Identifying Health Centers in Honduras Infested with Rhodnius Prolixus Using the Seroprevalence of Chagas Disease in Children Younger than 13 Years.

Am. J. Trop. Med. Hyg., 73(2), 2005, pp. 307–308

IDENTIFYING HEALTH CENTERS IN HONDURAS INFESTED WITH *RHODNIUS PROLIXUS* USING THE SEROPREVALENCE OF CHAGAS DISEASE IN CHILDREN YOUNGER THAN 13 YEARS

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Abstract. The objective of this study is to determine if a Chagas disease protocol starting with a serological survey is as reliable at identifying insect-infested areas as one using the gold standard entomological survey. The study found that health center areas infested with *Rhodnius prolixus* were identified using a threshold seroprevalence of 0.1%. The serological survey took half the time and was 30% less expensive than the entomological survey. Developing countries with limited resources may find this strategy useful in combating Chagas disease. This strategy also identifies seropositive children, which facilitates their treatment.

INTRODUCTION

In 2000–2001, Médecins Sans Frontières (MSF) conducted a program targeting Chagas disease in Honduras. Chagas disease is a serious problem in Mexico and the Andean and Central American countries with approximately 9 million people infected with the parasite and 25 million remaining at risk.[1] The prevalence of Chagas disease is reducing in South America with the success of the Southern Cone initiative launched in 1991. This initiative aims to eliminate transfusional transmission and to eradicate the principal insect vector in South America, *Triatoma infestans*. A similar initiative aims to eradicate *Rhodnius prolixus,* the principal insect vector in Central America. These programs use a World Health Organisation (WHO) protocol where an entomological survey identifies infested areas requiring spraying. While effective, this strategy is resource and time intensive. MSF adopted a different approach, developing a protocol using a serological survey to identify infested areas in need of spraying, which had the additional advantage of identifying and treating seropositive children. de Andrade and others found that a serological survey of schoolchildren allowed mapping of seroprevalence, detected child carriers of the disease, allowed comparison of different regions, and longitudinally could evaluate the efficacy of vector control measures.[2] The objective of this study is to determine if a protocol starting with a serological survey is as reliable at identifying infested areas as one using the gold standard entomological survey and to compare protocols for cost and time.

MATERIALS AND METHODS

The study area comprised three adjacent municipalities, Orica, San Ignacio, and Marale, located in the central mountains of Honduras. Another nongovernment organization in conjunction with the national vector control authorities was concurrently conducting a program of home improvement, including roof replacement in the worst affected parts of MSF's project area. The MSF team consisted of two brigades, each with one supervisor and six members. A process of community consultation and explanation of our activities was undertaken prior to both entomological and serological surveys. The brigades first conducted the entomological survey, searching for the principal insect vector, *R. prolixus*, in each village. Data on *Triatoma dimidiata* infestation were also collected. They then conducted the serological survey, taking a fingerprick sample of blood from each child under 13 years of age on Whatman no. 2 filter paper. All blood samples were taken in the presence of brigade leaders, the MSF social worker, the MSF doctor or trained local Honduran health staff. The procedure and the implications of positive and negative tests were explained to parents or the caregiver present with the child. It was explained that treatment would be offered in the event of a positive test. Refusal by parents, family members, or children was respected. These samples were analyzed in a central laboratory using a Chagatest ELISA IgG from Wiener Laboratory in Rosario, Argentina. The sensitivity of this test is 99.8% and the specificity is 99.2%. Positive ELISA tests and 10% of negative ELISA tests were confirmed with an immunofluorescence assay. Facilities allowing parasitological diagnosis were not available. All houses in health center areas infested with *R. prolixus* were sprayed using a pyrethroid insecticide, and seropositive children were treated with benznidazole in their communities for 60 days using a dose of 7.5 mg kg^{-1} day^{-1} in two divided doses.

A cost comparison of entomological and serological surveys was based on the time and running costs required to complete each survey using the two MSF brigades. Additional costs such as serological tests, filter paper, and the laboratory technician were factored into the cost comparison.

RESULTS

Complete results for entomological and serological surveys were obtained for all 11 health center areas in the three municipalities Orica, San Ignacio, and Marale. In this study area, 5,090 houses were searched, and *R. prolixus* infestation was identified in 22 communities. In the same area, 9,573 children were tested for Chagas disease, and 49 returned a positive result (Table 1). Refusal rates were low except for small clusters in certain communities, usually for religious reasons. Overall coverage in the serological survey was approximately 93%. In all health center areas, infestation with *R. prolixus* could be identified using a threshold seroprevalence of 0.1% (sensitivity 100%). The specificity at this level was 66% (Table 2). All health centers with a seroprevalence of more than 0.2% were found to be infested with *R. prolixus*. Therefore, using a threshold seroprevalence of 0.2%, the specificity of the test was 100%, and the sensitivity was 80%.

