
CLINICAL AND EPIDEMIOLOGICAL

CHARACTERIZATION OF *Trypanosoma cruzi* INFECTED

PATIENTS ATTENDING A REFERRAL CENTER OF CHAGAS

DISEASE IN PARAGUAY, PRELIMINARY RESULTS

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ABSTRACT

Although vector transmission of American trypanosomiasis has been interrupted and there are decreased rates of new infections in large areas of Latin America, there are still many chronically infected patients. We determined the clinical and epidemiological characteristics of *Trypanosoma cruzi* infected patients attending the Department of Tropical Medicine of the Institute of Research in Health Sciences (IICS) from 1985 to 2007 by analyzing their clinical records, maintaining anonymity and confidentiality. The SPSS 11.5 statistical package was used to analyze 1024 patient records of whom 70.1% (723/1024) were in the age group of 21-60 years (38.7±10.5); 74.5% (763/1024) were born in endemic departments, 13.2% (135/1024) in the Central department, 5.9% (60/1024) in Asunción and 6.4% (66/1024) in other departments. At consultation, 38.2% (391/1024) lived in endemic departments, 27.8% (285/1024) in Central Department, 22.6% (231/1024) in Asunción and 11.4% (117/1024) in others. Consultation reasons were: beatings (43.5%; 445/1024), effort dyspnea (34.1%; 349/1024), enervation (32.8%; 336/1024), headache (26.1%; 267/1024) and constipation (24.7%; 253/1024), among others. Half (512/1024) said they were not bitten by kissing bugs, 26.2% (268/1024) did not know or remember, 23.8% (244/1024) were bitten and 37.6% (385/1024) had kissing bugs in their houses. About 10% (104/1024) received blood transfusion and 89.8% (920/1024) did not; 24.8% (254/1024) donated blood while 75.2% (770/1024) did not. Clinically, 73.2% (750/1024) were indeterminate patients, 16.2% (166/1024) had cardiopathy, 5.1% (52/1024) megacolon and 1.5% (15/1024) megaesophagus. Most patients were in the age group of highest economic productivity and although the majority had been born in endemic rural regions most of them were living in urban areas, likely reflecting work migration. Clinically, most patients were indeterminate and cardiac lesions predominated over digestive lesions. This is a classical chagasic

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population and control programs should continue developing public health policies considering the characteristics of the affected populations to offer appropriate diagnosis and treatment.

KEY WORDS: Characterization; clinical; epidemiological; *Trypanosoma cruzi*; referral center; Chagas disease.

RESUMEN

Caracterización clínica y epidemiológica de pacientes infectados con *Trypanosoma cruzi* que asisten a un centro referente de la enfermedad de Chagas en Paraguay. Resultados preliminares

A pesar de que la transmisión vectorial de la tripanosomiasis americana se ha interrumpido y las tasas de nuevas infecciones se han reducido en grandes áreas de América Latina, todavía existen muchos pacientes infectados crónicos. Determinamos las características clínicas y epidemiológicas de pacientes infectados con *Trypanosoma cruzi* que asistieron al Departamento de Medicina Tropical del Instituto de Investigaciones en Ciencias de la Salud (IICS) desde 1985 al 2007 analizando sus fichas clínicas manteniendo el anonimato y la confidencialidad. El paquete estadístico SPSS 11.5 se usó para analizar 1.024 fichas de pacientes de los cuales el 70,1% (723/1024) estaba en el grupo etario de 21-60 años (38,7±10,5); 74,5% (763/1024) nació en departamentos endémicos, 13,2% (135/1024) en el Departamento Central, 5,9% (60/1024) en Asunción y 6,4% (66/1024) en otros departamentos. En el momento de la consulta, 38,2% (391/1024) vivía en departamentos endémicos, 27,8% (285/1024) en el Departamento Central, 22,6% (231/1024) en Asunción y 11,4% (117/1024) en otros. Los motivos de consulta fueron: palpitaciones (43,5%; 445/1024), disnea de esfuerzo (34,1%; 349/1024), decaimiento (32,8%; 336/1024), cefalea (26,1%; 267/1024), constipación (24,7%; 253/1024) entre otros. La mitad (512/1024) dijo no haber sido picada por vinchucas, 26,2% (268/1024) no sabía o no recordaba, 23,8% (244/1024) fue picado y 37,6% (385/1024) tuvo vinchucas en su casa. Alrededor del 10% (104/1024) recibió trasfusión de sangre y 89,8% (920/1024) no; 24,8% (254/1024) donó sangre mientras que el 75,2% (770/1024) no. Clínicamente, el 73,2% (750/1024) correspondía a pacientes indeterminados, 16,2% (166/1024) tenía cardiopatía, 5,1% (52/1024) megacolon y 1,5% (15/1024) megaesófago. La mayoría de los pacientes estaban en el grupo etario de mayor productividad económica y aunque gran parte había nacido en regiones rurales endémicas, la mayoría vivía en áreas urbanas reflejando probablemente la migración laboral. Clínicamente, la mayoría de los pacientes eran indeterminados y las lesiones cardíacas predominaron sobre las lesiones digestivas. Esta es una población chagásica clásica y los programas de control deberían continuar desarrollando políticas de salud pública que consideren las características de las poblaciones afectadas para ofrecerles diagnóstico y tratamiento apropiados.

