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Prevalence of small ruminant gastrointestinal parasites infections and associated risk factors in selected districts of Bale zone, south eastern Ethiopia

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Parasitic infections pose a serious health threat and remain one of the major impediments to small ruminant production in many part of the world including Ethiopia. Given the huge economic burden of the disease, a comprehensive study covering a wider study area is of paramount importance to generate accurate information about the disease. The current study was therefore, designed with the objectives to determine the prevalence, species involved and assesses the associated risk factors of gastrointestinal parasites (GIT) of Small ruminants in Bale zone. A cross-sectional study was conducted from January to May 2016 in the purposively selected three districts of Bale zone, Southern Eastern Ethiopia. Faecal samples were randomly collected from 384 shoats (41 sheep and 343 goats) and examined coprologically. Logistic regression was used to determine the association of risk factors with positivity for GIT parasite. The study revealed an overall prevalence of 77.8% of which 63.4 and 79.6% were sheep and goats, respectively. Nine genera of parasites with the overall prevalence of Strongyloides (25.2%), Trichostrongylus (13.8%), Coccidia (15.1%), Paramphistomum (14%), Fasciola (11.5%), Ostertagia (1.5%), Haemonchus (1%), Trichuris (0.26%) and Oesophagstamum (0.26%) with mixed infection (17%) were identified in the area. By categorizing parasites, Nematode, Trematodes and Eimeria were found to infect the small ruminants in the area with the overall prevalence of 40.8, 23 and 14% respectively. Logistic regression analysis showed that the risk of GIT parasite was significantly higher in goats than sheep (OR: 2.821, CI=1.27- 6.23, *P*=0.010) and in adult than young shoats (OR=2.19, CI= 1.296-3.714, *P*=0.003). The body condition was also significantly associated with risk of positivity for GIT parasite (*P*=0.004). However, there was no significant difference in prevalence between sex and district of the study animals. Overall prevalence in districts level was found to be 81.9, 74.6 and 76.9% in Madda Walabu, Haranna Buluk and Dallo Manna districts, respectively. From the studied animals, 37.8, 29.8 and 32.2% were lightly, moderately and heavily infested, respectively. This study thus revealed that polyparasitism is a major health problem and hindrance in small ruminants' production in current study area. Therefore, periodic and strategic deworming intervention with effective broad spectrum anti-helminths, awareness creation, proper grazing system and stocking size encompassing all localities of the study area is needed to mitigate this daunting problem.

Key words: Small ruminants, goat, sheep, gastrointestinal parasites, Bale, Ethiopia

INTRODUCTION

Ethiopia possesses an estimate of 28.89 million sheep and 29.7 million goats (CSA, 2016) which are well adapted to local climatic and nutritional conditions and contribute greatly to the national economy (Alemayehun and Fletcher, 1995). Sheep and goat are integral to the livestock production systems in crop-livestock mixed agriculture in the highlands and in the pastoral and agro-pastoral livestock production. They are particularly important resources of the country as they provide more than 30% of the local meat consumption and form a vital source of income for small-scale farmers (ILCA, 2007).

However, the benefits obtained from sheep and goats to date do not match their tremendous potential and significant losses resulted each year from the death of animals as a result of lack of appropriate veterinary services, lack of attention from government and wide spread endemic diseases which are considered as bottleneck for development of this sector in the country (Dabassa et al., 2013; Abdela and Jilo, 2016; Jilo et al., 2016; Abdela, 2016, 2017). By and large, parasitic infections pose a serious health threat and limit the productivity of livestock due to the associated morbidity and mortality (Abede and Esayas, 2001; Cernanska et al., 2005). More specifically, plethora of parasitic diseases plays a detrimental role in hampering small ruminant production leading to serious economic loss (Cernanska et al., 2005).

