

Hydatidosis in Sheep and Goats Slaughtered at Bishoftu Hashim Export Abattoir: Prevalence and Risk Factors

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Abstract: The study was conducted from November 2014 to April 2015 to determine the prevalence of hydatidosis in small ruminants slaughtered at Bishoftu Hashim export abattoir. Routine meat inspection procedure was conducted whereby lung, heart, liver, kidney and spleen were palpated, incised and visualized to detect the presence of hydatid cysts. Out of 652 small ruminants consisting of 200 sheep and 452 goats slaughtered and inspected, 28 (14.0%) and 42 (9.3%) sheep and goats respectively were found harboring hydatid cyst. Statistically significant difference was in infection rates between different age groups in both sheep and goats ($P < 0.05$), but results of the study showed that statistically significant variation was never observed in the prevalence of hydatid cysts between sheep and goat hosts. Over all hydatid cyst infection in sheep heart, lung, liver were found to be 0 (0.00%), 19 (9.5%) and 9 (4.5%) respectively. Similarly, 1 (0.2%), 18 (4.0%) and 23 (5.1%) of infection were recorded in goats heart, lung, liver respectively. There was statistically significant difference ($P < 0.005$) between organs affected. In general, out of 70 examined hydatid cysts, 40 (6.1%), 12 (1.8%) and 18 (2.8%) were fertile, sterile and calcified cysts respectively. Statistically significant difference was present between conditions of cyst ($P < 0.05$). In order to assess predisposing risk factors for distribution of the diseases in the area, it was found to be poor and improper fencing around disposal areas of abattoir, as well as offal selling markets on the road side; all dog owners were feeding dogs raw offals. Additionally, the knowledge of the people about the role of dogs in transmitting echinococcosis to humans and animals is very low.

Key words: Hydatidosis • Prevalence • Risk factors • Sheep and Goats

INTRODUCTION

Ethiopia has the largest small ruminants population in Africa which is reared by farmers mostly as subsidiary occupation or by poor people. It is more a way of life rather than a commercial enterprise. According to CSA [1], the population of sheep and goats in Ethiopia is estimated to be 26.1 and 21.7 million respectively. In spite of large livestock population in Ethiopia, the productivity remains marginal and this may be mainly due to malnutrition, prevalent diseases and management problems.

Helminthes are major causes of animal diseases and loss of productivity throughout the tropics [2]. Moreover, zoonotic diseases common to man and animals

continue to have high incidence rates and to cause significant morbidity and mortality. Infections and parasitosis of ruminants can reduce meat or milk production and can lead to death or destruction of the animals, all of which diminishes the supply of available food for man. These are also an obstacle for international trade as well as financial drain for cattle farmers and more broadly for a community's or country's economy, which can have wide repercussions for a society's health [3].

Hydatidosis (Cystic echinococcosis) caused by the larval stage (metacestode) of *Echinococcus granulosus* is the most widespread parasitic zoonosis. Dogs are the usual definitive hosts whilst a large number of mammalian species can be intermediate hosts, including domestic

ungulates and man [4, 5]. Adult *E. granulosus* releases ova in the small intestine of the canid host and passes with the fecal matter, where it can survive for an extended period of time (up to one year outside the host body). The eggs can adhere to the paws, muzzle and hair of the animal. So intimate contact with the animal can lead to ingestion by humans or transfer to grazing areas of ruminants [6]. Close contact between dogs and intermediate hosts and dog fecal contamination of water and pasture leads to ingestion of the eggs by the intermediate host. Dogs must ingest raw offal in order to complete the life cycle of *E. granulosus* protoscolices develop into adult flatworms in the duodenum of the dog.

Food animals such as sheep, goats, cattle, camels, buffaloes and pigs acquire the infection by ingestion of infective eggs with contaminated grass and water. Man is infected incidentally up on ingestion of infective eggs in contaminated water, vegetables, or other food or through direct contact with the dog. Upon ingestion, the oncospheres penetrate the intestinal wall and reach visceral organs such as the liver, lungs, heart and kidneys of animals and humans to develop to hydatid cysts [7].

