

# Echinococcosis/hydatidosis: its prevalence, economic and public health significance in Tigray region, North Ethiopia

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**Abstract** A cross sectional study was carried out to assess the prevalence, economic and public health significance of echinococcosis/hydatidosis in Tigray Regional State, north Ethiopia. Out of 18 stray dogs euthanized and examined, three of them were found harboring the adult parasite *Echinococcus granulosus* in their small intestine. From 5,194 cattle examined at slaughter houses, 1146 (22.1%) of them were found harboring hydatid cyst. The majority of the infected cattle had hydatid cyst in both liver and lungs. The hydatid cyst infection in the lung, liver, kidney, heart and spleen were found to be 13%, 8.1%, 0.5%, 0.4%, and 0.1%, respectively. The estimated total annual loss from bovine hydatidosis due to offal condemnation (lungs and liver) and carcass weight loss was 25,608 Ethiopian (Eth.) Birr. The present human hydatidosis survey conducted in all six zonal hospitals of Tigray Regional State disclosed one active clinical case in Mekelle hospital during the study period. While, the retrospective data analyses of the six zonal hospitals

indicated that eight cases of human hydatidosis were diagnosed since 2000. Thus echinococcosis/hydatidosis is considerably prevalent disease in cattle and it is a serious public health concern in Tigray region.

**Keywords** Echinococcosis/hydatidosis · Economic/public significance · Prevalence · Tigray region · Ethiopia

## Introduction

The world human population is growing at a rate much faster than food production and this increase is mainly in developing countries, which are unable to assure adequate food for their people. Developing countries have nearly 2/3 of the world's livestock population, but produce less than a third of the world's meat and a fifth of its milk (ILRI/FAO 1995). Similarly, in spite of large livestock population in Ethiopia, the productivity remains marginal due mainly to malnutrition, prevalent diseases and management problems.

Hydatidosis is one of the important parasitic diseases of livestock that has both economic and public health significance. It is associated with severe morbidity and disability, and is one of the world's most geographically widespread zoonotic diseases. The pathogenicity of hydatidosis heavily depends on the extent and severity of infection, and the organ on which it is situated. The occasional rupture of hydatid

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cysts often leads to sudden death due to anaphylaxis, hemorrhage and metastasis. Previous studies have shown that cystic echinococcosis represented a considerable economic and public health significance in different countries (Jobre et al. 1996; Azlaf and Dakkak 2006; Elshazly et al. 2007; Christodoulou et al. 2008; Sissay et al. 2008).

The total cattle population in Tigray region is estimated to be more than three millions. One of the major parasitic as well as zoonotic diseases prevailing in the region is echinococcosis/hydatidosis occurring both in domestic animals causing huge organ loses due to condemnation and humans. Therefore, knowledge on the epidemiology and extent of echinococcus/hydatidosis infection both in human and domestic and wild animal population would be of prime importance in targeting an effective control scheme in the country. This study is, therefore, aimed at assessing the prevalence of hydatidosis in cattle; investigate the occurrence of hydatidosis among human population and to recommend relevant control options against echinococcosis/hydatidosis in line with the prevailing situation in the Tigray region.

## Materials and methods

### Study area

The present study was conducted in all six zones of Tigray Regional State, north Ethiopia namely: Mekelle, Adigrat, Axum, Humera, Maichew, and Shire. The study areas have altitude ranging from 1400 to 2500 meters above sea level. The maximum and minimum annual rainfalls of the region are 1200 mm and 500 mm, respectively. The human population of the region is 3.5 million, while the annual temperature ranges from 20 °C–40 °C. The laboratory work was done at the Mekelle Regional Veterinary Laboratory and Mekelle University Faculty of Veterinary Medicine laboratory.

### Study animals

A total of 5,194 viscera (2389, 959, 248, 463, 403, and 732 from Mekelle, Adigrat, Axum, Humera, Maichew, and Shire zones, respectively) of slaughtered indigenous cattle were inspected and examined from all the six zones of Tigray Regional State. Moreover, 18 stray

dogs from Mekelle town were euthanized and examined for the presence of the adult parasite *Echinococcus granulosus*.

