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Host Related Risk Factors of Bovine Trypanosomosis and Vector Density in Halu District of Ilubabor Zone, West Ethiopia

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ABSTRACT

Background
Trypanosomosis is disease caused by unicellular parasites, trypanosome, found blood and other tissue of vertebrates; including livestock, wild life and people. It is a serious disease in domestic livestock causing a significant negative impact on food production and economic growth in many parts of the world, particularly in sub-Saharan Africa. Its epidemiology and impact on livestock production are largely determined by the prevalence and distribution of the disease and its vectors in the affected area.

Aim
To assess the host related risk factors of bovine trypanosomosis and apparent density of tsetse flies in four peasant associations of the study area. In relation to the host risk factors, the prevalence of bovine trypanosomosis was highest in those animals with poor body condition.

Results
The overall 5.32% prevalence of bovine trypanosomosis was recorded from 432 blood sample collected from randomly selected animals using Buffy coat method. *Trypanosoma congolense* was the dominant species 14 (60.87%). However, it was not statistically significant between sex of animals (p>0.05). The mean packed cell volume (PCV) value of the infected animals was lower (20.65%±2.85) compared to non-infected animals (25.74%±4.80). There was statistically significant difference (p<0.05) in the PCV values of infected and non-infected animals. Moreover, animals with different body condition exhibited statistically significant variation (p<0.05) in the prevalence of trypanosomosis. Overall an apparent density of the flies was 2.42 f/t/d by using mono-pyramidal and biconical traps. It indicated that, *G. morsitance submorsitance, G. pallidipes* and *G. tachinoides* were tsetse flies species caught.

Conclusion
Finally, this work showed that trypanosomosis is an important disease affecting the health and productivity of cattle in the district. Hence, due attention should be given to this sector so as to improve livestock production and agricultural development in the area.

Keywords
Halu; PCV; Trypanosomosis; Prevalence.

INTRODUCTION

African trypanosomosis is one of the major constraints of animal production in sub- Saharan African countries including Western and Southwestern parts of Ethiopia.[1] Vector borne trypanosomosis is excluding some 180, 000-200, 000 km^2 of agriculturally suitable land in the west and southwestern parts of the country.[2]

Trypanosomosis is disease caused by unicellular parasites, trypanosome, found blood and other tissue of vertebrates; including livestock, wild life and people.[3,4] It is a serious disease in domestic livestock causing a significant negative impact on food production and economic growth in many parts of the world, particularly in sub-Saharan Africa. Its epidemiology and impact on livestock production are largely determined by the prevalence and distribution of the disease and its vectors in the affected area.[5]

This disease is transmitted mainly by tsetse flies (cyclically), biting flies (mechanically) and by other means of transmission. The most important species that infected cattle include *Trypanosoma congolense*, *T. brucei* and *T. vivax*. Mechanical transmission is particularly important in relation to *T. vivax* and *T. evansi* particularly on the fringe of tsetse areas. It can also transmitted by biting. Trypanosomosis is prevalent in two main regions of Ethiopia i.e. the North West and the South West regions. In Ethiopia, trypanosomosis is one the most important disease limiting livestock productivity and agricultural development due to its high prevalence in the most arable and fertile land of south west part of the country following the grater basins of Abay, Omo, Ghibe, Didessa and Baro with a high potential for agriculture.[6]

The economic burden of trypanosomosis is not only due to the direct losses resulting from mortality, morbidity and infertility of the infected animals but also due to the indirect losses like exclusion of livestock and animal power based crop production from the huge fertile tsetse infested areas. In Ethiopia, about 5.5 million heads of cattle are exposed to the risk of trypanosomosis. Nevertheless, in Halu district the magnitude of trypanosome infection and the distribution of its vectors are not well-known except complaints from farmers of the area.

Therefore, the objective of the study was

- To determine the prevalence of bovine Trypanosomosis.
- To identify vector species and their apparent density.
- To assess the risk factors associated with the disease and collecting baseline data to control the vectors.