Worldwide, parasite helminthes are major cause of losses in productivity and health problem of goat and sheep and usually associated with huge economic losses especially in resource poor region of the world (Cernanska et al., 2005). Parasite helminthes also cause susceptibility to other diseases (Kumba et al., 2003; Githigia et al., 2005). The effect of infestation by gastrointestinal helminthes varies according to the parasite concerned, the degree of infestation and other risk factors such as species, age, season and intensity of worm burden (ILCA, 1990). The problem is much more severe in tropical countries due to very favorable environmental condition for parasite transmission, poor nutrition of host animals, and poor sanitation in facilities where animals are housed. As a result diseases caused by helminthes remain one of the major impediments to small ruminant production in tropics (Kumsa and Abebe 2009). In the tropics, up 95% of sheep and goat are reported to be infected with helminthes of which Haemonchus and Trichostrongylus are the two most common involved genera (Opara et al., 2005; Gathuma et al., 2007; Mbuh et al., 2008).

Helminthosis of sheep and goat is among the endoparasite infections that are responsible for economic losses through reduced productivity and increased mortality (Perry et al., 2002). The loss through reduced productivity is related to reduction of food intake, stunted growth, reduced work capacity, cost of treatment and control of helminthosis (Pedreira et al., 2006) and losses from clinical and sub-clinical level including losses due to inferior weight gains, lower milk yields, condemnation of organs and carcasses at slaughter and mortality in massively parasitized due to parasitic diseases were documented (Regassa et al., 2006).

Although considerable work has been done on gastrointestinal parasites of sheep and goats in many parts of Ethiopia (Regassa et al., 2006; Kumsa and Abebe, 2009; Zeryehun et al., 2012; Zeleke et al., 2013; Gizachew et al., 2014; Nana, 2016), most of the studies were restricted to only small study areas with limited GIT parasites (Bitew et al., 2010; Zeleke et al., 2013; Gizachew et al., 2014; Melkamu and Asrat, 2015; Nana, 2016). Thus, there is scarcity of study on gastrointestinal parasites of small ruminants in Ethiopia in general and no report so far has been published from the current study areas. However, given the huge economic burden of the disease, a comprehensive study covering a wider study area is of paramount importance to generate accurate information about the disease and thereby, design effective disease control and prevention strategies accordingly. Therefore, the objectives of this study were to determine the prevalence of GIT parasite of small ruminants, identify major GIT parasites and to assess the possible risk factors encompassing wider areas with a wide spectrum of GIT parasite in selected districts of Bale zone.

MATERIALS AND METHODS

Study area

The study was conducted from March to May 30, 2016 in three districts of Bale zone, namely Madda Walabu, Dallo Manna and Haranna Buluk. Bale zone is located in Oromia regional state at a distance about 650 km to South East of Addis Ababa. Resource use in the Bale is largely communal though with crop cultivation and private enclosures that appear to be increasing in recent decades. The area receives bimodal pattern of rainfall, characterized by wide variety of geomorphic landscape and has eight major agro-ecological zones and eleven sub-ecologies spatial and temporal variability in both the quantity and distribution of rainfall renders the area semi-arid, with an average annual rainfall ranging from 600 to 2300 mm in the north (Figure 1).

The average temperature varies from 0 to 30°C per annum. Bale zone has about 1,566,521 cattle, 298,293 sheep, 726,394 goats, 90,685 horses, 17,272 mules, 239,705 donkeys, 710,593 poultry and 190,847 beehives (CSA, 2016).

