



Epidemiology of Tick-Borne Hemoparasites of Cattle in Dabat and Lay Armachiho Districts of Amhara Region, Northwest Ethiopia

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Abstract

Tick-borne hemoparasitic diseases are economically important diseases of tropical and subtropical parts of the world. Tick-Borne hemoparasites constitute an important constraint on the livestock production in Ethiopia. A cross-sectional study was conducted from January 2024 to March 2026 in Wegera and Lay Armachiho districts of Amhara Region, Northwest Ethiopia with the objectives to quantify the epidemiology of tick-borne hemoparasites in cattle. Amultistage cluster sampling method was used for recruiting study animals. Mixed effect logistic regression was used to assess the associations between tick-borne hemoparasites and potential risk factors. A total of 450 blood samples were collected from selected study cattle and tested for the presence of tick-borne hemoparasites. The overall prevalence of tick-borne hemoparasite was 18.2% (95% CI: 0.15-0.22) in the study area. Among the tick-borne hemoparasites recorded, the species level prevalence was 8.9%, 3.8%, 4.9% and 0.7% for *A. marginale*, *A. centrale*, *B. bigemina* and *Theileria*, respectively. High prevalence of tick-borne hemoparasites was recorded in Lay Armachiho (23.1%; 95% CI, 0.178- 0.29) as compared to Dabat (13.3%; 95% CI, 0.09- 0.18) and the variation was statistically significant ($P=0.008$). Based on mixed effect logistic regression analysis, study district, body condition, communal grazing, and tick infestation were identified as potential risk factors. In conclusion, tick-borne hemoparasites are one of the most important cattle diseases in the study area. However, their knowledge to specific tick-borne hemoparasites was limited. Tick control intervention is recommended in the study area to minimize the occurrence of tick-borne hemoparasites and associated livestock production losses.

Introduction

Background

Tick-borne diseases are economically important diseases of tropical and subtropical parts of the world [1]. They have a serious economic impact on livestock sector due to decreased productivity, lowered working efficiency, increased cost for control measures and limiting introduction of genetically improved

cattle in the area and death of livestock [2]. Tick-Borne Hemoparasites (TBH) cause destruction of red blood cells resulting in anemia, jaundice, anorexia, weight loss and infertility [3]. The infection is mainly transmitted by arthropod vectors, or through blood transfusion [4].

The challenges of Tick-borne hemoparasites are growing steadily due to establishment of the tick vector in various geographical locations. In Ethiopia, anaplasmosis, babesiosis and

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theileriosis have been reported as major tick-borne diseases affecting domestic animals [5]. Environmental conditions and vegetation coverages determine the epidemiology for ticks and TBDs perpetuation [6]. The presence of tick-borne hemoparasitic disease broadly related to the presence and distribution of their vectors (ticks) in cattle [3].

Ticks are more prevalent in the warmer climates, especially in tropical and sub-tropical areas [7]. The seasonal variations within a bioclimatic zone may favour or hinder the development or activity of a tick species during certain periods [4]. Dry environmental conditions are a serious danger to ticks, particularly to the questing larvae, which are very susceptible to drying out fatally [8]. The success of tick and tick-borne hemoparasites control programs largely relies on developing a good understanding of farmers' knowledge about ticks and TBDs, their perceptions of the effectiveness of the proposed control and prevention methods in which such programs are to be designed and implemented [9]. Such information is typically gathered using the most popular and widely used Knowledge, Attitude and Practices (KAP) survey [10].

Various TBD studies have been conducted in different localities of Ethiopia. In the study area, information is scarce as there have not been any epidemiological and KAP studies conducted on ticks and TBDs in cattle. Therefore, this study was initiated to generate baseline information on the epidemiology of tick-borne hemoparasites and farmers' knowledge and control practices towards tick and tick-borne hemoparasites in cattle for developing disease control and prevention programs. It also expected to guide community-based awareness programs about ticks and tick-borne hemoparasites in the study area to improve effective tick and tick-borne hemoparasites prevention and control measures in cattle.

Statement of the problem

Tick-borne hemoparasite infections in cattle are economically important disease and major impediments to the health and productive performance of cattle in tropical and subtropical parts of the world [1]. This disease causes economic loss towards livestock production and has a negative impact on food security, animal product and by products [11]. In Ethiopia, ticks and tick-borne diseases in cattle population cause serious economic loss to smallholder farmers, the tanning industry and the country as a whole through the mortality of infected animals, decreased production, down grading and rejection of hide [12]. In addition, the influence of livestock farming practices on the spread and maintenance of TBH in cattle is poorly understood [7].

