Acta Parasitologica Globalis 6 (3): 209-214, 2015
ISSN 2079-2018

DOI: 10.5829/idosi.apg.2015.6.3.95220

Prevalence Survey on Hydatidosis and its Financial Loss in Small Ruminants Slaughtered at Addis Ababa Abattoirs Enterprise

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Abstract: The study was conducted from November 2009 to April 2010 at Addis-Ababa-Abattoirs-Enterprise. The aim of this study determining the prevalence of small-ruminant hydatidosis and to estimate the financial-loss attributed to hydatid-disease as a result of organ condemnation. Of 474 examined sheep, 110 (23.2%) and 414 examined goats 46 (11.1%) were found harboring hydatid-cysts. The total number of organs affected by one or more hydatid-cyst(s) was found to be 150 out of which lungs account 82 (54.7%), liver 66 (44%) and spleen 2 (1.3%) in sheep and lung 24 (40%), liver 34 (56.7%) and kidneys 2 (3.3%) in goats. Observation during the survey period revealed that differences in infection rate among the two species examined were found to be significant ($p<0.05$). The prevalence of hydatidosis with relation to the sex of animals indicated that higher infection rate was recorded in males than females in both species. Annual financial-loss from organ condemnation at the abattoir was estimated to be about 146,535.84 Ethiopian-birr. From the result obtained in this study, it can be concluded that hydatidosis is one of the most economically important disease in which it needs serious attention. Therefore, appropriate control and preventive measures need to be taken in order to minimize the economic-loss associated with the problem and to prevent the zoonotic-risk.

Key words: Prevalence · Hydatidosis · Small-ruminant · Addis-Ababa-Abattoirs-Enterprise

INTRODUCTION

Ethiopia owns huge number of small ruminants; about 24 million sheep and 18 million goats [1]. Sheep and goats cover more than 30% of all domestic meat consumption and generate cash income from meat, edible organs, live animals and skin. Despite its huge population size Ethiopian livestock productivity remains marginal due to prevalent disease, malnutrition and management constraints. Parasitism represents a major setback to the development of the sub-sector. However, data on epidemiology, economic loss and relative hierarchy of individual parasitic infections are hardly available, which otherwise of paramount competency investigated [2].

Echinococcosis is a term used to describe infection of different animal species and humans with larval or metacestode stage of *Echinococcus* species [3]. Hydatidosis is a zoonotic parasitic infection of many mammalian species caused by the adult or larval stage of the genus *Echinococcus* and family Taeniidae, which is found in the small intestines of dogs and other carnivores [4]. Four species are currently recognized within the genus *Echinococcus; E. granulosus, E. multilocularies, E. oligarthus and E. vogeli* [5]. Ungulates, including sheep, cattle, goats, pigs and horses are intermediate hosts in which hydatid cysts occur. The parasites are perpetuated in life-cycles with carnivores as definitive hosts, which harbour the adult egg-producing stage in the intestine and intermediate host animals, in which the infective metacestode stage develops after per oral infection with eggs [6].

E. granulosus is an obligatory heterogeneous parasite with a complex life cycle which includes domestic and sylvatic cycle. It requires two mammalian hosts to complete its life cycle. This involves the definitive hosts (domestic dogs and wild canids) and the intermediate hosts (domestic and wild ungulates and humans). The infective eggs in grass feed or water are ingested by the intermediate hosts and hatch into oncospheres (larvae) inside the stomach and intestine. The liberated larvae penetrate the small intestine and reach their final localization passing through vascular and lymphatic systems to the liver and lungs and they are rarely spread to other organs [7]. Transmission of Echinococcus is

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complex and involves a multiplicity of interacting factors associated with each life cycle stage of the parasite, the definitive and intermediate hosts and the environment. Definitive hosts, mainly canids, are infected when they ingest cysts (metacestodes) in the tissue of the intermediate hosts. Intermediate hosts are infected when they ingest the eggs of the definitive host. The majority of the eggs will be liberated in the environment, but some adhere to the coat of the definitive host. Environmental dispersion of egg is assisted, not only by the active movement of graved proglottids, but more significantly by arthropods and water [8]. Definitive hosts acquire infection by ingestion of viable protoscolices either as a result of predation and scavenging, or directly through human involvement with the feeding of infected visceral organs. The numbers of worms which is established and develop in the definitive host is primarily related to the number of viable cysts ingested by the definitive host [5].

