# Hydatidosis: Prevalence and Assessment of Financial Loss on Bovine Slaughtered at Bedele Municipal Abattoir, Southwest Ethiopia

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**Abstract:** Hydatidosis is the infection of humans and animals caused by the larval stages of genus *Echinococcus*. A cross- sectional study was conducted from November 2015 to April 2016 at Bedele municipal abattoir, Ilubabore Zone of Oromia Regional State, Southwest Ethiopia. It was aimed to determine the prevalence and estimate financial losses due to hydatid cyst as result of organ condemnation and carcass weight reduction. From the total of 409 cattle examined, 72(17.6 %) were found positive for hydatid cyst infection in one or more of its organs. There was statistically significant difference (P<0.05) with in age group and body conditions score of the animals. However, there were no significant variation observed in sex and origin of animals. Hydatid cyst count and characterization was conducted based on routine meat inspection with laboratory test. The anatomical distribution of the cysts indicated as 143(49.8%) in lung, 130(45.3%) in liver, 3(1.05%) in heart, 6(2.1%) in kidney and 5(1.74%) spleen, respectively. From the 287 cysts collected 65(22.65%), 222(77.35%) are calcified and non-calcified respectively and 107(47.37%), 71(31.98%), and 44(20.65%) were found as small, medium and large cysts respectively. The fertility rate was higher in lung 15 (10.5%) than in liver 10(7.7%) and the rate of calcification is higher in liver 65(50%) than in lung 9(6.3%). The total annual economic loss due to the direct and indirect losses was estimated to be 267,922.42 ETB or ($12,758.21) per annum. This indicated that hydatidosis is a major disease causing significant economic losses in the study area; Control strategies should be initiated taking into account the social, cultural and the economic condition of the people.
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**Key words:** Bedele, Bovine, Financial loss, Hydatidosis, Prevalence.

## Introduction

Among the many prevalent livestock diseases, parasitosis represents a major drawback to livestock production in the tropics. Hydatidosis is among the major parasite diseases contributing to low meat production due to carcass or organ condemnation, in particular Infection, with the metacestode hydatid cyst of *Echonococcus granulosus,* stage of parasite tape worms is recognized as one of the world's major zoonosis affecting both humans and domestic animals [1].

Hydatidosis and Echinococosis are terms often used interchangeably, to describe the zoonotic infection cycles caused by a cestode of genus *Echinococcus* with species *Echinococcus granulosus* [2]. Echinococosis has a worldwide distribution; the reason is mainly due to ability of this tape worm to adapt to a wide variety of domestic and wild intermediate hosts [3].

Four species of *Echinococcus* are currently considered taxonomically valid: *Echinococcus granulosus*, *Echinococcus multilocularis*, *Echinococcus oligarthrus* and *Echinococcus vogeli* [4]. *Echinococcus* species require two mammalian hosts for completion of their life-cycles. Segments containing eggs or free eggs are passed in the faeces of the definitive host, a carnivore. The eggs are ingested by an intermediate host, in which the metacestode stage and protoscolices develop. The cycle is completed if such an intermediate host is eaten by a suitable carnivore. The dynamic transmission of the parasite is determined by the interaction of factors associated with these hosts and external environment [5].

Hydatidosis is one of the major causes of organ condemnation in most Ethiopian abattoirs and slaughter houses leads to huge economic losses [6]. Human cases of hydatidosis are frequently reported from different corner of the country [7].

In Ethiopia, the presence and prevalence of Hydatidosis (Echinococcosis) is well established. The information existing from different authors confirms that the disease is prevalent in various parts of the country; in Tigray region, 22.1% [8], in Nekemte

17.34% [9] are some of the researches conducted in different parts of the country to determine the prevalence and economic impact of the disease.

Despite the above studies, in Ethiopia, the disease has not been investigated sufficiently, and information related to its prevalence, fertility, viability of cyst and economic impact is still limited especially in and around the study area (Bedele). Bedele is the smallest town, where a large population of cattle is reared with different husbandry system in and around the area. It is assumed that the problem (Hydatidosis) is a challenge in the study area like the other parts of the country. Therefore, the main objectives of this study were; to determine the prevalence of bovine hydatidosis, to estimate the financial losses due to the disease in the area.

