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Bovine trypanosomosis, vector distribution and infection rate in three districts of Gamo Zone, southwestern Ethiopia

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ABSTRACT

African animal trypanosomosis is one of the main obstacles to the development of livestock and agricultural output in Ethiopia. It usually results in a severe, frequently fatal sickness, and the infected animals were more weakened as the disease progress and become unfit for work. A cross sectional study design was conducted from December 2021 to April 2022 with the aim of estimating the prevalence of trypanosome infection both in *Glossina* spp. and cattle, and to assess apparent density of *Glossina* spp. A total of 298 cattle were selected and examined for trypanosome by using buffy coat technique. The overall prevalence of bovine trypanosomosis was 19.1%; and two species of trypanosomes, *T. congolense* and *T. vivax*, were identified in the study area. The prevalence of *T. congolense* and *T. vivax* were 15.8% and 2.3%, respectively. The prevalence of trypanosomosis was significantly higher in adult animals (OR = 2.7; $p < 0.05$) than in younger cattle and poor body condition (OR = 3.18; $p < 0.05$) than medium body condition animals. The mean PCV value of infected animals was 14.3% (13.3–15.4) significantly lower than the non-infected animals 18.5% (17.8–19.2). *Glossina pallidipes* is the only tsetse species encountered in all the study areas. In total, 2992 flies were caught of which 90.8% belong to *G. pallidipes* and 9.2% were other biting flies. The overall apparent density of *G. pallidipes* was 20.1 F/T/D and other biting flies were 2.0 F/T/D. A total of 307 live *Glossina pallidipes* were dissected. The overall prevalence of *Glossina pallidipes* infection rate was 9.1% (95% CI = 5.9–12.4). The prevalence of *G. pallidipes* infection was significantly higher in Kucha district (OR = 3.2, $\chi^2 = 2.6$, $p < 0.05$) than the other two districts, Daramalo and Arba Minch Zuria. Also it was significantly higher in flies trapped from riverine forest areas (OR = 5.5, $\chi^2 = 2.86$, $p < 0.05$). Therefore, to reduce the impact of trypanosomosis and *Glossina,* vector control and treating infected cattle with prophylactic or chemotherapeutic drugs and active community participation can play a key role.

1. Introduction

African animal trypanosomosis is caused by unicellular and flagellated protozoan parasite, *Trypanosoma* spp. It is that transmitted by *Glossina* spp. and various biting flies (Constable et al., 2017; Taylor et al., 2016). Bovine trypanosomosis causes serious economic losses in cattle production in sub-Saharan countries (Constable et al., 2017; Leta et al., 2016). According to Ayalew et al. (2021) on average trypanosomosis contributed to 33% of livestock deaths, 50% loss of milk yield and 65% higher cost incur in livestock

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production. Those areas with risk of animal trypanosomosis have lower calving rate, lower milk yield and higher calf mortality rate, and hence, require more frequent treatment (Swallow, 2000). African animal trypanosomosis usually results in a severe, frequently fatal sickness. Infected animals become more weakened and become powerless as the disease progresses, hence, unfit for work, hence the name of the disease "Nagana" which is a Zulu word "powerless/useless" (Winkle and der Menschheit, 2005 cited by Steverding, 2008).

Trypanosomes have developmental cycles in the tsetse fly prior to being transmitted to vertebrate hosts. Infected *Glossina* spp. remains infected and infective throughout its life. The occurrence and impact of trypanosomosis depend on the challenge of *Glossina* spp., host distribution, animal varieties, agricultural practices, and management methods (Rogers et al., 1996). So the fly dissection is helpful to examine the presence of trypanosomes in various organs (i.e. salivary gland, proboscis and midgut) of *Glossina* spp. (Bouyer et al., 2010; Lehane et al., 2000.

Animal trypanosomosis continues to be a serious animal health issue, with a significant morbidity and mortality. There are some reports on the prevalence of bovine trypanosomosis (Abayneh and Tadesse, 2019; Lejebo et al., 2019; Sheferaw et al., 2019; Girma et al., 2014; Ayele et al., 2012; Teka et al., 2012; Zecharias and Zeryehun, 2012) in Ethiopia, but there are few studies (Gebeyehu and Degneh, 2023; Seyoum et al., 2022; Tora et al., 2022) conducted on *Glossina* spp. infection. Therefore, the aim this study was to estimate the prevalence of trypanosomosis both in *Glossina* spp. and bovines in three selected districts of Gamo zone, southern Ethiopia.

