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Small Ruminant Fasciolosis in Jimma Area of South Western Ethiopia: Its Epidemiology and Minimum Monetary Loss

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Abstract: A cross sectional tudy was conducted from November 2011 to March 2012 on 512 animals (384 sheep and 128 goats) from Jimma and surrounding districts based on coprological and postmortem examinations. The objectives of the study were to estimate the prevalence of fasciolosis, assess associated risk factors, identify *Fasciola* speciecs, estimate monetary loss due to liver condemnation and estimate sensetivity of sedimentation techinique for detection of *Fasciola* eggs. An overall prevalences of 13.3% (14.6% in sheep and 9.4% in goats) and 24.0% (26.3% in sheep and 17.2% in goats) were recorded by coprology and postmortem examinations, respectively. The prevalence of fasciolosis was 1.72, 3.00 and 4.42 times higher in sheep than goats, animals with less or equal to two years than those above 4 years old and poor conditioned compared to those with good body condition score, respectively. Both species of Fasciola were recovered from sheep and goats of all study areas; *F. hepatica* being predominant (12.3%) compared to *F. gigantica* (4.3%). The sensitivity of the sedimentation technique to detect Fasciola eggs was 55.28% in relation to postmortem examination of fresh liver and a substantial agreement (kappa = 0.653) was obtained between the two tests. The minimum annual monetary loss from liver condemnation alone was 21,045.90 Ethiopian Birr (1,238.00 USD with 1 USD = 17.00 ETB). Study on eocnomic and public health implication of the parsite together with molecular typing of specices circulating in the area are recommended.

Key words: Fasciolosis · Epidemiology · Small ruminant · Monetary loss · Jimma · Ethiopia

INTRODUCTION

Small ruminants are the dominant livestock providing up to 63% of cash income and 23% of food sources in Ethiopia. Jimma zone has a population of about 942,908 sheep and 288,411 goats. It has been reported to be the third by its sheep population next to Arsi and north Shoa zones of Oromia regional state [1]. In Jimma zone, because of the scarcity of grazing land for large ruminants, most farmers are rising small ruminants specially sheep as source of financial income and food for family [2].

Small ruminant fasciolosis due to F. hepatica and F. gigantica is endemic and economically important in many parts of Ethiopia with prevalence ranging from 11.5% to 87.0% [3-6]. In central Ethiopia, the annual loss due to ovine fasciolosis was estimated to be 48.4 million Ethiopian Birr of which 46.5, 48.8 and 4.7% were due to mortality, loss of productivity and liver condemnation, respectively [7]. In addition to its effects on livestock production, the parasite has been reported to have significant public health implications [8, 9].

Knowledge on the epidemiology of the parasite is crucial for any attempt of prevention and control. Moreover, estimation of the economic significance of the disease is important for decision making, planning, development and implementation of control strategies. Despite the presence of large number of small ruminants and suitable environment for the parasite, study on small ruminant fasciolosis was not so far done in Jimma zone. Hence, no information is available about the extent of the problem and the diversity of the parasite species which could serve as a base line data if control measure based on sound scientific evidence is to be initiated. Therefore, the objectives of the present study were to estimate the prevalence, assess the risk factors associated with small ruminant fasciolosis, identify the species of *Fasciola*, estimate the minimum monetary loss due to

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small ruminants' liver condemnation and to estimate the sensitivity of sedimentation technique to diagnose fasciolosis in relation to postmortem inspection of liver.

MATERIALS AND METHODS

Study Area and Period: The study was conducted from November, 2011 to March, 2012 in Jimma town and the surrounding districts namely: Dedo, Kersa, Mana and Seka. Jimma town, the capital of Jimma zone is located in Oromia Regional Administration at 352km south west of Addis Ababa at a latitude of 7°41' N and longitude of 36°50' E. During the study period, the area received a mean annual rain fall of about 1530mm which comes from long and short rainy seasons. The average minimum and maximum annual temperatures were 7°C and 30°C, respectively. Agriculture is the livelihood for more than 90% of the population in rural community of the zone. The main agricultural system is mixed crop livestock production and animals are mainly produced in an extensive system [2].

Study Animals and Study Design: The study animal were local breeds of 384 sheep and 128 goats brought from the study areas to Jimma abattoir and main hotels in Jimma town for slaughter. All animals were managed under extensive management system. A cross-sectional study was the used design. It involves categorization of the study population according to their specific geographic origin (district), body condition score (BCS), sex and age to estimate the prevalence of fasciolosis and assess the associated potential risk factors.