The disease occurs throughout the world and causes considerable economic losses and public health problems in many countries. Hydatidosis causes decreased livestock production and condemnation of offal containing hydatid cysts in slaughterhouses [8]. Despite the large efforts that have been put into the research and control of echinococcosis, treatment cost and lost wages, it still remains a disease of worldwide significance.

Echinococcus granulosus infection is endemic in East and South Africa, Central and South America, South Eastern and Central Europe, Middle East, Russia and China. The highest incidence is reported mainly from sheep and cattle rearing areas [9]. Several reports from different parts of Ethiopia indicate that hydatid cyst is prevalent in livestock [10-14]. Condemnation of edible offal unfit for human consumption is the major economic loss incurred by hydatidosis [15, 16].

Therefore, the objectives of this study were undertaken:

- ✓ To determine prevalence and distribution of hydatid cyst on organ of small ruminants slaughtered at Hashim Ethiopian live and meat export (HELMEX) abattoir and
- ✓ To assess the way of offal disposal in abattoir and risk factors to animals' infection.

MATERIALS AND METHODS

Study Area: The current study was carried out in Bishoftu town which is located at 47 km South East from Addis Ababa. Geographically, Bishoftu is located 8°45' 00" N and 38°59' 00" E whose elevation is 1850 meter above sea level. Maximum temperature ranges between 17-25°C with an average rainfall of 1100 mm per year.

Study Animals: A total number of 652 animals (200 sheep and 452 goats) were presented for slaughter from which goats were higher compared to sheep due to less requirement of sheep than goats in the abattoir. The study was performed in visceral organs (liver, lung, heart, kidney, and spleen) of both sheep and goats. Animals were all males and originated from different parts of lowland of the country. These areas are like Babilie, Somale, Borena, Isa and Yabello. The animals were slaughtered in Hashim Ethiopian live and meat export (HELMEX) abattoir. The information obtained from all export abattoirs indicates that the average annual slaughtering capacity is 100,000-120,000 small ruminants.

Study Design and Sampling Method: The study design employed was a cross sectional type with the objective of determining the prevalence and assessment of some risk factors related to hydatidosis in sheep and goat by post mortem examination of visceral organs like lung, heart, liver, kidney and spleen. Systematic random sampling method was employed in selection of the sample units at all export abattoirs. The sample size for study animals was determined by the formula given by Thrusfield [17].

$$N = \frac{T^2 \times P_{exp} \times P [1 - P_{exp}]}{d^2}$$

where,

N = Sample size to be determined

T = Value at a given confidence level

P = Expected prevalence of hydatidosis in the study area

D = Accepted absolute error/level of precision

Taking into account 50% expected prevalence of hydatidosis in sheep and goat, 5% accepted absolute error was used in the calculation of sample size. The calculated sample size was 384. To increase the precision 652 samples were collected. A total of 652 animals (200 sheep and 452 goats) were inspected and examined. The study animals were randomly selected from

those inspected animals for slaughtering. During ante mortem inspection, the age of each animal was identified by visual observation of the teeth, for those which have not erupted permanent incisor teeth, were classified as young, while those with pair or more permanent incisor teeth erupted were classified as adult [18].

The study was conducted from November 2014 to April 2015. The organ which contain hydatid cyst was taken from abattoir and examined in the laboratory of Addis Ababa University, College of Veterinary Medicine and Agriculture, Department of Parasitology Laboratory. Individual cysts were carefully incised and examined for protoscolices which were similar to the appearance of white dots on the germinal epithelium; such cysts were characterized as fertile cysts.

Postmortem Examination: A total of 652 small ruminants consisting of 200 sheep and 452 goats were used during this study. Thus, the small ruminants were examined for the presence of hydatid cyst by routine meat inspection procedure conducted on heart, lung, liver, kidney and spleen. The infected organs from sampled animals were collected and registered. Moreover, the hydatid cysts were classified as active, transitional and calcified by visual examination and carefully incised, fluid was removed, contents were examined for the presence of protoscolices and fertility tests were carried out as described by Oostburg, Vrede and Bergen [19].

