

Original Research

Study on the Prevalence and Estimation of Monetary Loss of Hydatidosis in Cattle Slaughtered at Bedeno Municipal Abattoir, East Hararghe, Ethiopia

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ABSTRACT

Aim

This study was conducted by using the protocols of standard meat inspection (visual, palpation and incision) to assess the prevalence and associated risk factors and to estimate the economic loss in cattle slaughtered at Bedeno Municipal Abattoir, Eastern Hararghe, Ethiopia.

Method

A cross-section study design was conducted from February 2020 to November 2020, to determine the prevalence and its associated risk factors of bovine hydatidosis taking animal origin, sex and age and body condition as risk factors.

Results

From A total of 355 cattle examined using the protocol of standard meat inspection, 99(27.8%) of them are found positive to hydatid cysts. The prevalence of cattle hydatidosis based on animal origin was highest in older cattle 89(29.47%) than young 10(18.89%). Regarding body condition, score to significance variation was observed, as the prevalence was 41.89% for poor cattle followed by medium 24.07% and good 24.37%. Of the total 99 infected, 41(11.55%) of animals were infected in their lungs with only hydatid cysts and 24(6.76%) were infected in their liver, but the rest animals had multiple organ infections, 34(9.58%). Considering the current result, the total annual economic loss from organ condemnation and carcass weight loss due to bovine hydatidosis at Bedeno Municipal Abattoir was estimated at 6,671,803.8 Ethiopian birr (ETB).

Conclusion

This study reveals that cattle hydatidosis was a high prevalence diseases in the study area and needs paucity of information on control and prevention. The cattle owners to be educated and awareness programmes to be conducted about the diseases.

Keywords

Municipal; Hydatidosis; Prevalence; Bovine; Abattoir, Bedeno.

INTRODUCTION

The world human population is growing at a rate much faster than food production, and this increase is mainly in developing countries, which are unable to assure adequate food for their people. Developing countries have nearly 2/3 of the world's livestock population, but produce less than one third of the world's meat and one 5th of its milk.¹ Similarly, despite large livestock population in Ethiopia, the productivity remains marginal due mainly to malnutrition, prevalent diseases and management problems.

Cystic echinococcosis (CE) is a zoonotic parasitic infection of many mammalian species caused by the larval stage of *Echinococcus granulosus*.² The definitive hosts of the parasite, *E. granulosus*, are dogs, which harbor the adult parasites and excrete the parasite eggs along with their feces, while livestock and human are the intermediate hosts.³ Hydatid disease are characterized by cyst containing numerous tiny protoscolices that most often develop in the liver and lungs than kidneys, spleen, nervous tissue, bone and other organs.⁴

Hydatidosis is one of the most important parasitic diseases of livestock that has both economic and public health significance. It is associated with severe morbidity, economic losses, and it is one of the world's most geographically widespread zoonotic diseases. The pathogenesis of hydatidosis heavily depends on the extent and severity of infection, and the organ on which it is situated. The occasional rupture of hydatid cysts often leads to sudden death due to anaphylaxis, hemorrhage and metastasis. Previous studies have shown that CE represented a considerable economic and public health significance in different countries.⁵

The disease occurs throughout the world and causes considerable economic losses and public health problems in many countries. The diseases are chronic and affect all kind of food animals, including herbivorous and omnivorous mammals. Human can accidentally become hosts by ingesting the egg of *E. granulosus*. In humans, the cysts develop in the liver and lung but other organs and tissues may also become affected.⁶

Hydatidosis causes decreased livestock production and condemnation of offal containing hydatid cysts in slaughterhouses.⁷ Despite the large efforts that have put into the research and control of CE, it 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.⁸

The life cycle of these parasites involves two mammalian hosts. The adult cestode inhabits the small intestine of carnivores (definitive host) and produces eggs containing infective oncospheres. Either cestode segments, proglottids containing eggs or free eggs are released from the intestinal tract of the carnivores into the environment. After ingestion of eggs by an intermediate hosts (food animals: cattle, sheep, goats, pigs and camel) the larval stage a metacestode, mainly develops in liver and lungs of domestic ruminants.⁹

The epidemiology of hydatidosis varies from one area to another so control measures appropriate in one area are not necessarily of value in another. Hence, it is essential to have adequate knowledge of the epidemiology of the disease before contemplating control programmers.¹⁰

Therefore, the objectives of this paper are

- To determine the prevalence and associated risk factors of bovine hydatidosis in Bedeno slaughterhouses/abattoirs.
- To assess the economic importance of hydatidosis due to organ condemnation and carcass weight loss.