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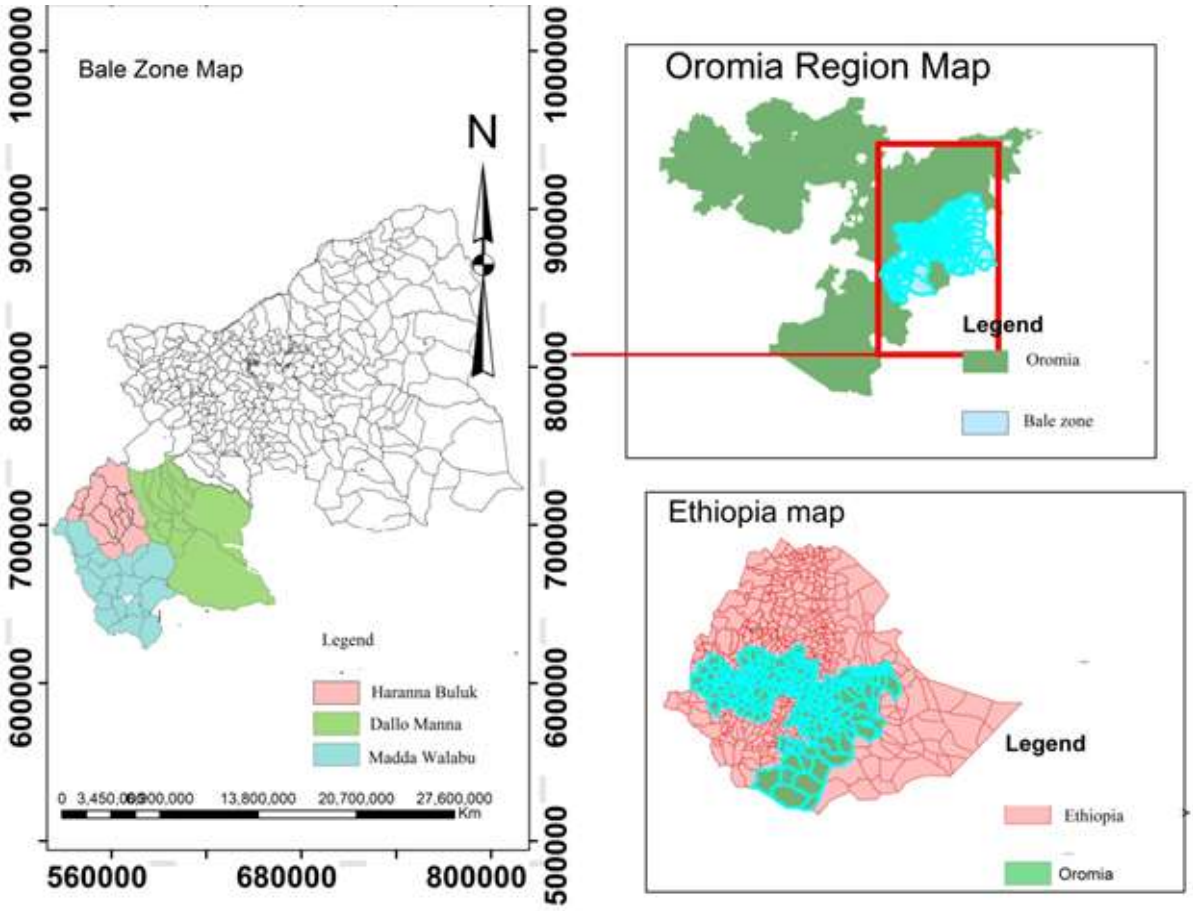

Figure 1: Map of Bale zone showing study districts

Study design and study population

Cross-sectional study design was used to determine the prevalence of GIT parasite of sheep and goat in the three districts of Bale zone. The study animals were sheep and goat in eight Peasant associations of three districts namely, Madda Walabu (Ella Bidire, Madda and Karjul); Dallo Manna (Chirri, Malka and Amana) and Haranna Buluk (Sodu Waymal, Kumbi and Shawe). All of the study animals were kept under traditional production system, featured by extensive pastoral management system where there is also agro pastoralism. Animals biodata like species, sex, age and body condition of the both species were recorded in a format prepared this purpose. Age of study animal was determined based on dentition by eruption pattern as per described by Steel (1996). Conventionally, the age was grouped as young (<2 years) and adult (≥2 years). Body condition of the animals was classified as poor, medium and good based on the appearance of animal and manual palpation of the spinus and transverse processes of lumbar vertebrae as described by Thomson and Meyer (1994).

Sample size determination and sampling technique

The desired sample size for the study was calculated using the formula given by Thrusfield (2005) with 95% confidential interval and 5 % absolute precision.

$N = 1.96^2 * P_{exp} (1\text{-}Pexp) / D^2$

Where; n =sample size, P_{exp}=expect prevalence, D=absolute precision (5%).

