Update on Chagas Disease in Venezuela – A Review

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The present article reviews the status of Chagas disease in Venezuela based on the detection of Trypanosoma cruzi *infections both in referred patients with clinical presumptive diagnosis (1988-2002) and in individuals sampled from rural localities representative of the different geographical regions of the country (1995-2002). In the former group from 306 individuals examined, 174 (56.8%) were seropositive to* T. cruzi; *73 (42%) in the acute phase with 52 (71%) showing blood circulating parasites, and from these 38% were children under 10 years old. The other 101 (58%) showed chronic infection at different degrees of cardiac complication. In addition, serologic examination of 3835 individuals from rural areas revealed 11.7% seroprevalence. From these, 8.5% (38/448) were children aged from 0 to 10 years old. These figures suggest that Chagas disease may be re-emerging in Venezuela judging for the active transmission detected during the last decade. The success of the Venezuelan anti-chagasic campaign during the last 40 years is evaluated in the frame of the present results. The epidemiological situation is discussed and recommendation to consider Chagas disease as a national priority is given.*

Key words: Chagas disease - re-emergence - update - Venezuela

Chagas disease, caused by the Kinetoplastida haemoflagellate protozoa *Trypanosoma cruzi*, is one of the most important endemic pathologies in America. It represents the third largest parasitic disease below malaria and schistosomiasis (World Bank 1993). The fact that 18-20 million people are already suffering *T. cruzi*-infection and nearly 120 million inhabitants of Latin American countries remain at risk of infection appears to support the above statement. In order to establish a campaign against Chagas disease in South America, an intergovernmental program known as Southern Cone Initiative was launched in 1991 by the governments of Argentina, Bolivia, Brazil, Chile, Paraguay, and Uruguay. Due to the apparent success of the Southern Cone Initiative, two further regional initiatives were later launched. One included the Central America countries (Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama) and the other the Andean Pact countries made up by Colombia, Ecuador, Peru, and Venezuela (WHO 1997, 1998). In all cases the basic control strategy involves avoidance of transfusional transmission and elimination of domestic populations of triatomine-bugs vectors of *T. cruzi* (Schofield 2000). Despite the common objective shared by all these countries, differential results have been observed with the three initiatives over the years. While Uruguay and Chile were declared free of Chagas disease transmission in 1997 and 1999 respectively, and parts of Brazil were considered to have interrupted transmission in 2000 (WHO 1998, 1999, 2000), the same trend in other countries will be doubtfully reached in the near future. The reasons for this disappointing statement include the lack of knowledge of the real prevalence of *T. cruzi*-infection in most of these countries, and/or the high prevalence or incidence rates detected in some, which can exceed 40 or 5% respectively (Schofield 2000). In addition, there are still countries in South America where acute cases have been recently detected suggesting an active transmission of *T. cruzi*-infection. This is particularly true in Venezuela where 59 acute phase cases were detected from 1988 to 1996 in a restricted area in the Western part of the country (Parada et al. 1997, Añez et al. 1999).

Financial support: Fonacit grant G-99000036, CDCHT-ULA-C-1016-00-07-AA
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Received 12 January 2004
Accepted 1 October 2004

