

Prevalence, Financial Loss and Public Health Significance of Ovine Hydatidosis in Adama Municipal Abattoir, Ethiopia

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Abstract: The study was designed to determine the prevalence, direct financial loss and public significance of Ovine hydatidosis in Adama municipal abattoir, Eastern Ethiopia. Both cross-sectional and retrospective studies were conducted from December 2013 to April 2014 at study area. Hydatid cyst count, characterization and financial loss estimation were done on 384 sheep slaughtered in the abattoir. Systematic random sampling was used to select the study animals. Out of 384 sheep inspected, 231(60.2%) were positive for the disease. The infestation of lung, liver, spleen, kidney and heart were 56.1%, 25.6%, 3.70%, 2.44% and 1.21%, respectively. There was statistically significant difference in origin and age of the sheep ($P < 0.05$). Hospital and clinic based retrospective study (from 2011 to 2013) was also performed in Adama Referral Hospital, Hebert clinic and Universal clinic to investigate the prevalence of human hydatidosis. Case book analysis revealed that of the total 121,785 admitted patients for ultrasound examination, 44 (0.03%) hydatid cases were recorded. The study revealed that the disease was highly prevalent and it has both economic and public health significance. Thus, there should be strict routine meat inspection so that infected organs and carcasses can be condemned as well as awareness creation on the community should be done.

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1. Introduction

Ethiopia owns a huge livestock population in Africa, which is estimated to be around 34-40 million TLU (Tropical live stock unit) out of which 17% and 12% cattle and small ruminants, respectively, are found in Ethiopia [1]. According to [2], the population of sheep and goats in Ethiopia is estimated to be 26.1 and 21.7 million respectively. These small ruminants and their milk/meat products represent an important export commodity, which significantly contributes to the national economy. There is also a growing export market for live sheep and meat in the Middle Eastern Gulf states and some African countries. At optimum off take rates, Ethiopia can export 700,000 sheep annually, and at the same time supply 1,078,000 sheep for the domestic market [3].

However, this great potential is not properly exploited due to endemic disease burdens, traditional management system, inferior genetic makeup coupled with malnutrition and absence of well developed market infrastructure [4]. Of the diseases that cause serious problems, parasitism represents a major impact on livestock production in the tropic. Among the parasitic disease metacestodes of *Taeniasis* and *Echinococcus* are the most important diseases that have economic as well as public health significance. Bovine cysticercosis has a worldwide distribution, but it is quite common in Africa reaching a level of 80%

in Ethiopia, 30-36% in Kenya, 15% in Rwanda, 20% in Guinea, 18% in Sierra Leone, 20% in Cameroon, 2% in Senegal and 8% in Sudan [5].

Hydatidosis is caused by the dog tape worm *Echinococcus*, its larval stage and the cyst. This parasite is found world widely and cause serious public health problems in certain parts of the world [6]. Larvae of *Echinococcus* or Hydatidosis are a disease of mammals due to the developments of cysts in certain organs or viscera. The larval stage (Metacestode) of this tapeworm has both public health and economic significance. Despite the great efforts that have been put into the research and control of echinococcosis, it still remains a disease of worldwide significance. In some areas of the world, cystic echinococcosis caused by *E. granulosus* is a re-emerging disease in places where it was previously at low levels [7]. Hydatid disease is a problem in Asia, the Mediterranean, South America and Africa and also the prevalence of the disease has increased in Europe and North America in recent years. In Africa *E. granulosus* has been recognized from most countries including Ethiopia. Previous and recent report has described the endemic occurrence of *E. granulosus* in dogs and livestock [8].

Most of the studies were focusing only on the prevalence and economic significance of the diseases. Moreover, to establish appropriate strategy for

prevention and controls, it is very important to know public perception about the diseases to specific agro-ecological zones with respect to socio-economic status. Thus, it would be essential to have information on occurrence of the diseases, financial loss and public health significance at the study area. Thus, the study was design to determine prevalence and public health significance, and to estimate financial loss due to Ovine hydatidosis at Adama Municipal Abattoir, Eastern Ethiopia.