Sample Size Determination and Sampling Method: The sample size for the study was calculated using the formula given earlier [10] with 95% confidence interval (CI) and 5% absolute level of precision as follows: $N = (1.96^2 x P_{exp} (1-P_{exp}))/d^2$ where: N= sample size, P_{exp}= expected prevalence (50%) and d = desired level of precision (5%). Since there was no study conducted in this area on small ruminant fasciolosis, 50% expected prevalence was taken. Accordingly, the sample size was determined to be 768 animals (384 sheep and 384 goats). But, due to the fact that, few goats were brought for slaughter during the study period, only 512 animals (384 sheep and 128 goats) were included in this study. The study animals were randomly selected from all sheep and goats brought for slaughtering at the Jimma abattoir and selected hotels in Jimma town on the dates of visit to both of them.

Ante Mortem Examination: During ante mortem examination, identification numbers were given to the study animals and their ages were recorded by looking the appearance of the incisor teeth [11]. Body Condition Score of the study animals was made by the method of previous workers [12]. Then, before slaughtering of selected animals, fresh fecal sample was collected directly from rectum and kept in separate glass or plastic container with individual animal identification number.

Faecal Examination for Detection of *Fasciola* Eggs: The collected fecal samples were taken to parasitology laboratory of the school of veterinary medicine of Jimma University and examined using standard sedimentation technique [13]. Coprological examinations were made within 24 hours [14]. To differentiate between eggs of *paramphistomum* species and *fasciola* species, a drop of methylene blue solution was added to the sediment. Eggs of *fasciola* species show yellowish brown with an indistinct operculum and embryonic cells, while eggs of *paramphistomum* species is large and show transparent egg shell with distinct operculum and clear embryonic cells [13].

Postmortem Examination of Fresh Liver: All animals from which fecal sample taken were followed for postmortmen examination. During the postmortem examination, livers were examined visually and by palpation of the entire organ. Then, it was followed by transverse incision of the liver across the thin left lob in order to confirm the case [15].

Sample Collection, Processing and Parasitological Examination: One hunred twenty three positive livers (101 from sheep and 22 from goats) were collected separately into ice box with ID number of the animal and transported to parasitology laboratory of school of veterinary medicine of Jimma University. Then, livers and gall bladders were subjected to thorough investigation for parasite count and species identification. The fluke recovery, count and specices identification were made as recommended eailer [16, 17]. Briefly, the gall bladder was removed and washed to screen out mature flukes. The liver was cut into slices of about 1cm thick and put in a metal trough of warm 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.

Estimation of the Monetary Losses from Liver Condemnation: The monetary loss was estimated based on liver condemnation due to fasciolosis [18, 19] as follows: LLC = NPSS x POF x CSL + NPGS x PGF x CGL where: LLC = loss due to liver condemnation, NPSS = annual slaughter rate of sheep, POF = prevalence of ovine fasciolosis (prevalence of liver condemnation due to 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 15 retailers of offal produced at Jimma municipality abattoir and 9 individuals working for three hotels in Jimma 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 6.00 ETB. Annual small ruminant slaughter rate in Jimma town was obtained from the record kept by the abattoir and interview with employers of the main hotels in the town on the number of sheep and goats they slaughter. As a result, a minimum of 10,950 sheep and 3,650 goats were reported to be slaughtered per year.

Statistical Analysis: Data were entered in Microsoft Excel 2007 spreadsheet and analyzed using SPSS statistical software package version 16.0. Descriptive statistics were computed as appropriate. Origin, species, sex, age and body condition score of the small ruminants were the major independent variables. The association of these variables with the prevalence of fasciolosis was assessed by logistic regression and Chi-squire test on the basis of postmortem examination result as it detects best than coprology. The sensitivity of the direct sedimentation technique was calculated by taking postmortem inspection of liver as gold standard. Kappa coefficient was used to compare the agreement between coprology and post mortem examination for diagnosis of fasciolosis. The kappa value was interprated as: agreement by chance (K< 0), slight agreement (K = 0.01-0.20), fair agreement (K= 0.21-0.40), moderate agreement (K= 0.41-0.60), susbistantial agreement (K= 0.61-0.80) and almost perfect agreement (K=0.81-0.99) [20]. A value of P<0.05 was considered significant at 95% confidence interval.

RESULTS

Prevalence: Summary of the prevalence of fasciolosis in sheep and goats obtained by coprology and postmortem examinations is presented in Table 1.

Prevalence of Small Ruminant Fasciolosis as Influenced by Different Risk Factors: The prevalence of fasciolosis was significantly influenced by species, age and BCS of the small ruminants included in this study (Table 2).

Fluke Burden and Species of *Fasciola*: The mean fluke burden was 49 with respective minimum and maximum of 3 and 95 flukes per infected liver. Of the 512 examined livers, 5.4, 10.9 and 7.6% had fluke counts between 1-20, 21-49 and 50-95, respectively. As indicated in Table 3, the overall prevalence of *F. hepatic* was 12.3% followed by that of *F. gigantica* (4.3%).

