

Reasons for Persistence of Dwelling Vulnerability to Chagas Disease (American Trypanosomiasis): A Qualitative Study in Northeastern Brazil

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Abstract

Interaction between Chagas disease vectors and man is continuous in vulnerable dwellings, in which the vectors feed on man and find conditions for reproduction. This study explores factors that affect the choice of home construction methods in a rural community in Brazil, emphasizing the rationale for the persistence of dwelling vulnerability. Information on local resident perspectives regarding safety and home construction methods was gathered through domiciliary interviews with open questionnaires. The study revealed a large proportion of vulnerable mud huts, with others under construction.

Insecurity over land tenure inhibits the construction of definitive houses. Mud homes are associated with greater structural stability. Cultural and economic factors have clearly been linked to the choice of method for home construction. The economic evolution of family conflicts with traditional aspects as well as the relative increased cost of the materials needed for mud house construction has not completely inhibited building with mud.

Introduction

Endemic Chagas disease, discovered at the beginning of the twentieth century, is the result of the close interaction between hematophagous insect vectors that transmit the protozoa *Trypanosoma cruzi* (the etiological agent) and man (Coura and Borges-Pereira 2012; Coura and Junqueira 2012; Neiva 1910, 1913). This vector–man interaction emerged from the establishment of propitious conditions for the triatomine colonization of human dwellings, that is, the development of a new habitat for these insects, an ecotope affording conditions for survival and reproduction (Dias 1946, 1954; Gurevitz et al. 2012; Hashimoto et al. 2012).

This process introduced man into the ancestral enzootic cycle of the parasite in nature (Guhl et al. 2009; Kirchhoff 2011; Prata et al. 2011; Roque et al. 2013). The socioeconomic characteristics of the settling process throughout the outback of northeastern, central, southeastern and southern Brazil were responsible for the demographic phenomena resulting in the establishment of the basic man–insect interaction unit – the mud hut, a primitive and particular kind of dwelling. In this context, characteristics of the Brazilian colonization process, such as landlordism, the enslavement of Africans, the imposition of European culture on the Amerindians, assimilation of mono cultivation and an export-oriented economy have produced poverty in vast rural regions (Prado Junior 1979; Wegenast 2010).

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... has led to many food-borne outbreaks.*

Recently, the transmission of Chagas disease in Brazil is shifting to the northern (Amazon) region and is associated with contact between man and non-domiciled wildlife vectors (Monteiro et al. 2012; Ricardo-Silva et al. 2012). The contamination of food with *T. cruzi*–infected triatomine feces is an example of such contact and has led to many food-borne outbreaks (Beltrão et al. 2009; Nóbrega et al. 2009), even outside the Amazonian region (Shikanai-Yasuda and Carvalho 2012). In addition, transmission of Chagas disease through blood transfusion has become an ever-increasing concern in non-endemic countries in Europe and North America as a result of emigration from Central and South America (Agapova et al. 2010; Jackson et al. 2009).

As the first step to a current comprehension of social and economic determinants of insect-borne transmission in northeastern Brazil, we have been studying the rationale for the persistence of dwelling vulnerability into the twenty-first century. In this paper we discuss some aspects that may be associated with the maintenance of vector-borne transmission of Chagas disease.

Population and Methods

In 2012, we visited rural localities in the semi-arid region of northeastern Brazil, within the Caatinga biome on the shore of Santo Antonio, an artificial lake created in 1927 and expanded in 1958. Chagas disease is considered endemic in this region (Alencar 1987). The lake is strategic for the irrigation projects carried out by the national anti-drought department (DNOCS, Portuguese acronym) in the lower Jaguaribe River region. Timbaúba do Pitingão, together with the localities of Riacho do Barro, Lagoa do Mato, São Pedro de Cima, Capim Grosso and Tabuleirinho, all located on the perimeter of the Santo Antonio reservoir, will be further studied in this research project.

We approached thirty-seven families to take part in our research. One occupant in each residence was interviewed in a qualitative study through semi-structured questionnaires. The survey axes were

organized into four spheres: (i) characteristics of the local landownership structure, (ii) activities involving household maintenance and income, including the characterization of extreme poverty defined by a per capita family income below 30 US dollars, (iii) perceptions concerning household safety regarding the transmission of Chagas disease, and (iv) possibilities and options for home building methods. The interviews addressed the four main spheres of qualitative observation, leaving respondents free to express their knowledge and insights on each topic. Responses were recorded for subsequent analysis.

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Thus, descriptive data were obtained through direct, interactive contact between researchers and interviewees. The methodological design employed was the case study, in which we sought a detailed examination of an environment, together with its inhabitants. All responses on each main study topic were systematically reorganized into a comprehensive framework, synthesizing residents' beliefs and perceptions with respect to the persistence of housing vulnerable to Chagas disease in the region.

Results

Our observations in the Timbaúba do Pitingão locality confirmed a large proportion of mud hut dwellings, with more under construction. Of the 37 families we visited, 51% (19) had decided to build their houses with mud and wood (Figure 1).

