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Prevalence of Trypanosomosis in Domestic Ruminants in Dawro Zone, Ethiopia

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Abstract: African animal trypanosomosis is the major constraint of livestock production in tsetse infested areas of Ethiopia and is the major challenge in Dawro zone. A cross-sectional study was conducted from November, 2017 to June, 2018 in the area with the aims of assessing the prevalence and risk factors of ruminants' trypanosomosis. The parasitological technique was conducted. Blood sample was collected from the marginal ear vein of 302 cattle, 126 sheep and 103 goats and tested at Tarcha Veterinary Laboratory. The data were analyzed using binary logistic regression. The findings of this study showed the overall prevalence of 15.6% (95% CI: 12.5%-18.7%) and the prevalence of 23.8% (95% CI: 19%-29.6%) in cattle, 4% (CI: 6%-7.4%) in sheep and 5.8% (CI: 1.3%-10.3%) in goats. The risk factors such as age (P-value = 0.01, OR = 3.3), coat color (OR = 2.6, P-value = 0.009), body conditions (P-value = 0.008, OR = 0.36) and forest coverage (P-value = 0.004, OR = 0.3) in bovine and age (P-value = 0.03, OR = 0.03), coat color (P-value = 0.005, OR = 0.17), body conditions (P-value = 0.005, OR = 0.07) and forest coverage (P-value = 0.04, OR = 0.2) in sheep and goats showed statistically significant association in the prevalence of trypanosomosis.

Key words: Bovine · Caprine · Dawro Zone · Ethiopia · Ovine · Prevalence · Risk Factors

INTRODUCTION

African Animal Trypanosomosis (AAT) is a vector born disease of livestock caused by haemo-parasites of the genus known as *Trypanosoma.* The parasite found in the blood and tissues of vertebrates including livestock, wildlife and people. It is considered to be one of the major constraints in improving livestock and agricultural production in Sub-Saharan Africa including Ethiopia [1]. Trypanosomosis is one of the major impediments to livestock development and agricultural production, which negatively affect the overall development in agriculture in general and to food self-reliance efforts of the nation in particular [2]. It is the common diseases of livestock in Ethiopia affecting livestock production and productivity particularly in cattle [2]. According to the Food and Agriculture Organization of the United Nations [3], it is probably the only disease which has been profoundly affecting the settlement and economic development of a major part of the continent.

The disease occurs in 37 Sub-Saharan Africa countries covering about 9 million km^2, an area which corresponds approximately to one-third of the total area of Africa [4]. An estimated 45 to 60 million cattle, 7 million equines, 1.8 million camels and about tens of millions of small ruminants are at risk of contracting trypanosomes [5, 6]. FAO estimates that about three million of cattle will die each year due to AAT [7]. The disease has been contributing to the direct and indirect economic losses to crop and livestock production in several countries of Africa including Ethiopia. In Ethiopia, trypanosomosis is widespread in domestic livestock in the Western, South and South-western lowland regions and the associated tsetse infested river basins (i.e. Abay, Ghibe, Omo, Baro/Akobo and Rift Valley) [8].

The tsetse fly (genus: *Glossina*) is the vector of trypanosomosis occurs only in sub-Saharan Africa. In other parts of the world, the transmission of pathogenic trypanosomes to animals is believed to be non-cyclical or mechanical and is effected mainly by blood sucking

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arthropods [2]. Currently about 220,000 Km^2 areas of the Western, South and South-western lowland regions are infested with five species of tsetse flies namely *G. Pallidipes*, *G. m. submorsitans*, *G. fuscipes*, *G. tachinoides* and *G. longipennis* [9] and these fertile lands are excluded from agricultural activities. The most important trypanosome species affecting livestock in Ethiopia are *T. congolense*, *T. vivax* and *T. brucei* in cattle, sheep and goat, *T. evansi* in camel and *T. equiperdum* in horse [8].

The prevalence and severity of diseases varies with seasons, animal species and breed, vegetation coverage, animal husbandry system, body conditions and other related factors [10]. In addition to the measurable economic impact on a national economy, the inability to sell their animal can bring severe hardship to a pastoral family with no other income sources of support [11]. The local breeds of cattle, sheep and goats are believed to be moderately susceptible to trypanosomosis. However, they are still highly affected by the diseases [10]. Therefore, this study was conducted to determine the current prevalence and associated risk factors of trypanosomosis in cattle, sheep and goats in the study areas.