2. Materials and methods

2.1. Study area

The study was conducted in three selected districts (Daramalo, Kucha and Arba Minch zuria) of Gamo zone, southern Ethiopia (Fig. 1). Gamo zone is located in the Rift Valley lakes, Abaya and Chamo. The study districts were selected purposively based on livestock population of the areas, and challenge of trypanosomosis. Geographically, Gamo zone is located between 5°37′2″ to 6°42′12″ N (latitude) and 36°22′55″ to 37°48′335″ E (longitude). The number of livestock existing in study area is described under Table 1 (Gamo zone livestock and fishery department, 2021).

The vegetation types of the study areas were classified based on the structure or physical appearance, what the community and the dominant species looks like, physiognomy (Eiten, 1992). Accordingly, the common vegetation types of the study areas were:

- Wooded grass land: Areas predominantly vegetated with grasses, and where the tree covers between 5 and 10% of the area.
- Bush land: A vegetation type where bushes cover 40% or more of the land
- Riverine forest: A forest area adjacent to water body

2.2. Study design

A cross-sectional study design was conducted from December 2021 to April 2022 to estimate the prevalence of bovine trypanosomosis, to assess and identify *Glossina* species circulating in the study areas. Moreover, to estimate *Glossina* spp. density and

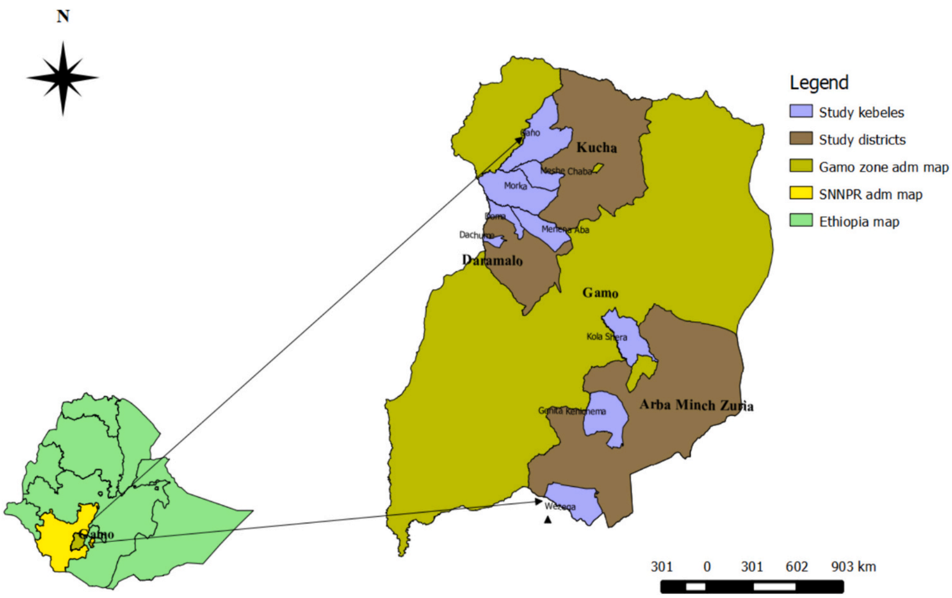

Fig. 1. Map of the study area.

Table 1
Livestock population of the study area (Gamo zone livestock and fishery department, 2021).

Animals	Districts		
	Daramalo	Kucha	Arba Minch zuria
Cattle	161,731	179,221	150,798
Sheep	64,531	19,746	50,727
Goats	56,148	67,261	61,889
Poultry	184,807	108,005	354,372
Horse	2809	2138	4370
Mule	2437	1696	2310
Donkey	10,311	7678	6462
Total	482,774	385,745	630,928

trypanosome infection rate in the three selected districts of Gamo zone, Ethiopia.