Sensetivity of Sedimentation Method for Detection of *Fasciola* Eggs: From the 123 small ruminats that had flukes in their livers, only 68 showed *Fasciola* eggs in their feces. The sensitivity of a single coprological examination by sedimentation was 55.28%. There was substantial agreement between the two tests (k = 0.653) (Table 4).

Monetary Loss Assessment Result: Annual minimum monetary loss from liver condemination due to small ruminant fasciolosis was 21,045.9 ETB (i.e. 10,950 slaughter rate of sheep x 0.263 prevalence of sheep fasciolosis x 6.00 ETB cost of one sheep liver + 3,650 slaughter rate of goats x 0.172 prevalence of goat fasciolosis x 6.00 ETB cost of a liver of goat =21,045.9 ETB).

DISCUSSION

Prevalences of ovine and caprine fasciolosis were 26.3 and 17.2%, respectively with overall prevalence of 24.0% by postmortem examination of livers. About thirty percent [21] and 32.9% [22] ovine fasciolosis and 15.9% caprine fasciolosis [22] were reported from different parts of Ethiopia. Similarly, a prevalence of 20.93 ovine fasciolosis and 12.26% caprine fasciolosis was reported from Quetta, Pakistan [17]. Higher prevalence of small ruminant fasciolosis have been reported from different parts of Ethiopia. A prevalence of 56.56% ovine fasciolosis was reported from the irrigation areas of upper Awash river basin [13]. Moreover, a prevalence of 49% was reported in sheep from Dawa-Chaffa –Kemissie [23] and Holeta [24] areas of Ethiopia. These findings show that fasciolosis is a prevalent and endemic problem of small ruminants in different parts of Ethiopia. The prevalence of fasciolosis is a function of the local climatic condition, availability of permanent water and other agricultural and livestock management practices that

Table 1: Over all prevalence of fasciolosis in sheep and goats slaughtered in Jimma town

	Examination method and prevalence			
	Coprology		Postmortem	
Species (examined number)	Positive (%)	95 % CI	Positive (%)	95 % CI
Sheep (384)	56 (14.6)	11.4-18.5	101 (26.3)	22.2-30.9
Goat (128)	12 (9.4)	5.5-15.7	22 (17.2)	11.6-24.7
Total (512)	68 (13.3)	10.6-16.5	123 (24.0)	20.5-27.9

Table 2: Prevalence of small ruminant fasciolosis as influenced by different risk factors

Variable	No. Examined	No. positive (%)	95% CI	OR (95% CI)
Origin				
Kersa	98	31 (31.6%)	23.3-41.4	1.432 (0.747-2.745)
Dedo	124	28 (22.6%)	16.1-30.7	0.903 (0.472-1.725)
Mana	104	23 (22.2 %)	15.2-31.0	0.879 (0.447-1.727)
Seka	100	20 (20.0%)	13.3-28.9	0.774 (0.386-1.549)
Jimma	86	21 (24.4%)	16.6-34.5	1
Species				
Ovine	384	101 (26.3%)	22.2-30.9	1.720 (1.030-2.870*)
Caprine	128	22 (17.2%)	11.6-24.7	1
Sex				
Male	321	79 (24.6%)	20.2-29.6	1.091 (0.715-1.663)
Female	191	44 (23.0)	17.6-29.5	1
Age (years)				
< or = 2	57	27 (47.4%)	35.0-60.1	3.000 (1.471-6.119*)
(2 to 3]	186	55 (29.6)	23.5-36.5	1.399 (0.783-2.501)
(3 to 4]	178	20 (11.2%)	7.4-16.7	0.422 (0.215-0.828*)
> 4	91	21 (23.1)	15.6-32.7	1
BCS				
Poor	83	37 (44.6%)	34.4-55.3	4.424 (2.395-8.171*)
Medium	273	62 (22.7%)	18.1-28.0	1.616 (0.962-2.716)
Good	156	24 (15.4%)	10.6-21.9	1

