Risk-related Activities and Control Problems of Human African Trypanosomosis in Western Equatoria State, South Sudan

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Abstract: Human African trypanosomosis is one of the most important transboundary diseases restricting economic development in sub-Saharan Africa. The present paper outlines human activities culminating in the HAT and highlights some problems related to measures applied to control HAT in Western Equatoria State, South Sudan. Review on relevant data to HAT in Western Equatoria State was comparatively made and analyzed. Graphs were drawn using Microsoft Excel 2007 Software and descriptive statistics done using statview version 5.0.1 for windows. The correlation between different activities and relative risk of the infection was deduced from a regression plot graph. Ibba County revealed the highest prevalence rate of HAT (30.5%) as compared with the lowest rate (3.7%) in Yambio County. Human social activities revealed significant correlation (R^2=0.971). Water collection activity revealed high association with the infection (relative risk = 1.1) compared to the lowest relative risk (0.5) associated with livestock care. This study revealed that human activities might increase the risk of infection with *Trypanosoma brucei gambiense*. The persistence of the disease and infection in the affected areas might be attributed to control-related problems of institutional development and social upheavals.

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1. Introduction

Human African trypanosomosis(HAT) or sleeping sickness, is caused by trypanosomes belonging to *Trypanosoma brucei* species which is transmitted to humans by tsetse flies.

A full description of sleeping-sickness in the Sudan has been given by Buxton (1955) and Bloss (1960). The only form of the disease present is that due to *T. b.gambiense* and this has been confined to a comparatively narrow belt of the country along the southern border of the then Equatoria Province, adjacent to Uganda, the Democratic Republic of Congo (DRC) and the Central African Republic (CAR).

At the present, in South Sudan, tsetse flies occur in the extreme south, along the Nile-Congo watershed, involving the upper parts of the tributaries of the Nile, where both *Glossina palpalis* and *G. morsitans* are prevalent in the absence of cattle. Other tsetse-fly species infest localized areas but they are of less importance. The situation is complicated by the activities of tabanids acting as mechanical vectors of animal trypanosomes in the grazing areas outside the tsetse-fly belt.

At the beginning of the last century, sleeping sickness was perceived by the colonial powers as far the most important public health problem in Africa. Huge epidemics devastated large areas of the continent.

In South Sudan cases of the disease were identified in Raga since 1909, in Yei since 1910, in Kajokeji since 1914, in Nimule since 1915, in Tambura since 1918, and in Yambio since 1924. However, all the aforementioned foci are still active and all epidemic outbreaks in those regions were attributed to the presence of active foci in neighboring countries, particularly those where tribal settlements straddled the borders; widespread distribution of the vectors; and political upheavals, instability and civil disturbance (Duku,1979).

The current resurgence of trypanosomosis is not confined only to Western Equatoria State, South Sudan, but also it occurred in the adjacent areas of the CAR and DRC.

Control of the disease depends mainly on chemotherapy and, to a limited extent, vector control. Treatment regimens using malarsoporol in countries where sleeping sickness is endemic dated back to colonial era. The regimens consisted of administration of three to four series of two to four injections of malarsoporol spaced out at seven to ten day intervals. Malarsoporol is a powerful trypanocide used exclusively for stage II disease because of its toxicity. In recent years, high rates of malarsoporol treatment failure (>20%) have been reported in *T. b. gambiense* endemic areas including the then Sudan (Pepin and Milord 1994; Legros et al., 1999). Such regimens, developed on an empirical basis, have helped control

HAT epidemics but could also be the cause of the growing number of recorded treatment failures.

In Ibba and Maridi Counties, Western Equatoria State, South Sudan, the situation was even more serious since the number of treatment failure reported within a short period were relatively high (Moore et al., 2001).

This study is expected to contribute to the understanding of the role of activities and other institutional-related problems to the resurgence of the disease in South Sudan after the disease had been controlled to a certain level. Based on the findings of this work an integrated intervention to prevent the infection with HAT, could be planned and used by decision-makers in planning for the control and surveillance activities.

The objectives of this study were to:

- Review the role of activities that facilitate the infection with HAT in Western Equatoria State.
- Examine and determine the problems which hampered the control measures, institutional development and capacity building related to the control and eradication of the disease.

