

Full Length Research Paper

Bovine hydatidosis: Prevalence, public health and its economic significance in and around Harar, Ethiopia

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Both cross-sectional and retrospective studies were conducted from October, 2011 to June, 2012 in and around Harar to determine prevalence, public health and economic significance of bovine hydatidosis. Out of 384 cattle examined with thorough carcass inspection at Harar city municipal abattoir, 36 (9.4%) were found to be infected with hydatid cyst. Significant differences were found among adult and young, poor, medium and good body condition cattle. However, no significant differences were found between sexes. Infected cattle harbored one or more hydatid cysts that were unequally distributed to lung, liver, kidney and spleen. In this study, 27 (52.94%) fertile cysts were observed and the rate of cyst calcification was higher in kidney (50%) than in other visceral organs. The direct and indirect annual financial loss from organ condemnations and carcass weight loss at the abattoir was estimated to be about 841,419.3 ETB. The retrospective case-book survey (2008 to 2011) of hospitals, health centers and clinic were indicated to be 0.195% (n=98,349) prevalence of human hydatidosis. A questionnaire survey and interview were also supplemented to a society in and around Harar to assess public awareness on hydatidosis. For this, 600 individuals (500 for questionnaires and 100 for interviews) were included using stratified random sampling in which educational level and profession were considered for stratification. This questionnaire survey and interview were made giving emphasis to way of acquiring hydatidosis and the individuals' source of information about the disease as a zoonosis; the result showed schools and health extension workers were the leading information sources in the society. In conclusion, results of the present study showed bovine hydatidosis as an importantly producing great economic loss and public health hazardous at the study area. Therefore, public awareness creation, and appropriate control and prevention mechanisms in animal population should be done.

Key words: Abattoir, bovine, financial loss, hydatidosis, prevalence, public health, Harar, Ethiopia.

INTRODUCTION

In spite of large livestock population in Ethiopia, the productivity remains marginal due to many factors like

malnutrition, management problems, prevalent diseases, etc. Among these hydatidosis is one of the important

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parasitic disease of livestock that has both economic and public health significance (FAO, 1995). Hydatidosis (*Cystic Echinococcosis*) is a zoonotic disease caused by the larval stages of *Echinococcus granulosus* for which domestic intermediate hosts (cattle, sheep, goats and camels) are major reservoirs for the occurrence of human hydatidosis (Torgerson and Deplazes, 2009). Dogs are the obligate final host and infected by ingesting infected offals (lung, liver, kidney, spleen, etc). Human and wide varieties of other animals also serve as an accidental intermediate hosts for the parasite (Thompson and Mcmans, 2002).

Hydatidosis constitute public health problem worldwide, particularly it causes heavy burden in developing countries (Eckert and Deplazes, 2004; Chhabra and Singla, 2009). Its transmission is most intensive in livestock raising regions where veterinary service is unsatisfactory and offal from slaughtered animals is accessible to dogs. Cattle and other intermediate hosts contract hydatidosis by grazing on pastures contaminated with dog faeces that contain eggs of the cestode (Acha and Szyfres, 2003). Man is an intermediate host and Plays no role in the transmission of the hydatidosis, unless the individual is eaten by carnivores. Nevertheless, people's sanitary habits make human being the main agent responsible for perpetuating the infection by feeding dogs viscera that contain hydatid cysts (Jobre et al., 1996; Chai, 1995). The life cycle of this parasite is completed when organs containing hydatid cysts are consumed by dogs (Torgerson and Deplazes, 2009). Therefore, theoretically the infection would die out if man ceased re-infecting dogs by feeding them raw viscera (Chai, 1995). Close contact with dogs and deficient personal hygiene practices such as not washing hands and vegetables before eating, and water contaminated with infected dog faeces are important factors in the transmission of human infection. Coprophagic flies may also serve as mechanical vector for eggs of the cestode (Acha and Szyfres, 2003).

The larval stage of hydatid cyst is fluid filled bladder containing cellular laminated layer with internally nucleated germinal layer. If the scolices separate from the inner lining of the capsule they caused hydatid sand (OIE, 2001).