MATERIALS AND METHODS

Study Area

The study area is located in Oromia regional state, Illiabbabor zone and lies at 035°29 to 035°35E longitudes and 08°14 to 08°37 latitude and north of equator. Altitude of the area ranges from 500 to 1800 m.a.s.l.. The climatology alternates with long summer rain fall (June-September), short rainy seasons (March-April) and winter dry seasons (December-February). The district has 32 °C maximum temperature and 15 °C minimum temperature and 1000 mm to 1800 mm rain-fall. The study was conducted in 4 peasant associations (PAs), namely Halu Gamachisa, Inago, Kidana Mirat and Walkitesa. There are river basins which flow throughout the year from the district to Gabba River system, namely Ibu, Aba Mamo, Kaso and Uka River other seasonal rivers which are tributers of Gabba and Uka Rivers. The different vegetation type which are found in the district, include *combretum Spp*, *Pillistigamathonningi*, *Acacia Spp* and *Ficassycomors*. Wild games like buffalos, bush pig, kudu, warthog, hippo and crocodiles are the most commonly found in the study area. Agriculture is the main stay of livelihood of people with a mixed farming system and livestock plays an integral role for agriculture.[7]

Physiology of the Liver

Invariable all age group of Local Zebu cattle maintained under extensive system of management are used for this study without sex difference. Agriculture is the main livelihood of the society with mixed farming system and livestock play an integral role for agriculture.

Study Design

Cross-sectional study was conducted to determine the prevalence of bovine trypanosomosis and apparent density of vectors (tsetse population).

Sample Size and Sampling Method

The simple random sampling technique was applied to collect from the ear vein. The sample size can be determined based on the study type and sampling method for investigation, 95% confidence interval, 5% desired absolute precision and 50% average prevalence.[8]

STUDY METHODS AND PROCEDURES

Entomological Survey

For the entomological study, tsetse flies and other flies were collected from selected sites of the study area. The altitude levels, Peasant Associations, numbers of traps, tsetse species caught, other biting flies, days and vegetation types were recorded during the sampling period. The different fly catches in each trap were counted and identified; the species of tsetse flies and other biting flies were identified based on their morphological characteristics such as size, color and wing venation structure.[9]

Determination of Packed Cell Volume

The capillary tubes were placed in micro-haematocrit centrifuge with sealed end outer most. The tube was loaded symmetrically to ensuring good balance after screwing the rotators cover and closing the centrifuge lid, the specimens were allowed to centrifuge at 12,000 revolutions per minute for 5-minutes. Tubes were then placed in a haematocrit and readings were expressed as a percentage of red blood cells to the total volume of whole blood. Animals with packed cell volume (PCV)<24% were considered to be anemic.[10]

Buffy Coat Technique

A small blood was collected from an ear vein using heparinized microhaematocrit capillary tube. The haematocrit tube with whole blood sample end was sealed with haematocrit clay. The tube was centrifuged at 12000 revolutions per minute for five minutes. After centrifugation trypanosome were usually found in or just above the buffy coat layer. The capillary tube was cut using a diamond tipped pen 1 mm bellow the buffy coat to include the upper most layers of the red blood cells and 1 mm above to include the plasma. The content of capillary tube was expressed on to side, homogenized on to clean side and covered with cover slip. The slide was under

40× objective 10× eye piece for the movement of the parasites.[11,12]

Data Management and Analysis

The prevalence was calculated as the number of infected individuals divided by the number of total examined and multiplied by 100. For the analysis of data statistical software program (statistical package for the social sciences (SPSS) 20.0) was used. Descriptive statistics were used to summarize data. The association between the prevalence of trypanosome infection and risk factors were assessed by logistic regression, whereas the two group mean comparison (*t* test) was used to assess the difference in mean PCV between trypanosome positive and negative animals. The density of fly population was calculated by dividing the number of flies caught by the number of traps deployed and the number of days of deployment and expressed as Flies/Trap/Day.

RESULTS

Entomological Survey

A total of 290 tsetse flies were caught during study period. The overall apparent density of tsetse flies was 2.42 f/t/d. Three tsetse species have been identified. 150 (51.72%) were *Glossina morsitance submorsitance*, 80 (27.57%) were *Glossina pallidipes* and 60 (20.69%) were *Glossina tachinoides*. From total tsetse flies trapped, females occupied larger proportion and out of 290 tsetse flies caught, 214 (73.79%) flies were female while the rest 76 (26.21%) were male (Table 1).

Parasitological Findings

Out of 432 cattle examined, 23(5.32%) were found to be infected with trypanosomes. The prevalence of Trypanosomosis was significantly high in Halu Gamachisa followed by that of Inago and Walkitesa. The highest prevalence on the basis of species was *T. congolense* followed by *T. vivax* (Table 2).

