

Abatoir Survey on Prevalence and Economic Significance of Fasciolosis in Small Ruminants Slaughtered in Addis Ababa Municipal Abatoir, Ethiopia

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Abstract: A cross-sectional study was carried out with the aims of determining the prevalence and economic loss of fasciolosis in small ruminants slaughtered in Addis Ababa abattoir. Accordingly, a total of 780 small ruminants (396 sheep and 384 goats) were subjected to routine post mortem examination for fasciolosis. The overall prevalence of fasciolosis in this study was proved to be 176/780 (22.6%). Of which, 120/396 (30.3%) and 56/384 (14.6%) was recorded in ovine and caprine respectively. Statistical analysis of the data revealed that, there was a statistically significant difference ($p < 0.05$) on the prevalence of fasciolosis among species of animals. The prevalence of the disease in adult and young small ruminants was confirmed to be 28.2% and 14.9% respectively. The prevalence in poor, moderate and good body condition animals was found to be 31.8%, 21.3% and 15%, respectively. Statistical analysis of the data showed the presence of statistically significant difference ($p < 0.05$) on the prevalence of fasciolosis in small ruminant on the basis of body condition score. The high level of fasciolosis in sheep and goats in the present study represents high rate of infection and immense economic losses to the country, Ethiopia. The economic loss in Addis Ababa Abattoir was approximately 343,440 ETB annually due to fasciolosis of small ruminants through condemnation of liver. In line with this finding it is recommended that farmers who rear sheep and goats should improve management practices and mainly provision of feeds to their animals so that, the animal can have good body condition that confers some level of resistance against fasciolosis. Besides, they should be able to regularly treat their animals with the appropriate antihelminthic and awareness should be created on the prevention and control methods of the disease.

Key words: Economic Loss • Ethiopia • Fasciolosis • Liver • Prevalence • Small Ruminant

INTRODUCTION

Ethiopia has a huge number of ruminant animals in Africa which are reared mostly by farmers as subsidiary occupation or by poor people [1]. In Ethiopia there are 23 million sheep and 18 million goats [2- 4]. In spite of large population, the productivity remains marginal mainly due to malnutrition, prevalent disease and management problems. The direct consequence of prevalent diseases are loss of production and productivity, hindrance to access the international animal and animal products' market, reduction in the quality of skin and hide, death of the animals, loss of weight and poor fertility performance [5]. Among prevalent diseases, fasciolosis is constantly

deteriorating the health and productivity of ruminants [6]. Fasciolosis is a serious infectious parasitic disease infecting domestic ruminants and humans, tops all the zoonotic helminthes worldwide [7]. It is caused by two trematodes, *Fasciola hepatica* and *Fasciola gigantica*. In general, this trematode are dorsoventrally flattened, some being leaf shaped and are hermaphrodite but, they have the ability to reproduce asexually and multiply in aquatic or amphibious snail which required as intermediate host in order to complete their life cycle. The geographical distribution this parasite is dependent on the distribution of suitable species of snail. *Lymnea truncatula* and *Lymnea natalensis* are the two major intermediate hosts for *F. hepatica* and *F. gigantica*,

respectively and both species have a worldwide distribution [8]. In Ethiopia, *F. gigantica* is found at an altitude below 1800 m above sea level while *F. hepatica* is found at altitude between 1200 to 2560 m above sea level. Mixed infection encountered at 1200 to 1800 m above sea level [9].

Animals acquire fasciolosis through ingestion of infective metacercariae with contaminated vegetation. The eggs laid by the adult parasite in the bile ducts of their hosts reach the duodenum with the bile and pass in feces. Miracidium stage then penetrates the intermediate snail host in the environment. Snails pass the motile cercaria which then attaches themselves to plant material and the metacercariae (Resistant cercariae) is the infective form to the definitive host [10]. Clinical examination of the infected animal showed pale visible mucous membrane or anemia due to severe liver damage caused by immature fluke tunnelling through the liver parenchyma with extensive tissue damage and haemorrhage that culminate in severe clinical disease. On post mortem the liver may have an irregular outline, pale and firm. The liver pathology of chronic fasciolosis is characterized by hepatic fibrosis and hyperplastic cholangitis [11].