The pathogenesis of hydatidosis heavily depends on the extents and severity of infections and the organ on which it is situated. The occasional rupture of hydatid cysts often leads to sudden death due anaphylaxis, hemorrhage and metastasis (Jobre et al., 1996); hence, the disease is associated with severe morbidity and disability. The status of hydatidosis in animals has been studied in some regions of Ethiopia and indicated hydatidosis is widely spread with great economic and public health significance (Kebede et al., 2009a). Apart from animal population, the status of human hydatidosis is among the most neglected parasitic diseases. In general,

hydatidosis results in enormous economic loss in animal population with risk of public health hazards. Therefore, the main objectives of this study were to determine prevalence and financial losses of bovine hydatidosis at Harar city municipal abattoir and to elucidate public health significance of hydatidosis and assess public awareness on the disease in the study area.

MATERIALS AND METHODS

Study area

This study was conducted in and around Harar, the capital city of Harari regional state, Ethiopia. This area constitutes 76% mid-subtropical weather of "weynadega" and 24% desert type climate of "kola" (NMSA, 2011). During this study, in average 40 cattle were slaughtered per day at the Harar city abattoir. The abattoir was not provided with proper waste disposal system as even condemned abattoir materials were accessible to dogs.

Study design

Both cross sectional and retrospective studies supported with questionnaires and interviews were conducted.

Study population

Local breed of apparently healthy cattle of different body condition, sex and age groups coming from neighboring provinces of Harar were included in the study. Most of the study animals were males though females with reproductive problem, poor performance and end productive life were also encountered. Concerning public health aspect, questionnaires were distributed to individuals living in and around Harar.

Sample size determination and sampling method

Sample size was calculated by considering 50% expected prevalence at 95% confidence level and 5% precision (Thrusfield, 2005). Accordingly,

$$N = (1.96)^2 P_{exp}(1-P_{exp})/d^2 = 384.$$

Then these animals were included in the study using systematic random sampling method. 500 individuals filled the questionnaires and 100 were interviewed applying stratified random sampling, using educational level and profession for stratification. Case book survey was also conducted to determine retrospective prevalence of human hydatidosis in patients that had come to hospitals, health centers and public clinic in and around Harar.

Experimental

Ante-mortem inspection

During ante-mortem inspection, each of the study animals was given an identification number. Age, origin, sex and body condition scoring of the study animals were made. The body condition score

was classified into poor, medium and good categories (Heinonen, 1989). Young and adult age groups were encountered following their dentations.

Post mortem inspection

During post mortem examination organs especially liver, lung, spleens, kidney, heart, muscle and head part as a whole were systematically inspected for the presence of hydatid cyst by applying the routine meat inspection procedure of primary examination followed by secondary examination (Alula, 2010). The primary examination involves visualizations of the organs whereas secondary examination involves further incision of each organ into pieces and whenever evidence of the cyst was found, it was classified as live or calcified and the cyst distribution to organs was also recorded.

Fertility and viability tests

Positive or suspected samples were taken to the laboratory for the cyst identification, fertility and viability tests were performed. Of the collected hydatid cysts, individual cysts were carefully incised and examined for protoscoleces, which are similar to the appearance of white dots on the germinal epithelium (Figure 1); such cysts were characterized as fertile cysts; fertile cysts were subjected to viability test. A drop of the sediment containing the protoscoleces was placed on the microscopic glass slide and covered with a cover slip and observed for amoeboid like peristaltic movements. For clear vision, a drop of 0.1% aqueous eosin solution was added to equal volume of protoscoleces in hydatid fluid on the microscopic slide with the principle that viable protoscoleces should completely or partially exclude the dye while the dead ones took it up. Furthermore, infertile cysts were further classified as sterile or calcified (Soulsby, 1982) (Table 2).