2. Materials and Methods

The study was conducted in Oromia regional state, East shewa zone at Adama City which is found about 99 km from Addis Ababa, the capital city of Ethiopia. The City is located at 08°33'N 39°16'E. Adama is located on the main roads of Addis Ababa to Dire Dewa road. In addition, the Ethio-Djibouti Rail way that crosses and the number of population the City are 300,000 [2]. Moreover about 25,000 estimated people visit every day. The populations of the city are increasing from time to time so that the demand of meat consumption is rising from time to time. Adama Municipal Abattoir is located at Boku shenan kebele on the main road of Adama-Wanji road. In this abattoir an average 20 sheep are slaughtered every day.

Study population for this study was sheep brought to the abattoir and the hotel from different areas mainly from Arsi, Harar, Bale and Borena. Accordingly, those animals were subjected as a study population for active abattoir survey. The animals were classified as lean, medium and fat (Nicholson and Butterworth, 1986). The study population was grouped into three categories; less than 1 year (young), 1-3 year (adult) and greater than 3 year (old) age groups. Regarding zoonotic impacts case book survey of patients admitted for ultrasound examination in Adama General Hospital, Hibrat clinic, and Universal clinic were included.

A cross sectional study design and retrospective studies were conducted from December 2013 to April 2014 to determine the prevalence, financial loss and public significance of Ovine hydatidosis at the study area.

The total number of sheep required for the study was calculated according to formula [9]. Systematic random sampling was used to select the study animals. By the rule of thumb, where there is no information for an area, it is possible to take 50% expected prevalence. The Z value of 1.96 is used at 95% CI and margin of error is 5% (n = sample size, p =proportion, d = margin of error). Accordingly, the sample size (n) of the study was calculated as follows,

$$n = \frac{1.96^2 (p) (1-p)}{d^2}$$

Where n = sample size

p = Expected prevalence

d = Desired level of precision (5%)

$n=384$

The cystic echinococcus cases from the total ultrasound admitted patients during January 2010 to December 2013 to hospital and clinics in Adama was collected from recorded data of the hospital and clinics case book records to determine retrospective prevalence of human hydatidosis.

The active abattoir survey was conducted during meat inspection on randomly selected 384 slaughtered at Adama municipal abattoir. In the survey, study animal were selected by systematic random sampling on the basis of the entrance of animals into lairage. In line with these, risk factors such as age, sex, origin, breed and body condition score were recorded during anti-mortem inspection. During postmortem inspection, detail carcass and predilection sites of the suspected parasites were thoroughly inspected and the number of organ infected with the parasite and the number of cysts per each organ were also recorded. Up on examination the postmortem judgments to be passed on the organs were recorded and the direct financial loss was estimated according to [10, 11].

The annual average sheep slaughtered in the abattoir was 5000 while the current market price of each organs and carcass were used to estimate the financial losses. For confirmation of cyst fertility and viability, all encountered fertile cysts were taken to Asella Regional Parasitology laboratory. The diameter of the cyst was arbitrarily classified into three categories: small (<5cm), medium (between 5-10cm) and large (>10cm) [4]. The cyst volume was also classified into three categories: low (volume < 6ml), medium (between 6-20ml) and high (>20ml).

Furthermore, the collected cysts were classified based on the presence (known as fertile cyst) and absence (known as infertile cysts) of brood capsule containing protoscolices in Hydatid fluid. Likewise, infertile cysts were further classified as sterile (fluid filled cysts without any protoscolices) and calcified [12]. Fertile cysts were also subjected for viability test. To determine viability of protoscolices for Hydatid cyst, a drop of fluid consisting of protoscolices was placed on microscope slide and after covering with cover slip observation for the amoeboid like peristaltic movement of protoscolices with an objective of $\times 40$. When it became doubtful to observe such movements, a drop of 0.1% aqueous eosin solution was added to equal volume of protoscolices in Hydatid fluid on a microscope slide with the principle that viable protoscolices should

completely or partially exclude the dye while the dead one take it up [13].

The collected data were recorded on specially designed forms and entered in to the Microsoft excel. The outcome variables for the abattoir study were cases of Hydatid cyst detected during routine meat inspection at the abattoir. SPSS 21 statistical software was employed to analyze the association of the occurrence of the disease with potential risk factors.

Before any attempt to collect data, the protocol was approved by Institutional Review Board (IRB) of College of Medical and Health Sciences, Wollega University. Official permission was also obtained from Nekemte Referral Hospital. The anonymity was warranted for all those records review.