Infection of domestic ruminants with *F. hepatica* (temperate liver fluke) and *F. gigantica* (Tropical liver fluke) cause significant economic loss estimated at over 200 million US \$ per annum to the agricultural sector worldwide with over 600 million animals infected [12]. The annual loss due to endo-parasite in Ethiopia is estimated at 700 million Ethiopian birr/annum [9]. Particularly financial loss due to ovine fasciolosis alone is estimated at 48.8 million ETB/annum [13]. Among this, 46.5%, 48.8% and 4.7% were due to mortality, reduced productivity (weight loss and reproductive wastage) and liver condemnation [14].

Estimation of the economic losses due to fasciolosis at national level is, however hampered by lack of accurate information of the disease prevalence, complexity in disaggregating and quantifying the direct and indirect effect of the disease and lack of a common methodology for assessing economic loss [15].

A number of surveys have been carried out to determine the prevalence of fasciolosis in different parts of Ethiopia. However, there is a need to gather data on regular basis in order have a clear picture of the current situation of the prevalence and economic significance of fasciolosis in small ruminants in Addis Ababa Abattoir. Therefore, the objectives of this study were, to determine the prevalence and influence of risk factors associated

with small ruminant fasciolosis as well as to define economic loss associated with liver condemnation.

MATERIALS AND METHODS

Description of Study Area: The study was carried out in Addis Ababa abattoir. Addis Ababa is the capital city, which is situated at latitude of 9°3' and 38°43' east. It lies in the central highlands of Ethiopia with an altitude of 2,000-3,000 m.a.s.l. The annual average maximum and minimum temperature are 21°C and 14°C respectively, with an overall average of 17°C. The highest temperature is reaching in May. The mean annual rain fall is 1,800ml with bimodal pattern. There are alternating dry and rainy season in the area. The long rainy season extends from June to September that contribute about 54% of the total annual rain fall, while the dry season lasts from October to February. The short rainy season lasts from March to May. Addis Ababa has a relative humidity varying between 70% to 80% during the rainy season and 40% to 50% during the dry season; the mean relative humidity is 61.3% [1].

Study Animals: The study animals were local breeds of 396 sheep and 384 goats brought from different agro ecological zones to Addis Ababa abattoir for slaughter. The sex and age of the study animals include male and females as well as young and adults, respectively.

Study Design: Cross-sectional type of study was carried out in the study area from November, 2015 to March, 2016 on randomly selected animal to determine prevalence and economic loss due to fasciolosis.

Sampling Methods and Determination of Sample Size: The study animals have been selected by simple random sampling method. In this study, small ruminants were grouped based on age as young and adult, based on sex as male and female and based on body conditions as poor, moderate and good. The animal were grouped to young (Under 1 year of age in goat and 1 year 3 months in sheep) and adults (Above or equal to 1 year of age in goat and above one year and 3 month in sheep) based on appearance of incisor teeth according to Gatenby [16] and Steele [17]. Body Condition Score of the study animals was made by the method of Thompson and Meyer [18].

The sample size required was determined according to the formula given by Thrusfield [19]. Attempt was made to take the maximum sample with 50% prevalence and absolute desired precision of 5% at confidence level of

95%.

$$n = \frac{1.96^2 P_{exp} (1 - P_{exp})}{d^2}$$

where,

n = sample size

P_{exp} = expected prevalence;

d = absolute precision;

According to the above formula, the calculated sample size was 384 however, for sake of higher precision a total sample size was increased to 780 (396 sheep and 384 goats).

Ante Mortem Examination: During ante mortem examination, identification numbers were given to the study animals and their ages and body condition were recorded by looking the appearance of the incisor teeth and performance of spinal process, respectively.