## Materials And Methods

Study Area Description

The study was conducted at Bedele Municipal Abattoir located in Illubabore Zone of Oromia region, Southwestern part of Ethiopia from November 2015 to April 2016. Bedele is located 480 kilometers west of Addis Abeba at altitude of 2060 meters above sea level. The mean annual rain fall of the area is about 1800mm and the mean annual minimum and maximum temperatures are 14.5 $^0$ C and 30.4 $^0$ C, respectively. The climatic condition of the area is mainly Woina Dega. The town has resident of 36,945 people, 107,446 heads of cattle (21,061 cows, 15,633 oxen, 10,810 bulls, and 10,562 calves), 23,607 heads of sheep, and 24,192 heads of goats, 8,134 equine and 48,400 heads of poultry [10].

**Study Populations**

The study animals were indigenous zebu cattle (*Bos indicus*) brought to the abattoir for slaughter from districts around the town such as Gechi, Abdela and Chewaka.

**Study Design**

A cross sectional study was employed to determine the prevalence and associated risk factor of hydatidosis in cattle slaughtered at Bedele municipal abattoir.

**Sample Size Determination**

Sample size was calculated according to Thrusfield [11] formula and Cattles presented for slaughter at Bedele municipal abattoir was examined for hydatid cyst considering 50% prevalence since there was no previous study specifically in the study area.

$N = 1.96^2 \text{ pexp } (1\text{-pexp})/ d^2$

Where: N = sample size required

1.96 = the value of Z at 95% confidence interval

Pexp= expected prevalence

d= desired absolute precision

An expected prevalence of the given area is 0.5 considering a 5% absolute precision and at 95% confidence level was gave us 384 sample sizes. However, estimate the prevalence of bovine hydatidosis and its economic importance in the Bedele municipal abattoir, a thorough meat inspection was conducted on 409 head of cattle during the study period.

**Sampling Technique**

Systematic random sampling technique used to identify the study animals for inspection purpose during the study period.

**Study Methodology**

*Ante Mortem Inspection*

During every visit, each animal was identified based on enumerated marks on its body tagging before slaughter then data like age, sex, origin and body conditions of each animal was recorded. The body condition score was ranked as poor, medium and good [12]. Estimation of age was done by the examination of the teeth eruption [13]. Two age groups were considered: $\leq$ 5 and >5 years.

*Post Mortem Inspection*

Postmortem examination was carried out on different organs of each of the slaughtered animals, particularly lung, liver, kidney, heart, spleen and muscles. Each organ was assessed macroscopically by visual inspection, palpation and where necessary one or more incisions were included to detect small hydatid cysts [14]. The infected organs from each positive animal were collected. The total number of hydatid cysts were counted per infected organ and recorded on the prepared sheet.

**Hydatid Cyst Distribution and Characterization**

All cysts were transported to Bedele Regional Veterinary Laboratory for cyst size measurement and for confirmation of cyst fertility and viability. Individual cysts were grossly examined for any evidence of degeneration and calcification and the diameter of the hydatid cyst was measured divided as small (<5 cm), medium (5-10cm) and large (>10cm) [15].

The cyst wall was penetrated with hypodermic needle and opened with scalpel blade and then the contents of cyst was checked by transferring in to a sterile container and examined microscopically (40X) for the presence of protoscolices. Based on the presences or absence of protoscolices in hydatid fluid, cyst where identified and classified as fertile and infertile. The fertile cysts were also further studied for viability. Protoscolices viability was assessed by the motility of flam cells as well as protoscolices should completely or partially exclude the dye (0.1 % eosine solution) while the dead ones take it up [16]. Furthermore, infertile cysts were further classified as sterile or calcified. Sterile hydatid cysts were

characterized by their smooth inner lining usually with slightly turbid fluid in its content. Typical calcified cysts produce a gritty sound feeling up on incision [17].

Assessment of Economic Losses

The losses due to hydatidosis at Bedele municipal abattoir was estimated by direct and indirect losses. Direct and indirect losses were the basis for the estimation of the annual economic losses. Direct losses were calculated on the basis of condemned organs, whereas the indirect losses were estimated on the basis of live weight loss caused by hydatidosis [18, 19].