PALABRAS CLAVE: Caracterización; clínica; epidemiología; *Trypanosoma cruzi*; centro referente; enfermedad de Chagas.

INTRODUCTION

The regional initiatives for the control of American trypanosomiasis in Latin America that started in 1991 interrupted transmission in large areas and reduced the rate of new infections to zero in others. Consequently, the estimated prevalence of people infected by the causative agent, *Trypanosoma cruzi*, decreased progressively to approximately 10 million and the risk population to around 25 million. In spite of this, Chagas disease is still endemic in 21 countries of Latin America and in recent years cases have been increasing in the United States, Canada

and other European countries, especially in Spain, due to work migration from Latin America (WHO, 2010).

Trypanosoma cruzi is a flagellated protozoan parasite transmitted to humans by insect vectors (hematophagous triatomines that deposit their infected feces on the skin at the time of the bite), transfusion of infected blood, transplacentally or by organ transplantation. The infection risk is directly related to poverty because the insects live in the cracks of the mud walls and in the straw roofs of the poor dwellings of rural areas and peripheral urban neighborhoods (WHO, 2002).

The acute phase of the disease is generally seen in children who present with fever, inflammation of the lymphatic ganglia, swollen liver and spleen and local inflammation of the infection site. However, frequently acute clinical manifestations are not observed and patients remain without symptoms. Around 40% of the infected people develop some kind of chronic lesions 10 to 20 years after the onset of infection, causing severe and irreversible damage in the heart, esophagus or colon with dilatation and disorders in the nervous conduction of these organs. Thirty percent present with chronic chagasic cardiopathy that causes 10% of the deaths in the adult population (WHO, 2010).

Formerly, treatment with benznidazole or nifurtimox was recommended only for acute patients, but around fifteen years ago treatment of chronically infected children less than 12 years old started. Currently, the recommendation to treat all chronic patients with or without lesions, except those who have contraindications for treatment, is gathering strength (Apt & Zulantay, 2011; Rodrigues Coura & Borges-Pereira, 2011). However, the limited availability of nifurtimox and benznidazole complicates the implementation of treatment in this way (Hernández, 2011; Médicos Sin Fronteras, 2011).

In Paraguay, before the initiative cases of *T. cruzi* infection were widespread and the main vector was *T. infestans* (Rojas de Arias, 1996; Ferreira et al., 1998). The country participated actively in the Southern Cone initiative from the beginning through the support of the National Program of Chagas Disease Control and the Health Sciences Research Institute (IICS) (PAHO, 2010; Rojas de Arias, 1996; Schofield, 1992; Schofield & Dias, 1991; Schofield, 1988). In 2008, Paraguay was certified as a country free of vector transmission of Chagas disease in children under 5 years in 14 departments of the eastern regions and this year in one department of the western region or Chaco, but the disease is still a public health problem because of the number of existing chronic patients and the uncontrolled vector transmission in two departments of the western region. Another achievement of the initiative in Paraguay is that blood transfusion is now 100% serologically controlled (PAHO, 2010; WHO, 2010).

