Acta Parasitologica Globalis 8 (2): 85-90, 2017
ISSN 2079-2018

DOI: 10.5829/idosi.apg.2017.85.90

Prevalence, Cyst Characterization and Economic Significance of Bovine Hydatidosis in Jigjiga Municipal Abattior, Ethiopia

[1]Abdifetah Mohamed, [2]Tsehaye Hadush and [1]Mulisa Megersa

[1]Jigjiga University, College of Veterinary Medicine, Ethiopia
[2]Wolaita Sodo University, School of Veterinary Medicine, Ethiopia

Abstract: A cross sectional study was conducted in Jigjiga municipal abattoir from October, 2015 to May, 2016 with the aim to determine the prevalence, cyst characteristics and economic losses of hydatidosis in cattle. Out of 384 total inspected animals, (10.9% n=42) were having a single or multiple hydatid cyst(s). Significant variation was observed among different body condition of animals ($P < 0.05$) and the highest prevalence was recorded in animals with poor body condition (25.4%) compared to animals with medium (7.8%) and good body condition scores (7.4%). At organ level, cysts were distributed (35.7% n=25) in the lung, (28.6% n=20) in the liver, (15.7% n=11) in the heart, (12.8% n=9) in the spleen and (7.1% n=5) in the kidneys. Of the total 129 cysts examined, (21.7% n=28) were found calcified, (64.3% n=83) were sterile and (14.0% n=18) were fertile out of which (44.4% n=8) were viable and the rest (55.6% n=10) were found to be nonviable. Higher number of fertile (33.3% n=6) and sterile (49.3% n= 41) cysts were observed in lungs, but cyst calcification was found to be higher in the liver (67.8%) than in other organs. The total annual economic loss from direct and indirect annual economic losses due to bovine hydatidosis was estimated to be 1,546,938 ETB per annum based on the local market prices during the study period. This study revealed that hydatidosis is prevalent and economically significant disease of cattle in the study area which necessitates designing and implementation of appropriate strategies for its control.

Key words: Cattle · Cyst · Economic loss · Hydatidosis · Jigjiga · Prevalence

INTRODUCTION

Livestock are of enormous importance in Africa, economically, for nutritional and agricultural purposes and socially [1]. The size and diversity of Ethiopia's major agro-ecological zones render it suitable for the support of large numbers and class of livestock. Among the livestock population of Ethiopia, there are about 53.4 million of cattle; 25.5 million sheep; and 22.78 million goats [2]. In the country, livestock play vital role in farming system; however, poor health and productivity of animals due to disease has considerably become the major stumbling block to the potential of livestock industry [3].

Echinococcosis (hydatidosis) is a chronic cyst-forming parasitic disease of domestic and wild ungulates as well as human beings caused by infection with the larval stage (metacestode) of dog tapeworm belonging to the genus *Echinococcus* and family *Taenidae*. Three broad morphological forms of echinococcosis are recognized clinically: cystic echinococcosis caused by *Echinococcus granulosus,* alveolar echinococcosis caused by *E. multilocularis* and polycystic echinococcosis caused by *E. vogelior*. The life cycle of *Echinococcus* species is complex, involving two hosts (definitive host and intermediate host) and a free-living egg stages. Dogs are the usual definitive hosts whilst a large number of mammalian species can be intermediate hosts, including domestic ungulates and man [4].

The adult parasite is a small (2-8 mm) cestode of carnivores especially dogs and has a number of strains. It is found in the small intestine of carnivores while metacestode (hydatid cyst) is found in different organs of a wide variety of ungulates and man. Its larval stage, hydatid cyst, is a disease of immense medical and economic importance [5].