MATERIALS AND METHODS

Study Area

The study was conducted in Bedeno town at Bedeno Municipal Abattoir. Located at eastern, Hararghe, oromia regional state. Based on data obtained from the Bedeno Woreda Agricultural Office,¹¹ the Woreda contains enormous number of livestock about

212842, cattles, 235613 goats, 99426 sheep, 34108 donkey, 128 horse 10 mules, 91 camels and 379157 chickens. The economy of the population depends on livestock and livestock product, especially cattle. They send milk to Haramaya and Awaday cities and fattened livestock to the Somali region. The area is located 547 km east of Addis Abebe and 47 km west of Harar. The area contains 97410 total hectares and the climatic condition of the woreda divided into three. They are temperate rainy, tropical rainy and tropical dry agro-climatic zone covering about 32%, 48% and 21% of the total area respectively. The geographical location of the area is found at 80 52' 30" N, 90 13' 30" N latitude and 410 30' 0" E, 410 50' 0" E longitude. The altitude is from 1200 to 3381 m above sea level, the woreda has an average annual temperature of 22 °C, and the mean annual rainfall of the areas ranges from 400 to 1200 mm.

Study Design and Study Animals

A cross-sectional observational study methods were carried out to assess the prevalence and economic significance of hydatid cyst in slaughtered cattle at Bedeno municipality abattoir and a total of 355 indigenous zebu cattle slaughtered during the study period were included in the study.

Sample Size Determination

The sample size was calculated according to De-Lahunta et al¹² by considering a prevalence of 36.3% (Abera, 2013) as expected prevalence and 5% accepted error at 95% confidence interval.

$$n = \frac{1.962 \text{ Pexp} (1 - \text{Pexp})}{d^2}$$

$$n = 1.96^2 \times 0.363 (1 - 0.363) / 0.05^2 = 355$$

Where n=required sample size

Pexp=Expected prevalence (36.3%)

D=Desired absolute precision level at 95% confidence level (5%)

Accordingly, 355 cattle sampled.

Study Methodology

Regular visits (two-days per week) were made to conduct ante and post-mortem examination of slaughtered cattle. During ante mortem, examination age and body condition of each animal was recorded. The age of the animals was determined based on the dentitions as described by Nicholson et al¹³ and two age groups were considered below and above five-years. It was difficult to precisely indicate the geographical origin of all animals slaughtered at the abattoir and relate the findings on hydatidosis to a particular locality.

The body condition scoring was done according to Nicholson and Butter worth⁷ and classified in to three categories as poor, medium and good. Since almost all, the cattle presented to slaughtering in the study area were male and local breed, infection prevalence regarding sex and breed variation were not included. All the animals were identified based on enumerated marks on their body surface using ink, and this marking was transferred to all vis-

ceral organs during post-mortem inspection. During post-mortem examination each visceral organ particularly the liver and lung were systematically inspected by visual inspection, palpation and incisions for the presence of hydatid cyst and total numbers of hydatid cysts were collected and counted per infected organ.

Economic Analysis

To determine the economic losses due to hydatidosis in cattle, both direct and indirect losses were considered. The calculation of the direct losses is based on condemned organs (lung and liver, the indirect losses were assessed based on live weight reduction due to hydatidosis. In calculating cost of condemned edible organs and carcass weight loss, four different meat sellers were selected randomly to establish the price per unit organ and the collective price of lung and liver was determined. Average price was drawn out from that data and this price index was later used to calculate the meat loss in terms of Ethiopian Birr (ETB). A 5% estimated carcass weight loss due to bovine hydatidosis described by Endrias⁷ would be taking into account to determine the carcass weight loss. Average carcass weight of an Ethiopian Zebu was taken as 126 kg, as estimated by International Livestock Center for Africa.¹⁴