Despite the widespread distribution of various tick species across the study area little is known about the spread of harmful hemoparasite carried by ticks. Thus, there is paucity of information on TBH in the districts of Wegera and Lay Armachiho. In order to address the above problems, a study is required to fill the gaps in knowledge about the disease and its vectors in order to create baseline information that can be used to develop efficient disease control and prevention program. So, because of these problems the following research questions are formulated.

Research questions

This research work was attempted to answer the following research questions.

- ✓ What are the prevalence and its associated risk factors of tick-borne hemoparasites in cattle in the study districts?

Objectives

General objective

- The aim of this study was to quantify the epidemiology of tick-borne hemoparasites in cattle in Wegera and Lay Armachiho districts of Amhara region, Northwest Ethiopia.

Specific objectives

The specific objectives of this study are:

- To determine the prevalence and its associated risk factors of tick-borne hemoparasites in cattle in the study districts.

Significance of the Study

This study would be used to quantify the epidemiology of tick-borne hemoparasites and farmers' knowledge and control practices towards tick and tick-borne hemoparasites in cattle in the study area. To update the required bodies about the important risk factors responsible for the occurrence of tick-borne hemoparasites in cattle. The study would be promoted to future researchers to use the gap for further investigating the occurrence of this disease in cattle. Therefore, this study would facilitate zonal and regional animal health sectors used to designing and implementing effective control and prevention strategies of tick and tick-borne hemoparasitic diseases.

Materials and methods

Study area

The study was conducted in Wegera and Lay Armachiho districts in Amhara region, Northwest Ethiopia from January 2024 to March 2026. The two administrative zones were selected purposively based on their livestock population agro ecology representation and accessibility.

Wegera is one of the districts in the North Gondar Zone of the Amhara region of Ethiopia. It has latitude and longitude of 12.46°N and 37.36° E and an altitude range from 1600- 3200 meters above sea level with the average of 2900 meter above sea level. Amba Giyorgis town is the administrative center of the district. It located at 778 km from Addis Ababa and 40 km from Gondar town. The district has a total of 185,152 area coverage in hectare. The temperature and rainfall ranges between 10-28°C and 800-2100 mm, respectively. Livestock populations in the district were 178,944 cattle, 200,000 sheep, 148,764 goats, 338,719 chickens, 9,000 horses, 1,600 mules and 25,257 donkeys [13]. The human population of the district is estimated to be 267,972 (130,242 males and 137,730 females).

Lay Armachiho district is found in Central Gondar zone with an area of 1,059.33 square kilometers. It is located in Central Gondar zone, Amhara regional state, Northwest Ethiopia, located at latitude of 13°N and longitude of 37.2°E at an altitude range from 1,500-2,700 meters above sea level. The administrative center of the district is Tikel Dingay, with 29 rural and two town administrative units/kebeles. The agro climatic zone of the area is characterized as highland (7%), midland, (61%) and lowland (32%) with the temperature and rainfall ranges between 18-30°C and 800-1,500 mm, respectively.

It is located 749 kilo-meters away from Addis Ababa, the capital city of the country, and 207 kilo-meters away from Bahir Dar, the capital city of the region [14]. The livestock populations of the district were 456,522 (cattle 145,733, sheep 40,917, goats 72,247, horses 330, mules 295, donkeys 20,219 and poultry

197,000) [15]. A total human population of a district estimated to be 157,836, of whom 79,538 were males and 78,298 females.

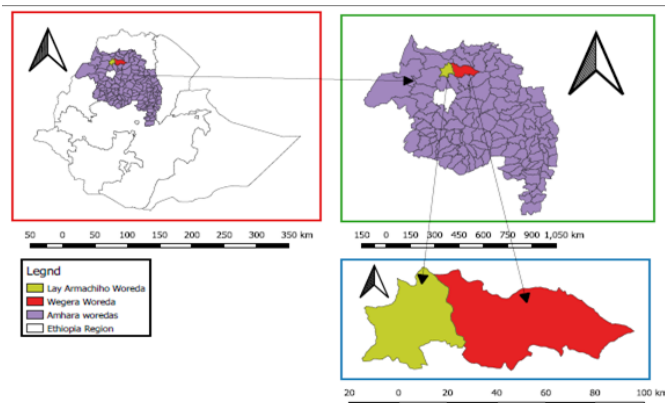


Figure 1: Maps of the study area.