*Direct financial loss*

Lungs, livers, kidneys, hearts and spleens were condemned due to hydatidosis. Annual cost of the condemned organs due to bovine hydatidosis was assessed using the following formula set by (Ogurinade, [20].

ACLiLuKHSC = CSR X PLiC X LiC+ CSR X PLuC X LuC + CSR X PKC KC + CSR X PHC X HC +PSC XSC

Where, ACLiLuKHSC=Annual cost of liver, lung, kidney, heart and spleen condemned

CSR = average number of cattle slaughtered per annual at Bedele municipal abattoir

PLiC = percentage of liver condemned

LiC = mean cost of one liver

PLuC= percentage of lung condemned

LuC= mean cost of one lung

PKC=percentage of kidney condemned

KC= mean cost of one kidney

PHC= percentage of heart condemned

HC= mean cost of one heart.

PSC= percentage of spleen condemned

SC= mean cost of one spleen

*Indirect Financial Loss*

A 5% carcass weight loss due to hydatidosis in cattle has been described by Polydrous, [21] and an average carcass weight of Ethiopian cattle is 126 Kg [22]. Therefore annual carcass weight loss due to hydatidosis is:

ACW=CSR X CL X BC P

ACW=CSR X 126Kg X 5% X BC X P

Where; ACW= Annual cost from carcass weight loss

CSR=Average slaughter cattle per annual in the abattoir

CL (126 x 5%) = Carcass weight loss in the individual

BC= Average price of one Kg carcass at Bedele town

P= Prevalence rate of hydatidosis at Bedele municipal abattoir

Total economic loss=A+B, where:

A=Annual cost of organs condemned

B=Annual cost carcass weight losses

**Data Management and Analysis**

The data was entered and managed in Microsoft excel spread sheet. SPSS software version 20 was employed to analyze the association between hydatid cyst and risk factors sex, age, origin, and body condition,) Descriptive statistics such as percentage and frequency distribution was used to describe the nature and the characteristics of data. The prevalence of bovine hydatidosis was analyzed using percentage. The association of different risk factors with prevalence of bovine hydatidosis was computed by Chi-square test.

**Results**

**Table 1:** Various risk factors associated the occurrence of bovine hydatidosis

| Risk factors | No of animals Examined | No of case (%) | $X^2$ | P- Value |
|---|---|---|---|---|
| **Sex** | | | | |
| Female | 9 | 1(11.11) | 0.26 | 0.338 |
| Male | 400 | 71(17.75) | | |
| **Age** | | | | |
| ≤ 5 years | 28 | 0 | 6.42 | 0.004 |
| > 5 years | 381 | 72(18.89) | | |
| **BCS** | | | | |
| Good | 206 | 20(9.71) | 24.67 | 0.000 |
| Medium | 184 | 43(23.34) | | |
| Poor | 19 | 9(47.37) | | |
| **Origin** | | | | |
| Bedele | 178 | 29(16.23) | 0.958 | 0.811 |
| Gechi | 143 | 26(18.18) | | |
| Abdela | 45 | 10(22.22) | | |
| Chewaka | 43 | 7(16.28) | | |
| **Total** | **409** | **72(17.6)** | | |

Of 409 heads of cattle slaughtered and examined at Bedele Municipal Abattoir 72((17.6%) were found to be harboring one or more hydatid cysts involving different visceral organs (Lung, liver, kidney, heart and spleen). Rate of infection of hydatidosis with respect to age group was statistically significant ($P < 0.05$) being higher in cattle above five years (18.89%) than in five or below five years old (0%). With respect to body condition of cattle, highest prevalence 9 (47.37%) was recorded in cattle with poor body condition followed by medium 43 (23.34%) and good body condition scores 20(9.7%) ($P < 0.05$). However, significant variation was not observed related with sex and origin of animals (Table 1).

Post mortem examination revealed that out of 409 cattle examined, 34 (47.22%) of them were harboring one or more hydatid cysts in their lungs, 14 (19.44%) in livers, and 24(33.33%) in multiple organs as a mixed infection (Table 2).