### Study design

The study design employed was a cross sectional type with the objectives of determining the prevalence, economic and public health significance of echinococcosis/hydatidosis in the study areas. After slaughter, the different visceral organs of cattle including liver, lungs, kidneys, heart, and spleen were carefully examined by inspection, palpation and incision for the presence of hydatid cysts. The observed non-calcified hydatid cysts were arbitrarily classified into large, medium, and small based on their size. About 90% of the study cattle were males. The age was determined based on visual observation of teeth and information obtained from the owners and all the study cattle had age greater than five years. Although it was difficult to precisely trace back the geographical origins of all animals' slaughtered, approximately 90% of the cattle were originated from the Tigray Regional State.

Representative hydatid cyst specimens were randomly selected and were subjected to cyst fertility and viability study. For the fertility test, the selected individual cysts were carefully incised and opened, the content poured into clean glass petridish, and examined under a microscope (X40) 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 with in the suspension, the cyst was categorized as fertile. Then the fertile cysts were further subjected for viability test according to the procedures described by Dalimi et al. (2002).

The stray dogs were euthanized using strychnine baits and then immediately transported to Mekelle Regional Veterinary Laboratory for detail postmortem examination of the small intestine. After taking out the first half meters of small intestine, both ends were tied and then longitudinal incision was made to open it. Then the part of the small intestine was washed and scrapping of the mucosa was undertaken in a tray containing 1% saline solution. The suspension was transferred to conical flask to allow gravitational sedimentation. The supernatant discarded and replaced with 1% saline solution and this procedure was repeated until clear sediment was obtained. Then the

sediment was examined against a black background for contrast and easy identification of the adult parasite *Echinococcus granulosus* (Jobre et al. 1996).

A structured questionnaire survey was used to assess the significance of hydatidosis among human populations in all the six zones of Tigray Regional State. In the questionnaire survey a total of 138 randomly selected health professionals from the zonal hospitals were interviewed. Moreover, the zonal hospitals data records were analyzed retrospectively.

#### Data management

The annual economic losses due to organ condemnation in the study areas was estimated by considering the following current price of the respective organs at Mekelle town in Tigray Regional State: Liver (42 Eth. Birr) and lung (8 Eth. Birr). The annual average cattle slaughtering rate of the abattoir was calculated from the abattoir records, and the average price of indigenous cattle and 1 kg beef was obtained from the local market.

A 5% carcass weight loss due to cystic echinococcosis was used for determining the carcass weight loss. Annual loss due to liver, and lung condemnation and carcass weight loss due to cystic echinococcosis was estimated using the following formula (Jobre et al. 1996):

$$(P3*P1*C1*AS1) + (P3*P2*C2*AS1) \\ + (P3*C3*AS1*AS2)$$

Where:

- P3 the mean prevalence of hydatidosis
- C1 the mean retail price of a bovine lung
- AS1 estimated annual cattle slaughter rate
- AS2 carcass weight loss due to hydatidosis
- P1 percent involvement of lung
- C2 the mean retail price of a bovine liver
- P2 percent involvement of liver
- C3 the mean retail price of a kilo of beef

#### Results

The abattoir based cystic echinococcosis survey in the intermediate host (cattle) revealed that 1146 (22.1%) of the total 5,194 cattle viscera examined had hydatid cyst. In the current study, lungs were the most frequently infected (13%) followed by liver (8.1%) (Tables 1 and 2). From the total of 4083 hydatid cysts encountered in all six zonal abattoirs of Tigray Regional State, 883 (21.6%), 847 (20.7%), 2165 (53%), 188 (4.6%) were large, medium, small and calcified cysts, respectively (Table 3). From the total 509 hydatid cysts randomly selected and examined for fertility, 243 (47.7%), 141 (27.7%), 125 (24.6%) were sterile, fertile and calcified cysts, respectively (Table 3). The estimated total annual loss from bovine hydatidosis due to offal condemnation (lung and liver) and carcass weight loss in the study areas was 25, 608 Eth. Birr (1 USD=9.12 Eth. Birr).