Sources: QGIS software version 3.22

Study population

The study was conducted on local and cross breed of cattle with different age, sex and Body Condition Scores (BCS).

Study design

A cross-sectional study was conducted from January 2024 to March 2026. Study animals were selected by multistage cluster sampling in which herds were considered the primary sampling units and the individual cattle within the herds were considered the secondary sampling units.

Body condition scores of each cattle was evaluated during sample collection and the cattle was classified as emaciated (poor), moderate (medium) and good based on anatomical parts and the flesh and fat cover at different body parts [16]. (Annex 1). Animals were conveniently classified as young (<3 years) and adult (>3 years) age categories as described by [17]. Herd selection was randomly made based on their location by village and the willingness of the farmers to participate in the study. Since cattle from the adjacent villages share common grazing land and watering point, therefore, few village clusters per kebele were selected.

Sample size determination and sampling method

Sample size was calculated using the method described by [18,19 and 20]. The sample size to estimate the prevalence of tick borne hemoparasites with a specified precision is given by:

$$n = gc = \frac{P(1-P)D}{SE^2} = \frac{25 \times 18 \times 0.5(1-0.5)}{0.05^2} \times 4.6 = 460$$

Where:

n = sample size

P = prevalence

D = design effect

SE = standard error

g = average number of individuals sampled per cluster and

c = number of clusters

[21] Revealed that the prevalence of *T. parva*, *A. marginale* and *B. bigemina* ranged from 14% to 97% in different studies. Therefore, we used 50% expected prevalence (P) and a 5% Standard Error (SE) and adjusted for design effect (D), which was estimated using formula below.

The design effect is given by formula [18]:

$$D = 1 + (g - 1) ICC = 1 + (25 - 1) 0.15 = 4.60$$

Where g is the average number of individuals sampled per cluster, and c is the number of clusters to be sampled. The Intra-herd Correlation Coefficient (ICC) relates to the relatedness of clustered data.

Assuming an ICC of 0.15 and considering the possibility of collecting about 25 blood samples in a village per cluster, D equals 4.6. The ICC estimate was based on the reported intra-herd correlation coefficient for exposure to *A. marginale* [22]. Sampling 25 animals in a village per cluster with an expected disease prevalence of 50% and the desired precision of 5% gave approximately 18 village clusters and thus a total sample size of around 450 cattle. The clusters and the total sample size are more or less equally distributed among 2 study districts.

Multistage cluster sampling technique was used to select study districts, kebeles, villages and animals. First, administrative zones were selected purposively based on their ease of livestock population, agroecology representation and accessibility. Next districts within administrative zones, kebeles within districts, villages within kebeles and households within villages were selected randomly. List of kebeles within districts and villages within kebeles were obtained from the district agricultural office and list of household herds were obtained from the respective selected kebele development agent. Three kebeles per district and three villages within kebeles and 25 animals within villages were selected randomly. Each herd was sampled with the informed consent of its owner. There were no sex restrictions, but cattle were not eligible for sampling if they were less than six months of age.

Sample collection and examination

Blood sample collection and laboratory analysis

A total of 450 blood samples were collected from ear vein of randomly selected cattle following the standard protocol described by [23]. Briefly, after proper restraining of the animal, ear vein was disinfected with alcohol (70%) and the hair around the intended area was shaved with scalpel blade followed by a slight tearing of the vein with sterile, pyrogen free and non toxic disposable blood collection lancet. A drop of blood on a grease free clean slide was taken and spread the blood by another clean slide at angle of 45° then it was dried quickly and labeled. After labeling, it was transported to District, Veterinary parasitology laboratory.

Blood sample examination

Slides were fixed with methyl alcohol for 2 minutes. Giemsa staining and microscopic examination of the slides were conducted. The slides were immersed in 0.76% Giemsa stain solution for 30 minutes according to [24]. The excess Giemsa solution was washed using distilled water and allowed to dry by standing up right on the rack and examined under the microscope with oil immersion objective lens [25]. A minimum of 50 fields from each stained slides was examined for identification of blood parasites to say positive or negative [23]. Diagnosis of the blood parasites in the smears was based on the description of [24,26].

Babesia: It is pear shaped or round, usually centrally located in the erythrocytes and often found in pairs that are at an obtuse and acute angle to each other [24,26].