MATERIALS AND METHODS

Description of the Study Area: This study was conducted from November, 2017 to June, 2018 in Dawro zone which is one of the 14 zones in Southern Nations, Nationalities and Peoples Regional State. The zone is located at about 497 km far from Addis Ababa, capital city of Ethiopia and 319 km South West of Hawassa, the capital city of the SNNP regional state. Geographically, it is roughly lies between 6°59'-7°35' North Latitude and 36°6'-37°53' East Longitude and the altitude of the zone is between 1300-3500 meter above sea level [12]. It is bordered with Oromiya region in the North West, KembataTembaro Zone in the North East, Wolaita Zone in the East, Gamo Gofa Zone in the South and Konta special Woreda in the West. The total area of the zone is estimated to be 4,436 square kilometers and it shares 4.07% of the total area of the region. The population size of the zone is 617,897 accounting nearly 3.3% of the total population of the Region. The livestock population of the zone comprises of 765,179 cattle, 366,342 sheep, 175,867 goats, 29,747 horses, 24,980 donkeys, 37,462 mules and 957,213 poultry. In study area, livestock are managed under traditional management system [13].

The mean annual rain falls and the temperature of Dawro Zone ranges from 1201-1800mm and 15.1-34.5°C, respectively. Among many rivers, Omo (Gilgel Gibe III hydroelectric power project is currently under operation) is one of the region's biggest drainage basins which flows and surrounded the zone. River Omo is the longest rivers bordering Dawro zones and other river basins within the zone which create suitable agro-ecology for the tsetse fly include Gojeb and Manisa river basins. Due to the activities and intervention of man and animals, forest resource is changed in to crop and grazing land. The dominant natural vegetations are mainly broad-leafed forest like Weira, Tide, Zigba, Koso, Tikure inchet, Bamboo tree, etc. The zonal agro–ecological zones are midland, lowland and highland. About 41%, 38% and 21% of the zonal land is expressed under midland, lowland and highland from the total agro-ecological zones, respectively. The three agro-ecological zones are suitable for agricultural production and human settlement. The mean annual temperature and rain fall of Tocha district are15.1-25°C and 1401-1800mm respectively and the altitude is 501-3000m. In addition, the mean annual temperature and rain fall of Tarcha town are 20.1-25°C and 1401-1800mm respectively and the altitude of 501-2500m [13].

Study Design: Cross-sectional study was performed for the achievement of the predetermined research objectives.

Study Population: The study animals were indigenous local breeds of zebu cattle (because of the inaccessibility of exotic breed cattle) of the ages greater than or equals to one year (their exposure to the vectors is found high) and all shoat populations of six months (because considering the average age on which these animals have enough exposures to the vectors) and above ages old. All the studied animals were kept under traditional management (extensive) production systems. The ages of cattle were determined by dentition [14] but the ages of shoats were determined by dentition in addition to the history obtained from the farmers in the community.

Sample Size Determination: Sample size was determined according to Thrusfield [15] formula which stated as:

$$n = \frac{1.96^2 \text{ x } P (1-P)}{d^2}$$

where:

n = Required sample size

P = Expected prevalence
d = Absolute precision

According to Teklebirhan, Kifleyohannes and Tonamo [16], the prevalence of bovine trypanosomosis in similar agro-ecology in the zone of the study area was reported to be 26.82% and according to Bedaso, H. Seifu and Getachew [17], the prevalence of the disease in sheep and goats in nearly the same agro-ecology was 9% and 7.2%, respectively. The absolute precision at 95% CI is (0.05). Replacing each value in the above formula was resulted in 302 cattle, 126 sheep and 103 goats. Therefore, the total numbers of domestic ruminants required to determine the prevalence of trypanosomosis in the current study areas were 531.

Sampling Strategy: In this study, Tocha district and Tarcha Town Administration of Dawro zone were selected purposively. These two study areas were selected based on prevalence of trypanosomosis, apparent tsetse density and the history of previous application of control intervention strategies of trypanosomosis and its vectors and the availability of study animal populations in the areas. From the two study areas, the numbers of Kebeles and study animals were determined by proportional sampling methods (all 3 kebeles in Tarcha and 17 kebeles from Tocha, the total of 20 Kebeles were lowland in agro-ecology with the history of trypanosomosis control interventions). Then, the determined 5 Kebeles from Tocha district and 1 Kebele from Tarcha town were selected by using simple random sampling methods from the lists of peasant associations with past and present history of tsetse and trypanosomosis intervention strategies (in Some peasant associations there is no the history of application of control intervention strategies of tsetse and trypanosomosis) in collaboration with the Dawro Zone Livestock and Fishery Development Department. Study animals of all species were selected by using simple random sampling strategies.