Abattoir Survey

Liver Inspection: Animals were identified by the code given during ante mortem examination. This code was written on the carcass after slaughtering. After evisceration, serially numbered different paper ticket with different plastic tickets were placed on the liver and transported to the laboratory found in the abattoir. Then, livers and gall bladders were subjected to thorough investigation for *Fasciola* count and species identification. The fluke recovery, count and species identification were made as recommended earlier by Ahmed *et al.* [20]. The gall bladder was removed and washed to screen out mature flukes. The liver was cut into slices of about 1 cm thick and put in a metal trough of saline water to allow mature flukes lodged in smaller bile ducts to escape and then the heads of the flukes were counted. Identification of the species involved was carried out using the size parameters. Categorization of the pathological lesions observed in affected liver was based on the approach by Ogunrinade *et al.* [15] as lightly affected, moderately affected and severely affected.

Fasciola Species Identification: *Fasciola* species that were found in the bile duct was taken out and collected separately, then the species identified based on their morphology and size of each species and the result record as *F. hepatica* and *F. gigantica*. The identification of different species of *Fasciola* was done as follows:

Fasciola hepatica when it has become fully mature in the bile duct, it is leaf shaped gray brown in

color and is around 3.5 cm in length and 1.0 cm in width. The anterior end is conical and marked off by distinct shoulder from the body. *Fasciola gigantica*, it is larger than *F. hepatica* and can reach 7.5 cm in length. The shape is more leaf like; the conical anterior end is very short the shoulder characteristics are barely perceptible.

Assessment of Direct Economic Loss: In assessing the economic loss, the direct economic losses due to condemnation of liver were considered. The analysis was based on the annual average slaughter rate of abattoir, average price of liver in the Addis Ababa town and the prevalence of fasciolosis in sheep and goats.

Accordingly, the monetary loss estimated was calculated by formula set by Mungube *et al.* [21] as follows:

$$LLC = NPSS \times POF \times CSL + NPGS \times PGF \times CGL$$

where,

LLC = Loss due to liver condemnation

NPSS = Annual slaughter rate of sheep

POF = Prevalence of ovine fasciolosis

CSL = Average cost of sheep liver

NPGS = Annual slaughter rate of goats

PGF = Prevalence of goat fasciolosis and

CGL = Cost of goat liver.

All affected livers were condemned since partial approval was not practiced in the abattoir. An interview was made with 10 retailers of offal produced at Addis Ababa abattoir and 6 individuals working for three hotels in Addis Ababa town to obtain information on the average price of a liver from sheep and goats. Accordingly, the average market price of sheep and goat liver was found to be 12 ETB. Annual slaughter rate of small ruminant in the abattoir was obtained from the record kept by the abattoir. As a result, a minimum of 80,000 sheep and 30,000 goats were reported to be slaughtered per year.

Data Analysis: The data which were recorded during the study period were entered into Microsoft excel sheet. Data were summarized and analyzed using SPSS version 20 computer program. Descriptive statistics such as proportion was used to describe the nature and the characteristics of the data. Analytic method including chi-square and logistic regression was used to test the presence of association and strength of association

between liver fluke and risk factors (Season, species, age and body condition) of study animals. The difference was considered as statistically significant if the p- value was less than 0.05.

RESULTS

Prevalence: The overall prevalence of fasciolosis in the study was 176/780 (22.6%). The highest prevalence of fasciolosis was seen in ovine 120/396 (30.3%) and the lowest prevalence was investigated in caprine 56/384 (14.6%). Statistical analysis of the data showed that there was a significant difference (P<0.05) on the prevalence of fasciolosis among species. The result of odds ratio showed that ovine are 2.6 times affected than the reference one (Caprine). Odds ratio > 1 shows that, one group is more affected than the reference. Therefore, ovine are more affected than caprine as revealed by odds ratio (Table 1).

Of the total 780 livers examined at the abattoir 176 (22.6%) were found positive for *Fasciola*. In percentage composition *Fasciola hepatica* was the highest with 78(44.3%) while *F. Gigantica* was the lowest compared to *Fasciola hepatica* which was 66 (37.5%). Mixed infestation with the two species was recorded as 22 (12.5%) and immature flukes which were not identified to species level were found as 10 (5.7%) as it is indicated in Table 2.

The prevalence of fasciolosis was found to be 127/451 (28.2%) in adult small ruminant and 49/329(14.9%) in young one. Statistical analysis showed that there was a statistically significant difference (P< 0.05) on the prevalence of fasciolosis between ages. The result of

odds ratio revealed that, young age group are 0.5 times affected than the reference age group (Adult). Odds ratio < 1 shows that, one group is less affected than the reference. Therefore, young age group are less affected than adult age group as indicated by odds ratio result (Table 3).

