Journal of
Dairy & Veterinary Sciences
ISSN: 2573-2196

Research Article
Volume 10 Issue 5 - March 2019
DOI: 10.19080/JDVS.2019.10.555797

Dairy and Vet Sci J

Prevalence Major Metacestodes of Ruminant Slaughtered at Elfora Export Abattoir and Public Health Importance

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Submission: February 11, 2019; **Published:** March 21, 2019

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Abstract

A cross-sectional study was carried out from November 2015 to March 2016 in the Elfora export Abattoir, in the Bishoftu city of Ethiopia with the objective of estimates the prevalence, organ distribution, viability of metacestodes, to identify major risk factors and to assess the level of risk perception of community about zoonotic cestodes. Out of the total 785 small ruminants examined for the presence of hydatid cysts and Coenurus cerebralis an overall prevalence of 7.39% and 3.8% was recorded, respectively. Of the total 400 goats examined for hydatid cysts, 6.8 % and *Coenurus cerebralis*,5% were found positive. There was no significant difference in the prevalence of *Coenurus cerebralis* in sheep and at different age groups and in both species. However, young goats found significantly affected by Coenurosis. More Hydatid infected sheep were found in Negelle where as 11.7 % of goats with Hydatid cyst was found in Yabello zone. Organ distribution hydatid cyst revealed that lung and liver were found frequently infected. Out of 49 sheep with hydatid cysts, 57.1 % harbored hydatid cysts in lung, 36.7 % in liver, 2.04% in kidney and 4.08 % in muscle. In sheep, a total of 49 cysts were examined to identify cyst fertility or viability out of these 24%, 20%, 28% and 28% were identified as fertile, non-viable, sterile and calcified, respectively. From a total of 27 lung cysts there was no fertile cyst detected in goats.

The total 119 Hydatid cysts being collected from the infected animals were distributed as in the lungs 63.03 %, liver 33.6 % and kidneys 3.36 %. The retrospective survey revealed that *T. saginata*/taeniosis is a wide spread problem in study area. The prevalence of sex was statistically significant. Of a total of 74684 patients admitted for stool examination in the two private clinics and one referral hospitals in Bishoftu, 495 (0.61%) Taeniosis cases were registered between September 2005–August 2007 E.C. Education status created significant role in risk of exposure in which tertiary educated individuals has low risk than illiterates and other levels of education. From a total of 100 people 69% knew that tapeworm could spread from animals to humans. There was significant difference in high risk group where large number of Christians experienced consumption of raw meat ($p = 0.001$). In general, the low risk group was more likely to agree that tape worm infection and its consequences were serious. Interestingly, high risk groups were also more likely to agree that the absence of access to cooking facilities, inspected meat or abattoir slaughtered meat increase their chances for the consumption of raw meat there by tends to attain the parasite. These results suggest that the high prevalence of metacestode infestations in this area is a great concern for both medical and veterinary authorities to design therapeutic and preventive programmes to overcome this problem.

Keywords: Cestodes; *Coenurus cerebralis*; Hydatid Cysts; Taeniosis; Viability

Introduction

Ethiopia's estimated livestock population is often said to be the largest in Africa. In the country, there were approximately 57.8 million cattle, 28 million sheep, 28.6 million goats, 1.23 million camels and 60.5 million poultry [1]. Ethiopia's great livestock potential is not properly exploited due to different factors such as traditional management system, limited genetic potential, lack of appropriate disease control policy and lack of appropriate veterinary services. Apart from this [2]. Foods of animal origin are often the preferred source of protein. However, if not properly prepared or handled, they can lead to food-borne infections [3]. In a country confronted with challenges of an ever-rising human population and food shortage, such enormous losses caused by helminthes parasites, 'the silent predators', are intolerable [4]. Moreover, these diseases are also known to cause public health problems as humans can be infected from accidental ingestion of parasite eggs/larvae passed into the environment with faeces from definitive hosts [5,6].

Cestodes of the family Taeniidae infect dogs and humans as the definitive host and are transmitted to a wide range of intermediate host species where they cause Coenurosis, Hydatidosis,

and Cysticercosis, respectively. Infestations with the larval stage of some species of *Taenia* are not only of public health importance, but also of veterinary significance because they cause economic losses due to condemnation of infected offal or meat [7]. The infestation may lead to lower production and even death of the animals in cases of heavy infestations [8]. Hydatidosis and Taeniosis are parasitic zoonoses that present major public health problems in lower income countries and some industrialized countries [7,9-11]. The prevalence is considered to be higher in developing countries because of poor sanitation, traditional cattle husbandry systems and inadequate meat inspection facilities [11,12]. As a result, the quality of human life, the aesthetic value of meat and the trading of meat and offal are compromised [11,13].