Risk Factor Variable

The prevalence of trypanosomosis was higher in males as compared to female animals. However, the difference was not statistically significant ($p>0.05$). The prevalence of trypanosomosis between body condition scores was highest in poor and it was statistically significant ($p<0.05$).

Haematological Findings

The mean PCV value of the infected animals was lower (20.65%±2.85) as compared to the mean PCV value of non infected animals (25.74%±4.80) and statistically significant difference was observed between the PCV value of infected and non-infected animals ($p<0.05$) (Table 3).

Table 1. *Tsetse Distribution in Different Peasant Associations in Halu District*

PAs	No of Trap Deployed	*G.pallidipes*		*G.tachinoides*		*G.m.submorsitance*		Total	FTD
		M	F	M	F	M	F		
Halu Gamachisa	15	4	23	6	14	12	31	90	3
Inago	15	2	10	5	8	13	26	64	2.13
Kidane mirat	15	5	16	2	12	10	24	69	2.3
Walkitesa	15	3	17	3	10	11	23	67	2.23
Total	60	14	66	16	44	46	104	290	2.42

PAs: Peasant associations, FTD: Fly per trap per day, F: Female, M: Male

Table 2. *The Prevalence of Trypanosomosis in Different Area with Respective Species*

Peasant Association	Number of Animal Examined	Number of Infected Animals	*Trypanosome spp.* Identified		Prevalence (%)
			T.c	T.v	
Halu Gamachisa	168	15	8	7	8.93
Inago	96	3	2	1	3.13
Kidane mirat	72	2	2	-	2.7
Walkitesa	96	3	2	1	3.13
Total	432	23	14(60.87%)	9(39.13%)	5.32

Table 3. *The Mean Packed Cell Volume of Examined Cattle in Halu District*

Group	Observations	Mean PCV	SE	SD	95% CI
Negative	409	25.74	0.23	4.80	25.27---26.20
Positive	23	20.65	0.59	2.85	19.41--- 21.88
Total	432	25.46	0.23	4.85	25.01---25.92

SD= Standard Deviation, SE= Standard Error, PCV=Packed cell volume

Prevalence of Trypanosomosis According to Sex and Body Condition

The prevalence of trypanosomosis was higher in males as compared to female animals. However, the difference was not statistically significant (p>0.05). The highest prevalence was observed in the poor body condition animals and the variation in prevalence between the different body condition group was statistically significant (p<0.05).

DISCUSSION

The present study revealed that from a total of 432 randomly selected cattle's in the study area, 23(5.32%) animal were found positive for trypanosomes. This finding was lower than the previously reported infection rate of 18.5% in Arba-Minch Zuria district,[13] 11.7% in Abay Basin North Western Ethiopia,14 20.4% in Wolyta and Dawero Zone of Southern Ethiopia,[15] 16.9% in Sayo, district, Kellem Wollega, Western Ethiopia[16] and 29% prevalence in Gawo-Dale, West Oromia.[17] The lower prevalence in the current study might be due to the use of prophylactic and trypanocidal drugs, application of relatively designed method of tsetse fly control and expansion of cultivation land in the area which indirectly affects its vectors.

Out of the 5.32% overall prevalence of trypanosome infection, 3.24% were due to *T. congolense* and 2.08% were due to *T. vivax*. The finding of this study showed that the total trypanosome positive animals 60.87% were found to be infected with *T. congolense* and 39.13% were infected with *T. vivax*. The higher proportion of *T. congolense* in this study was in agreement with the previous results of Abebe et al[18] for tsetse infested areas of Ethiopia (58.5%); NTTICC[19] Frat Adanhegn Peasant Association (62.5%); Muturi[20] at Mereb Abaya, South Ethiopia (66.1%) and Terzu[21] in selected sites of Southern region (63.4%). Moreover, the results of Tewelde et al[22] at Kone (75%); Duguma et al[23] (85.2%) in Southwestern Ethiopia and Lelisa et al[24] in Hawa Gelan, Kellem Wollega, west Ethiopia (84%) had also shown higher results of *T. congolense*. These suggest that the major cyclical vectors or Glossina species are more efficiently transmitters of *T. congolense* than *T. vivax* in East Africa[25] and also due to the high number of serodems of *T. congolense* as compared to *T. vivax* and the development of better immune response to *T. vivax* by infected animals. According to Getachew,[26] *T. vivax* is highly susceptible to treatment while the problems of drug resistance are higher in *T. congolense* and *T. congolense* is mainly confirmed in the blood, while *T. vivax* and *T. brucei* also invade the tissues. *T. congolense* and *T. vivax* are the most prevalent trypanosomes that infect cattle in tsetse infested and tsetse free areas of the Ethiopia, respectively.