The prevalence of small ruminant fasciolosis on the basis of sex of animals examined disclosed that 86/397 (21.7%) and 90/383 (23.4%) were for male and female, respectively. However, there was no statistically significant difference on the prevalence of fasciolosis among sexes as indicated in Table 4.

Higher prevalence of fasciolosis was observed in poor body condition small ruminant with prevalence of 75/236(31.8%) followed by medium body condition animals with prevalence of 66/310(21.3%).The lowest prevalence of fasciolosis was recorded in good body condition animals which were proved to be 35/234 (15%). Statistical analysis of the data revealed a significant difference (p<0.05) on the infection of small ruminants with fasciolosis among the three different body conditions of the examined animals. Odds ratio result revealed that, poor body condition animal are 4.3 times and medium body condition animal are 1.8 times affected than the reference group (Good body condition animal). Generally, poor and medium body condition animals are more affected than good body condition animals (Table 5).

Table 1: Prevalence of small ruminant fasciolosis in Addis Ababa Abattoir.

Species	No. examined	No of positive	Prevalence (%)	OR	95% CI
Ovine	396	120	30.3	2.606	1.794-3.786
Caprine	384	56	14.6		
Overall	780	176	22.6		

p<0.001

Table 2: Percentage of *Fasciola* species in small ruminants in Addis Ababa Abattoir.

<i>Fasciola</i> species	No. of infected liver	Percentage (%)
<i>F. hepatica</i>	78	44.3
<i>F. gigantica</i>	66	37.5
Mixed	22	12.5
Immature	10	5.7
Total	176	100

Table 3: Prevalence of small ruminant fasciolosis among different age groups in Addis Ababa Abattoir.

Age group	No of animal examined	No of positives	Prevalence (%)	OR	95% CI
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Young	329	49	14.9	0.462	0.311-0.685
Adult	451	127	28.2		
Total	780	176	22.6		

p= 0.002

Table 4: Prevalence of small ruminant fasciolosis based on sexes in Addis Ababa Abattoir.

Sex	No examined	No positives	Prevalence (%)
Male	397	86	21.7
Female	383	90	23.4
Total	780	176	22.6

p= 0.604

Table 5: Prevalence of small ruminant fasciolosis based on body condition in Addis Ababa Abattoir.

Body condition	No examined	No of positives	Prevalence (%)	OR	95% CI
Poor	236	75	31.8	4.294	2.563-7.194
Medium	310	66	21.3	1.823	1.123-2.961
Good	234	35	15		
Total	780	176	22.6		

p= 0.000

Table 6: Prevalence of small ruminant fasciolosis on the basis of different seasons in Addis Ababa Abattoir.

Seasons	No examined	No of positives	Prevalence (%)	OR	95% CI
Autumn	230	75	32.6	2.147	1.417-3.562
Winter	307	53	17.3	0.688	0.588-0.934
Spring	243	48	19.8		
Total	780	176	22.6		

p= 0.011

In the present study, seasonal prevalence of small ruminant fasciolosis was assessed and revealed high occurrence during late rainy season (Autumn) than the dry season (Winter). The recorded prevalence in autumn and winter was 32.6% and 17.3%, respectively. Statistical analysis of the data on seasonal prevalence of small ruminant fasciolosis showed a statistically significant difference (p<0.05) among the different seasons as shown in table 6.

Assessment of Economic Loss: A huge amount of economic loss was resulted from liver condemnation as the result of small ruminant fasciolosis in Addis Ababa Abattoir. Generally, all infected livers with fasciolosis were found unfit for human consumption. In the present study the average number of annually slaughtered sheep and goats was estimated to be 80,000 and 30,000, respectively. The average retail price of sheep and goats liver in Addis Ababa town was 12 ETB. From the findings of the present study, the prevalence of fasciolosis in sheep and goats from Addis Ababa Abattoir was 30.3% and 14.6%, respectively.