Sample Collection

Retrospective Data Collection: At the beginning of this study, retrospective data of about ten years was collected from Wolaita Soddo Tsetse and Trypanosomosis Investigation and Control sub center operation office which is the only station assigned to perform local trypanosomosis control intervention and follow up the situation in the study area. Baseline data concerning the prevalence of trypanosomosis and prevalent species in domestic ruminants, the apparent density and species of *Glossina* circulating in the study areas before intervention commencement were collected. Furthermore, the data related to the type, frequencies and efficacy of the control interventions that applied so far in the study areas were gathered. In this data collection, the laboratory procedures that were undertaken for animal species were the same and the sample sizes were also approximately the same.

Blood Sample Collection: To perform parasitological tests or to determine the packed cell volume (PCV%) and the existing *Trypanosoma* parasite species, 50μl of the blood samples were collected aseptically by puncturing the marginal ear veins of each animal species using sterile blood lancet and heparinized capillary tubes that filled 3/4th of the height and sealed with soap after restraining the animals according to the procedures and steps indicated in OIE terrestrial manual [18]. Corresponding to each sample; the species, age, sex, coat color, body conditions, forest coverage, kebeles and herd or flock sizes registered on a separate data collection sheet.

Parasitological Laboratory Examination: A small quantity of blood samples were collected into heparinized hematocrit capillary tubes (that filled up to about ¾ of its height) from marginal ear vein by pricking the tip with a sterile blood lancet after properly securing the animal and aseptically preparing the area according to the procedures indicated by OIE diagnostic manual [18].

Buffy Coat Technique: Buffy coat technique was performed. The capillary tube was cut 1 mm below and 3mm above the Buffy coat using diamond pencil since *Trypanosoma* species are found in the Buffy coat layer of the blood sample. The content of the capillary tube was expressed onto a clean microscope slide and covered with a 22x22 mm cover slip. Then the slide was examined for *Trypanosoma* parasite based on the type of movement in the microscopic field with 400x objective and 10x eye piece lens magnification light microscopy [1].

Packed Cell Volume (PCV) Determination: The collected blood samples were centrifuged at 12,000 revolutions per minute for 5 minutes according to the steps stated by OIE laboratory manual [18]. The centrifuged capillary tubes with blood were then measured by hematocrit reader and the reading was recorded in percentage. Then the packed cell volume (PCV) value of each domestic ruminant's was recorded. Then the cattle with PCV<24% were considered as anaemic and those with PCV$\geq$24% were taken as non-anaemic [1]. The sheep and goats with PCV≥24% were judged as non-anaemic and those with PCV<24% were categorized as anaemic [19].

Data Management and Analysis: Data was categorized, filtered, coded and entered in to MS Excel and was transferred to Statistical Package for Social Sciences (SPSS) Software version 20 [20]. Prevalence of *Trypanosoma* infection was calculated as the number of positive animals divided by the total number of animals multiplied by 100. The statistical significance of prevalence of trypanosomosis in different explanatory variables (species, sex, breed, coat color, age, body condition, *Trypanosoma* species and forest coverage) was discussed by analyzing the data with the binary logistic regression and using the *P-values* from analysis. A binary logistic regression analysis was also conducted in order to establish the magnitudes of association of different risk factors with Buffy coat trypanosomosis positivity. The mean PCV% of the parasitaemic and aparasitaemic for trypanosomosis were determined by Independent sample t-test analysis after classifying and grouping collected data with their disease status.

The Ethical Consideration: During blood sample collection, all procedures that avoid pain, distress, morbidity, death or secure animal safety were applied. Blood samples were not taken from physically emaciated and known diseased animals. 50μl of blood samples were collected. These concepts were reflected in the regulations and guidelines that govern this research to the end of the use of animals.

RESULTS

Parasitological Laboratory Findings: In the current study, 531 blood samples of domestic ruminants were collected and processed in the Tarcha Veterinary laboratory in collaboration with Wolaita Soddo Tsetse and Trypanosomosis Investigation and Control Station (WSTTICC). Out of them, 302 were cattle, 126 sheep and 103 goats. The present study showed the prevalence of 23.8% (72/302) ×100, 4% (5/126) ×100 and 5.8% (6/103) ×100 for cattle, sheep and goats respectively. The overall prevalence of trypanosomosis in domestic ruminants was estimated to be 15.6% (83/531) ×100 with the 95% CI (12.8% - 19%). Among the different Kebeles from which samples were taken, the highest and lowest prevalence were recorded in Wara Wory and Gorika Bersa in cattle respectively. In sheep and goats the highest prevalence was recorded in Tarcha Zuria and Wara Wory Kebeles respectively compared to the other Kebeles (Table 1).

