



Assessment of the Socio-Economic Burden of Trypanosomiasis Infection in Selected Tsetse Endemic Communities of Enugu South L. G. A.

**Victor Stephen Njom ^{a*}, Iyam Orok Iyam ^b,
Awam, Chibueze Odi ^b, Obilor Charles Ifeanyichukwu ^b
and Obini, Felicia Udu ^b**

^a *Applied Biology and Biotechnology Department, Enugu State University of Science and Technology
Enugu, Nigeria.*

^b *Nigeria Institute for Trypanosomiasis (and Onchocerciasis) Research (NITR) Southeast Zona Office,
Enugu, P M B 1660 Indp layout, Enugu State, Nigeria.*

Authors' contributions

This work was carried out in collaboration among all authors. Author VSN conceptualized, designed and wrote the manuscript, authors IOI, ACO, OCI and OFU carried the field work. All authors read and approved the final manuscript.

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ABSTRACT

Human African Trypanosomiasis (HAT) is a debilitating public health disease of the poor. It is transmitted mainly by tsetse flies. The abundance of this fly in an area is correlated with the disease prevalence. A significant gap exists in current knowledge regarding trypanosomiasis and its socio-

*Corresponding author: Email: victor.njom@esut.edu.ng, njomvic22@gmail.com;

economic impacts in Enugu State. Despite limited available research, the resurgence of tsetse fauna, coupled with climate change, social instability, and disruptions in disease surveillance, underscores the urgent need for updated information. This study accessed the socio-economic impacts of HAT in Akwuke and Ugwuaji communities of Enugu State Nigeria. Pre pre-tested structured questionnaire was used to collect information about the knowledge of the vector, the disease and its social and economic impacts. The study recruited 347 participants and results revealed that 255 of the respondents (73%) demonstrated a solid understanding of tsetse flies while 159 (46%) have knowledge of the disease trypanosomiasis. A total of 14 (4%) claimed to have been previously diagnosed with the disease and 12 (3.5%) of them were out of work /farm activities when sick. The cost of treatment and hospitalization was borne by 13 (37%). However, stigmatization was reported by one person (0.3%). Therefore, it is imperative that health education intervention be carried out to improve knowledge concerning the disease, thereby improving the health seeking behavior in both communities. Active surveillance and integrated tsetse control approach should be considered in both study areas.

Keywords: *Trypanosomiasis; surveillance; respondents; fauna; tsetse-fly; stigmatization; disease.*

1. INTRODUCTION

Human Africa Trypanosomiasis (HAT) is among the debilitating neglected tropical diseases ravaging Africa which occurs in sub-Saharan Africa. The disease is endemic only in sub-Saharan Africa and is caused by two subspecies of *Trypanosoma brucei*, a slender monophyletic flagellate protozoan parasite that lives and multiplies extra-cellularly in the blood and tissue fluids of the host: *T. b. gambiense* in West and Central Africa, and *T. b. rhodesiense* in East Africa [1]. The disease is predominately found in Africa, hence the name African trypanosomiasis[2].

According to World Health Organization (WHO) (1995), about 25,000 cases were detected, though about 300,000 undetected cases were estimated within the region. [3]. Despite reports of fewer incidence [4], Human Africa Trypanosomiasis (HAT) (Sleeping sickness) still threatens millions of people in 36 countries in sub-Saharan Africa. According to recent reports, an estimated 55 million people were at risk from 2016 to 2020, with three million facing moderate to high risk [2,5,6]. Data from the Institute for Health Metrics and Evaluation (IHME) indicated that Human African trypanosomiasis contributed approximately 562,262 disability-adjusted life years (DALYs) to the global burden of disease, as per the worldwide burden of disease assessment [7].

