

Epidemiology of Fasciolosis in Small Ruminants and Assess Control Practice in Selected Districts of East Gojjam Zone, Northwest Ethiopia

Birara Ayalneh Tamiru

Hulet Ejju Enesie District Veterinary Clinic East Gojjam Zone, Northwest Ethiopia.

ABSTRACT: A cross sectional study using questionnaire survey and coprological examination technique was conducted in Hulet Ejju Enesie and Bibugne districts of East Gojjam Zone, Northwest Ethiopia from February 2025 to January 2026 to determine the prevalence of Sheep and Goat fasciolosis, associated risk factors and their control practice. The questionnaire survey indicated that small ruminant fasciolosis control practice in the study area was poor. Among the major constraints identified by the respondents' poor management systems, pond and river watering point, marsh grazing area, shortage of anthelmintics, inaccurate dose and lack of well organized laboratory are the main ones. A total of 414 fecal samples were randomly collected directly from the rectum of individual animal. Parasitological investigation was performed using sedimentation technique. Data were analyzed using Stata version 12.0 software programs. Accordingly, an overall prevalence 41.3% was observed (56.44 %) in sheep and (7 %) in goats. A statistically significant difference ($P < 0.05$) was found in prevalence between species, age group, body condition and district for each factor associated with *Fasciola* infection. The chance of *Fasciola* infection was 17.6 times higher among ovine than those caprine. *Fasciola* infection in the current study was 6.1 and 5.6 times higher chance among small ruminants with adult and old respectively than those with young animals. Similarly *Fasciola* infection with poor and medium body conditions had 4.8 and 2.4 times higher level of infection than those with good body conditions respectively. *Fasciola* infection at Hulet Ejju Enesie was 2.7 times higher level of infection than Bibugne district. In conclusion the questionnaire survey and parasitological examination revealed that fasciolosis is a major health problem in small ruminants in both districts. Therefore, during the control and treatment of small ruminant fasciolosis age group, body condition, district and species of the animals should be considered as potential risk factors for the occurrence of parasitic disease in the study areas.

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INTRODUCTION

Fasciolosis is one of the most prevalent helminthes infections of ruminants in different parts of the world. It causes significant morbidity and mortality[1]. Both the highland *Fasciola hepatica* and the low land *Fasciola gigantica* types of liver flukes cause severe losses in many parts of Ethiopia where suitable ecological conditions for the growth and multiplication of intermediate host snails are found. Areas with slowly flowing water ways, irrigation channel, pond, marsh area and banks of rivers are among the important environment for breeding of snails' vectors of fasciolosis. This snail born trematode infection is one of the major diseases contributing to loss in productivity of livestock industry in Ethiopia[2].

Fasciolosis causes a substantial economic loss which include death, loss in carcass weight, reduction in milk yield, condemnation of affected livers, decline in production and reproductive

performances, predispose animals to other diseases and cost of treatment expenses impose serious limitations on small ruminant production in Ethiopia[3].

The prevalence and economic impact of small ruminant fasciolosis in Ethiopia were reported by several workers at different locations. The previous studies indicated that small ruminant fasciolosis is widely distributed disease with high prevalence rate and economic significant in the highlands of Ethiopia. In Ethiopia losses in ovine fasciolosis was estimated at 48.8million Ethiopian Birr per year of which 46.5%, 48.8% and 4.7% were due to mortality, productivity (weight loss and reproductive wastage) and liver condemnation respectively [4].

Small ruminants in East Gojjam Zone particularly areas bordering Choke mountains have a paramount importance for the livelihood of the people. The majority of small ruminants are sheep in highland

and midland areas while goats take the largest proportion in lowland and midland areas. Parasitic diseases often prevent them from attaining optimum productivity. However, the magnitude and the control practice of small ruminant fasciolosis is not well addressed in Hulet Ejju Enesie and Bibugne district where the present study was conducted.

Objectives of Study

General objective

The general aim of the study is to estimate the current prevalence and control practice of small ruminant fasciolosis in the study area.

