

Study on Prevalence and Associated Risk Factors of Bovine Hydatidosis in Hawassa Municipal Abattoir, Ethiopia

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Abstract: A cross-sectional study was conducted from November 2015 to April 2016 to estimate the prevalence and risk factors associated with the hydatidosis incurred due to the disease in cattle slaughtered at Hawassa municipal abattoir. Among the total of 400 cattle examined, 164(41%) of them had harbored hydatid cyst(s) in their organs. From the total of 80 hydatid cysts collected and characterized, these 78.67%(129), 54.3%(89), 2.43%(4), 0.6%(1) and 0.6%(1) of them were obtained from lung, liver, spleen, kidney and heart respectively. Of the 80 hydatid cysts collected and examined for status of fertility, sterility and calcification 14(17.5%) were fertile, 39(48.75%) sterile and 27(33.75%) calcified and out of 14 fertile cysts tested for viability, 10(12.5%) were viable and 4(5%) were non viable. There was statistically significant association between the body condition of the cattle and the occurrence of hydatidosis ($X^2 = 21.948$; $P < 0.05$). There was no statistically significant difference between infection rate and breeds, sex and origin of the animals. In conclusion, the study indicated that high prevalence of hydatidosis in Hawassa municipal abattoir with implication for public health calling for intervention. Establishment of policy on dog keeping and handling including registration, treatment and elimination of stray dogs are recommended to control the disease.

Key words: Bovine Hydatidosis • *E. granulosus* • Prevalence • Risk factors

INTRODUCTION

Infection with the metacestode hydatid cyst of *Echinococcus granulosus*, stage of parasite tape worms is recognized as one of the world's major zoonosis affecting both humans and domestic animals [1]. Echinococcosis 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 [2]. Echinococcosis is an emerging and re-emerging zoonotic parasitic disease caused by the cestode species of the genus *Echinococcus* and is one of the most important helminthic diseases within Europe, Asia, Africa, South America, Canada and Australia [3]. The highest incidence is reported mainly from sheep and cattle rearing areas [4].

This multi host parasite is prevalent all over the world and annually the economic loss in livestock due to this parasite is significant. In Africa, hydatid disease is reported more common in cattle those are communally owned or are raised of free range and which associated more intimately with domestic dogs. Hydatidosis in

domestic ruminants inflicts enormous economic damage due to the condemnation of the affected organs and lowering of the meat, milk and wool production [5].

In Ethiopia, meat inspection was started in 1910's with the aim of improving productivity and trade in animals and animal products as well as protecting the public from zoonotic diseases. Despite one century of experience on modern animal health activities, there exist very few legislation and regulation animal diseases control and meat inspection [6]. In Ethiopia, hydatidosis has been known and documented as early as 1970's. Hydatidosis is the major cause of organ condemnation in most Ethiopian abattoirs and slaughter houses causing huge economic losses [7]. 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 in Ethiopia [8].

The tapeworm spends most of its adult life in the intestine of its definitive host, namely canids and in particular the dog. The tapeworm eggs become voided in the canids' faeces and as a result ingesting the eggs,

infection passes to the intermediate host, commonly herbivores while grazing. However, humans can become accidentally infected and hydatid cysts may develop throughout the body. Therefore, cystic echinococcosis (CE) or hydatidosis is a disease caused by the metacestode stage of *Echinococcus granulosus*. The disease is not apparent to farmers but is of considerable economic and public health importance [8].

Hydatidosis caused by the metacestode of *Echinococcus granulosus* is a widely spread parasitic zoonosis that had caused public health problems in many countries [8, 9]. Several reports had indicated that hydatidosis is widely prevalent in livestock population of various regions of Ethiopia [8]. *Echinococcus* species require two mammalian hosts for completion of their life-cycles. Segments containing eggs or free eggs are passed in the faeces of definitive host, a carnivore. The eggs are ingested by intermediate host, in which the metacestode protoscolices develop. The cycle is completed if intermediate host is eaten by a suitable carnivore [9].

