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This series includes meeting documents, internal reports, and preliminary technical documents that may later form the basis of a formal publication. A Manuscript Report is given a small distribution to a highly specialized audience.

La présente série est réservée aux documents issus de colloques, aux rapports internes et aux documents techniques susceptibles d'être publiés plus tard dans une série de publications plus soignées. D'un tirage restreint, le rapport manuscrit est destiné à un public très spécialisé.

Esta serie incluye ponencias de reuniones, informes internos y documentos técnicos que pueden posteriormente conformar la base de una publicación formal. El informe recibe distribución limitada entre una audiencia altamente especializada.
Leishmaniasis control strategies
Leishmaniasis control strategies: A critical evaluation of IDRC-supported research

Proceedings of a workshop held in Mérida, Mexico, November 25–29, 1991, sponsored by the International Development Research Centre, in collaboration with the Universidad Autónoma de Yucatán (UADY) and the Universidad Peruana Cayetano Heredia (UPCH)

Edited by
Pandu Wijeyaratne, Tracey Goodman and Carlos Espinal
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Three Research Perspectives on Transmission Related Risk Factors for Cutaneous Leishmaniasis in Costa Rica

I. New Strategy for the Control of Cutaneous Leishmaniasis: The Case of Acosta, Costa Rica

J.C. Rojas

Introduction

In a previous study in Acosta on cutaneous leishmaniasis, we estimated the odds ratio (OR) for several variables (1). Due to a previous lack of knowledge in intra and peridomiciliary risk factors, that pilot study shed light onto some of the variables that could be associated with the transmission of the disease. At the same time, it initiated a larger study which is presently being carried out. Among the objectives of this new study are: 1) to validate the findings of the pilot study; 2) to explore new potential risk factors for disease transmission; and 3) to acquire the knowledge to develop a specific strategy for the control of the transmission of cutaneous leishmaniasis.

For such control several measures have been taken around the world. These vary according to the ecological characteristics of the disease (vectors, reservoirs and the environment where transmission takes place). Examples of these control measures include: leishmanization, vaccination, deforestation, use of residual insecticides, host protection, etc. Some of these have been successful only in certain areas, others have been only partially effective and others have not been effective at all. In none of these experiences was the impact of the measure or intervention, estimated before it was implemented. This means that there was no previous knowledge of their impact in reducing the incidence of the disease.

The population attributable risk percent (PAR%) estimates the proportion of disease that is reduced in the population when a variable or factor is controlled. In other words, it is the proportion of cases in the target population attributable to exposure to a given variable.

In a multifactorial disease such as cutaneous leishmaniasis, factors related to the host, the vector, the reservoirs and the environment in general, play an important role in the transmission dynamics of the disease. Therefore, it is very important that the investigator and especially the health authorities know which factors are involved in

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transmission and what proportion each of them contributes. This is basic knowledge that should be known before designing control measures. Once we have this information (PAR%), it is necessary to consider the economical and practical feasibility of implementing the measure. At the same time, we also have to consider the acceptance of the intervention by the community in question; is the measure consistent with their culture, beliefs and values? These are questions to be asked before initiating any intervention.

In this preliminary report, I will show the use of the PAR% as a tool for planning control in a directed and intelligent approach.

Materials and Methods

The population under study is the county of Acosta, the characteristics of which have been described previously (1). The data comes from an on-going study that started in 1989 and is planned to end in 1992. The sample size used in this interim analysis consists of 105 houses, with 29 cases and 76 controls.

The study design is a population case-control, with the house as the unit of interest. To be considered a house-case, a house should have a child with a recent lesion (< 6 months) of cutaneous leishmaniasis diagnosed by our personnel. This child should be <10 years of age and with a positive Montenegro skin test. To be considered a house-control, a house should have a child in the same age range (± 2 years) without a history of disease and with a negative Montenegro skin test. Also the house-control should be within a radius of ± 100 meters from the house-case.

We are working only with incident cases; this has several advantages related to control of biases, that we would not have if working with prevalent cases. Other characteristics of the design and advantages have been previously described elsewhere (2).

The odds ratio (OR) was first estimated by constructing 2x2 tables, then a logistic regression model was constructed to simultaneously control for potential confounders. From the estimated beta coefficient of the logistic model, the OR and its 95% confidence interval (95% CI) and the PAR% were calculated.

In order to estimate the population attributable risk percent or etiological fraction we need to know: a) the prevalence of the variable of interest in the population under study; b) the estimated OR in a case-control study or the relative risk (RR) in a prospective cohort study, for the variables of interest.
The formula for its calculation is:

$$\text{PAR\%} = \frac{\text{Pe} \times (\text{OR} - 1)}{\text{Pe} (\text{OR} - 1) + 1} \times 100$$

Where: Pe is the proportion of the population exposed to risk. OR is the odds ratio (OR) estimated for that factor.

Results

After the interim analysis of 29 house-cases and 76 house-controls, several variables were found to be associated with the intra and/or peridomiciliary transmission of cutaneous leishmaniasis in the area of study. Only 6 variables were included in the model based on previous knowledge of: 1) place where domestic garbage is discarded; 2) animals that sleep underneath the house; 3) pigs around the house; 4) high number of members per house; 5) use of latrine; and 6) presence of hen-houses.