Specific objectives

- To determine the current prevalence of small ruminant fasciolosis in the study areas.
- To assess the risk factors associated with the occurrence of fasciolosis.
- To assess the control practice of small ruminant fasciolosis in the study areas.

MATERIALS AND METHODS

3.1. Study areas

The study was conducted from February 2025 to January 2026 in Hulet Ejju Enesie and Bibugne districts of East Gojjam Zone, northwest Ethiopia as indicated in (Figure 1). The areas were selected purposively by considering the importance of fasciolosis in small ruminants. The district has highland, midland, and lowland agro-ecologies. Hulet Ejju Enesie is located in the East latitude and longitude of $11^{\circ}15'(11.25^{\circ})$ north $37^{\circ}45'(37.75^{\circ})$ east. With an elevation vary from 1200 to 3500m.a.s.l. The rainfall distribution varies from year to year and across seasons. Accordingly the annual rainfall distribution varies between 1150mm to 1189mm. The long rain season extends from June to September followed by a dry season October to February. The shorter rainy season lasts from March to May. The daily temperature varies from 8°c to 30°c with the average temperature of 22°c . Bibugne is located in the East latitude and longitude of $11^{\circ}00'0.00''\text{N}$ $37^{\circ}34'59.99''\text{E}$ with an average elevation of 2,216.m.a.s.l. The daily temperature varies from 7°c to 25°c . Small ruminant populations are estimated at 116124 sheep, 43727 goats and 55989 sheep, 21567 goats in Hulet Ejju Enesie and Bibugne districts respectively[5].

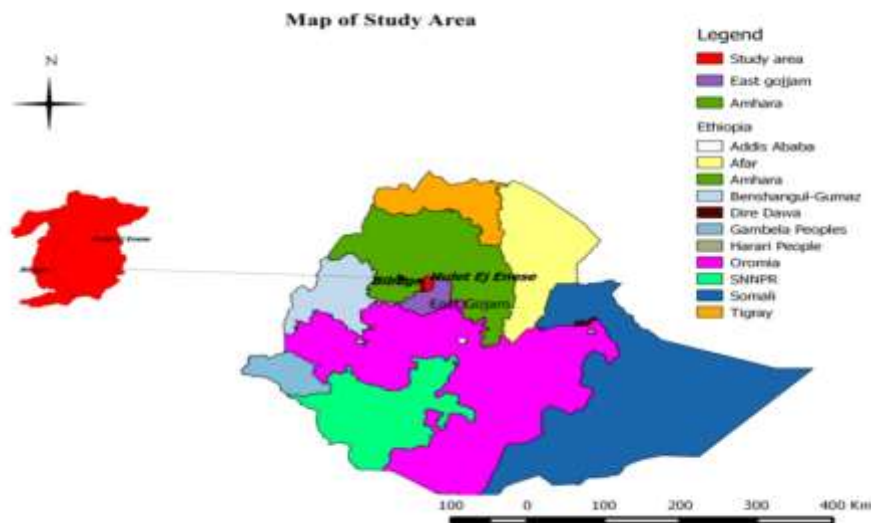


Figure 1: Map of study area. Source [6]

Study design and sample size determination

A cross-sectional study design was used to determine the prevalence of *Fasciola* infection and its associated risk factors in small ruminants in the study area. Multistage simple random sampling method was followed the study. First stage districts purposively selected, second stage peasant association and household last third stage randomly implemented for sampling of sheep and goats. Fifty six and twenty eight household were picked from Hulet Ejju Enesie and Bibugne districts respectively; each household had 3-23 small ruminants. Number of animals to be sampled was allocated proportionally. Individual animals were sampled randomly from selected household until the

sample size attained. The sample size for the study was calculated using the formula given by Thrusfield [7]. With precision level of 5%, confidence interval of 95% and the expected prevalence of 42.44% in Yilmana Densa districts surrounding the study areas[8]. Accordingly, the required sample size was 375 sheep and goats. However, in order to increase the precision 414 study animals were taken. The sample animals were 208 sheep and 68 goats from Hulet Ejju Enessie and 79 sheep and 59 goats from Bibugne districts.

$$n=1.96^2 * P_{exp} (1-P_{exp}) / d^2$$

Where n=require sample size, P_{exp} =expected prevalence, CI=confidential Interval (95%), d=desired absolute precision (5%).