**Table 1** Prevalence and distribution of hydatid cysts in slaughtered cattle in Tigray Regional State, north Ethiopia

Slaughter house	No. of cattle examined	Slaughtered cattle Positive for hydatidosis		Organ involvement with hydatid cyst					
				Liver		Lung		Heart	
		No.	%	No.	%	No.	%	No.	%
Mekelle	2389	761	31.9	253	10.6	471	19.7	6	0.3
Adigrat	959	195	20.3	42	4.4	147	15.3	6	0.6
Axum	248	41	16.5	31	12.5	10	4	–	–
Humera	463	54	11.7	35	7.6	17	3.7	2	0.4
Maichew	403	40	9.9	40	9.9	–	–	–	–
Shire	732	55	7.5	18	2.5	30	4.1	7	1
Total	5,194	1146	22.1	419	8.1	675	13	21	0.4

\*In addition four spleen and 27 kidneys from Mekele slaughter house were found to be infected with hydatid cysts.

**Table 2** Description of the encountered hydatid cysts in cattle from six zonal slaughter houses of Tigray Regional State, north Ethiopia

Cyst type	Liver	Lung	kidney	Heart	Spleen	Total
Large: No. (%)	141 (13.8)	718 (24)	16 (59.2)	6 (18.8)	2 (50)	883 (21.6)
Medium: No. (%)	185 (18.1)	637 (21.3)	11 (40.7)	14 (43.6)	–	847 (20.7)
Small: No. (%)	661 (64.5)	1490 (49.7)	–	12 (37.5)	2 (50)	2165 (53)
Calcified: No. (%)	38 (3.7)	150 (5)	–	–	–	188 (4.6)
Total	1025	2995	27	32	4	4083

The current echinococcosis survey in the definitive host (dogs) conducted in different sites of Mekelle, the capital of the Tigray Regional State revealed the occurrence of the adult parasite *Echinococcus granulosus* in the small intestines of three (16.7%) out of 18 dogs examined.

The present human hydatidosis survey conducted in all six zonal hospitals of Tigray Regional State disclosed the occurrence of one clinical case in Mekelle hospital during the study period. This active clinical case was diagnosed in the liver of 67 years old woman in February, 2008. The origin of this patient was from Asti district about 38 Km away from Mekelle, the capital of Tigray region. Moreover, the retrospective hospital record analyses revealed that eight cases of human hydatidosis in three (Axum, Maichew and Mekelle) zonal hospitals since 2000. The age range of those eight human cases of hydatidosis diagnosed was between 33 and 67 years and both sexes were involved equally (Table 4).

Based on the retrospective hospital record analysis and interviews made with physicians in the respective zonal hospitals, most of the human hydatid cyst cases were from Astibi district (Astibi town) about 38 Km from Mekelle. Furthermore, the questionnaire survey carried out in Astibi district mainly to veterinary professionals, butchers and other residences of the

town, disclosed that the district is highly populated with sheep. Most of the population in Astibi district was observed to keep dogs and sheep living together. The dogs and sheep were seen in a close proximity even at grazing, watering and shelter places. In Astibi town where there is a small scale slaughter house, most people rarely use the slaughter house to kill their animals. Moreover, it is a common practice to see sheep and cattle slaughtered in backyard system in residential houses and at the grazing field. In addition, the disposal of infected organs was not done properly, where such organs were left to dogs.

## Discussion

The present cross sectional study, which was conducted in six zones of Tigray Region to assess the prevalence of bovine hydatidosis, indicated that the prevalence to be 29.8% in Mekelle, 20.3% in Adigrat, 16.5% in Axum, 11.7% in Humera, 9.9% in Maichew and 7.5% in Shire. Comparable findings of bovine hydatidosis were reported in other African countries (23% in Morocco – Azlaf and Dakkak 2006 and 16.4% in western Iran – Dalimi et al. 2002).

