

Prevalence and economic importance of bovine hydatidosis in animal slaughtered in Dalomana municipal abattoir Southeastern, Ethiopia

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Abstract

A cross-sectional study was conducted on bovine hydatidosis from May 2018 to November 2020 with the aims of finding its incidence and economic losses in bovine slaughtered for human consumption in Dalomana municipality abattoir. Usual ante mortem and post-mortem inspection was carried out on overall of 430 selected slaughtered cattle. From this total inspected, 82(19.1%) of them had harboured hydatid cyst (s) in one or more of their organ's. Age and body condition as a risk factor were statistically significant as older zebus and medium were more infected ($P < 0.05$, $\chi^2 = 14.597$ and $p \text{ value} < 0.05$ $\chi^2 = 9.68$) respectively. Similarly, the geographical origin of the animals had significant contribution on hydatid cyst distribution ($P < 0.05$, $\chi^2 = 12.724$). Sex was statistically non-significant ($P > 0.05$, $\chi^2 = 0.74$) and have no difference. The single and multiple organs were infected by hydatid cysts. From the total of 282 hydatid cysts collected and characterized lung and liver took more percentage in harboring cysts, from this 137(48.58%) and 126(44.68%) cysts were observed in lung and liver respectively and 19(6.74%) are observed in other organ, such as spleen kidney, and heart. The study indicated that annual economic failure due to direct organ condemnation and indirect carcass weight loss from the disease in Dalomana was estimated to be 105769.657 ETB. Hence, bovine hydatidosis is significantly a common disease in cattle, with severe public health fears and leads considerable observable and undetectable losses in bovine in Dalomana and its surroundings.

1. Introduction

Hydatidosis caused by the cestode parasite known as *Echinococcus granulosus* which infect the animal at larval stage (metacestode) (1; 2). Dogs are the popular definitive hosts whereas many mammalian species are intermediate hosts, including domestic ungulate s and man. It is a cosmopolitan zoonotic infection (3). The disease is still a challenge for global health despite a great effort to conduct a research for controlling its transmission. In different parts of the world, Cystic echinococcosis caused by *E. granulosus* is a re-emerging disease in places where it was previously at low levels (4; 5).

Echinococcus granulosus infection is widespread in sub Saharan Africa, Latin America, South Eastern and Central Europe, Arab countries and Far East countries. The main occurrence is observed in sheep and cattle raising places (6). The hydatidosis is most significant disease in livestock farming which is managed under extensive grazing system. A number of studies from different parts of Ethiopia indicated that hydatid cyst is rampant in domestic animals of the country (7; 8). According to Abebe and Yilma (2011) a prevalence of 72.4%, 37.72%, 33.78% and 13.7% was reported in bovine slaughtered in Assella, Adama, Gonder and Dire Dawa respectively point out its significance in domestic animal production (9). The occurrence of the disease is the most common in under developed nations particularly in rural communities where there is close contact between dogs (definitive host) and various domestic animals' intermediate hosts (10). By affecting several animal's species, intermediate animal's hosts and humans, the hydatidosis causes remarkable economic losses in different parts of the world particularly areas where the disease is endemic (4).

Knowledge in relation to the distribution of the diseases combined with associated risk factors as component of the epidemiology of the disease is vital for any attempt of prevention and control of the disease in question. Furthermore, determination of the economic importance of the disease is vital for decision making, planning, and implementation of local control strategies. Hence, the aims of our research were:

- To know the distribution of Hydatidosis and its associated risk factor in bovine slaughtered for human consumption at Delomena district and its surrounding.
- To investigate the economic importance of the hydatidosis in bovine.

2. Materials And Methods

2.1. Study Area and Period

The study was performed in district of Bale zone namely Dalomana of the Oromiya regional state South east of Ethiopia about 430kms away from the capital city of Ethiopia, Addis Ababa. The area is characterized by flat lands and moderately steep rolling hills with valley bottoms. The altitude of the district ranges within 850–2800 meters above sea level. The rainfall pattern in the area is the bimodal type, that is, middle of March to end of May (short rain season) and September to October (the main rainy season). Annual rainfall ranges within 700–1200 mm. Natural forest and woodlands still account for the largest share of the land use types in the district. Dalomana district has several rivers, perennial rivers, lakes (manmade and natural lake), deep wells, ephemeral ponds and seasonal streams which are sources of water for livestock and people. Dalomana district has an agricultural vocation and a mixed farming system with crop-livestock production (11).