Figure 1. Dwellings in Timbaúba do Pitingão, State of Ceará, northeastern Brazil



- A** A mud hut in which the outer surface of mud has collapsed, exposing the wooden frame.
B A mud house partially damaged, although part of the coating of clay, painted white, is preserved.
C A clay block house, newly built, beside a mud house.

D An improved clay block house.

Interviewees' responses led us to realize that almost all inhabitants leased the land from the Brazilian federal government, in an irrigation and colonization program administered by DNOCS. Participants in the program pay low fees for the land – approximately 30 dollars per year for seven hectares. More fertile land is available during the six-month drought than in the rainy season, which causes flooding. People mainly plant corn and beans, but squash, cucumber, papaya and guava are also grown. Most of these crops, as well as goats, sheep, chickens and pigs that are reared, are for home consumption.

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In our study we also strive to characterize activities associated with household maintenance and income for the definition of extreme poverty. Most families do not receive government income assistance (Family Financial Aid, a federal income transfer program to mitigate extreme poverty), as there is usually at least one family member receiving retirement social security. For example, in one family, the sum of the monthly value of two benefits reached 620 dollars, which, divided by the five family members, gave a per capita monthly income of 124 dollars. This amount disqualified the family from the classification of extreme poverty, which is the case for the majority of households in the region. The poorest families we interviewed had a per capita family income of 40 dollars per month (10 dollars above the limit). Therefore, we did not identify any households in Timbaúba do Pitingão eligible for extreme poverty classification.

There are a few families in the Timbaúba do Pitingão community with members working in the urban heart of Russas, in the large local shoe industry. We observed that the houses of these families were built of masonry. Instead of paying rent in the city, they choose to live in Timbaúba do Pitingão, where the cost of living is cheaper and life is more serene.

Concerning dwelling security, residents' perceptions and beliefs through systematization of information from interviews disclosed that for most of the community, the mud houses are safer, as "they are bound" and "anchored to the ground," whereas the clay brick structures have no pillars. In Timbaúba do Pitingão, we encountered mud houses built recently (five months ago), so this construction technique is still under way in the area. Some residents refused to modernize their mud houses, although they knew of association between the mud huts and insect vectors that transmit Chagas disease. Interestingly, there have been reports of mild earthquakes in the area, according to one family of fishermen. These natural phenomena would also explain the anxiety about and avoidance of clay brick construction, reinforcing the belief that the mud housing is more secure.

Regarding the *bicudos*, the name people use for the insects that transmit Chagas disease in northeastern Brazil, some residents understood about the relocation of the vectors from the wild to dwellings and told us that these insects are brought in from the forest with firewood. A 52-year-old woman said, "If the *bicudos* have the opportunity, they hide in the cracks of the mud hut walls, come out at night and use us as a food [blood] source while we are sleeping."

With respect to residential construction in the region, a clay brick house costs between 2,000 and 2,500 dollars, while a mud dwelling costs around 1,500 dollars, with most of the manual labour provided by the family. Analyses of the interviews confirm that many of the residents were born and raised in mud houses and resist accepting an alternative. For example, a woman living in the same mud hut for over 30 years declared that her cousin, living in another location, had built his mud house just six months ago. Intriguingly, after purchasing all the wood needed, the home ended up being almost as expensive as a clay brick house and more complicated to build, possibly because instead of gathering wood directly from the forest, people now have to

buy it from local dealers.

Nevertheless, many people still base their building preference for mud on financial resources, even though, as described above, the construction costs are now comparable. Therefore, for some inhabitants, the justification for retaining mud houses must be more cultural than economic. A 72-year-old resident was a subsistence farmer who had lived most of his life in mud houses.

He related that in the past, clay brick dwellings were virtually non-existent because of the difficulty and expense of construction. Now, he states his preference for clay brick houses with the misconception that people do not build them for financial reasons. As a boy, he lived in mud houses and never saw *bicudos*, probably because the houses were always sprayed with insecticides.

Discussion

Results of this qualitative study demonstrate that mud houses represent not only the present but also the future, as well as the past. Furthermore, the absence of land property deeds discourages housing upgrades to more durable structures such as the clay brick.

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of their high depreciation factor.*

The interviews revealed that most of the families have traditionally lived for many years in these triatomine-susceptible dwellings and probably will continue to do so. Contrastingly, residents' life stories suggest that building a mud house now can be almost as expensive as a brick house, because the good-quality wood essential for mud hut construction is no longer freely available. To build a mud dwelling, different species of wood are required, including aroeira (*Schinus terebinthifolius*), pau-branco (*Auxemma onocalyx*), marmeleiro (*Cydonia oblonga*) and carnauba (*Copernicia prunifera*). These trees, now scarce because of deforestation of the region, are sold by the owners of ranches and farms at prices residents consider exorbitant. For example, carnauba trunks are necessary for the roof's supporting beams but can no longer be cut locally. As these palm trees are the source of carnauba wax, an important natural resource, their maintenance is closely regulated by the government. Currently, mud dwellings are still being constructed in the location. However, most of the older mud structures undergoing the natural process of degradation are now being replaced by more modern masonry houses. In the study area, some mud house residents have recently built masonry houses because of a raw material shortage for mud walls, which in some cases is critical for the choice of construction technique. Nevertheless, despite a rise in raw material prices, mud dwellings still seem to be the preference, regardless of their high depreciation factor in contrast to masonry. For example, some mud houses are now worth only about 200 dollars, while clay brick structures have maintained their value of between 2,500 and 3,000 dollars.