Generally such variation (ranging from 7.5% to 29.8%) in prevalence of bovine hydatidosis recorded

**Table 3** Fertility status of of hydatid cysts encountered in cattle in Mekelle slaughter house in Tigray Regional State, north Ethiopia

Organ	No. of cysts examined	Cyst condition				
		Fertile			Sterile No. (%)	Calcified No. (%)
		Motile No. (%)	Non-motile No. (%)	Total No. (%)		
Lung	392	74 (18.9)	26 (6.6)	100 (25.5)	200 (51.0)	92 (23.5)
Liver	113	23 (20.4)	17 (15.0)	40 (35.4)	40 (35.4)	33 (29.2)
Kidney	3	–	1 (33.3)	1 (33.3)	2 (66.7)	–
Heart	1	–	–	–	1(100)	–
Total	509	97 (19.1)	44 (8.6)	141 (27.7)	243 (47.7)	125 (24.6)

**Table 4** Description of human cases of hydatidosis diagnosed from 2000 to 2008 in Tigray Regional State, north Ethiopia

Case No.	Year	Age	Sex	Hospital	Treatment employed
020338	2000	48	F	Mekelle	Surgical removal
018356	2001	33	F	Mekelle	Surgical removal
048095	2007	53	M	Mekelle	Surgical removal
049267	2008	67	F	Mekelle	Surgical removal
049361	2000	58	F	Mekelle	Albendazole
049478	2000	45	M	Mekelle	Albendazole
003897	2004	45	M	Axum	Surgical removal
076897	2005	51	F	Axum	Albendazole
58694	2000	50	M	Maichew	Surgical removal

in all six zones of Tigray region might be due to the fact that difference in agro-climatic locations of the study sites and livestock management. In the present study the overall prevalence of hydatidosis was found to be relatively higher possibly attributed to the age of the slaughtered animals. Most of the slaughtered animals were old with high chance of exposure to the disease (parasitic ova) over a long period of time with an increased possibility of acquiring the infections. Some previous studies conducted strongly suggest that the prevalence of bovine hydatidosis is heavily influenced by age (Lahmar et al. 2001). In almost all parts of Tigray region there is an evident cultural taboo which favors the keeping of dogs in close association with their family and farm animals. Apart from this, the higher number of stray dogs and practice of backyard slaughtering are the main incriminated factors for the wide occurrence of hydatidosis in the study area.

The underlying reasons why the backyard slaughtering is common in Tigray region include: the existing abattoirs are functioning totally under capacity where there is lack of basic equipment and insufficient water and electricity supply. As a result of this most of the butcheries were noted to slaughter their animals in backyards and roadsides. The wide spread tradition of offering uncooked infected offal's to dogs and cats around homestead, poor public awareness about the disease including professionals from study zonal hospitals and the habit of improper disposing of dead wild or domestic animals, unburied and left open for scavenging carnivores creates favorable condition for environmental contamination by maintaining the life cycle of echinococcosis in stray dogs.

In the present study animals with poor body condition were found to have higher hydatid cyst counts. The poor condition in such animals is

probably a reflection of the effect of relatively high cyst burden. Moderate to severe infection the parasite may cause retarded performance and growth, reduced quality of meat and milk as well as live weight (Battli 1997). The present study also disclosed that hydatid cysts occur predominantly in the lung and liver and occasionally in heart, kidney and spleen. Most of the infected cattle (66.7%) had hydatid cysts both in the liver and in the lungs as reported also by Giannetto et al. (2004) in Sicily and by Azlaf and Dakkak (2006) in Morocco. This is explained by the fact that lungs and livers possess the first great capillaries sites encountered by the migrating echinococcus 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. In addition, the lungs were predominantly infected with hydatid cyst than any other organ probably due to the presence of greater capillary beds in the lungs than other organs.