2.3. *Study animals*

The study animals were local zebu (*Bos indicus*), older than 6 months of age, various body condition scores, and both sex groups. They graze together during the day time and returned to their individual owner's farmstead at late afternoon. The age of animals was determined by dentition (Food Safety Inspection Service, 2013) and categorized into three age groups young (≤3), adult (>3 and <7) and old (≥7) years. The body condition of animals was also grouped as 'good, medium and poor' settled on the appearance of ribs and dorsal spines utilized for zebu cattle (Nicholson and Butterworth, 1986).

2.3.1. *Inclusion and exclusion criteria*

Cattle above six months of age and all cattle treated within fifteen days of blood collection were excluded from the study as treated cattle are not normally expected to be positive.

2.4. *Sample size determination*

The sample size required for the study was calculated by using the formula for systematic random sampling method that described by Thrusfield (2018). The study considered 5.1% prevalence of trypanosomosis reported by Sheferaw et al. (2019), 95% confidence interval and 5% desired absolute precision. Accordingly, a total of 74 cattle were required for the study, but to improve the accuracy the sample size was increased by four fold. So, a total of 298 cattle were selected for this study.

2.5. *Sampling*

A total of nine Kebeles (Kebele is the smallest administrative unit), three from each district, were selected by purposive sampling method based on location of the Kebeles (i.e. Near Maze and Nech-Sar national parks and lake Abaya and Chamo), cattle population and vegetation type of the area that makes favorable condition for multiplication of *Glossina* spp.. The study animals were selected by systematic random sampling technique to examine the animals for trypanosome infection. In all the study Kebeles, in the morning when the animals released every 22nd cattle was selected by waiting around the entry to communal grazing areas.

2.6. *Study methodology*

2.6.1. *Parasitological examination and PCV measurement*

Blood samples were collected from ear vein by heparinized haematocrit tube; and one end of the tube sealed with Hawksley Cristaseal. Then, it was placed in microhaematocrit centrifuge and centrifuged at 12,000 rpm for 5 min. The haematocrit tube was taken from microhaematocrit centrifuge and placed on haematocrit reader, and the PCV measured. Then after, the haematocrit tubes were cut by using a diamond tip pen at about 1 mm below the buffy coat to include the most top part of RBC and 1 mm above the buffy coat. Its content expressed on to the microscopic slide and covered by the cover slide. Finally, the slide was examined with compound microscope total magnification x100 and/or x400 for the movement of motile trypanosome parasite (Uilenberg, 1998; Murray and Dexter, 1988; Murray et al., 1977).

2.6.2. *Entomological Survey and examination*

The entomological study was conducted from January 2022 to February 2022, which is dry season of the study areas. A total of 45 odour-baited (Acetone) NGU traps were deployed in the study districts, which was 15 traps in each of the three study districts. The traps were deployed at 6.32–6.37 latitude and 37.21–37.30 longitude, 5.77–6.03 latitude and 37.46–37.60 longitude, and 6.46–6.51 latitude and 37.28–3729 longitude, respectively. The altitudinal range of the traps deployment were 1004–1161 (Daramalo), 1109–1183 (Arba Minch) and 1035–1088 (Kucha) meters above sea level. The traps were coded and the deployment sites were geo-referenced by using GPS; and the vegetation types were recorded. The traps were deployed in the communal grazing areas, around watering areas and closer to trees and/or bushes that commonly visited by cattle. The traps were deployed at about 100 m intervals for 72 h.

2.7. Species, sex and apparent density of *Glossina*

After 72 h of traps deployment flies caught, tsetse fly and biting flies, were collected, counted, identified and sexed as described by Leak et al. (2008), Wall and Shearer (2001) and Pollock (1982). The species of *Glossina* were identified based on their morphology (Leak et al., 2008; Pollock, 1982), and the other biting flies according to their morphological structures as described by Wall and Shearer (2001) to genera level. The number of tsetse flies per trap per day was computed and the apparent densities was determined (Leak, 1999).