Chagas disease occupied fourth place among the diseases of Latin America and the Caribbean that caused largest disability in sick people. The Human Development Report of the UNDP indicated that the estimated annual average of the *per capita* gross burden in Latin America was US\$ 2,966 and the economic

loss of the continent due to mortality and early incapacity caused by the disease in more economically productive young adults reached US\$ 8,156 million, which was equivalent to 2.5 % of the external debt of the American continent (World Bank, 1993). In the 1990s, estimates of Chagas disease incidence in Paraguay revealed 14,680 new infections per year and a loss per year of work of about US\$ 30 million due to early death in the acute and chronic phases of the disease (Schofield, 1991).

Rural/urban migration movements, inside and outside Latin American countries, from the 1970s and 1980s influenced the traditional epidemiological pattern of Chagas disease, which has been transformed to an urban peripheral infection, strengthened by lack of analysis of blood transfusion as second route of transmission (Briceño-León, 2007).

In 1950, the Paraguayan population was mostly rural (65.4%). Since then, this has decreased steadily, reaching 41.9% according to the 2002 census, while the urban population increased from 35.0% in 1950 to 58.1% in 2006 (MSPBS, 2008). This migration phenomenon, influenced by economic factors, could have affected the proportion of chagasic patients in urban and rural areas.

Currently, many Latin American countries are in the most difficult control phase: community surveillance to avoid reinfestation, which implies follow-up and supervision including technology transfer. The appearance of secondary triatomine species which are potential vectors is a major concern for control programs (Ferro et al., 1995; Gurtler et al., 1988; Jamison DT et al., 2006; PAHO, 2008; Rojas de Arias, 1995).

Only comprehensive interventions are successful in the control and prevention of parasitic infections because the factors related to the parasite, vector and host as well as socio-cultural factors determine the transmission and persistence of these diseases (Mata, 1988). Scientific analysis based on demographic, epidemiological and economic evidence is essential to implement control measures and reduce the disease burden in developing countries (da Silva, 1995; Hotez et al., 2004; Jamison, 2006).

It is therefore very important to collect information about the demographic and socio-cultural characteristics of the populations affected by American trypanosomiasis as well as the changes these populations experience (due to the impact of those characteristics on the epidemiological pattern) to orientate appropriate control strategies especially those related to treatment and diagnosis (Barreto & Andrade, 1994; De Rissio et al., 2002; Dias, 1993; Gontijo et al., 1996; Gurtler et al., 1998; Leiby et al., 2002).

Also, the clinical and epidemiological characterization of the chagasic population in Paraguay could show the advances of the Southern Cone Initiative carried out from 1991 to 2008 for the elimination of *Triatoma infestans* and transfusion control of Chagas disease.

In order to contribute to the epidemiological and clinical characterization of the Paraguayan population affected by Chagas disease, we developed this

descriptive study that analyzed the clinical and epidemiological characteristics obtained from the clinical records of a *T. cruzi* infected population that attended the department of Tropical Medicine of the IICS, a referral center for the disease during a 22 year time period (1985-2007).

MATERIALS AND METHODS

Our study population was patients affected by Chagas disease from different parts of the country. We ultimately selected as the sample population, due to financial restrictions, patients who attended the consultation room of the Department of Tropical Medicine of the IICS. We designed a descriptive cross-sectional study including *T. cruzi* positive serology for patients who attended the Department of Tropical Medicine of the IICS from 1985 to 2007 and were referred from health services of different parts of the country for clinical and serological analysis due to suspected Chagas disease. In that period of time there were 4,037 clinical records of *T. cruzi* infection positive and negative patients in the archives of the Department. The patients were selected by consecutive sampling of all that fulfilled the inclusion criteria (sex male or female, age 1 to 95 years, *T. cruzi* positive serology by IIF, complete clinical and epidemiological records kept in the archives of the Department of Tropical Medicine of the IICS). The final sample population included 1,024 clinical records. A database was constructed with the variables of interest (age, sex, place of birth, place of residence, consultation reason, blood reception or donation, bug bites, presence of bugs in the dwelling, clinical diagnosis) obtained from the patients' records. The data of the first visit (epidemiological data and consultation reasons) and successive visits (clinical and serological data) included in the clinical record of the patients were incorporated into the database.