Theileria: It forms in red blood cells are mainly rod-shaped, 1.5-2µm by 0.5-1µm; however, round, oval, comma and ring shaped form may also occur in erythrocytes [26].

Anaplasma: Morphologically the genus *Anaplasma* can be described as small, often pleomorphic coccoid to ellipsoidal organisms that reside within cytoplasmic vacuoles, either singly and more often in compact inclusions. In mammalian hosts they are present in mature or immature haematopoietic cells, particularly myeloid cells and erythrocytes, in peripheral blood or tissues as well as organs of the mononuclear phagocyte system [24,26].

Data analysis

The collected data was entered into Microsoft Excel, coded and summarized using descriptive statistics. The prevalence was calculated for all data by dividing positive samples over the total number of examined samples and multiplying by hundred. All statistical analyses was done using Stata 17 statistical software. A mixed effect logistic regression model (household was taken as random effect) was used to assess the association of risk factors with the occurrence of hemiparasite infections in cattle. Districts, breed, sex, age category, health status, season, body condition score, tick infestation, communal grazing land and watering points were the predictor variables in which associations examined. Factors with p-value less than 0.25 in the univariable analysis were incorporated into the multivariable mixed effect logistic regression model. In the multivariable mixed effect logistic regression, P-value < 0.05 was considered as statistically significant and Odds Ratio (OR) and 95% CI were also calculated. Correlation, confounding and interaction tests were checked.

The socio-demographic questions were included respondents' sex, age, marital status, religion and educational status. Age class of the respondents was classified to three groups as less than 30 years, 30–45 years and greater than 45 years following previous recommendations for social science research [27].

Respondents who scored yes and/correct responses were considered as having adequate knowledge and those who scored no and/ incorrect responses were considered as having inadequate knowledge. Similarly, respondents who scored yes and/correct responses were categorized as having good practice and individuals scored no and/ incorrect responses as having poor practice. The attitude questions were set in Likert scale and were scored as 1=strongly disagree, 2=disagree, 3=uncertain, 4=agree and 5=strongly agree which depends on the nature of the statement. A farmers attitude was determined good attitude as a proportion of agree and strongly agree greater than or equal 50%, poor attitude as a proportion of disagree and strongly disagree less than 50% and neutral attitude based on the scores by respondents given for questions measuring attitude by Likert scale.

Results

Socio-demographic characteristics of the respondents

Majority of respondents (90%) in the study area were males, and 65% were aged >45 years old. More than two third of the respondents (85%) were married and 66.7% had illiterate. Besides, 100% of the study respondents were full time farmers and most of the respondents were Orthodox Christians. All (100%) of the respondents were used to reared livestock for different agricultural purposes (Table 1).

Table 1: Socio-demographic characteristics of the respondents.

Variables	Categories	Lay Armachiho	Dabat	Total
Sex	Male	56 (93.3%)	52 (86.7%)	108 (90%)
	Female	4 (6.7%)	8 (13.3%)	12 (10%)
Age group	>45	42 (70%)	36 (60%)	78 (65%)
	30-45	15 (25%)	21 (35%)	36 (30%)
	<30	3 (5%)	3 (5%)	6 (5%)
Level of educated	Illiterate	38 (63.3%)	42 (70%)	80 (66.7%)
	Basic educate	12 (20%)	10 (16.67%)	22 (18.3%)
	Elementary	7 (11.7%)	5 (8.33%)	12 (10%)
	High school	3 (5%)	3 (5%)	6 (5%)
Marital status	Married	51 (85%)	51 (85%)	102 (85%)
	Single	2 (3.3%)	4 (6.7%)	6 (5%)
	Divorce	4 (6.7%)	5 (8.3%)	9 (7.5%)
	Windowed	3 (5%)	0 (0%)	3 (2.5%)
Religion	Orthodox	60 (100%)	60 (100%)	120 (100%)

Table 2: Prevalence of tick-borne hemoparasites in cattle.

