lauricella et al. 1989). These features may explain why the risk of a child being infected with *T. cruzi* was strongly related to the household number of dogs or cats. In a *Panstrongylus megistus*-infested area, the household presence of infected dogs or cats was significantly associated with the presence of infected children (18).

The number of triatomine bugs captured in a house has been considered an important factor in the transmission of *T. cruzi* in highly endemic areas (18). In our study, bug density was not a significant predictor of risk, possibly because timed manual capture with a flushing-out agent is inaccurate, lacks precision, and gives a point estimate of bug density. Current bug density estimates may not be representative of prior conditions, even in the absence of insecticidal sprays, because domiciliary triatomine populations may vary over time.

Peridomestic structures housing goat, pigs and chickens usually sustain dense populations of *Triatoma infestans* and other species of triatomines.

Peridomestic structures are also the main source of triatomines that reinvade houses after mass insecticidal campaigns, but at least for *Triatoma infestans* in northern Argentina, peridomestic bugs have marginal rates of infection with *T. cruzi* (4). More peridomestic structures may imply more potential triatomine foci and a greater chance that at least one of them becomes infested. Infested peridomestic structures may increase the likelihood of initial invasion and subsequent colonization of human habitations, therefore increasing the risk of human infection with *T. cruzi*. In an endemic setting, with no prior control activities, these structures increase the risk o vector density, vector infection and therefore transmission, when control activities are in place, the condition may change.

This study shows a direct and statistically significant association between the number of peridomestic structures and human seropositivity for *T. cruzi* using a GOM model. In contrast, other study (Gurtler et al. in press) in Amama, northeast Santiago del Estero, found a statistically significant negative association between the number of corrals or livestock and human seropositivity for *T. cruzi* using a multiple logistic regression analysis, which was interpreted as an indirect effect of improved living conditions and concomitant attitudes toward house hygiene on the risk of infection. This contradiction may arise from differences between Termas and Amama in socioeconomic and demographic factors. A significant fraction of Termas' residents migrate seasonally to urban centers or uninfested rural areas bringing the whole family with them for extended periods. In such situation, the number of peridomestic structures may be an indicator of actual residence in the study area and increased exposure to triatomines. In Amama, only men migrate to other infested rural areas for variable periods, with the family living on a subsistence economy based on raising chickens, goat and pigs. Here the number of peridomestic structures may be an index of well-being.

Although reasonable, we do not know of data that substantiate this hypothetical chain of causation.

The type of roof and the condition of the walls are principal indicators of the quality of a house. Not surprisingly, most of the literature of Chagas' disease refers to roofs and walls as the determinants of risk for human infection, and control activities have been proposed that would repair and replace these structures. However, in our study, neither the quality of roof and walls as the number of beds and bedrooms nor the gallery roof quality indicated differences in risk when several other factors were taken into account. Therefore, to use those factors as unique markers to differentiate between low and high-risk populations would be inappropriate.

The control of vector-mediated *T. cruzi* transmission relies mainly on the application of residual insecticides to eradicate domestic triatomine bugs.

Since their inception, spraying activities have responded only to the presence of triatomines, without any consideration of house structure and human behavior as additional factors. Control agencies treat all houses with identical methodology.

The use of insecticides for vector control has led to reduction in the human incidence of *T. cruzi* infection, but the subsequent reinfestation (4) usually threatens the gains accrued. In addition, the toxic nature of these chemicals poses hazards to human health and the environment. To secure the longest-lasting impact in the most sustainable manner, the ideal control program is one developed in accordance with the needs of the community while taking into account its possibilities for development. This growing realization should be widely disseminated to assist in disease control and environmental management.

Concise and inspiring health messages are all too often absent from public education or public awareness campaigns. There is a major need for the development of carefully sculptured health education messages designed to motivate people in various social settings. Communities must be better prepared for the future. It is necessary to design flexible long-term programs capable of adjusting to control needs as time passes. Community members want and need to be involved in the development of control programs. In practical terms, community participation in vector control usually involves undertaking self-help measures such as improving environmental hygiene in order to reduce the number of places where bugs can hide. In Chagas' disease vector control, communities may participate by replastering the walls of their houses to reduce the populations of triatomine bugs. However, even this simple measure is proving difficult to implement because people feel it may not be sufficiently effective in the control of the vector population.

Our results show that behavioral patterns play an important role in the transmission process. Environmental modifications, such as reducing the number of dogs and cats or cleaning the food-storage outhouses, can reduce the risk of acquiring *T. cruzi* even in an endemic setting. It is fundamentally important to realize that environmental management is a preventive strategy and that it is possible to achieve positive results while minimizing the rate of insecticide spraying.

The goal of this study was to identify interrelated factors that facilitate and maintain the transmission of *T. cruzi* in the house and to develop an improved householder-based environmental management scheme. By using a profiling strategy to predict the high-risk transmission houses in each community, it is possible to implement risk-reduction measures designed to prevent *T. cruzi* transmission in areas where *Triatoma infestans* is the local vector. The multivariate analysis using GOM models shows variables which, in endemic settings, act as risk factors for *T. cruzi* infection in children between 5 and 14 years old. The final profiles show that even in a highly endemic setting it is possible to maintain populations with low rates of human *T. cruzi* infection (7.69%) by carrying out a simple environmental strategy.

Ultimately, however, it is the community that will benefit from habitat-specific, sustainable actions.

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RESUMO

Doença de Chagas - Avaliação de risco por meio de variáveis ambientais no nordeste da Argentina

O controle vectorial da doença de Chagas tem-se baseado quase que exclusivamente no uso de inseticidas. Neste trabalho foi desenvolvida uma abordagem complementar de controle ambiental utilizando-se dados de campo de uma comunidade endêmica em Santiago del Estero, Argentina. Foram identificados fatores associados à infecção humana pelo *Trypanosoma cruzi* por meio da aplicação de modelagem estatística para definição de gradientes de alto e baixo risco. O estudo foi conduzido em uma área endêmica heterogênea onde vários indicadores relacionados ao ambiente e ao hospedeiro poderiam ser determinantes do grau de soropositividade. Foram identificados os números de estruturas peridomésticas e de cães e gatos, em que as ações de controle podem ser efetuadas no nível da casa. A

sopositividade entre as crianças de 5 a 14 anos domiciliadas em ambientes de risco elevado foi de 36,4%, enquanto aquelas habitando ambientes de baixo risco foi de 7,7%. Essas diferenças foram marcantes para áreas endêmicas sem experiência anterior na intervenção para o controle da doença de Chagas.

UNITERMOS: Triatomíneos. Transmissão vetorial. Modelos de risco. Epidemiologia. Doença de Chagas. Inseticidas. Controle ambiental. *Triatoma infestans.*

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