We considered patients infected who had positive IgM and/or IgG serology (1:20 or higher) determined by an IIF test using *T. cruzi* epimastigotes (Y strain) and performed according to a technique previously described (Camargo, 1966).

Acute patients were those with inoculation chagoma, IgM positive serology determined by IIF (1:20 or higher) and positive direct parasitemia.

The clinical evaluation included physical examination, ECG, echocardiography, X-Ray but unfortunately other important data, such as BMI, as an indicator of nutritional status, were not originally included in the clinical records of each patient. The clinical record is a standard questionnaire used by the consultation service of the Department of Tropical Medicine to collect information from its patients and it was not designed specifically for this study.

Statistical analysis

All variables except age were nominal or dichotomic variables and therefore, only descriptive analysis (proportions in percentages) was applied to

them. In the case of age, a continuous variable, measures of central tendency (mean and SD) were calculated. In the comparison of mean age between groups we used the Student's t test and the p value for significance was $p < 0.05$. The database was analyzed using the SPSS 11.5 statistical package and Excel 2007.

Ethical aspects

There was not informed consent from the patients but it should be considered that they were not exposed to any risk as the information contained in the records was used assuring their anonymity and confidentiality and the work consisted of the application of descriptive statistics to previously coded data.

All *T. cruzi* positive patients received medical attention at the IICS while those that could not attend IICS regularly because of distance were sent to the National Program of Chagas Disease Control to receive medical attention.

RESULTS

A total of 1,024 records were analyzed; 51.6% (528/1024) of patients were men, 48.4% (496/1024) were women. In the age groups, the highest proportion of patients, 42.2% (432/1024), was found between 21-40 years (31.4 ± 5.8) and most of the patients (70.1% (723/1024) were between 21-60 years (38.7 ± 10.5) (Figure 1). When age groups were divided by sex, we found that in all groups men predominated over women except in the age group of 21-40 which had 54.9% (237/432) of women and the age group of 81-95, in which 53.3% (13/25) were women (Figure 2).

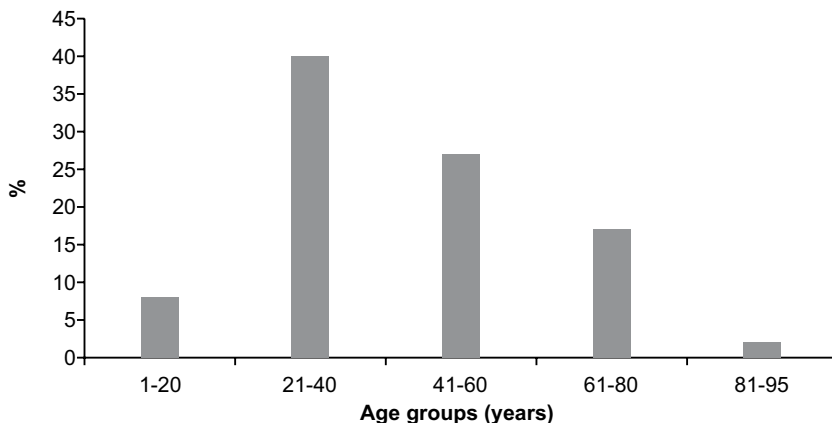


Figure 1. Distribution by age groups of *T. cruzi* infected patients attending the consultation room of the IICS in the period 1985-2007

