

Prevalence of *Trypanosoma Cruzi* infection in donors from a blood bank in the department of Boyacá

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Abstract

Introduction: Chagas Disease, also known as American Trypanosomiasis, is a public health problem. It is estimated that in the world there are between 6 and 7 million people infected with *Trypanosoma cruzi*, most of them in Latin America.

Objectives: To identify the prevalence of *Trypanosoma cruzi* infection in donors from a blood bank in the department of Boyacá 2016-2018.

Materials and methods: Retrospective-descriptive study carried out in 25,920 blood donors from the department of Boyacá (Colombia). The source of information was secondary. The prevalence of *Trypanosoma cruzi* infection was determined and compared according to sex, age group and type of donor through frequency analysis.

Results: 9187 donors were evaluated during 2016; 8,517 in 2017 and 8,216 in 2018, of which 56.1% were female and 43.9% male. The prevalence of *Trypanosoma cruzi* infection was 0.17% in screening and 0.08% with confirmatory tests of which 70.0% were women, 85.0% first-time volunteer donors, the range of The age at which the highest prevalence of this serological marker was found was 41 to 50 and 51 to 65 years with 35.0% each. The prevalence of Chagas infection showed a statistically significant association with age ($p < 0.05$).

Conclusions: Blood banks turn out to be one of the sources of information available to monitor the behavior of Chagas disease and evaluate decision-making in public health, taking into account the characteristics of the disease in which the majority of cases they are asymptomatic and without clinical compromise.

Keywords: Blood banks; *Trypanosoma cruzi*; blood transfusion; prevalence; Serum markers.

Prevalencia de Infección por *Trypanosoma Cruzi* en donantes de un banco de sangre de Boyacá, Colombia

Resumen

Introducción: La Enfermedad de Chagas también conocida como Tripanosomiasis americana es un problema de salud pública. Se calcula que en el mundo hay entre 6 y 7 millones de personas infectadas por *Trypanosoma cruzi*, la mayoría de ellas en América Latina.

Objetivo: Identificar la prevalencia de infección por *Trypanosoma cruzi* en donantes de un banco de sangre del departamento de Boyacá 2016-2018.

Materiales y métodos: Estudio descriptivo retrospectivo realizado en 25.920 donantes de sangre del departamento de Boyacá. La fuente de información fue secundaria. Se determinó la prevalencia de la infección por *Trypanosoma cruzi* y se compararon según sexo, grupo etario y tipo de donante a través de análisis de frecuencias.

Resultados: Se evaluaron 9187 donantes durante el año 2016; 8517 en el 2017 y 8216 en el 2018, de los cuales 56,1% eran de sexo femenino y 43,9% masculino. La prevalencia de la infección por *Trypanosoma cruzi* fue 0,17 % en la tamización y 0,08 % con las pruebas confirmatorias de las cuales el 70,0% eran mujeres, el 85,0% donantes voluntarios por primera vez, el rango de edad en el que se presentó mayor prevalencia de este marcador serológico fue de 41 a 50 y de 51 a 65 años con un 35,0% cada uno . La prevalencia de la infección de Chagas presentó asociación estadísticamente significativa con la edad ($p < 0,05$).

Conclusiones: Los bancos de sangre resultan ser una de las fuentes de información disponibles para monitorear el comportamiento de la enfermedad de Chagas y evaluar la toma de decisiones en salud pública, teniendo en cuenta que la enfermedad se caracteriza de manera

asintomática y sin compromiso clínico en la mayoría de los casos.

Palabras clave: Bancos de sangre, *Trypanosoma cruzi*, transfusión sanguínea, prevalencia, marcadores séricos.

Introduction

Chagas disease (CD), also known as American Trypanosomiasis, is a parasitic disease caused by the flagellate *Trypanosoma cruzi* (T cruzi), of the Trypanosomatidae family. The etiological agent was identified for the first time in Brazil. It is on the list of Diseases neglected by the World Health Organization (WHO), and it is a public health problem in the countries of Central America and South America. The disease is closely related to social determinants such as poverty, poor sanitation and populations lagging behind in the health system (1).