Table 1 shows the OR's with their 95% CI and its PAR% for the variables. Houses where garbage was not discarded in an appropriate hole were 2.6 times (95% CI=1.2-4.1) more likely to be case-houses than houses where garbage was discarded adequately. The PAR% of this variable was 57%, the highest obtained, meaning that if the population under study discarded the garbage in an appropriate hole, the incidence of the disease would be reduced by 57%. The houses that were built on stilts and had domestic animals that slept at night in the space between the floor of the house and the dirt, were 3.6 times (95% CI=2.1-5.0) more likely to be case-houses than houses that did not have animals in this space. The PAR% for this variable was 50%, meaning that if the animals were removed from this space, the incidence of disease would be reduced by the 50%.

The variables, presence of pigs around the house during the day and high number of members per house (>5), presented an OR of 2.9 and 2.2, respectively. Both variables presented a PAR% of 49%. Those houses that had a latrine were 2.0 times (95% CI= 0.6-3.5) more likely to be case-houses than those that did not have a latrine; its PAR% was 46%. The last variable, hen-houses, had an OR of 0.7, meaning that it had a protective effect. This means that the houses that had hen-houses around had a 30% reduction in the incidence rate of disease compared with the houses that did not. Also, this variable had a wide confidence interval that included the null value, (95% CI=0.3-2.4) with a PAR% of 19%.

Discussion

In this interim analysis, variables that were not in the pilot study were included. Among these were: garbage disposal, animals that sleep under the house at night, pigs around the house during the day, and location of the latrine.
In the pilot study the variables, number of members (OR=6.6 95% CI=1.1-70.3), houses with stilts (OR=3.0 95% CI=0.6-13.6), animals inside the house (OR=8 95% CI=1.2-53.4) and hen-houses (OR=0.2 95% CI=0.01-0.9) were found to be associated with the house being a case. In this interim analysis, those variables were also found associated with transmission of cutaneous leishmaniasis. This analysis considers only animals that sleep at night in the space of the stilts but not houses with stilts alone or domestic animals inside the house.

Odds Ratios (OR) in Multivariate Logistic Regression and Population Attributable Risk Percent (PAR%) for Variables Associated with the Transmission of Cutaneous Leishmaniasis in Acosta, San José, Costa Rica, 1991

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>OR (95%CI)</th>
<th>% EXPOSED INDIVIDUALS</th>
<th>PAR %</th>
</tr>
</thead>
<tbody>
<tr>
<td>GARBAGE DISPOSAL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OTHER VS HOLE</td>
<td>2.6 (1.2-4.1)</td>
<td>84</td>
<td>57</td>
</tr>
<tr>
<td>ANIMALS UNDER HOUSE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YES VS NO</td>
<td>3.6 (2.1-5.0)</td>
<td>39</td>
<td>50</td>
</tr>
<tr>
<td>PIGS AROUND HOUSE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YES VS NO</td>
<td>2.9 (1.9-4.0)</td>
<td>50</td>
<td>49</td>
</tr>
<tr>
<td>MEMBERS PER HOUSE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIGH VS LOW</td>
<td>2.2 (1.0-3.4)</td>
<td>79</td>
<td>49</td>
</tr>
<tr>
<td>LATRINE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YES VS NO</td>
<td>2.0 (0.6-3.5)</td>
<td>85</td>
<td>46</td>
</tr>
<tr>
<td>HEN-HOUSES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YES VS NO</td>
<td>0.7 (0.3-2.4)</td>
<td>58</td>
<td>19</td>
</tr>
</tbody>
</table>
We have to consider that in the pilot study, the analysis was bivariate, controlling only by number of members, that were found to be confounder. In this analysis the logistic procedure was used to control for several confounders simultaneously. This means that we were able to control for the effects of the other variables, so that we were able to obtain the effect of only one variable at the time.

Among the new variables, we observed that the manner of garbage disposal was associated with a house being a case. Those houses that discarded the garbage in places other than a hole presented a risk of having a child with the disease 2.6 times greater than those where the garbage was discarded in a hole. Garbage disposal had been reported as associated with the transmission of leishmaniasis (3), but had not been quantified.

Domestic animals that sleep under the house at night and pigs around the house during the day, could act as bait for sandflies, increasing the risk for children having contact with sandflies. In the pilot study we reported only the presence of this space as a risk factor. Here we are adding some information to the variable, and for further analysis we will determine if there is a particular animal species that is more important.

A high number of members per house is associated with the status of a house-case. We have reported that this variable could act only by increasing the contact rate between the host and the vector, so that the more members per house the more likely one of them would become a case (1).

The effect of the variable, use of latrine, is related to the fact that this place is a preferred resting site for sandflies (4); hence, persons using such a facility are more exposed to contact with the vector.

Hen-houses presented an adjusted OR of 0.7, (95% CI=0.3-2.4). As we discussed in relation to the pilot study, this variable was found to be protective against the transmission of cutaneous leishmaniasis. Even though in this analysis its 95% CI includes the null value, the fact the in the pilot study it was significant (OR=0.2, 95% CI=0.01-0.9) makes this variable a good candidate for intervention, with a PAR% of 19%. It is important to mention that these estimates could change once more variables are added to the logistic model. This is why this analysis should be considered as preliminary.