There was no previously published and documented prevalence in the study area. Therefore, sample size was calculated using expected prevalence of 50% by substituting the value, the required sample size was calculated to be 384 and it was collected accordingly. Simple random sampling technique was employed for selection of animal and study areas in the zone. About 10 g of fecal sample was randomly collected directly from the rectum of sheep and goats those were not dewormed for three months. The collected fecal sample were placed in universal bottles and preserved by using potassium dichromate and labeled appropriately then dispatched to Yabello Regional Veterinary Laboratory within 24 h for carpological examination. Qualitative (flotation and sedimentation) and quantitative examinations (MCmaster egg counting techniques) were employed according to Hansen and Perry (1994). The degree of infection was categorized as light moderate and severe (massive) according to their egg per gram of faeces (EPG) counts. Egg counts from 50-799, 800 1200 and over 1200 eggs per gram of feces were considered as light, moderate and massive infection, respectively (Hansen and Perry, 1994).

Statistical analysis of data

All collected data were entered to Micro-Soft Excel sheet 2010 and analyzed by SPSS version 20. Descriptive statistics was used to

Table 1. Logistic regression analysis output of risk factors associated with GIT parasite of sheep and goats in selected districts of Bale zone.

Risk factors		No. examined	No. positive	Prevalence (%)	Univariable		Multivariable	
					COR (95% CI)	P-value	AOR (95% CI)	P-value
Species	Goat	343	273	79.6	2.25 (1.131 - 4.475)	0.021	2.82 (1.27 - 6.23)	0.010
	Sheep	41	26	63.4				
Age	Adult	231	189	81.8	1.759 (1.082 - 2.859)	0.023	2.19 (1.296 - 3.714)	0.003
	Young	153	110	71.9				
Sex	Male	87	69	79.3	1.117 (0.622 - 2.006)	0.712	1.409 (0.745 - 2.663)	0.291
	Female	297	230	77.4				
Body condition	Good	125	109	87.2	Reference		Reference	
	Medium	225	166	65.0	0.352 (0.142 - 0.871)	0.010	0.278 (0.107 - 0.724)	0.004
	Poor	34	24	70.5	0.413 (0.226 - 0.755)		0.37 (0.201 - 0.707)	
District	MaddaWalabu	133	109	81.9	1.54 (0.857- 2.782)		1.874 (1.008 - 3.484)	
	Harana Buluk	117	90	76.9	1.13 (0.635 - 2.024)	0.341	1.316 (0.673 - 2.572)	0.139
	Dallo Manna	134	100	74.6	Reference		Reference	

COR =crude odd ratio, AOR= adjusted odd ratio, CI =Confidence Interval.

determine the frequency and percentage of both dependent and independent variables. The prevalence was calculated as percent of infected animals from the total number of animals examined. Logistic regression was applied to assess association of risk factors and strength of association. For statistical analysis, a confidence level of 95% and a *P*-values less than 5% were judged as significant.

RESULTS

The overall prevalence of gastrointestinal parasites in small ruminants in this study was 77.8% (299/384) while prevalence in goats and sheep were 79.6% (273/243) and 63.4% (26/41), respectively. By category, Nematode, Trematodes and Eimeria parasites were found to infect the small ruminants in the area with the overall prevalence of 40.8, 23 and 14% respectively (Table 5). The study revealed the statistically significant variation of prevalence of GIT parasite between species in which goats were 2.821 time more likely to be positive for GIT parasite than sheep (*OR*: 2.821; CI=1.27- 6.23, *P*=0.010). Body condition scores (p=0.004) and age (p=0.003) of study animals were also significantly associated with positivity for GIT parasite. Likewise, adult animals were 2.19 more likely to be prone to GIT parasite than young animals (OR=2.19, CI= 1.296-3.714, P=0.003) (Table 1).