In recent years, parasite transmission studies include routes other than that produced by the vector bite, the risk that exists in procedures such as blood transfusion, organ transplants, has been described, considered as the second source of transmission of T cruzi. Other forms described are transmission from mother to child during the gestational period and due to occupational accidents, the latter as isolated cases (2). As vector control progresses, other sources of infection, such as transmission by transfusions, become more relevant, especially if it is considered that more than 70% of the population lives in urban areas of the continent, and most of them are made up of immigrants who have spent their first years of life in endemic areas (3).

Chagas disease is an emerging disease in the United States of America (USA), in Canada and in European countries (Spain, Holland, Switzerland), as well as in Australia and Japan (4,5). Migratory movements in search of employment of the inhabitants of rural areas where the infection is more frequent, take them, even to urban areas of the same country or beyond the borders of Latin America, where the epidemiology of the disease has changed considerably, which is no longer exclusive to this region (6)

It is estimated that in the world there are between 6 and 7 million people infected with *Trypanosoma cruzi*, most of them in Latin America (7). Chagas disease is found mainly in endemic areas of 21 countries in Latin America. Colombia has the most alarming figures in the general population of the Andean region after Bolivia, although it is important to keep in mind that the population of Colombia is 4.6 times the population of Bolivia. It is estimated that in Colombia the number

of infected is around 437,960, the new cases per year due to vector transmission oscillate in 5,274 (1). During 2016 Casanare, Santander, Boyacá, Tolima and Arauca registered 79% of the cases of Chagas in chronic phase (8), in 2017 the departments that confirmed the most cases were Casanare with 24.6%, Bogotá DC 20%, Arauca 19.5% and Santander 13.2%, among these they add up to 77.3% of confirmed cases in the country (9). The percentage of reactivity in donors for the serological marker anti - T. cruzi at the national level for the year 2016 corresponded to 0.27%; 0.19% in 2017 and 0.14% in 2018 (10,11,12). The objective of this work was to identify the prevalence of *Trypanosoma cruzi* infection in donors from a blood bank in the department of Boyacá 2016-2018.

Materials and methods:

Retrospective descriptive study, in which the seroprevalence of T. cruzi infection was established in 25,920 blood donors recruited in the department of Boyacá by the blood bank Hemocentro del Centro Oriente Colombiano (HCOC), during the years 2016 to 2018 a through the haemovigilance information system.

The data was entered and refined in the Microsoft Excel program, where the variables of age, sex, type of donor, origin, screening test and complementary tests for T cruzi were included. The information was retrieved from a secondary source in the format REG-R01.002.5080-017 hemovigilance monthly statistical report of blood banks until 2017 and from the SIHEVI-INS Hemovigilance Information System for the year 2018.

To screen for *Trypanosoma cruzi* infection, the blood bank used the chemiluminescence technique; For the complementary tests, the technique of Indirect Immunofluorescence IFI and ELISA Chagas III Total Ags was used, following the guidelines established in technical Annex No. 2 and No. 3 of Circular 0082 of 2011 issued by the National Institute of Health and the Ministry of Health and Social Protection (13).

Analysis of variables

A univariate analysis was performed calculating the frequencies of the sociodemographic characteristics. The prevalence for Chagas disease infection was established through the screening and complementary tests. For the bivariate analysis, the prevalence of the infection marker was compared, according to sex, type of donor and origin, using Fisher's chi square. Finally, processing and statistical analysis was performed using R Project software.

Ethics component

According to Colombian resolution 8430 of 1993 of the Ministry of Health, the study is considered a risk-free investigation. Obtaining the information was in accordance with the ethical standards of guaranteeing confidentiality, benefits and minimal risk for the participants.