Questionnaire survey

Semi-structured questionnaire format was employed to collect information on major constraints of raising small ruminant production and to assess the practice of controlling parasitic diseases. The questionnaire was tested before the actual data collection to evaluate the clarity of the questions and interpretation of the questions by the small ruminant holders and time required for an interview. Moreover, direct observation, focus group discussions and key informant interview was conducted with small ruminant owners. Sixty and forty small ruminant owners were interviewed from Hulet Ejju Enessie and Bibugne district respectively. The sample size of the respondents was determined using the formula ($n = 0.25/SE^2$) proposed by Arsham[9] at the standard error (SE) of 0.05 with 95% confidence interval.

Study animals

The study was conducted on indigenous sheep and goats kept under extensive management system owned by owners. The study population was comprised both sexes, different age and body condition groups. The age of animals was determined by dentition and were considered as less than 1 year, 1-2 years, 2-3 years, 3-4 years, more than four years and aged [10]. However, in our case less than 1 year = young, more than 1 year = adult and aged = old. Body condition score of each animal was determined based on criteria set by ESGPIP [11] using the 6 point scale starving =0, very thin=1, thin=2, moderate=3, fat=4, very fat =5. It can be assessed by palpation around the lumbar vertebrae between the back of the ribs and the front of the pelvic bones. However, in this study the animals was categorized in 0, 1 and 2= poor, 3= medium and 4 and 5= good body condition.

Sample collection and fecal examination techniques

Four hundred fourteen fresh faecal samples were collected from the rectum of each animal using disposable plastic glove. All samples were kept in clean sampling bottles containing 10% formalin as a preservative and labeled with the necessary information appropriately. The samples were transported to Motta district animal health clinic laboratory for examination. Then, the samples were processed in the laboratory using the sedimentation technique[12]. Identification of *Fasciola* eggs was done using a standard microscope with x10 objective magnification. To differentiate between eggs of *Paraphistomum* species and *Fasciola* species a drop of methylene blue solution was added to the sediment. Eggs of *Fasciola* species show yellowish brown color with an indistinct operculum and embryonic cells while eggs of *Paraphistomum* species is large and show transparent egg shell with distinct operculum and clear embryonic cells[13].

Data management and analysis

Data collected from each study animal and the laboratory results were entered into Microsoft Excel spreadsheet. Depending on the type of information collected, different analysis methods were employed using Stata version 12.0 software programs. Qualitative data was presented using descriptive statistics such as percentages and frequencies. Summarized data was presented in the form of tables and figures. The questionnaire survey data obtained in this study was summarized using descriptive statistics. The prevalence was calculated for all assumed risk factors as the number of infected individuals divided by the number of individuals sampled multiplied by 100. Factors thought to be associated with the prevalence of *Fasciola* infection were analyzed first by Pearson's chi-square test and then by multivariable logistic regression to account for confounding and interaction between variables. In the analyses, the confidence level was held at 95% and p-value less than 0.05 was considered as significant.