2. Material and Methods

2.1 Description of the study area

Western Equatoria is one of the three States in the Equatoria region, South Sudan (Figure 1). It has an area of 79,319 km² and an estimated population of 360,000 (Census, 1983). Its capital is Yambio. The State is divided into Counties. They include: Yambio County , Nzara County, Ibba County , Ezo County, Maridi County, Tambura County , Mundri West County, Mundri East County, Mvolo County and Najero County . It is located between Latitudes $4^{o}40`$-$5^{o}$ N., and Longitudes $30^{o}30`$-$31^{o}45`$ E. It has an equatorial or semi-equatorial climate. The main evergreen trees include: *Ficus religiose, Borassus aethiopum, Ziziphus spina-christi, Tamarindus indica, Khaya senegalensis, Anogeissus leiocarpus* and *Combretum glutinosum.* The soil is of the loamy and loamy-clay types transected by a vast number of streams, rivers and water courses which generally originate from the Nile/ Congo water shed.

2.2 Data Collection

The data used in this study was merely secondary data on the epidemiology of trypanosomosis obtained from the following sources:

1. World Health Organization (WHO) Annual Reports on trypanosomiaisis
2. Scientific Working Group Report on African trypanosomiasis published in 2001.

The data obtained from these sources was extracted, thoroughly analyzed and compared based on their fitness to the subject of this study.

2.3 Statistical Analysis

The correlation between the activities and the relative risk of infection was deduced from a regression plot graph after quantification of the activities. The activities with high frequencies of occurrence were given heavy weight of 10 and the ones with the least occurrence frequency were given the lightest weight of 4. The weights of the activities range between 4 and 10 depending on the frequency of occurrence. All the descriptive statistics were done using statview version 5.0.1 for windows and the graphs were drawn using Microsoft Excel Software for Windows 2007.

3. Result

3.1 General trends of Sleeping sickness cases in Sudan (1990-2004)

In table 1, the mean cases of infection were 1045.40 ±1110.62, the maximum cases of infection were 3,163 individuals in 2002 and the minimum cases were 28 which occurred in 1992 in the whole country. The trend of the cases of infection started to incline from the year 1996 till 1998 then declined in the year 1999 and started to incline again from the year 2000 to 2002 then finally declined to 766 patients in 2004 (Figure 2).

