RISK FACTORS ASSESSMENT
FOR T. B. RHODESIENSE SLEEPING SICKNESS
ACQUISITION IN S.E. UGANDA.
A case-control study

by

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Summary – The major risk factors associated with acquisition of T. b. rhodesiense sleeping sickness in the Busoga focus, S.E. Uganda were investigated using a case-control study. 122 cases and 244 matched controls were used in the study. For each case two age-, sex- and residence controls (1 matched nearest neighbour control and 1 village control) were selected. Patients and controls answered the same questionnaire which had been developed and field tested before the field study started. A logistic regression model for a 1:2 matched case control design was fit to the data.

The following factors were found significant: cases spent more time outside their village of residence than controls and visited more SS high risk areas than controls, more cases than controls collected firewood in the forests. Generally, cases had less domestic animals grazing near the places of man-fly contact, especially near water and firewood collecting and bathing points, and near farms and gardens, than controls. Cases had more antecedents of sleeping sickness in the family. Generally cases had a less well developed information network than controls, and belonged economically to a less powerful group. Based on these results we may conclude that the risk to develop T.b. rhodesiense sleeping sickness depends upon a multitude of economical, cultural and human behaviour factors. These factors should be taken into account in the planning and monitoring of sleeping sickness control programmes.

KEYWORDS: Rhodesiense sleeping sickness; Risk factors assessment; Case-control study; Uganda

Introduction

A Rhodesian sleeping sickness (SS) epidemic transmitted by Glossina fuscipes fuscipes tsetse flies has ravaged Busoga region in S.E. Uganda (Fig. 1). The epidemic started in 1976 in the county of Luuka in central Busoga. Till now, more than 40,000 cases were reported (1). A combination of control measures have been put in place to contain the epidemic, and has had a significant impact on the incidence. Sleeping sickness cases reported in the Busoga focus have therefore reduced drastically since mid-1988 and the epidemic appears to be phasing out now in the 3 districts of central
Busoga, but has spread since 1988 into the neighbouring districts of Tororo and Mukono (Fig. 1).

As a result, the number of SS-cases picked up by the Sleeping Sickness Orderlies (SSOs) in central Busoga (i.e. monovalent community-based active medical surveillance workers of the National Sleeping Sickness Control Programme (NSSCP)) has dropped very much (Fig. 3 and 4). The work of the SSOs therefore becomes more difficult. There was therefore a need to understand better the determinants of the disease occurrence, in order to
rationalise control activities and to adapt the surveillance strategy of the SSOs, if necessary. We have carried out a case-control study in order to determine the major risk factors for acquisition of T. b. rhodesiense SS in the Busoga focus in S.E. Uganda. This paper reports the results of this study.

Materials and methods

The study area was briefly described by Okoth (2), while Abaru (3) described the general topographical and environmental conditions of the Busoga region.

Cases: all SS patients residing in Busoga region were eligible for inclusion in the study, except visitors and recent migrants (less than 3 months) to the area. SS cases were defined as individuals from whom trypanosomes were detected through the presently existing surveillance systems in place in S.E. Uganda. The detection was either passive through the existing sleeping sickness diagnosis & treatment centers or active through homevisits by SSOs. All eligible persons were included in the study. The diagnosis was based on direct parasitological methods.

Controls: for each case, two matched controls were selected: there was one nearest neighbour control and a village control. All controls were checked for absence of present SS disease through direct parasitological examination, and for former SS infection through anamnesis. Matching criteria were: age, sex and residence. Cases and controls were matched for age as in Wyatt (4) as follows: Within 12 months for patients aged 0-4 years,
within 5 years for patients aged 5-14 years, within 10 years for patients aged 15-50 years, and of any age above 50 years for patients aged over 50 years. However, even for patients aged above 50 years we tried to match them within 10 years.

The nearest neighbour control was selected by going to the case's home and inquiring about the nearest homestead where a person of the same sex and age as the patient could be found; consequently the interviewer went to the residence of the potential neighbour control, explained the objectives of the subject and asked the permission to interview. If the person was not home, then the interviewer returned later on.