The Prevalence of Trypanosomosis Based on the Risk Factors: The findings of this study showed that the higher prevalence of *T. vivax* was recorded in cattle and sheep whereas the prevalence of *T. vivax, T. congolense* and *T. brucei* were found to be the same (1.9%) in goats. The determined prevalence of *T. congolense* was highest next to *T. vivax* and *T. brucei* in cattle. The prevailing *Trypanosoma* species with their prevalence on the domestic ruminants under study was determined and also indicated in Table 2.

The *Trypanosoma* prevalence in the three groups of domestic ruminants was determined from the findings of current study. From these findings, the highest and lowest prevalence was determined on cattle and sheep respectively.

Out of the total animals reported to be positive for one or more species of Trypanosoma, the proportion for T. vivax, T. congolense and T. brucei was found to be 56.63%, 34.94% and 8.43%, respectively for all domestic ruminants under study (Table 2). The prevalence of trypanosomosis across animal species indicated statistically significant variation (P-value = 0.005) and the odds ratio of (3.8) indicated that the prevalence of trypanosomosis in cattle is 3.8 times more in exposed group of cattle than sheep and also the second odds ratio of (0.67) indicated that the prevalence of trypanosomosis in goats is 0.67 time less in exposed goats than cattle under study.

A comparison of *Trypanosoma* prevalence between sexes of cattle was made. The higher prevalence was determined in female cattle. The variations in prevalence of disease based on sexes of study cattle was statistically not significant (*P-value* = 0.36) and the odds ratio of (0.7) shown that the disease prevalence was 0.7 times more likely less in exposed male than females. The prevalence of *Trypanosoma* infection was found higher in old age categories (45.2%) than in young cattle. This difference is statistically significant (*P-value* = 0.01) and the strength of the association is high (OR=3.3) which means trypanosomosis is 3.3 times more likely common in old than in young cattle. The highest disease prevalence was recorded in black colored cattle where gray color cattle come next. This is statistically significant (*P-value* = 0.02) and the association strength is 2.6 (OR=2.6) indicating that the disease was 2.6 times more likely common in black colored than red cattle (Table 3).

Table 1: The prevalence of trypanosomosis in domestic ruminants in various kebeles, Dawro Zone, Ethiopia

Kebele	Animal species	No examined	№ Positive	Prevalence (%)	95%CI Lower	95%CI Upper
Tarcha	Bovine	47	11	23.4	11.3	35.5
	Ovine	21	4	19	2.3	35.8
	Caprine	13	0	0.00	0.00	0.20
Lala	Bovine	51	12	23.5	11.9	35.2
	Ovine	21	0	0.00	0.00	0.13
	Caprine	18	2	11.1	3.4	25.6
Wara	Bovine	51	17	33.3	20.4	46.3
	Ovine	21	1	4.8	0.1	23.8
	Caprine	18	3	16.7	3.6	41.4
Waruma	Bovine	51	15	29.4	16.9	41.9
	Ovine	21	0	0.00	0.00	0.13
	Caprine	18	0	0.00	0.00	0.15
Gorika	Bovine	51	8	15.7	5.7	25.7
	Ovine	21	0	0.00	0.00	0.13
	Caprine	18	0	0.00	0.00	0.15
Abba	Bovine	51	9	17.6	7.2	28.1
	Ovine	21	0	0.00	0.00	0.13
	Caprine	18	0	0.00	0.00	0.15

Table 2: The composition of *Trypanosoma* species from domestic ruminants in Dawro, Ethiopia

Animal species	Tested animals	Positive animals	*Trypanosoma* species T.v	T.c	T.b	Prevalence (%) (Overall) T.v	T.c	T.b	95%CI lower	upper
Bovine	302	72	42	25	5	13.9	8.3	1.7	19	29
Ovine	126	5	3	2	0	2.4	1.6	0.00	1.7	9
Caprine	103	6	2	2	2	1.9	1.9	1.9	2.7	12.1
Over all	531	83	47	29	7	8.9	5.5	1.3	12.8	19.0

T.v = *Trypanosoma vivax,* T.c = *T.congolense and* T.b = *Trypanosoma brucei*.

