Prevalence of Fasciolosis in Small Ruminants and Associated Risk Factors in and Around Mekelle

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Abstract: Fasciolosis is one of the most common widespread parasitic diseases of domestic livestock particularly in cattle, sheep and goats. A cross-sectional study was conducted from November, 2017 to March, 2018 in sheep and goats to determine the prevalence of fasciolosis and associated risk factor in sheep and goats in and around Mekelle. Faecal sample collected from a total of 412 small ruminants comprising of 259 sheep and 153 goats were examined by using the sedimentation technique to find out the eggs of fasciola parasite. Out of the total 412 examined faecal samples 67 were found positive for fasciolosis with an overall prevalence rate of 16.3%. According to the finding of this study the prevalence of fasciolosis was higher in sheep (22.8%) as compared to goats (5.2%). Statically significant difference ($P<0.05$) was observed in occurrence of fasciola between animal species. Based on body conditions of the animal, the fasciola disease was higher in poor followed by medium and good body conditions, respectively. Results indicate that there was significant difference ($P<0.05$) among body condition. However, regarding to both sex and age groups the prevalence of fasciolosis between males and females as well as young and adult were not significantly different. The result among the origins of the animals also revealed that there were not significance differences ($p>0.05$). This study indicated that fasciolosis to be the major parasitic health problem and prevalent in these area which reduce the body condition of small ruminants. Therefore, it needs further investigation to reduce the impacts of the disease on animal production with implementations of successful intervention strategies.

Key words: Fasciolosis, Goats, Mekelle, Sedimentation, Sheep

INTRODUCTION

The livestock sector generally contributes 40% of the global value of agricultural output and support the livelihoods and food security of almost a billion of people [1]. Ethiopia is a home for many livestock species and suitable for livestock production. Ethiopia is believed to have the 10th largest livestock population in Africa. An estimated indicates that the country is a home for about 59.5 million cattle, 30.70 million Sheep and 30.20 million goats, respectively. From the total cattle population 98.2% are local breeds and the remaining are hybrid and exotic breeds. Out of 30.70 million Sheep and 30.20 million goats found in the country, 72.14% and 70.61% are female sheep and goats and about 27.86% and 29.39% are male sheep and goats, respectively. Nearly 99.8% of the sheep and all goats’ population of the country are local breeds [2].

The small ruminants are the most important livestock species that have a considerable important to the GDP of the Ethiopia [3]. In Ethiopia small ruminants became the most important animals, which provide the animal protein that contributes to the improvement of the nutritional status of the people. The small ruminants also play an important role in providing export commodities, like skins to earn foreign exchanges to the country [4]. Furthermore, sheep and goats provide farm yard manure that is commonly applied to improve the soil fertility and also used as a source of energy. Sheep and goats have many advantages over large ruminants for most small holder farmers such as less feed costs, quicker turn over, easily manageable and appropriate size to handle at slaughter.
According to the Ethiopian sheep and goats production report, the increase in international demand for meat in general and the high demand for sheep and goats meat in the middle east countries is also another incentive for increased sheep and goats production in Ethiopia [6]. Despite the large number of small ruminant population in the country, their potential uses were hampered by different widespread disease, inadequate feed and insufficient infrastructure [7]. A disease due to parasitic infection has a great impact on global economy by hindering the productivity and the health of animals especially in developing countries [8]. Fasciolosis is one of the most common economically important and widespread parasitic diseases of domestic livestock particularly in cattle, sheep and goats [9]. This disease is caused by digenean trematodes of the genus fasciola commonly referred to as liver fluke [10]. The two species most commonly implicated as the etiological agents of fasciolosis are Fasciola hepatica and Fasciola gigantica [11].

Fasciola hepatica has a worldwide distribution, but predominates in temperate zones, while F. gigantica is found in most continents, primarily in tropical regions [12]. May be, sometime the species of these two fasciola can be occurred in the same country as well as in the same areas of agro-ecological region of one country, this is may be due to the presence of the marsh area for the development of the intermediate hosts, the lymnae snail [11]. Climate and environmental conditions, such as presence of water bodies, pastures and wetlands are strongly linked with the fasciola distribution. These conditions create a favorable environment for the development and transmission of free living fluke stages and for the growth and reproduction of the intermediate host, the lymnae snail [13].

The transmission of fasciola is depends on an intermediate host, the lymnae snail. Animals ingest metacercaria, up on grazing of pasture in the marsh area and the worm migrates to the liver where it causes extensive damage and the mature worm inhabits the bile duct [14]. Fasciola infections are known to cause clinical signs such as weight loss, sudden death and anemia [15]. Clinical disease is well known; however, sub-clinical infections are often remaining unnoticed, leading to marked economic losses, reduced milk yield, weight loss, reduced fertility and immunity [16].