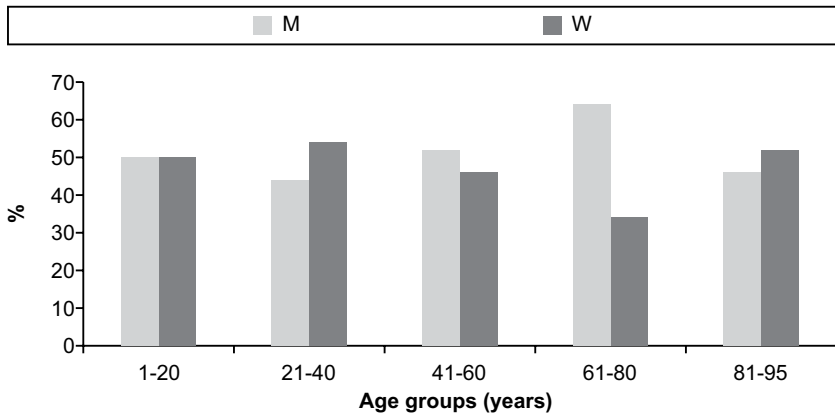


Figure 2. Distribution by sex in age groups of *T. cruzi* infected patients attending the consultation room of the IICS in the period 1985-2007

In relation to birthplace, 74.5% (763/1024) were born in endemic departments (Concepción, San Pedro, Cordillera, Guairá, Caaguazú, Caazapá, Misiones and Paraguairí in the eastern region and the three departments of the western region or Chaco), 13.2% (135/1024) in the Central department, 5.9% (60/1024) in Asunción and 6.4% (66/1024) in other departments. At the time of consultation, 38.2% (391/1024) lived in endemic departments, 27.8% (285/1024) in the Central department, 22.6% (231/1024) in Asunción and 11.4% (117/1024) in other departments. Table 1 shows the origin of patients, Figure 3 shows a map of Paraguay and Figure 4 shows a comparison between proportions of birthplace and origin.

Concerning clinical diagnosis, 73.2% (750/1024) were chronic patients without lesions, 16.2% (166/1024) had cardiopathy, 5.1% (52/1024) had megacolon, 1.5% (15/1024) megaesophagus and 4% (41/1024) others (Figure 4).

Endemic departments for Chagas Disease		
1	Concepción	10 Alto Paraná
2	San Pedro	11 Central
3	Cordillera	12 Ñeembucú
4	Guairá	13 Amambay
5	Caaguazú	14 Canindeyú
6	Caazapá	15 Presidente Hayes
7	Itapúa	16 Alto Paraguay
8	Misiones	17 Boquerón
9	Paraguairí	★ Asunción

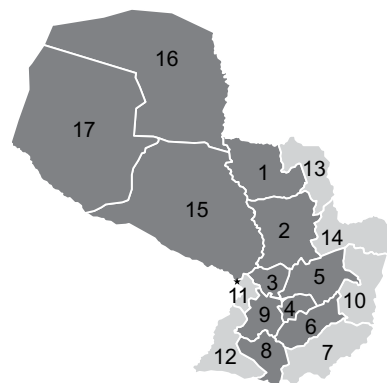


Figure 3. Map of Paraguay. Source: Portal Paraguayo de Noticias.

Table 1. Origin of *T. cruzi* infected patients attending the consultation room of the Tropical Department of the IICS in the period 1985-2007

Origin (Departments)	No. of patients (% of patients) N = 1.024
1. Concepción*	1.3 (13/1024)
2. San Pedro*	6.3 (64/1024)
3. Cordillera*	9.2 (94/1024)
4. Guairá*	2.2 (22/1024)
5. Caaguazú*	6.0 (61/1024)
6. Caazapá*	1.0 (10/1024)
7. Itapúa	2.3 (24/1024)
8. Misiones*	0.7 (7/1024)
9. Paraguari*	7.7 (79/1024)
10. Alto Paraná	3.6 (37/1024)
11. Central	27.8 (285/1084)
12. Ñeembucú	1.4 (14/1024)
13. Amambay	1.0 (10/1024)
14. Canindeyú	3.1 (32/1024)
15. Presidente Hayes*	2.8 (29/1024)
16. Alto Paraguay*	0.2 (2/1024)
17. Boquerón*	1.0 (10/1024)
Asunción (capital)	22.6 (231/1024)