**Table 2**: Distribution of hydatid cyst in different organs of infected animals

| **Organs** | **No of examined Animals** | **No of infected Animals** | **Proportion (%)** |
|---|---|---|---|
| Lung | 409 | 34 | **47.22** |
| Liver | 409 | 14 | **19.44** |
| Lung and Liver | 409 | 18 | **25.0** |
| Lung and heart | 409 | 2 | **2.78** |
| Lung and kidney | 409 | 1 | **1.388** |
| Lung, Liver, Spleen and Kidney | 409 | 1 | **1.388** |
| Lung and Spleen | 409 | 1 | **1.388** |
| Liver and kidney | 409 | 1 | **1.388** |
| **Total** | **409** | **72** | **100** |

A total of 222 hydatid cysts were collected, of which 107(47.37%) were small, 71(31.98%) medium, and 44(20.65 %) were large (Table 3).

**Table 3**: Distribution of hydatid cyst in different organs with respect to their size

| **Organ** | **Size** | | | **Total (%)** |
|---|---|---|---|---|
| | **Small (%)** | **Medium (%)** | **Large (%)** | |
| **Lung** | 53(39.5) | 49(36.6) | 32(23.9) | **134(60.32)** |
| **Liver** | 43(57.3) | 20(26.7) | 12(16.0) | **75 (33.8)** |
| **Kidney** | 5(83.3) | 1(16.66) | 0 | **6(2.7)** |
| **Heart** | 2(66.6) | 1 ( 33.3) | 0 | **3(1.35)** |
| **Spleen** | 4(100) | 0 | 0 | **4(1.8)** |
| **Total 107(47.37)** | | **71(31.98)** | **44(20.65)** | **222(100)** |

In relation to fertility, highest number of fertile cysts 15(10.5%) from lung, lowest from liver10 (7.77%) and not found from other organs. Highest number of calcified cyst 55(42.3%) in liver and lowest in lung 9(6.3%) were recorded (Table 4).

**Table 4:** Fertility and viability status of hydatid cyst in different organs

| | | **Fertile cysts** | | **Non fertile cysts** | | | |
|---|---|---|---|---|---|---|---|
| **Name of organ** | **frequency of organ** | **fertile (%)** | **viable (%)** | **non-viable (%)** | **sterile (%)** | **calcified (%)** | **Total(%)** |
| Lung | 56 | 15(10.5) | 7(4.9) | 8(5.6) | 119(83.2) | 9(6.3) | **143(49.8)** |
| Liver | 34 | 10(7.7) | 4(3.08) | 6(4.6) | 65(50) | 55(42.3) | **130(45.3)** |
| Heart | 1 | 0 | 0 | 0 | 3(100) | 0 | **3(1.05)** |
| Kidney | 3 | 0 | 0 | 0 | 6(100) | 0 | **6(2.1)** |
| Spleen | 2 | 0 | 0 | 0 | 4(80) | 1(20) | **5(1.74)** |
| **Total** | **96** | **25 (8.7)** | **11(3.8)** | **14(4.9)** | **197(68.6)** | **65(22.6)** | **287(100)** |

Estimation of financial loss: In the present study, a total of 56 (58.33%) lungs, 34(35.42%) livers, 1(1.042%) heart, 3 (3.125%) kidneys and 2 (2.08%) spleens were condemned due to detection of hydatid cysts during the study period. The assessment of retail average market price of each organ at Bedele town was 8, 30, 10, 10 and 4 ETB respectively with economic loss of 448, 1020, 10, 30 and 8 ETB respectively. The average number of animals slaughtered annually at abattoir was determined from the records of the last three years as 1800 and calculated to be 28421.62 ETB per year due to organ condemnation (Table 5).