2.2. Study animals and Population

The study populations were cattle of local breeds which slaughtered at Dalomana municipal abattoir for human consumption. Most of the animals slaughtered in abattoir were female. The Dalomana and its surrounding districts, Harenabuluk and Madawolabu contributed the slaughtered animals for Dalomana town municipal abattoir. The body condition score was categorized into poor, medium and good (12). From the three classification of body condition score only fat and medium body condition score is taken as study population. The age was determined by dentition formula concurrent to the technique explained by De lahunta and Habel (1986), (13) and cattle categorized into three age groups (< or = 5, 5–8, and > 8 years).

2. 3. Sampling method and Sample Size Determination

Simple random sampling was employed to generate data for the study at Dalomana town Manucipal abattoir on animal presented for slaughter from Dalomana town and its neighboring districts. Sample size was calculated according to Thrusfield (2005 since there was no previous work done on prevalence

of bovine hydatidosis in study area. (14) With a desired absolute precision of 5% and 95% level of confidence, sample sizes of at least 384 animals were required

About 430 animals (263 female and 167 male) of animals were examined for the presence and absence of hydatidosis in organs of animals. In general, body condition, age, sex and origin of animals were regarded as risk factors.

2.4. Study Design

A cross sectional study was conducted from May, 2019 to November, 2020 by examining animals during slaughtered at abattoir on conditions associated with hydatidosis in cattle. The study was performed to find out recent information on the animal health and economic significance of the disease in study area. The abattoir was visited three days in a week.

2.5. Study Methodology

2.5.1. Ante mortem examinations

Ante mortem examinations of animals were performed in the lairage to identify the sex, age, body condition and origin of cattle. Identification numbers were given for each animal to examine after evisceration. During ante-mortem examination animals were clinically diagnosed for any sign of disease at rest and during movement of animals in lairage as described by (4). And following the judgments passed (15).

2.5.2 Post mortem inspection

Organs of slaughtered animal specially, lung, spleen, kidney, heart and other different organs were inspected for the presence of hydatid cyst by conducting the routine meat inspection procedure. The procedure includes visualizations and palpation of organs also further systemic incision of each organ into pieces for identification of presence/ absence of hydatid cyst. The cyst was categorized as live or calcified and the cyst distribution into organs was recorded (16).

2.5.3. Estimation of economic losses due to hydatid cyst

To study the economic losses due to hydatidosis in cattle, both direct and indirect losses were considered. The disease made direct economic losses and indirect economic losses. due to condemnation of different organs(liver, lung, heart, spleen and kidney) causes for direct economic losses while the indirect losses were estimated based on live weight reduction due to hydatidosis. In calculating price of condemned edible organs and carcass weight loss, five different meat sellers were asked randomly to determine the price per unit organ and the collective price of lung, liver, heart, spleen, and kidney. 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). Average annual slaughter rate of cattle in Dalomana municipality abattoir was estimated based on retrospective analysis of data recorded from three years. A 5% estimated carcass weight loss due to bovine hydatidosis described by (17) was taken 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 (18). Accordingly, the loss from liver, heart, kidney, lung, spleen condemnation was calculated as follows (19). Loss of organs condemned= (NAS x ph x plu x cplu) + (NAS x ph x phr x cphr) + (NAS x ph x pli x cpli) + (NAS x ph x psp x cpsp) + (NAS x ph x pkid x cpkid);

Where NAS – Average number of cattle slaughtered annually

Ph-prevalence rate of hydatidosis

P = percent involvement organ (Plu = percent involvement of lung, so lu = lung, hr = heart, li = liver, sp = spleen, kid = kidney) of lung

Cp = current mean retail price of organ (Cplu = current mean retail price of lung and each organ abbreviated as above)

N: B-All prices are estimated based price at Dello mena town.

Loss from Carcass Weight Loss

Thus the loss from carcass weight loss was computed as follows;

$LCWL = NAS \times ph \times CPB \times 5\% \times 126kg$

Where LCWL-loss from carcass weight loss

5%- estimated carcass weight loss due to hydatidosis (Polydrous, 1981).