Most of the human cases of hydatid cysts were originated from Atsibi district that were admitted and treated in the Mekelle hospital. The possible factors that attribute for the occurrence of human hydatidosis in Astibi district include that most of the residences of Astibi district keep dogs and sheep together and there is a close contact between humans and animals particularly with dogs. Moreover, in Atsibi District there is only one small scale slaughter house and butchers are rarely using this small scale slaughter house. It is also a common practice to see sheep slaughtered in residential houses and at the grazing field. Moreover, the disposals of affected organs or offal's are not done properly, where most of the time routinely left to dogs.

The questionnaire survey conducted to assess the public health significance of hydatidosis indicated

that the awareness of most of the physicians working in zonal hospitals to human hydatidosis was very little. In some of the zonal hospitals there was poor recording system. Medical professionals from Mekelle zonal hospital were found to be very much interested in hydatid cyst survey in humans. The finding of one clinical human hydatidosis case motivated and encouraged them as a step forward for studying other zoonotic diseases in close collaboration with Bureau of Health and Bureau of Agriculture and Rural development of Tigray region. The number of diagnosed clinical hydatidosis patients would have been increased, if there had been accurate diagnostic techniques in all the other zonal hospitals. Based on the information obtained from the recorded secondary data (retrospective survey), miss-diagnosis of clinical cases of human hydatidosis seems to be very common. For instance, the clinical hydatidosis case that was diagnosed in Mekelle hospital during this study period, at first the physicians suspected Pulmonary Tuberculosis and treated the patient with Streptomycin for 60 days, which brought no change to the patient. But later it was realized that the case was hydatidosis. Based on the current findings and the previous reports of fragment studies in different parts of the country strongly suggest that echinococcosis/hydatidosis is one of the highly prevalent diseases of ruminants incurring huge economic loss and acting as serious public health threat in Ethiopia.

The observed prevalence of echinococcosis (16.7%) in adult stray dogs in Mekelle town was considerably significant. A relatively similar finding was observed in other studies (5–15% prevalence rates) in hydatidosis endemic areas of Sichuan, Qinghai and Gansu Provinces of China (Craig et al. 2007). Similarly in Tunisia (Lahmar et al. 2001) reported a higher prevalence (21%) in dogs. On the other hand, Gemelle et al. (2001) reported that 8470 eggs were shed from average infected dog per day. Thus the high prevalence of echinococcosis in dogs either in rural or in peri-urban areas and the high proportion of stray and free roaming dogs could lead to high contamination of the environment by *Echinococcus granulosus* eggs (Dakkak 1992; Christodoulou et al. 2008). Therefore, the dissemination of eggs and the subsequent contamination of water and food and the risk to contaminate farm animals and humans are very high.

In conclusion, hydatidosis is one of the major parasitic infections with public health significance in Tigray region, north Ethiopia warranting for serious attention. Hydatidosis causes considerable economic loss in livestock due to condemnation of organs and associated live weight loss. It is well known that an efficient meat inspection service should function as an important monitoring agent in the control of animal diseases with considerable economic and public health significance mainly in cases of chronic and ill-defined conditions which are not apparent either to the livestock owners or Veterinary surgeon. More importantly a feedback from the slaughterhouses to the individual farm is of great value in the field of preventive medicine. The general lack of hygiene in rural areas, the high infection rate of dogs, the high level of the environment, water and food contamination with *Echinococcus granulosus* eggs and the less awareness of the community makes the human hydatid infection risk very high as it was indicated in recent report (Christodoulou et al. 2008). In line with the above conclusion, establishment of well equipped standardized abattoirs, creation of public awareness in terms of knowledge of zoonotic importance of echinococcosis/hydatidosis and control of stray dogs in order to minimize the risk of acquiring the two most important zoonotic diseases (hydatidosis and rabies) are paramount importance.

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