The prevalence of trypanosomosis based on herd sizes was higher in small and medium but lower in large sized herd sizes of cattle. However, the trypanosomosis prevalence variation based on herd sizes shown statistically non-significant variation (*P-value* = 0.13) in reference herd size and the strength of association is also low (OR= 0.6) which shown that the prevalence of trypanosomosis in medium sized herd is 0.6 times more likely less than the small sized herd of cattle. The highest and lowest prevalence of trypanosomosis was recorded in poor and good body conditions of cattle. This was shown statistically significant variation (*P-value* = 0.008) and the association (OR= 0.36) indicated that the disease prevalence is 0.36 times more likely lower in medium than poor conditioned cattle. In addition, the highest and lowest prevalence of trypanosomosis was recorded in Riverine forest and wooded grass land respectively in cattle. This disease prevalence difference indicated statistically significant association (*P-value* = 0.014) but the strength of association is low (OR = 0.3). It means that there is 0.3 times more likely less prevalence of trypanosomosis in wooded grass land than riverine forest. These findings of prevalence of trypanosomosis on cattle based on herd size, sex, age, body conditions and forest coverage of the study area (Table 3).

The higher prevalence was determined in female of sheep and male of goats' respectively. The variations in prevalence of disease based on sexes of studied shoats was statistically not significant (*P-value* = 0.13) and the strength of association is also low (OR = 0.4). It shows that the disease prevalence was 0.4 times more likely less in exposed female than males.

The prevalence of small ruminant trypanosomosis was recorded higher in old and lower in young aged shoats. This variation in prevalence of trypanosomosis was showed statistically significant association (P-value = 0.03).

Table 3: Final model outputs for the prevalence of trypanosomosis in cattle from Dawro, Ethiopia

Species	Factors	Category	Total examined	№ Positive	Prevalence (%)	OR (95%CI OR)	*P-value*
Bovine	Sexes	Male	121	21	17.4		
		Female	181	51	28.2	0.7(0.4-1)	0.36
		Total	302	72	23.8		
	Age	≥1year≤4yrs	111	21	19		0.02
		>4years≤7yrs	160	37	23.1	0.97(0.5-2)	0.94
		>7years≤10yrs	31	14	45.2	3.3(1.3-8.7)	0.01
	Coat	Red	116	17	15		0.02
	Color	White	33	3	9	0.8(0.25-2.7)	0.76
		Black	89	33	37	2.6(1.3-5.3)	0.009
		Gray	64	19	30	2(0.9-4.6)	0.06
	Herd size	1-10	209	55	26		0.13
		11-20	70	16	23	0.6(0.3-1.3)	0.21
		21-40	23	1	4	0.2(0.5-1.3)	0.09
	BCS	Poor	146	45	31		0.014
		Medium	77	13	17	0.36(0.2-0.8)	0.008
		Good	80	14	18	0.5(0.2-1)	0.05
	Forest coverage	Riverine forest	137	41	30		0.014
		Wooded grassland	91	11	12	0.3(0.1-0.7)	0.004
		Cultivated land	74	20	27	0.6(0.3-1.3)	0.2

The strength of association is low (OR = 0.03) which shown that the prevalence of trypanosomosis in old age is 0.03 times more likely less than the young aged shoats.

The slightly higher prevalence of trypanosomosis was recorded in black shoats followed by red colored and the variation in prevalence based on coat colors of small ruminants was statistically significant (*P-value* = 0.005). But the strength of association was found low (OR = 0.17) which indicated that the disease occurrence in black was 0.17 times more likely less than red colored shoats. The higher and lower disease prevalence was recorded in poor and good body conditioned shoats respectively. This disease prevalence variation of shoats indicated statistically significant association (*P-value* = 0.005). However, the strength of association is low (OR = 0.07). This means that the prevalence is 0.07 times more likely less in medium than poor body conditioned shoats. These findings of prevalence of trypanosomosis on the potential risk factors under consideration on shoats including herd size, sex, age, body conditions and forest coverage of the study areas were shown on Table (4).