There are currently very few studies conducted about hydatidosis and the prevalence rates were changing between 7.2% [10] to 72.44% in cattle [11]. But it is limited by its coverage of Ethiopia so that doesn't indicate the whole picture of the prevalence in Ethiopia. Therefore, the principal objectives of this study were to estimate the prevalence of bovine hydatidosis based on postmortem examination and assess the associated risk factors with the bovine hydatidosis in Hawassa municipal abattoir and

MATERIALS AND METHODS

Study Area: The study was conducted at Hawassa Municipal abattoir in Hawassa town. Hawassa is the capital of Sidama zone administration and Southern Nations Nationalities and Peoples' Regional State (SNNPRS) as well. It is located in the northern part of SNNPR's, 275 km South of Addis Ababa. It geographically lies between 4°27' and 8°30' N latitude and 34°21' and 39°1' E Longitude at an altitude of 1,790 m above sea level. The area receives average rain fall annually ranging from 800 to 1,000 mm of which 67% falls in the long rainy season, which extends from June to September. The mean minimum and maximum temperatures of the area were 20.1°C and 30°C, respectively and 51.8% mean relative humidity. The area is mainly covered by dry savannah and bush type of vegetation (NMA, 2008). The total livestock population of Sidama zone (including Hawassa) is estimated at 1,721,341 cattle, 228,941 goats, 457,465 sheep, 57,643 horses, 54,066 donkeys, 725,540 poultry and 44,492 beehives [12].

Study Animals: The study animals were local and cross breed cattle brought from various localities to Hawassa Municipal abattoir for slaughtering purposes. It was difficult to precisely indicate the geographical origin of all animals slaughtered at Hawassa Municipal abattoir and relate the findings on hydatidosis to a particular locality. Nevertheless, attempts made in this regard revealed that majority of them were brought from nearby markets (Shashemene, Arsi-Negelle, Hawassa, Wolayta Sodo and Tula) [13].

Sample Size Determination: Sample size was calculated according to Thrusfield, [12] by considering (52.69%) from [14-18] expected prevalence and 95% confidence interval with a 5% desired absolute precision.

$$n = \frac{1.96^2 \times P_{exp}(1 - P_{exp})}{d^2}$$

where, n = required sample size; Pexp = expected prevalence and d = desired absolute precision.

An expected prevalence of 52.69% was used and considering a 5% absolute precision with 95% confidence level was given 383 sample sizes calculated. However, to increase the accuracy, 17 samples were added to the normal sample. Therefore, 400 cattle were sampled and examined in the study. These sample sizes were selected by systematic random sampling method during the ante mortem inspection.

Study Design: A cross-sectional study was conducted to determine up to date information on the prevalence and cyst characteristics of bovine hydatidosis at Hawassa Municipal abattoir. Systematic (three slaughtering days per week) visits were made to Hawassa Municipal abattoir from November 2015 to April 2016.

Study Methodology: Ante-mortem inspection was carried out using visual examination to evaluate the body condition of the animals and interview was also conducted to obtain data on animal's origin. During antemortem inspection, each of the study animals was given an identification number (with a paint mark on their body). Age, sex and body condition scoring of the study animals were also recorded. Estimation of age was carried out by examination of the teeth eruption using the approach forwarded by De Lahunta and Habel [13]. Two age groups were considered; less or equal to 5 years and above 5 years old. Cattle presented to slaughtering in the

study area were mostly male with a few females. The body condition scoring was classified into three categories as poor (1, 2, 3), medium (4, 5, 6) and fat (7, 8, 9) according to Nicholson and Butterworth [14].

Following a thorough visual inspection, palpation and incision of some suspected organs (such as liver and lung) [5]. Postmortem examination was carried out through visual inspection, palpation and incision of visceral organs (lung, liver, heart, spleen and kidney) and the presence of hydatid cyst and the organ distribution were recorded. Hydatid cysts were carefully removed and separately collected (in organ basis) in clean containers for further cyst characterization. Hydatid cyst characterization was made to assess the status of the cysts.

Cyst Fertility and Viability Study: The collected hydatid cysts were taken to Hawassa University laboratory. Hydatid cysts (80 from the lung, liver, kidney, heart and spleen) were randomly selected for fertility and viability tests. The pressure of the cyst fluid was reduced by using a sterile needle. Then cysts were incised with a sterile scalpel blade and the content was poured into a glass petridish to be examined. The presence of protoscolices presence in the cyst fluid was considered as indicative of fertility by using a light microscope at 10x to 40x objective [15] Fertile cysts were further subjected to viability test.

For clear vision, a drop of 0.1% aqueous eosin solution was added to equal volume of protoscolices in hydatid fluid on microscope slide with the principle that viable protoscolices should completely or partially exclude the dye while the dead ones take it up and observed under 40x objective (Elissondo, 2008). Furthermore, infertile hydatid cysts were classified as sterile or calcified by their smooth inner lining usually with slight turbid fluid in its content. Typical calcified cysts produce a gritty sound feeling upon incision [16].

Data analysis: The data was entered into MS Excel 2007 spread sheets and analyzed using SPSS version 20 statistical software. Descriptive statistics such as percentages and frequency distribution was used to describe the nature and the characteristics of the data. Chi square test was used to see association of risk factors with the prevalence of hydatidosis. In all analyses confidence level was at 95% and $p < 0.05$ was taken as significance.