The direction to locate a village control was chosen randomly by writing North, East, South and West on 4 different pieces of paper, folding them up and asking a member of the case's family to choose one piece of paper. The direction written on this paper was followed, and after moving then one mile (1.5 km) from the patient's home, the village control was chosen. Because of the small sizes of the villages in Busoga, some village controls were located in the next village to that of the case. Any chosen control was not replaceable. Those not found at home were revisited and interviewed.

The questionnaire had been developed by the research team and field tested. Interviewers were selected and trained on the administration of the questionnaire before the field study started. The questionnaire had the following variables: age, sex, ethnic group, marital status, residential history, religion, educational standard, occupation activities, mobility to SS endemic areas, exposure to animal reservoir, health behaviour, socio-economic status of the family, and SS control activities. Regular supervision and spot-checks were done to monitor the quality of the data collected by the interviewers. The blood slides of all SS cases and about 20% from the controls were collected and counterchecked at the NSSCP central laboratory at Jinja (Uganda) for trypanosome positivity and negativity respectively. The data was entered in an EPI-INFO database. The point estimation of the relative risk with 2 controls matched to each case, and the interval estimation was done by means of EGRET statistical software. Throughout the analysis the alpha error was maintained at the 0.05 level. A conditional logistic regression model was fit to the data.

Results

122 SS patients, 122 corresponding nearest neighbour controls and 122 village controls were administered the same questionnaire.

The bivariate results of the comparison of patients and matched controls are shown first on Table 1. The following factors were found significantly associated: Cases spent more time outside their village of residence than controls, more cases visited SS endemic area, more cases than controls collected firewood in forests and had antecedents of SS in the family. In general cases had less domestic animals grazing near places of man-fly contact, and especially near water collecting and bathing points, farms and gardens, and near firewood collecting points than the controls.

Generally cases had a less well developed information network than controls, and belonged economically to a less powerful group. Cases reported more antecedents of being bitten by glossina in the forests.
The logistic regression results are shown on table 2. The best fitted model includes 7 factors. The resulting likelihood ratio statistic (7df) = 73.0; p < 0.001. Of the nine factors that were significant in bivariate analysis, 2 had no significant contribution in the conditional logistic regression model: the factor «regularly visiting SS endemic areas» (as it was highly correlated with the factor «regularly leaving the village of residence») and the factor «antecedents of domestic animals grazed near firewood collecting points».

**TABLE 1:**
Significant determinants of *T. b. rhodesiense* sleeping sickness; based on 122 cases, 122 matched nearest neighbours and 122 matched village control (Busoga, 1992).

<table>
<thead>
<tr>
<th>Determinants</th>
<th>OR</th>
<th>95% confidence intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regularly leaving the village of residence</td>
<td>4.8</td>
<td>2.6 ; 8.8</td>
</tr>
<tr>
<td>Regularly visiting SS endemic areas</td>
<td>5.1</td>
<td>2.8 ; 9.1</td>
</tr>
<tr>
<td>Antecedents of SS in the family</td>
<td>2.1</td>
<td>1.3 ; 3.5</td>
</tr>
<tr>
<td>Antecedents of being bitten by glossina flies in the forest</td>
<td>1.9</td>
<td>1.1 ; 3.5</td>
</tr>
<tr>
<td>Antecedents of domestic animals grazed near - firewood collecting points</td>
<td>0.4</td>
<td>0.7 ; 0.2</td>
</tr>
<tr>
<td>- water collecting and bathing points</td>
<td>0.3</td>
<td>0.5 ; 0.1</td>
</tr>
<tr>
<td>- farm and garden</td>
<td>0.2</td>
<td>0.5 ; 0.1</td>
</tr>
<tr>
<td>Ownership of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- radio</td>
<td>0.6</td>
<td>0.9 ; 0.4</td>
</tr>
<tr>
<td>- shop or business</td>
<td>0.7</td>
<td>0.8 ; 0.1</td>
</tr>
</tbody>
</table>