The prevalence of trypanosomosis was higher in small and lower in large sized flocks of goats. However, the higher prevalence in large sizes but lower prevalence small flocks of sheep. However, the difference in prevalence was statistically insignificant in association (*P-value* = 0.057) and the strength of association is found low (OR = 0.3). This indicated that the disease prevalence in medium sized flock is 0.3 times more likely than the disease in small sized flock of small ruminants. The highest and lowest prevalence of trypanosomosis was recorded in Riverine forest and wooded grass land in goats. In addition, the same prevalence was identified in Riverine forest and cultivated land in sheep. This disease prevalence difference in occurrence in studied areas indicated statistically significant association (*P-value* = 0.04) and the strength of association is low (OR = 0.2). This indicated that the prevalence of disease was 0.2 times more likely lower in wooded grass land than riverine forest coverage. The prevalence of trypanosomosis based on flock sizes was higher in small but lower in large sized flocks of goats but the higher and lower prevalence of disease were recorded in large and small flocks of sheep respectively. However, the difference in prevalence was statistically insignificant in association (*P-value* = 0.057) and the strength of association is found low (OR = 0.3). This indicated that the disease prevalence in medium sized flock is 0.3 times more likely than the disease in small sized flock of small ruminants. The highest and lowest prevalence of trypanosomosis was recorded in Riverine forest and wooded grass land in goats. In addition, the same prevalence was identified in Riverine forest and cultivated land in sheep. This disease prevalence difference in occurrence in studied areas indicated statistically significant association (*P-value* = 0.04) and the strength of association is low (OR = 0.2). This indicated that the prevalence of disease was 0.2 times more likely lower in wooded grass land than riverine forest coverage. The prevalence of small ruminants` trypanosomosis based on the risk factors.

Table 4: Final model outputs for the prevalence of trypanosomosis in small ruminants from Dawro Zone, Ethiopia

Species	Factors	Category	№ of examined	Positive	Prevalence (%)	OR (95%CI)	*P-value*
Sheep	Sexes	Male	58	1	1.72		
		Female	68	4	5.8	.4(0.1-1.4)	0.13
		Total	126	5	4		
	Age	≥6month≤3yrs	41	1	2.4		0.05
		>3years≤6yrs	85	4	4.7	0.03(.1-0.9)	0.03
	Coat	Red	41	2	4.9		0.05
	color	White	52	0	0	.1(.01-0.8)	0.029
		Black	33	3	9	.17(.05-0.5)	0.005
	Flock size	1-8	118	4	3.4		0.308
		9-20	8	1	12.5	0.3(0.1-1)	0.057
	BCS	Poor	44	4	9		0.02
		Medium	60	1	2	.07(.02-0.2)	0.005
		Good	22	0	0	.02(.01-.03)	0.05
	Forest coverage	Riverine forest	56	2	4		0.11
		W. grassland	42	2	5	.2(.04-.9)	0.04
		Cultivated land	27	1	4	1.2(.2-5.5)	0.8
Goat	Sexes	Male	40	3	7.5		
		Female	63	3	4.8		
		Total	103	6	5.8	*	*
	Age	>6month≤3yrs	26	1	3.8		*
		>3years≤6yrs	77	5	6.5	*	*
	Coat color	Red	40	2	5		*
		White	29	1	3.4	*	
		Black	34	3	8.8	*	*
	Flock size	1-8	80	6	7.5		*
		9-20	23	0	0	*	*
	BCS	Poor	35	3	9		*
		Medium	48	3	6	*	*
		Good	20	0	0	*	*
	Forest coverage	Riverine forest	46	2	13		*
		W. grassland	31	1	3	*	*
		Cultivated land	26	3	12	*	*

Determination of PCV or T-Test Statistics: The present study estimated an overall mean PCV% values for parasitaemic and aparasitaemic cattle which were 23.24±3.04SD and 27.37±4.18SD respectively. Similarly, the recorded mean PCV% for parasitaemic and aparasitaemic goats under study were 19.67±1.86SD and 26.73±4.19SD respectively. From these, the mean PCV% for parasitaemic and aparasitaemic shoats was estimated to be the same. The mean PCV% for parasitaemic animals was lower than the mean PCV% for aparasitaemic animals.

In the current study, 12.58% of cattle were both anemic (PCV<24%) and positive for trypanosomosis whereas; 15.24% were found to be non-anemic (PCV≥24%) but they were positive for the trypanosomosis. Whereas, for sheep under this study, 3.17% were found to be both anaemic and positive for the disease and 1.08% were non-anaemic but determined as trypanosomosis positive. For goat, 5.82% were both anaemic and diseased while 21.36% were found to be anaemic but free from disease.