Hemoparasites	No. Positive	Prevalence (%)	(95% Conf. Interval)
<i>Anaplasma marginale</i>	40	8.9	0.06 - 0.120
<i>Anaplasma centrale</i>	17	3.8	0.022 - 0.059
<i>Babesia bigemina</i>	22	4.9	0.019 - 0.054
<i>Theileria</i>	3	0.7	0.001 - 0.019
Overall	82	18.2	0.15 - 0.22

Prevalence of tick-borne hemoparasites in cattle

A total of 450 blood samples were collected and examined using thin smear and an overall prevalence of 18.2% (95% CI, 0.15 - 0.22) was recorded in the study areas. In this study, *A. marginale*, *A. centrale*, *B. bigemina* and *Theileria* species were identified as a tick-borne hemoparasites in cattle with the prevalence of 8.9% (95% CI, 0.06 - 0.120), 3.8% (0.022 - 0.059), 4.9% (95% CI, 0.019 - 0.054) and 0.7% (95% CI, 0.001 - 0.019), respectively (Table 2).

Prevalence distribution of tick-borne hemoparasites by different categories in cattle

Prevalence distribution of TBH at genus level was 12.7% due to *Anaplasma*, 4.9% *Babesia* and 0.7% due to *Theileria* spp. Among TBH species reported 3.8%, 8.9%, 4.9% and 0.7% was due to *A. centrale*, *A. marginale*, *B. bigemina* and *Theileria* species respectively (Table 3).

Risk factors for tick-borne hemoparasites in cattle

In univariable logistic regression, the risk factors such as districts, kebeles, breed, sex, age, body condition score; season, health status, tick infestation, communal grazing land and communal watering points were analyzed. Among these factors, districts, breed, sex, health status, body condition, season, tick infestation, communal grazing land and communal watering points were found to be significantly associated with tick-borne hemoparasite infections (P<0.25) (Table 4).

Table 3: Prevalence distribution of tick-borne hemoparasites by different categories in cattle.

Variables	Categories	Number examined (%)	<i>Anaplasma centrale</i>	<i>Anaplasma marginale</i>	<i>Babesia bigemina</i>	<i>Theileria species</i>
Districts	Lay Armachiho	225 (23.1)	10 (4.4)	22 (9.8)	18 (8)	2 (0.9)
	Wegera	225 (13.3)	7 (3.1)	18 (8)	4 (1.8)	1 (0.44)
Breed	Local	335 (20.6)	15 (4.5)	34 (10.15)	18 (5.4)	2 (0.6)
	Cross	115 (11.3)	2 (0.6%)	6 (5.2)	4 (3.5)	1 (0.87)
Sex	Male	229 (15.3)	5 (2.2)	16 (6.98)	12 (5.2)	2 (0.87)
	Female	221 (21.3)	12 (5.4)	24 (10.86)	10 (4.5)	1 (0.45)
Age	Young	72 (13.9)	1 (1.4)	3 (4.16)	6 (8.3)	0 (0)
	Adult	378 (19)	16 (4.2)	37 (9.8)	16 (4.2)	3 (0.8)
Season	Dry	225 (13)	5 (2.2)	12 (5.33)	8 (3.6)	1 (0.44)
	Wet	225 (23.6)	12 (5.3)	28 (12.44)	14 (6.2)	2 (0.88)
Body condition score	Good	162 (8)	1 (0.62)	7 (4.32)	4 (2.5)	1 (0.62)
	Medium	181 (18.2)	8 (4.4)	14 (10.5)	10 (5.5)	1 (0.55)
	Poor	107 (33.6)	8 (7.5)	19 (13.08)	8 (7.5)	1 (0.93)
Tick infestation	Infested	233 (24.5)	13 (5.6)	29 (12.45)	13 (5.6)	2 (0.86)
	Non-infested	217 (13)	4 (1.8)	11 (5.07)	9 (4.1)	1 (0.46)
Health status	Sick	69 (11.6)	1 (1.5)	3 (4.35)	3 (4.3)	0 (0)
	Apparently healthy	381 (19)	16 (4.2)	37 (9.71)	19 (5)	3 (0.79)
prevalence by species		450 (18. 2)	17 (3.8)	40 (8.9)	22 (4.9)	3 (0.7)
Overall prevalence by genus		450 (18. 2)	57 (12.7)		22 (4.9)	3 (0.7)

Table 4: Univariable logistic regression analysis of risk factors associated with tick-borne hemoparasites in cattle.