The disease in livestock, Animal African Trypanosomiasis (AAT) is recognized as an important constraint in about 38 countries with a high potential of producing meat, dairy products and food crops, and most particularly denies the use of cattle for transport and traction [6]. For

agricultural communities, this means that only small areas can be tilled by hand, leaving the communities vulnerable to food shortages, low natural resource utilization, poor animal health, starvation and famine [8]. The economic impacts of the disease on humans, livestock, agriculture and forestry development are colossal as the vector (tsetse flies) are distributed over a wide range of habitat covering about 10 million square kilometres of potential grazing land in 38 countries extending on both sides of the equator—a third of the landmass of Africa, which are rendered unsuitable for livestock breeding and farming, [9,10,11]. Globally about 55 million herds of cattle, 30 million sheep and 40 million goats are at risk of infection [12].

Its burden cuts across Nigeria to other sub-regions of Africa inflicting untold hardship, particularly to people in the rural communities giving rise to extreme poverty, a decrease in the quality of life and productivity of employees, hindering physical and cognitive growth, school dropout due to lack of concentration in class, disturbances in sleep pattern, maternal and child disease and even death [13 14,15,16,6,17]. The infection in livestock reduces milk production by 10-40%, the number of cattle by 10-50% and agricultural production by up to 2-10%. Currently, trypanosomiasis threatens the livestock sector and agricultural Gross Domestic Product (GDP) [18]. In Nigeria, Agriculture contributes 30% of the total national GDP. It's a key activity for Nigeria's economy after petroleum oil and provides livelihood to many Nigerians, [19]. Forestry policies have been hampered (Idumah et al., 2016), owing to the close relationship of vegetation to tsetse flies' distribution and their peri-urban activities in the ecosystem [20].

Human African trypanosomiasis is classically transmitted by the bite of blood-sucking tsetse flies (Diptera, genus *Glossina*) [21]. Two forms of the disease exist: the slow-progressing form, caused by *Trypanosoma brucei gambiense*, which is endemic in western and central Africa; and, the faster-progressing form, caused by *Trypanosoma brucei rhodesiense*, found in eastern and southern Africa [22]. Trypanosomes are obligatory parasites in nature usually having two hosts, namely the vertebrate and invertebrate hosts. The invertebrate host is generally biting insect-tsetse fly while the vertebrate host includes humans and other wild animals [23,24,25]. Trypanosomiasis, and its vector as far as humans and animals in Africa are concerned, is considered a major challenge to socio-economic development in sub-Saharan Africa. It is listed sixth about the number of causes of death among Neglected Tropical Diseases (NTDs) [26,14,27,6]. The disease could affect both males and females, young and old, including livestock, inducing severe morbidity and mortality in humans and livestock [8,11].

The major vector of HAT is the tsetse fly genus *Glossina* [24,28,1]. The vector acquires the parasites during blood meal while feeding on an infected person and its subsequent transmission when feeding on a non-infected person [16,20]. The disease is common in remote or rural areas of Africa, where most of the population are farmers and movement of herds and herders is unrestricted with consequent fly-cattle-human contact [26]. The situation is made worse because early detection of infection does appear impossible.

1.1 Statement of Problem

The risk of Trypanosomiasis and the resurgence of sleeping sickness is intricately linked to factors such as poverty, migration, drought, armed conflicts, deforestation, and the heightened exposure of humans and livestock to tsetse flies (*Glossina* sp.) in tsetse-inhabited areas. Furthermore, socio-economic instability and geopolitical disputes undermine the delicate disease surveillance systems [29]. Currently, the emergence of Human African Trypanosomiasis (HAT) in sub-Saharan Africa is exposing 60 million people to the risk of infection. At the turn of the century, sleeping sickness reached epidemic proportions in Angola, the Democratic Republic of Congo, Uganda, and Sudan. Its prevalence has also increased in Cameroon,

Congo, Côte d'Ivoire, Central African Republic, Guinea, Mozambique, Tanzania, and Chad [30].