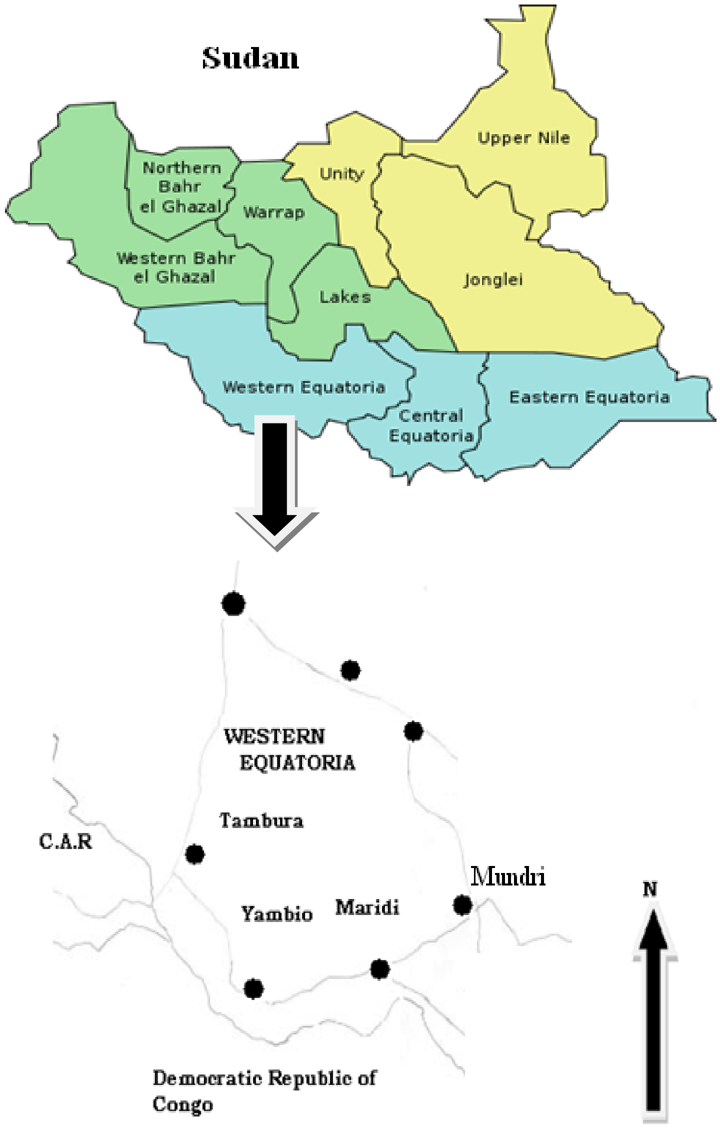

Figure 1. Location of Western Equatoria State in South Sudan

3.2 Sleeping sickness cases in Western Equatoria State (1997-1999)

Table (1) explains the disease cases by areas/ Counties from the year (1997-1999). The highest prevalence rate was 30.5% in Ibba, Ibba County for a sample size of 200 individuals, then Bambuti, CAR (11.1%) for a sample size of 90 individuals, Tambura County (9.3%) for a sample of 35,724 individuals, Kajokeji County (7.4%) for 393, Naisa, DRC (6%) for a sample size of 200 individuals and the lowest one was 3.7% in southern Yambio County for a sample of 2,000 individuals. For Maridi County data was not available.

Table 1. Sleeping sickness cases in Western Equatoria State , CAR and DRC (1997-1999).

Site	Sample size	Infected %
Tambura County	35,724	9.3
southern Yambio County	2,000	3.7
Ibba ,Ibba County	200	30.5
Maridi, Maridi County	N.A	N.A
Kajo Keji, Kajo Keji County	393	7.4
Bambuti, CAR	90	11.1
Naisa, DRC	200	6

NA: information not available

3.3 Activities leading to Infection with the Disease in the Study Area

Table (2) shows the different activities and prevalence rate of trypanosomosis in those practicing the activities. The highest prevalence rate occurred in those involved in water collection with 19.5%, followed by a prevalence rate of 19.4% for those engaged in farming activities; 17.4% for fire wood collectors; 16.4% for market dealers; 15.5% for cassava soakers; 14.3% for hiders in the bush; 11.9% for hunters; 11.8% for fishmongers and finally livestock keepers recorded a prevalence rate of 9.1%.

Table 2. Activities and prevalence rate of trypanosomosis as % seropositive

Activity	% Seropositive
Water collection	19.5
Farming	19.4
Fishing	11.8
Fire wood collection	17.4
Soaking cassava	15.5
Hunting	11.9
Marketing	16.4
Livestock care	9.1
Hiding	14.3

Figure (2) shows a correlation of the different activities with the relative risk which is positively correlated with the different activities (R^2=0.971).

The study showed that activities were associated with the infection with the parasite. It was observed that individuals who collected water from the river(weighted factor=10) had the highest relative risk of 1.1, the higher relative risk of 1.0 was found in those involved in farming(Weighted factor=9); fire wood collectors (Weighted factor=8)had relative risk of 0.8; both the category of those frequented market places(Weighted factor=7) and cassava soakers (Weighted factor=7) shared a relative risk of 0.8; hiders in the bush(Weighted factor=6) had a relative risk of 0.7; hunters (Weighted factor=5)with relative risk of 0.6; fish mongers (Weighted factor=5) and those keeping livestock (Weighted factor=4)had the lowest relative risk of 0.5.

3.4 Control Measures Applied in the Study Area

The study also indicated that measures related to the control of the disease applied in the study area was faced with several problems such as treatment failure, high death rates following administration with malarsoporol, availability of treatment centre in only one site, the Li-Rangu Hospital. Moreover, the distance travelled to the only treatment centre presented a problem which demanded transport means and drugs for treatment .Besides, the limited drugs supply and unpaid staff involved in the treatment program had exacerbated the problem.

3.5 Relative Risk of the Disease as a Function of the Different Activities in the Study Area

Figure (3) shows detection and treatment of trypanosomosis in Western Equatoria State (1997-1999). From the figure 5 it is clear that in Tambura County 58% of all the detected cases of stage 1 was treated whereas 17% and 29% of the detected cases of stage1 treated in Maridi and Yambio Counties, respectively. In stage 2 only 42%, 83% and 71% of the detected cases were treated in Tambura, Maridi and Yambio Counties were treated, respectively. The study also showed that 80% of the total relapse cases were treated in Tambura County whereas only 16% and 4% of the relapse cases treated in Maridi and Yambio Counties, respectively.