2.8. *Glossina* dissection and infection proportion determination

The collected *Glossina* flies were identified as teneral and non-teneral groups (Haines, 2013), and then non-teneral that died fresh and live *Glossina* flies were subjected to dissection and examination for trypanosome infection following the procedure described by Leak et al. (2008) and Pollock (1982). Dissected flies body parts like mid gut, salivary gland and proboscis were examined by using a compound microscope x400 and x1000 total magnification (Pollock, 1982). Giemsa stained smears were examined under oil immersion of compound microscope (100× magnifications) and the species of trypanosome were identified based on their morphological appearances (Uilenberg, 1998). The infection proportion of Glossina flies was computed by using the following formula.

$$\text{Infection rate} = \frac{\text{Number of } \textit{Glossina} \text{ flies infected}}{\text{Total number of } \textit{Glossina} \text{ flies dissected}} \times 100.$$

2.9. Data analysis

Collected data entered into Microsoft Excel spread sheet, edited and coded for ease of analysis. Then after, it was summarized by using descriptive statistics like mean or proportion, and standard deviation. The prevalence of trypanosomosis was calculated by dividing the number of positive cattle for the total number of cattle examined. The association of the risk factors for the occurrence of trypanosomosis was analyzed first by using univariable logistic regression analysis. And then was followed by multivariable logistic regression analysis of those variables non-collinear, and with p-value <0.25 in univariable logistic regression analysis. Apparent density, number of flies per traps per day, computed by dividing the total number of flies caught in 72 h for three and then by dividing for the total number of traps deployed.

For the analysis STATA version 14 (StataCorp, 4905 Lakeway Drive, College Station, Texas 77,845, USA) was used. The study considered 95% CI and 5% level of precision; and $p < 0.05$ was considered as significant.

3. Results

3.1. Parasitological results

3.1.1. Prevalence and species of trypanosome

From a total of 298 examined cattle 57 (19.1%) were found positive for trypanosome infection. The univariable and multivariable logistic regression analysis for the prevalence of trypanosome infection vs. the risk factors considered for this study is shown in Table 2.

Multicollinearity matrix showed that none of the predictive variables were collinear. Hence, the predictive variables district, age and body condition score were subjected to multivariable logistic regression analysis. The multivariable logistic regression model has Hosmer-Lemeshow chi-square (8) = 2.87, p-value = 0.942 and ROC = 0.6973, and so, there is no significant difference between the

Table 2
Univariable and multivariable logistic regression analyses with potential risk factors of trypanosomosis.

Risk factors	Category	No examined	No positive (%)	95% CI	Univariable		Multivariable	
					OR	P-value	OR	P-value
Districts	Daramalo	100	15 (15.0%)	9.2–23.5	Ref.		Ref.	
	Kucha	100	26 (26.0%)	18.3–35.5	1.91	0.057	0.95	0.341
	A/zuria	98	16 (16.3%)	10.2–25.1	0.26	0.797	1.09	0.278
Age	Young	77	15 (19.5%)	12.0–30.0	1.03	0.302	1.54	0.290
	Adult	99	25 (25.3%)	17.6–34.8	2.11	0.035	2.70	0.012
	Old	122	17 (13.9%)	8.8–21.3	Ref.		Ref	
Sex	Male	130	28 (21.5%)	15.3–29.5	0.93	0.353	–	–
	Female	168	29 (17.3%)	12.2–23.8	Ref.		–	–
BCS	Medium	108	9 (8.3%)	4.4–15.3	Ref.		Ref	
	Poor	190	48 (25.3%)	19.6–32.0	3.40	0.001	3.18	0.001
Total		298	57 (19.1%)	15.0–24.0				

Ref = Reference, OR = Odds Ratio

observed and predicted values.

Both univariable and multivariable analyses revealed that among the potential risk factors considered for this study age and body condition were significantly affecting ($p < 0.05$) the prevalence of cattle trypanosomosis.

Two species of trypanosomes (*Trypanosoma congolense* and *Trypanosoma vivax*) were identified from the two districts (Kucha and Arba Minch Zuria districts) and only one species (i.e. *Trypanosoma congolense*) was identified from Daramalo district. The overall *Trypanosoma congolense* prevalence was 15.8%, and it was the most commonly encountered species in the study areas (Table 3).