Trypanosomiasis was nearly eradicated in the 1960s through colonial control programs. However, the disease has resurged in epidemic proportions over the past two decades due to conflicts, population displacement, and the collapse of healthcare systems. Between 2008 and 2009, Nigeria was among the 10-12 African countries reporting fewer than 100 new cases annually. The past success in controlling the disease appears to have diminished governmental attention and funding, resulting in reduced surveillance and vector control efforts over several decades [31,3].

Livestock farming is a common practice in Nigeria, prevalent among both urban and rural populations. According to a report, Nigeria boasts a significant livestock population, including approximately 19.5 million cattle, 72.5 million goats, 41.3 million sheep, 7.1 million pigs, 28,000 camels, and 974,499 donkeys. [32] However, a substantial portion of this livestock resides in regions infested with tsetse flies, placing them at risk of contracting Animal Trypanosomiasis (AAT). [33]. Akwuke and Ugwuaji, riverine towns in Enugu State, are identified as endemic regions for Trypanosomiasis [33]. The towns' savannah-like vegetation, topography, and river system have fostered epidemiological activities such as cattle herding, piggery, fishing, and crop cultivation, thereby increasing human-tsetse fly interaction. Proximity to the state capital has led to the establishment of numerous piggery farms and Fulani cattle herding settlements within the communities. The presence of these livestock influences the prevalence of tsetse flies and trypanosomiasis in the surrounding area. A significant gap exists in current knowledge regarding the trypanosomiasis and its socio-economic impacts in the region. Despite limited available research, the resurgence of tsetse fauna, coupled with climate change, social instability, and disruptions in disease surveillance, underscores the urgent need for updated information.

This study aims to address this knowledge deficit by assessing the socioeconomic dimensions of tsetse flies and trypanosomiasis within the selected communities. Specifically, the research will determine the socioeconomic burden of

trypanosomiasis in the Akwuke and Ugwuaji communities of Enugu South Local Government Area.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in Akwuke and Ugwuaji communities of Enugu South Local Government Area, Enugu State Nigeria. Enugu South is one of the seventeen Local Government Areas (LGA) of Enugu State. It has coordinates of 6°24'N 7°30'E, occupying a land mass of about 67 square kilometres, with an average temperature of 27°C, relative humidity of 69%. There are two main seasons – dry and rainy with the dry season occurring between November to March while the rainy season occurs between April to October. According to the 2006 Nigeria National Census report, Enugu South has a population of 198,723 persons. The people are predominantly farmers, others are civil servants, traders and artisans.

The two selected study communities; Akwuke and Ugwuaji are semi-urban, few kilometres from the Enugu capital city. Both communities are riverine, each with a river that transverses the community.

Akwuke community has the Nyaba River that provides the water needs of the inhabitants and attracts piggery, vegetable, and fish farming, along the coast. Also, a portion of the Nyaba River has a wide expanse of sandy beach which is a tourist haven. The vegetation is mostly composed of guinea forest trees. The area is dominated by a tropical hinterland climate with lateritic soil and an average temperature of 26°C. Surface water is relatively okay across the year but during the rainy season, more water surfaces spring up flooding the hinterland. The average annual rainfall is 1730-2500 mm.

Ugwuaji is located at latitudes 6°19'N and 6°51'N and longitudes 7°42'E and 7°51'E with enormous natural resources while residents are predominantly farmers, civil servants, herders, businessmen and women. There are common rivers known as Ine and Afa that serve the community for domestic water supply, washing, bathing, piggery, and fish farming. Both communities have a history of Human African Trypanosomiasis [33] hence they were selected for the current study.

2.2 Study Design

A cross-sectional descriptive survey was conducted to obtain information on Human African Trypanosomiasis's (HAT) socio-economic impact in both communities between March and June 2022. A total of three hundred and fifty (347) participants were recruited. Akwuke community had 174 participants while 173 were recruited from Ugwuaji. Only those who have lived up to two years or more in either of the communities were recruited for the study.