NAS- Average number of cattle slaughtered annually

CPB –current average price of 1 kg of beef at Dalomana town

126 kgs- Average carcass weight (dressing percentage) of adult zebu cattle

Total Economic Loss Estimation

Total economic loss was estimated based on both direct economic losses (condemnation of edible organs and indirect economic losses (loss from carcass weight loss).

Total loss = direct loss (loss from organ condemnation) + indirect loss (loss from carcass weight loss).

2.6. Data Analysis

The data collected from the study animals were keyed in Excel (Microsoft Corporation, 2010) and exported to SPSS version 23.0 for further analysis. Data was analyzed by the SPSS statistical software. The Chi-Square test was used to evaluate the association between hypothesized risk factors

and hydatidosis. The confidence level was held at 95% and $P < 0.05$ was used to check the significance level

3. Result

3.1. Overall Prevalence

This study was demonstrated at Dalomana municipal abattoir and 430 cattle were studied. From this 82(19.1%) animals had single or multiple hydratid cysts. Post mortem examination result indicated that different organs were affected with hydatid cyst. Single and multiple infections of organs were reported. From total 82 cattle harboring hydatid cysts; 36(43.9%) were found involving only a single organ and the remaining 46 (56.1%) had a multiple organ infections. Among the different organs affected, lung and liver constituted the highest infection rate

Table 1: Overall prevalence of bovine hydatidosis in study area

Total	No. of examined	number of positive	number of negative	Prevalence (%)
430		82	348	19.1

3.2. Prevalence and its associated risk factors of bovine hydatidosis

Prevalence of the disease in bovine was evaluated based on risk factors (age, sex, origin and BCS of the examined animals). Age and origin of animals were statistically significant and p value < 0.05 (Tables 2 and 3).

Table 2
Prevalence of hydatidosis based on Age, (N = 430)

Variable	No. of examined	No. of positive	prevalence	χ^2	DF	P-
Age				14.59	2	0.001
≤ 5	40	3				
5–8	186	24				
8>	204	55				
Total	430	82	19.1			

Table 3
Prevalence of hydatidosis based on origin (N = 430)

Variable	No of examined	No of positive	No of prevalence	X2	DF	p-value
Orign						
Heranabuluk	152	16	10.52	12.74	2	0.02
Madawolabu	89	25	28.08			
Dalomana	189	41	21.693			
Total	430	82	19.1			

Prevalence of bovine hydatidosis based on sex which is stastically none significant, p-value > 0.05, while body condition score is significant difference p-value < 0.05 value Table 4.

Table 4
Prevalence of hydatidosis based on Sex and BCS, (N = 430)

Variable	Number of examined	Number of positive	prevalence	χ^2	DF	Pvalue
Sex						
Female	263	52		0.74	1	0.676
Male	167	30				
BCS						
Fat	196	32		9.680	1	0.002
Medium	234	50				
Total	430	82	19.1			

3.3. Infection of Organs and distribution of cysts

From the 82 infected animals 26, 6 and 5 of them were affected by hydatid cysts on their lung, spleen and liver alone, respectively while other animals had hydatid cyst on two and more than two organs as shown in Table 5.

Table 5
Distribution of hydatid cysts in different visceral organs of positive cattle (N = 82)

Organs affected	No.of animal affected	% affected
Lung only	26	31.7
spleen only	6	7.3
liver only	5	6.9
Heart only	5	6.9
Kidney only	1	1.25
Lung and liver	28	34.1
Lung + spleen	28.4	34.6
Liver + lung + spleen	2	2.44
Lung + liver + spleen + kidney	2	2.44
Total	82	100

3.4. Economic loss estimation

The affected organs are condemned due to aesthetic value and to control and prevent the transmission of the disease. A total of lung, liver, spleen, kidney and heart were condemned due to hydatidosis with an economic loss of 45864 ETB, 98607.6 ETB, 2247.336 ETB, 963.144 ETB and 687.96 ETB respectively. The direct and indirect economic loss was about 148370.04 ETB and 3756261.6 ETB respectively. The total annual financial loss due to bovine hydatidosis was estimated to be 3904631.64 ETB.