RESULTS

During the study period from November, 2015-April, 2016, out of the total 400 heads of cattle slaughtered and examined at Hawassa municipal abattoir 164 (41%) was infected with hydatid cyst involving different visceral organs (lung, liver, kidney, spleen and heart). Analysis of the occurrence of infection with regard to place of origin, age, sex, breed and body condition was made by using proportions and chi-square test.

Risk Factors and Prevalence of Hydatidosis: Rate of infection in different age groups (≤ 5 and > 5 years) was assessed and age prevalence has shown statistically insignificant variation ($p > 0.05$, $\chi^2 = 0.62$) with adult having higher infections. The prevalence was also assessed in terms of sex and it was found that 33.33% prevalence in female and 41.23% in male. It was statistically not significant variation ($p > 0.05$, $\chi^2 = 0.584$). The prevalence was also assessed in terms of body condition scores and it was found that cattle having poor body condition had highest prevalence 68.8%, 38.28% in medium which followed by 27.27% in good. There was significant difference revealed between body condition score with regard to cyst detection ($p < 0.05$, $\chi^2 = 21.948$). Rate of infected animals based on origin was assessed and has shown statistically insignificant variation ($p > 0.05$, $\chi^2 = 1.66$), (Table 1).

Table 1: Analysis of Risk factors with regard to detection of hydatid cysts in cattle

Variable categories	No. examined	No. positive	Prevalence (%)	χ^2	p-value
Breed					
local	368	151	41	0.002	0.964
cross	32	13	40.6		
Age					
≤ 5 year	207	81	39.13	0.62	0.431
> 5 year	193	83	43		
Body condition					
Poor	54	37	68.8	21.948	0.000
Medium	291	112	38.48		
Good	55	15	27.27		
Sex					
Male	388	160	41.23	0.301	0.584
Female	12	4	33.33		
Origin					
Hawassa	99	41	41	1.66	0.798
Tula	73	33	45		
Arsinegelle	70	29	41		
Shashamane	76	32	42		
Woloyta Sodo	82	29	35.36		
Total	400	164			

Table 2: Distribution of hydatid cyst in affected organs

Infected organs	Number	Percent (%)
Lungs	129	78.67
Liver	89	54.3
Spleen	4	2.43
Kidney	1	0.6
Heart	1	0.6

Table 3: Status of hydatid cyst in different organs (fertile,sterile and calcified) of cattle slaughtered at Hawassa municipal abattoir

Type of organ	Number of cyst collected	Fertile cyst							
		Viable		Non viable		Sterile cyst (%)		Calcified (%)	
		No.	(%)	No.	(%)	No	(%)	No	(%)
Lungs	51	9	17.64	2	3.9	28	54.9	12	23.5%
liver	25	1	4	2	8	7	28	15	60
spleen	2	0	0	0	0	2	100	0	0
kidney	1	0	0	0	0	1	100	0	0
heart	1	0	0	0	0	1	100	0	0
Total	80	10	12.5	4	5	39	48.75	27	33.75

Cyst Distribution in Different Organs: Overall distribution of cysts in different organs of cattle slaughtered at Hawassa municipal abattoir was described in the table 3. From 400 cattle examined, 224 visceral organs were found to be affected. From these 78.67%(129), 54.3%(89), 2.43%(4), 0.6%(1) and 0.6%(1) cysts were found from lung, liver, spleen, kidney and heart respectively.

Cyst Status Characterization: Of the 80 hydatid cysts collected and examined for status of fertility, sterility and calcification 14(17.5%) were fertile, 39(48.75%) sterile and 27(33.75%) calcified and out of 14 fertile cysts tested for viability, 10(12.5%) were viable and 4(5%) were non viable (Table 3).

DISCUSSION

The current study reveals that the prevalence of bovine hydatidosis at Hawassa Municipal abattoir was found to be 41%. Reports show that bovine hydatidosis is widespread in Ethiopia. In the current finding the prevalence of hydatidosis in cattle was lower than with the report of 72.4% which was recorded in Assela [11] and 61% [17], 52.69% in Hawassa [18] 46.5% in Debre Zeit [19], 48.9% in Debre Markos [20]. But it is slightly higher than 34.05% in Bahir Dar [21], 32.1% in Mekelle (43). The finding is quite higher than with the prevalence of 22.4% in Jimma [22], 22.6% in Konso [23] and 20.3% in Debre markos [8]. The current finding is closely related to report of 40.5% in Addis Abeba [24].

The variation in prevalence rate within the same species of animals could be attributed to the differences in seasonal variation, geographical locations, environmental conditions, hygienic status of slaughter houses, climatic conditions, contamination rate in the intermediate host and feeding status of animals, livestock stocking intensity and livestock movement that contribute to the differences in prevalence rates [25, 26].