Hydatidosis has been known and documented in Ethiopia as early as 1970; it is still a major cause of organ condemnation in most Ethiopian abattoirs and leads to

Corresponding Author: Abdifetah Mohamed, Jigjiga University, College of Veterinary Medicine, Ethiopia.

huge economic losses in the livestock sector [6]. The disease is widely prevalent in livestock population of various regions of the country [7]. Despite this fact, there is no clear picture regarding the extent of bovine hydatidosis and associated economic losses in the Ethiopian Somali Region. Therefore, this study was conducted with the objectives to determine prevalence, hydatid cyst characterization and economic losses due to bovine hydatidosis in Jigjiga municipal abattoir

MATERIALS AND METHODS

Study Area: The study was conducted in Jigjiga municipal abattoir from October, 2015 to May, 2016. Jigjiga is the capital city of the Ethiopian Somali Regional State (ESRS) and it is found in Eastern part of the country at 630 km from Addis Ababa. Human population size of Jigjiga is estimated to be 400,634. Jigjiga is situated at an altitude ranging from 1,660 to 1,710 meters above sea level at geographic coordinates of approximately 9020^0 North latitude and 45056^0 East longitudes. The climate of Jigjiga is semi-arid type which is characterized by high temperature and low rainfall. The mean annual temperature and mean annual rainfall are about 22^0C and 543 mm respectively [8]. The region has a livestock population of 3,796,000 cattle, 9,053,000 sheep, 8,547,000 goats and 2,032,000 camels [9].

Study Animal Population: The study animals were all local zebu cattle (*Bos indicus*) brought to Jigjiga municipal abattoir for slaughter from districts around the town. Animals of different age, sex and body conditions were included in the study.

Sample Size and Sampling Method: The sample size of the study animals were determined using the formula given by Thrusfield [10]. Since there was no information about the prevalence of the disease in the study area, 50% expected prevalence was taken to calculate the sample size with 5% absolute precision and 95% confidence interval.

$$Therefore,\ N = \frac{1.96^2 \ x\ Pexp\ (1\text{-}Pexp)}{d^2}$$

Where:
N = required sample size
Pexp = expected prevalence
d = desire absolute precision

Hence, the sample size required as per the above formula was 384 heads of cattle. Sampling of the study animals was done by simple random sampling method. Regular abattoir visits of once per 2 weeks was done and all cattle brought for slaughter on the selected visiting days were sampled until the sample size limit was reached.

Study Design and Methodology: A cross-sectional study involving gross ante-mortem and postmortem inspection, cyst characterization and economic assessment of bovine hydatidosis was carried out.

Ante-Mortem and Postmortem Inspection: During ante-mortem inspection, each animal was given an identification number. The sex, age and body condition of each individual animal was assessed and recorded. Body condition of cattle was classified as poor (hide bound with obvious bony prominences and deep sunk tail base), medium (ribs and other bony prominences noticeable on visual inspection but have fair fleshy background on palpation) or good (bony structures notable only on palpation). Animal's age was also categorized into young (<5 years) and old (≥5 years) based on dentition [6]. Postmortem examination was conducted by visual inspection, palpation and systematic incision of each visceral organ particularly the lung, kidney, liver, spleen and heart. The number of positive animals and the total number of hydatid cysts per infected organ were counted and recorded.

Cyst Characterization: Cysts from different organs were collected and subjected to fertility and viability tests at Jigjiga Regional animal health investigation & diagnostic center. To reduce intra-cystic pressure, the cyst wall was penetrated with a needle and opened up with a scalpel and scissor. The contents were then transferred into a sterile container and examined microscopically (40×) for the presence of protoscoleces. Cysts, which were not containing any protoscoleces as well as heavily suppurative or calcified, were considered unfertile [11]. The viability of protoscoleces was assessed by the motility of flame cells together with staining with a 0.1% aqueous eosin solution; because viable protoscoleces did not take up the stain, while nonviable ones take it up [12].

Economic Loss Assessment: The total economic losses due to hydatidosis was estimated by considering both the direct economic losses associated with condemnation of locally usable visceral organs and the indirect losses

from carcass weight. The direct economic loss due to hydatidosis at the abattoir was computed by multiplying the average number of cattle slaughtered annually with the percent involvement of each organ out of the condemned organs and with the mean price of condemned organ in the study area. To calculate the price of the condemned organs, data was randomly collected from meat sellers and the mean price was determined. The average annual slaughter rate of cattle at the abattoir was also determined based on retrospective analysis of data recorded from the last three years. Therefore, the annual direct economic cost was calculated using the formula set by Ogunrinade and Ogunrinade [13].