Of the total *Trypanosoma* spp. identified *T. congolense* acount for 82.4% (Fig. 2)

3.2. Hematological findings

The overall mean PCV of examined animals were 17.7% ± 5.5 (95% CI = 17.1–18.4). The mean PCV of infected and apparently healthy cattle were 14.3% ± 4.0 (95% CI = 13.3–15.4) and 18.5% ± 5.5 (95% CI = 17.8–19.2), respectively. The mean PCV of apparently healthy cattle was significantly higher than the infected animals ($t = 5.41$ and $p < 0.05$). From a total of 298 examined animals about 260 (87.2%) were with PCV <24% and only 38 non-infected cattle (12.8%) were with PCV >24%.

3.3. Entomological results

From a total of 45 NGU traps that deployed, for 72 h, in all of the study districts about 2992 flies were collected, and from these 2716 (90.8%) were *Glossina* species. The biting flies that were commonly encountered during the study period were the *Stomoxys* species 93 (3.1%) and *Tabanus* species 183 (6.1%). *Glossina pallidipes* was only species identified in all the study areas. The overall apparent density of *Glossina pallidipes* was 20.1 F/T/D and that of biting flies were 2.04 F/T/D. (Table 4). The overall sex proportion of Male and female *Glossina pallidipes* was 29.6% and 70.4%, respectively.

3.4. Glossina infection rate

A total of 307 *Glossina pallidipes* were dissected, and 28 (9.1%, 95% CI = 5.9–12.4) were found infected by *Trypanosoma* species (Table 5). Infection was significantly higher (OR = 5.5, $\chi^2 = 2.86$, $p < 0.05$) in flies trapped from riverine areas. *T. congolense* and *T. vivax* accounted for 71.4% ($n = 20$) and 28.6% ($n = 8$) infection of the flies, respectively. Infection rate of male (9.0%, 95% CI = 4.0–18.7) and female (9.2%, 95% CI = 6.1–13.6) *Glossina pallidipes* were not statistically different (OR = 0.97, $\chi^2 = 0.05$, $p < 0.958$). *Glossina* infection rate was 3.2 times more in Kucha district (17.7%, 95% CI = 10.0–29.4%, $p < 0.05$) than in Arba-Minch zuria (6.3%, 95% CI = 3.5–11.1%) 1.4 time more in Daramalo district (8.5%, 95% CI = 3.8–17.7%) than in Arba-Minch zuria. Infection of the flies was mainly observed in mid gut (6.5%, 95% CI = 4.2–9.9) and proboscis (2.6%, 95% CI = 1.3–5.1).

4. Discussion

The overall prevalence of cattle trypanosomosis in selected districts of Gofa zone is 19.1%; and no significant variation was observed between the districts. But it was relatively higher in Kucha district. The ecological conditions of the districts were more or less similar. This prevalence is comparable with the report from Zaba Goza district (Dawuro zone) by Mathewos et al. (2022), but comparatively lower than the reports from different areas of Gamo zone and Omo-Ghibe tsetse belt (Seyoum et al., 2022; Abebe et al., 2017; Girma et al., 2014) and the neighbouring zone, Dawuro zone (Sheferaw et al., 2019). The univariable logistic regression analyses revealed that the prevalence of cattle trypanosomosis was significantly higher in adult (OR = 2.11, $p < 0.05$) and poor condition animals (OR = 3.4, $p < 0.05$). It is difficult to conclude that poor body condition is the risk factor for trypanosomosis, because it could be the outcome of this disease or other factors. Trypanosomosis is a chronic and wasting disease (Constable et al., 2017). *Trypanosoma congolense* (15.8% and 95% CI = 12.0–20.4) and *T. vivax* (2.3%) were the two species of trypanosome that identified in this study. *Trypanosoma congolense* (95% CI = 12.0–20.4) was the dominant species compared to *T. vivax* (95% CI = 1.1–4.9). This is the commonly reported *Trypanosoma* species in Gamo zone and surrounding (Sheferaw et al., 2019; Lejebo et al., 2019; Girma et al., 2014; Ayele et al., 2012; Zecharias and Zeryehun, 2012; Seyoum et al., 2022; Abebe et al., 2017; Hundessa et al., 2021; Balcha, 2019; Sheferaw et al., 2016). Generally, *T. congolense* is more prevalent in areas where *Glossina* spp. is predominating.