DISCUSSION

The current findings indicated that the prevalence of trypanosomosis in cattle was relatively lower than previous findings including 26.82% prevalence of bovine trypanosomosis in the Loma District of Dawro Zone [16], 50% prevalence in bovine in West Gojam of Amhara Regional State [21], 25.80% prevalence of the disease in bovine in Assosa District of Benishangul Gumuz Regional State, Ethiopia [22] and the prevalence of 27.50% in Arba Minch District of Southern Ethiopia [23]. However, the prevalence of trypanosomosis in cattle from the current study was higher than the findings of different authors including; 17.90% in cattle in Bale Zone, Southern Ethiopia [24], 15.57% in East Wellega Zone, Oromiya Region [25], 13.30% in Mandura District of Benishangul Gumuz Region [26], 6.25% in Chiliga, Northwest Ethiopia [27], 5.60% in Bullen district of Metekele zone [28], 21.50% in Bambasi district, Western Ethiopia [29], 3.70% in Abaya District, Borena Zone, Ethiopia, [30], 5% in Northern

Tanzania [31], 2.5% in Upper West Region of Ghana [32], 21.33% in Konta Special District, Southern Ethiopia [33] and 1.3% in Gamo Gofa Zone, South Ethiopia [34].

The relatively higher prevalence of trypanosomosis in cattle in this study might be related to the low frequency of intervention strategies applied for tsetse and trypanosomosis, higher level of vector-host contact, lower attentions given to control the mechanical vectors of the disease, less sustainability of the control interventions in the areas, the higher distribution of the vectors, the impacts of Gilgel Gibe III hydroelectric power dam construction and not practicing of new methods of tsetse and trypanosomosis control interventions in the areas such as Sterile Insect Techniques (SIT), ground spray or air spray in wider areas and might be the use of lower numbers of impregnated targets and traps that were deployed in the studied each kebele before the time to estimate the tsetse density with the ongoing parasite and vector control programmes applied by National Institute for Tsetse Control and Eradication of Tsetse and Trypanosomosis.

The present disease findings of prevalence of trypanosomosis in sheep and goats were relatively higher than the prevalence findings of 3.75% in shoats in Upper Didessa Valley [35], 3.82% and 1.76% in sheep and goats respectively in Benishangul Gumuz Regional State [36], 3.70 and 1.96% sheep and goats respectively in Dangur District of Benishangul Gumuz Region [37], 3.33% and 4.67% prevalence in sheep and goats respectively in Kaduna of Nigeria [38], 3.6 % and 3.17% prevalence in sheep and goats respectively in Assosa District of Benishangul Gumuz Regional State, Western Ethiopia [39]. But these findings showed relatively lower prevalence of the disease in sheep and goats than the finding of the prevalence of 9% and 7.2% respectively in Mareka District of Dawuro Zone, Southern Ethiopia [17], 51.6% and 33.3% in sheep and goats respectively in Gboko local government area of Benue state [40] and 4.7% in sheep in Oyo Sate of Nigeria [41]. The lower prevalence of the disease in sheep and goats might be due to the reasons that the small ruminants most of the time have lower exposure to the vector because they were tied and stay around the human residency areas where the habitats of vectors were destroyed by human settlement and the smokers and other conditions make the areas uncomfortable for tsetse to approach.

The *Trypanosoma* species occurrence proportion of domestic ruminants under study were 56.62%, 34.39% and 8.43% found to be *T. vivax, T. congolense* and of *T. brucei* respectively. Also the prevalence of *T. vivax* was highest in cattle followed by *T. congolense* and *T. brucei* in cattle and sheep but the prevalence of *T. vivax*, *T. congolense* and *T. brucei* was found the similar in goats. These findings were in agreement with the findings of Dagnachew *et al*. [42], the study on the prevalence and vector distribution of bovine trypanosomosis in controlled and non-controlled districts bordering upper Anger Valley of East Wellega, Western Ethiopia, determined the prevalence of 63.6% and 36% for *T. vivax and T. congolense* respectively in cattle and Abera and Regassa [43] also reported that the prevalence of *Trypanosoma* species of *T. congolense* (69.2%), *T. vivax* (15.4%) and *T. brucei* (12.8%) in cattle. Bacha *et al*. [39], in addition, determined the prevalence of 40%, 26.6%, 13.3% of *T. congolense, T. vivax* and *T. brucei* respectively in sheep, 46.1%, 23% and 7.7% of *T. congolense, T. vivax* and *T. brucei* respectively in goats. All the authors concluded that the difference in prevalence among *Trypanosoma* species was highly statistically significant (P<0.05).

The prevalence of *Trypanosoma* infection between age categories within cattle indicated lowest prevalence (19%) in young and highest in old animals (45.2%). The higher disease prevalence was recorded in old ages category whereas the lower prevalence in young animals respectively. The findings of the prevalence of disease based on age categories indicated statistically significant variation (P<0.05).