2.3 Pre-survey Visits

Visits were made to the two communities selected for the study, and the nature, public health and socio-economic importance of the survey were explained to the traditional and youth leaders as well as other community members and only those who consented to participate in the research were recruited for the study. Structured questionnaires were randomly administered to those who consented to the study, in English language and where necessary an Igbo interpreter was called to explain in the native dialect. After the survey, questionnaires were sorted according to communities and data extracted and tabulated.

2.4 Data Analysis

Data was descriptively analyzed using Statistical Package for Social Sciences (SPSS) version 21.0, and results presented in frequencies and percentage. Responses according to communities and villages were compared using the student T-test. The level of significance was assumed at <0.05.

3. RESULTS

3.1 Socio-Demographic Features of Respondents

A total of 347 respondents participated in the study (Table 1). Among them, 55 (15.9%) were under 20 years old, 95 (27.4%) were between 21-30 years, 91 (26.2%) were between 31-40 years, 60 (17.3%) were between 41-50 years, and 46 (13.3%) were over 51 years old. The respondents had varying levels of education: 33 (9.5%) had tertiary education, 66 (19%) had secondary education, 106 (30.5%) had primary education, and 142 (40.9%) had no formal education. In terms of occupation, 97 (28%) were

farmers, 79 (22.8%) were students, 76 (21.9%) were traders, 55 (15.6%) were self-employed, and 40 (11.5%) were civil servants. When categorised by communities, the data revealed that respondents under 20 years old were more in Ugwuaji (31 respondents, 17.9%), while those between 21-30 years were more in Akwuke (49 respondents, 28%). Additionally, 77 (44.3%) of respondents with no formal education were from Akwuke, compared to 65 (37.57%) from Ugwuaji. Fifty-three (30.6) respondents from Ugwuaji were

farmers as against the 44 (22.9) from Akwuke. Also, 40 (22.9%) and 36 (20.8%) respondents from Akwuke and Ugwuaji respectively were traders while 41(23.6%) of participants from Akwuke were students, 38 (22%) were observed as students in Ugwuaji. Respondents who are civil servants were more in Akwuke 21 (12.1%) than 19(11), as recorded in Ugwuaji. Similarly, self-employed respondents were 28 (16.1%) in Akwuke but 27 (15.6%) in Ugwuaji (Table 1).

Table 1. Socio-demographic features of respondents

Variables	Akwuke Community (n= 174) (%)	Ugwuaji Community (n=173) (%)	Total (n=347) (%)
Age in years			
<20	24(13)	31(17.9)	55(15.9)
21-30	49(28)	46(26.6)	95(27.4)
31-40	43(24.7)	48(27.7)	91(26.2)
41-50	33(19)	27(15.6)	60(17.3)
>51	25(14.4)	21(12.1)	46(13.3)
Education			
Tertiary	14(8.05)	19(10.99)	33(9.5)
Secondary	29(16.67)	37(21.39)	66(19.0)
Primary	54(31.03)	52(30.06)	106(30.5)
None	77(44.3)	65(37.57)	142(40.9)
Occupation			
Farmer	44(25.3)	53(30.6)	97(28.0)
Student	41(23.6)	38(22.0)	79(22.8)
Trader	40(22.9)	36(20.8)	76(21.9)
Self employed	28(16.1)	27(15.6)	55(15.6)
Civil servant	21(12.1)	19(11.0)	40(11.5)

Table 2. Socio-economic impact of Trypanosomiasis

Variables	Akwuke community (n=174) (%)	Ugwuaji community (n=173) (%)	Total (%) (n=347)
Knows Trypanosomiasis and that it is transmitted by tsetse?			
Yes	78(44.8)	81(46.8)	159(46.0)
No	96(55.2)	92(53.2)	188(54.2)
Knows and seen tsetse fly			
Yes	125(71.8)	130(75.1)	255(73.5)
No	49(28.2)	43(24.9)	92(26.5)
Have been bitten by tsetse fly?			
Yes	96(52.3)	87(55.8)	187(53.9)
No	78(44.8)	70(40.7)	148(42.7)
Have you ever been diagnosed of Trypanosomiasis (excessive sleeping)?			
Yes	9(5.2)	5(2.9)	14(4.0)
No	165(94.8)	168(97.1)	333(96.0)
Were you sick before the diagnosis?			
Yes	8(4.6)	5(2.9)	13(3.7)
No	1(0.6)	0	1(0.29)