**TABLE 2:**
Results of the conditional logistic regression model fit to the 1 : 2 matched data.

<table>
<thead>
<tr>
<th>Terms</th>
<th>Coefficient</th>
<th>p value</th>
<th>OR</th>
<th>95% confidence intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regularly leaving the village of residence</td>
<td>1.34</td>
<td>&lt; 0.001</td>
<td>3.8</td>
<td>2.0 ; 7.4</td>
</tr>
<tr>
<td>Antecedents of SS in the family</td>
<td>0.71</td>
<td>0.015</td>
<td>2.0</td>
<td>1.1 ; 3.6</td>
</tr>
<tr>
<td>Antecedents of being bitten by glossina flies in the forest</td>
<td>0.88</td>
<td>0.016</td>
<td>2.4</td>
<td>1.2 ; 5.0</td>
</tr>
<tr>
<td>Antecedents of domestic animals grazed near</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- water collecting and bathing points</td>
<td>-1.35</td>
<td>0.006</td>
<td>0.3</td>
<td>0.7 ; 0.1</td>
</tr>
<tr>
<td>- farm and garden</td>
<td>-1.29</td>
<td>0.010</td>
<td>0.3</td>
<td>0.7 ; 0.1</td>
</tr>
<tr>
<td>Ownership of</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* radio</td>
<td>-0.61</td>
<td>0.028</td>
<td>0.5</td>
<td>0.9 ; 0.3</td>
</tr>
<tr>
<td>* shop or business</td>
<td>-1.25</td>
<td>0.054</td>
<td>0.3</td>
<td>1.02 ; 0.08</td>
</tr>
</tbody>
</table>

**Discussion**

This study shows that a multitude of socio-economic, cultural and human behaviour factors, are major risk factors for acquisition of *T. b. rhodesiense* sleeping sickness in the Busoga focus in S.E. Uganda.
Mobility was shown to be a very significant risk factor. This finding is concordant with results by other investigators who demonstrated that people who are more mobile, have a higher risk of becoming infected, as they pass tsetse infested areas more frequently (4, 5). In our study cases visited more frequently SS high risk areas than controls.

Some authors have concluded from studies on peridomestic breeding sites of G. f. fuscipes in the Busoga focus that peridomestic transmission is the most likely cause of the current SS epidemic in Busoga (6). Our results, however, do not confirm that observation: firstly, no significant difference was found in the domestic activities between cases and controls. Secondly, although a bit more cases had Lantana bushes and coffee/banana plantations around their homesteads than controls, the difference was, however, not significant (p = 0.88). These findings imply that peridomestic transmission is less important in the Busoga focus than generally accepted. We would therefore suggest that the importance attached to peridomestic transmission in the current SS epidemic in Busoga as advanced by earlier authors, be critically reviewed.

Enyaru (7,8) found zymodemes from domestic animals (cow, pig) identical to those in man, implicating domestic stock in the transmission of human disease in south-east Uganda (7,8). Our results, however, suggest the role of domestic animals in transmission of human disease to be controversial. Whereas it has been speculated by some authors in West Africa that epidemics of swine fever resulted in the closer contact between tsetse flies and people and increased the risk of transmission of gambiense SS (9,10,11), this study has shown that domestic animals grazing near places of man-fly contact has a protective effect on the acquisition of rhodesiense SS in Busoga. The presence of these animals near places of man-fly contact appears to attract tsetse flies to feed on these animals rather than on man. Indeed, several studies on the hosts of G. f. fuscipes in Busoga have shown that this tsetse species frequently feeds on bovids and pigs from which it gets more than 45% of its bloodmeal (12,13).

In West Africa, several authors have observed familial concentration of SS cases as an important epidemiological property of SS (14,15). This observation has been confirmed in our study as regards to T. b. rhodesiense SS as well. A plausible explanation according to our observation in Busoga, is that this distribution of T. b. rhodesiense cases at family level is a result of the common activities of members of the same family group (work in the same fields, same sources of water and cooking fuel, bathing, travel, etc.), associated with an amplifying factor, the most probable being interrupted feeding of an infected tsetse fly.