Variables	Categories	Number examined	Number positive (%)	OR (95% CI)	P-value
Districts	Dabat	225	30 (13.33)	Ref.	-
	Lay Armachiho	225	52 (23.21)	0.51 (0.31- 0.84)	0.008
Breed	Cross	115	13 (11.3)	Ref.	-
	Local	335	69 (20.6)	2.01 (1.06 - 3.79)	0.032
Sex	Male	221	35 (15.83)	Ref.	-
	Female	229	47 (20.52)	0.70 (0.42- 1.13)	0.137
Age	Young	72	10 (13.9)	Ref.	-
	Adult	378	72 (19.05)	1.46 (0.71- 2.98)	0.301
Health status	Sick	69	8 (11.6)	Ref.	-
	App.H	381	74 (19.4)	1.83 (0.84 - 4.01)	0.126
Season	Dry	225	29 (12.9)	Ref.	-
	Wet	225	53 (23.55)	2.08 (1.27- 3.42)	0.004
BCS	Good	162	13 (8.02)	Ref.	-
	Medium	181	40 (22.1)	2.74 (1.49 - 5.02)	0.001
	Poor	107	29 (27.1)	2.08 (1.04 - 4.17)	0.038
Tick infestation	Non- infested	217	25 (12.9)	Ref.	-
	Infested	233	57 (24.46)	2.96 (1.77 - 4.95)	0.001
Communal grazing land	Absent	151	16 (10.6)	Ref.	-
	Present	299	66 (22.07)	2.39 (1.33 - 4.30)	0.004
Communal watering point	Absent	176	21 (11.93)	Ref.	-
	Present	274	61 (22.26)	2.11(1.24 - 3.62)	0.006

BCS: body condition score, OR: odd ratio, CI: confidence interval, Ref. : Reference App.H: Apparently Healthy.

For final mixed effect logistic regression model, factors with p-value <0.05 in the multivariable logistic regression analysis were included to fit the model. In the final multivariable logistic regression analysis; district, tick infestation, BCS and grazing land were found to be the potential risk factors for the occurrence of tick-borne hemoparasites in the study area.

The effect of tick infestation showed that higher prevalence of tick-borne hemoparasite was recorded in tick-infested (24.5%) than non-infested (12.9%). The risk of occurrence of tick-borne hemoparasite in tick-infested cattle was 5.43 times higher than non-infested cattle (OR=5.43; 95% CI=3.04- 9.68; P=0.001) (Table 5).

Table 5: Final multivariable logistic regression model of factors associated with tick-borne hemoparasites in cattle.

Variables	Categories	Number examined	Number positive (%)	OR (95%CI)	P-value
Tick infestation	Non-infested	217	25 (12.9)	Ref.	-
	Infested	233	57 (24.5)	5.43 (3.04- 9.68)	0.001
BCS	Good	162	13 (8.02)	Ref.	-
	Medium	181	40 (22.1)	2.67 (1.40- 5.08)	0.002
	Poor	107	29 (27.1)	2.15 (1.03- 4.49)	0.042
Districts	Wegera	225	30 (13.3)	Ref.	-
	Lay Armachiho	225	52 (23.1)	0.60 (0.35-1.02)	0.05
Communal grazing land	Absent	151	16 (10.6)	Ref.	-
	Present	299	66 (22.07)	5.13 (2.66- 9.91)	0.001

BCS: Body Condition Score; OR: Odd Ratio; CI: Confidence Interval; Ref.: Reference

The prevalence of tick-borne hemoparasite infection rate was significantly varied based on the body condition score of the study animals. The highest prevalence was recorded in animals with a poor body condition (27.1%) followed by medium body conditioned animals were (22.1%) and the lowest in animals with good body condition scores were (8%) (Table 5).

As indicated in table 5, the prevalence of tick-borne hemoparasites in cattle was significantly (OR=0.51; 95% CI=0.35-1.02; p=0.008) higher in Lay Armachiho (23.1%) than Wegera (13.3%). Breed of cattle was also shown a significant effect on the occurrence of hemoparasites infection in the present study (Table 5).

Animals having communal grazing land access had higher prevalence of tick-borne hemoparasite (22.07%) compared to absence of communal grazing land access (10.6%). The odds of animals having access of grazing on communal land for the occurrence of tick-borne hemoparasite were 2.39 times more likely of infection higher than in absence of grazing communal land access (Table 5).

Discussion

In the present study, the overall prevalence of tick-borne hemoparasites was found to be 18.2% in cattle in the Wegera and Lay Armachiho districts. The present result coincides with the previous report of [5] in Ethiopia and [28] in India. However, the present finding disagrees with the studies made in Ethiopia by [29-31,6,7,11,33] with a prevalence of 2.1%, 3.9%, 6.3%, 6.51%, 9.4%, 78.1% and 96.9%, respectively. The variation in the prevalence of hemoparasites could be due to the climatic factors which directly influence the vector distribution, animal husbandry practices and time of study.