OR: Odds ratio, CI: Confidence Interval, * there was significant association

Table 3: Prevalence of *Fasciola* species in small ruminants from Jimma area

Variable (N)	*F. hepatica*	*F. gigantica*	Mixed	Immature	χ^2 (P-value)
Species					
Ovine (384)	48 (12.5)	19 (4.9)	13 (3.4)	21 (5.5)	7.683 (0.046)
Caprine (128)	15 (11.7)	3 (2.3)	4 (3.1)	0 (0.0)	
Origin					
Kersa (98)	11 (11.2)	9 (9.2)	4 (4.1)	7 (7.1)	18.867 (0.092)
Dedo (124)	16 (12.9)	4 (3.2)	7 (5.6)	1 (0.8)	
Mana (104)	12 (11.5)	5 (4.8)	1 (1.0)	5 (4.8)	
Seka (100)	11 (11.0)	0 (0.0)	4 (4.0)	5 (5.0)	
Jimma (86)	13 (15.1)	4 (4.7)	1 (1.2)	3 (3.5)	
Sex					
Male (321)	41 (12.8)	14 (4.4)	10 (3.1)	14 (4.4)	
0.294 (0.961)					
Female (191)	22 (11.5)	8 (4.2)	7 (3.7)	7 (3.7)	
Total (512)	63 (12.3)	22 (4.3)	17 (3.3)	21 (4.1)	

Table 4: Sensetivity of coprological examination for detection of *Fasciola* eggs

	Postmortem examination			
Fecal examination	Positive	Negative	Total	Kappa
Positive	68	0	68	0.653
Negative	55	389	444	
Total	123	389	512	

influence the parasite and/or hosts [25]. These could be the reason for the difference in the prevalence of fasciolosis from different parts of Ethiopia.

The result of the present study showed significantly higher prevalence of fasciolosis in sheep compared to goats similar to earlier reports [17, 22]. This could be due to the difference in the feeding behavior 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 behaviors increase the chance of exposure for sheep and reduce that of goats [4]. Sheep and cattle couldn't develop strong immunity [26] and sheep are thought to acquire little resistance to fasciolosis [27].

Significantly high prevalence of fasciolosis in sheep and goats under or equal to two years old (47.4%) and the least in those about four years of age (11.2%) were observed in the current study. Lower prevalence of gastrointestinal parasites including fasciolosis was reported in older animals [28]. This was suggested to be due to the immunological maturity and development of acquired immunity as animals get older. This hypothesis was also supported by different experimental studies [29]. In the present study, the prevalence of fasciolosis was 4.4 times higher in sheep and goats with poor body condition compared to those with good body condition score. This might be due to the fact that fasciolosis cause weight loss and emaciation and/or shoats with poor body conditions are more susceptible to the parasite [17].

Both species of *Fasciola* are infecting sheep and goats from all study areas with single or mixed infections as proved in the present study. In Ethiopia, *F. hepatica* is common in areas above 1800 meters above sea level, while *F. gigantica* is predominant in those areas having altitude bellow 1200 meters. The co-existance of both specices was reported in areas with altitude ranging from 1200 to 1800 meters above sea level [4]. Jimma town and surrounding areas have altitudes ranging from 1710-2110 meter above sea level which enhance co-existence of both species of *Fasciola* [2].

A study on fluke count revealed a mean fluke burden of 49 per infected liver. This implies high pathogenicity of liver flukes and significant economic importance in the study area. More than 40 and 50 flukes per liver indicate a high pathogenicity in small ruminants and cattle, respectively [16]. Significant production losses also reported in infections with 30 flukes per liver [30, 31].

In the current study, the sensitivity of sedimentation technique to detect *Fasciola* eggs was 55.28%. This is comparable to the reports of 56.7% in Vietnam [32] and 60% in Switzerland [33]. The low sensitivity of sedimentation method may be attributed partly to the fact that *Fasciola* eggs only appear in feces 8-15 weeks post infection [11]. Furthermore, detection of *Fasciola* eggs is not reliable during the prepatent period as eggs are expelled intermittently depending on the evacuation of the gall bladder [34].

The 21,045.9 ETB ($1,238.0) financial loss observed in the present study is relatively lower than the $3,784.52 loss from Modjo Modern Export Abattoir [4] and $5,8411.26 from Ada Liben district of Ethiopia [35]. This is due to the fact that most individuals and butchers in Jimma zone slaughter animals, mostly small ruminants, at home. In Jimma and surroundig districts, 91.6, 28.0 and 9.4% householders, butchers and abattior workers were slaughtering animals outside abattior [36]. 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 [3]. It is difficult to estimate acurate financial loss only from liver condemnation and using data under reporting on number of animals slaughtered per year. As a result, the current result showed under estimation of the actual economic loss due to fasciolosis in the area.

CONCLUSION

Infection with *Fasciola* parasite was found to be common in small ruminants from Jimma and the surrounding districts. The prevalence was significantly influenced by species, age and body condition score of the small ruminants. Most of the animals were negative for coprological examination by simple sedimentation technique even though they are infected and found positive by postmortem examination of the liver. The high prevalence of fasciolosis obtained in the present study clearly indicates the high risk the parasite poses to the economy and public health in Jimma zone. Detailed study

on the economic and public health implications of the parasite, molecular typing of *Fasciola* species circulating in the area and initiation of suitable control programs are recommended.

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