Another significant finding of this study is that cases belong economically to a less powerful socio-economical group than the controls. We speculate that people of a lower socio-economic status may be more mobile, looking for means of survival (working in rich people’s gardens and looking after their cattle, etc.); another possible explanation may be that people of a lower socio-economic status have no protective domestic animal screen around them. Thus they may have a more intimate contact with tsetse flies and are therefore more likely to get infected than those of a higher socio-economic status.
The present study has also shown that birth outside the Busoga SS focus does not increase the risk of acquiring SS. This finding is in accordance with the results of similar studies in Zambia (4). Marital status, educational standard and current sources of water are also not shown to increase the risk of acquiring *T. b. rhodesiense* SS in the Busoga focus. Ethnic group and main occupation did not differ between cases and controls. This is mainly due to the fact that in the Busoga SS focus people of all ethnic strata have similar activities and also similar sources of water, despite their marital status and educational standard.

In conclusion, this study suggests that there is need to concentrate SS surveillance on the poor people especially on those individuals whose activities involve a lot of movement, and also on patients’ family groups and those of their neighbours, and in areas reporting SS cases but with having few or no domestic animals.

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Facteurs de risque pour la maladie du sommeil à *T. b. rhodesiense* au S.E. Ouganda.

**Résumé.** — Les facteurs de risques principaux de développer la maladie du sommeil (trypanosomiase à *T. b. rhodesiense*) dans le foyer de Busoga, au sud-est de l’Ouganda, ont été étudiés avec une étude cas-témoins. 122 cas et 244 témoins appariés ont été inclus dans l’étude. Pour l’âge, le sexe et la résidence de chaque cas, un voisin proche et 1 personne du village ont été sélectionnés comme témoins. Les malades et les témoins ont répondu au même questionnaire développé et testé sur le terrain avant le début de l’étude.

Les facteurs suivants se sont révélés significatifs : les cas sont plus longtemps absents de leur village et vont plus souvent dans les zones à risque pour la maladie du sommeil que les témoins, il y a plus de cas qui récoltent du bois en forêt que les témoins. Généralement, les cas ont moins d’animaux domestiques qui paissent près des lieux de contact homme-glossines, spécialement près des points d’eau, de collection du bois et des lieux de baignades, et près des fermes et des jardins, que les témoins. Les cas ont plus d’antécédents de maladie du sommeil dans leur famille que les témoins. Généralement, les cas ont moins bien développé leurs outils d’information que les témoins et font partie d’un groupe économiquement plus faible.

D’après ces résultats, nous pouvons conclure que le risque de développer une trypanosomiase à *T. b. rhodesiense* dépend d’une multitude de facteurs économiques, culturels et comportements humains. Ces facteurs devraient être pris en compte dans la planification et le monitoring des programmes de contrôle de la maladie du sommeil.

Risicofactoren van *T. b. rhodesiense* slaapziekte in Z.O. Uganda.

**Samenvatting.** — De voornaamste risicofactoren van *T. b. rhodesiense* slaapziekte incidentie in Busoga-land, Z.O. Uganda, werden bestudeerd via een case-controle studie. Er werden 122 gevallen en 244 matched controlopes opgenomen in de studie. Voor elk geval werden 2 controlopes geselecteerd en gematched op leeftijd, geslacht en verblijfplaats. Aan gevallen en controlopes werd dezelfde vragenlijst voorgelegd; deze was voorzien zorgvuldig uitgetest. De analyse beoordeeld via EGR : er werd een logistic regression modaal voor 1:2 matched gegevens gemaakt. De volgende factoren werden significant bevonden : verblijf buiten het dorp (geval len verblijven langere tijd buiten het dorp, en bezochten frequenter slaapziekte endemische gebieden, dan controlopes); houden van huisdieren (in vergelijking met controlopes vermelden de gevallen dat minder huisdieren graasden dichtbij plaatsen van contact met tse-tse vliegen, zoals waterputten, plaatsen waar brandhout gekapt wordt, badplaatsen, boerderijen en tuinen); familliale antecedenten van slaapziekte (gevallen hadden meer familliale antecedenten van slaapziekte dan controlopes); informatiebronnen (gevallen hadden minder toegang tot informatie dan controlopes); socio-economisch niveau (gevallen behoorden tot een minder krachtige economische groep dan controlopes).
REFERENCES