The tick-borne hemoparasite prevalence distribution in the present study was varied among genus and species of the hemoparasites. In the present study *Anaplasma* was found to be the most prevalent tick-borne hemoparasites in 12.7%, this is in agreement with the previous reports of [34-36] with a prevalence of 11.25%, 11.46% and 14.4% in Pakistan, Ethiopia and Uganda, respectively. This result strongly disagrees with [5,31,37] who reported a prevalence of 1.9%, 6.8% and 8% in Ethiopia and Uganda. Similarly, the finding of the present study

disagrees with the finding of [38-41] (serological method), who reported 18.5%, 19.3%, 30.8% and 99% prevalence in Uganda, Bangladesh and Ethiopia respectively.

With regard to *Babesia*, 4.9% infections were recorded in the present study. This finding is similar with the reports of [5,42,43] who recorded prevalence of 3.64%, 5.2% and 6.1% respectively in Ethiopia. However, it disagrees with the previous studies of [3,31,44-46] who reported 0.6%, 1.5%, 11.2%, 16.9%, and 21.7% respectively in Ethiopia.

In the present study, infection of *Theileria* was comparatively lower than the other tick-borne hemoparasites in which 0.7% of prevalence in the present study. This is in line with the reports made by the [47 and 48] with a prevalence of 2.2% and 1.2% in Ethiopia and India respectively. However, it is inconsistent with reports of [28, 49 and 50] with a prevalence of 6.6%, 8% and 8.62% respectively in Ethiopia and India.

The occurrence of tick-borne hemoparasites in tick infested cattle was higher prevalence (12.7%) than tick non-infested cattle (5.5%). This variation is due to the reason that ticks are very important vectors that transmit tick-borne hemoparasites in cattle during blood sucking from the infested host.

Body condition score of study animals was significantly affected the occurrence of tick-borne hemoparasites infection. This could be due to the fact that cattle with poor body condition have lower immunity which encourages infection of animal by different hemoparasites. In addition, during this survey it was very common to see high burden of ectoparasite (ticks) on cattle with poor body condition and this can increase rate of infection from tick-borne hemoparasites. With regard to the body condition, poor body condition cattle were highly infected with the tick-borne hemoparasites. Similar result had been reported by [44]. According to the reports of [51], poor body condition cattle harbor higher number of tick infestation. Because poor body conditioned animals had reduced resistance to tick infestation and they exposed tick infestation during grazing on the field than medium and good body conditioned animals.

Animals having access of grazing on communal land was significantly affected and higher occurrence of tick-borne he-

moparasites infection than animals having no access of grazing on communal and. This could be due to the reason that cattle having access of grazing on communal land have high chance of contact with tick infected animals and tick vectors that helps the transmission of tick vectors and hemoparasites from tick infested to tick non-infested animals.

In the present finding, the occurrence of tick-borne hemoparasites in Lay Armachiho district was 11.5% in which it was higher than Wegera district (6.7%). This variation could be due to the difference in cattle management system, burden of tick and agro-climatic condition of the study areas.

Conclusion and recommendations

An overall prevalence of tick-borne hemoparasites from the present study was 18.2% and this study revealed that tick-borne hemoparasites (*Anaplasma*, *Babesia* and *Theileria*) are important cattle health problems in the study districts. The main risk factors found to be significantly associated with the occurrence of tick-borne hemoparasites were tick infestation, body condition, district, and communal grazing area. With regard to the knowledge and control practice majority of cattle owners were farmers and used to reared livestock for different agricultural purposes. Currently low level of awareness or knowledge of livestock owners about the tick-borne hemoparasites which transmitted by ticks in the study area. In conclusion, tick and tick-borne hemoparasites are one of the most important cattle diseases in the study area.

Based on the above conclusions the following recommendations are forwarded;

- Strategic tick control measures should be carried out mainly during season of high tick occurrence in order to minimize losses attributed to ticks and tick-borne hemoparasites in the area.
- Knowledge on tick-borne hemoparasites of cattle seems low among the farmers hence cattle owners should be made aware of harmful effect of the ticks and TBD through training.
- The economic impact and effects of ticks and TBD on cattle productivity should be further studied at zonal and regional level.
- Further research works on molecular level should be carried out.

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