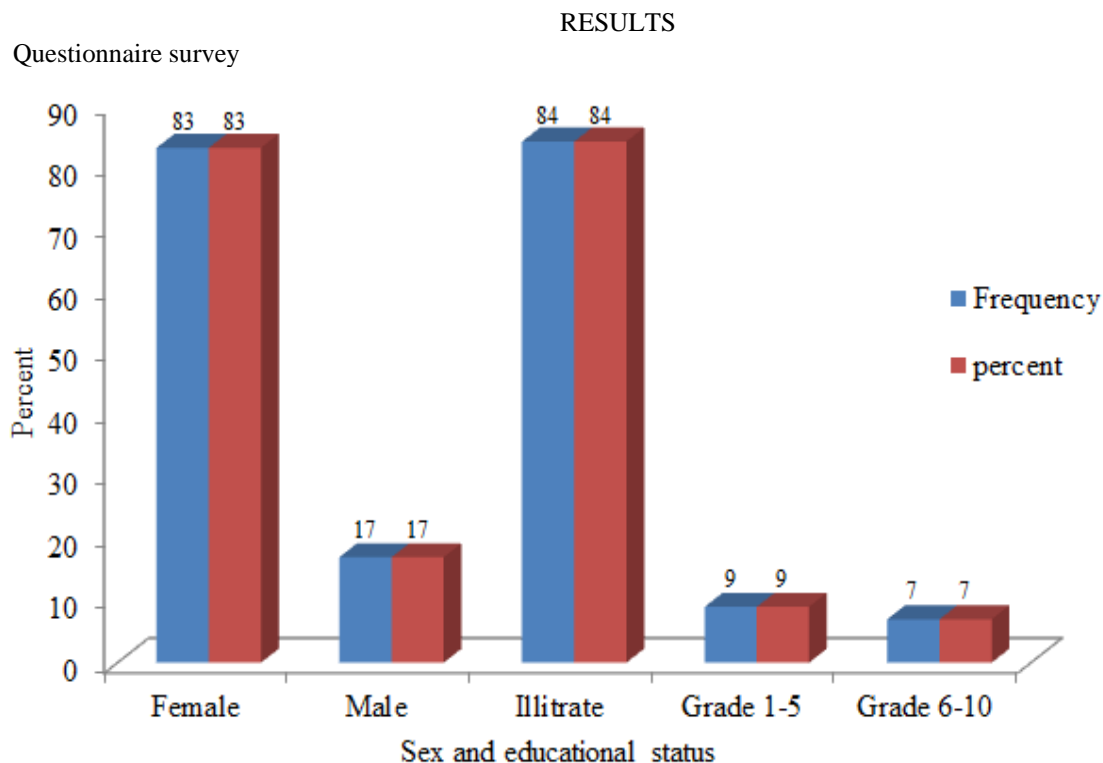


Figure 2: Socio-demographic characteristics of Hulet Ejju Enese and Bibugne districts.

This study indicates that distribution of small ruminants based on grazing area the majority of respondents said that 48% near river while the rest 14% near pond, 21% dry land and 17% marsh area. According to watering places the respondents stated that 77% river, 19% pond, 4% tap water. All of the respondents were recognized the clinical signs of fasciolosis of which 12% diarrhea, 32% emaciation, 48% bottle jaw and 8% ascites were the principal ones. Eighty seven percent of the respondents showed the source of veterinary service obtained from private and government whereas 13% from government only. However, small ruminant diagnostic techniques employed by veterinary health experts is limited from this 19%, 70% and 11% of the respondents were depend on clinical sign and history, history of the owner and without diagnosis respectively. The majority of respondents practiced anthelmintic treatment to control and prevention of small ruminant fasciolosis. Accordingly the respondents reported that albendazole was the most commonly used anthelmintic in small ruminant followed by triclabendazole and tetramisole as indicated in (Table 1).

Table 1: Proportions of respondents according to grazing area, watering point, fasciolosis clinical signs, source of veterinary service, diagnosis technique and anthelmintics used in Hulet Ejju Enese and Bibugne districts.

Parameter	Categories	Number Respondent	(%)
Grazing area	Near river	48	48
	Near pond	14	14
	Dry land	21	21
	Marsh area	17	17
Watering point	River	77	77
	Pond	14	14
	Tap water	4	4
Clinical Signs	Diarrhea	12	12
	Emaciation	32	32
	Bottle jaw	48	48
	Ascites	8	8

Source of veterinary service	Private and government	87	87
	Government	13	13
Diagnosis technique employed	Clinical sign and history	19	19
	History of the owner	70	70
	Without diagnosis	11	11
Commonly use Anthelmintics	Triclabendazole	21	21
	Albendazole	62	62
	Tetramisole	17	17