Factors such as difference social activity, lack of proper removal of infectious carcass and attitude to dogs in different regions might have contributed to the variation in prevalence in different areas of a country [27] and strain differences of *E. granulosus* that exists in different geographical location [28].

The prevalence of hydatidosis was higher in cattle having poor body condition (68.8%) followed by medium (38.48%) and good (27.27%). Body condition significantly affected the prevalence of hydatidosis ($X^2 = 21.948$, $P < 0.05$) and animals with poor body condition were with higher prevalence of hydatidosis. The differences between body conditions score may be due to animals with poor body condition have low immunity to hydatid disease. Moderate to severe infection the parasite may cause retarded growth; reduce meat and milk production as well as live weight [29].

Out of the 164 infected cattle, 4(33.33%) were females and 160(41.23%) males were positive with ($p > 0.05$, $x^2 = 0.301$) which suggests that there is no association between sex and prevalence of the disease. This may be due to small number of female animals slaughtered at the abattoir during the study. Females were kept for breeding;

hence only females with reproductive problem, poor performance and end productive life were slaughtered as the abattoir. Regarding the breed, out of 400 cattle 368 (41%) local and 32(40.6%) cross were positive with ($p>0.05$), which also showed insignificance between breeds. Participation of small number of cross cattle might be possible reason. The result has similarly registered by Temesgen [30].

This study showed that there was no positive correlation between the age of cattle examined and infection rate ($p>0.05$) which is not significant. In present study the prevalence of hydatidosis seems to increase as the animal's age advances. The finding is in agreement with the findings of other researchers where they reported a higher prevalence in older animals [31]. This could be mainly due to the fact that aged animals have longer exposure time to *Echinococcus granulosus* eggs and weaker immunity to resist the infection [32]. There was no significant difference in the prevalence of the disease among animals from the different regions. This could be due to the similarity in socio-economic status and animal's husbandry practices of community in the study area [33].

The present study indicated that the occurrence of cyst was highest in the lungs (78.67%) followed by liver (54.3%), spleen (2.43%), heart (0.6%) and kidney (0.6%). (Table 2). Similarly result had been obtained by (33) and (18). Other similar reports from abroad also indicated that lungs were found to be the most infected organs in cattle, buffalo and sheep [34]. Therefore the findings in this study were in conformity with previous studies made in Ethiopia and abroad. This might be due to the presence of greater capillary beds in the lung than other organs and due to the fact that cattle are slaughtered at older age, during which period the liver capillaries are dilated and most oncospheres pass directly to the lungs; additionally, 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 lung may be infected before or instead of liver [35].

With the status of hydatid cyst, the finding of 48.75% sterile, 17.5% fertile and 33.75% calcified cyst may generally imply that most of the cysts in cattle are sterile. The variation of infertility rate among different species and in different geographical zone could be due to the differences in strain of *E. granulosus* [36]. But the percentage of calcified cyst was found to be higher in the liver than in the lung. This may be associated with the higher reticuloendothelial cell and abundant connective tissue reaction of the organ [37]. In the fertility study of

the parasite, the rate in the current study is related as compared to previous reports. In other study, the percentage of fertile cysts: 19.3% [38] Fikire *et al.*, 2012), 17.44% [39]. and 14.95% [40]. were documented. The higher fertility rate in lungs (21.5%) than liver (12%) is due to the fact that relatively softer consistency of lung tissue allows easier development of the cyst (Smyth 1985). Information about prevalence and fertility of hydatid cysts in various organs of cattle are important indicators of potential source of infection to perpetuate the disease to dogs [41-43].

CONCLUSION

Hydatidosis is one of the most highly prevalent parasitic diseases of cattle in Ethiopia. The present output of this study indicates high prevalence of hydatid cyst (41%, 164/400) in Hawassa Municipal abattoir. The possible reason for high prevalence could be due to several factors of which keeping dogs in close association with cattle. The distribution of prevalence of hydatid cysts infection by age showed that the prevalence in above five year animals is slightly higher than in below (equal) five year animals. Significant association was observed between hydatid cyst infection and body condition of animals ($p<0.05$). For the location of hydatid cyst in organs, the lung was found to be the most affected organ (78.67%).

In view of the present findings and current situation in Hawassa Municipal abattoir the following recommendations are forwarded:

- Establishment of policy on dog keeping and handling including registration, treatment and elimination of stray dogs is essential.
- An effort should be made to control the transmission of cystic echinococcosis from slaughter houses by the safe disposal of infected offal.
- Further studies on the prevalence of hydatidosis in different zones of the region involving different hosts should be conducted.

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