HISTORICAL REMARK OF CHAGAS DISEASE IN VENEZUELA

Ten years after Carlos Chagas reported his monumental findings in Brazil, Tejera (1919) in Venezuela detected, for the first time, the presence of *T. cruzi* naturally associated with *Rhodnius prolixus*. However, only in the 1930s, Torrealba (1940) realized the magnitude of the presence and severity of Chagas disease in this country. This author used xenodiagnosis for the first time as a tool for epidemiological purposes. He obtained 25% positive results in the first study carried out with samples of individuals from the Venezuelan Llanos. Torrealba (1940) also reported that *T. cruzi*-infected patients used to live in primitive dwellings plagued with *R. prolixus*, which during the day keep hidden in the thatched roof and/or the cribs of the mud walls. The figures reported during the 1940s and 1950s using xenodiagnosis to detect *T. cruzi*-infection ranged from 30 to 40% in different regions of Venezuela. Most cases were diagnosed during the clinical acute phase of Chagas disease, so there were no doubts of the existence of a high incidence of this trypanosomiasis. The authors also detected and reported cases from the Llanos, in the central part of the country, to the mountains in the Andean region of Western Venezuela (Torrealba et al. 1940, 1954, 1955a, b, 1958). The campaign against Chagas disease started in Venezuela in 1961 (Berti et al. 1961, Acquatella 1987, Aché & Matos 2001). However, in a survey carried out during the 1960s comprising 8 states and a total of 10,300 inhabitants, Pifano (1974) reported 43.9% of seropositives, including 4% positive to xenodiagnosis. The analysis of these results also revealed that the age group of 0-10 years had 20.4% seropositives, indicating recent active transmission. As expected, the age group over the 50 years showed the highest prevalence with figures of 63% of seropositives. The author pointed out that during the period from 1960 to 1973 nearly 5000 deaths were possibly attributable to Chagas disease. Pifano's figures were supported by official reports that showed, from 1962 to 1971, values of seroprevalence of up to 51.3% and xenodiagnosis around 12% (Pifano 1974, MSAS 1970, 1972). During the 1980s, according to official reports, Chagas disease was significantly reduced as a consequence of the anti-chagasic program. In this context, Maekelt (1983) reported that seropositives in the age group of 0-10 years fall from 20.4%, as demonstrated by Pifano (1974), to 3.2%. More recently, Aché and Matos (2001) summarized the official effort to interrupt Chagas disease transmission in Venezuela. They made an epidemiological description based on cumulative data from 1958 to 1998, available at the national Chagas disease control program archives. The authors pointed out how seroprevalence declined from 44.5 to 9.2% during the last four decades. They also attributed to the Chagas disease control program the reduction of the original endemic area from 750,000 km^2 to 365,000 km^2, making an estimation of nearly 4×10^6 people living at risk of infection. Despite the apparent control attributable to the effect of the campaign against Chagas disease in Venezuela, there is, at present, a re-emergence of the disease judging for the increasing number of reported acute cases during the last decade (Parada et al. 1996, 1997, Añez et al. 1999). This information appears to be relevant taking into consideration that in just one rural area eight acute chagasic patients per year were diagnosed, with a mortality of 12.5% irrespective of the received treatment (Parada et al. 1996, Añez et al. 1999). In the present study, thus, we bring up to date the prevalence of Chagas disease in Venezuela, based on data from two different sources. One group is made up by 306 referred patient from clinical units located at different parts of the country. In this case patients were referred with a presumptive clinical diagnosis for Chagas disease to be confirmed in our research group. The other group consisted of 3835 individuals chosen from 75 localities of 10 states of Venezuela and from whom the seroprevalence to *T. cruzi*-infection was estimated. The aim of the present review is to shed some light on the real estimation of the prevalence of Chagas disease in Venezuela.

Sampling methods, diagnostic criteria, and statistical analysis

Samples obtained from 1995 to 2002 on 3835 individuals from 75 endemic localities of 10 states were seroparasitologically processed. This included estimation and/or detection of *T. cruzi*-infection for territorial units, sex and age group. The study also includes a sample of 306 individuals referred during the period 1988-2002 from cardiologic units to a unique diagnostic center located in Western Venezuela. Most patients came from localities where Chagas disease is endemic. They were clinically examined prior to be referred for parasitological and/or serological diagnosis. Serological methods were standardized using samples from individuals at different phases of the infection. The methods were statistically evaluated to estimate their specificity and sensitivity, and were also compared to know the reliability and concordance among them (Añez et al. 1999). The evaluation of serology in samples from endemic areas was carried out in a similar manner as those referred samples evaluated at the laboratory.

Blood samples for seroparasitologic examination were taken as previously indicated (Añez et al. 1999). Prior to sampling, a written consent from the patients to be included in the study protocol and the approval from the Biomedical Committee of the National Research Council, were obtained as previously indicated (Añez et al. 1999). In all cases parasitologic methods included a hemoculture of 0.5 ml of blood in NNN culture medium with insect saline solution as an overlay, and xenodiagnosis using 10 clean III instar nymphs of colonized *R. prolixus* kept at the laboratory**.** The choice of these two methods was decided after a statistical correlation analysis revealed that hemoculture and xenodiagnosis were the most reliable and concordant methods when compared with fresh peripheral blood samples, blood smears stained with Giemsa stain and subcutaneous inoculation of mice with blood samples. Patients with allergy problems were excluded or an artificial xenodiagnosis was performed (Añez et al. 1999).

