World Applied Sciences Journal 38 (6): 479-485, 2020
ISSN 1818-4952

DOI: 10.5829/idosi.wasj.2020.479.485

# Cystic Echinococcosis and Direct Financial Loss Due to Organ Condemnation in Cattle Slaughtered at Addis Ababa Abattoir

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**Abstract:** Across sectional study was conducted during the period November 2011 to April 2012 to determine the prevalence, characterization of cysts and estimating the financial loss due to cystic hydatidosis in cattle slaughtered at Addis Ababa abattoir enterprise. Total of 383 cattle were slaughtered and examined visually, manually (palpation and incision). Individual cyst was grossly examined for any evidence of degeneration and calcification. The number of cyst per organ was counted and recorded. The cysts were randomly selected and collected from different organs to conduct fertility and viability test in the laboratory, Out of 383 cattle slaughtered, 138 (36.03%) were found harboring a single or multiple hydatid cysts. Significantly, higher infection rate ($p<0.05$) was observed in age group greater than four years (>4years), than in 126 (40.25%) those less than or equal to four year 12 (17.14%) and significant infection ($P<0.05$) was found in female 6 (75%) than male 132 (35.2%). However, the difference in body condition and breed was not significant ($P>0.05$). Of 1261 cysts examined for fertility and viability, 947 (75.099%) were sterile, 189 (14.98%) were calcified, 39 (3.09%) were viable (live) and 86 (6.82%) were fertile but non-viable. It was observed that pulmonary and hepatic cysts had fertility rate of 87 (13.18%) and 31(5.2%), respectively. The rate of cyst calcification was found higher in the liver 161(27.01%). Echinococcosis has great impact on economy and health which requires an appropriate strategy for its prevention and control and backyard slaughtering is considered to be the major means for infection and transmission of the disease.

**Key words:** Echinococcosis · Prevalence · Hydatid Cyst · Financial Loss · Abattoir

## INTRODUCTION

Livestock resource is the backbone of the agricultural sector of the country as means of drought power for crop agro-economy, food and in come generation. Ethiopia's livestock population is estimated to be 40.9 million heads of cattle, 22.5 millions of heads of sheep, 23.4 million goats, 2.7 million horses, 5 million donkey and about 2.3 million camels[1]. However, contribution from these huge livestock resources to the national income is disproportionately small, owing to several factors [2]. One of the major causes of economic losses and low productivity of livestock in Ethiopia is, the widely spread of animal disease. This causes reduced meat and milk production, reduced drought power, difficulty in penetrating the international markets, zoonosis and impairment of human welfare [3]. Hydatidosis and cysticercosis are the most important parasitic diseases of livestock that have both economic and public health significance [4-7].

Cystic *Echinococcosis* is a Zoonotic parasitic infection of many mammalian species caused by larvae of *Echinococcus granulosus*, which is found in the small intestine of dogs and other carnivores [8]. The transmission is most intense in livestock raising regions where veterinary services are unsatisfactory and where offal from slaughtered animals is accessible to dogs [9]. Due to lack of well documented data from many countries in Africa the sub-Saharan picture current situation is not complete [10].

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The absence of proper meat inspection procedures and the presence of large stray dog population are thought to contribute significantly to the prevalence of the disease [11].

Various investigations have been conducted via abattoir survey to determine the economic importance of organs condemnation. Rejection or condemnation of organs which are use full for human consumption will cause direct or indirect economic losses [4, 12-15]. However, there is no enough information regarding the economic significance of hydatidosis in Addis Ababa and its surroundings. Therefore, the major objective of this study was to determine the status of cystic hydatidosis in Addis Ababa abattoir and estimate direct and indirect economic losses associated with the disease.

## MATERIALS AND METHODS

**Study Area:** The study was conducted in Addis Ababa abattoir where postmortem examination of slaughtered cattle for detection of hydatidosis and other diseases was carried out. Addis Ababa city which is the capital city of Ethiopia lies between 2200 and 2, 500m.a.s.l. The city receives average annual rainfall of about 1180.4mm. The lowest and the highest annual average temperature are 9.89 and 24.64°C respectively.

**Study Animal:** The study animals were cattle presented to the abattoir for slaughtering purpose. Both female and male animals slaughtered even though females are not as many as male slaughtered.

**Study Design and Data Collection:** A cross section study on cattle hydatidosis was conducted from November 2011 to February 2012 at Addis Ababa enterprise abattoir.