Direct Loss from Organ Condemnation

Annual economic loss=(PI1×Tk×C1)+(PI2×Tk×C2))

Where PI1=Percent involvement of lung out of the total examined

PI2=Percent involvement of liver out of the total examined

C1=Average market price of lung

C2=Average market price of liver

TK=Average annual slaughtered of cattle

Indirect Loss from Carcass Weight Loss

Annual economic losses due to carcass weight loss=N_s×C_i×P_a.¹⁵

Where N_s=Total number of animals slaughtered and positive for hydatidosis; C_i=Carcass weight lost in individual animals; P_a=Average market price of a kg of beef in Jimma town; Annual economic losses were calculated by adding both direct and indirect losses.

Statistical Analysis

Collected data were coded and stored in to Microsoft excel and analyzed by using statistical package for the social sciences (SPSS) version 20. The prevalence was calculated as the number of positive samples divided by the total number of examined samples. Chi-square (χ^2) test was used to evaluate the association of different host related factors such as age and body condition of cattle and p value<0.05 was considered as significant.

RESULTS

Prevalence

Overall prevalence: In current study, out of 355 heads of cattle

slaughtered and examined, 99 (27.8%) were found to be infected with hydatid cyst in either of the following visceral organs (lung, liver and/or both liver and lung at the same time).

Age and prevalence: Rate of infection in different age groups (≤ 5 and >5 -years) was assessed and described in Table 1. Age prevalence has shown a statistically significant variation ($p<0.05$, $\chi^2=12.191$) with older age group having higher infections.

Table 1. Prevalence of Hydatidosis in Different Age Groups

Risk Factors	No. of Examined	No. Positive	Prevalence	χ^2	P
Age group (yrs)					
Young	53	10	18.87%	2.52	0.000
Adult	302	89	29.47%	2.52	0.000
Total	355	99	27.8%		

Body condition score and prevalence: Prevalence was also assessed in terms of body condition score (Table 2). It was found that cattle having poor body condition had the highest prevalence (41.89%) followed by Good (24.37 %) and Medium (24.07 %). The difference in prevalence rate among the body condition scores was statistically insignificant ($p=0.446$, $\chi^2=9.1205$).

Table 2. Prevalence of Hydatidosis in Cattle Slaughtered Based on Their Body Condition

Body Condition Score	Animals		Percent (%)	χ^2	p-value
	Examined	Infected			
Poor	74	31	41.89	9.1205	0.446
Medium	162	39	24.07		
Good	119	29	24.4		
Total	355	99	27.8		

Origin of animals and prevalence: Based on the origin of animals highest prevalence 40.74%) observed in Danaba followed by Mojo (39%), Ramis 36.25%), Tortora (14.67%) and Ganame (12.82%). The difference in prevalence rate among the origin of animals was statistically not significant ($p=0.54$, $\chi^2=1.7$) Table 3. Prevalence of hydatidosis in cattle slaughtered based on origin of animals.

Table 3. Prevalence of Hydatidosis in Cattle Slaughtered Based on Origin of Animals

Origin	Animals		Prevalence	χ^2	p-value
	Examined	Infected			
Danaba	41	16	39.02	2.52	0.112
Mojo	81	33	(40.74%)		
Ramis	80	29	(36.25%)		
Tortora	75	11	(14.67 %)		
Ganame	78	10	(12.8%)		

Distribution of Hydatid Cyst in Different Organs

Overall distribution of cysts in different organs of cattle slaugh-

tered at Bedeno Municipal Abattoir was described according to (Table 4). Of the total 99 cattle positive, 41 (11.55%) had cysts merely in lungs, 24 (6.76%) in liver, whereas, the rest of 34 (9.58%) infections involved multiple organs (Table 5).