Symptoms presented?			
Hard painful nodules/chancere	7(4.0)	5(2.9)	12(3.5)
Fatigue, headache, increased sweating	6(3.4)	3(1.7)	9(2.6)
Urge to sleep	5(2.9)	4(2.3)	9(2.6)
Were you out of work/farm when sick from Trypanosomiasis?			
Yes	7(4.0)	5(2.9)	12(3.5)
No	167(96)	168(97)	335(96.5)
Were you treated at the hospital or self-medication?			
Treated at the hospital	7(4.0)	4(2.3)	11(3.2)
Self-medication	2(1.1)	1(0.6)	3(0.9)
Did you pay for treatment or treated free?			
Treated free	0(0)	1(0.6)	1(0.3)
Paid for treatment	9(5.1)	4(2.3)	13(3.7)
Were family and friends aware that you have Trypanosomiasis?			
Yes	7(4.0)	4(2.3)	11(3.2)
No	2(1.1)	1(0.6)	3(0.9)
Were family and friends supporting you?			
Yes	7(4.0)	4(2.3)	11(3.2)
No	2(1.1)	1(0.6)	3(2.0)
Did family and friends discriminate against you because of your Trypanosomiasis status?			
Yes	1(0.6)	0(0)	1 (0.3)
No	8(4.6)	5(2.9)	13(3.7)

3.2 Respondent's Knowledge and Socio-Economic Impact of Trypanosomiasis

During the study, 159 (46.0%) respondents demonstrated knowledge of Trypanosomiasis (Table 2). In addition, 255 (73.5%) were familiar with the tsetse fly, while 187 (53.9%) reported being bitten by tsetse. Moreover, 14 (4.0%) respondents confirmed a disease diagnosis, with 13 (3.7%) claiming to have been unwell before diagnosis. Reported symptoms included hard painful nodules and chancre (3.5%), fatigue, headache, increased sweating (2.6%), and an increased urge to sleep (2.6%). Interestingly, 12 (3.5%) individuals ceased work or farming activities due to Trypanosomiasis. Out of those affected, 11 (3.2%) received treatment in a hospital, while 3 (0.9%) resorted to self-medication. Treatment costs were incurred by 13 (3.7%) individuals, with only 1 (0.3%) obtaining free treatment. When queried about their awareness of the ailment, 11 (3.2%) respondents confirmed that their family and friends were informed and provided support. Furthermore, 13 (3.7%) reported no discrimination, except for one individual in the Akwuke community (Table 2).

4. DISCUSSION

The findings of this study revealed that a higher percentage (73%) of respondents demonstrated

a solid understanding of tsetse flies compared to their knowledge (46%) of the disease trypanosomiasis. The level of awareness of the tsetse fly observed in this study is similar to the report of [17] that observed 100% understanding of what tse tse fly is among herders in the state of Enugu. The poor awareness of the disease trypanosomiasis within the studied community suggests a potential risk of fatal outcomes for infected individuals, as they may not seek proper medical attention. Understanding a disease and its causative agent significantly impacts the epidemiology and control of diseases [34]. The impact of disease awareness on behaviour within a population can lead to valuable insights. When individuals become aware of a disease in their vicinity, they are more likely to take proactive measures to protect themselves and reduce their susceptibility to the disease. This awareness, whether gained through first-hand observation or word of mouth, can potentially contribute to positive changes in community health and the management of infectious diseases [35,14]. The respondents affirmed increased tsetse fly bite (53.9%) indicating a potential danger for the communities studied. Human tsetse fly contact is one of the risk factors influencing the transmission of HAT. This observation collaborates with earlier reports [16,1,36]. The presence of herder settlements within the two