**Sample Size and Sampling Method:** The sampling method employed was systematic random sampling. The total number of cattle require for sampling was calculated based on the formula given by Thrusfield [16] by considering 50% expected prevalence to be determined with 95% CI and 5% desired absolute precision (d= 0.05).

$$N = \frac{(1.96)^2 (P\exp)(1 - P\exp)}{d^2}$$

where, N = Total number of animal (sample size), P = Expected prevalence and d = desired level of precision (5%). Therefore, N = 384 cattle. But only 383 animals were included in this study.

**Ante Mortem Inspection:** During ante-mortem inspection, each animal was given an identification number, regular visit was made. Related risk factor such as age, sex, breeds and body condition of individual animals were assessed and recorded. Based on body condition, animals were grouped as poor, medium and good [17]. Animal's age was categorized generally into two; as those < 4 years and those equals to 4 years. The estimation was based on the owner information and dental eruption recorded in the abattoir [18].

**Postmortem Inspection:** After slaughtering, post-mortem examination was conducted through visual inspection, palpation and systemic incision of each visceral organs or particularly the lung, liver, kidney, spleen and heart were inspected according to the procedures recommended by FAO/WHO [19]. The infected organs from all positive animals were collected and total numbers of hydatid cysts were counted.

**Cyst Characterization:** Individual cyst was grossly examined for any evidence of degeneration and calcification. The number of cyst per organ was counted and recorded. The cysts were randomly selected and collected from different organs to conduct fertility and viability test in the laboratory. All organs harboring hydatid cysts were partially or totally condemned and judged according to guide lines on meat inspections for developing countries [20]. After each representative hydatid cyst was randomly collected from different organs and taken to the laboratory, the cyst wall was carefully opened with scalpel blade and the contents were poured into a clean glass Petri dish and examined under a microscope (40X) for the presence of hydatid protoscolices. If the protoscolices were present, seen as white dots on the germinal epithelium or brood capsule or hydatid sands within the suspension, the cyst was categorized as fertile. Then the fertile cysts were further subjected for viability test. A drop of the sediment consisting of the protoscolices was placed on microscope glass slide and a drop of 0.1% aqueous eosin solution was added and the covered with cover slip and observed under microscope (40X), with the principle that viable protoscolices should completely or partially exclude the dye while the dead ones takes it up Dalimi *et al.* [21].

**Direct Financial Loss Due to Visceral Organs Condemnation:** The direct financial loss during study period due to hydatidosis in cattle was estimated by considering the cost of organs condemned (lung, liver,

kidney, heart and spleen) and the mean price of respective organs which was obtained from butchers in Addis Ababa during the study period. Therefore, losses occur as result of condemnation of visceral organs due to hydatidosis was computed as follow.

L = N x P, where L = Total loss
N = Number of visceral organs
P = Average price of visceral organs.

**Data Analysis:** The data obtained from ant mortem and postmortem finding and characterization of cysts was recorded in micro soft excel spread sheet and the prevalence of hydatid cyst was calculated by dividing the number of hydatid positive animals with the total number of animals examined. The associations of risk factors with the disease were assessed using Pearson's chi square. The tool used to analyze data was STATA software for windows version. Probability (p) value less than 5% ($p<0.05$) was set as statistically significant in all cases.

## RESULTS

**Prevalence of Hydatidosis:** Of the total 383 animals inspected, 138(36.03%) animals were positive for bovine hydatidosis. The infection rate was 75% in female and 35.2% in male. The prevalence was statistically significant ($P< 0.05$), between sex groups. The prevalence was 35.61% in poor, 33.67% in medium and 40.35% in good body conditioned animals and the infection rate was 39.13% in exotics breed and 35.83% in local animals. However, among different body condition and between breed groups there was no statistical significance ($P>0.05$) difference (Table 1).

**Frequency of Cysts in Different Organs:** The overall distribution of cysts in different organs of cattle slaughtered at Addis Ababa abattoir enterprise was described in (Table 2). Of the 138 cattle positive for cysts, 43(31.15%) of the cases where bearing cysts in single organ while the remaining 95(68.84%) cases with multiple organ involvement.