The multivariable logistic regression analyses also revealed that the prevalence of trypanosomosis was significantly (OR = 2.70, $p < 0.05$ and OR = 3.18, $p < 0.05$) higher in adult and poor body condition cattle. Since one of the effects of trypanosomosis progressive wasting (Constable et al., 2017), poor body condition is not necessarily considered as predisposing factor. Higher prevalence of

Table 3
Proportion of *Trypanosoma* spp. identified in cattle from the three districts.

Districts	Examined animals	Infected animals	*Trypanosoma* spp. and No. Positive (%)			Total prevalence
			T. congolense	*T. vivax*	Mixed	
Daramalo	100	15	15(15.0%)	–	–	15.0%
Kucha	100	26	19(19.0%)	5(5.0%)	2(2.0%)	26.0%
Arba Minch	98	16	13(13.3%)	2(2.0%)	1(1.0%)	16.3%
Overall	298	57	47(15.8%)	7(2.3%)	3(1.0%)	19.1%

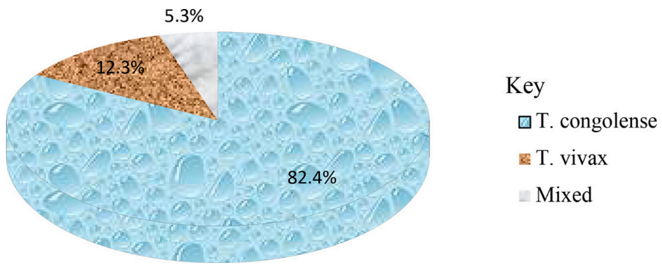

Fig. 2. Proportion of *Trypanosoma* spp. identified in cattle.

Table 4
Proportion of flies caught and F/T/D in the study areas.

Districts	Traps	Days	G. species found		Other biting flies caught			
			G. pallidipes	F/T/D	*Stomoxys*	*Tabanus*	Total	F/T/D
Daramalo	15	3	1583	35.2	25	39	64	1.4
Kucha	15	3	651	14.5	27	55	82	1.8
A/zuria	15	3	482	10.7	41	89	130	2.9
Overall	45	3	2716	20.1	93	183	276	2.0

Table 5
Univariable logistic regression analysis of *Glossina pallidipes* infection vs. potential risk factors.

Variables	Category	No. flies dissected	No. infected (%)	95% CI	OR	χ^2	*P*-value
Districts	A/zuria	174	11 (6.3%)	3.5–11.1	Rf.	–	–
	Daramalo	71	6 (8.5%)	3.8–17.7	1.4	0.59	0.553
	Kucha	62	11 (17.7%)	10.0–29.4	3.2	2.6	0.011
Veg.	WGL	139	11 (7.9%)	4.4–13.8	2.0	1.2	0.234
	RF	69	13 (18.8%)	11.2–29.9	5.5	2.86	0.004
	BUL	99	4 (4.0%)	1.5–10.4	Ref.	–	–
Sex	M	67	6 (9.0%)	4.0–18.7	Rf.	–	–
	F	240	22 (9.2%)	6.1–13.6	1.0	0.05	0.958
Overall		307	28 (9.1%)	5.9–12.4			

NB. WGL = Wood grass land, RF = Riverine forest and BUL = Bush land

trypanosomosis was recorded in adult cattle than in younger and older. According to Wellde et al. (1981) the younger cattle might be more resistant to trypanosome infection than the adults. This might be related to the higher rates of defensive movements by the young cattle that reduced the risk of contracting trypanosomosis (Torr and Mangwiro, 2000). Also it might be related to the exposure to biting flies increase with age, higher in adults than in younger. Because the younger animals might protected to some extent by the antibody derived from the dam, and the older animals might acquire some level of resistance to infection through repeated exposure that is if the there is a limited number of trypanosome serodeme to which the cattle exposed (Leak, 1999). Moreover, the younger animals kept around homestead and not let with cows i.e. for sake of milk production (Rowlands et al., 1993).