study locations and the presence of tsetse flies pose a great danger for the inhabitants as there could be rapid transmission within the population either from herders to humans or vis-à-vis. The study also recorded a low prevalence of trypanosomiasis. Interestingly, 14 (4.0%) respondents claimed to have been previously diagnosed with trypanosomiasis and were treated in the hospital. This study could not validate their claims as we were unable to conduct any diagnosis or sight any hospital records. Symptoms reported by respondents were not different from the previous report; hard painful nodules/chancres (3.5%), fatigue, headache, increased sweating (2.6%) and urge to sleep (2.6%). The finding is in agreement with. There has been a dearth of literature regarding new trypanosomiasis infections in Nigeria despite the increasing prevalence of the vector and uncontrolled movement of herders from the northern savanna region of the country to the southern rainforest. Movement of cattle and other reservoir hosts of *Trypanosoma* sp into the tropical forest that supports the breeding of tsetse flies has been one of the important epidemiological factors influencing spread of the diseases. Eneh et al. [37] reported a case of fatal Trypanosomiasis in the Obinagu community in Enugu state. They observed that West African HAT caused by *Trypanosoma brucei gambiense* is usually contracted close to settlements, requiring only a small vector population. Thus, it is particularly difficult to be eradicated. Obinagu, Akwuke and Ugwuaji are very close neighbouring communities with similar geographical features that support the breeding and spread of the tsetse fly vectors as both communities are also host to herders. All these factors contribute to frequent human-fly contact in the rural farm settlement, which is intersected by a small river system, along with some cattle-rearing activities in the three communities [37,8].

Socio-economically, the study recorded 3.5% of respondents who were out of work or farming activities due to infection with trypanosomiasis probably due to various short- and long-term effects on livelihood and coping strategies of sleeping sickness victims, including physical and mental health effects [14]. Equally, the cost of treatment was borne by a few of the patients (3.7%). This finding collaborates with other studies [38] that observed that Trypanosomiasis has been responsible for serious socio-economic implications, including treatment and hospitalization costs. Most of the respondents (3.2%) who claimed to have been diagnosed with

trypanosomiasis interestingly affirmed that their families and friends supported them during the trying period of treatment except for one respondent (0.3%) in one of the studied communities who reported that she was discriminated against by family and friends. Change in attitude towards patients of trypanosomiasis as observed in this study might be due to solid understanding among community members that trypanosomiasis is not contagious but transmitted during the bite of tsetse flies. This finding is in contrast with the reports [39,11,40] that observed discrimination of patients by family and other members of the community. Among the social consequences of HAT previously reported were misunderstanding, stigma, school dropout, pain, amnesia and disability, and loss of self-esteem [38]. Both on community and family levels, stigmatization, mental confusion, personality and behaviour changes led to school drop-outs, mortality, divorce or break-up of relationships, and resulted in an unfavourable climate for bringing up children. Mental confusion caused the victims not to associate with friends, while pain made the victims stay home, depriving them of social life [41,42].

5. CONCLUSION

There was a strong understanding of the vector of trypanosomiasis though the disease itself was not clearly understood by the respondents. There was a low prevalence of trypanosomiasis unfortunately the patients were negatively impacted socio-economically as they were out of work during the treatment period. The patients also paid for treatment and few were stigmatized in their community.

6. RECOMMENDATION

Therefore, health education intervention must be carried out to improve knowledge concerning the disease, thereby improving the health-seeking behaviour in both communities. Active surveillance and integrated tsetse control approach should be considered in both study areas especially Akwuke, where socioeconomic activities are carried out daily, especially sand evacuation. Further molecular survey is recommended to ascertain the trypanosome strain prevalent in the study areas.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models

(ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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