The classical diagnosis of fasciolosis based on examination of liver and finding of the adult parasite or presence of its eggs through faecal examination [17]. Small ruminant fasciolosis due to F. hepatica and F. gigantica is endemic in many parts of Ethiopia with prevalence ranging from 11.5% to 87% [18]. However, the prevalence of fasciolosis in small ruminants in and around Mekelle was not investigated before. Therefore, the objective of this study was to determine the prevalence of fasciolosis and to assess its associated risk factor in and around Mekelle.

**MATERIALS AND METHODS**

**Study Area:** The study was conducted in and around Mekelle. Mekelle is the capital city of Tigray National Regional State in the northern Ethiopia. It is located around 783 kilometers north of the Ethiopian capital city Addis Ababa. The town is located at 39°28'E longitude and 13°29'N latitude situated in the extension of the central highlands of Ethiopia, with an elevation of 2084 meters above sea level. Mekelle is found under climatically conditions of "WoinaDega" (Temperate), with an average rainfall and temperature ranges from 600mm and 17-21 °C, respectively. Its rainy season occurs mainly between June and September, although a short rainy season do occur on March and April [19]. Also, it has a moisture index ranging in between 0.25 and 0.5, which indicates moderately dry area [20]. The total livestock population of the town is composed of 36,863 cattle, 7,085 sheep, 5,388 goats, 235 camels, 4,793 asses, 403 mules, 2,851 horse and 5,224 poultry 418swine 949 bees [21].

**Study Animals:** The study was conducted on sheep and goats at the field area in and around Mekelle. The study animals were 259 sheep and 153 goats which were kept under extensive production system. The study animals were with the different age groups, body condition, origin and sex. In this study the origin of sheep and goats were recorded from Ayinalem, Enderta woreda and Dagia. The age of the animals was determined as young (Up to 2 years) and adult (Above 2 years) by considering the rate of teeth eruption [22]. The body condition score was determined according to Kripaliet al. [23] grouped as poor, medium and good.

**Study Design:** A cross-sectional study design was conducted from November, 2017 to March, 2018 to determine prevalence of fasciolosis and associated risk factor in small ruminant in and around mekelle.

**Sample Size Determination:** For the selection of study animal’s simple random sampling method was used in which sample size determination was based on the expected prevalence of 50% and absolute desired...
precision of 5% at confidence level of 95%. The sample size was calculated as per the method described by Thrusfeild [24].

\[ n = \frac{1.96^2 \times P_{exp} (1-P_{exp})}{d^2} = \frac{(1.962)^2 \times 0.5 \times (1-0.5)}{0.052} = 384 \]

where,

- \( n \) = required sample size
- \( P_{exp} \) = expected prevalence
- \( d \) = desired absolute precision

However, due to limited accuracy of the prevalence of fasciola, in the study area the sample size is increased to 412 for the study in and around mekelle.

**Data Collection:** During the study period a total of 259 sheep and 153 goats were randomly selected and fresh faecal sample was collected from individual animal by using disposable glove directly from the rectum of sheep and goats. After collection, the faecal samples were transferred to sample bottle and preserved by 10% formalin. Each sample was clearly label with species, place of collection (Origin), body condition, sex and age. Then the labeled sample was submitted to mekelle University College of Veterinary Medicines, Parasitological laboratories where they were examined immediately as soon as possible or stored in refrigerator at 4°C for processing of next day. The faecal samples were examined by using the sedimentation technique according to Kedar [25] to determine the prevalence of fasciolosis in small ruminant using the standard procedure.

**Sedimentation Technique:** From collected faecal samples for each case 3 gm of faeces was measured and placed in to a mortar. Then 42 ml of water were added and crushed thoroughly with the pestle. The suspension was then filtered through a mesh sieve in to a beaker. After gentle shaking, the suspension was filled in to a test tube and centrifuged at 1500 revolution per minute for 5 min. After removing the supernatant carefully the sediment was agitated till homogenous fluid was obtained at the bottom of the test tube. The sediment was re-suspended with equal amount of water to the previous level and allowed to sediment for 5 min. The supernatant was removed and the content of the tube was mixed thoroughly with the thumb over the open end of the tube. Then, using a pasture pipette, one drop of methylene blue was added to the sediment for staining. A single drop of sediment was taken and transferred to microscopic slide. Then after, covered with cover slip and examined under microscope to check the presence of fasciola eggs. During examination under microscope fasciola eggs were observed as oval, operculated and yellow brown with dense cells.

**Data Analysis:** All collected data regarding faecal examination was recorded and entered into Microsoft Excel spread sheet and statitical analysis was conducted using SPSS software (Version 20.0). The prevalence of fasciola was calculated by dividing the number of sheep and goats having the parasite to the number of sheep and goats examined. Chi-square was used to measure the association between the prevalence of the fasciola with body condition, age, sex, origin and species. Confidence level was held at 95% with degree of freedom 5% and statitical analysis for the difference in prevalence of fasciola among risk factor were considered significant when the p-value was set at \( p<0.05 \).