Questionnaire: Study was conducted by questionnaire survey concerning details of possible risk factors to human and animals associated with hydatid cyst in small ruminants. The questionnaire was designed to gather information by observing and interviewing with dog owners, offal retailers and offal disposal system in abattoir.

Data Analysis: All data collected from the abattoir were recorded and entered in to Ms excel sheet. The data were analyzed using SPSS 15.0 window software. Chi square (χ^2) statistical test was applied to see the differences in the prevalence of hydatid cyst in the animals slaughtered. A statistically significant association between variables were said to exist if the P-value was less than 0.05.

RESULTS

Prevalence in Different Age Groups: Out of a total of 652 sheep and goats slaughtered at Hashim export abattoir, 28 sheep (14%) and 42 goats (9.3%) were found to be infected with one or more hydatid cysts involving different organs. The overall prevalence was 10.7%. Out of 200 sheep (1 young and 199 adults) examined, positivity to hydatidosis was 0 (zero) in young and 27 in adult of sheep. As to the prevalence of hydatid cyst with relation to the age of animals concerned, higher infection rates were observed in older sheep (Table1). The study showed that there is no statistical significant variation ($P=0.686$) among the adult and young sheep.

As to the prevalence of hydatid cyst with relation to the age of animals concerned, higher infection rates were observed in older goats (Table 2). Out of 261 and 191 young and adult of goats, positivity to hydatid cyst was 15 and 27 in young and adult goats respectively. The study showed that there is no statistical significant variation ($P=0.002$) among the adult and young goats.

Prevalence in Different Species Group: Out of a total of 652 shoats inspected, 70(10.7%) were infected with hydatid cysts. Cysts were detected in 200(14%) and 42(9.3%) of the examined sheep and goats respectively (Table 3). The current study shows no statistical significant variation ($P=0.073$) among sheep and goats.

Table 1: Prevalence in different age groups in sheep

Age groups in sheep	No. of animals		Prevalence (%)	χ^2	P-value
	Examined	Infected			
Young	1	0	0	0.16	0.686
Adult	199	28	14.07		
Total	200	28	14.		

Table 2: Prevalence in different age groups in goat

Age groups in goat	No. of animals		Prevalence (%)	χ^2	P-value
	Examined	Infected			
Young	261	15	5.75	9.21	0.002
Adult	191	27	14.13		
Total	452	42	9.5		

Table 3: Prevalence in sheep and goats

Species	No. of animals		Prevalence (%)	χ^2	P-value
	Examined	Infected			
Ovine	200	28	14	3.207	0.073
Caprine	452	42	9.3		
Total	652	70	23.3		

Table 4: Cyst in different organs of infected sheep and goats slaughtered in the Hashim export abattoir

Species	Distribution of cyst in organs			
	Lung (%)	Liver (%)	Heart (%)	Total (%)
Ovine	19 (2.9)	9 (1.4)	0 (0)	28 (14)
Caprine	18 (2.8)	23 (3.5)	1(0.1)	42 (9.3)
Total	37 (5.7)	32 (4.9)	1 (0.1)	70 (10.7)

P<0.05, [Chi square (χ^2)] =652.00

Table 5: Distribution of cysts based cyst condition

Organ	No. of cysts	Fertile (%)	Sterile (%)	Calcified (%)
Liver	32	16 (50.0)	8 (25.0)	8 (25.0)
Lung	37	23 (62.16)	4 (10.8)	10 (27.03)
Heart	1	1 (100)	0 (0.0)	0 (0.0)
Total	70	40 (57.14)	12 (17.14)	18 (25.72)

P<0.00, [Chi square (χ^2)] =682.250

Distribution of Cyst on the Organ and Character of Hydatid Cyst: In this study lung and liver were the most affected organ in both species of animals (Table 4) there was significant variation (P<0.05). Lungs were the most affected organs than the other examined organs. In the current study total of 28 cysts from sheep and 42 cysts from goat were collected from infected organs and differentiated as fertile, sterile and calcified (Table 4).