The outcome of infection in livestock is hydatid cyst development in the lung, liver or other organs [9]. Apart from its zoonosis, *E. granulosus* represented a considerable economic significance in different countries. Hydatid cysts in animals cause condemnation of lung and liver, losses of meat and milk production and fleece values from infected sheep may also occur. These losses are of special significance in countries with low economic outputs where sheep production is of particular importance [10].

So far in Ethiopia most studies on hydatidosis are concerned about bovine hydatidosis only and yet there is lack of information for small ruminants'.

Therefore, the objectives of this study are to determine the prevalence of hydatidosis in small ruminants slaughtered at Addis Ababa Abattoirs Enterprise and to estimate financial loss of hydatidosis based on organ condemnation.

MATERIALS AND METHODS

Study Area: The study was conducted at Addis Ababa Abattoirs Enterprise (AAAE). Addis Ababa is located at 9.03° North latitude and 38.8° East longitudes with an average altitude of 2400 meters above sea level. Addis Ababa covers about 54,000 hectares of land with an average population of more than 3 million. It has an average temperature during winter 6°c minimum and 23°C maximum and during summer 10°C minimum and 24°C maximum with an annual temperature of 15.9°C. It also receives an annual rain fall of 1089 mm or 91 mm per month with 60.1% annual relative humidity which ranges from 49% in February to 82% in July [11].

Study Population: The study was conducted on 474 sheep and 414 goats that are brought to the abattoir from different regions of the country for slaughter. According to the information obtained from the abattoir the average daily slaughter rate is 200 sheep and 75 goats. On average 72,000 sheep and 27,000 goats are slaughtered annually.

Study Design: A cross sectional study design was used and conducted by using systematic random sampling method from October 2009 to April 2010 to determine the prevalence of small ruminant hydatidosis slaughtered at Addis Ababa Abattoirs Enterprise.

Sample Size Determination: The required sample size of the study for both species of animals were determined by the formula given in Thrusfield [12] with 95% of confidence interval and at 5% desired precision. By using this formula and prevalence of 19% in sheep and 16% in goats reported in the study area, then the required sample size becomes 474 in sheep and 414 in goats. A total of 888 sheep and goats were examined for the presence of hydatid cysts in different organs like liver, lungs, kidneys, heart and spleen.

Study Methodology

Prevalence Study: The study was conducted from November 2009 to April 2010. Post mortem examination was carried out on 888 sheep and goats that were slaughtered at AAAE. During examination of each slaughtered animal, a thorough inspection was carried out on organs, particularly the lungs, liver, spleen, kidneys and heart. Each organ was assessed macroscopically by visualization and palpation and when necessary incision was made [13].

Estimation of Financial Losses Due to Hydatidosis: The estimation of financial loss is based on determining average market price of the condemned edible offals like liver, lungs, heart and kidneys. Accordingly the average annual slaughter level and the retail market price of different edible offals in AAAE were considered as the parameters in calculating price of condemned edible offals. The average annual slaughter level of AAAE is 72,000 sheep and 27,000 goats with a total of 99,000 and retail market price of edible offals were 12 birr; 5 birr and 3 birr for liver, lung and kidney respectively. The estimated annual loss due to edible offals condemned in hydatidosis is assessed by the using the following formula [14).