Therefore, the annual minimum monetary loss from liver condemnation due to small ruminant fasciolosis was 343,440 ETB (i.e. 80,000 average number of annually

slaughtered sheep * 30.3% prevalence of sheep fasciolosis * 12 ETB cost of one sheep liver + 30,000 average number of annually slaughtered goats * 14.5% prevalence of goat fasciolosis * 12 ETB cost of one liver of goat).

DISCUSSION

Fasciolosis accounts to be great animal health and economic significant in ruminants in Ethiopia. The result of the present study proved that the prevalence of fasciolosis to be 30.3% and 14.6% in ovine and caprine, respectively with overall prevalence of 22.6% by postmortem examination of livers. The prevalence of fasciolosis in the current study was in line with the previous reports of Dinka [22] 32.9% in ovine and 15.9% in caprine in and around Asella; Sirajudin et al. [23] 26.3% in ovine and 17.2% in caprine in Jimma and Temesgen et al. [24] 24.2% in ovine in Alamata district of Ethiopia. In other hand, the prevalence in the present study was lower as compared to the previous report of Getachew [25] in Addis Ababa (51% in ovine and 47% in caprine) and Mezgebu [26] in Addis Ababa (63.8% in ovine). The low prevalence in the current study may be due to the expansion of animal health extension and veterinary service and intervention of nearby veterinary drug shops,

which enables the farmer to have more access for disease control and prevention. On the other hand, the study was higher as compared to the previous report of Dawit and Adam [27] in Modjo modern export abattoir (5.6% in ovine and 0.8% in caprine). These findings show that fasciolosis is a prevalent and endemic problem of small ruminants in different parts of Ethiopia. The wide gap in the prevalence of fasciolosis in different area may be due to irregular topography of the study area, the variation in sampling time which result higher prevalence in certain months and vice versa, a function of the local climatic condition, availability of permanent water and other agricultural and livestock management practices that influence the parasite and/or the intermediate hosts and variation in accessibility of animals to swampy communal grazing land [8]. These could be the reason for the difference in the prevalence of fasciolosis from different parts of Ethiopia.

Of 120 examined *Fasciola* positive ovine liver 36 (30%) were lightly, 51 (42.5%) moderately and 33 (27.5%) severely affected. On the other hand of 56 examined *Fasciola* positive caprine liver 18 (32.14%) lightly, 24 (42.85%) moderately and 14 (25%) severely affected. The extent of liver lesion may be attributed to the number of immature fluke's migrating in the parenchyma and adult flukes living and wandering in the bile ducts and the level of immunity in the host. If many metacercariae are ingested, the intensity of lesion in the parenchyma and consequently in the bile ducts may be moderate or severe. The migration of immature flukes in the parenchyma causes hepatic fibrosis the extent of which depends on the number of immature flukes and presence of adult flukes in the bile ducts is responsible for hepatic cholangitis [28]. Fluke species, *Fasciola hepatica* and *Fasciola gigantica* were encountered in infected liver during post mortem inspection. Mixed infection and immature flukes were also encountered in lower amount in the study. Throughout the study period *F. hepatica* was found higher prevalence than *F. gigantica*. The result is in agreement with the previous work done in Debre Birhan by Zerihun [29]. This might be associated with the existence of favorable ecological and climatic condition for the development of intermediate host *Lymnaea truncatula* in different part of the country. Fluke count conducted on 176 infected liver revealed average fluke burden of 52 per liver, implying high fluke burden in the study. Soulby [28] demonstrated that the presence of more than 40 fluke per liver indicates high pathogenicity.

The prevalence of the disease in the present study was recorded as 30.3% and 14.6% in ovine and caprine, respectively. The result of the current study showed

significantly higher ($p < 0.05$) prevalence in ovine compared to caprine similar to earlier reports by Henok and Mekonnen [30] who reported 14.6% and 8.8% in ovine and caprine, Yemisirach [31] who reported 20.8% and 13.6% in ovine and caprine and Surajudin *et al.* [23] who reported 26.3% and 17.2% in ovine and caprine, respectively. This could be due to the difference in the feeding behaviour of the two species of animals and the nature of their immunological reaction to the parasite. Sheep are grazers and they graze near the ground, while goats are browsers. Such feeding behaviours increase the chance of exposure for sheep and reduce that of goats to the infective metacercariae of *Fasciola* which are commonly found on grasses around marshy area [27].