Table 4. Distribution of Hydatid Cysts in Different Organs of Positive Cattle

Origins Infected	Number of Animals		Prevalence	p-value CI
	Examined	No. of Cases		
Lung only	355	41	11.55	
Liver only	355	24	6.76	
Lung and liver	355	34	9.58	
Total	355	99	27.8	100

Table 5. Distribution of Hydatid Cysts in Different Organs and Proportion of Organs Involved in the Study Animals

Origin	Examined	Proportion (%) Affected	From Infected Animal	From Total Examined Animal
Liver	355	58	58.6	16.33
Lung	355	75	75.76	21.12
Total	355	133		27.8

Estimation of Economic Loss

• Loss due to organ condemnation (Direct economic loss) direct loss in this study 75 lungs (74.76%) and 58 livers (59.59%) were very condemned due to the presence of hydatidosis cysts. The mean current unit price of these organs in Bedeno town during the study period was lung (55 ETB) and liver (85 ETB), While the mean current price of 1 kg beef is 280 ETB. Mean number of animals slaughtered annually at Bedeno Municipal Abattoir was determined from the records of the last 1-year and it was 12,000. Then, the annual economic loss due to organ condemnation is estimated as follows:

$$\begin{aligned} \text{Annual economic loss due to organ condemnation} &= (\text{PI1} \times \text{Tk} \times \text{C1}) + (\text{PI2} \times \text{Tk} \times \text{C2}) \\ \text{Direct Loss} &= (0.2112 \times 12,000 \times 55) + (0.1633 \times 12,000 \times 85) \\ &= 139,392 \text{ ETB} + 628,656.6 \text{ ETB} = 768,048.6 \text{ ETB} \end{aligned}$$

• 4.3.2 Carcass weight loss (Indirect Economic loss)

$$\text{IACW} = \text{CSR} \times \text{CI} \times \text{BC} \times \text{Perv}$$

Where:

IACW=Indirect annual carcass weight loss
 CRS=Average number of cattle slaughtered per year at Bedeno abattoir.
 CL=Carcass weight loss in individual cattle due to fasciolosis
 BC=Average price 1 kg beef in Bedeno town
 Prev=Prevalence rate hydatid cysts at Bedeno municipal abattoir.
 $\text{IACW} = \text{CSR} \times \text{CI} \times \text{BC} \times \text{Perv}$

$$\begin{aligned} \text{IACW} &= 12,000 \times (126 \times 5\%) \times 280 \times 27.89\% \\ &= 12,000 \times (126 \times 0.05) \times 280 \times 0.2789 \\ &= 12,000 \times 6.3 \times 280 \times 0.2789 \\ &= 5,903,755.2 \text{ ETB} \end{aligned}$$

Therefore, annual economic loss in Bedeno Municipal Abattoir=Annual economic losses due to organ condemnation+Annual economic losses due to carcass weight loss.

$$\begin{aligned} \text{Annual economic loss} &= 768,048.6 \text{ ETB} + 5,903,755.2 \text{ ETB} \\ &= 6,671,803.8 \text{ ETB or } \$ 313,574,778.6 \end{aligned}$$

Hence, the total loss from organ condemnation and meat production loss in cattle slaughtered at Bedeno Municipal Abattoir estimated at 6,671,803.8. ETB or \$ 313,574,778.6.

DISCUSSION

The current study revealed that the overall prevalence of hydatid cyst was 27.8%. This result is similar with previous work of Yet-nayet¹⁶ who reported a prevalence of 27.2% from Gondar town. Nevertheless, it is higher than the report of Kebede et al¹⁷ in Tigray region (22.1%), Azlaf et al¹⁸ in Morocco (22.9%), Kebede et al¹⁷ in Shire (7.5%) and Tsehaye¹⁹ in Debre Birhan (7.2%).

On the other hand, the current report is lower than the report of Tolosa et al²⁰ in Jimma Abattoir, who reported prevalence 36.3% and 31.15% respectively. The present reported prevalence also lower than the report of Nigatu et al²¹ from Bahir Dar (32.11% in cattle). Berhe et al²² from Mekelle (29.69% in cattle), Endrias et al⁷ from Ambo (48.9% in cattle), Nigatu et al²¹ from Debre Markos (46.8% in cattle), Getaw et al²³ from Nazareth (29.3%) and Regassa et al²⁴ from Hawassa (52.69% in cattle). Furthermore, the current prevalence is significantly lower than the finding of Nigatu et al²¹ who reported a prevalence of hydatidosis to be 79.5% in Gondar, and FinoteSelam Municipal Abattoirs. Factors like difference in culture, social activity, animal husbandry systems, lack of proper removal of infectious carcass, attitude to dogs in different regions and the difference in strains of *E. granulosus* that exist in different geographical situations Injibara might have contributed to the variation in prevalence in the different areas of the country.²⁵