Estimated financial loss

Losses due to organ condemnation was calculated by considering information on the retail market price of condemned organs (Ogunirale and Ogunrinade, 1980), obtained from butcher shops of Harar city during the study period. The average annual slaughter rate of cattle at the abattoir was estimated from the retrospective data of the last two years. In line with this:

$$LOS = MAK \times PH [(P_1 C_1) + (P_2 C_2) + (P_3 C_3) + (P_4 C_4)]$$

where LOS = loss due to organ condemnation, MAK = annual average number of cattle slaughtered at Harar city municipal abattoir, PH = prevalence of hydatidosis, P_{1-4} = prevalence of each organ condemned, C_{1-4} = main retail cost of single organs condemned.

The financial loss encountered from carcass weight losses was also calculated by considering retail market cost of 1 kg beef at Harar city, and 5% carcass weight loss due to hydatidosis was considered as described by Polydrous (1981). Accordingly,

$$LCWL = MAK \times PH \times CPB \times 5\% \times 126 \text{ kg,}$$

where LCWL = loss from carcass weight loss, NAS = average number of cattle slaughtered annually, CPB = current average price of 1 kg beef, 126 kg = average carcass weight dressing percentage of an adult zebu cattle. The total annual financial loss was the sum of losses from organ condemned and carcass weight lost.

Questionnaire and retrospective studies

Evaluation on public awareness about hydatidosis was done through well designed interview and questionnaires. Stratified random sampling method was considered based on educational level and profession. Accordingly, designed questionnaires were supplemented to 500 selected people of whom 200 were elementary and high school students, 100 were university and college students, 50 were health professionals and 150 non health professionals of different departments. In addition, 20 health and 20 non health professionals, 10 veterinarians and 50 illiterate local people were interviewed about their custom of consuming backyard slaughtered beef, drinking surface water, washing vegetables and their hands before meal, attitude of offering dogs raw viscera and their close contact with stray dogs in their social activity. Mass media, schools they attended and have been attending, health extension workers and other informal sources (including family, religious leader advises, etc.) were also filled in questionnaires and interviewed as a source of information about hydatidosis for individuals.

Retrospective cystic echinococcus cases from the total ultrasound admitted patients during January, 2008 to December, 2011 in hospitals and cases registered as hydatidosis at health centers and clinic in and around Harar were collected from the institutions case book reports.

Data management and analysis

The information or data about bovine hydatidosis was collected and later entered in to Microsoft excel 2010 spreadsheet and analyzed using SPSS statistical software version 20. Prevalence data were analyzed by chi-square, and descriptive statistics were also used. $P \leq 0.05$ was considered as statistically significant at 95% CI.

RESULTS

Prevalences

The present study showed 9.4% (n=384) bovine hydatidosis at Harar city municipal abattoir. There was a significant difference in the harboring of hydatid cyst between age groups and body condition scores. The prevalence was significantly higher in adult and poor body condition than in young, and medium, good body condition cattle ($p < 0.05$). However, there was no significant difference between sexes ($p > 0.05$) (Table 1).

Among the infected organs, the highest prevalence was found in liver and followed by lung, which accounted for 56.86 and 27.45%, respectively. The rate of cyst calcification was by far higher in kidney (50%) than in other visceral organs, the least calcification rate (20.69%) was encountered in liver.

Financial loss assessment

Cystic echinococcus financial loss assessment was made based on the direct and indirect losses. The direct loss was losses due to condemnation of the offals like lung,