The hydatid cysts were collected and carefully incised and examined for protoscolices which were similar to the appearance of white dots on the germinal epithelium; such cysts were characterized as fertile cysts. From the total of 37 infected lungs, 23 (62.16%), 4 (10.8%) and 10 (27.03%) were fertile, sterile and calcified respectively; whereas, from 32 infected livers, 16 (50.0%), 8 (25.0%) and 8 (25.0%) were fertile, sterile and calcified respectively. The difference between the affected organs and condition of cyst is statistically significant [P<0.005 (Table 5)].

Questionnaires Results: Offal disposal system in both abattoir and risk factors for transmission of hydatid cysts Questionnaire survey concerning possible risk factors to animals associated with hydatid cyst in ruminant was conducted at Bishoftu municipal abattoir and Hashim

export abattoir. The questionnaires include offal disposal system in these two abattoirs and dog owners and offal retailers. Out of the two abattoirs, Bishoftu municipal abattoir has only one veterinarian for meat inspection. Commonly encountered zoonotic parasitic diseases occurred during meat inspection in the abattoir were hydatid cyst and *C. bovis* affecting organs like liver, kidney, heart spleen, and lung mostly. The abattoirs dispose the infected organ by burying and therefore, there is high probability of dogs to get access to condemned organs. Parasitic infection is a primary reason for detection of offal in the abattoir and it is known that it can be transmitted to human through contact with dog or contaminated food.

On the other way, Hashim export abattoir has two veterinarians, two assistant veterinarians and one laboratory technician. The most common zoonotic parasite diseases occurred during meat inspection in this abattoir were hydatid cyst, *Cenurus cerebrallis* and fluke causing great impact on lung and liver. The main disposal system of infected organs of both abattoirs is burying in which dogs can get access to condemned organs because of lack of fence which facilitate the chance of distribution of the parasite into animals and humans deteriorating the level of infection.

Table 6: Risk factors associated with dog owners and offal retailers

Risk factor	Response	Frequency	%
Management	Freely roaming	3	18.8
	Periodically release	8	50
	Tied in compound	5	31.1
Offal feeding	Raw	16	100
	Cooking	0	0
Knowledge of disease	Yes	1	25
	No	15	75
Source of offal for dogs	Road side	14	87.5
	Abattoir	1	6.5
	Others	1	6.5
Which abattoirs	Hashim	9	56.3
	Elfora	1	6.3
	Modjo and Elfora	3	18.8
	Unknown source	2	12.5
	Non abattoirs	1	6.3

Table 7: Animal risk factors (age, species of the animal)

Risk factors		Animals examined	Infected animals	%
Age	Adult	390	55	14.1
	Young	262	15	5.7
	Total	652	70	19.8
Species	Ovine	200	28	14
	Caprine	452	48	9.3
	Total	652	70	23.3

Risk Factors Associated with Offal Retailers and Dog Owners: Out of 16 dog owners and 16 offal retailers at road side respondents, the dog owners who tied their dogs in the compound were 5(31.3%), those who left their dogs to freely roaming were 3(18.8%) and those who periodically release were 8(50%) and types feed provided for their dogs was only offal for 2(12.5%) and both offal and enjera for 14 (87.5%). 14 (87.5%) of the dog owners take (buy) offals from road side, 1 (6.3%) of them directly get from abattoir and 1 (6.3%) get from others. All dog owners were feeding their dogs raw offals. 13 (81.3%) retailers take from abattoir, 1 (6.3%) from backyard and 2 (12.5%) from others. Hashim, 9(56.3%); Elfora, 1(6.3%); Modjo and Elfora 3(18.8%); unknown sources, 2(12.5%) and from backyard 1 (6.3%). These results indicated that distribution of offal was high in Hashim export abattoir and highly associated to risk factors to continue hydatid cyst life cycle.