The prevalence of exposure variables among the population in the study directly affects the estimation of the PAR%. For example, the variable garbage disposal had a smaller OR (OR=2.6) than animals that sleep at night under the house (OR=3.6), but 84% of the houses in the population under study do not discard garbage into a hole. Therefore, when trying to implement a control measure, we have to consider not only the OR or relative risk, but also the prevalence of the exposure in the population under study. To do this the PAR% is calculated, even though the advantage of using the PAR% is seldom recognized in public health. Recently the WHO has been making an effort to implement the use of this measure in studies on malaria.
Because a logistic model assumes a multiplicative relation between the variables included in the regression equation, adjusted PAR% for individual factors will not add to the overall PAR% for all the factors considered jointly (5). The sum of the adjusted PAR% for individual factors may exceed 100% and as a result, the risk estimates may be difficult to interpret.

Recently new techniques have been developed to overcome this problem (5,6) and will be used in our subsequent analysis. Nevertheless, this interim analysis illustrates how calculation of the PAR% can be of great help when implementing control measures.

When researchers and public health officials know the PAR% of exposures for the disease of interest, in this case leishmaniasis, the strategy for controlling the disease can be implemented with a known probability of success, i.e., what percent the incidence of disease will be reduced.

However, public health officials should also know what will be the acceptance of the control measures by the community, as well as their economical feasibility and sustainability. That is why the participation of the community is essential in all stages of the investigation, so that when control measures are to implemented, the community already knows why and we will also know if they will accepted. In this area the participation of the social sciences is very important. Ideally we have to stratify the potential control measures based on the PAR%, acceptance by the community, economic feasibility and sustainability.

In a multifactorial disease such as leishmaniasis the identification and quantification of its risk factors is essential for integrated control. That is why research on leishmaniasis should include all the components of the transmission chain: host, vector, reservoir and environment. Even more important is the quality of the data; if this is poor, the conclusions will be poor and results will not be replicable.

This research is being supported by IDRC (International Development Research Center), Ottawa, Canada.

REFERENCES


II. Phlebotominae Sandflies (Diptera: Psychodidae: phlebotominae) Associated with Human Houses in an Endemic Area for Cutaneous Leishmaniasis in Costa Rica

M.V. Herrero2, J.C. Rojas3, A.E. Jiménez4, and R. Zeledón1, R. Pereira1 and H. Gutiérrez1

Introduction

The first step to plan and execute vector control of any disease is the proper identification of target species (Metcalf, 1982); however, in tropical America this is not an easy task in most endemic areas due to high diversity of phlebotominae sandflies and to the difficulties involved in parasite detection.

In Costa Rica, cutaneous leishmaniasis caused by Leishmania panamensis has been studied since 1946 (Peña et al. 1946). It had been possible to isolate the parasite from Lutzomyia ylephiletor and Lutzomyia trapidoi (Zeledón and Alfaro 1973; Zeledón et al. 1977); however, there had been found 18 species able to be attracted to and feed on the human host which could be involved in the transmission cycle of leishmaniasis (Zeledón et al. 1985).

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There had been collected, inside human houses where there were infected patients, the following phlebotominae species in Ceiba Este (Acosta, San José, Costa Rica) an endemic area for cutaneous leishmaniasis: Lutzomyia youngi, Lutzomyia ylephiletor, Lutzomyia shannoni, Lutzomyia sanguinaria, Lutzomyia cruciata, Lutzomyia gomezi, Lutzomyia trapidoi, Lutzomyia panamensis, Lutzomyia goniculata, Lutzomyia gorbitzi and Lutzomyia sordelli (Murillo y Zeledón 1985). Based on this type of information we hypothesized that in Costa Rica cutaneous leishmaniasis transmission could be domiciliary (Zeledón et al. 1982) and some house characteristics have been found associated with transmission of disease (Rojas et al. 1988; Rojas, 1991) then further studies are needed to associate particular species with the human housing system in endemic areas.

The objective of this paper is to report on phlebotominae species associated to human houses in an endemic area for cutaneous leishmaniasis and to provide entomological information for a broader epidemiological study of risk factors associated with disease transmission.

Materials and Methods

Description of the study areas: This study is being conducted in Acosta (county # 12, San José, Costa Rica) which is an agricultural area sited in the folds of Bustamante mountainous chain and planted with coffee, citric and ornamental plants.

Eight localities where cutaneous leishmaniasis is endemic were selected to conduct entomological monthly surveys, they were:

1. Breñón (Code: 525; altitude: 740 m; latitude: 9° 44' N; longitude: 84° 16' W)
2. Agua Blanca (Code: 114; altitude: 900 m; latitude: 9° 49' N; longitude: 84° 11"W)
3. Linda Vista (Code: 416, altitude: 927 m; latitude: 9° 45'N; longitude: 84° 13' W)
4. Hondonada (Code: 212; altitude: 980 m; latitude: 9° 48' N; longitude: 84° 13' W)
5. Chirraca (Code: 103; altitude: 1000 m; latitude 9° 49' N; longitude: 84° 10' W)
6. Ceiba Este (Code: 404; altitude: 1060 m; latitude: 9° 45' N; 84° 10' W)
7. Sabanas (Code: 525; altitude: 1100 m; latitude: 9° 44' N; longitude: 84° 16' W)
8. Ococa (Code: 202; altitude: 1100 m; 9° 48'N; longitude: 84° 12' W)

In this study the human house has been identified as our sampling unit and each house has been divided in domiciliary and peridomiciliary areas; peridomiciliary area usually includes animal installations, latrines and a small garden with vegetation.
Sampling methods: Selection of houses (location, number and type) within each locality was made based on epidemiological criteria previously discussed (Rojas and Zeledón, 1990). The entomological survey in each house was organized considering the following:

a) period: diurnal or nocturnal.
b) type: active search in resting areas during diurnal hours and passive using CDC light traps during nocturnal hours.
c) frequency: once a month (one day) for each locality during the study period (since January, 1990 to September, 1991).
d) traps location: one inside each house and one outside in peridomestic iary areas; traps were located 1 m height.
f) number of traps: 2 per house, however we put only one where people do not allow us to locate one inside. Sand flies collected were properly labeled and transported to the laboratory.