This questionnaire survey result indicated that 82% of the respondents were deworm small ruminants from July to September while the remainder 8%, 5%, and 5% of respondents deworm from October to January, February to April and May to June respectively. Regarding treatment frequency 72% of respondents treated their small ruminants once a year, 14% two times a year and 14% three times a year. Seventy six percent of the respondents stated that availability of anthelmintics was poor whereas 16% good and 8% very good. All of the respondents explained that the only control and prevention method of fasciolosis was anthelmintic deworming without measuring the body weight of the animals as indicated in (Figure 3). In addition nine veterinary professionals stated that fasciolosis control practice and veterinary service delivery in the study area is poor. They mentioned that there is lack of strategic deworming, prevention measure, available drug, accurate dose and appropriate diagnosis in their respective veterinary clinic.

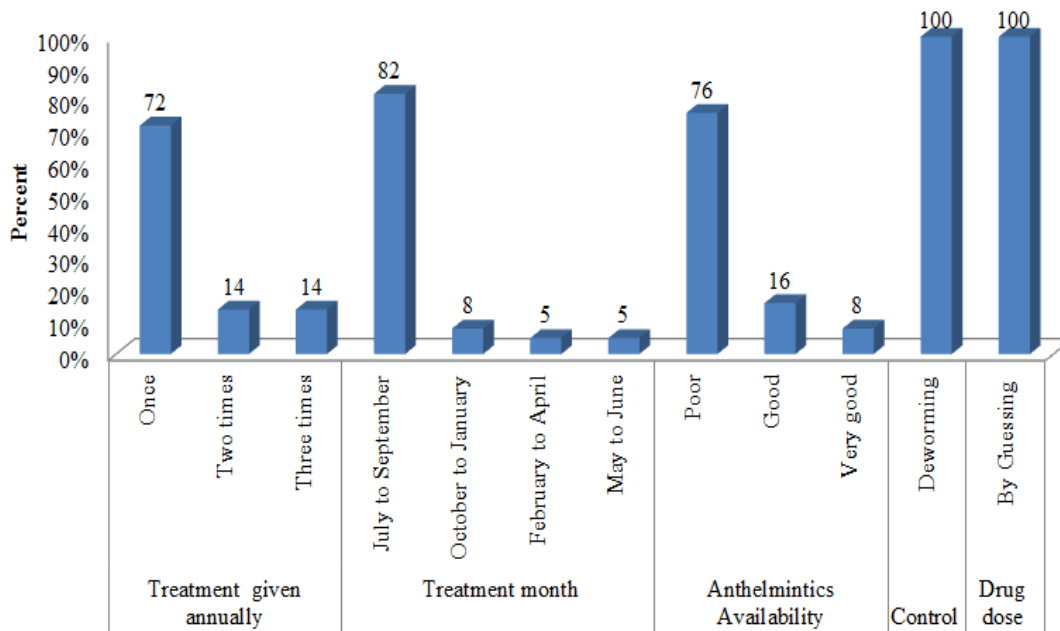


Figure 3: Proportions of respondents according to availability of anthelmintics, treatment given annually per animal, treatment month, fasciolosis control method and dose of anthelmintics in Hulet Ejju Enese and Bibugne districts.

Parasitological findings

In this study the parasitological findings indicated that the overall prevalence of small ruminant fasciolosis was 41.3%. The prevalence of *Fasciola* infection in male and female animals was 39% and 42.49% respectively. Although the prevalence was relatively higher in female, the difference was not statistically significant ($p > 0.05$) as indicated in (Table 2). Prevalence of fasciolosis varied based on species. Highest prevalence was observed in ovine 56.44% than caprine 7% with a significant difference ($p < 0.05$) as shown in (Table 2).

Table 2: Prevalence of fasciolosis based on sex and species in Hulet Ejju Enese and Bibugne districts.

