Acta Tropica 113 (2010) 257–262

Contents lists available at ScienceDirect

Acta Tropica

journal homepage: www.elsevier.com/locate/actatropica

Seroprevalence of *Trypanosoma cruzi* infection and vector control activities in rural communities of the southern Gran Chaco (Argentina)

Mariana Laura Moreno[a], Edgardo Moretti[b], Beatriz Basso[b], Maria Frias Céspedes[c], Silvia S. Catalá[a], David E. Gorla[a,*]

[a] *Centro Regional de Investigaciones Científicas y Transferencia Tecnológica (CRILAR), , Mendoza y E. Ríos, 5301 Anillaco, La Rioja, Argentina*
[b] *Coordinación Nacional de Control de Vectores, Argentina*
[c] *Area de Epidemiología, Ministerio de Salud de Córdoba, Argentina*

ARTICLE INFO

Article history:
Received 20 November 2008
Received in revised form
19 November 2009
Accepted 23 November 2009
Available online 27 November 2009

Keywords:
Chagas disease
Trypanosoma cruzi
Vector control
Triatoma infestans
Gran Chaco

ABSTRACT

We compared age-related seroprevalence of *Trypanosoma cruzi* infection with history of vector control interventions and social and ecological changes in three historically endemic departments of Cordoba province, Argentina, covering an area of 42,600 km^2 of the Gran Chaco region. Using a cross sectional design, blood samples of 5240 people between 6 months and 40 years of age, living in 192 rural communities were analyzed to detect *T. cruzi* infection using ELISA tests, and confirmed with indirect immunofluorescent antibody test and indirect haemoagglutination. Overall seroprevalence was 5.4%, 7.9% and 7.5% in the north, northwest and west studied areas (average for all areas 6.95%). Seroprevalence for *T cruzi* increased with population age, especially in age classes older than 15 years of age. Communities of the north and west areas showed 0.59% seroprevalence for *T. cruzi* in children below 15 years of age, whereas children of the same age in the northwest region showed a seroprevalence of 3.08%. Comparative analyses indicate that vector control activities and land use changes during the last decades are the most likely causes of the overall reduction of *T. cruzi* prevalence. Results suggest that the vectorial transmission of *T. cruzi* has been strongly reduced and probably interrupted in the north and west areas, but it is still active in the northwestern rural settlements of Córdoba province.

1. Introduction

Chagas disease (American trypanosomiasis) is one of the main endemic diseases of Latin America, produced by *Trypanosoma cruzi* and mainly transmitted by triatomine bugs (Hemiptera, Reduviidae, Triatominae). Following successful vector control campaigns that started in the 1980s and 1990s, together with improvement of living conditions of many people in rural areas, the affected population in Latin America decreased from around 20 millions in the 1980s to less than 10 millions during the first years of 2000 (Remme et al., 2006). With the successful elimination of domestic infestations of *Triatoma infestans* (the main vector species) in most of the affected areas of the southern cone of South America, the epidemiological situation of Chagas disease is at present a heterogeneous mosaic in the area (Schofield et al., 2006).

Vectorial transmission of *T. cruzi* by *T. infestans* in the Southern Cone countries of South America has been interrupted in Chile (1997), Uruguay (1999), Brazil (2006), and some regions of Argentina and Paraguay (OPS, 2006). Within the areas where vectorial control was successful, the detection of infected children allows for elimination of the infection through available parasitological treatments. In areas where the vectorial transmission of *T. cruzi* is interrupted, the infection can be found only in adults that were not treated as children or did not respond positively to the parasitological treatment (OPS, 2001, 2002a,b, 2003; Dias et al., 2002; Gürtler et al., 2003).

But vectorial transmission of *T. cruzi* is still apparent in several areas of the Gran Chaco region of Argentina, Bolivia and Paraguay. In this area, that covers around 1 million km^2, people of all ages can be found infected by *T. cruzi*, especially in those areas where the vectorial control interventions has been sporadic and not sustained over time (Gürtler et al., 2005).

Towards the southern part of the Gran Chaco, the northern departments of Córdoba province (Argentina) were early identified as highly endemic. By the mid 1960s, rural houses of these departments showed rates of infestation by *T. infestans* averaging 50% (Segura, 2002). As in many endemic areas of Argentina, political and economic instability affected the activities of the vector control program in Córdoba, with sporadic pulses of activity followed by years of stagnation (Sosa Estani et al., 2006). Yet even with poorly sustained vector control activities, house infestation rates

* Corresponding author at: CRILAR, Mendoza y E. Ríos, 5301 Anillaco, La, Rioja, Argentina. Fax: +54 3827 494231.
E-mail address: dgorla@crilar-conicet.com.ar (D.E. Gorla).

0001-706X/$ – see front matter © 2009 Elsevier B.V. All rights reserved.
doi:10.1016/j.actatropica.2009.11.007

decreased to 20% between 1988 and 1992. By 1992, all activities for the control of vectorial and non-vectorial transmission adhered to the protocol approved by the Southern Cone Initiative, and house infestation was reduced to less than 5% by the year 2000 through selective spraying of infested houses reported by the community (Chüit et al., 1992; Segura et al., 1994; Segura, 2002). Because of the Argentinean economic crisis that started in 1999, vector control activities were reduced and house infestation increased to 6.5% in the intradomestic structures and 10.7% in the peridomestic structures (OPS, 2001; Segura, 2002; Dirección de Zoonosis, Córdoba Ministry of Health, unpublished data).

