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The Status of Cystic Echinococcosis (Hydatidosis) in Small Ruminants Slaughtered at Addis Ababa Municipal Abattoir

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Abstract: A cross-sectional study was carried out from November 2008-April 2009 in Addis Ababa abattoir to overview the status of hydatidosis in small ruminants in the country. A total of 611 sheep and 389 goats brought for slaughter from different parts of the country were involved. Out of 1000 small ruminants examined 97 (9.7%) were found to harbor hydatid cysts. Infection was significantly higher ($p<0.05$) in sheep (13.9%) than goats (3.1%). Likewise, significantly higher infection ($p<0.05$) was found in older age category (29.78%) than it was in younger (3.87%). However, sex did not demonstrate a difference of statistical significance ($p>0.05$). Out of 111 hydatid cysts recovered for laboratory observation, 52.25% were fertile while 28.83 and 18.92% were sterile and calcified, respectively. About 54% of the cysts from sheep were fertile while it was 33.33% for goats. Such an observation of a higher prevalence and fertile cysts in sheep compared to goats may suggest the enormous role that sheep could play in the occurrence of hydatidosis. Inline with this finding, the need for proper disposal of offal, termination of backyard slaughter and control of stray dogs is recommended to prevent the economic loss and public health hazards associated with the disease.

Key words: Hydatidosis, Addis Ababa, abattoir, small ruminants, risk factors, Ethiopia

INTRODUCTION

With about 23.62 million sheep and 23.33 million goats (Institute of Biodiversity Conservation (IBC), 2004) in Ethiopia, small ruminants represent an important component of the farming system. They provide about 12% of the value of livestock products consumed at the farm level and 48% of the cash income generated but account for only 6.6% of the capital invested in the livestock sector (Kassahun *et al*., 1989). Of those factors impeding productivity, diseases were recorded to play a leading role (Biffa *et al*., 2006).

In Ethiopia, significant losses result each year from death of animals, inferior weight gain, condemnation of edible organs and carcass at slaughter due to helminthes (Biffa *et al*., 2006). Echinococcosis is a zoonotic infection caused by adult or larva (metacestode) stage of cestodes belonging to the genus *Echinococcus*, family Taeniidae (Eckert *et al*., 2001). *Echinococcus granulosus* and its metacestode (hydatid cyst) in herbivores and humans have been recognized as the most important helminth zoonoses with great economic and public health significances in developing countries (Schantz, 1991). It remains persistent and re-emerging problem in countries of low economic status where a resource for an intensive control program is limited (Schantz *et al*., 2003).

It is the main cause of organ condemnation and causes huge economic losses in Ethiopia (Demeke, 1987). Several reports are available as to the impact of hydatidosis in cattle of various parts of the nation (Bekelea *et al*., 1988; Jobre *et al*., 1996; Yimer *et al*., 2002; Kebede *et al*., 2009a, b). Yet information pertinent to the status of hydatidosis in small ruminants is limited. Therefore, this research attempts to overview the status of hydatidosis in the country as the animals in the abattoir are coming from different parts of the country and observe the importance of sheep and goats in the occurrence of the disease.

MATERIALS AND METHODS

Study area: The study was conducted from November 2008-April 2009 in Addis Ababa abattoir which is found in Addis Ababa city. Addis Ababa is located at 9°3' North, latitude and 38°43' East, longitude. It lies in the central highlands of Ethiopia at an altitude of 2500 m above sea level. It has an average rainfall of 1800 mm per annum. The annual average maximum and minimum temperature is 26 and 11°C, respectively; with an overall average of 18.7°C. Highest temperature is reached in May. The main rainy season extends from June to

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September. Addis Ababa has a relative humidity ranging from 70-80% during rainy season and 40-50% during dry season. The human population is estimated at about 3 million inhabitants (NMSA, 1999).

Study design and animals: The study (cross sectional) comprised an active abattoir survey of sheep and goats brought for slaughter from various parts of the country (Borana, Guji, East and West Hararghe, Awash, Matahara, Afar, Wollo, Tigray and Shewarobit). During antemortem examination each animal was given an identification number. The record included species, estimated age based on dentition (Gatenby, 1991; Steele and Smith, 1996) and lesion distribution and nature of the cyst at postmortem examination.

Sample size: The sample size was determined using systematic random sampling technique after having the following parameters predetermined expected prevalence of 10.6% in sheep (Kebede *et al*., 2009a) and 2.7% in goats (Adem, 2006), confidence level 95% and desired precision level of 5% (Thrusfield, 2005). Thus, 389 goats and 611 sheep were included in the study. The sampling interval 61 for sheep and 30 for goats were calculated by dividing the study population reported 37500 sheep and 11250 goats slaughtered between October and February to the sample size (Dohoo *et al*., 2003).

Active abattoir survey and laboratory procedure: The inspection procedure used during the post mortem examination consisted of primary and secondary examinations. The primary examination involved visual inspection and palpation of organs and viscera. The secondary examination involved further incisions into each organ if a single or more cysts found. Liver, lungs, heart, spleen, mesentery and omentum of each animal were examined grossly. Each organ was also incised once or twice with a knife. Whenever and wherever cysts were present, they were removed, put in polythene bags separately, labeled and then taken to the laboratory for further studies.