Laboratory analysis: In the laboratory, all specimens were counted, sexed and identified based on genital and cibarial structures using as a guide the papers by Murillo and Zeledón, 1985 (Murillo and Zeledón, 1985) and the original description of each species referenced in the above paper.

Each species has been identified with a code as follow:
(03) Warileya hertigi; (04) Warileya rotundipennis; (05) Lutzomyia cruciata; (06) Lutzomyia gomezi; (08) Lutzomyia longipalpis; (10) Lutzomyia rosabali; (15) Lutzomyia reburra; (18) Lutzomyia ylephiletor; (22) Lutzomyia carrerai thula; (27) Lutzomyia odax; (29) Lutzomyia youngi; (30) Lutzomyia serrana; (31) Lutzomyia ovallesi; (34) Lutzomyia vespertilionis; (35) Lutzomyia viriosa; (38) Lutzomyia zeledoni; (41) Lutzomyia shannoni; (45) Lutzomyia hartmanni; (46) Lutzomyia sanguinaria; (49) Lutzomyia barrettoi majuscula; (51) Lutzomyia runoides; (52) Lutzomyia atroclavata; (56) Lutzomyia pia; (57) Lutzomyia trinidadensis; (59) Lutzomyia gorbitzi and (62) Lutzomyia bispinosa. The occurrence of Lu. bispinosa in Costa Rica has been recently reported (Herrero and Jiménez 1991).

Females were divided in three groups:

1. engorged females with fresh blood were stored at -20 °C for future blood meal identification.
2. a representative part of each sample were dissected and cultured to isolate the etiological agent.
3. the rest of the material collected was mounted in Hoyer medium and maintained as a reference collection in the Entomology laboratory.
The condition of the female regarding gravid or empty; with or without blood in the abdomen and the blood status (fresh or not) was recorded by direct observation using an stereoscope. Most of the data collected will not be presented in this paper and will be the objective of future communications.

Results

Phlebotominae abundance: Table 1 shows a summary of overall collection data obtained sampling from houses in the localities under study; tree buttresses were, also, sampled but these data are not used for this analysis.

As shown in Table 1 a greater number of sandflies were captured during nocturnal hours than in diurnal hours what is expected due to phlebotomine habits and is explained by differences on collection methods. The relationship between female abundance, inside and outside, is different among the eight communities being the number of sandflies collected inside houses greater than those collected outside in (202) Ococa (88/54), (404) Ceiba Este (88/40) and (416) Linda Vista (165/52). It is, also, obvious that in localities (103) Chirraca and (114) Agua Blanca a smaller number of phlebotomine sandflies was collected which may be related to house structure or to the fact that they are more urban areas.

Geographical and spatial distribution: Two aspects of spatial distribution of phlebotomines are considered 1. geographical (among localities within the region) and 2. habitational (assuming the house as the habitat unit, it is the distribution within the house). In this part of the paper we assume that geographical coincidence between a disease and its vector could be used as a clue to indicate potential vectors; we also indicate that these potential vectors may be found inside human houses as well as outside.

Table 2 shows the species collected inside human houses; it is noted that most of them have been previously reported as anthropophilic in Costa Rica (Zeledón et al. 1985).

It is clear that all the species collected have been found at least once inside human houses; it is shown in Table 2 that Lu. cruciata (O = 7/8), Lu. gomezi (O = 7/8), Lu. vlephiletor (O = 7/8) and Lu. serrana (O = 8/8) are the most commonly distributed species found inside houses. Lu. shannoni (O = 6/8); Lu. youngi (O = 5/8) and Lu. pia (O = 5/8) were not present inside houses in all localities but they are among the most commonly found species outside.
TABLE 1: Abundance of phlebotominae sandflies collected in human houses by locality, period and collection site

<table>
<thead>
<tr>
<th>Locality</th>
<th>n*</th>
<th>Period&lt;sup&gt;(1)&lt;/sup&gt;</th>
<th>Indoors M</th>
<th>Indoors F</th>
<th>Outdoors M</th>
<th>Outdoors F</th>
<th>Overall M</th>
<th>Overall F</th>
</tr>
</thead>
<tbody>
<tr>
<td>103</td>
<td>6</td>
<td>D</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>1</td>
<td>4</td>
<td>27</td>
<td>74</td>
<td>28</td>
<td>78</td>
</tr>
<tr>
<td>114</td>
<td>3</td>
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<td>0</td>
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<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>4</td>
<td>2</td>
<td>28</td>
<td>23</td>
<td>32</td>
<td>25</td>
</tr>
<tr>
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<td>D</td>
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<td>0</td>
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<td>D</td>
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<td>194</td>
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<td>274</td>
</tr>
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<td>1</td>
<td>0</td>
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<td>88</td>
<td>27</td>
<td>40</td>
<td>58</td>
<td>128</td>
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<td>416</td>
<td>4</td>
<td>D</td>
<td>2</td>
<td>7</td>
<td>68</td>
<td>65</td>
<td>70</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>275</td>
<td>165</td>
<td>68</td>
<td>52</td>
<td>243</td>
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</tr>
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<td>513</td>
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<td>D</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>7</td>
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<td>28</td>
<td>21</td>
<td>36</td>
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<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>58</td>
<td>39</td>
<td>33</td>
<td>85</td>
<td>91</td>
<td>124</td>
</tr>
</tbody>
</table>

Total (n): 933 1155

* n: refers to the number of houses per locality; <sup>(1)</sup> period: D diurnal and N nocturnal.
**TABLE 2:** Phlebotominae sandflies species collected inside human houses in an endemic area for cutaneous leishmaniasis in Costa Rica.