**RESULTS**

The total prevalence of fasciolosis in this study was 16.3%. Out of 412 animals examined 67 of them was infected up on examination by sedlimentation technique. Regarding the species, the prevalence of fasciolosis was higher in ovine than caprine with (22.8% and 5.2%), respectively. Hence, there was significant difference \( (P<0.05) \) between the species. According to the result obtained from the study, the occurrence of fasciolosis was slightly higher in adult (16.4%) as compared to young (16.0%) animals. But, the result showed there was no significant difference \( (P>0.05) \).

The prevalence of fasciolosis was different with different body condition. The occurrence of parasite was highest in animals with poor (38%) followed by medium (10.5%) and good (9%) body condition and there was significant difference \( (P<0.05) \). The present study shows no statitical significant difference in the occurrence of fasciolosis between male and female animals and among animal’s origins \( (P>0.05) \).

<table>
<thead>
<tr>
<th>Species</th>
<th>Number of examined</th>
<th>Number of affected</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovine</td>
<td>25959</td>
<td>59</td>
<td>22.8%</td>
</tr>
<tr>
<td>Caprine</td>
<td>153</td>
<td>8</td>
<td>5.2%</td>
</tr>
<tr>
<td>Total</td>
<td>412</td>
<td>67</td>
<td>16.3%</td>
</tr>
</tbody>
</table>

\( x^2 = 21.757 \) which is significant; \( P=0.001 \)
Table 2: Prevalence of fasciolosis based on animal origins

<table>
<thead>
<tr>
<th>Origin</th>
<th>Number of examined</th>
<th>Number of affected</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ayinalem</td>
<td>203</td>
<td>33</td>
<td>16.3%</td>
</tr>
<tr>
<td>Dagia</td>
<td>100</td>
<td>18</td>
<td>18%</td>
</tr>
<tr>
<td>Enderta</td>
<td>109</td>
<td>16</td>
<td>14.7%</td>
</tr>
<tr>
<td>Total</td>
<td>412</td>
<td>67</td>
<td>16.3%</td>
</tr>
</tbody>
</table>

$x^2=0.422$ which is insignificant; $p = 0.81$

Table 3: Prevalence of fasciolosis based on body condition

<table>
<thead>
<tr>
<th>Body condition</th>
<th>Number of examined</th>
<th>Number of affected</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>9235</td>
<td>358</td>
<td>38%</td>
</tr>
<tr>
<td>Medium</td>
<td>209</td>
<td>22</td>
<td>10.5%</td>
</tr>
<tr>
<td>Good</td>
<td>111</td>
<td>10</td>
<td>9%</td>
</tr>
<tr>
<td>Total</td>
<td>412</td>
<td>67</td>
<td>16.3%</td>
</tr>
</tbody>
</table>

$x^2=41.39$ which is significant; $P=0.001$

Table 4: Prevalence of fasciolosis based on sex

<table>
<thead>
<tr>
<th>Sex</th>
<th>Number of examined</th>
<th>Number of affected</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>262</td>
<td>41</td>
<td>15.6%</td>
</tr>
<tr>
<td>Male</td>
<td>150</td>
<td>26</td>
<td>17.3%</td>
</tr>
<tr>
<td>Total</td>
<td>412</td>
<td>67</td>
<td>16.3%</td>
</tr>
</tbody>
</table>

$x^2=0.199$ which is insignificant; $p = 0.65$

Table 5: Prevalence of fasciolosis based on age

<table>
<thead>
<tr>
<th>Age</th>
<th>Number of examined</th>
<th>Number of affected</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young</td>
<td>156</td>
<td>25</td>
<td>16.0%</td>
</tr>
<tr>
<td>Adult</td>
<td>256</td>
<td>42</td>
<td>16.4%</td>
</tr>
<tr>
<td>Total</td>
<td>412</td>
<td>67</td>
<td>16.3%</td>
</tr>
</tbody>
</table>

$x^2=0.01$ which is insignificant; $p = 0.92$

**DISCUSSION**

In this study the overall prevalence of fasciolosis was 16.3% and it was 22.8% in sheep and 5.2% in goats, respectively. The current prevalence observed was lower than that reported by Abel et al. [26] previous study in Addis Ababa abattoir enterprise with the total prevalence of 18.8% in small ruminants and 25.9% in sheep and 10.6% in goats, respectively. The study in the region of Azad Jammu also described prevalence of 17.88% in small ruminant and 26.49% in sheep and 9.9% in goats [27]. In other way the study result was higher than that of Henok and Mekonnen [28] who described the overall prevalence of fasciolosis as 11.6% (14.6% in sheep and 8.8% in goat) in and around Hirna woredas. Dawit et al. [29] also reported total prevalence of fasciolosis 13.88% in small ruminant with the prevalence of 23.26% in sheep and 4.12% in goats in Haramaya District, Eastern Ethiopia which is lower than the present study.