*Chagas disease endemic departments

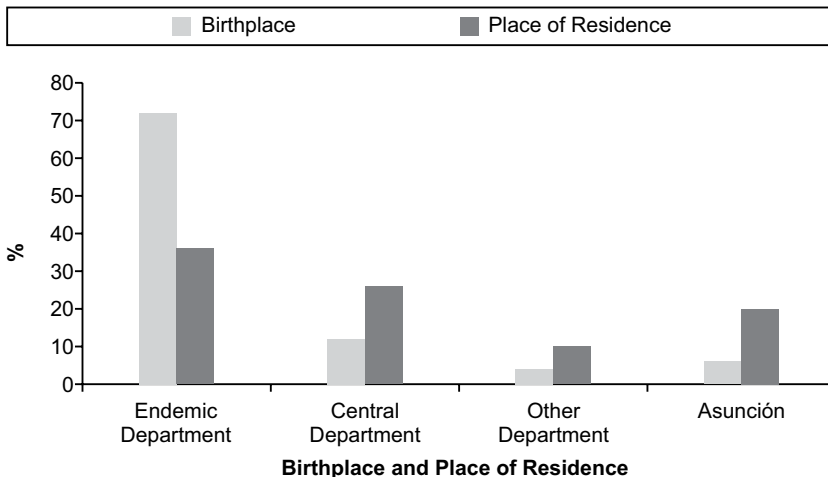


Figure 4. Distribution by birthplace and place of residence (origin) of *T. cruzi* infected patients attending the consultation room of the Department of Tropical Medicine of the IICS in the period 1985-2007

In relation to the origin of indeterminate patients: 34.7% (260/750) came from endemic departments, 30.3% (227/750) from the Central department,

22.2% (167/750) from Asunción and 12.8% (96/750) from other departments. When the origin of patients with lesions was analyzed, distribution was as follows: cardiopathy; 48.2% (80/166) from endemic departments, 19.9% (33/166) from the Central department, 22.9% (38/166) from Asunción and 9% (15/166) were from other departments. In the case of megacolon; 51.9% (27/52) from endemic departments, 15.4% (8/52) from the Central department, 21.2% (11/52) from Asunción and 11.5% (6/52) from other departments) and in megaesophagus; 66.7% (10/15) from endemic departments, 20% (3/15) from the Central department and 13.3% (2/15) from Asunción.

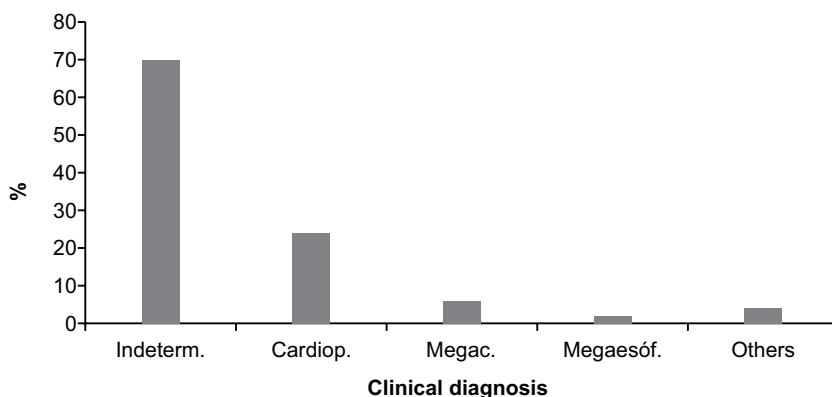


Figure 5. Distribution by clinical diagnosis of *T. cruzi* infected patients attending the consultation room of the Department of Tropical Medicine of the IICS in the period 1985-2007

The mean ages and standard deviations of the groups of patients with lesions were: 57.0 ± 19.8 in the cardiopathy group; 63.9 ± 12.3 in the megacolon group and 61.0 ± 12.8 in the megaesophagus group. In the case of indeterminate patients, the mean age was 39.6 ± 16.9 . When the mean ages of the groups with lesions were compared with that of the indeterminate group by Student's t test, the differences were significant ($p < 0.05$). When the mean ages of groups with lesions were compared, the differences were not significant ($p > 0.05$) except for the cardiopathy group and the megacolon group ($p = 0.02$).