Serologic methods to detect circulating anti-*T.cruzi* antibodies were carried out with sera obtained on the same day that parasitologic examination was performed. The sera were tested by the direct agglutination test (DAT), the indirect immunofluorescence antibody test (IFAT), and an enzyme-linked immunosorbent assay (ELISA) following standard procedures (Vattuone & Yanovsky 1971, Voller et al. 1975). Samples were considered positives to *T. cruzi*-infection when they showed titers ≥ 1:64 for DAT and IFAT and an optical absorbance > 0.2 for ELISA. Patients were considered seropositive when they showed reactivity in at least two of the three methods. In addition, samples from seropositive patients were processed for detection of anti-*T. cruzi* specific immunoglobulin (IgM and IgG) levels using IFAT (Camargo 1966). Quantification of IgM and IgG levels was performed using serum dilutions from 1:2 to 1:4096 for each patient sample exposed to anti-human IgM and IgG fluorescein isothiocyanate conjugates. For diagnosis of the different phases of Chagas disease IgM and IgG levels were determined using the same methodology. So, acute-phase patients were characterized by high IgM levels, which statistically correspond to titers from 1:512 and up (1:512 to 1:4096) and low IgG levels up to 1:256 (range 1:2 to 1:256). Chronic-phase patients were those seropositive with high IgG levels (≥ 1:512) and low IgM levels (≤ 1:256). Those seropositive asymptomatic patients showing low IgM and IgG levels (< 1:256), were considered to have *T. cruzi* inapparent infection as previously described (Añez et al. 2001). To estimate the reliability of parasitologic and serologic methods a correlation analysis was carried out using the

Cronbach Coefficient Alpha (ρ^2). Concordance between methods was estimated by applying the Phi Coefficient (φ). Pairwise correlation between IgM, IgG and age was computed by Kendall's rank correlation tau with S-Plus statistical software (Stuart & Ord 1991, Mathsoft 1999). In addition, the analysis of the 3835 samples from different areas was performed using correspondence analysis and proportions test. The former let us to group chagasic infection per geographical entities, clinical condition and age using bi-plot graphs. The proportions test allowed us to verify whether the observed groups accepted the hypothesis of equal proportions in relation to the phase of infection or age group.

RE-EMERGENCE OF CHAGAS DISEASE IN VENEZUELA

Detection of *T. cruzi* - infection in referred patients

A total of 306 individuals with a clinical presumptive diagnosis for Chagas disease were referred for confirming diagnosis to the Center for Parasitological Research at the Faculty of Sciences, University of Los Andes, Merida, Venezuela, during the period 1988-2002. They came from 10 states of Venezuela, including Barinas (190), Merida (68), Trujillo (16), Portuguesa (14), Zulia (10), Tachira (4), Carabobo (1), Lara (1), Federal District (1), and Falcon (1). All of them were clinically controlled at local cardiovascular centers or cardiologic units located in different parts of the country.

From the total 306 referred patients examined for chagasic infection, 174 (56.8%) showed to be positive by serologic methods, and 52 of them (29.8%) showed *T. cruzi*-blood circulating trypomastigotes when parasitologic tests were applied. This indicates that the decision of referring patients to a diagnostic center to confirm a presumptive clinical diagnosis was successful in more than a half of the cases. The group of infected people was composed of 99 males (57%) and 75 females (43%), with a male to female sex ratio of 1.3:1, and a mean ± standard deviation age of 29 ± 17 years (range, 1-78 years).