Building a mud house consists of the following steps. First, you dig deep into the ground to install the "forks," which are the main support beams. These beams are made of aroeira tree trunks. Centre columns are higher, for roof support. Subsequently, carnauba beams are secured on top, either inclined or horizontally, according to the length of the forks, to support the roof. Pau-branco vertical sticks are inserted from the ground and attached to the horizontal carnauba beams for the wall structure. The next step is to complete the wall, nailing horizontal quince sticks to the vertical pau-branco sticks, forming a grid to sustain the mud filling. Then, the gaps in the grid are manually filled with clay. Afterwards, the irregular surface is smoothed with a thin and homogeneous mixture of soil, sand and, optionally, cement, thus concluding the construction of the walls. The roof construction is the final step, traditionally completed with rafters, joists and ceramic tile. In our research we witnessed, in some homes, every aspect of construction.

The farmer who described the mud house construction technique had wished to build his house with clay bricks when he was getting married, thirteen years earlier. However, at that time, clay brick dwellings were forbidden because residents did not have legal land ownership, and permission to establish permanent dwellings would automatically entitle them to the land (squatters' rights). An additional problem was the possibility of the Santo Antonio dam expansion causing flooding in the area and forcing evacuation. At that time, even ceramic tile roofing of mud houses was prohibited, only straw roofing being permitted. The dwellings had to be temporary so that they could be moved and rebuilt in other locations in case of expropriation. Such a measure would not result in mandatory compensation for the relocated family.

We attested to the weaknesses of clay brick houses constructed in Timbaúba do Pitingão, due to simplified techniques and poor masonry which have been adapted for building with clay brick at minimum cost, compatible with the relative poverty of the region. This justifies the safety concerns of the interviewees.

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There are no pillars or foundations in these houses, just fragile columns of clay bricks bonded with mortar that support the vertical clay brick walls. There are no concrete columns reinforced with steel, and the walls are attached to one another directly. They are seldom plastered and usually spackled in the attempt to increase strength and waterproofing.

Nowadays, inhabitants are authorized to build clay brick homes in Timbaúba do Pitingão, which is exactly what some retired local farmers do. Retirees have fixed monthly incomes of 310 dollars and the possibility of bank loans with automatic paycheque deductions. Two to three thousand dollars affords construction of a clay brick house, especially if the residents can save on manual labour, using family members to help. If any family member is a bricklayer, a bank loan of less than 1,500 dollars may be enough. In our observations, we found that many clay brick houses were built after the retirement of a family member, with funds raised in the form of loans. More clay brick constructions are imminent, awaiting the retirement of one of the future inhabitants.

The local vegetation is characterized by the presence of the black jurema bush (*Mimosa tenuiflora*). The initial entomological surveys we conducted in Timbaúba do Pitingão established the presence of *Triatoma pseudomaculata* (another formidable Chagas disease vector) in some sylvatic and peridomestic areas, the association of black jurema with this species of triatomine already having been confirmed (Freitas et al. 2004). The black jurema is an important source of firewood for cooking. Brought for storage in the domestic and peridomestic environments, the firewood serves as a vehicle for *T. pseudomaculata* to invade and colonize the dwelling, linking wild and domestic cycles of *T. cruzi* transmission. Our entomological survey did not identify bug colonies in the home environment, demonstrating that, despite the vulnerability of mud houses, the entomological surveillance system conducted by the authorities for the control of Chagas disease in the city has been effective.

According to Pisani (2004), the soil has been used as a raw material for buildings since the prehistoric period. It is an ancient construction technique that has benefits such as regulating the internal temperature of the environment and the possibility of easy relocation with minimal economic loss. We realized that a key feature of the mud structures was the need for regular maintenance. The wooden frame of mud houses, although able to endure for many decades, is subject to annual cycles of rain and drought, suffering dilations after the rainy season. This expansion of the wood frame induces cracks and blisters in the plastered walls, generating numerous crevices that serve as shelter for the insects that transmit American trypanosomiasis, which affords

the process of colonization by the bugs. The mud houses, therefore, require annual maintenance in order not to become susceptible to triatomine colonization.

In conclusion, Timbaúba do Pitingão is still a locality with a large proportion of vulnerable mud dwellings. Cultural and economic factors have clearly been linked to the choice of method for home construction. While some masonry houses are replacing the old mud huts, mud dwellings are still being built, exhibiting the dilemmas associated with beliefs and perceptions about the safety of mud houses and the possibility of building clay brick houses. In this context, the economic evolution of family conflicts over traditions, as well as the relative increased cost of the materials needed for mud house construction, has not completely inhibited building with mud. It may be that a housing alternative with higher quality and safety has, as yet, not been offered in the region.

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