<table>
<thead>
<tr>
<th>Species/Locality</th>
<th>103</th>
<th>114</th>
<th>202</th>
<th>212</th>
<th>404</th>
<th>416</th>
<th>513</th>
<th>525</th>
<th>0*</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>W. rotundipennis</em>*</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>5/8</td>
</tr>
<tr>
<td><em>W. herigi</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1/8</td>
</tr>
<tr>
<td><em>Lu. cruciata</em>*</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>7/8</td>
</tr>
<tr>
<td><em>Lu. gomezi</em>*</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>7/8</td>
</tr>
<tr>
<td><em>Lu. trinidadensis</em></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5/8</td>
</tr>
<tr>
<td><em>Lu. sanguinaria</em>*</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4/8</td>
</tr>
<tr>
<td><em>Lu. shannoni</em>*</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>6/8</td>
</tr>
<tr>
<td><em>Lu. youngi</em>*</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>C</td>
<td></td>
<td></td>
<td></td>
<td>5/8</td>
</tr>
<tr>
<td><em>Lu. ylephiletor</em>*</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>7/8</td>
</tr>
<tr>
<td><em>Lu. serrana</em>*</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>8/8</td>
</tr>
<tr>
<td><em>Lu. longipalpis</em>*</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4/8</td>
</tr>
<tr>
<td><em>Lu. ovallesi</em>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3/8</td>
</tr>
<tr>
<td><em>Lu. pia</em>*</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>5/8</td>
</tr>
<tr>
<td><em>Lu. zeledoni</em></td>
<td>X</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4/8</td>
</tr>
<tr>
<td><em>Lu. runoides</em></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1/8</td>
</tr>
<tr>
<td><em>Lu. rosabai</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2/8</td>
</tr>
<tr>
<td><em>Lu. gorbitzi</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1/8</td>
</tr>
<tr>
<td><em>Lu. atroclavata</em></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3/8</td>
</tr>
<tr>
<td><em>Lu. bispinosa</em>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2/8</td>
</tr>
<tr>
<td><em>Lu. odax</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1/8</td>
</tr>
<tr>
<td><em>Lu. vespertilionis</em></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>2/8</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Number of Species</th>
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<th>5</th>
<th>8</th>
<th>12</th>
<th>11</th>
<th>16</th>
<th>13</th>
<th>15</th>
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<tr>
<td>Anthropophilic sps**</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>9</td>
<td>9</td>
<td>11</td>
<td>8</td>
<td>12</td>
</tr>
</tbody>
</table>

*Occurrence: Defined as the number of localities in which a species occurred divided by the total number of localities. ** Based on Zeledón et al. 1985.

Table 3 shows the species of sandflies collected in the peridomiciliary area; it is obvious that a greater number of species is collected outside than inside human houses. As shown in this table, *Lu. cruciata* (8/8), *Lu. gomezi* (8/8), *Lu. shannoni* (8/8), *Lu. youngi* (7/8), *Lu. ylephiletor* (8/8), *Lu. serrana* (8/8) and *Lu. pia* (7/8) are the most commonly distributed species outside houses.

Murillo and Zeledón collected phlebotominae sandflies mostly in Cangrejal (Tiquires, Naranjal, Ceiba Oeste, Gravilias, Mesa, Ceiba Este, Escuadra), San Ignacio (Chirraca, San Luis), Guatil (Ococa, Cruz) and Sabanillas (Uruca, Sabanás)(Murillo and Zeledón, 1985). We have collected specimens in three of these localities: Ceiba Este, Chirraca and Ococa. There were significant differences on species composition between their findings and ours on locality (404) Ceiba Este; however, these differences may be explained because they do not restrict themselves to the house as sampling unit.
TABLE 3: Phlebotominae sandflies species collected in peridomicial areas of human houses in an endemic area for cutaneous leishmaniasis in Costa Rica.

![Table with species distribution](attachment:image.png)

*Occurrence*: Defined as the number of localities in which a species occurred divided by the total number of localities. **Base on Zeledón et al. 1985.

Occurrence data show how spread is the geographical distribution of a particular species; from the data it is possible to observe highly distributed species such as *Lu. serrana*, *Lu. ylephiletor*, *Lu. cruciata*, *Lu. gomezi*, *Lu. shannoni*, *Lu. youngi* and *Lu. pia* and poorly distributed species such as *Lu. hartmanni*, *Lu. gorbitzi*, *Lu. barrettoi* majuscula and *War. hertigi.*

**Inside/Outside Capture ratio**: The house should be a physical barrier between the domiciliary and the peridomestic environment; it is a common control method to screen windows and doors to improve the quality of houses and avoid arthropod infestation. For the purpose of this analysis we assume that the occurrence of one infected individual of phlebotominae vector is enough to transmit disease and then the occurrence of a species is recorded when at least one individual is captured.
We defined I/O Ratio as the ratio between the number of species captured inside by the number of species captured outside; I/O Ratio antropophil. is the I/O ratio corrected using only known anthropophilic species and I = O when the number of species captured inside and outside houses is the same. It is clear that I = O give a I/O ratio = 1. This parameters will be used to indicate the utility of house characteristics to avoid arthropod infestation.