Even though higher infection rate was registered for males as compare to the females, the difference was not statistically significant (p>0.05). This result is in agreement with the previous researches reported by Adane et al[27] and Abebayehu et al.[28] This might be due to the fact that both sexes have virtually similar exposure to flies in grazing areas.

The prevalence of Trypanosomosis under different body condition groups indicated statistically significant difference (p<0.05) with higher infection rate in poor body conditioned than medium and good body conditioned cattle. Similar findings were reported in Abay (Blue Nile) base areas of Northwestern, Ethiopia[29]; in Bure district, western Ethiopia.[30] On another hand disagreement with the study in Metekel and Awi zone of North West Ethiopia.[31] On one hand, the disease itself results in progressive emaciation of the infected animals; nevertheless, on the other hand non-infected animals under good body condition are with good immune status that can respond to any foreign protein better than those non–infected cattle with poor body condition which can be immune compromised due to other diseases or malnutrition, since malnutrition and concurrent infections depress the immune responsiveness in some cases.[32]

The present study indicated that the difference between mean PCV values of parasitaemic (20.65%+2.85) and aparasitaemic (25.74%+4.80) cattle of the study area was statistically significant (p<0.05). This result was in agreement with the previous work done in Bilo Nopha district, South West Ethiopia[33] and three highland districts bordering LakeTana, Ethiopia.[34] Being intracellular blood parasites, trypanosomes result in lowering PCV of cattle because they lyse and destruct the red blood cells. The appearance of trypanosomosis in negative animals with PCV values of less than the threshold values (25%) may be due to the inadequacy of detection method used or delayed recovery of aneamic situation after current treatment with trypanocidal drugs or due to be anaemic by other complicative cause like malnutrition. Parasitaemic animals with PCV values greater than 25% might be thought of recent infection. Trypanosome infection and mean PCV values obtained in this study in the parasitaemic animals was found to be highly associated. Different authors in southern, northwestern and southwestern Ethiopia[35,36] also reported similar results. The mean PCV can be affected by many factors including helminth parasites infections, nutritional deficiencies and blood parasites, other than trypanosomosis, however, these factors are likely to affect both trypanosomosis positive and negative animals.[37,38]

The risk of trypanosomosis is also influenced by apparent density of the tsetse flies and type of vector prevailing in the area. In this study, the entomological findings revealed that three species of Glossina (*Glossina pallidipes*, *G. tachinoides* and *G. morsitance* sub-morsitance) out of five reported in Ethiopia. The overall apparent density of *Glossina species* was 2.42 Flies/Trap/Day. These findings lower than the previous report 11.9 Flies/Trap/Day from Hewa-Gelan district, Oromia region, West Ethiopia,[39] 4.3 Flies/Trap/Day from Lalo-Kiledistrict, KellemWollega Zone, Western Ethiopia.[40] The result also higher than the previous report 1.15 Flies/Trap/Day for tsetse in East Wollega zone[41] and 1.35 Flies/Trap/Day in southern rift valley of Ethiopia.[42] Higher percentage of female (73.79%) tsetse flies was caught than males (26.21%) that are in line with various reports from different parts of Ethiopia.[43,44] This could be adhered to longer lifespan of female tsetse flies than males.[45-47]

CONCLUSION AND RECOMMENDATIONS

Our study revealed that *T. congolense* and *T. vivax* were the prevailing species of trypanosomes in the study area. In relation to the host risk factors, the prevalence of bovine trypanosomosis was highest in those animals with poor body condition than animals with good and medium body condition. Finally, bovine trypanosomosis is an important disease and a potential threat affecting the health and productivity of cattle in the district. Hence, the necessary strategic control of bovine trypanosomosis including integrated and sustainable vector control should be strengthened to improve livestock production and agricultural development in the area.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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