Results

25,920 donors were evaluated, 9187 during 2016; 8,517 in 2017 and 8,216 in 2018, of which 56.1% were female and 43.9% male, the age range in which more donors appeared was 18 to 30 years with 47.1%. In the screening test for T. cruzi infection, the prevalence was 0.17% (45 / 25,920), of which 77.0% were women, 80.1% were first-time voluntary donors. The age range in which the highest prevalence occurred was between 18 and 30 years with 33.3%. The largest number of donors came from the city of Duitama with 22.2% followed by donors from other departments with 17.7% (Table 1).

Table 1. Epidemiological characteristics of blood donors reactive for anti-T. cruzi antibodies, Boyacá, Colombia 2016 - 2018 (n = 45)

Variable		n	%	95 % IC
Year	2016	18	40,0	(26,67 - 56,16)
	2017	5	11,1	(0 - 27,27)
	2018	22	48,8	(35,56 - 65,05)
Gender	Feminine	34	75,5	(64,44 - 87,98)
	Masculine	11	24,4	(13,3 - 36,8)
Age	18-30 years-old	15	33,3	(20 - 49,6)
	31-40 years-old	11	24,4	(11,1 - 40,7)
	41-50 years-old	9	20,0	(6,6 - 36,3)
	51-65 years-old	10	22,2	(8,8 - 38,5)
Donor type	Volunteer first time	36	80,0	(71,1 - 92,3)
	Voluntary non-repetitive	8	17,7	(8,8 - 30,1)
	Repetitive volunteer	1	2,2	(0 - 14,5)

Region	Tunja	6	13,3	(2,2 - 28,0)
	Duitama	10	22,2	(11,1 - 36,9)
	Paipa	2	4,4	(0 - 19,1)
	Sogamoso	6	13,3	(2,2 - 28,0)
	Chiquinquirá	3	6,7	(0 - 21,3)
	Moniquirá	3	6,7	(0 - 21,3)
	Other municipalities of Boyacá	7	15,6	(4,4 - 30,7)
	Other Departments	8	17,8	(6,6 - 32,4)

The prevalence with the complementary test was 0.08% (20 / 25,920) of which 70.0% were women, 85.0% voluntary donors for the first time, the age range in which the highest prevalence of this was presented. Serological marker was 41 to 50 and 51 to 65 years with 35.0% each (Table 2). In 2017 there were no positive cases.

Table 2. Epidemiological characteristics of blood donors confirmed for Chagas. Boyacá, Colombia 2016 - 2018 (n = 20)

Variable		n	%	95 % IC
Year	2016	7	35	(20 - 58.58)
	2018	13	65	(50 - 88.58)
Gender	Feminine	14	70	(55 - 91.86)
	Masculine	6	30	(15 - 51.86)
Age	18-30 years-old	2	10	(0 - 33.13)
	31-40 years-old	4	20	(0 - 43.13)
	41-50 years-old	7	35	(15 - 58.13)
	51-65 years-old	7	35	(15 - 58.13)
Donor type	Volunteer first time	17	85	(75 - 100.00)
	Voluntary non-repetitive	2	10	(0 - 26.07)
	Repetitive volunteer	1	5	(0 - 21.07)
Procedencia	Tunja	3	15	(0 - 39.91)
	Moniquirá	3	15	(0 - 39.91)
	Sogamoso	1	5	(0 - 29.91)
	Chiquinquirá	1	5	(0 - 29.91)
	Duitama	1	5	(0 - 29.91)
	Other municipalities of Boyacá	4	20	(5 - 44.91)
	Other Departments	7	35	(20 - 59.91)

Table 3 shows that the prevalence of Chagas infection presented a statistically significant association with age ($p < 0.05$), with a greater presence in the 41-50 and 51-65 year-old groups.

Table 3. Association of the prevalence of infection by *T. cruzi* with the complementary test in blood donors from Boyacá, according to the epidemiological characteristics.