3. Results

3.1 Prevalence and associated risk factors: From the 384 examined sheep at Adama Municipal abattoir, 231(60.2%) were found to be positive for Ovine hydatidosis. Higher prevalence of the disease was recorded in Adult sheep (26.7%) than young age sheep (9.80%). There was statistically significant difference in origin and age of the animal ($p < 0.05$). However, there was no statistical significance difference between sex and body condition score with the occurrence of the disease ($p > 0.05$) (Table 1).

Table 1: The prevalence of Ovine hydatidosis with various potential risk factors in Adama Municipal Abattoir

Risk factors	Category	No of Inspected	No+ ve	P-value (X ²)
Sex	Female	26	11(42.3%)	0.06 (34.6)
	Male	358	61(17.0%)	
Age	Young	174	16 (9.20%)	0.02 (364.5)
	Adult	210	56 (26.7%)	
Body Condition	Lean	51	5 (9.80%)	0.09 (25.6)
	Medium	139	33 (23.7%)	
	Fat	194	34 (17.5%)	
Origin	Arsi	157	49 (31.2%)	0.00 (385.6)
	Bale	118	13 (11.0%)	
	Borena	109	10 (9.20%)	

3.2 Anatomical Distribution of Metacestode

During detail postmortem inspection of the slaughtered cattle, a total of 231 Hydatid cysts were detected on different organs. The study was indicated that Hydatid cysts were highly found in lungs (56.1%) followed by liver (25.6%), and lung and liver (9.76%) respectively (Table 2).

Table 2: Total number, relative prevalence and number of cysts harbored in affected organs

Organ	No of infected organs	Percentage (%)
Lung	46	56.1
Liver	21	25.6
Lung and liver	8	9.76
Heart	1	1.21
Kidney	2	2.44
Lung, liver, spleen	1	1.21
Spleen	3	3.70
Total	82	100

3.3 Laboratory Test Results

During laboratory test, 17 large cysts were observed on the lungs, liver and spleen which measuring more than 10cm in diameter. The large and small size cysts were more found in lung than other organs. The total cyst counted with respect to size in each infested organ of sheep (Table 3).

Table 3: Cyst size and counts in relation with organs of infested slaughtered Sheep at Adama Municipal abattoir

Organ	Small Size	Medium Size	Large Size	Total
Lung	95 (61.3%)	51 (32.9%)	9 (5.81%)	155
Liver	39 (56.5%)	25 (36.2%)	5(7.25%)	69
Heart	2 (100%)	0	0	2
Kidney	1 (100%)	0	0	1
Spleen	0	1(25%)	3(75%)	4
Total	137	77	17	231

Fertility test: The 231 Hydatid cysts were further examined for fertility test and higher fertile cyst 37 (23.9%) were inspected on lung than other organs due to soft consistence and favor development. About 33(14.3%) cysts were found to be calcified, but high percentage of calcification were found in liver, 19(27.5%). The intensity of Hydatidosis infestation showed higher in lung and liver (average of 4 cysts per organ) (Table 4).

Table 4. Fertility and viability of Hydatid cyst in different organs of slaughtered Sheep at Adama Municipal abattoir

Organ	Fertile	Sterile	Calcified (%)	Total
Lung	37 (23.9%)	95 (61.3%)	12 (3.87%)	155
Liver	11 (15.9%)	39 (56.5%)	19 (27.5%)	69
Heart	0	2 (100%)	0	2
Kidney	0	0	2 (100%)	2
Spleen	0	3 (100%)	0	3
Total	48 (20.8%)	139 (60.2%)	33 (14.3%)	231

About 75 Hydatid cysts were further examined for viability test and the viability percentage of protoscolices was higher in liver (32%) and lung 11(28.2%) (Table5).

Table 5. Viability of *Hydatid cyst* in different organs of slaughtered Sheep in study area

Organ	No of cyst examined	Viable (%)	Non-viable (%)
Lungs	39	11(28.2)	28(71.8)
Liver	25	8 (32.0)	17 (68.0)
Lung and Liver	8	0 (0.00)	0 (0.00)
Heart	1	0 (0.00)	1 (100)
Kidney	2	0 (0.00)	2 (100)
Total	75	18 (24%)	48 (76%)

3.4 Direct financial loss: The direct financial loss due to Hydatid cysts, 155 lungs, 69 livers, 2 hearts, 1 kidney and 4 spleens were condemned during the study period with the direct financial loss of 2760 ETB, 1550 ETB, 30 ETB, 20 ETB and 20 ETB respectively. It was assessed from the mean retail market price of each organs and the total number of organs condemned during the study period in study area (Table 6).