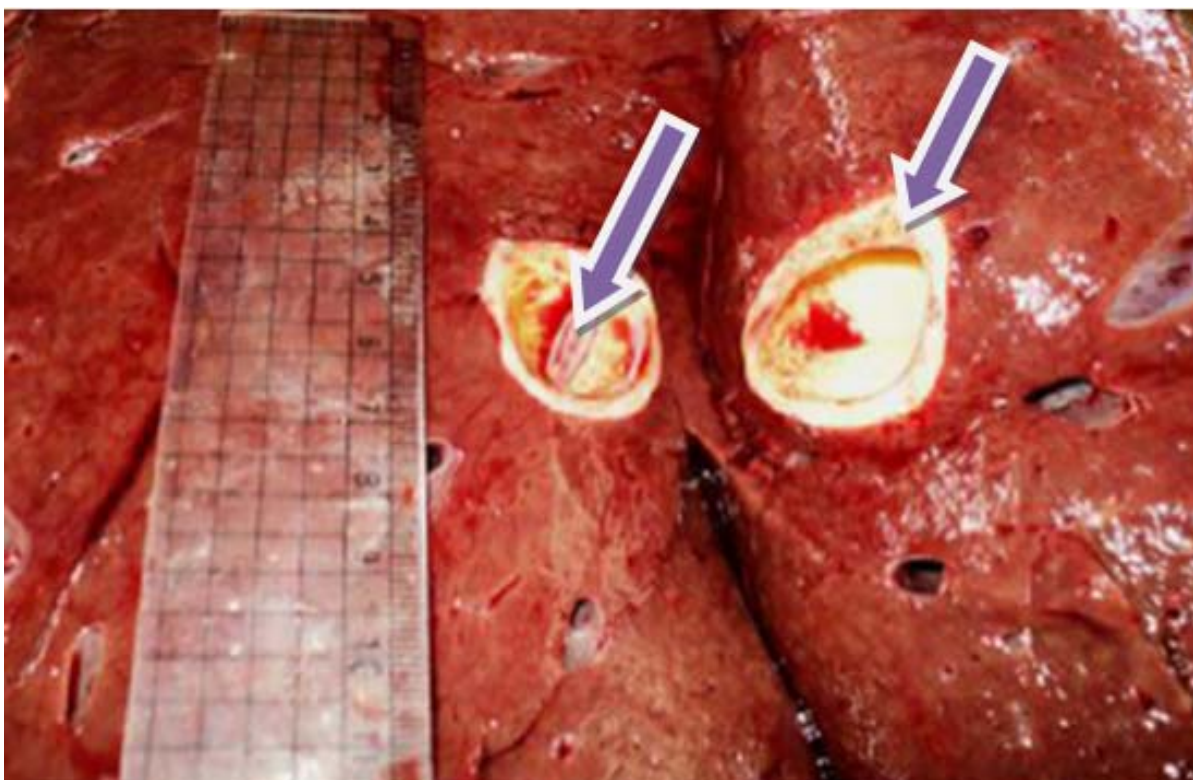


Figure 1. Cattle liver with cross section of hydatid cyst.

Table 1. Prevalence of bovine hydatidosis by sex, age and body condition score at Harar city municipal abattoir.

Variable	Levels	No. examined	No. positive (%)	P value
Sex	Male	292	30 (10.28)	0.061
	Female	92	6 (6.52)	
Age	Young	161	9 (5.60)	0.042
	Adult	223	27 (12.11)	
Body condition score	Poor	94	20 (21.28)	0.012
	Medium	25	2 (8.00)	
	Good	265	14 (5.28)	
-	Total	384	36 (9.40)	-

spleen, liver and kidney, whereas carcass weight loss due to hydatid cyst is indirect loss. The retail market price of different edible offals' and 1 kg beef in Harar city were considered as a parameter for this calculation (Table 3).

Therefore, by applying the formula of Ogunirale and Ogunrinade (1980) and Polydrous (1981), the annual financial loss due to bovine hydatidosis at the study area

could be as followed.

Direct loss (DL)

$$\text{LOS} = \text{MAK} \times \text{PH} [(P_1C_1) + (P_2C_2) + (P_3C_3) + (P_4C_4)] = (10950 \times 9.4\%) [(7.84\% \times 5) + (27.45\% \times 45) + (56.86\% \times 85)]$$

Table 2. The distribution and conditions of hydatid cysts in different organs of cattle slaughtered at Harar city municipal abattoir.

Organ	Hydatid cyst condition (%)			total cysts
	Fertile	Sterile	Calcified	
Lung	9 (64.29)	2 (14.29)	3 (21.43)	14 (27.45)
Liver	14 (48.28)	9 (31.03)	6 (20.69)	29 (56.86)
Spleen	3 (75.00)	0	1 (25.00)	4 (7.84)
Kidney	1 (25.00)	1 (25.00)	2 (50.00)	4 (7.84)
Total	27 (52.94)	12 (23.53)	12 (23.53)	51 (100)

Table 3. Retail market price of different organs and carcass at butcher shops in Harar city.