The prevalence of fasciolosis was found to be 28.2% and 14.9% in adult and young age groups of small ruminants, respectively. This study indicated that there was a significant difference ($p < 0.05$) between age groups. This is in agreement with the report of Yemisirach [31] who reported 27.6% in adult and 14.4% in young. The higher prevalence of fasciolosis in adult small ruminants compared to the young one could be due to the fact that young animal are not allowed to go far with adult animals for grazing that they have reduced chance of exposure to infective metacercariae as compared to adults.

The prevalence of the disease in female and male animal was recorded as 23.4% and 21.7%, respectively. There was no a statistically significant difference ($p > 0.05$) between the sexes of small ruminants. This result agrees with the finding of Dinka [22], Henok and Mekonnen [30], Mohammed [32], Ahmed [33] and Gebreyohannis *et al.* [34]. The study indicating that sex seems to have no effect on the prevalence of the disease. This could be explained by the fact that there is no difference in the grazing behaviour animals between sexes.

The prevalence of fasciolosis was found to be 15%, 21.3% and 31.8% in good, medium and poor conditioned animals, respectively. The result of this study indicated that infection in poor body condition animals were significantly higher ($p < 0.05$) than that of medium and good body condition animals. This result agrees with the finding of Yemisirach [31] who reported that 15.4%, 20.6% and 27% in good, medium and poor condition animal. This proves the importance of fasciolosis in causing weight loss and emaciation to be a characteristic sign of the disease. Besides this, the high prevalence of fasciolosis in poor condition animals could be justified by the fact given by Devendra and Marca [35] who indicated that, animal with poor body condition are vulnerable to parasitic diseases. The significant variation in the

prevalence of fasciolosis in relation to body condition could be further justified by the fact that as the body condition improves, infection with fasciolosis decreases because *Fasciola* worms are known to suck blood and tissue fluid and even damage the parenchyma of the liver due to the migrating immature worms [36]. Moreover, cholangitis and liver cirrhosis induced in chronic fasciolosis could reduce bile flow to the duodenum and hence reduced lipid emulsification, digestion and absorption of fatty acid and lipid soluble vitamins [37].

Statistical analysis has indicated that, there was a significant variation in prevalence of fasciolosis among three different seasons in the study period. The highest prevalence was recorded in autumn (October and November); 32.6% for both ovine and caprine. In winter, the prevalence followed a decreasing order until the beginning of the next season (Spring). The result was in agreement with the finding of Dinka [22]. The decrease in prevalence in winter probably resulted from the decline in the active snail population which was due to the dry conditions that prevailed at the time. The rise of infection in autumn and spring appears to have been acquired from snails which were infected during the end of the previous rainy season and short rainy season respectively, providing favourable condition for the development of snail intermediate host.

The 343, 440ETB financial loss observed in the present study is relatively higher than the 71,900.75ETB loss from Modjo Modern Export Abattoir reported by Dawit and Adam [27] and 21,045.9 ETB loss from Jimma municipal abattoir reported by Sirajudin *et al.* [23]. The difference in the economic loss in different region/ abattoirs may be due to the variation in the prevalence of disease, average slaughter rate of the different abattoir and variation in the retail market price of liver in different region. Moreover, fasciolosis also cause significant economic loss due to mortality, reduced growth rate, increased susceptibility to secondary infections and expenses for control measures in addition to the loss from liver condemnation [38].

CONCLUSION

Fasciolosis is an important helminthes disease and one of the major obstacles for livestock development in Ethiopia and causing remarkable economic losses. The present study confirmed that the prevalence was significantly influenced by species, age and body condition score of the animals. significantly higher

prevalence was recorded in ovine species, adult age group and poor conditioned animals. The disease was found to be significantly influenced by season and high prevalence was recorded in autumn. The high prevalence of fasciolosis obtained in the present study clearly indicates the high risk the parasite poses to the economy loss. Therefore, strategic treatment and training owners to improve the management system were recommended.

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