DISCUSSION

Hydatidosis is known to be important in livestock and public health in different parts of the world and its prevalence and different workers in different geographical areas have reported its economic significance. The prevalence may however vary from country to country or even within a country. In this study

overall prevalence of hydatidosis in small ruminants was 10.7%. This finding is higher than the results from previous studies conducted at Modjo modern export abattoir which was 8.7% [20] and at Addis Ababa abattoir enterprise which was 8.6% [21].

Hydatid cysts were detected in 28 (14%) sheep and 42(9.3 %) goats examined. The current prevalence in sheep is higher than the findings of 10.2% at Jimma [22] and 4.4% at Desse [23]. But lower than finding of 22.2% at Nekemte [24] and in goats the findings were higher than 18(6%) and 5(3.3%) at Hashim Ethiopian live animal and meat export abattoir and ELFORA export abattoir were reported. But lower than 75(24.8%) at Jimma [25]. The prevalence was high in sheep compared to goats although the difference was not statistically significant ($P > 0.05$).

In the current study an overall prevalence of 15(5.7%) and 55(29.4%) was obtained from young and adult animals of both species respectively. In both categories these values are higher as compared to Getachew, Guadu and Fentahun [21] report but agree in their significance ($P < 0.005$). The current study showed that out of the 200 sheep, 199 adult and 1 young, positive to hydatid cyst were only adult sheep 28(14%). This finding in adult goats is higher than 20 (13.07%) at Bahir Dar. In case of goats, 261 and 191 young and adult examined, 15(5.75%) and 27(14.66%) young and adult

goats are positive to hydatidosis. Previous studies strongly suggest that the prevalence is heavily influenced by age [26]. In addition the variation in the prevalence may be due to the difference in the origin of animals brought for slaughter and also due to change in environmental and epidemiological factors, which could affect the rate of transmission of echinococcosis/hydatidosis [27].

In this study, the livers and lungs were the most frequently infected visceral organs in both host species examined. The distributions of cysts in the organ of sheep were 19 (2.9%), 0 (0%) and 9 (1.4%) in lungs, hearts and livers respectively and the distributions of cysts in the organ of goats were 18 (2.8%), 23 (3.5%) and 1(2%) in lungs, livers and hearts respectively. Current prevalence was high in lung of both species and also in liver of goats is in agreement with Getachew, Guadu and Fentahun [21] but lower in lung of the sheep as compared to findings of 3.3%, 2.7% in lung and 0.7%, 1.7% in liver of sheep and goat respectively at the same study area [28] but lower than finding of hydatid cyst in sheep (60%) in lung, (36%) in liver and in goats was (70%) in lung (18.5%) at Modjo Luna export slaughter house [21]. This is explained by the fact that livers and lungs possess the first great capillaries sites encountered by the migrating echinococcus oncosphere (hexacanth embryo) which adopt the portal vein route and primarily negotiate the hepatic and pulmonary filtering system sequentially before any other peripheral organ is involved [29]. Statistical analysis revealed a real significant difference ($P < 0.005$) between organs and it is in agreement with the literatures [30, 31]. The observation in this study shows that the lung in both sheep and goat was found to be more commonly infected with hydatid cysts than the liver is in agreement with the previous findings of Daryani *et al.* and Ibrahim [32, 33].