The combination of clinical and seroparasitologic methods allowed the detection of 73 (42%) acute and 101 (58%) chronic cases. The fact that 52 (71%) of the acute-phase patients showed blood circulating parasites and high levels of anti-*T. cruzi* specific IgM, revealed that an active transmission had been occurring during the study period. The 174 individuals that resulted with *T. cruzi* infection came from villages located in seven of the ten mentioned states. The higher proportion of the infection was detected in people from Barinas, a state located in Western Venezuela, from which 116 chagasic cases were diagnosed, 70 suffering the acute phase and 46 in the chronic condition of Chagas disease. The analysis also revealed three more groups of infected people. One with the patients from Merida, a state located in the Andean region, with 17% of the total cases; a second group made up by individuals from Trujillo, Zulia, and Portuguesa with an average of 5% of chagasic infection, and the third group with two chronic cases, one from Tachira state, also located in the Andean region, and one from Carabobo state located at the central part of the country. Distribution according to the geographical origin of the Venezuelan chagasic cases during the period 1988-2002, is presented in Table I; details on the amount of acute and chronic cases are also given. The fact that 38% of the referred acute chagasic cases occurred in children from 0 to 10 years old (Fig. 1) indicates an active transmission in some regions of Venezuela in recent years; Barinas state seems to be the more affected area, judging by the high number of acute cases detected in children of the first age group. This also indicates that the anti-chagasic campaign established in 1961 has not been efficient enough, at least in the Western part of the country. An aspect that appears to support this claim is the detection of *T. cruzi*-infection in people from 0 to 30 years old in the states of Barinas, Merida, Trujillo, Zulia, and Portuguesa, located in Western Venezuela. One more point to be considered in support to the above statement is the fact that 66% of the individuals that resulted with *T. cruzi*-infection informed on the presence of triatomine-bugs colonizing indoors. In some cases engorged bugs were collected, and they showed *T. cruzi* infective forms when the digestive tract was microscopically examined. In addition, 6% of the infected people reported the presence of adult bugs attracted by light during nights, and 28% declared the absence of triatomine-bugs indoor. However, they admitted the presence of palm trees close to their respective dwellings, from which infected bugs (*R. prolixus* and *R. robustus*) have been previously found (Añez et al. 1999). Although the amount of chagasic cases referred to and detected at

TABLE I

Distribution of referred acute and chronic chagasic cases diagnosed according to the state of origin in Venezuela during the period 1988-2002

State of origin	Acute cases nr (%)	Chronic cases nr (%)	Total cases nr (%)
Barinas	70 (60)	46 (40)	116 (67)
Merida	1 (3)	28 (97)	29 (17)
Trujillo	0 (0)	11 (100)	11 (6)
Zulia	1 (14)	6 (86)	7 (4)
Portuguesa	1 (11)	8 (89)	9 (5)
Tachira	0 (0)	1 (100)	1 (0.5)
Carabobo	0 (0)	1 (100)	1 (0.5)
Total	73 (42)	101 (58)	174 (100)

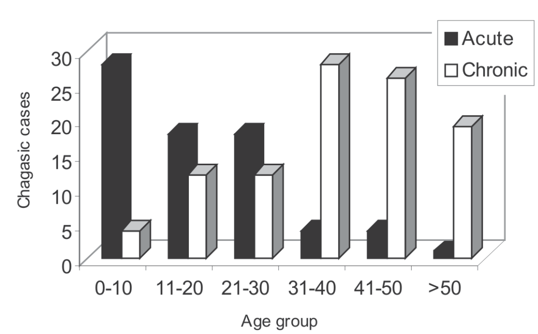

Fig. 1: age group distribution of chagasic cases referred for diagnosis during the period 1988-2002 from different endemic areas in Venezuela.

the diagnostic center appears to be insufficient to conclude on the efficiency of the anti-chagasic campaign in Venezuela, what must be taken into consideration is the fact that in a restricted area 174 cases were detected during the last 15 years, with an estimate of 11.6 ± 7 cases/year, and that the 52.8% of the patients referred from seven states were under 30 years old. These figures, together with the reduction of the vector control due to the suspension of dwellings sprayings with insecticide during recent time, and the finding of infected bugs transmitting infection using different strategies, lead us to conclude that the re-emergence of Chagas disease in Venezuela is imminent in the near future. Hence it is not difficult to predict that Chagas disease in Venezuela at the beginning of the 21st century will not be so different of that casuistic lived during the early years of the past century, if correctives to avoid vectorial transmission are not quickly taken into consideration.

Estimation of seroprevalence to *T. cruzi* in people from rural localities

This part of the present study was carried out during the period 1995-2002 in an unbiased collection of samples in 3835 people from 75 rural localities (with an average population of 400 inhabitants) of 10 states of Venezuela where Chagas disease is considered to be endemic (Fig. 2). The total samples were taken at local health centers, rural schools or sampling people at their own houses accordingly. Although the *a priori* established sampling criterion considered the possibility of getting a quite similar number of samples to be taken at the different territorial units, in some cases a reduced number of people were sampled. Two principal factors conspired against the purposes: distant localities and/or a few population found by the time of sampling. However, apart from the states of Anzoategui and Apure with 2% each of the total sampled people, the other studied areas contributed with proportions from 5 to 20% of the total analyzed samples. The analyzed samples per states included Anzoategui (n = 80), Apure (n = 72), Barinas (n = 390), Cojedes (n = 722), Falcon (n = 627), Merida (n = 285), Monagas (n = 195), Portuguesa (n = 425), Trujillo (n = 693), and Yaracuy (n = 346). The group was composed of 1570 males (40.9%) and 2265 females (59.1%) with a male to female sex ratio of 0.7:1, and a mean ± standard deviation age of 26.7 ± 18.6 years (range, 1-100 years). The total number of sampled people was divided into six age groups. These included 0 to10 years (926; 24.1%), 11-20 (822; 21.4%), 21-30 (671; 17.5%), 31-40 (565; 14.7%), 41-50 (369; 9.6%), and > 50 (482; 12.6%).