Table 6
Direct economic losses associated with CE in infected cattle in Dalomana municipal abattoir .organs condemned and their price in ETB during study period.

Organs	No.of organs condemned	% of condemned	price per organs	Total price in ETB
Lung	63	50.4251575 40	40	2520
Liver	43	34.5	60	2580
Spleen	11	8.810	50	550
Kidney	5	4	20	100
Heart	3	2.4	25	75
Total	125	100	195	5,825

Direct economic loss from loss of organs condemned = $NAS \times ph [(plu \times cplu) + (pli \times cpli) + (psp \times cpsp) + (phr \times cphr) + (pkid \times cpkid)]$.

NAS = Number of animals slaughtered annually in Dello mena municipal abattoir were = 648

Loc = $648 \times 0.191[(0.504 \times 25) + (0.345 \times 60) + (0.088 \times 10) + (0.04 \times 20) + (0.024 \times 25)] =$

$123.768[(12.6) + (20.7) + (0.88) + (0.8) + (0.6)]$

$= 123.768[(35.58)] = 4403.6654 \text{ ETB}$

*1USD = 20.5 ETB

$= 214.812 \text{ USD}$

In direct economic loss

Loss from carcass weight loss = $\text{NAS} \times \text{ph} \times \text{CPB} \times 5\% \times 126\text{Kg}$

1 Kilo gram of beef meat in Dello mena town is 130ETB

$\text{LCWL} = 648 \times 0.191 \times 130 \times 0.05 \times 126$

$= 101365.992 \text{ ETB}$

$= 4944.6826 \text{ USD}$

Total economic loss = direct loss + in direct loss

$= 4403.665 + 101365.992$

$= 105769.657 \text{ ETB}$

$= 5159.49546 \text{ USD}$

4. Discussion

In the present study the prevalence of Bovine hydatidosis in Dalomana Municipal abattoir was found to be 19.1% which is comparable with the results of works conducted, in Adigrat 20.3% (5), and Jimma 22.4% (20), Konso 22.57% (21) and Nekemte 31.19% (22). The present study was less than the prevalence of Asella 72.44% (23) and 61.0% (24), 62.96% around Bale Robe (25), and 59.9% Bahirdar (26), 50.29% reported by (27) from Asella, and Jimma 31.44% (28). This study was higher compared to the prevalence reported by (29) (7.5%) in Shire.

The prevalence rate of 19.1% in the Dalomana abattoir was comparatively low. This might be due to the bad attitudes to have dogs so that rare contact among the cattle which are act as intermediate hosts and dogs as infected final hosts, lack of provision of infected organ of cattle to dogs and others intermediate hosts.

In general, the prevalence of hydatidosis is varied in different geographical locations. The reason could be related to the strain difference of *echinococcus granulosus* parasite that occurred in different areas (30). Furthermore the prevalence of the disease could be varied in different geographical due to age, body condition score, another risk factors like diversity of culture related to management of dogs and different socio-economical activities of different communities. Similar to this study, it was observed that hydatidosis was higher for older animals (3; 31). Most of the infections were observed in cattle above eight years of age were statically significant (p value < 0.05). This might be commonly due to the fact that old animals have longer exposure time to parasite eggs. In addition, aged animals might have less immunity defence against infection (32). Our study is analogous to the study of (21, 18 33, 3 and (34). Hydatidosis was more prevalent in animals with medium body condition score comparatively animals with fat body conditions. This finding is similar to the finding of (35). the reason might be due to animal with medium body condition have weaker immune system to overcome the infection.

The occurrence of the disease by origin of animals was evaluated and statistically significant difference (p value < 0.05) was reported showing that geographical regions play a main task in circulation of the cysts. This may possibly due to the variation in the socio-economic category and animal husbandry practices of society in all places from where animals were transported for slaughter and regular contact of cattle with dogs.