In a fourth municipality, Guayape, the serological survey revealed four health center areas with a seroprevalence

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TABLE 1
Summary data from the study area

	Number
Summary data from the study area	
Houses in census	7,303
Houses searched	5,090
Health centers infested with *Rhodnius prolixus*	5
Children in census	10,283
Children tested	9,573
Seropositive children	49
Overall seroprevalence	0.51%
Municipality of Guayape	
Children in census	5,195
Children tested	4,878
Seropositive children	28
Overall seroprevalence	0.57%

greater than 0.2%. Although no formal entomological survey was performed in this municipality, the brigades reported seeing *R. prolixus* in all four of these health center areas. In addition, no *R. prolixus* was seen or reported from the remaining two health center areas with a seroprevalence of 0%.

There was no correlation found between health center seroprevalence and infestation with *T. dimidiata.* This vector appeared to account for 6% of the seropositive children in our project. All the children with a confirmed positive test were asymptomatic and were offered treatment with benzonidazole. Seventy percent of these children in treatment had no side effects. Side effects were common though generally mild and included loss of appetite, rash, dizziness, stomach pain, headache, and fatigue. Only two children ceased treatment, both after 1 month and both due to a severe rash. Local health authorities undertook to follow up children who were treated with trypanocidal medication. The national vector control authorities have undertaken to follow up MSF's work with repeat spraying to maintain vector eradication.

The running costs of our activities were calculated for the 11 health centers belonging to the 3 municipalities of Orica, San Ignacio, and Marale. The serological survey took half the time of the entomological survey representing 50 days less per municipality. This time saving led to reduced running costs such that the serological survey was 30% less expensive than the entomological survey, or US$3,761 per municipality.

DISCUSSION

This study has found that the presence or absence of the principal insect vector *R. prolixus* can be predicted using the seroprevalence of children under the age of 13 years in health center areas. Health centers were used as our geographical unit of reference as they are a realistic area in which to spray all houses if *R. prolixus* infestation exists. *R. prolixus* spreads from house to house and is also spread passively by people moving along access routes.[3] Local topography often determines house to house spread, the course of these access routes, and the boundaries of the local health center. Municipalities are large enough to ensure that *R. prolixus* infestation will translate into seropositive children; however, it is an unrealistic area to spray without more specific entomological data. Individual villages may be infested without seropositive children. This method does not allow for detection of areas at risk of *T. dimidiata*, a sylvatic vector, which is not targeted for eradication and is a secondary priority to *R. prolixus* in Central America.[4] The serological survey in our project took half the time and cost 30% less than the entomological survey. This difference would be greater for local authorities with existing infrastructure. By inviting children to health centers, taking fingerprick blood samples and sending these to a central laboratory, local authorities would know the Chagas disease status of a health center within a week. Health centers could then be prioritized according to seroprevalence with resources diverted at a seroprevalence less than 0.1%, further investigation at 0.1% to 0.2%, and spraying of the entire health center area once seroprevalence rises above 0.2%. The local health center could then start anti-trypanocidal medication for seropositive children, which has been shown to improve parasite-related outcomes.[5] The serological survey is a useful tool in assessing and combating Chagas disease. It deserves particular consideration in communities lacking the resources to undertake an entomological survey.

TABLE 2
Correlation of seroprevalence of Chagas disease in children younger than 13 years and the presence of *Rhodnius prolixus* in health center areas

	Insect search for *R. prolixus*		
Seroprevalence	Positive	Negative	Total
> 0.1%	5	2	7
< 0.1%	0	4	4
Total	5	6	11

Sensitivity = 5/5 = 100% (95% CI: 57–100%)
Specificity = 4/6 = 67% (95% CI: 30–90%)
Positive predictive value = 5/7 = 71% (95% CI: 36–92%)
Negative predictive value = 4/4 = 100% (95% CI: 51–100%)
Prevalence = 5/11 = 45% (95% CI: 21–72%)

Received January 10, 2005. Accepted for publication March 17, 2005.

Acknowledgments: The authors acknowledge the hard work of the local Honduran MSF brigades who gathered the information for the entomological and serological surveys.

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