Organ	Retail market price (ETB)
Lung	45
Liver	85
Spleen	5
Kidney	15
1 kg beef	120

$$+ (7.84\% \times 15)]$$

$$= 63268.50\text{ETB}$$

Indirect loss (IL)

$$\text{LCWL} = \text{MAK} \times \text{PH} \times \text{CPB} \times 5\% \times 126 \text{ kg}$$

$$= 126 \times 5\% \times 10950 \times 9.4\% \times 120$$

$$= 778150.8 \text{ ETB}$$

Total financial loss (TFL)

$$\text{TEL} = \text{DL} + \text{IL}$$

$$= 63268.50 + 778150.8$$

$$= 841,419.3 \text{ ETB; about } \sim \$46,745.5$$

Questionnaire and retrospective studies

Results of questionnaire and interview showed that 74.3 and 48.8% of the participants got information about way of acquiring hydatidosis from schools and health extension workers, respectively (Table 4). On the other hand, about 38.0% of the participants had direct contact with stray dogs in their daily activities. The results also indicated only 84.7% of our study population washed their hands and vegetables before they eat it (Table 5).

Case book analysis showed that out of 98,349 total patients admitted for ultrasound and clinical examinations

at hospitals, health centers and clinic in and around Harar, 192 (0.195%) individuals were registered as positive cases for hydatidosis. There were prevalence variations among the institutions and the highest prevalence (0.5%) was found at Abdi Boru clinic (Table 6).

DISCUSSION

The present 9.4% prevalence of bovine hydatidosis at Harar city municipal abattoir was in agreement with the report of 9.38% (Wubet, 1987), from Hararge region; however, this prevalence was less than the findings of 37.7% (Roman, 1987), 34.05 and 15% (Kebede et al., 2009b; Belina et al., 2012), and 32.1% (Berhe, 2009), from Gonder, Bahir Dar and Mekele, respectively. Relatively lower prevalence in current study may be due to adverse conditions of high temperature and low humidity encountered at the origin of animals on survival of *E. granulosus* egg (Thompson and Allsopp, 1988), as majority of the study animals came from low land areas. The prevalence variations with geographical regions may also have some connection with cultural and religious taboos such as backyard slaughtering of animals, attitudes in offering uncooked infected offal to pet animals, close contact with stray dogs in social activities and in general poor public awareness about the hydatidosis. Njoroge et al. (2002) explained environmental conditions, livestock stocking intensity and

Table 4. Sources of information in way of acquiring hydatidosis by study participants in and around Harar.

Strata	Mass media	Electronic media	Schools	Health extension	Others
Elementary and high school students (n=200)	46 (23.0)	21 (10.5)	164 (82.0)	149 (74.5)	59 (31.0)
University and College Students (n =100)	57 (57.0)	44 (44.0)	96 (96.0)	36 (36.0)	41 (74.0)
Health Professionals (n=70)	32 (45.7)	5 (7.1)	67 (95.7)	0 (0)	15 (21.4)
Non health profess (n =170)	96 (56.5)	12 (7.0)	109 (64.1)	64 (37.6)	85 (50)
Veterinarians (n =10)	2 (20.0)	0 (0)	10 (100)	1 (10)	0 (0)
Illiterate local people (n =50)	2 (4.0)	0 (0)	-	43 (86.0)	14 (34.0)
Total (N= 600)	235 (39.2)	82 (13.7)	446 (74.3)	293 (48.8)	214 (35.7)

Table 5. Knowledge of the study participants on way of acquiring hydatidosis in and around Harar.