The present study revealed statistically significant variation of prevalence of GIT parasites in relation to the body condition of animals as animal with good body condition was found more likely harbors GI parasite than poor and medium body conditioned animals (Table 4). In overall degree of infestation, 32.2% of animals were heavily, 29.8% moderately and 37.8% of animals were lightly infested (Table 4) and up on categorized parasites in to genera; nematode parasites were found the most heavily infesting parasite followed by highest degree of moderately and lightly infesting *Eimeria* species (Table 7).

Regarding GIT parasite prevalence distribution among districts the highest prevalence was recorded in Madda Walabu, 81.9% (109/133) followed by Haranna Buluk, 76.9% (90/117) and Dallo Manna district, 74.6% (100/134) which were dominated by Nematode parasites followed by Trematodes and *Eimeria* species respectively in each districts (Tables 2 and 5). However, this variation was not statically significant (p=0.139).

Table 2. Prevalence of GIT parasite at districts and peasant association level.

District	Peasant associations	Prevalence	Overall prevalence
MaddaWalabu	Ella Bidire	97.7%(44/45)	81.9 %
	Madda	68%(32/47)	
	Karjul	80.4%(33/41)	
Harana Buluk	SoduWaymal	77.0%(37/48)	76.9%
	Kumbi	57.1%(4/7)	
	Shawe	79.0%(49/62)	
Dallo Manna	Chirri	81.4%(57/70)	74.6%
	Malka Amana	67.1%(43/64)	

Concerning the prevalence at peasant associations (smallest administrative unit in Ethiopia) level heterogenic prevalence was recorded ranging from 57.1 to 97.7% in different peasant associations of the study districts (Table 2). Concerning species of parasites in study area Strongloides (25%), Trichostrongylus (13.8%), Coccidia (15.1%), Paramphistomum (14%), Fasciola (11.5%), Ostertagia(1.65%), Haemonchus (1%),Trichuris (0.7%) and Oesophagastamum (0.26%) with mixed infection (17.4%) were the most prevalent GIT parasites (Table 3).

In relation to the species of animal to parasites identified all three genera: Nematode, Trematodes and Eimeria were more prevalent in goats than sheep (Table 6). Regarding the relationship of age with specific genera of parasite; Nematodes were higher in adult; whereas Trematodes and Eimeria were higher in young animals (Table 6). In sex wise prevalence, Nematodes and Trematodes were found higher in female while Eimera oocysts were higher in male animals. This study revealed that males were 1.409 times more likely to be positive for GIT parasite than females. However, this variation were not statically significant during multivariable logistic regression analysis (OR=1.409, CI=0.745- 2.663, *P*= 0.291) (Table 6).

At the specific species, Strongloides (25.36 and 24.4%), Trichostrongylus (14.8 and 4.8%), Coccidia (15.7 and 9.7%), paramphistomum (14.5 and 9.7%), Ostertagia (1.7 and 0%), Haemonchus (1.2 and 0%), Trichuris (0.3 and 0%) and mixed infection (17.5 and 17%) were recorded in goats and sheep, respectively.

Furthermore, the prevalence of Oesophagastamum (0 and 2.4% and Fasciola (9.7 and 11.7%) were recorded in sheep and goats, respectively which were the only genus recorded more prevalently in sheep than goats (Table 3). Regarding the relationship of age with specific species of parasite; Haemonchus, Paramphistosomum, Coccidia, Oesophagastamum and mixed infection were higher in young; whereas Fasciola, Strongloides, Ostertagia, Trichostrongylus, and Trichuris were higher in adult animals (Table 3). Regarding the association of sex with GIT parasite of small ruminant the study revealed that males were 1.409 times more likely to be positive for GIT females. However, this variation were not statically significant during multivariable logistic regression analysis (OR=1.409, CI=0.745-2.663, *P*= 0.291). The parasite than prevalence of Fasciola, Paramphistosomum, Trichuris, Ostertagia, Strongloides, Trichostrongylus species and mixed infection were higher in female than males in both animals (Table 3).