Identification of cysts was carried out based on the morphological criteria described by Soulsby (1982). Microscopic examination of the cyst fluid was conducted to look for the characteristic protoscolices. The content of the cyst was poured into a petridish and examined with ×40 magnifications for assessment of the condition of the cyst. If the protoscolices were present, they were seen as white dots on the germinal epithelium or brood capsule (hydatid sands) within the suspension and the cysts were categorized as fertile. Fertile cysts were further subjected to viability test. A drop of fluid from cyst containing the protoscolices were placed on the microscope glass slide and covered with cover slip and observed for amoeboid like peristaltic movements with ×40 objective. For clear vision a drop of 0.1% aqueous eosin solution was added to equal volume of protoscolices in hydatid fluid on microscope slide with the principle that viable protoscolices should completely or partially exclude the dye while the dead ones take it up (Macpherson *et al*., 1984; Smyth and Barrett, 1980). Sterile hydatid cysts are characterized by their smooth inner lining usually with a slight turbidity of the contained fluid and typical calcified cyst produced a gritty sound feeling upon incision (Parija, 2004; Soulsby, 1982).

Data analysis: Data obtained from record format and detail postmortem and microscopic examination of organs and cysts were recorded on Microsoft excel 2003 computer program. Statistical software STATA 9 was used for data analysis. Prevalence was calculated as percentage value and the possible association of infection with hypothesized risk factors was analyzed using logistic regression.

RESULTS AND DISCUSSION

Overall prevalence: Out of a total 1000 sheep and goats examined during the study period 97 (9.7%) were found to harbor one or more hydatid cysts in their visceral organs.

Hydatidosis in relation to hypothesized risk factors: In this study sex, species and age were considered as potential risk factors for the occurrence of the cyst. Accordingly, 10.8% (49/453) males and 8.8% (48/547) females were found to have the cyst in one or more of their organs. Regarding species, 13.9% (85/611) sheep and 3.1% (12/389) goats were found to be infected. For age based estimation, the small ruminants were categorized into two age categories as young (<3 years) which had a 3.87% (30/775) while old (above or equal to 3 years) were detected to have 29.78% (67/225) (Table 1).

Table 1: Prevalence of hydatidosis in relation to hypothesized risk factors

Factors	Category	Number examined	Number infected	Prevalence (%)	95%CI
Species	Sheep	611	85	13.90	11.15-16.67
	Goat	389	12	3.10	1.35-4.810
Sex	Male	453	49	10.80	7.94-13.68
	Female	547	48	8.78	6.39-11.15
Age	Young (<3 years)	775	30	3.87	2.12-5.340
	Old (>3 years)	225	67	29.78	24.29-34.25

CI: Confidence Interval

Table 2: Organ distribution of hydatid cyst in sheep and goats

Species	Lung	Liver	Heart	Spleen	Kidney
Sheep	62	39	1	0	0
Goat	8	7	0	0	0
Total	70 (59.83%)	46 (39.32%)	1 (0.34%)	0	0

Table 3: Cyst status versus species

Species	No. of cysts	Fertile (%)	Sterile (%)	Calcified (%)
Sheep	99	54 (54.55)	29 (29.29)	16 (16.16)
Goats	12	4 (33.33)	3 (25.00)	5 (41.67)
Total	111	58 (52.25)	32 (28.83)	21 (18.92)

Table 4: Hydatid cyst status in different organs

	Organ							
Cyst status	Lung	%	Liver	%	Heart	%	Total	%
Fertile	38	52.05	20	54.05	0	0.00	58	52.25
Calcified	13	17.81	8	21.62	0	0.00	21	18.92
Sterile	22	30.14	9	24.32	1	100.00	32	28.83
Total	73	-	37	-	1	0.90	111	100.00

Organ distribution of hydatid cyst: Lung was the most affected organ (59.83%) followed by liver (39.32%) where cysts were detected out of 97 infected small ruminants. No hydatid cyst was recovered from spleen and kidney (Table 2).

Fertility status of cysts: Out of 111 cysts collected to observe the fertility status of each, 52.25% (58) were fertile, 18.92% (21) calcified and 28.83% (32) sterile. Of the 58 fertile cysts, 54 were recovered from sheep while the remaining 4 were goat origin (Table 3).

Pertinent to organ level distribution, fertile cysts recovered of lung origin were 52.05% while that of liver were 54.05%. The difference between fertile cysts originating from these two organs was not statistically significant ($p>0.05$). However, due to the large number of cysts detected from lung compared to liver, the former organ seems to be more important in the occurrence of hydatidosis (Table 4).

Univariable logistic regression analysis: Univariable logistic regression analysis of the three risk factors (age, sex and species) considered and the percent of cysts recovered in sheep and old age category demonstrated higher infections with statistical significance from their respective categories ($p<0.05$). However, sex didn't show any difference of statistical significance (Table 5).