In present study, a significant variation was observed in the rates of infections between age groups where animals above 5-years of age were highly infected. This is in agreement with the findings of Azlaf et al¹⁸ and Regassa et al.²⁴ This could be mainly because aged animals have longer exposure time to eggs of *E. granulosus* in addition to weaker immunity to combat against the infection.¹⁵ In addition, most of the slaughtered animals were culled animals due to less productiveness and hence were exposed to the diseases (parasitic ova) over long period with an increased possibility of acquiring the infections.

The prevalence of hydatidosis was slightly higher in cattle having poor body condition (41.89%) followed by good body condition (24.40%) and medium (24.07%). Polydrous²⁶ explained that

in moderate to severe infections, the parasite may cause retarded performance and growth, reduced quality of meat and milk, as well as live weight loss.

In this study, it has been shown that hydatid cysts occurred most commonly in the lungs (11.55%) followed by liver (6.76%). Similar findings were reported by Abebe,²⁷ Haftay,²⁸ Yechale²⁹ and Zelalem⁸ which show that the lung and liver are the most common sites of hydatid cyst in domestic animals. It is due to the fact that the lung and liver possess first great capillaries 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. This might be because cattle are slaughtered at older age and during this period, liver capillaries might be dilated and allow most oncospheres directly pass to the lung and result in more lungs that are positive. Additionally, it is possible for the hexacanth embryo to enter the lymphatic circulation and carried *via* the thoracic duct to the lungs in such a way that the lungs may be infected before or instead of liver.^{2,30}

In the current study, it will be emphasized to carry assessment on annual economic loss due to bovine hydatidosis at Bedeno Municipal Abattoir. Losses from organ condemnation and carcass weight loss (meat production loss) in infected cattle were assessed and estimated at 308,748 ETB. The current estimation is much greater than previous estimation by Kebede et al¹⁷ in Tigray region (25,608 ETB). However, it is far lower than the finding of Regassa et al²⁴ from Hawassa Municipal Abattoir (1,791,625.89 ETB). The difference in economic loss estimation in various abattoirs/regions may be due to the variations in the prevalence of disease, mean annual number of cattle slaughtered in different abattoirs and variation in the retail market price of organs.¹⁵ Considering the current result, hydatidosis is an important disease of cattle in Bedeno and its surroundings, causing substantial visible and invisible losses. It causes considerable economic loss in livestock due to condemnation of organs and loss associated with body weight gain of infected livestock.

CONCLUSION

Hydatidosis is a serious health problem of cattle, which causes liver, lung and other organs condemnation in the abattoir, reduction in the production of the animal. The output of this study indicates that the overall prevalence of hydatidosis was 27.89%. The distribution of prevalence of hydatid cysts infection by age showed that the prevalence in old animals is higher than in young animals. Significant association was observed between hydatid cyst infection and age of animal (p value=0.001). For the location of hydatid cyst in carcass organs, the liver was found to be the most affected organ (58%). There was paucity of information on control and prevention options of the disease.

RECOMMENDATIONS

From the result obtained in the present study and considering the reality in Bedeno Municipal Abattoir and its surrounding, the following relevant points are recommended to alleviate the spread

and reduce its economic impact.

- As it is mandatory for launching a control program proper disposal of affected offal's freely for dogs and wild canids (the usual practice in the community) should be stopped and all the condemned organs should be either buried or incinerated. The existing abattoir should be fenced properly to stop access of some wild canidae (particularly hyenas) and stray dogs.
- Thorough meat inspection should be there; the veterinarians should strictly examine the organs like lung and liver of the slaughtered cattle for strict condemnation.
- The specific origin of the cattle slaughtered at the abattoir will be properly known and registered to determine the geographical distribution of hydatidosis.
- Awareness will be created on the knowledge of the public about the role of dogs in transmitting Echinococcosis of animal.
- Further studies on the prevalence and economic importance of hydatidosis should be encouraged to establish clear information system on hydatidosis.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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