Annual direct economic loss = (pI1xTkxc1) + (pI2xTkxc2) + (pI3xTkxc3) + (pI4xTkxc4) + (pI5xTkxc5)

Where,
(PI1 = percent involvement of lung out of total condemned
PI2 = percent involvement of liver out of total condemned
PI3= percent involvement of spleen out of total condemned
PI4 = percent involvement of heart out of total condemned
PI5 = percent involvement of kidney out of total condemned
C1 = average market price of lung
C2 = average market price of liver
C3 = average market price of spleen
C4 = average market price of heart
C5 = average market price of kidney and
Tk = average annual kill of bovines)

The indirect annual economic loss from carcass weight loss due to hydatidosis was calculated according to the formula given by Polydorous [14]:

Indirect annual economic losses = 5% NAS×PH×CPB×126 kg.

Where, 5% = A reduction of 5% in meat production due to hydatidosis established by Polydorous [14]: NAS = average number of cattle slaughtered annually; PH = prevalence rate of hydatidosis; CPB = current average price of 1 kg of beef at Jigjiga town; 126 kg = the dressed average carcass weight of adult Zebu cattle [15]. Therefore, the total annual economic loss due to hydatidosis was calculated as the summation of the direct financial loss due to hydatidosis and indirect economic loss from carcass weight loss.

Data Management and Analysis: Data collected from ante-mortem, postmortem and laboratory findings were entered into Microsoft Excel 2007 and then, analyzed by statistical software (SPSS version 20). Descriptive statistics were used to summarize the data and Chi-square (x^2) was used to determine the association of hydatid cyst infection with hypothesized risk factors. In all calculations, the confidence interval and the significance level were set at 95% and at 5% respectively.

RESULTS

In this study, the prevalence of bovine hydatidosis in Jigjiga municipal abattoir was found to be (10.9% n=42). Significant variation was observed among body condition of the study animals and higher cyst prevalence was recorded in animals with poor body condition (25.4%) followed by animals with medium (7.8%) and good body condition scores (7.4%). Age and sex of the animals showed no significant variation in cyst prevalence (Table 1).

Table 1: Prevalence of hydatidosis based on the different risk factors.

Risk factors	Total number examined	Number of positive cases (%)	x^2	P-value
Sex				0.484
Male	329	34(10.3)	0.858	
Female	55	8(14.5)		
Age			2.934	0.087
Young (< 5 years)	185	15(8.1)		
Adult (≥5 years	199	27(13.6)		
Body condition score			18.586	0.001
Poor	71	18(25.4)		
Medium	219	17 (7.8)		
Good	94	7 (7.4)		

The postmortem inspection revealed that different organs were affected with hydatid cyst(s). The highest proportion of hydatid cysts was recorded in the lungs (35.7%) followed by liver (28.6%) and heart (15.7%) (Table 2).

Table 2: Distribution of bovine hydatidosis in different organs of inspected cattle

Organ inspected	Number of positive organs	Relative prevalence (%)
Lung	25	35.7
Heart	11	15.7
Liver	20	28.6
Kidney	5	7.1
Spleen	9	12.8
Total	70	100

Of the total 129 cysts examined, (14.0% n=18), (64.3%, n=83) and (21.7%, n=28), were found to be fertile, sterile and calcified cysts respectively. More fertile (33.3% n= 6) and sterile (49.3% n=41) cysts were observed in lungs than other organs. The rate of cyst calcification was higher in the liver (67.8% n=19) than in the other organs (Table 3).

Table 3: Fertility and viability test of hydatid cysts collected from different organs.

Category	Total number (%) of cysts
Calcification	
Calcified	28(20.7)
Non calcified	101(79.3)
Total	129(100)
Fertility test of the non-calcified cysts	
Sterile	83(82.2)
Fertile	18(17.8)
Total	101(100)
Viability test of the fertile cysts	
Viable	8(44.4)
Nonviable	10(55.6)
Total	18(100)

In the current study, 10 lungs, 3 hearts, 4 livers, 3 kidneys and 7 spleens were condemned due to bovine hydatidosis during the study period with an economic loss of 59940, 23976, 319680, 23976 and 6912 ETB, respectively. In the present study the total annual direct economic loss due to bovine hydatidosis was found to be 434,484 ETB per annum (Table 4).

Table 4: Direct economic loss due to organ condemnation as a result of bovine hydatidosis during the study period.