When we analyzed the clinical pattern of the 21-40 years age group we found: cardiopathy 3.5% (15/432), megaesophagous 0.7% (3/432), megacolon 0.7% (3/432) and indeterminate 95.1% (411/432).

The most frequent consultation reasons were: beating 43.5% (445/1024), effort dyspnea 34.1% (349/1024), enervation 32.8% (336/1024), headache 26.1% / (267/1024), constipation 24.7% (253/1024), paroxysmal nocturnal dyspnea 23.7% (242/1024) and dyspnea at rest 23.2% (238/1024) (Figure 4). It should be noted that

many cases had more than one reason for consultation. When consultation reasons were distributed by clinical pattern, the most frequent among indeterminate cases were palpitations 39.3% (295/750), enervation 29.5% (221/750), effort dyspnea 27.9% (209/750) and headache 25.3% (137/750) while in those with cardiopathy they were effort dyspnea 40.4% (67/166), palpitations 37.4% (62/166), and dyspnea at rest and lower limb edema 33.1% (55/166). In those with megacolon, the most frequent consultation reasons were constipation 73.1% (38/52) and enervation 25.0% (13/52) while in those with megaesophagus were dysphagia to solids 53.3% (8/15) and constipation 26.7% (4/15) (Figure 6).

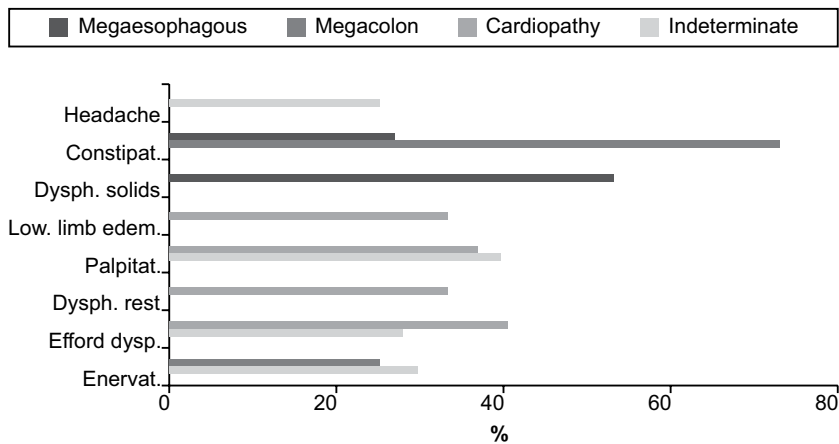


Figure 6. Distribution of consultation reasons by clinical pattern of *T. cruzi* infected patients attending the consultation room of the Department of Tropical Medicine of the IICS in the period 1985-2007

Fifty percent had not been bitten by the bug, 26.2% did not know or did not remember it and 23.8% recalled that they had been bitten. 37.6% said that the presence of triatomines in their dwellings was common. 10.2% said they had received blood transfusion and 89.8% said they had not, while 24.8% said they had donated blood and 75.2% said they had not.

DISCUSSION

This descriptive study, which analyzed the clinical and epidemiological characteristics of a *T. cruzi* infected population that attended the Department of Tropical Medicine of the IICS, a referral center for the disease, in a period of time of 22 years (1985-2007) showed a slight predominance of male patients in contrast to what is described by other similar works that found a predominance of women in this type of chagasic population because the usual place where infection occurs is

the rural house where women spend more time than men (Alarcón et al., 2010; De Rissio et al., 2002; Orellana & Orellana, 2002) and women tend to be more worried about their health.

These results also show that most patients (70.1%) were in the age group of highest economic activity (21 to 60 years) emphasizing once more the economic losses caused by the disease (Rojas de Arias, 1996; Schofield, 1991; World Bank, 1993). The age group with higher frequency (41.2%) was the 21-40 years age group and when the clinical pattern of this group was analyzed, it was found that 95.1% of the cases were indeterminate (Ferreira et al., 1998). This finding should reinforce the efforts of the National Chagas Control Program in relation to prevention or at least, early detection of cases with cardiac and digestive lesions in order to provide specific treatment if possible in this numerous group of patients. Indisputably, education campaigns directed at the population at risk would be of great value for the identification of these patients and to provide them with the appropriate treatment.