Table 6: Estimated financial loss due to Ovine hydatidosis in Adama municipal abattoir during the study period

Organs inspected	No of Organs condemned	Unit Price	Price (ETB)
Liver	69 (29.9%)	40	2760
Lung	155 (67.1%)	10	1550
Heart	2 (0.87%)	15	30
Spleen	4 (1.73%)	5	20
Kidney	1 (0.43%)	20	20
Total	231	90.0	4380.00

Hospital Based Records: During study period 44 Hydatidosis cases were reported from Adama Referral Hospital, Hebert clinic which indicated the transmission of *T. saginata* infestation from animals to humans. The occurrence of the diseases was observed in both sex and varies age groups (Table 6). From the total of 121,785 patients admitted for ultrasound examination, 44 (0.03%) human cystic echinococcosis cases were registered between November 2010 and April 2013. Among these, 15 cases were from Adama Referral Hospital, 24 from Hebert clinic and 5 from Universal clinic. Accordingly, the highest rate for hydatidosis cases were recorded in Hebert Clinic (0.05) (Table 7).

Table 7: Factors associated with the prevalence of Taeniasis at Adama Referral Hospital.

Address	Age	Sex	Cyst Type	Cost of Rx
Arsi	50	M	Cryptocystic cyst	3750
Bale-Goba	17	M	Panchymatic cyst	3750
Modjo	30	M	Cyst mass	3750
Harar	45	M	Single cyst	3750
Borena	50	F	Single cyst	3750
Arsi	29	F	Epididimal cyst	3750
Adama	18	M	Epididimal cyst	3750
Asella	45	F	Cyst mass	3750
Bokoje	50	F	Cyst mass	3750
Bale Robe	57	F	Cyst mass	3750
Zuway	32	M	Cryptocystic cyst	3750
Makey	56	M	Single cyst	3750

Table 8: Prevalence of Taeniasis in the Adama Referral Hospital and Private Clinic of Adama City.

Year	Adama Referral Hospital		Hebert Clinic	
	Admitted	Cases (%)	Admitted	Case (%)
2010	12,861	3(0.02)	13,212	5(0.04)
2011	16932	4(0.024)	8,324	6(0.07)
2012	19,729	6(0.03)	7,832	10(0.13)
2013	24,161	2(0.01)	14,015	3(0.02)
Total	73,683	15(0.02)	43,383	24(0.05)

4. Discussion

In the present study, the overall prevalence was found to be 60.2% at Adama Municipal Abattoir during the study period. The finding was higher than that were reported by other researcher in different abattoirs of the country findings that were conducted in different corner of Ethiopia, [14] who reported 15% from Bahir Dar municipal abattoir; [15] who reported 11.6% from Abergelle Export Abattoir, Mekelle, Northern Ethiopia; such as 25.7% in South Omo by [16], 22.2% in Nekemte, 21.18% in Arsi region by [17], 18.8% in Soddo by [18] and 16.4% in Addis Ababa by [19]. However, our finding is greater than the findings by [20] 10.6% in Bahir Dar, [21]; 8.7% in Gonder abattoir [22], 9.38% in Hararge region, [23], 10.8% in Jimma abattoir, [24], 12.45% in Debre Zeit, and [25], 9.1% in Addis Ababa, [26] who reported 8.06% from slaughtered at El-Karhga, New-Valley Governorate, Egypt. This may be due to the fact that the cultural and religious taboos favor the keeping of dogs often in close association with the family and farm animals in our study area. However, the result was lower than the finding of the report of [27] who reported (83%) in Sardinia. The variation in the prevalence between the various areas might be attributed principally to strains difference and relationship in *E. granulosus* that exist in different geographical situations [28]. Moreover, additional

reasons could be the difference in the level of awareness of the community with regard to methods of its transmission as people used to slaughter small ruminants at home and throw the offal's to the dogs around their villages. Furthermore, difference in culture, social activity and attitude to dog in different regions might have contributed to such inconsistency [13].