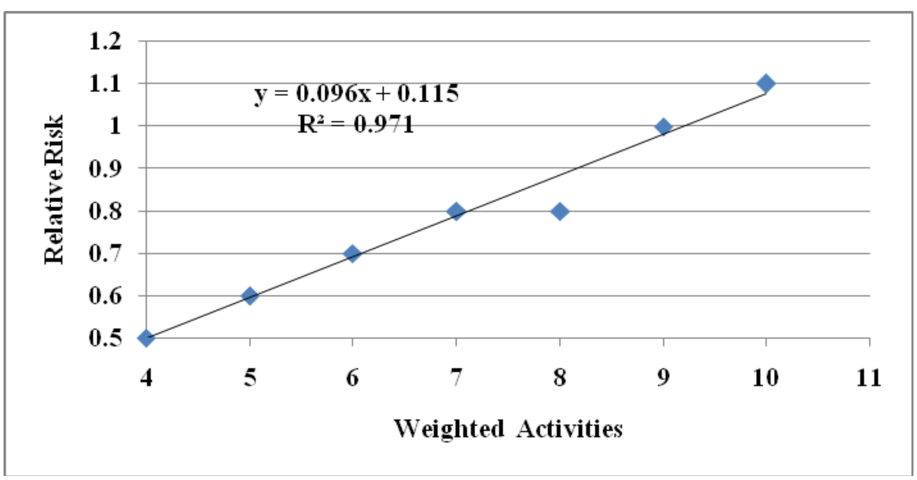

Figure 2. Correlation between the different activities and the infection Relative Risk

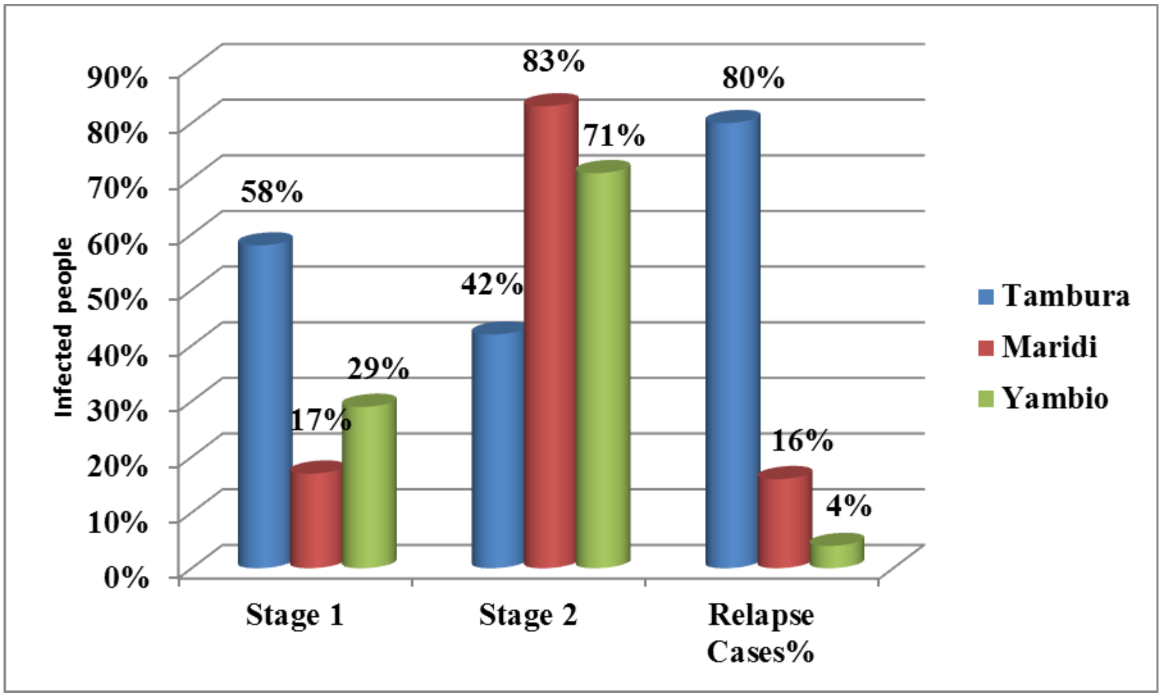

Figure 3. Detection and Treatment of Trypanosomosis in Western Equatoria State (1997-1999)

4. Discussions

The results showed that the prevalence rates had started to rise as from 1996 compared to the lowest prevalence rate in 2002. This might be due to the cessation of the control programs in the dawn of 2000 in those residual hot spots with high prevalence rates. This resulted in the rising of prevalence rates in those areas which represented the current high prevalent foci where case finding and treatment availability was limited (Moore et al., 1999) and the collapse of the trypanosomosis control programme in1990 due to the devastating civil war which occurred in South Sudan.