As shown in Figure 1 there is a greater number of species collected inside houses in localities 416 and 525; this difference approach 1 when the I/O ratio (defined as the ratio between the number of species collected inside and those collected outside) is referred only to species previously reported in the literature as anthropophilic. It is interesting to observe that, for locality 416, the abundance of phlebotomines inside houses (165) is three times greater than the abundance outside (52) which also could be related with house characteristics.

These type of data will be more meaningful when we compare between houses using the case-control design as previously used (Rojas et al. 1988; Rojas 1991).

Female reproductive status: It is necessary to record the reproductive status of specimens collected to suggest a relationship between phlebotominae life cycle and human houses. Most phlebotominae sandflies are anautogenous and a blood meal is necessary to complete each gonotrophic cycle and, also, to become infected and transmit leishmaniasis. Phlebotomines do not flight too far after a blood meal, a blood meal is necessary to produce eggs and gravid females can be easily differentiated. A survivorship index has been developed for vector populations based on this type of information from resting populations (Colless, 1958); better methods have been used with phlebotominae sandflies to grade by age group and parity but these methods have been standardized in a reduced number of species (Magnarelli et al. 1984).

We found fed and gravid females in collections made from each locality studied (Fig 2); it was interesting to observe that the greater number of gravid females was collected in (416) Linda Vista and the smaller in (114) Agua Blanca. However, the greater number of empty females was captured in (212) Hondonada.

In Figure 3 we show the distribution of not empty females by species; it is clear that the species that show the greater number of gravid females, Lu. serrana (30), Lu. longipalpis (08), Lu. ylephiletor (18), Lu. gomezi (06), Lu. shannoni (41), Lu. youngi (29), Lu. cruciata (05) and Lu. sanguinaria (46) are known to feed on humans. A higher proportion of Lu. serrana, Lu. longipalpis, Lu. ylephiletor and Lu. gomezi than to any of the other species was found gravid inside houses.
Fig 1: Phlebotominae species, inside/outside capture ratio, in eight localities of an endemic area for cutaneous leishmaniasis in Costa Rica (see materials and methods for locality codes).
Fig 2: Physiological status of female phlebotomines collected from houses in an endemic area for cutaneous leishmaniasis in Costa Rica (by locality; see materials and methods for locality codes).
Fig 3: Physiological status of female phlebotominae collected from houses in an endemic area for cutaneous leishmaniasis in Costa Rica (by species; see materials and methods for species codes).
Discussion

Phlebotominae sandflies have been identified as vectors of leishmaniasis in many areas of tropical America. Originally associated with forested and selvatic areas, they have adapted themselves to a man made environment such as coffee plantations and cultivated areas in Acosta where primary forested areas have been destroyed.

The human house in this situation may represent shelter and food to the flies; it is normally provided with humid - shadowed areas and associated with domesticated animals such as pigs, chickens, dogs, cattle which may be used as alternative hosts (Rojas et al. 1988; Rojas 1991). Phlebotomines are not specific on their selection of host and human exposure may be a factor on disease transmission; it has been shown in this paper that in some areas the house do not represent a physical barrier for phlebotomines and even it is possible to obtain a 1:1 relationship between anthropophilic species collected inside and outside houses.

Other aspects besides phlebotominae abundance, species composition, spatial distribution, I/O ratio, female reproductive status are being studied; these are blood meal source, seasonality and resting places dynamics.

In this paper, we have cited a number of species collected on human houses and we have indicated a possible relationship between houses and phlebotomine life cycle. Further information is being produced as part of an epidemiological study on "Risk Factors associated to cutaneous leishmaniasis in Costa Rica" and will be presented on future communications analyzed dividing houses in cases and controls to evaluate differences.

Transmission of cutaneous leishmaniasis is a multifactorial problem; risk factors associated with disease should be identified using epidemiological quantitative tools. Once these factors are known we will conduct field experiments to demonstrate that our recommendations are useful to decrease the incidence of this disease.

Acknowledgments: We are grateful to the communities in which we conducted this study. We also appreciate the help of Carlos Rivera and Pedro Morales during field collection periods. Dr. Marco V. Herrero is member a fellow member of the National Council for Science and Technology (CONICIT) of Costa Rica. This research is being supported by IDRC (International Development Research Center), Ottawa, Canada.

REFERENCES


III. Anthropological Input for Epidemiological Research on Cutaneous Leishmaniasis Risk Factors

A. Dobles-Ulloa* and J.C. Rojas

Introduction

The objective of this paper is to discuss some of the several ways in which anthropological, qualitative observational input and derived insights are already contributing to sharpen epidemiologic risk factors analysis. This contribution takes mainly the form of a methodological control on the deductive passage from epidemiologic hypothesis to observations; methodological control on the inductive passage from data to empirical summaries is also important.