Table 1: Prevalence of hydatidosis based on age, sex, breeds and body condition of animals

| Risk factor | Number observed | Number of +Ve | Percentage (%) | P-Value |
|---|---|---|---|---|
| Sex | | | | |
| Female | 8 | 6 | 75 | |
| Male | 375 | 132 | 35.2 | 0.020 |
| Age | | | | |
| 4 years | 70 | 12 | 17.14 | <0.001 |
| < 4 Years | 313 | 126 | 40.25 | |
| Breed | | | | |
| Cross breed | 23 | 9 | 39.13 | ……. |
| Local | 360 | 126 | 35.83 | |
| Body condition | | | | |
| Poor | 73 | 26 | 35.61 | |
| Medium | 196 | 66 | 33.67 | ……. |
| Good | 114 | 46 | 40.35 | |
| Total | 1532 | 552 | 36.03 | |

Table 2: Distribution of hydatid cysts in different organs

| No | Organs affected | Animals examined | Positive cases | % | Relative frequency |
|---|---|---|---|---|---|
| 1 | Liver only | 383 | 16 | 4.18 | 11.6 |
| 2 | Liver and ugly | 383 | 64 | 16.71 | 46.37 |
| 3 | Liver lung spleen | 383 | 8 | 2.09 | 5.8 |
| 4 | Liver, heart, KD, LG | 383 | 2 | 0.52 | 1.45 |
| 5 | Liver, heart, lung | 383 | 4 | 1.04 | 2.0 |
| 6 | Liver and kidney | 383 | 3 | 0.78 | 2.17 |
| 7 | Liver, kind lung | 383 | 11 | 2.87 | 7.97 |
| 8 | Liver & Spleen | 383 | 1 | 0.26 | 0.72 |
| 9 | Lung only | 383 | 27 | 7.05 | 19.56 |
| 10 | Spleen & lung | 383 | 2 | 0.52 | 1.45 |
| | Total | 383 | 138 | 36.02 | 100.00 |

Table 3: Cyst fertility and viability in different organs

| | | Sterile | | Calcified | | Viable | | Dead | |
|---|---|---|---|---|---|---|---|---|---|
| Organs | Total cyst count | N | % | N | % | N | % | N | % |
| Liver | 596 | 404 | 67.78 | 161 | 27.01 | 6 | 1 | 25 | 4.19 |
| Lung | 637 | 522 | 81.19 | 522 | 4.4 | 28 | 4.39 | 59 | 9.26 |
| Spleen | 8 | 6 | 75 | 0 | 0 | 2 | 25 | 0 | 0 |
| Heart | 6 | 5 | 83.33 | 0 | 0 | 1 | 16.67 | 0 | 0 |
| Kidney | 14 | 10 | 71.43 | 0 | 0 | 2 | 14.28 | 2 | 14.28 |
| Total | 1261 | 947 | 75.09 | 189 | 14.98 | 39 | 3.09 | 86 | 6.82 |

Table 4: Direct financial loss due to visceral organ condemnation

| No | Organs affected | Number of positives | Average price | Financial Loss |
|---|---|---|---|---|
| 1 | Lung | 128 | 7 | 826 |
| 2 | Liver | 109 | 35 | 3816 |
| 3 | Kidney | 16 | 18 | 288 |
| 4 | Heart | 6 | 15 | 90 |
| 5 | Spleen | 11 | 6 | 66 |
| Total financial Loss | | | | 5086 ETB |

**Cyst Status Characterization:** Of the 1261 Hydatid cysts collect and examined for the status of fertility, viability, sterility or calcification of the total cysts, 125 (9.91%) were fertile and containing protoscolices whereas the reaming 947(75.09%), 189(14.98%) were sterile and calcified cysts, respectively. Of the fertile cysts (125), 39 (3.09%) were viable whereas 86(6.82%) were non-viable (Table 3).

**Direct Financial Loss:** The direct economic loss due to hydatidosis during the study period was losses due to visceral organ condemnation. Therefore, the estimated financial loss in cattle slaughtered at Addis Ababa abattoir enterprise was estimated to be 5086 Ethiopia birr (ETB) (Equivalent of 299. 18 US dollar) (Table 4).

## DISCUSSION

The current cross sectional study revealed that the prevalence of hydatidosis in cattle slaughtered at Addis Ababa abattoir enterprise was 36.03%. The prevalence is very much closer to that reported as 36.3%Yimer *et al*. [22] in the same study area. However, reports show that bovine hydatidosis is wide spread in Ethiopia. The current prevalence is lower than the finding from different places in Ethiopia like 61% in Asella[23], 52.69% in Hawassa [9], 48.90% in Debremarkos [24] and 46.5% in Debre Zeit [25] and slightly higher than those finding from 32.1% in Mekelle [2], 22% in Tigray [24] and 22.40 in Jimma [3].