Additionally, the risk of transfusion transmission from this important number of seropositive patients should not be ignored, even though it could be limited because currently all blood to be transfused is serologically controlled in Paraguay. This group also implies a risk of congenital transmission as the proportion of women (54.9%) was high and women in rural areas frequently do not follow prenatal control. Luckily, Paraguay has a very efficient and successful program of treatment and control of congenital Chagas disease.

The high proportion of cases in this age range is probably related to vector infection as the interruption of vector transmission only occurred in 2008 in the Eastern Region of Paraguay.

The significant difference between the mean age of the group of patients with lesions and those indeterminate seems logical considering the time required to develop the lesions.

Most patients had been born in endemic rural regions but a considerable percentage were living in urban areas at the time of consultation, mainly in Asunción and the Central department, possibly reflecting the current population redistribution towards the capital and its surroundings due to the urban-rural migratory currents motivated by economic factors that affect the epidemiological characteristics of the disease, a fact already showed by other studies (Alarcón et al., 2010; Orellana & Orellana C, 2002; Russomando, 2012).

In relation to consultation reasons, there seemed to be more non-specific symptoms in the indeterminate group (palpitations, enervation, effort dyspnea, headache) and more specific symptoms related to their lesions in the cardiopathy (effort dyspnea, palpitation, dyspnea at rest, lower limb edema), megacolon (constipation, enervation) and megaesophagus (dysphagia to solids and constipation) groups.

An important proportion (37.6%) lived together with the vector at some point and vector bites were commonplace for these patients, confirming the classical mechanism of transmission. Blood transfusion could have been the transmission route in part of the remaining group. Also, many infected women that have migrated to urban areas free of the vector could have infected their children during pregnancy, creating a second generation of infected people (Vera et al., 1998). Unfortunately, a very limited number of records included information about the *T. cruzi* serological situation of the patients' mothers that could explain the infection route in other cases.

Concerning clinical findings, cardiac lesions prevailed over digestive ones although the information contained in the records and the techniques used were not enough to determine if those lesions were compatible with chagasic cardiopathy. Important percentages of cardiopathy, megacolon and megaesophagus cases came from endemic departments supporting the possibility of a chagasic origin of their lesions.

The findings of this study correspond to a 12-year period (1985-2007) that includes the year the Initiative for Chagas control started (1991) and ends a year before the certification of the interruption of vector control in the eastern region of Paraguay. The fact that most patients in this study were in the chronic state (indeterminate and with lesions) could be linked to the advances achieved by the Initiative through vector and transfusion control.

Most patients potentially infected by *T. cruzi* are generally not detected by health services and those included in this study came to Asunción looking for relief from their clinical manifestations. In general, this population presented the typical characteristics of a chagasic population but it should be kept in mind that these results arose from a confirmatory referential diagnosis of a directed population (De Rissio et al., 2002). However, the information obtained in this study should be considered at the time of elaboration of control strategies of Chagas disease because it showed the characteristics of the affected population. These results will contribute to comprehensive interventions that are successful in the control and prevention of Chagas disease because factors related to the parasite and socio-cultural factors together influence its transmission and persistence (Mata, 1988). The analysis of demographic characteristics of the populations affected by this disease as well as the changes these populations experienced because of the impact of those characteristics on the epidemiological patterns is essential to orientate appropriately control strategies (Barreto & Andrade, 1994; De Rissio et al., 2002; Dias, 1993; Gontijo et al., 1996; Gurtler et al., 1998; Leiby et al., 2002).

In spite of the great advances achieved in the control of Chagas disease, the control program of Paraguay should continue developing health policies that offer appropriate diagnosis and treatment to the large number of existing chronic patients, mainly those indeterminate, who are frequently forgotten especially after the interruption of vector transmission, for whom the health system is still responsible more than one hundred years after the discovery of the disease.

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