Variable		n	%	95 % IC
Year	2016	18	40,0	(26,67 - 56,16)
	2017	5	11,1	(0 - 27,27)
	2018	22	48,8	(35,56 - 65,05)
Gender	Feminine	34	75,5	(64,44 - 87,98)
	Masculine	11	24,4	(13,3 - 36,8)
Age	18-30 years-old	15	33,3	(20 - 49,6)
	31-40 years-old	11	24,4	(11,1 - 40,7)
	41-50 years-old	9	20,0	(6,6 - 36,3)
	51-65 years-old	10	22,2	(8,8 - 38,5)
Donor type	Volunteer first time	36	80,0	(71,1 - 92,3)
	Voluntary non-repetitive	8	17,7	(8,8 - 30,1)
	Repetitive volunteer	1	2,2	(0 - 14,5)

* Significant value < 0.05

Regarding the confirmed donors, 55.0% were from the Boyacá department and 45% from other departments such as Casanare, Meta, Santander, Norte de Santander and Córdoba (Figure 1)

Figure 1. Map of Colombia of geographical distribution of confirmed positive cases for anti-*T. cruzi* antibodies.



Discussion

The results of the present study showed a prevalence of antibodies against *Trypanosoma cruzi* in the screening of 0.17% and in the complementary test it was 0.08%, similar to that found in Barranquilla which was 0.27% and 0.03% (14) and in Córdoba of 0.43% and 0.39% (15) respectively, but lower than that reported at the national level (10,11,12).

The data obtained from the behavior of this event in the Blood Bank of the department of Boyacá, can be associated with strict compliance with the guidelines of the national level regarding voluntary blood donation in which it is sought to identify risk factors that may harm health donor and recipient (16). In addition to the prevention and vector control actions carried out by the Boyacá Ministry of Health, strengthened with chemical and comprehensive interventions that involve community participation, have allowed a more conscious population to identify their exposure to risk and that at the time of donating blood an adequate and effective selection is made. The department has an international certification for the elimination of transmission in 39.3% of the municipalities at risk, which has allowed to reduce the incidence of Chagas disease in areas at risk.

Regarding sex, it was found that the female population was the one that made the largest donation with

56.1%, contrary to what was expected according to the recommendations described by the World Health Organization in which, to avoid iron deficiency in blood donors, women can donate less frequently than indicated for men (16). For the results of the complementary test, the female sex presented a higher frequency with 70.0%, different from that described in Caquetá which was 74.0% of men (17) and in other regions of the world such as in Brasilia with 63.4% (18).

The age range with the highest frequency of positive donors for Chagas in the present study was between 41-51 years and 51-65 different from that reported in two studies carried out in Venezuela (19) and Peru (20) in which the range of the age with the highest prevalence was 18–31 years with 50.4% and 33.3% respectively. We found a statistically significant association between age and seropositivity similar to that reported in a study carried out in Mexico (21) and coinciding with what was observed in open population studies, where seroprevalence increases considerably in the fourth and fifth decades of life (22).

The first-time volunteer donors presented a higher percentage of positivity for *T. cruzi* infection with 85%, similar to that described in a study carried out in Brazil in the Hemotherapy Service in which it was 75.3% (23); In the Centro de Uberaba Fundación Hemominas, which was 99.2% and in which they found a significant association (OR = 607; 84.9-4348.3) (24) different from the one described in the present work, in which no significant association was found. Repetitive volunteer donors are previously selected since they have undergone clinical and serological screening in previous donations, and therefore, have lower seropositivity rates (25), coinciding with what was found in the present study.

Blood banks turn out to be one of the sources of information available to monitor the behavior of Chagas disease and evaluate decision-making in public health, taking into account the characteristics of the disease in which most cases are asymptomatic and without clinical commitment. The regulations that govern blood banks in the face of screening and complementary tests for serological markers, including anti-*T. cruzi*, facilitate the strengthening of the comprehensive health care route implemented in the department, the active search and effective channeling through of the actors of the health system allowing complementary diagnosis, follow-up and treatment, complying with the algorithms and related regulations in force. The department of Boyacá, following the actions of prevention and control of diseases transmitted by vectors, especially Chagas disease, with a population that is widely

sensitized to the determining factors of the presence of the disease that allows the blood bank to have a selection process of more reliable and effective donors.

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