DISCUSSION

The present study revealed the overall GIT parasite prevalence of 77.8% (299/384) with 79.6%(273/343) and 63.4%(26/41) in goats and sheep, respectively. This result coincides with the results of previous studies reported from different parts of Ethiopia which includes prevalence of 76.03% from Welinchity, Central Ethiopia (Moti, 2008) and79.09% from Debre Berhan, Northern Ethiopia (Achenef, 1997). The result of current study was higher than the result of different scholars. For instance, Arsi Negele (Central Ethiopia) with prevalence of 69.01% (Dilgasa et al., 2015), Haromaya town (South Eastern Ethiopia) with prevalence of 70.2% (Berisa et al., 2011), Gonder town (Northern Ethiopia) with prevalence of 70.8% (Yimer and Birhan, 2016), Walanchity (Central Ethiopia). However, the prevalence found by this study was lower than that reported from Wolayita Soddo, 86% (Dereje, 1992); Illubabor, 91.4% (Melkamu, 1991). This variation could be due to the difference in agro-ecology of area of study, season of study, sample size, methods of examination employed, flock size, management system and deworming activities performed in respective areas. In this study, there was statistically significant difference (p=0.010) in prevalence between species of animals as goats were 2.821 times more likely to be positive for GIT parasite than sheep. This result coincides with (Abebe and Esayas, 2001) and could be due to higher immune response of sheep to GI parasites than goats and the habit of mixed flock, in which sheep are relatively passive and usually graze/browse from back of the flock following more alert and voracious mass of goats in front line that may get access to more feedstuff and parasites as well.

Table 3. Prevalence of different genera of parasites in relation to species, age and sex of study animals.

		Fasciola	Strongloides	Haemonchus	Trichostrongylus	Coccidian	Ostertagia	Trichuris	Paraphistomum	Oesophagostomum	Mixed infection
Species	Caprine	9.7	25.36	1.1	14.8	15.7	1.7	0.3	14.5	0	17.5
	Ovine	11.7	24.4	0	4.8	9.7	0	0	9.7	2.4	17
	Overall	11.5	25.26	10.4	13.8	15.1	1.5	0.26	14	0.26	17
Age	Adult	12.6	28.3	0.4	15.6	10.8	2.2	0.8	11.7	0	11.7
	Young	9.7	20.1	1.9	11	21.4	0.6	0.6	17.5	0.6	26
Sex	Male	10.3	19.5	1.1	8	31	0	3.4	11.5	1.1	15
	Female	11.5	26.6	1	15.4	10.4	2	0	14.8	0	18

Table 4. Degree of parasite infestation in study animals.

Degree of infestation	Caprine n (Prevalence)	Ovine n (Prevalence)	Overall Prevalence (%)
Heavy	85(31.1%)	10(38.5%)	92(31.8%)
Moderate	84(30.7%)	6(23%)	90(30.1%)
Light	104(38%)	8(30.7%)	112(37.5%)
Total	273(79.6%)	26(63.4%)	299(77.8%)

n= Number of positive animals.

Table 5. Prevalence of grouped parasite among districts.

District	Nematode	Trematode	Eimeria	Overall
MaddaWalabu	64(58.7%)	31(28.4%)	14(12.8%)	**109(81.9 %)**
Harana Buluk	48(53.3%)	25(27.8%)	17(18.8%)	**90(76.9%)**
Dallo Manna	45(45%)	32(32%)	23(23%)	**100(74.6%)**
Overall	**157(40.8%)**	**88(23%)**	**54(14%)**	**299(77.8%)**

Regarding the prevalence of identical genera of sheep and goats are heterogeneously infested. The prevalence of identified parasites was higher in goats than sheep except Fasciola and Oesophagostomum which may account for the species susceptibility and resistance to the specific parasite. Additionally, unlike goats, sheep are grazers and may harbor Fasciola with contaminated pastures or by grazing around swampy area.

This study also revealed significant difference in prevalence of GIT parasite among different body condition scores (P=0.004). Animal with good body condition was more likely prone to the GIT parasites disagreeing with (Abebe and Esayas, 2001; Tefera et al., 2009) but we justify this that emaciation observed in studied animals might be due to malnutrition, concurrent infections and/or

Table 6. Prevalence of grouped parasite among species, sex and age of animals.