The presence of the cyst in internal organ was different this study indicated that lung was found to be the most commonly affected organ (50.4%) followed by liver (34.5%) and this was similar with report of (36) 50.5 for lung and 40.6 for liver and also similar result of 54.5% and 43.5% was reported by (37) on lung and liver respectively. This study was higher than study of (38) who observed 12.5% and 4.25% prevalence for lung and liver respectively while 92.7% in lung and 53.2% in liver which is higher than this study was also recorded by (39). In this study number of cysts collected from lung 137(48.58) was greater than that collected from liver 126(44.68%) and that of spleen, heart and kidney in which 19(6.74%) was recorded. Comparable results were reported by (40), 47.04% and 44.2% for lung and liver respectively and 9.41% for spleen, heart and kidney. This might be due to the fact that cattle are slaughtered at older age, during the time the liver capillaries are dilated and most oncospheres directly pass to the lung; moreover the hexacanth embryo can enter the lymphatic drainage and be transported over the thoracic duct through heart and lungs in such a way that the lungs may be infected before or instead of liver (41). Additionally, the lung and liver which are most commonly infected organs might be due to the fact that lungs and livers have the first large capillaries of sites affected by migrating echinococcus oncosphere (hexacanth embryo) which take up the portal vein route the first large capillaries encountered by migrating blood borne oncospheres and mainly settle pulmonary and hepatic filtering system consecutively before any other organ is absorbed. On the other hand, progress of hydatid cysts happens intermittently in other organs like spleen, kidney and heart and other organs and tissues when oncospheres entered into general systemic circulation (4).

The annual economic loss due to the disease was estimated to be 105769.657 ETB. The finding was comparatively with the report of (42) 160,032.23ETB of (43) and with annual economic loss of 841,419.3

and respectively and lower than that of the (44)19,847,704.5ETB at Addis Ababa abattoir enterprise and (45) 5,544,591.74 ETB in Finfine abattoir. The economic losses was varied from the finding of others studies in the Ethiopia which might be due to the variation of epidemiology of the disease and variation in numbers of animal slaughtered in different abattoirs and also variation of prices of each organs in different places(17).

5. Conclusion And Recommendations

The prevalence reported in the finding showed high in cattle, greate impact on economic losses in the area and this might be due to numerous reasons of which keeping dogs in fequent contact with cattle. From the report finding in the present study and considering the reality in Dalomana municipal abattoir and its surrounding, the following significant activities are recommended to control the distribution of the disease and diminish its economic losses.

- As it is compulsory for instigating a control programs for proper disposal of affected visceral organs freely for dogs and wild canids should be stopped and all the condemned organs should be either buried or incinerated.
- The slaughter houses and abattoirs ought to be fenced to prevent definitive host animal (dogs, hyena and others) contact with condemned internal organs and carcasses.
- Routine meat inspection should be performed by veterinarians.
- Reduction of stray dog population should be practiced to prevent the risk of hydatidosis to farm animals.
- The exact origin of the animal slaughtered at the abattoir should be properly identified and registered to investigate the geographical distribution of hydatidosis.
- Awareness should be created on the knowledge of the public about the role of dogs in transmitting Echinococcosis of animal.
- Slaughtering outside abattoirs practices should be controlled by enforcing the law and regulation related to meat hygiene.
- Usual testing and deworming of dogs should be formed all over the country.
- Advanced studies on epidemiology of the disease and economic significance of the disease should be performed to determine clear information system on hydatidosis

Abbreviations

BCS	Body condition score
DF	Degree of Freedoom
ETB	Ethiopian Birr

FAO	Food and Agricultural Organization
OIE	Office of international des Epizootic

Declarations

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Availability of data and materials

The data obtained during this study is publicly available at Dello Mena municipal Annual Report of Abattoir in 2014 from pages 12-56 and will available when requested.

Authors' contributions

SAJ generated ideas and coordinated the study. SZA assisted all activities related to project and write the manuscript. NTS wrote the manuscript and manages the document. JAH undertake the activity of anti mortem and post mortum examination. Dr. SKPN managed the project and supervises all activities. AAG managed materials and resources of research and support animal examination at abattoir. All authors read and approved

Competing interests

The authors declared that there is not conflict of interest.

Consent for publication

Not applicable

Ethical clearance/considerations

The ethical clearance was taken from Delo Mena agriculture office with ref no D/A/O/ 123/ 2012. Further, no loss or harm came to the study participants of this study. In addition confidentiality of data and information from this study was maintained.

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