Organ examined	Number (%) of organs condemned	Average unit price (birr)	Average annual kill of bovines	Total price (birr)
Lung	10(37.0)	15	10800	59,940
Heart	3(11.1)	20	10800	2,3976
Liver	4(14.8)	200	10800	319,680
Kidney	3(11.1)	20	10800	23,976
Spleen	7(12.8)	5	10800	6,912
Total	27(100)			434,484

The annual indirect bovine hydatidosis economic loss in the study area was estimated based on the average annual kill of cattle (10800), prevalence of hydatidosis (10.9%), current average price of 1 kg of beef (150 ETB), dressed average carcass weight of adult Zebu cattle (126 kg) and A reduction of 5% in meat production due to hydatidosis were considered and it was found to be 1,112,454 ETB annually. The total annual economic loss due to bovine hydatidosis in Jigjiga municipal abattoir was then calculated as the summation of the direct annual economic losses due to organ condemnation and indirect annual economic losses from carcass weight loss and was found to be 1,546,938 ETB per annum.

DISCUSSIONS

The prevalence of hydatidosis in cattle was found to be (10.9% n=42) during the study period in Jigjiga municipal abattoir. This is in agreement with the findings in Mizan Tepi (11.2%) by Jemere *et al.* [16] and in Dire Dawa (12.7%) by Daniel [17]. However, this result disagrees with the report of Tolosa *et al*. [18] of 34.0% prevalence in Bahir Dar town and 40.5% prevalence in Addis Ababa by Dechassa *et al*. [19]. A possible reason for the difference in the prevalence of hydatidosis in different areas including this study could be related to the source of cattle, dog population, dog management, deworming practices, offal disposal habits and the strain difference of *E.granulosus* that exists in different geographical situations [20].

In this study, an assessment was done on the relationship between different risk factors and cyst infection. Sex, age and body condition of the study animals were considered as risk factors. The current study showed that there was no statistically significant prevalence variation between animals of different sex groups even though higher prevalence rate was observed in females (14.5% n=8) than male animals (10.3% n=34). Similar finding was reported by Belina *et al*. [21]. The reason may be due to the small number of female animals (55 out of 384) slaughtered during the study period. The result also indicated that the rate of infection was higher in adult animals (13.5 n=27) than in young ones (8.1% n=15), but there was no significant difference ($P>0.05$) in the rate of infection between the different age groups. This is in agreement with the findings of Buzuayehu *et al*. [22]. However, animals having poor body condition score were found to have statistically significant ($P< 0.05$) higher cyst infection rate (25.4% n=18) than medium (7.8% n=17) and good body condition (7.4% n=7) scoring animals.

This finding is an agreement with the finding of Melaku *et al*. [23]. The reason for this is possibly that in moderate to severe infection, the parasite may cause retarded growth, reduced quality and yield of meat and milk as well as live weight loss [24].

In the current study, the lung was the most frequently affected body organ (35.7% n=25) followed by liver (28.6% n=20). This result is in line with the findings of Dawit *et al.* [25] who reported a prevalence of 63.8% and 33.22% in the lung and liver, respectively. This could be due to the fact that the liver and lung are the first large capillary fields encountered by the blood born onchosphere and the lung also has larger capillary bed than any other organ [26]. This may account for the observed higher prevalence of the cysts in the lungs than seen in other organs.

The laboratory findings of the hydatid cysts recorded during the study period indicated that a lower percentage of fertility (14.0% n=18) was identified out of the total cysts examined (129 cysts) and relatively higher percentage was found to be sterile (64.3% n=83) and calcified (21.7% n=28). This finding is in line with that of Melaku *et al.* [27] who reported a lower fertility (13.8%) and higher sterility (63.5%) and calcification (22.5%) percentages of bovine hydatid cysts in Dessie municipal abattoir, North-eastern Ethiopia. This result showed the importance of cattle in maintaining the parasite cycle in minimal level and it may imply that most of the cysts in cattle in the study area are infertile. The variation in fertility, sterility and calcification among the hydatid cysts may be related with the *E. granulosus* strain difference in the different geographical locations, the immune system of the host and other factors like deworming practices [15].