Parameters		Nematode	Trematode	Eimeria
Species	Caprine	143(41.6%)	81(23.6%)	49(14.3%)
	Ovine	14(34.1%)	7(17%)	5(12%)
	Overall	**157(40.8%)**	**88(23%)**	**54(14%)**
Sex	Male	26(30%)	18(20.6%)	25(28.7%)
	Female	130(43.7%)	69(23.2%)	31(10.4%)
Age	Adult	106(45.8%)	48(20.7%)	30(13%)
	Young	51(33.3%)	40(26.1%)	24(15.6%)

Table 7. Degree of infestation for grouped parasites.

Degree of infestation	Nematode	Trematode	Eimeria	Overall
Light	54(34.4%)	32(36.4%)	22(40.7%)	**108(36%)**
Moderate	42(26.7%)	26(29.5%)	22(40.7%)	**85(28.4%)**
Heavy	61(38.8%)	30(34.1%)	10(18.6%)	**92(30.7%)**
Overall	**157(40.8%)**	**88(23%)**	**54(14%)**	**299(77.8%)**

since more than 77% of studied animals were female lowered body condition could be due to lactation and post kidding stresses. In addition, development of an acquired immunity after prolonged exposure may obscure manifestation of clinical signs in infested animal.

Regarding association of sex with GIT parasite of small ruminant the study revealed that males were 1.409 times more likely to be positive for GIT parasite than females. However, this variation were not statically significant during multivariable logistic regression analysis (*P*= 0.291). This result agrees with (Tefera et al., 2009; Fikru et al., 2009) who showed that there is no significant association between sex of animal and prevalence of GIT parasites in small ruminants and revealed that both sexes have equal chance to get infection equally as both male and female animals are kept under similar management system. However, at the generic level the prevalence of Fasciola, paramphistosomum, Trichuris, Ostertagia, Strongloides, Trichostrongylus species and mixed infection were higher in female than males in both animals. Higher prevalence of these parasites in female animals agrees with (Emiru et al., 2013; Owusu et al., 2016) and may be due to stress and reduced immune status during pregnancy, parturient paresis and lactation periods.

The current study showed the statistically significant variation in overall prevalence of GIT parasite in age group. Adult animals were 2.19 more likely to be prone to GIT parasite than young animals. This result is in agreement with (Emiru et al., 2013). Furthermore, at level of specific species of parasite, the prevalence of Haemonchus, Paramphistomum, Coccidia, Oesophagastamum and mixed infections were higher in young; whereas Fasciola, Strongloides, Ostertagia, Trichostrongylus, and Trichuris were higher in adult animals. This result agrees with Emiru et al. (2013) and Admasu and Nurlign (2014). This variation in susceptibility could be due to nutritional factor, immune status, management system and the frequency of exposure to the respective parasite.

Regarding GIT parasite prevalence distribution among districts, the highest prevalence was recorded in Madda Walabu (81.9%) followed by Haranna Buluk (76.9%) and Dallo Manna district (74.6%). However, this variation was not statistically significant during multivariable analysis (p=0.139). At Peasant association level, parasite prevalence is highest in Ella Bidire Peasant association (97.7%) while lowest prevalence was that of Kumbi Peasant association (57.1%). Difference in agro-climate, management system and veterinary service in the respective districts and Peasant associations might attribute to the variations of prevalence recorded.

Conclusion

Present study revealed that polyparasitism is a major health problem and hindrance in small ruminants' production in current study area due to high prevalence (77.8%).

A burden of gastrointestinal parasite is distributed in heterogeneous manner among districts and respective Peasant associations; indicating uneven delivery of veterinary service and unsound husbandry and management practice among districts and Peasant associations. Therefore, periodic and strategic

deworming intervention with effective broad spectrum anti-helminths encompassing all localities of the study area is needed to mitigate this daunting problem. In addition, proper grazing system and stocking size should be practiced. Furthermore, awareness of the society toward GIT parasite has also paramount importance in prevention and control measures. Moreover, further studies are also recommended to identify the more genus and species of GIT parasites in this area.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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