Variable	Categories	Number Examined	Number Positive	Prevalence (%)	χ^2	P-value
Sex	Male	141	55	39	0.46	0.495
	Female	273	116	42.49		
Species	Goat	127	9	7	88.4	0.000
	Sheep	287	162	56.44		
Overall		414	171	41.3		

The prevalence of fasciolosis in age groups was 51.86% adult, 48.21% old and 16.24% young animals. The difference in prevalence between age groups was statically significant ($p < 0.05$) as shown in (Table 3). Prevalence of fasciolosis on poor body condition animals was 63.55%. However, animals with medium and good body condition showed prevalence of 42.65 % and 13.54% respectively as described in (Table 3). Significant difference ($p < 0.05$) was observed among body condition of the study animals. The influence of agroecology on the prevalence of small ruminant fasciolosis revealed that there was higher prevalence rate 47.82% in highland area and lower prevalence rate in midland areas 38%. But there was no significant difference on the prevalence of small ruminant fasciolosis based on agroecology ($p > 0.05$) as indicated in (Table 3). The prevalence of fasciolosis was higher in Hulet Ejju Enesie (48.55%) than Bibugne district (26.81%) and ($p < 0.05$) as shown in (Table 3).

Table 3: Prevalence of small ruminant fasciolosis with respect to different possible risk factors in Hulet Ejju Enese and Bibugne districts.

Variable	Categories	Number Examined	Number Positive	Prevalence (%)	χ^2	P-value
Age	Young	117	19	16.24	42.5	0.000
	Adult	241	125	51.86		
	Old	56	27	48.21		
Body condition	Good	96	13	13.54	52.5	0.000
	Medium	211	90	42.65		
	Poor	107	68	63.55		
Agroecology	Midland	276	105	38	3.63	0.057
	Highland	138	66	47.82		
Districts	Bibugne	138	37	26.81	17.9	0.000
	Hulet Ejju Enesie	276	134	48.55		

Multivariable logistic regression analyses as shown in (Table 4) below; among the factors shown significant in the chi-square test; species, age group, body condition and districts of the animals were the factors remained significant ($p < 0.05$) for each factor associated with *Fasciola* infection in the final multivariable logistic regression analyses. It was indicated that ovine were 17.6 times more likely to be infected than caprine. Adult and old animals were 6.1 and 5.6 times more likely to be infected than younger animals respectively. It was also observed that animals with poor and medium body conditions had 4.8 and 2.4 times higher level of infection than those with good body conditions respectively. Similarly the result indicates that prevalence of fasciolosis at Hulet Ejju Enesie was 2.7 times higher than Bibugne districts.

Table 4: Results of multivariable logistic regression analysis of those variables significant in chi-square test in Hulet Ejju Enese and Bibugne districts.

Variable	Categories	OR	Std. Err.	P> z	[95% Conf. Interval]	
Species	Caprine					
	Ovine	17.6	6.860552	0.000	8.212008	37.79318
Age	Young					
	Adult	6.1	1.995238	0.000	3.217259	11.5844
	Old	5.6	2.659332	0.000	2.211931	14.20483
Body condition	Good					
	Medium	2.4	.9484522	0.018	1.167078	5.244769
	Poor	4.8	2.093709	0.000	2.082856	11.30396
Districts	Bibugne					

Hulet Ejju	2.7	.7905465	0.000	1.556184	4.82294
Enesie					

DISCUSSION

The questionnaire survey result indicates that all respondents kept their Small ruminants under extensive management systems. This is in line with previous findings [14,15] who reported extensive systems as the most common systems of production in Degehabur Zone, Eastern Ethiopia. This is contrary to the findings of Chah *et al.*[16] who reported intensive management systems are common in Anambra State Nigeria. Distribution of small ruminants according to the grazing area the majority of respondents said that 48% near river while the rest 14% near pond, 21% dry land and 17% marshy area. Similar finding was reported by Girma *et al.* [17]. Regarding watering place the respondents stated that 77% river, 19% pond, and 4% tap water.

All the respondents recognized the clinical signs of which 12% diarrhea, 32% emaciation, 48% bottle jaw and 8% ascites were the principal one. Based on the questionnaire survey result majority of the respondents deworm small ruminants from July-September. Treatment frequency showed 72% of respondents treated their small ruminants once a year, 14% two times a year and 14% three times a year. This indicated that majority of the respondents treat their small ruminants once per year from July to September. However, effective fasciolosis control programmes involves two treatments per year. The first treatment is given at the end of rainy season October to November to eliminate the adult parasites so that the animals pass the dry season in good condition and to avoid contamination from the dry season water holes. The second treatment should be planned for the end of the dry season April to May when the immature fluke migrate through the hepatic parenchyma with drugs active against immature flukes [18].