The overall mean PCV of studied cattle was 17.7%, which is below the minimum cut point for anaemia in cattle. The mean PCV of infected cattle (14.3%) was significantly ($t = 5.41$, $p < 0.05$) lower than apparently healthy cattle (18.5%). But overall the mean of all studied cattle were below the normal range. This might be due to the effect of the study period i.e. dry period when there was severe feed scarcity for animals (Sawadogo et al., 1991). Also the influence of internal parasites and ticks on PCV should be credited (Dwinger et al., 1994). The mean PCV of infected cattle was significantly ($t = 5.41$ and $p < 0.05$) lower than in the apparently health animals as also reported from various parts of the country (Seyoum et al., 2022; Hundessa et al., 2021; Balcha, 2019; Eyasu et al., 2021; Desta et al., 2013).The lower PCV in infected animals could either due to the impact of trypanosome or nutrition problem or other blood parasites.

Glossina pallidipes was the only biological vector that was caught in the study areas. It is highly distributed in eastern Africa (Leak, 1999; Pollock, 1982), and the most reported from south western part of Ethiopia (Seyoum et al., 2022; Eyasu et al., 2021; Sheferaw et al., 2019; Desta et al., 2013). By using 45 NGU traps a total of 2716 *Glossina pallidipes* (803 Male and 1913 Female) was caught, and the overall fly per trap per day was 20.1 (i.e. 4.9F/T/D and 14.5 F/T/D of male and female, respectively). A higher proportion of female (70.4%) *Glossina pallidipes* was caught than the male (29.6%). It is due to the reason that the females live longer than the males; and hence, a field population of *Glossina* spp. normally has more females than males (Leak, 1999; Pollock, 1982). The overall infection rate of *Glossina pallidipes* was 9.1% (95% CI = 5.9–12.4), which is in a general agreement with the systematic review and meta-analysis report (95% CI = 8.1–12.4) of Abdi et al. (2017). There is no significant difference ($\chi^2 = 0.96$, $p > 0.05$) between male (9.0%, 95% CI = 4.0–18.7%) and female (9.2%, 95% CI = 6.1–13.6%) *Glossina pallidipes* infection rate. According to Leak (1999) when age is taken in to account, infection rates of males and females are more or less equal. *Trypanosoma* spp. was observed in the proboscis (28.6%) and mid-gut (71.4%) of infected *Glossina pallidipes*. According to Rotureau and Den Abbeele (2013) *T. congolense* develop and differentiated into trypomastigote in the mid gut, while *T. vivax* restricted in the proboscis. So, more proportion of flies infected by *T. congolense*, and it is reflected on the prevalence of *T. congolense* infection of cattle.

5. Conclusion and recommendation

The parasitological examination of blood revealed an overall cattle trypanosomosis prevalence of 19.1%, which is high enough to hamper livestock productivity. The species of *Trypanosoma* circulating in the study areas were *T. congolense* and *T. vivax*; and *T. congolense* was more frequently observed. Among the risk factors considered for this study age and body condition of cattle were found to affect the prevalence of trypanosomosis. *Glossina pallidipes* was the only species of *Glossina* enountered during the study period; and the overall apparent density of this fly was 20.1 F/T/D. In the study areas, *Trypanosoma* spp. infection rate of *G. pallidipes* was 9.1%.

So, for the control of the disease and vector strong extension work shall be implemented. Mobilizing and practicing community based control program in the areas is by far helpful to reduce the problem.

6. Limitations

The study was limited to only dry period, and hence, it is impossible to appreciate the seasonal picture of trypanosomosis and its vectors. Absence of molecular or highly sensitive serological test/s.

Ethical approval

Informed consent was obtained from owners

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Consent for publication

All authors checked the manuscript and approved for publication

CRediT authorship contribution statement

Amsayas Tsolo: Conceptualization, Data curation, Writing – original draft. **Kokeb Kore:** Data curation, Methodology, Supervision. **Desie Sheferaw:** Conceptualization, Formal analysis, Methodology, Writing – review & editing.

Declaration of competing interest

The authors declare no competing interest

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