Strata	Eat backyard slaughtered beef	Close contact with stray dogs	Feed dogs raw viscera	Wash vegetables and their hands before eat	Drink surface water
Elementary and high school student	74 (37.0)	83 (41.5)	61 (30.5)	168 (84.0)	42 (21.0)
University and college students	36 (36.0)	67 (67.0)	69 (69.0)	88 (88.0)	9 (9.0)
Health professionals	14 (20.0)	7 (10.0)	9 (12.9)	60 (85.7)	0 (0)
Non health professionals	36 (21.2)	42 (24.7)	37 (21.8)	163 (95.9)	9 (5.3)
Veterinarians	1 (10.0)	2 (20.0)	0 (0)	10 (100)	3 (30.0)
Illiterate local people	38 (76.0)	27 (54.0)	32 (64.0)	19 (38.0)	35 (70.0)
Total	199 (33.2)	228 (38.0)	208 (34.7)	508 (84.7)	98 (16.3)

movement in different regions contribute to the prevalence differences. Attributing to the work of Belina et al. (2012), our current study indicated there was no significant difference ($p>0.05$) between sex groups, though higher prevalence was found in male animals. This may be due to small number of female animals slaughtered at the abattoir during our study. Females were kept for breeding, hence only females with reproductive problem, poor performance and end productive life were slaughtered at the abattoir. However, significant ($P=0.01$) higher prevalence was found in animals with poor body condition score which probably reflected the effect of relatively high cyst burden. According to Polydrous (1981) and Battelli (1997), moderate to severe infection of the parasite leads to live weight loss, retarded performance and growth with reduced quality of meat and milk. Our finding also showed there was a significant difference between age groups ($p<0.05$) in harboring hydatid cyst. Majority of the studied animals were adult and hence, they were exposed to the disease (parasitic ova) over a long period of time with an increased possibility of acquiring the infections than younger ones. It has been stated that the easier development and the fertility rate of hydatid cysts may show the tendency to increase with advancing age of the hosts (Himonas et al., 1987). In the present study, the highest cyst frequency was observed in liver and

followed by lung which is in agreement with report of Belina et al. (2012). This is explained by the fact that livers and lung possess the first greater capillary sites encountered by the migrating *E. granulosus* oncosphere (hexacanth embryo) which adopt the portal vein route and primarily negotiate hepatic and pulmonary filtering system sequentially before any other peripheral organ is involved (Alula, 2010).

The annual financial loss of 841,419.3 ETB, in our study due to bovine hydatidosis from offal condemnation and carcass weight loss was greater than the findings of Yilma (1984), 813,526.46, Wubet (1987), 64,920.00 and Kebede et al. (2009a), 25,608.00 ETB from Debrezeit abattoir, Hararge zone, and Tigray region, respectively; however, by far lower than the report of Regassa et al. (2010), 1791625.89 ETB from Hawassa municipal abattoir. According to Alula (2010), the financial loss varied from region to region and even from abattoir to abattoir based on the prevalence of hydatidosis, mean annual number of cattle slaughtered at different abattoirs and the retail market price of organs.

The results of the questionnaire and interview showed that 74.3% of the participants got information about way of acquiring hydatidosis from schools. Information from school was the leading one in this study. However, Sisay et al. (2012) reported that majority of the elementary and high school students get information about zoonotic

Table 6. Prevalence of human *Echinococcus* cases at hospitals, health centers and clinic in and around Harar (January 2008 - December 2011).

		Cases	44 (0.23)	67 (.25)	32 (0.14)	49 (0.16)	192 (0.2)
Sub-total (%)		Visited	19435	26243	22796	29875	98349
clinic	Abdi boru (%)	Cases	15 (0.53)	13 (0.52)	6 (0.21)	12 (0.61)	46 (0.5)
		Visited	2852	2498	2903	1958	10211
Health center	Adelle (%)	Cases	10 (0.37)	18 (0.63)	8 (0.28)	11 (0.04)	47 (0.4)
		Visited	2716	3628	2876	2724	11944
	Haramaya (%)	Cases	9 (0.30)	17 (0.58)	12 (0.29)	14 (0.04)	52 (0.4)
		Visited	3016	2927	4139	3481	13563
Hospital	Jugol (%)	Cases	6 (0.12)	12 (0.15)	4 (0.07)	7 (0.07)	29 (0.1)
		Visited	4820	8016	6016	10282	29134
	Hiwot Fena (%)	Cases	4 (0.07)	7 (0.08)	2 (0.03)	5 (0.04)	18 (0.05)
		Visited	6031	9174	6862	11430	33497
Years			2008	2009	2010	2011	Total