The findings of this study in the age category were similar to the findings of Tekle and Mekonen [25], who determined the prevalence of infection in adult cattle to be 19.03% which is higher in old and Tesfaye and Ibrahim [22] reported 10.53% for young ages. The study on prevalence of the bovine trypanosomosis in Assosa District of Benishangul Gumuz Regional State, Ethiopia, were demonstrated variations in prevalence among different age groups and they all based on their findings concluded that the disease prevalence variation among ages of animals was statistically significant (P<0.05). However, the results showed disagreement to the findings of Ayana *et al*. [36], Lelisa *et al*. [37] and Aki *et al*. [28]. Therefore, these might be due to the reason that calves and young animals were less exposed to the vector since they were either tethered or kept close to the homestead where tsetse habitat has been destroyed or the tsetse flies do not want to approach the areas because of smoking and other non-comfortable situations. In addition, it can also be suggested that trypanosomes challenge is higher in older animals may be due to tsetse feeding preference for old animals, they have their immunities challenged and weakened and they were usually driven for grazing and watering to the habitats of vectors.

The present study determined the highest and lowest prevalence of trypanosomosis in poor and good conditioned animals respectively. There was statistically significant variation ($P<0.05$) in prevalence of trypanosomosis among the different body conditions of cattle, sheep and goats. These findings of body conditions were in agreement with Abera *et al*. [33], Girma *et al.* [34], Tesfaye and Ibrahim [22], Habte *et al*. [44], Bacha *et al*. [39] and Swai and Kaaya [31] and they all based on their findings reached in conclusion that poor body conditioned animals were highly affected compared to the rest body condition. It can be concluded based on these results that the disease is responsible to reduce the body conditions of animals or trypanosomosis infection occurs in animals with poor body conditions which are likely to have poor immunity against the disease. However, these results were in disagreement with the study findings of Lelisa *et al*. [37].

The results of prevalence of trypanosomosis based on coat colors were higher in black (37%) and lower in white (9%) colors compared to other colored cattle. The prevalence in shoats was showed higher in black and lower in white colors. The prevalence based on coat colors of cattle, sheep and goats under study, indicated statistically significant association ($P<0.05$) to domestic ruminant trypanosomosis. These findings of trypanosomosis prevalence based on coat colors is in agreement with the findings of Mekonen *et al*. [45] and Girma *et al.* [34]. These findings based on animals coat colors might be suggested to the observation that Glossina species prefers black surfaces as its strongest landing response.

The results of current study were in disagreement with the findings of Teka *et al*. [46]. The prevalence in cattle was higher in Riverine forest (30%) and slightly lower in wooded grass land (12%). The prevalence was similar in Riverine forest (4%) and wooded grass land (4%) in sheep and the prevalence in goats was relatively higher in Riverine forest (13%) and lower in wooded grass land (3%). These findings are in agreement with the findings of Pagabeleguem *et al.* [47] and Majekodunmi *et al*. [48].

The findings of this study indicated that the mean PCV% value for the parasitaemic and aparasitaemic cattle, sheep and goats under study were determined. In all animals, the mean PCV% values for aparasitaemic animals were found higher than the parasitaemic animals and the prevalence of trypanosomosis was higher in parasitaemic animals. These findings are in line with the study by Abera *et al*. [28], Habte *et al*. [33], Bacha *et al*. [39] and Aki *et al*. [44].

CONCLUSION AND RECOMMENDATION

The present study showed the prevalence of 23.8%, 4% and 5.8% for cattle, sheep and goats respectively with overall prevalence of trypanosomosis was estimated to be 15.6%. As the findings indicated that the potential risk factors facilitating the occurrence of trypanosomosis in domestic ruminants include age, body condition, coat color and forest coverage which indicated significant associations. Even though the tsetse control interventions have been on implementation, the prevalence of trypanosomosis is increasing. Based on this conclusion, the following recommendations are forwarded: appropriate control measure like sterile insect technique, air sprays and ground sprays that will be found better in efficacy will be needed to take in place. The control interventions of trypanosomosis that will be applied in the area would have to consider the potential risk factors of the disease before application like continuous treatment of diseased old, black colored and emaciated animals. Standards should be set by authorized regulatory body and a comprehensive nationwide evaluation of the impacts of applied trypanosomosis control interventions. There is a need of integrated approach with famers for the application of trypanosomosis control interventions in the areas.

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