In present study higher number of active (fertile) cysts was recorded in sheep and goats, (sterile) transitional cyst and calcified cyst were low in number. In sheep and goat affected lung with fertile cyst was 23 (62.16%), liver 16 (50%) and heart 1 (100%); sterile cyst in lung 4 (10.8%), liver 8 (25%) and heart 0 (%) and calcified cyst in lung 10 (27.03%), liver 8 (25%) and heart 0 (0%) statistical significant difference was there between condition of cyst ($P < 0.05$), fertile cysts mostly occurred in lung. This finding is in agreement with that of Dalimi *et al.*, [34] and Kebede *et al.*, [35]. This fertile cyst result was higher than finding of (14.95%) in lung, (6.95%) in liver [36] at Addis Ababa abattoir enterprise. In the present study total fertile cyst was 40 (57.14%), non fertile (which are sterile and calcified) in sheep and goats was

12 (17.4%) and 18 (25.7%), total non fertile was 30 (43.1%). In current study the prevalence of fertile cyst is higher than finding of 0.7% at Australia [37], 2.6% at Sardinia [38] and 4.0% at Sicily [39].

The fertility of cysts is an important factor that can influence the transmission of *E. granulosus* [40]. In comparison of the fertility rates by organs it was higher in lungs than in livers in both sheep and goats. It has been stated that the relatively softer consistency of lung tissue allows the easier development of the cyst and the fertility rate of hydatid cyst may show a tendency to increase with advancing ages of the hosts [41].

The difference between tissue resistances of the infected organs may also affect the fertility rate of cyst. In the liver, host reaction may limit fertility rate of hydatid cysts. The difference in fertility rate among different species and in different geographical zones could be due to the variation in strain of *E. granulosus* [42].

Our questionnaire survey result showed existence of many risk factors associated with occurrence of the diseases. Among these, poor and improper fencing around disposal area of both abattoirs; dogs around the abattoir easily feed condemned offals, lack of sufficient meat inspector in municipal abattoir as compared to Hashim export abattoir as well as offal selling markets on the road side in Bishoftu town where most of these offals were infected by the cysts. Furthermore, almost in all parts of Ethiopia owing to cultural and religious taboo, dogs are kept in close association with the family and farm animals. In addition to this, the dogs are not normally dewormed and managed; the owners sometimes release their dogs. At that time, the dogs may defecate on grasses where animals graze and as a result this poor management of dogs is a risk factor to transmission of hydatidosis. Apart from this, the higher number of stray dogs and practice of back-yard slaughtering, lack of public awareness about the disease, the absence of proper fencing and disposal pits for condemned offals due to hydatid cysts at slaughter houses, dog and other carnivores get easy access to them. The habit of leaving dead domestic animals unburied and leaving them open for scavenging carnivores create favorable condition of maintaining the life cycle.

It is well known that an efficient meat inspection service should function as an important monitoring agent in the control of animal diseases with considerable economic and public health significance mainly in cases of chronic and ill-defined conditions which are not apparent either to the stockowner or veterinary surgeon [43].

CONCLUSION AND RECOMMENDATION

The current study clearly demonstrated that Hydatidosis is highly prevalent in small ruminants slaughtered at Hashim export abattoir. Vital internal organs such as lung, liver and heart were among infected organs in both sheep and goats. The most important risk factor for distribution of the diseases in the area was found to be poor and improper fencing around disposal areas, open field disposal of offal as well as offal selling markets on the road side in Bishoftu town where most of these offals were found to be infected by the cysts. All dog owners were feeding their dogs with raw offals. In addition to these, knowledge of the people about the role of dogs in transmitting echinococcosis to humans and animals is very low.

Therefore, it needs considerable attention to control the distribution of hydatid disease in both public health sectors as well as in livestock production development in the country. Further, a community-based study is required to know the actual magnitude of hydatid disease of human in Ethiopia.

Based on the above conclusive remarks, the following recommendations are forwarded:

- ✓ Detailed investigation should be conducted on the basic local epidemiological factors contributing to the spread of hydatidosis,
- ✓ Animals origin should be clearly defined before slaughter,
- ✓ Awareness should be created concerning the routes of infection and transmission of the disease,
- ✓ Enforcement of legislation that will put an end to backyard and road side offal selling practices,
- ✓ Establishment of policy on dog keeping and handling, including registration, treatment and elimination of stray dogs,
- ✓ Promoting constructions of abattoirs with appropriate disposal areas and blocking the access of dog and other carnivorous to disposed organs.

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