Visited: Number of patients who visited the hospital/health center/clinic; Cases: number of patients who diagnosed as positive for hydatidosis.

diseases from their families in the form of advice, though most health professionals get their information from medical schools they attended. On the other hand, 48.8% of our participants got information about way of acquiring hydatidosis from health extension workers. Health extension workers have high chance of getting all social classes from all corners and they have been working on zoonosis and communicable disease (working on prevention) is their main objective, as Ethiopian government has been working with the principle of at least one health extension worker to one kebele/PA. Furthermore, the most important social classes (86% of illiterate local people) got information about way of acquiring hydatidosis from health extension workers. The study also showed that none of the illiterate local people got information about the disease from media and schools.

Contact with stray dog, not washing vegetables and their hands before eating are important way of acquiring hydatidosis (Ketema, 2010). However, in the present study, 38% of the participants had close contact with stray dogs in their social activities, and only 84.7% of the study population washed their hands and vegetables before they ate. Supporting this study, Tamiru et al. (2008) and Avery (2004) reported in their previous study, that eating uninspected backyard slaughtered raw meat had been considered as risk factor for hydatidosis. This could be due to the low level of awareness of the people on the importance of using inspected meat, because of cultural beliefs that raw meat is better than cooked one and the deeply established traditional habit of eating raw meat in the country (Sisay et al., 2012). About 69% of the

university and college students, 64% of illiterate local people and even 12.9% health professionals support feeding dogs raw viscera unlike veterinarians. None of the veterinarians were in favor of cultural beliefs and traditional habit of offering uncooked infected offal to dogs. Veterinarians possess better knowledge on animal diseases and food productions, as well as training in ecological, economic and human cultural issues, make them the leaders in developing and implementing new methods of promoting sustainable public health (King and Khabbaz, 2003). Sisay et al. (2012) also stated, besides educating health professionals and directors of public health, it is important to increase the involvement of veterinarians in public health improvement.

Retrospective case book analysis of patients admitted for ultrasound and clinical examinations at hospitals, health centers and clinic in and around Harar showed 0.195% (192/98,349) human hydatidosis. This prevalence was higher than the report of 0.044% (Belina et al., 2012) from Bahir Dar. The higher current prevalence might be because of the low public awareness, backyard slaughtering practices, poor control measures and presence of a large number of stray dogs that contributed to human infection. In addition to this, our study area lacks modern diagnostic facilities, and there was inability to offer treatment by the most vulnerable sections of the society. However, 1.6 and 0.5% human hydatidosis were also screened with ultrasound from southern part of Ethiopia in 1987 and 1996, respectively (Eckert et al., 2002). Battelli (2003) also reported 0.22% human cases from Portugal.

In conclusion, the present study showed 9.4% prevalence of bovine hydatidosis with significant estimated financial loss in and around Harar. Body condition score and age groups cattle were statistically risky factors unlike sexes in the study area. The result also showed liver was the most frequently affected organ and cyst calcification was by far higher in kidney among other examined organs. In average, about 841,419.3 ETB financial losses were encountered in the current study. 0.195% human hydatidosis was recorded from retrospective hospitals, health centers and clinic case book analysis that hydatidosis is an important zoonotic disease. The results of the questionnaire and interview data showed that majority of the participants got information about way of acquiring hydatidosis from schools and health extension workers. In addition, people in and around Harar do not have enough knowledge about way of acquiring hydatidosis where majority of the people were accustomed to consuming backyard slaughtered beef and even offering infected raw offals to dogs. Therefore, based on this study, we recommended that effective control and prevention mechanisms in animal population should be done and stray dogs have to be restricted; there must be legislation that will strictly prevent backyard slaughtering practice, and public health veterinarians should work with medical professionals and reach the rural areas; schools and other public institutions have to teach society at large, and lastly creation of public awareness about hydatidosis as zoonosis and the present works of health extension workers in Ethiopia should be encouraged and further expanded.

Conflict of interest

The authors declare that there is no conflict of interest.

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