The result revealed that activities were positively correlated with the infection relative risk of trypanosomiasis. Activities such as farming, fishing, poaching, livestock rearing, collecting water and fire wood are important socio-economic determinants that might have played important roles in increasing the risk of trypanosomosis in the endemic areas since they facilitate the vector-host contacts by exposing human hosts to the *G.palpalis* the vector agent of trypanosomiasis in Western Equatoria State. Among these factors, some are well associated with increasing the risk for infection with the disease in the study area. The study demonstrated that the risk of infection with the disease was higher for some activities than others. Activities of collecting water from the river and farming showed the highest relative risk compared to activities such as poaching, fishing, staying in market place and hiding which indicated low relative risk for trypanosomiasis. There are correlations between increasing the risk for infection with the disease and the distance to the market place (Alsopp et al.,1972) introduction of untreated infected livestock to a previously unaffected area (Fevre et al.,2001); agricultural developments (Morris , 1960) and population movement from one place to another although not epidemiologically significant but may have played a role to increased transmission of sleeping sickness in Tambura County focus (Moore et al.,1999).The Relative Risk of trypanosomiasis showed no uniformity to all individuals in the study area; it varied generally with the different age group (Moore et al.,1999). The lowest Relative Risk in children of age group 6-9 years (Fig.5) is mostly dependent upon parents for their needs which imply that they may not get infection with the disease unless they are exposed to the sites with high *Glossina* density.

The study also evidenced the highest prevalence rate in those who had the highest relative risk of infection (Table 3). For example, water collectors (relative risk=1.1; prevalence rate=19.5%); farmers (relative risk= 1; prevalence rate=19.4%); firewood collectors, cassava soakers and market dealers all have the same relative risk of 0.8 and have prevalence rate which are slightly different but within the same range (17.4%, 15.2% and 16.4%, respectively); hiders (relative risk=0.7; prevalence rate=14.3%) and finally livestock keepers(relative risk =0.5; prevalence rate=9.1%). It is apparent from the above discussion that the highest prevalence rate occurred in firewood collectors because they had much more relative risk of exposure to the vector agent of the disease than any other category, while the category with the lowest prevalence rate had much less relative risk of exposure to tsetse flies. This finding was in conformity with that of Moore et al. (1999).

Many other factors could be considered for the persistence of the disease in Western Equatoria State. Moore et al. (1999) indicated that the highest prevalence rate had occurred in Ibba , Ibba County. This might be attributed to the failure of malarsoporol and technical problems including the distance to the only hospital that made difficulty for some patients to reach there, poor transport facility and staff in the control program were unpaid (Moore et al., 2001). Apart from treatment failure reported above, there had been high rates of malarsoporol treatment failure (>20%) in *T. b. gambiense* endemic areas (Pepin and Milord 1994; Legros et al., 1999). Nevertheless, the administration of Malarsoporol needed that diagnosis of the disease should be conducted first which implies that before administering the drug a case detection of the parasite is necessary. However, the detection of the disease presented a problem since there was no active case detection (ACD) in southern Sudan from 1989 until late 1997(Moore et al., 2001).Another challenge to efforts of control measures was the sole treatment of sleeping sickness in Southern Sudan at the Li-Rangu Hospital , Yambio County. This was worsened by provision of no payment to the staff and deficient transport to the hospital. Furthermore, the control problems were aggravated by institutional development-related issues (physical infrastructure, equipment and vehicles, resources for laboratory and field works, and depletion of research and field staff). Besides, staff retention problem including slow career advancement, lack of career prospects, poor working conditions as well as lack of both transport and self-worth (Scientific Working Group,2001).These factors have all challenged disease control that might have led to the persistence of trypanosomosis in the region.

Conclusion

Problems posed by trypanosomosis almost affect every aspect of human activity. This paper stresses on the role of the different human activities in bringing about infection by the disease and difficulties faced by the eradication efforts in the study area. Activities such as poaching, farming and water collection are central in maintaining lives in most African villages. These activities might increase the risks of trypanosomosis.

The highest prevalence rate occurred in those individuals who had the highest relative risk of exposure to the vector agents of the disease due to factors inherent in their activities such as duration and frequency of their daily work, especially in areas infested with tsetse flies. The relative risk of infection is not the same to all the age group. This might be low in one age group and high in another. This has to do with the different activities that might demand movement from one point to another into which an individual is engaged.

The causes of the emergence and resurgence of disease epidemics are varied. However, they can be conveniently grouped into political, economic and behavioral factors, besides the impacts of climate change and vegetation on tsetse flies distribution.

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