From the total people sampled, 448 (11.7%) were seropositive for *T. cruzi*. Infection was detected in people with mean ± standard deviation age of 42.2 ± 21 years (range, 1-100 years). The gender composition was 195 (43.5%) males and 253 (56.5%) females, with a male:female sex ratio of 0.7:1. In all the states under study, except Apure, *T. cruzi*-infection was detected, ranging from 3.1% in Merida to 20% in Barinas and Cojedes. Once the total number of seropositive for *T. cruzi* was determined, the established criteria to quantify IgM and IgG levels allowed us to identify 2.7% (12/448) individuals with recent or acute infection, 34.4% (154/448) in chronical clinical condition and 62.9% (282) of the seropositives bearing an inapparent or occult infection. Although acute infections were only detected in three states [Barinas (7.9%), Cojedes (3.3%) and Trujillo (2.6%)], people in chronic phase and with inapparent infections were detected in localities of all the nine states where *T. cruzi* was circulating. Details on the proportion of infection observed at different geographical entities in relation to the age group of sampled people, is presented in Table II. In addition, the proportion of people detected at different phase of chagasic infection distributed according to its respective age group is shown in Table III. The analysis of the prevalence observed in sampled people from different geographical entities in Venezuela revealed an increasing value from the youngest to the oldest age group. It is relevant to note that 8.5% of *T. cruzi* infection was detected in children from 0 to 10 years old. A similar figure was observed in the age groups 11-20 and 21 to 30 years. This indicates that infection has been actively occurring in Venezuela during the last three decades, affecting children in almost all the territory. This fact appears to be more relevant taking into consideration

TABLE II

Age group distribution of seroprevalence to *Trypanosoma cruzi* in rural populations at different states in Venezuela

States of origin	Nr of sampled people	Seropositive nr (%)	Nr (%) of infected people/Age group in years					
			0 – 10	11 – 20	21 – 30	31 – 40	41 – 50	> 50
Anzoategui	80	16 (20)	2 (12.5)	0 (0.0)	2 (12.5)	2 (12.5)	3 (18.8)	7 (43.7)
Apure[a]	72	0 (0)	-	-	-	-	-	-
Barinas	390	89 (22.8)	17 (19.1)	19 (19.1)	11 (12.3)	11 (12.3)	15 (16.8)	18 (20.2)
Cojedes	722	91 (12.6)	1 (1.1)	2 (2.2)	9 (9.9)	8 (8.8)	31 (34.1)	40 (43.9)
Falcon	627	18 (2.9)	0 (0.0)	1 (5.6)	1 (5.6)	6 (33.3)	4 (22.2)	6 (33.3)
Merida	285	14 (4.9)	3 (21.4)	3 (21.4)	0 (0.0)	1 (7.1)	3 (21.4)	4 (28.6)
Monagas	195	34 (17.4)	2 (5.9)	2 (5.9)	2 (5.9)	5 (14.7)	9 (26.5)	14 (41.1)
Portuguesa	425	83 (19.5)	4 (4.8)	7 (8.4)	12 (14.5)	15 (18.1)	8 (9.6)	37 (44.2)
Trujillo	693	76 (10.9)	7 (9.2)	6 (7.9)	8 (10.5)	8 (10.5)	11 (14.5)	36 (47.4)
Yaracuy	346	27 (7.8)	2 (7.4)	5 (18.5)	2 (7.4)	3 (11.1)	4 (14.8)	11 (40.7)
Total	3835	448 (11.7)	38 (8.5)	43 (9.6)	47 (10.5)	59 (13.2)	88 (19.6)	173 (38.6)

a: only one sampled locality.