At organ level, more fertile (33.3%) cysts were found in the lung. This is in line with the finding of Buzuayehu *et al*. [22], who reported higher rate (60.5%) of fertile cysts in the lung. The reason for this may be the relatively soft consistency of the lung tissue which allows easier development of the cysts [28]. The greater prevalence and higher fertility of pulmonary cysts over cysts found in other organs of cattle indicated the importance of lung as potential source of infection to dogs. However, higher rate of calcified cysts (67.8%) were observed in the liver than in other organs. Similar findings by Nuraddis and Endalew [29] and Endrias *et al*. [30], were reported from Gondar and Ambo respectively. The reason for this could be attributed to the relatively higher reticuloendothetial cells and abundant connective tissue reaction of the organ [31].

This study revealed that the total annual economic loss due to bovine hydatidosis in Jigjiga municipal abattoir was 1,546,938 ETB per annum based on the local market prices in the study period. Different annual economic losses due to bovine hydatidosis were also reported from different parts of the country. For example, economic losses of 129,135.6 ETB and 70,422 ETB were reported in Adama and Mekele municipal abattoirs respectively [32]. The difference in the amount of economic loss in different areas could be due to the variation in the prevalence of the disease, retail market price of condemned organs and mean annual slaughter rate of cattle in different abattoirs.

CONCLUSION AND RECOMMENDATIONS

The study indicated that bovine hydatidosis is prevalent disease and causes considerable economic losses in and around Jigjiga city. Body condition of the study animals was found as a significant risk factor for hydatidosis infection in the study area. Even though large number of cysts in cattle were found sterile in this research, the presence of high number of viable cysts among the fertile cysts indicate that cattle are still an important intermediate host for bovine hydatidosis in the region. Therefore, appropriate control program involving proper disposal of condemned offal, regular deworming of dogs, prohibition of back yard slaughtering, control of stray dogs and raising awareness of the community about the disease should be designed and implemented.

ACKNOWLEDGEMENTS

The authors of this study would like to acknowledge all the Jigjiga municipal abattoir workers for their cooperation and kind support during the study.

REFERENCES

1. FAO, 2002. Food, Agriculture and Food security: the global dimension. FAO, Rome.
2. CSA, 2010. Central statistical agency agricultural sample survey. Rep. Livestock Char. 238: 20-24.
3. Bansal, G.C., 2005. Bovine theileriosis in India: an overview. In the Proceedings of the 2005 National Academy of Science, India.
4. Thompson, R.C.A. and P. Mc Manus, 2002. Etiology of parasites and life cycle, Lea and Tebiger Publishers.
5. Ahmedi, N.A. and M. Meshkehkar, 2011. An abattoir based study on the prevalence and economic losses due to cystic echinococcosis in slaughtered herbivores in Ahwaz, south-western Iran. J. Helminthol., 85: 33-39.