**Table 5**: Total numbers of organ condemned at Bedele municipal abattoir, from November 2015 to April 2016

| **Organs** | **No organ condemned** | **price per organ** | **%** |
|---|---|---|---|
| Lung | 56 | 8 | 58.33 |
| Liver | 34 | 30 | 35.42 |
| Heart | 1 | 10 | 1.042 |
| Kidney | 3 | 10 | 3.125 |
| Spleen | 2 | 4 | 2.08 |
| **Total** | **96** | | **100** |

A 5% carcass weight loss due to hydatidosis was considered and average number of animals slaughtered at Bedele municipal was 1800 and the formula given previously to estimate the direct economic loss resulted 28421.62 ETB per annum and the indirect loss is 239500.8 ETB. So the total economic loss in the abattoir was calculated by direct loss plus in indirect loss which is equal to 267,922.42 ETB or ($12,758.21) per annum.

**Discussion**

Hydatid disease is an important medical and veterinary problem in the world and considered to be an endemic disease in Ethiopia. Domestic intermediate hosts (cattle, sheep, goats and buffaloes) are major reservoirs for the disease in humans. The widespread distribution and nature of the life cycle of *Echinococus granulosus* suggest that there will always be a risk of re-introducing the cestoda as long as live animals are imported [23].

Out of a total of 409 cattle slaughtered at Bedele municipal abattoir the overall prevalence of 72 (17.6%) was recorded. This value was in agreement with the prevalence of cattle slaughtered at Nekemte (17.3%) [9], at Kombolcha (17.4%) [24], at Wolaita (16.85%) [25] and (16 %) [26], at Adgrat (18.6%) [27], at Birre-Sheleko and Dangila (15.20%) [28], in Western Iran (16.4%) [29], in Turkey (16.6%) [30], in Turkana Kenya (19.4%) [31].

It was less than the previous findings of 22% in Tigray [8], 29.69% in Ambo [32], 34.05% in Bahir Dar [7], 46.5% in Bishoftu [33], 48.7% in Ngorongoro districts of Tanzania [34], 52.69% in Hawassa [35] and 61% in Assela [36].

The present study is higher than 11.26% in Mizan tappi by Jemere *et al.,* [37], 11.6% in Mekele export abattoir by Yitbarek *et al.,* [38], 11.66 % in Bako by Berihu and Toffik [38], 6.99% in Iran by Ahmadi and Mushkehkar, [39], 2.8% in Sudan by Sahar and Atif, [40], 2.1% in Zambia by Fridrick *et al.,* [41]. This variation in prevalence of hydatidosis could be due to differences in animal husbandry system, illegal slaughtered of animals, lack of proper disposal of infected carcass and the presence stray dog and their relations with animals.

In general, terms, throughout the world, there had been different magnitude records of hydatidosis in cattle with low, medium and high rates of occurrences. Generally, the variation in prevalence rate among different geographical locations could be ascribed to the strain differences of *Echinococcus granulosus* that exists in different geographical locations [42].

In this study there is statistical association ($P<0.05$) between body condition with hydatidosis. Animals with poor body condition were found to have higher hydatid cyst count and the poor condition among animals is probably a reflection of the effect of relatively high cyst burden. This is agree with previous study by Muje, and Degefa, [9], Miheret *et al.,* [43], Zelalem *et al.,* [44], Battelli, [45] explained that in moderate to severe infection, the parasite may cause retarded performance and growth, reduced quality of meat and milk, as well as live weight loss.

The study showed that the infection rate increase as the animals become old. There was statistical association between the age of cattle inspected and hydatid cyst ($p<0.05$). This finding is in agreement with the reports of Endiras *et al.,* [32], Muje, and Degefa, [9]. This may be due to the fact that the cattle are slaughtered when they became old with which they have greater chance of being infected with the diseases

[26]. More over the growth of the hydatid cyst is slow, maturity being reached in six to twelve month [46].

No significant variation was noticed with regard to sex of animals. This may be explained by indiscriminate exposure to risk irrespective of sex in the management system of the area. There was also no significant variation noticed with regard to origin of animals. This could be due to similar socio-economic status and animal husbandry practice of community in all areas from where animals were brought for slaughter.