The source of anthelmintics for the treatment of fasciolosis accounts 87% from private and government whereas 13% from government only. However, diagnostic techniques employed by veterinary health experts is limited from this 70% of the respondents' were stated depend on history of the owner while the remainder 19% and 11% of the respondents' were depend on clinical sign and history and without diagnosis respectively. The survey result indicated that animal health service in the study area is gradually being improved but cannot yet deliver complete services. One of the constraints on the veterinary services is the lack of available drugs and laboratory diagnosis. At present there are many veterinarians working in the study area but they are unable to deliver satisfactory services to meet the needs of small ruminant owners. This is also supported by the interviewed nine veterinary professionals in the study areas.

The respondents indicated that they practiced anthelmintic treatment to control and prevention of small ruminant fasciolosis. Majority of the respondents reported that albendazole was the most commonly used anthelmintic in small ruminant followed by triclabendazole and tetramisole. Small ruminant owners recognized these drugs as green, pink and white respectively based on colors particularly for illiterate farmers. All of the respondents said that the only control and prevention method of fasciolosis was anthelmintic deworming without measuring the body weight of the animals and confirmatory diagnosis when the animal shows parasitic clinical signs. This survey indicates that lack of knowledge about effective fasciolosis control strategies and anthelmintic use in the study areas. The only measure applied was chemotherapy. This finding is in agreement with reports from Spain. [19]. who reported that anthelmintic drugs have been used as the sole means of control but these drugs are now failing due to the emergence of resistant strains of helminthes. However, careful use of anthelmintics is necessary if drugs are to remain effective. Under dosing or overdosing and frequent use of drugs may lead to the development of resistance [19]. Therefore, it is always good to give accurate doses by calculating the weight of individual animals and laboratory diagnosis.

In general this questionnaire survey implies that there is lack of awareness to the owners about control measures of small ruminant fasciolosis regarding with season and frequency of treatment, management system, grazing and watering point in the study area. In addition to this lack of quality veterinary service delivery and availability of different anthelmintics in order to treat small ruminant fasciolosis is in agreement with Girma *et al.*[17].

The overall prevalence of *Fasciola* infection in small ruminants observed in this study was 41.3%. On species basis the prevalence was 56.44% in sheep and 7% in goats with significance difference between the two species. The current prevalence observed in sheep was higher than that reported by. [20]. who observed 44.3% in and around Debre Elias district East Gojjam, Northwest Ethiopia, [8] 42.44% in Yilmana Densa district, West Gojjam Zone, Amhara Region, Northwestern Ethiopia, [20] 28.7% in Debre Zeit town, Ethiopia, [21] 26.4% in selected regions of Azad Jammu and Kashmir, [22] 37.12% in Haramaya district, Eastern Ethiopia. A possible reason for the higher prevalence of fasciolosis in the study area might be due to poor management systems of animals, shortage of anthelmintics, inadequate veterinary service delivery, lack of awareness of the society about the control of fasciolosis and strategic deworming. It might be also due to differences in the use of anthelmintics against *Fasciola* species, because

albendazole is the most commonly used drug in the study area which act only on adult flukes. However the prevalence observed in sheep was lower than that of Ashenafi *et al.*[23] who reported 68.1% in and around Kombolcha. Similarly the current prevalence observed in goat was lower than that of Sirajudin *et al.*[24] who reported 9.4% in Jimma Area of South Western Ethiopia and [25] 22.9 % in Haramaya district. A probable reason for the lower prevalence in the current study might be season, because the study was carried out in dry season when most of the snail habitats were dried up.