6. Alemu, B., K. Nigatu, T. Tariku, T. Getachew and K. Tesfu, 2013. Occurrences and financial significance of bovine cystic echinococcosis in Southern Wollo, Northeastern Ethiopia. J. Vet. Med. Anim. Healt., 5(2): 51-56.
7. Launta, A. and R.E. Habel, 2007. Applied veterinary anatomy, Lea and Tebiger Publishers.
8. CSA, 2012. Central statistical agency agricultural sample survey. Rep. Livestock Char., 240: 9-15.
9. ESRSLRDB, 2015 Ethiopian Somali Regional State Livestock and Rural Development Bureau. Rep. Livestock population. pp: 47.
10. Thrusfield, B.M., 2005. Veterinary epidemiology. Black well science Ltd, U.K.
11. Soulsby, E.J., 1982. *Helminthes, Arthropods* and *Protozoa* of domestic animals. Lea and Tebiger, Philadelphia, USA. pp: 98-111.
12. Smyth, J.D. and N.J. Barrett, 1980. Procedure of testing the viability of human hydatid cyst following surgical removal, especially after chemotherapy. Tropic. Med. and Hyg., 74: 649-652.
13. Ogunrinade, A.F.I. and B.I. Ogunrinade, 1980. Economic importance of bovine fasciolosis in Nigeria. Trop. Anim. Health Prod., 12(3): 155-160.
14. Polydorous, K., 1981. Animal health and economics case study: Echinococcosis with reference to Cyprus. Bull. Int. Epizoot., 93(5): 981-992.
15. ILC, 1979. International livestock center: Trypanotolerant livestock in West and Central Africa: General study. ILCA Monograph 2, ILCA, Addis Ababa, Ethiopia. pp: 1: 147.
16. Jemere, B., K. Wosenyelesh, S. Shishun and S. Desie, 2013. Prevalence and economic loss estimation of cystic echinococcosis in cattle slaughtered at Mizan Tefri and Teppi municipal abattoirs, South-Western Ethiopia. Eur. J. App. Sci., 5: 12-18.
17. Daniel, F., 1995. Economic importance of organ condemnation due to fasciolosis and hydatidosis in cattle and sheep slaughtered at Dire Dawa abattoir, DVM thesis, Addis Ababa University, Debre Zeit, Ethiopia.
18. Tolosa, T., W. Tigre, G. Teka and P. Dorny, 2009. Prevalence of bovine cysticercosis and hydatidosis in Jimma municipal abattoir, South West Ethiopia. J. Vet. Res., 76: 323-326.
19. Dechassa, T., K. Kibrusfaw, B. Desta and W. Anteneh, 2012. Prevalence and economic loss estimation of hydatidosis of cattle slaughtered at Addis Ababa abattoirs enterprise. J. Vet. Med. Anim. Healt., 4: 42-47.
20. Arene, F.O., 2013. Prevalence of hydatid cysts in domestic livestock in the Niger Delta. Tropic. Anim. Healt. Prod., 17: 3-5.
21. Belina, D., G. Fekadu, E. Zegaye and S.Belina, 2015. Bovine hydatidosis: Prevalence, public health and its economic significance in and around Harar, Ethiopia. J. Vet. Med. Anim. Healt., 7(1): 18-26.
22. Buzuayehu, L., A. Tsegalem, U. Befikadu, N. Ayalew and A. Abebe, 2014. Prevalence of bovine hydatidosis and its economic significance in Harar Municipality Abattoir, Eastern Ethiopia. Americ-Eur. J. Sci. Res., 9(5): 143-149.
23. Melaku, A., B. Lukas and B. Bogale, 2012. Cyst viability, organ distribution and financial losses due to hydatidosis in cattle slaughtered at Dessie municipal abattoir, North-eastern Ethiopia. Vet. World. 5(4): 213-218.
24. Eckert, J. and R. Thompson, 2011. Intraspecific variation of Echinococcus granulosus and related species with emphasis on their infectivity to humans. Acta Trop., 64: 19-34.
25. Dawit, G., A. Adem, K. Simenew and Z. Tilahun, 2013. Prevalence, cyst characterization and economic significance of bovine hydatidosis in Mekele municipal abattoir, Northern Ethiopia. J. Vet. Medi. Anim. Healt., 5(3): 81-86.
26. McManus, D.P., 2006. Molecular discrimination of Taeniid Cestodes. Parasitol. Inter., 55: 31-37.
27. McManus, D.P. and R.C. Thompson, 2003. Molecular epidemiology of cystic echinococcosis. Parasitol., 127: 37-51.
28. Mulatu, M., H. Mekonenen, T. Tassew and A. Kumar, 2013. Bovine hydatidosis in Eastern part of Ethiopia. Momo. Ethio. J. Sci., 5: 107-104.
29. Nuraddis, I. and D. Endalew, 2013. Prevalence and economic importance of hydatidosis in cattle slaughtered at North Gonder Elfora Abattoir, Gonder, Ethiopia. Eur. J. of App. Sci., 5(1): 29-35.
30. Endrias, Z., T. Yechale and M. Assefa, 2012. Bovine hydatidosis in Ambo municipality abattoir, West Shoa, Ethiopia. Ethio. Vet. J., 14(1): 114.
31. Gemmel, M.A. and JR. Lawson, 2011. Epidemiology and control of hydatid disease. Biology of Echinococcus and hydatid disease, Thompson RCA, George Allen and Unwin, London. pp: 189-216.
32. Getaw, A., D. Beyene, D. Ayana, B. Megersa and F. Abunna, 2010. Hydatidosis: Prevalence and its economic importance in ruminants slaughtered at Adama municipal abattoir, Central Oromia, Ethiopia. Acta Tropica. 113: 221-225.