FL= (NAS x PH x PHLU x CPLU)
+
(NAS x PH x PHLI x CPLI)
+
(NAS x PH x PHK x CPK)
+
(NAS x PH x PHS x CPS)

Where;
FL= Financial loss
NAS= Average number of small ruminants slaughtered annually
PH= Prevalence rate of hydatidosis
PHLU= Prevalence of lung hydatidosis
CPLU= Current average price of lung
PHLI= Prevalence of liver hydatidosis
CPLI= Current average price of liver
PHS= Prevalence of spleen hydatidosis
CPS= Current average price of spleen
PHK= Prevalence of kidney hydatidosis
CPK= Current average price of kidney

Data Management and Analysis: The data collected from the study area were recorded in the format developed for this purpose and later on entered into Microsoft excel 2007 program and analyzed using SPSS 17 version.

RESULT

Prevalence Study: A total of 474 sheep and 414 goats were examined at Addis Ababa Abattoirs Enterprise for the presence of hydatid cyst. Of these animals 110 (23.2%) sheep and 46 (11.1%) goats were found harboring hydatid cysts (Table 1). Post mortem examination of organs that revealed as being 82 (54.7%) lungs, 66 (44%) liver and 2 (1.3%) spleens in sheep and 24 (40%) lungs, 34 (56.7%) liver and 2 (3.3%) kidney in goats were infected with hydatid cyst (Table 2). A significant difference x^2= 11.163, $p < 0.05$ in prevalence rates was observed between sheep and goats. According to the prevalence of hydatidosis with relation to the age and sex of animals, high positive association between sex of sheep and age of goats were observed in this study (Table 3 and Table 4).

Estimation of Financial Losses: By applying the formula stated previously the annual financial loss associated with hydatidosis is calculated as follows.

FL= (NAS x PH x PHLU x CPLU) + (NAS x PH x PHLI x CPLI) + (NAS x PH x PHK x CPK) + (NAS x PH x PHS x CPS)
= (99000 x 17.6% x 50% x 12) + (99000 x 17.6% x 47.6% x 5) + (99000 x 17.6% x 1% x 3)
= 146,535.84 Ethiopian birr

Table 1: Overall prevalence of small ruminant hydatidosis in the study area

Species	No of animals examined	No of animals infected	Prevalence (%)	X^2	P value
Sheep	474	110	23.2	11.163	0.001
Goats	414	46	11.1		
Total	888	156	17.6		

Table 2: Number of organs infected and distribution of hydatid cysts on different organs

	Sheep		Goats	
Organs examined	No. of organs infected	Percent (%)	No. of organs infected	Percent (%)
Lung	82	54.7	12	40
Liver	66	44	17	56.7
Spleen	2	1.3	-	-
Kidney	-	-	1	3.3
Total	150	100	30	100

Table 2: Prevalence association of hydatidosis with sex of sheep and goats

Species	Sex	No examined	No infected	X^2	P value
Sheep	M	142	62 (13.1%)	23.290	0.000
	F	332	48 (10.1%)		
Goats	M	244	30 (7.2%)	0.422	0.516
	F	170	16 (3.9%)		

Table 3: Prevalence association of hydatidosis according to age (years).

Species	Age	No examined	No infected	X^2	*P value*
Sheep	<1	194	38 (8%)	1.207	0.547
	1-3	218	56 (11.8%)		
	>3	62	16 (3.4%)		
Goats	<1	208	8 (2%)	13.376	0.001
	1-3	162	26 (6.2%)		
	>3	44	12 (2.9%)		

Table 4: Prevalence association of hydatidosis with sex of sheep and goats

Species	Sex	No examined	No infected	X^2	P value
Sheep	M	142	62 (13.1%)	23.290	0.000
	F	332	48 (10.1%)		
Goats	M	244	30 (7.2%)	0.422	0.516
	F	170	16 (3.9%)		

DISCUSSION

The result of this study show high cystic echinoccoccus infection levels of sheep (23.2%) and goats (11.1%). A possible reason for the high prevalence of hydatidosis might be due presence of backyard slaughtering system, contact between large number of stray dogs with the flock of small ruminants and humans and improper disposal of affected offal in the origin of the animals. Dogs, which are the primary predisposing factor for the disease transmission are kept together with a flock of shoat and are routinely fed with uncooked offals which deemed unfit for human consumption [15].