The difference in the prevalence of fasciola may be due to the difference in presence of a favorable environment for the availability of the intermediate host, snails, where the study animals originated. Climate conditions, particularly rainfall, were frequently associated with difference in the prevalence of fasciola species infection because this was suitable for intermediate hosts like snails to reproduce and to survive longer period under moist conditions. These snails require neutral soil which remains moist throughout the year and tend to do better in areas with moderate winters which allow the eggs and immature stages to survive [10].

In relation to host and management, traditional husbandry system, malnourished condition and immune suppression of the host, improper sanitation, ignorance of animal health problems contribute greatly for parasite and its vector growth, development and transmission in the environment. The differences might also be due to the use of anthelmintics against fasciola in the study areas. Generally, the variation of this infection in these areas might be due to the variation in agro-ecological condition, geographical variation, number of study samples and climatic conditions of the areas [30].

The present study showed significantly fasciolosis was detected at higher proportion in sheep as compared to goats. This result agrees with finding of Abel et al. [26] who reported 25.9% and 10.6% in sheep and goats, respectively and Dawit et al. [29] who described the prevalence of fasciolosis as 23.26% and 4.12% in sheep and goats, respectively in Haramaya district, Eastern Ethiopia. The variation in the prevalence of fasciolosis between species might be due to the fact that sheep had unselective 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. Goats also graze on leaves and branches from bushes and trees but sheep graze on plants which are on the ground where metacercaria are mostly found. So, the possibility of infection with metacercaria is higher in sheep than goats [31].

There was also considerable significant variation regarding body conditions. The disease was higher in poor body conditions followed by medium and good body conditions. The result was in agreement with Mathewos et al. [32], Desta et al. [33] and Mulatuet al.[34]. Obviously, this could be due to the fact that animals with poor body condition are usually less resistant and are consequently susceptible to infectious diseases. In the other way, the presence of high prevalence of fasciolosis in animals with poor body condition may be due to the effect of the parasite in the animal as fasciola species are blood and tissue fluid suckers and even damage the parenchyma of the liver.
(Immature fasciola) and causes bleeding while the adult parasites are in the bile duct, which ultimately decrease protein from the host which leads to poor body condition [35].

The significant variation in the prevalence of fasciolosis in relation to body condition could be further justified by the fact that 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 [36]. This finding confirmed the importance of fasciolosis in causing weight loss and emaciation as a characteristic sign of the disease [15].

Regarding the sex the prevalence of fasciolosis between the male and female are not significantly difference. This may indicate that the sex of sheep and goats has no effect on the prevalence of fasciolosis. These animals expose to graze and parasitic infection with equal rate and move in searching of food and water together, which expose to the same risk of infection. In a study from Iran, Khanjari et al. [37] reported no sex related difference in prevalence of fasciolosis in sheep and goats. Non-significant results were also reported by Gebreyohannes et al. [38] for the sex of sheep. Solomon[39] has also suggested that fasciolosis equally affect both sex.

According to the result of the present study showed no significant difference among the origins of the animals (P>0.05). This might be due to the similarity of agro-ecological and climatic conditions of the area such as rain fall and temperature. Based on the result obtained from the study, the occurrence of fasciolosis was slightly higher in adult as compared to young animals. Even though there was difference between the two age group there was no statically significance difference between them (p>0.05).

CONCLUSION AND RECOMMENDATIONS

The current study results show that fasciolosis is an important disease in different parts of the study areas with an overall prevalence of 16.3%. The prevalence of fasciolosis in this study is significantly associated (p<0.05) with body condition and species. However, sex, origin and age were not significant with the prevalence of fasciolosis. Generally risk factor like climate and environmental conditions, such as presence of water bodies, pastures and wetlands are strongly linked with the fasciola distribution and favor the distribution of disease. Apart from climate and environmental factors, animal level factors like age, body condition and animal species are also associated with the occurrences of the infection.

Therefore, the following recommendations are forwarded:

- Animal should be kept in high level of nutrition (Management) especially those with poor body condition and young’s in order to develop immunity against fasciola.
- Strategic anthelminthics treatment with appropriate flukicidal drugs should be practiced to control the load of the parasites.

An appropriate control and prevention methods of fasciola should be designed like: avoiding the intermediate host (Snail) and preventing the animals from infected pasture.

List of Abbreviations:

- GDP  Gross Domestic Product
- SPSS  Statistical Package for the Social Sciences
- $x^2$ chi-squared

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