Among the assessed associated risk factors, there was statistically significant difference between age and origins of animals ($p < 0.05$) with the occurrence of the disease. However, there was no statistically significance difference between sex and body condition score with the occurrence of the disease ($p > 0.05$). This was in line with the findings [14, 15, 28, 29]. This might be due the difference in agro ecology, management system of the sheep and the majority of slaughtered sheep were adult and hence they were exposed to the disease (parasitic ova) over a long period of time with an increased possibility of acquiring the infections. It has been stated that the easier development of the cyst and the fertility rate of hydatid cysts may show tendency to increase with advancing age of the hosts [30]. This may be attributed probably due to declining immunological compatibility of animals at their older age of infection.

In the present study, higher prevalence of the Ovine hydatidosis was found in female sheep (42.3%) than male sheep (17.0%). The finding was in line with the report of [31] stated that the prevalence of hydatidosis is greater in female sheep than males. Additionally, female animals are usually exposed to different production and productivity related stress conditions than males and hence they are more likely have a chance of harboring hydatid cysts.

Regarding organ distribution, the current study showed that lungs (56.1%) were the most preferred predilection site for Hydatid cysts followed by liver (25.6%). This might be due to the fact that sheep are slaughtered at older age, during which period the liver capillaries are dilated and most oncospheres pass directly to the lung. It is also possible for the hexacanth embryo to enter the lymphatic circulation and be carried via the thoracic duct to the heart and then trapped in the lungs [32]. Furthermore, the lungs and liver possess the first great capillaries encountered by the migrating echinococccs oncospheres (hexacanth embryos) which adopt the portal vein route and primarily negotiate hepatic and pulmonary filtering system sequentially before any other peripheral organ is involved [33].

Examination for the condition of cyst fertility and viability (20.8%) fertile, (60.2%) sterile and (14.3%) calcified cysts was obtained. The fertility rate of cysts was higher in lungs than liver. This is in

agreement with the result of other workers [17,34] in different parts of Ethiopia. The variation in fertility, sterility and calcification was described based on strain difference, immune status of the animal and longevity of animal infected with the parasite [15]. Higher calcification the cysts were recorded in liver (27.5%) than lungs (3.87%) in this study during the study period. The higher yield of calcified cysts in liver could be attributed to relatively higher reticulo-endothelial cells an abundant connective tissue reaction of the organ [35].

In the present study, direct financial loss was estimated to be 4380 ETB were lost due to the effect of the diseases during the study period on the peculiar organs examined. Affected organs were condemned accordingly as per the degree of infestation. This result was lower than the reports conducted by [36]. Variations in the amount of economic lost in different abattoirs probably due to the differences in the prevalence of diseases, rejection rate of organs, slaughtering capacity of the abattoirs, local market price of organs and management of animals.

In this study, of 121,785 patients admitted for ultrasound examination, 44 (0.03%) human cystic echinococcosis cases were registered between November 2010 and April 2013 which indicated the transmission of *T. saginata* infestation from animals to humans. Currently, hydatidosis is not a well-known medical condition in Ethiopia and there are limited surveillance data available about humans in the country. This result was in line with the finding of [14] from Bahir Dar Hospital and clinic retrospective study; the community-based surveys conducted in Southern Ethiopia in 1987 and 1996, 1.6% ($n=1997$) and 0.5 % ($n=3224$) were respectively screened with ultrasound [8]. The average annual incidence in humans per 100,000 has been reported in a number of studies from different countries. For example, it was reported as 2.2 in Portugal [37], 3.3 in Bulgaria [38], 3.4 in Greece [39], 3.6 to 15.8 in Morocco [40], 3.4 to 4.6 in Algeria [41]. This may be because of the low public awareness, backyard slaughtering practices, poor control measures and presence of a large number of stray dogs that contributed to human infection.

The present study revealed that the Hydatidosis was highly prevalent in the study area. Moreover, the disease has both economic and public health significance. The age and origin of the sheep were the potential associated risk factors with the occurrence of the disease. Lungs and liver were the most condemned organs during the study period. Thus, there should be strict routine meat inspection so that infected organs and carcasses can be condemned accordingly. Proper disposal of condemned organs to eradicate the effect of the disease on public health, ensuring sanitary condition for slaughtering done on

ranches and preventing dogs from free access to raw viscera, reducing the number of stray dogs and treating them for echinococcus on regular bases and awareness creation on the community should be done.

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