In the current study, hydatid cysts were found predominantly in lung and liver representing 143(49.8%) and 130(45.3%) respectively. Literature indicates that hydatid cysts are most commonly found in lungs and liver of ungulates and it is in agreement with the findings of Bekele and Butako [25], Njoroge *et al.,* [31], lung and liver are the most common sites of hydatid cyst in domestic animals. This could be justified by the fact that lungs and liver possess greater capillary fields, which allow these organs efficiently filter the ingested oncospheres from the blood. Liver and lungs undergo sequential filtration of blood. Liver undergoes primary filtration of blood from portal veins which is followed by pulmonary filtering actions before other organs are invaded. Only those oncospheres which transfer the blood will reach to the systemic circulation and other tissues Eckert and Deplazes, [47]

High numbers of small, medium and large size cysts were found in lungs than in the liver, while the liver harbored higher number of calcified cysts. The reason for higher percentage of small, medium and large cysts in the lungs is due to soft structure of the lung, while the higher yield of calcified cysts in liver could be attributed to relatively higher reticuloendothetial cells and abundant connective tissue reaction of the organ. The higher proportion of a small cyst may be due to immunological response of the host which might preclude expansion of cysts life [48 & 3].

Furthermore, lungs were the most frequently infected organs than any other organ. This is justified by the fact that cattle are slaughtered at older age, during which period the liver capillaries are dilated and most cysts directly pass to the lungs. Also during this period, it is possible for the hexacanth embryo to enter the lymphatic circulation and be carried via the thoracic duct to the heart and lungs in such a way that the lungs may be infected before the liver and / or instead of the liver (Arene, [49].

The overall percentage of fertile cysts in present study was 25(8.7%) This finding was comparable to the fertility rate of 9.85% in Nekemte [50], But, it was lower compared to the finding of 19.4% in Nekemte [9]. Yet, lower fertility rates of 1.76% in Wolaita Soddo [51], 6.2% in Bahir Dar [51] were reported. The variation in fertility rates among different geographical zone could be due to difference in strain of *Echinococcus granulosus* [52].

Variation in fertility rate among the organs might be due to the difference in tissue resistance among of the organs [49]. The percentage of fertile cysts observed in this study is higher in lungs (10.5%) than in liver (7.7%). This finding is in agreement with the work of Abera, *et al.,* [53], Kebede *et al*., [7] and Kebede *et al*., [26], in Mekelle, Jimma, Bahir Dar and Wolaita Sodo, respectively. This is due to the relatively softer consistency of lung tissue which allows the easier development of the cyst.

Hydatidosis is the major cause of organ condemnation in Ethiopian abattoir and slaughter houses [54]. It is the second cause of liver condemnation next to fasciolosis and the first cause of lung condemnation in the abattoir. Losses from organ condemnation (Direct loss) and carcass weight loss (Indirect loss) in infected cattle were assessed and extended estimated to be 267,922.42 ETB or ($12,758.21).

The current estimation of annual economic losses is higher than the report Muje and Degefu, [9] who reported annual economic loss 8561.61 ETB at Nekemte municipal abattior, Kebede *et al*., [8] reported annual economic loss of 25, 608 ETB in Tigray region of Northern Ethiopia, 144,623 ETB in Hossana municipal abattoir, reported by Girma, [56]. However, it was lower than 1,761,625.98 ETB at Hawassa municipal abattoir that was estimated by Regassa *et al*., [35], $21,833.60 in Arbaminch Municipality Abattoir, that was estimated by Tilahun and Terefe, [56].

The difference in economic loss estimation in various regions/abattoirs may be due to the variation in the prevalence of the disease, mean annual number of cattle slaughtered in different abattoirs and variation in the retail markets price of organs in different regions.

**Conclusion And Recommendations**

The prevalence of hydatidosis is likely to be moderate in the study area. This makes Bovine hydatidosis is important parasitic diseases with economic and public health significance. Factors like presence of more stray dogs that visits the abattoir ground and fed on condemned organs, low public awareness about hydatidosis and backyard slaughtering favors the disease transmission in the area. Based on the above conclusion the following recommendations are forwarded.

- The government should give attention towards building standard abattoirs with

- Good facilities and control backyard slaughtering houses.
- Educate of farmers, animal attendants, abattoir workers and butchers about the disease.
- Establishment of policy on dog keeping and handling including registration, and treatment and reduction of stray dog population.
- Feeding of infected offal's to dogs should be avoided and all infected visceral organs should be buried properly.

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