TABLE III

Discrimination of clinical conditions per age group in asymptomatic seropositive people from endemic areas of Chagas disease in Venezuela based on anti-*Trypanosoma cruzi* specific immunoglobulin M and G levels

Age group (years)	*T. cruzi*-infected people nr (%)	Clinical condition [a] Acute infection nr (%)	Chronic infection nr (%)	Inapparent infection nr (%)
0 – 10	38 (8.4)	2 (5.3)	6 (15.8)	30 (78.9)
11 – 20	43 (9.6)	1 (2.3)	8 (18.6)	34 (79.1)
21 – 30	47 (10.5)	4 (8.5)	9 (19.1)	34 (72.3)
31 – 40	59 (13.1)	0 (0.0)	19 (32.2)	40 (67.8)
41 – 50	88 (19.6)	2 (2.3)	39 (44.3)	47 (53.4)
> 50	173 (38.6)	3 (1.7)	73 (42.2)	97 (56.1)
Total	448	12 (2.7)	154 (34.4)	282 (62.9)

a: Acute indicates high Ig M and low IgG; Chronic indicates high IgG and low IgM; Inapparent indicates low IgM and low IgG; for level definitions see text.

that in the states of Barinas and Merida, which are geographically very different, the level of prevalence in young children was almost the same.

When the statistical correspondence analysis was applied to the nine states in which chronic infections were diagnosed, two major groups were clearly detected. One conformed by Trujillo (50%), Monagas (47.1%), Anzoategui (43.8%), and Merida (42.9%); and a second group made up by the states of Barinas (28.1%), Yaracuy (25.9%), Portuguesa (24.1%), and Cojedes (23.1%). The state of Falcon, which showed the greatest proportion of chronic infection with 77.8%, conformed an isolated point from the two groups. The use of the proportion test to corroborate whether the presence of chronic infections among states of the same group was significantly similar, revealed p values of 0.8794 and 0.9409 for both groups of states respectively. This analysis revealed that chronic *T. cruzi*-infection may occur in the same proportion in different geographical regions in Venezuela, which may be considered a very important fact from the epidemiological point of view. This is particularly true when the states of Monagas and Anzoategui, located at low altitudes at the Eastern part of the country, were compared with Merida and Trujillo, which are located at the Andean region of Western Venezuela. In addition, the fact that Barinas, Yaracuy, Portuguesa, and Cojedes showed a similar proportion in the chronic infection revealed similar risk conditions in these bordering states located in the llanos of the West-central part of Venezuela. One additional fact that puts into evidence the general distribution of chronic *T. cruzi*-infection is the finding of the major proportion of this clinical condition in Falcon, a state located in a semiarid region in the coastal North-western part of the country. These findings clearly contrast with those of Aché and Matos (2001) who stated that the chagasic endemic areas in Venezuela are confined to geographical landscapes of piedmonts as well as patchy foci in higher mountain where the exclusive vector is *R. prolixus.*

The practice of insecticide spraying during the antimalarial and/or antichagasic campaigns of the 1960s, together with the improvements in rural housing over the last 20-30 years, have caused a significant decrease of triatomine-bugs in Venezuela. However, the information obtained in the present work showing the presence of triatomine vectors of *T. cruzi* in endemic areas during the last five years, clearly contrasts with the data from the aforementioned statement. In fact, the survey carried out in 38 localities of 10 states of Venezuela, revealed that 427 out of 1388 individuals (30.7%), including children, were able to recognize triatomine-bugs, principally *R. prolixus* at any developmental stage. Similarly, 419 of 1996 sampled people (20.9%) claimed to have found bugs indoor, most of them engorged with blood and near to the resting places; but what appears to be more important is that 171 of 2048 people (8.3%) declared to have been bitten by triatomine-bugs. Obviously, these figures on the presence of triatomine-bugs strongly support the argument that in rural areas of Venezuela highly risk conditions for active transmission of Chagas disease still persist.