The recrudescence of the domestic infestation was reflected by the detection of 7 acute cases in the north and west of the province, between 1998 and 2005 (Coordinación Nacional Control Vectores Argentina, unpublished data). From 1994, newborns of infected mothers were being monitored for infection, and serological screening in blood banks was well established in the province of Córdoba (Segura et al., 1994, 2000; OPS, 2002a,b; Segura, 2002).

This investigation is part of a larger project that studies the association between environmental changes and the epidemiology of Chagas disease in the southern part of the Gran Chaco. We report here on the age-specific seroprevalence of *T. cruzi* infection in human populations up to 40 years of age, and assess this against vector control activities during the last decade in rural communities in the north, northwest and west of Córdoba province (Argentina).

2. Material and methods

2.1. Study area

The study area is located towards the south of the Gran Chaco of Argentina, in the north and west of the province of Córdoba (Fig. 1). The region covers around 42,600 km^2 and has a Mediterranean climate, with annual average temperature of 19 °C with hot summers and cold winters (extreme temperatures over 35 °C and below 5 °C are frequent). Rainfall (especially between November and March) decreases from an average annual total of 700 mm in the SE to less than 550 mm in the NW of the study area (Zak and Cabido, 2002; Zak et al., 2004). The selected area covers the departments historically endemic for Chagas disease, with high seroprevalence and high domestic infestation by *T. infestans* in rural houses, reported in a number of studies (Chüit, 1989; Esteco, 1984; Giojalas et al., 1990; Martínez, 1996; Crocco and Sanmartino, 2000). Within the selected region, three areas were identified, according to history of land use and land cover changes during the last 30 years. A north area includes parts of the departments of Río Seco and Tulumba, a northwest area includes parts of the departments Cruz del Eje and Ischilín, and the west area includes parts of Pocho and San Alberto (Fig. 1). During the last 40 years, the north area showed a strong change towards intensive soya production, the northwest area showed a land use change towards an increase of cattle production, and the west area developed low-impact tourism and showed few land cover changes. Rural communities of each area were cartographically located using a Garmin GPS.

2.2. Study design

The seroprevalence of *T. cruzi* infection was estimated through a cross sectional sampling design (Nelson et al., 2001). Individuals included in the study were those that lived their entire life in the rural community (or spent a maximum of 2 years outside it) and had between 6 months and 40 years of age. The age limit of 40 and residence time was imposed by the period of interest of the study that seeks to understand the epidemiology of Chagas disease during the last 40 years in the north and west of Córdoba province.

Minimum sample size was estimated in two steps. In the first step, a preliminary minimum sample size (n_0) was calculated as pq/EE^2, where p is the expected prevalence of Chagas disease in the

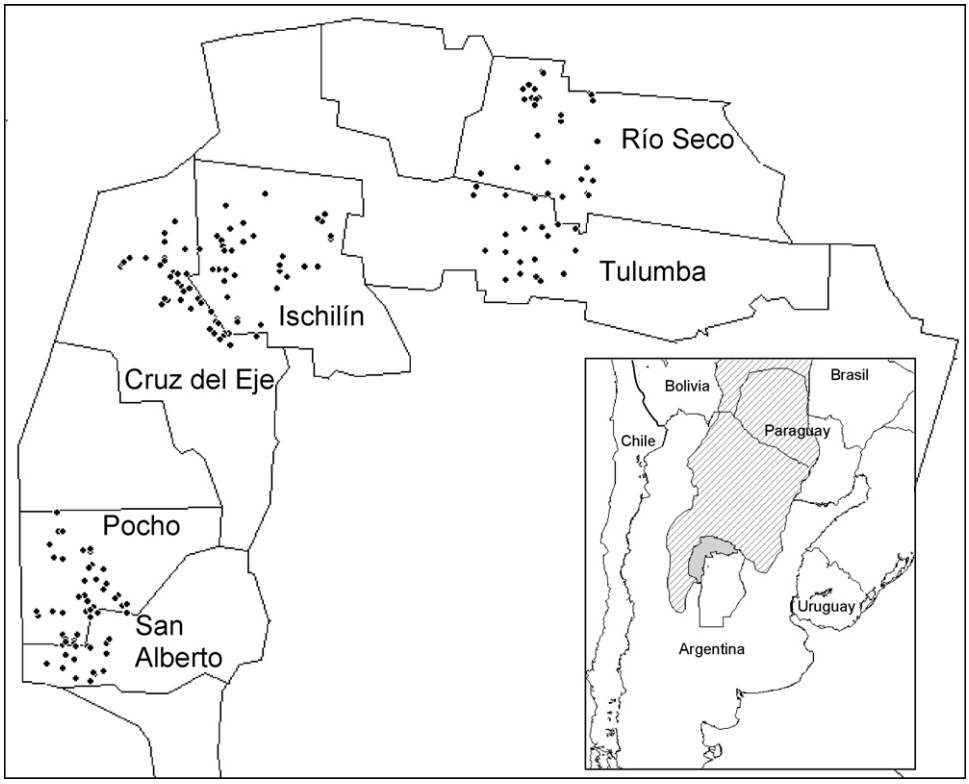

Fig. 1. Study area north, northwest and west of Córdoba province (in grey), showing the localities included for the collection of serology samples. The Gran Chaco area is shown by the diagonal fill in the inset.