The prevalence of fasciolosis with regard to sex was 42.49 % and 39% in female and male animals respectively. It was higher in female animals than in males, nevertheless it was not statistically significant. The absence of significant in sex related differences was also reported by many authors [26,27,28,29,30]. This signifies sex seems have no impact on the infection rate and both male and females are equally susceptible and exposed to the disease. In contrast to this finding, Tsegaye and Anwar [31] reported that there was significant difference between sex on the prevalence of small ruminant fasciolosis.

Prevalence of *Fasciola* infection in different agroecological conditions of the two districts was 47.82% in highland and 38% in midland areas were recorded which showed insignificant. This is in line with Dawit *et al.*[22]. The reason might be due to the fact that there was no an ecological variations like temperature, water lodging areas or ponds and dry areas for the multiplication of intermediate host and also there is no difference between them to apply fasciolosis control practice.

Species, age group, body condition and districts of the animals were the factors remained significant for each factor associated with *Fasciola* infection. The chance of *Fasciola* infection was 17.6 times higher among sheep than those goats. The variation in the prevalence of fasciolosis among species might be due to the fact that sheep had indiscriminate type of grazing behavior which led to a high chance of acquiring infection whereas goats were selective grazers or browsers and did not graze on marshy areas where there was a high chance of picking the metacercaria along with the grass, because of this there chance of exposure to infective metacercariae not as higher as that of sheep. Similar observations have been made in several studies including [23, 24, 32, 33]. Contrary to this finding Solomon *et al.* [34] who reported that failed to reveal significant variation between sheep and goats.

The chance of *Fasciola* infection in the current study was 6.1 and 5.6 times higher in adult and old respectively than those with young animals. This finding agreed with other researches [30, 35]. The increase in the level of *Fasciola* infection with age might be associated with the possibility of higher chance of movement of animals for grazing away from homestead to *Fasciola* infested areas. On the other hand, younger small ruminants were not often driven with adults to watering and grazing points, instead they were kept at homesteads where the chance of exposure to *Fasciola* infective stages was less than adult animals. This might be also that the higher exposure risk of adults and old may be due to physiological differences, such as stress, pregnancy, lambing, inadequate nutrition, and infectious diseases. Furthermore, it might be due to a long period of life cycle of *Fasciola* in the host in which infection at younger age could be detected at adult age that shaded eggs in feces. Similar results were reported by Kebede and Wakgari [36]. In contrast to the present finding, Rubina *et al.* [37] reported that younger animals showed higher prevalence than adult and old.

The chance of *Fasciola* infection with poor and medium body conditions had 4.8 and 2.4 times higher level of infection than those with good body conditions respectively. It indicates that fasciolosis cause reduction of body weight. This finding agrees with the result of many authors [26,29,38] in different study areas. The probable reason could be due to the fact that animal with poor body condition are relatively less resistant compared with that of medium and good body conditions and are consequently susceptible to various disease including fasciolosis and may be created by lack of essential nutrients and poor management [39].

The chance of *Fasciola* infection at Hulet Ejju Enesie was 2.7 times higher than Bibugne districts. This could be due to the fact that variation between deworming activity, differences in the use of anthelmintics, availability of anthelmintic, watering and grazing point are the main factors influencing the prevalence of fasciolosis between districts.

CONCLUSION AND RECOMMENDATIONS

The result of the present study indicated that *Fasciola* is an important parasite in sheep and goats in the study areas. Consequently species, age, districts and body condition score of the animals were the major risk factors for *Fasciola* infection in the study areas. The high prevalence of fasciolosis found in this study could be associated to lack of awareness about the transmission and control of fasciolosis as well as inadequate diagnosis, inappropriate dose and shortage of anthelmintics. Furthermore, the extensive management systems and the presence of marshy areas at the grazing areas of animals and the tendency of farmers to graze their animals in these areas because of feed scarcity. Therefore based on the above conclusion the following recommendations are foreword:

- Awareness creations to small ruminant owners in relation to transmission, prevention and control methods of fasciolosis in the study areas.
- Veterinarians should prescribe the drugs based on confirmatory diagnosis and appropriate dose by measuring the body weight of the animals.
- Further studies should be designed about economic loss, dynamics of the disease and anthelmintics efficacy against *Fasciola*.

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