CONCLUDING REMARKS

The analysis of the present data related to the epidemiological situation of Chagas disease in Venezuela, lead us to reach the following conclusions: there has been, during the last decade, a remarkable decrease on the effect of the vector control program due to reduction or elimination of the anti-triatomine spraying activities in some geographical areas as a consequence of budget adjustment from the central or local governments. This assumption finds support in the fact that a high proportion of people living in areas considered endemic for Chagas disease, were able to recognize the insect vector (30%), have found bugs indoor (21%) or have been bitten by triatomine-bugs (8%); the high population of palm trees found all around the localities or houses in most of the endemic areas facilitates the presence of *R. prolixus* and *R. robustus* species naturally inhabiting this plant, from which the local people benefit much. The fact that local people use palm trees to build up house roofs, or house accessories, may allow the establishment of bug's domestic colonies favoring indoor transmission when arriving infected or when encountering domestic and peridomestic animals with *T. cruzi* infections; the regular finding, nearby the houses, of triatomine-bugs attracted by light during night from close palm trees enables us to interpret the dynamic transmission of chagasic infection in triatomine-free houses. In fact, this aspect call the attention for a new epidemiological situation which appears to be different from the well known traditional one with triatomine domiciliation. In this case *T. cruzi*-infection may be produced as a consequence of the bite and posterior defecation of visiting infected bugs, a possibility recognized by nearly 30% of people living under risk conditions.

Considering the argument given above, it is not difficult to conclude that, at present, Venezuela is far from getting eradication of domestic populations of triatomine-bugs vectors of *T. cruzi* as expected in the Andean Pact Countries Initiative and as it was successfully obtained in the South Cone Initiative. Ecological conditions, social behavior and lack of constancy in the vector control program, conspire all against the purposes of the plan established for Venezuela to eliminate Chagas disease transmission.

One more aspect that strongly support the idea of a re-emergence of Chagas disease in Venezuela is the detection of *T. cruzi*-infection in 56% (174/304) of the patients referred from different clinical units, located in 10 states, to our diagnostic center during the last 14 years, with 30% (52/174) of them bearing blood circulating parasites. If this figure is impressive itself, what appears to be more relevant is the fact that 38% of the detected acute cases were children less than 10 years old. The high proportion of acute phase cases of Chagas disease is indicative of the existence of a significant incidence of this trypanosomiasis. In addition, one may speculate that if the above figures were detected in an unique diagnostic center, most of the time located far away from the place where the case originally occurred, much more cases would be detected if each state were provided with the facilities to detect *T. cruzi*-infection in any of its phases in the infected individuals. The problem appears to be more dramatic if we add to the above, the 11.7% (448/3835) seroprevalence estimated in a survey carried out during the last seven years in individuals from 75 rural localities of 10 states of Venezuela, from which 8.5% (38/448) were children under 10 years.

Contrary to the opinion that geographical distribution of *T. cruzi* active transmission is restricted to the states of Portuguesa, Barinas, and Lara (WHO 1999, Moncayo 2003) or that it is confined to geographical landscapes of piedmonts and mountains where coffee plantation are exploited (Aché & Matos 2001), the analysis of the results presented here revealed that *T. cruzi*-infection may occur in very diverse geographical regions of Venezuela. Indeed, the infection has been found extended from the eastern states of Monagas and Anzoategui, located at low altitudes (Fig. 2. 1, 7), to the western states of Merida and Trujillo in the Andean region at high altitudes (Fig. 2. 6, 9), crossing the west central states of Barinas, Cojedes, Portuguesa, and Yaracuy, located in the Llanos (Fig. 2. 3, 4, 8, 10) to reach the state of Falcon, a semi-arid zone located at the coastal North-western part of the country (Fig. 2. 5).

Considering together all the aspects discussed above, we support a previous opinion (Feliciangeli et al. 2003) that despite annual incidence has been reduced in the last decades, Chagas disease eradication in Venezuela may be difficult to achieve and that in the susceptible populations living in endemic areas, transmission could now be increasing. Similar to what has been confirmed in most Latin-American countries (Dias et al. 2002), in Venezuela

Fig. 2: geographical location of rural localities sampled for estimation of seroprevalence to *Trypanosoma cruzi* in Venezuela.

there is also a tendency for the government and the political and sanitary authorities to give priority to other public health problems such as dengue fever or other emerging diseases, placing Chagas disease in a second place of attention. Accordingly, the improvement of health services in areas where Chagas disease is endemic, with trained personnel with ability enough, at least, to suspect the presence of the infection in patients who need to be referred to specialized diagnostic centers is mandatory.

Finally, we use the argument given in the present review to suggest the Venezuelan central government the creation of a law declaring Chagas disease control as a policy of the state. This is, in our opinion, the only way the department of health may give priority to the control of Chagas disease, increasing, at the same time, scientific interest on the disease and its control in universities, research institutions and the national population as a whole.

ACKOWLEDGEMENTS

To Dr G Fermin for critical reading of the manuscript, Mr M Aguilera for technical assistance during sampling and Mr N Diaz for statistical advice.

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