Child Behaviour Study

An important set of risk factors for cutaneous leishmaniasis, as defined by previous epidemiological work, can be said to be behavioral in nature (Rojas et al., 1988; Rojas 1991). Children aged nine and under constitute an especially prone group in the particular context of Acosta county, where there is a strong suspicion that transmission is occurring domiciliary or peridomiciliary (Rojas et al. 1988).

Thus, the behaviour of this age group has been closely observed, providing a very first recording of this kind of information currently under analysis. Documenting child behaviour patterns in the predetermined setting (houses and their environs) is expected to help identify the role of these behaviours in increasing or decreasing the risk of becoming infected with leishmaniasis.

For this observation, anthropological techniques were used in building up appropriate recording instruments. First, the project's field assistants performed a considerable number of "candid" observations of children with which they were already familiar (so that their activity would be less affected). The only instruction given was to record on a notebook everything that happened to the child in periods of 40 minutes to three hours.

These written records, qualitative in the highest degree, were later analyzed in order to quantify and establish the hierarchy of their referents, actions and modifiers. The sorted listing, still very long, was discussed with the epidemiologist bearing in mind the objectives proposed and the provisionally defined risk factors, until a manageable set of variables was deduced.

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The variables so constructed were put on the columns of a spreadsheet; first row is used to note the time at the beginning of the observation and the codes for the initial status of each variable. Each time that one of these changed, a new row was used to note the time and new variable status.

In practice, this is a very easy and accurate procedure, allowing analysis based on sorting and grouping variables as well as on summing the total time spent at each status during the observation period. Later a comparison will be made between cases and controls.

Child behaviour observation was made by previously trained project personnel on one child per house, using a random subsample of 27 houses comprising both cases and controls. This was done twice a day, at supposed peaks of vector’s biting activity (three hours early in the morning, starting at dawn; three hours late in the afternoon, finishing just after dusk), on three alternate days.

The whole procedure was performed twice in the rainy season and once in the dry season, because some variation in children activities is anticipated due to weather and school work (dry season roughly corresponds to school holidays).

A different recording form was designed to be used by the mothers of these same children. Each variable was assigned a different sheet, and within one sheet categories were illustrated by simple drawings in a row; columns stand for rough time periods of half an hour. Mothers are expected to mark the cross-space if they actually observe their child in the situation described by the drawing, and leave it blank if they do not. This observation was performed on the same days as project field assistants plus on the alternate days.

This procedure turned out to be easily followed even by illiterate women, though this situation could be different in other cultural settings, where close attention should be payed to the vocabulary and grammatical structures of the instructions. Simple as they are, drawings should be discussed beforehand with local people and modified accordingly, as was done in Acosta.

Both types of observation were not thought to be comparable, because of the differences in observer, instrument, scale and time intervals. Nevertheless, observation by mothers has shown to be a better input source than thought previously. Independent of it information value, the procedure has been a highly valuable and recommendable one in order to involve community participation and interest in the project.

Unexpected insight arose as mothers recurrently made the "mistake" of marking at the same time in two rows that had been thought to be incompatible: "My child is inside the house" and "My child is on the cleared space around the house", and also "My child is inside the house" and "My child is under the house" (a large number of houses being built on stilts).
These apparent contradictions were discussed with the mothers, leading to the realization that the two spaces mentioned are clearly regarded by them as extensions or even as parts of the house itself, as far as child activities are involved. This concept changed depending on the child's sex and age.

Clearly, it appeared that for the purposes of the risk factors study it is important to understand the domestic and peridomestic space as people see and feel it, not only as it is epidemiologically defined. This issue was included among others in a more specifically anthropological exploration of risk factors supported by a TDR small grant through Central University of Venezuela's Social Research Laboratory.

**Cross-Control on Observers' Bias**

An epidemiological survey is being carried on using a comprehensive questionnaire consisting of 65 items, mostly questions to be asked but also observations to be made and measurements to be taken. Again, the anthropologist played an important role in the instrument design, including checking vocabulary and grammar details with local population.

As stated in the original proposal, a cross-control for observers' bias was performed at a relatively early stage of the research for the epidemiologic questionnaire and corresponding field measurement and observation procedures.

The whole survey was repeated on a random subsample of 16 houses, at an average interval of some three months after it had first been done (this was expected to reduce respondent's recall and fatigue biases, but in our experience the period of time was too short for that to matter). Interviewers were interchanged so that each one could act as a control for the other.

Simple comparison of frequencies seemed to indicate some possible problem with the following: instrument's design, coding, instruction sheet, respondent's bias and last but not least, interviewers' bias for which the procedure was primarily intended, as well as the interviewer's training.

This was a quite worrying result, so a critical analysis was readily carried on in order to localize, detail, evaluate and hierarchically sort out the differences which were found. The objective of analysis was to assign each difference to one or more of the causes enumerated above, so that these could be corrected as much as possible.

The largest number of differences affected the following items:
Number 24 (interrogation): "I will repeat you the whole list of animals, in order to be sure none has been skipped and to know how many they are" (question "how many?" is asked each time a category of animals is marked).

Number 52 (observation): "With which material are the windows closed or covered?" (observer is to note how many windows are closed with each category of materials and how many are not closed at all).

Number 58 (observation): "What kinds of plants, trees and crops are there around the house? Note usual names" (observer is to note how many are there of each usual name between each category).

Number 65 (observation): "What distance is there between the house and the facilities built around it?" (observer is to measure and note distance between house and each category of facilities built around it).