Multivariable analysis: Further, multivariable logistic regression analysis of species and age identified both as important risk factors in the final model as well ($p<0.05$) (Table 6).

This survey disclosed that the overall prevalence of hydatidosis in small ruminants slaughtered at Addis Ababa municipal abattoir was 9.7%. This finding is lower when compared to that of Kebebe *et al.* (2010) where an overall prevalence of 18.4% was recorded in small ruminants brought for slaughter to Addis Ababa abattoir from various sites in a period from October 2007 to May 2008. This variation might be resulted from greater proportion of younger animals being slaughtered during the current study period in which only few were found to harbor cysts.

Table 5: Univariable logistic regression analysis of hypothesized risk factors

Risk factors	Category	Number infected	Prevalence	p-value	OR	95%CI
Species	Sheep (611)	85.00	13.900			
	Goat (389)	12.00	3.100	0.000	5.07	2.73-9.42
	Male (453)	49.00	10.800			
Sex	Female (547)	48.00	8.780	0.278	1.26	0.82-1.91
Age	Young (775)	30.00	3.870			
	Old (225)	67.00	29.770	0.038	1.62	1.02-2.53

OR: Odds Ratio

Table 6: Multivariable logistic regression analysis of the risk factors

Factors	OR	SE	Z	p>/Z/	95% CI
Species	5.14	1.6255810	5.18	0.000	2.76-9.55
Age	1.68	0.4028984	2.19	0.029	1.22-2.85

The infection rate in sheep was 13.9% while it was 3.1% in goats. Accordingly sheep were seen to suffer higher risk of infection compared to goats. The current finding in sheep is in close agreement with the research of Jobre *et al.* (1996), Koskei (1999) and Kebede *et al.* (2009a) where they reported 11, 9.1 and 10.6% in South Omo, Addis Ababa and Bahir Dar, respectively. Moreover, there are also reports that reveal the presence of very high prevalence, 40.3% in Sheno (Fekadu, 2003) and 68% in eastern Ethiopia. In goats, such a low prevalence (<3.1%) had also been documented in east Shewa (Yemane, 1992), Bahir Dar (Gebre, 1996) and Debrezeit (Adem, 2006). Perhaps this could be attributed to the browsing nature of goats that made them feed on relatively less contaminated vegetation than sheep which are relatively grazers (Dalimi *et al.*, 2002). In a nut shell, this finding probably suggests the importance of sheep as the main reservoir of infection (important intermediate host) in maintaining and perpetuation of the domestic life cycle of *E. granulosus* in the region (Kebede *et al.*, 2009a).

The observation made pertinent to sex disclosed prevalence of 10.8 and 8.78% in females though the difference in this regard did not show any significance. This may be explained by indiscriminate exposure to risk irrespective of the sex in the extensive management system. On the other hand, the categorical analysis of age in this study demonstrated an infection rate of 3.87% in young and 29.78% in older age category. The observed difference between the two age categories reveals that older age group was found to be 1.6 times more at risk compared to the younger age category. Like most other

studies, this observation also establishes age as an important risk factor in the occurrence of hydatidosis (Torgerson *et al*., 1998; Larrieu *et al*., 2001).

Regarding cyst distribution, higher infection was recorded in lung (59.83%) followed by liver (39.32%). There was a single infection record (0.85%) in heart muscle and neither spleen nor kidney had observable cyst. This is explained by the fact that lung and liver posses the first great capillary sites encountered by the migrating Echinococcus oncosphere (hexacanth embryo) which adopt the portal vein route and primarily negotiate hepatic and pulmonary filtering system sequentially before any other peripheral organ is involved (Schantz, 1982). The percentage of fertile cysts recovered from lung was 65.52% while the remaining 34.48% was liver origin. Likewise, Adem (2006) and Kebede *et al*. (2009b) reported the recovery of high proportion of fertile cysts in the lung compared to liver. The relatively softer consistency of lung tissue that allows easier development of the cyst and the fertility (Himonas, 1987) may explain the difference in this and other similar findings.

In this study 52.25% of the detected hydatid cysts were fertile while 28.83 and18.92% sterile and calcified, respectively. Of the fertile hydatid cysts, 93% (54) were recovered from sheep while the remaining 7% (4) from goats. This finding is in agreement with reports of Dalimi *et al*. (2002) and Kebede *et al*. (2009a). Data on the prevalence and fertility of cysts in various domestic herbivores provide reliable indicators of the importance of each type of animal as a potential source of infection to dogs (Daryani *et al*., 2006). In light of this fact, the presence of high prevalence compounded with such very high fertility, possibly emphasize the enormous role of sheep in the occurrence of hydatidosis.

CONCLUSION

Taking the current finding into consideration, the observation of high prevalence and fertile cyst in sheep compared to goats, dictates that sheep have a substantial contribution to the occurrence of hydatidosis. Moreover, as animal gets older the risk of acquiring hydatid infection was seen to be higher. Therefore, there is a need for proper disposal of offal in the abattoir and a means has to be devised to terminate the practice of backyard slaughter.

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