There is also variation in prevalence of hydatidosis is cattle in different African countries. In Sudan, 3% [26], In Tanzania (Ngorongoro district), 48% [27], In Kenya, 19.4% [28], in Niger Delta, 32% [29], In Libya, 6.4% [30], In Nigeria, 13.9% [31] and in Morocco, 22.98% [11].

This variation in prevalence of Echinococcosis/ Hydatidosis could be due to lack of awareness to dog, low educational status in country to zoonotic disease, improper postmortem examination of visceral organ of slaughtered animals. Other reports states that the variation in prevalence of echinococcosis could be due to differences in animal has boundary system, illegal slaughtered of animals, lack of proper disposal of infected carcass and the presence of stray dog and their relation with animals [32]. Furthermore, MacManus [33] reported that the variation in prevalence in different geographical location could be attributed mainly to the strain differences of *Echinococcus granulose* that exists in different geographical location and other factors like difference in culture, social activities and attitudes to dogs in different region may contribute to variation [34].

The study showed that the infection rate increases as the age increases. It was found that there was positive correlation between the age group of cattle examined and infection rate ($P<0.05$). Thus, the reason for the higher prevalence rate of hydatidosis in those greater than four years (> 4 years) may be related with large number of animals grazing in field which increase exposure. Those less than or equal to 4 years is also include calves which kept indoors but other reporter states that the reason for lower prevalence rate of hydatidosis in younger cattle may be early culling of infected young cattle through selling or slaughtering before they reach old age [35].

Sex differences also significantly affected the prevalence of hydatidosis in the present study $P<0.05$ ($x^2=5.3832$, $P = 0.020$) and females show higher prevalence of echinococcosis but this may be related to sample size.

Out of the 138 infected cattle, 129(35.83%) were local and 9(39.13%) Exotic were positive with p>0.05 which suggests that there is no significance association between breed and prevalence of the disease regarding the body condition, out of 383 cattle, 26(35.61%) were poor, 66(33.67%) were medium and 46(40.35%) Good body condition were positive (P>0.05), which also showed no association between different body condition.

A lower fertility percentage (9.91%) was identified out of the total cysts examined and relatively higher percentage (75.09%) and (14.98%) of the total cysts were sterile and calcified which show the importance of cattle in maintaining the cycle in minimal level and it may imply that most of the cysts in cattle are infertile. This finding is in line with that of Melaku *et al*. [36]. The variation in fertility, sterility and calcification may be related with the strain differences [34]. The fertility rate was higher among the cysts of lungs since lung has relatively softer constancy which allows easier development of the cysts.

In this study significant financial loss was registered due to hydatidosis with estimated loss of 5086 ETB which is about 299.18 United States dollars (USD) per annual. Different financial losses regarding bovine hydatidosis were also reported from different part of the country. For example, Melaku *et al.* [36] reported 39, 157.12 USD losses per annual in Dessie municipal abattoir North-Eastern Ethiopia and other reports have been stated that the extents of economic loss varies because of the variation of the prevalence of the disease and the differences of causes of organ condemnation in different abattoirs [37-41].

## CONCLUSION AND RECOMMENDATIONS

Echinococcosis is one of the most important parasitic diseases with economic and public health significance. In Ethiopia, the prevalence of echinococcosis is significant due to several factors, of which keeping dogs in close association with animals and humans is the most prominent. Moreover, the back yard slaughtering is widely practiced activity which increase the risk of infection in dogs by hydatid after ingesting hydatid cyst containing protoscolices from organs disposed everywhere.

Based on the above conclusion and other facts, the following recommendations are forwarded:

- Public awareness about the disease transmissions and control should be in place
- Organs condemned should not be exposed to stray dogs and cats which transmit the disease to the public
- There should be enforcement of legislation that will put an end to back yard and road side slaughtering practices.
- Abattoirs construction should be as per the international standards
- There should be more studies about echinococcosis and its economic impact in the country at large.

## ACKNOWLEDGMENT

Authors would like to thank staffs of Addis Ababa municipality abattoir enterprise for their support during sample collection and processing and Hawassa University for its financial support and supervision during all the study period.

**Data Availability:** All data generated or analyzed during this study are included in this published article

**Ethical Considerations**

**Conflict of Interests:** There is no conflict of interest to be disclosed.

**Animals Used:** Slaughtered animals in the abattoir for consumption have been used in this study; indicates no need of direct ethical clearance.

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