As it can be seen, first three items involve counts and the last one involves continuous measurement. It was decided to accept all differences within an average of ±1 standard deviation, and to accept a largest difference in all but two of the sixteen houses (that is 10.5% rounded upwards). Thus corrected, the test was good as much as observer’s bias is concerned. Nevertheless, first results pointed out important features to be taken into account and clarified by closer qualitative observation (also under TDR’s small grant).

The recall question on animals (as possible reservoirs, or as vectors’ attractors) led us to realize that differences in their numbers can indeed be real within a three month period, mainly if a seasonal weather change is also involved. Greater variation was observed in higher reproduction rate animals, dogs and domestic fowl.

The number of domestic fowl was found to be more accurately reported by women. The number of dogs, pigs, milking cows, newborn calves and caged birds did not seem to show a difference (note that all these animals are at least partially peridomestic). Men were found to more accurately report numbers of all other animals, which are generally kept at a greater distance from the house and pertain to masculine tasks.

Potential periodical variations were found to be:

- a decrease in number of domestic fowl due to Holy Week (large family and community celebrations, Roman Catholic traditional ritual interdiction of red meat consumption during this time, drying up of corn supplies for feeding fowl);

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This list recalls the animals that have just been classified in the preceding questions and uses the following categories: i) come or stay around (or under) the house during daytime; ii) come or stay inside the house during daytime (even for short periods); iii) come or sleep around (or under) the house during nighttime and using to sleep inside the house during nighttime (even for short periods).
- a decrease in the number of pigs due to Christmas and New Year (large family and community celebrations, pork meat consumption as a choice dish - mainly in the form of "tamales", which also employ large quantities of corn);

- a variation in the numbers of bovines (milking cows and their newborn calves as it has been indicated, but also oxes for sugarcane grinding, a masculine task performed close to the house).

Differences in window covering materials concerned mostly a special kind of window, described by one of the observers as "Closed with wood" and by the other as "Closed with a material other than the above". For this, the latter is correct, for if in this kind of window the material employed is wood, it generally consists of narrow slabs in the form of a lattice.

There is usually one window of this kind per house (when there is one), placed behind kitchen sink. It is a usual location for women and young age children. The space under it is always humid and bears food rests carried by washing water. Such a water and food source is very attractive for animals.

In connection with this, it has later been observed that clothes washing is usually not performed in this same sink, but near the water source which, incidentally, is regarded by people as the main locale for cutaneous leishmaniasis transmission (a biologically sound folk-assumption, which has not been epidemiologically demonstrated or tested).

With regards to plants, trees and crops around the house, taken into account as selective sugar sources for vectors (Sclein and Yuval 1987), a relatively high variation was expected. It should be noted that practically no rice, beans nor corn crops exist around houses. Analysis of differences within this question has led to further anthropological work on: seasonal variations of blooming and fruit-bearing periods of most extended varieties; cutaneous leishmaniasis folk-treatments attributed to certain plants; the aesthetic and other criteria for the choice and combination of plants within a garden by women; the influence of fashion and novelty phenomena concerning the changing of varieties; and informal observation of gardening behaviour patterns.

A grouping of the most popular plant varieties by their potential as a food source for vectors been proposed and will be carried on jointly by an anthropologist and entomologist.

Finally, analysis of the question concerning facilities built around the house has led to more detailed questioning and observation on the various folk definitions and changing uses made of each facility. A tendency toward separate male and female spaces between and within facilities, as well as inside the house, has been observed and demands more clarification.
Discussion

Two ways in which anthropological data and techniques can be used to assist evaluation of epidemiological data on cutaneous leishmaniasis risk factors have been presented.

Anthropological input into epidemiological research on risk factors for cutaneous leishmaniasis has been shown to be important for designing culturally-sensitive questionnaires, interview instruments and children's behaviour recording instruments, as well as for developing an awareness on how some measurement techniques are not always the most appropriate.

Methodological issues raised by combining the disciplines of epidemiology and anthropology to determine the actual appropriateness of risk factor measurements in the group being studied have been showed to be potentially relevant to the further development of control and prevention initiatives. This is especially true for those risk factors that stem from the behaviour of individuals or from alterable aspects of human domiciliary and peridomiciliary spaces.

Through anthropology greater attention is been given to the interrelationships of risk factors, and to understanding the host-environment interactions in the unique social and cultural group of Acosta peasants. On the other hand, quantitative epidemiological measurements have directed qualitative anthropological research by pointing to patterned relationships between variables that require further in-depth analysis.

The importance of this kind of research collaboration for cutaneous leishmaniasis control and prevention lies in providing data vital to the successful implementation of culturally-appropriate actions or programs. Without significant input from anthropology, in terms of analyzing the context and determinants of individual risk behaviour, epidemiological data alone would seemingly provide only an incomplete basis for the design of sound control and prevention strategies.

Grassroots anthropological insights into the community and its culture have so been shown to enable the evaluation of social inputs in terms of their relative importance as determinants of cutaneous leishmaniasis transmission and later in its control and prevention through measures that can be integrated into the various lifestyles of the community.

The application of anthropological knowledge needs to be directed primarily towards socio-cultural solutions rather than medical interventions. Risk intervention should be redirected to the socio-environmental contexts, which requires political and economic solutions. This paper has clearly stressed that anthropological input can be useful in the continuous monitoring of epidemiological data quality and collecting procedures, which is essential to ensure that the control and prevention measures that are proposed and implemented on the basis of these data will be highly effective.
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