The result of this study is comparable with the findings of other workers in different regions of Ethiopia, such as, Bersisa [16] 22.2% of sheep in Nekemt and Fikre [17] 18.8% of sheep and 9.3% of goats in Soddo. Comparable findings were found in Africa for this result. These include 24% of sheep in Niger Delta [18], 20.4% of sheep in Kenya [19] and 9.6% of goats in Djibouti [20].

In this study, the prevalence of hydatidosis in sheep was 23.2% and 11% in goats which is lower compared with the prevalence reported by Sissay *et al*., [21], 68% in Eastern Ethiopia and Ararso [22], 53.5% in Assela but greater than 8.7% of sheep and 4.6% of goats in Gondar [23]. It is also lower compared with other findings out of Ethiopia, for example, 74.4% of sheep and 20% of goats in Iran [24], 63.8% of sheep and 34.7% of goats in Tanzania [25]. Differences in strain of *E. granulosus*, host age factors, abundance of final infected hosts and stocking rate of livestock are other contributing factors that have been suggested by Smyth [26].

The present study revealed that the spreading of infection by hydatid cyst is an indication of environmental contamination with the eggs of the adult dog tape worm. *E. granulosus* infection rate shows highly statistically significant ($x^2 = 11.163$, $p < 0.05$) between sheep and goats. Sheep were more frequently infected than goats in the study area (23.2% in sheep compared to 11.1% in goats). This could be due to the feeding behavior of goats as they usually prefer browsing than grazing which may reduce the chance of acquiring the *E. granulosus* infective egg from the ground.

In the present study male sheep and goats were more infected than females. This contrasts the observation of Daryani *et al*., [24] who reported that female small ruminants were more likely to have cystic echinococcosis infection than males. The most probable explanation for the high infection rate in male animals in this study could be attributed to the practice of slaughtering large number of male in relation to females in the abattoir.

Organ wise distributions of hydatid cysts were compared and again hydatid cysts predominantly (98.7%) were found in lung and liver of the examined organs. This fact is in agreement with the result of Yemane [27] who reported hydatidosis in 52.8% and 25% in lungs and livers respectively in sheep. This could be due to the fact that lungs and livers posses the first great capillaries sites encountered by the migrating *Echinococcus* oncosphere which adopt the portal vein route and primarily prefer hepatic and pulmonary filtering system sequentially before any other peripheral organ is involved. In addition, the lungs were predominantly infected with hydatid cyst than any other organ probably due to the presence of greater capillary beds in the lungs than other organs which is in agreement with Kebede *et al*. [28]. The kidney and spleen are the least affected organs in the study animal. Similar findings were also obtained by various workers and it is indicated that the liver and lungs are the most commonly affected organs with hydatid cyst due to

the reason that there are the first large capillary fields encountered by the blood borne onchospheres. However, development of hydatid cysts occurs occasionally in other organs and tissue when onchosphere escape in to the general systemic circulation [29].

The financial loss incurred during this study as a result of condemnation of ovine and caprine species was estimated approximately about 146,535.84 Ethiopian birr at Addis Ababa Abattoirs Enterprise.

CONCLUSION

Echinococcosis, which causes a considerable loss to livestock industry, is also a serious threat to public health. In this study high prevalence of hydatidosis was recorded in both species of small ruminants and high financial loss is recorded. The abattoir does not have proper origin recording system, so it is difficult to contribute in the control by feedback mechanism by reporting the prevalence of the disease to the area that animals were originated. Presence of backyard slaughtering system, packs of stray dogs, the relations existing between livestock and pet animals and the nil emphasis given to the health of pet animals in the country are the main factors that may have contributed to the prevalence and distribution of the disease.

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