Hydatid cyst is the metacestodes of the tapeworm *Echinococcus granulosus*. Adult worms have been reported to be found in small intestines of dogs and wild carnivores like the wolf and fox. Infested carnivores eliminate eggs with their faeces. Herbivores (intermediate host) become infested with the eggs on account of having fed on contaminated pastures [14]. Man is infected incidentally up on ingestion of infective eggs in contaminated water, vegetables and other food or through direct contact with dog. Possible intermediate hosts for *Cysticercus cerebralis* are sheep and goats, for *cysticercus bovis* are cattle and buffalo, and for hydatid cysts, domestic ungulates and man act as an intermediate host [15]. Consumption of offal containing viable cyst results in infection of definitive host carnivores including dogs. The adult tapeworm in definitive host is harmless unlike the metacestodes in the intermediate host animals that is responsible for immense economic and medical importance in infected host [16-18]. The remarkable biotic potential of *E. granulosus* is known by the fact that a heavily infested dog may carry as many as 40,000 tapeworms, shedding approximately 1,000 eggs per 2 weeks [19]. Clinical hydatidosis is uncommon in animals, but hydatid cysts in the liver and other tissues at slaughter are widespread and cause condemnation and economic loss [20].

Coenurosis, the bladder worm stage of *Taenia multiceps* predominantly develops in the brain and spinal cord of many mammal species, including human [21-24]. Coenuruses due to larval stage of *Taenia* multiceps can occur in both an acute and a chronic disease form. Acute coenuruses occurs during the migratory phase of the disease, usually 10 days after ingestion of the large number of tape worm eggs. Young lambs aged 6-8 weeks are most likely to show signs of acute disease. The signs are associated with an inflammatory and allergic reaction. There is transient pyrexia and relatively mild neurological signs such as listlessness and a slight head aversion. Occasionally the signs are more severe and the animal may develop encephalitis, convulse and die within 4-5 days [24]. The infection is acquired in cattle by grazing on pasture contaminated with faeces of humans. *Cysticercus bovis* infection in cattle may not show any clinical disease and therefore goes un-noticed except during abattoir meat inspection. These larvae remain embedded in the tissues of cattle posing serious public health threats. The observations were reinforced by a probabilistic model developed by Kyvsgaard [25] which showed that over 85% of infected animals may be missed during routine meat inspection.

Hydatidosis and taeniosis is of public health and economic importance not only in areas of endemicity but also in non-endemic countries due to the migration of infected people and livestock exchange, their products, and potentially contaminated produce or other fomites which promotes emergence in previously free-disease areas [26]. They are frequently reported from different corners of the country [27-29], and the disease is much more common in rural areas of Ethiopia where dogs and domestic animals live in a very close association [30]. Additionally, where home slaughtering of cattle, sheep, goats and camels is still predominant and uncooked offal and carcass wastes are normally given for dogs and cats, peoples to eat the ingestion of raw or undercooked beef dishes such as ''kurt'' and ''kitfo'' [31-33]. However, there is lack of recent information on some major metacestodes in East Shoa Zone of Oromia Regional State particularly in and around Bishoftu. This area is known for its commercial, domestic and export abattoirs growing in number currently. To establish appropriate strategy for prevention and controls, it is very important to know public perception about the risk of the diseases and up to date epidemiological information is needed on zoonotic parasites and their public health importance's.

Therefore, the objectives of current study are:

a. To determine the prevalence, organ distribution, viability of metacestodes

b. To identify major risk factors associated with metacestodes in cattle, sheep and goats slaughtered at Elfora export abattoir.

c. To assess the level of risk perception by community about zoonotic cestodes.

Materials and Methods

Study Animals

All local breeds' sheep and goats that originated from neighboring localities and/or regions for slaughter in Elfora export abattoir were included in the study population. Consequently, all male sheep & goats were subjected for the study and age of the animals were grouped based on dentition, for those which have not erupted permanent incisor teeth, are classified as young, while those with pair or more permanent incisor teeth erupted were classified as adult [34]. All cattle inspected were adult males and from similar agro-ecological sites and husbandry systems

Study Design and Sample Size

A cross-sectional study type was carried out from November 2015 to April 2016. The total number of animals required for the study was calculating based on the formula given by Thrusfield [35]. A stratified random sampling procedure was employed to carry out this study. By rule of thumb where there is no information for an area it is possible to take 50% of expected prevalence. Using 5% degree of absolute precision, 384 animals need to be

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sampled. For this study, the required sample size was 384, but in order to increase precision, it was maximized to a sample size of 384 for cattle, 385 for sheep and 400 for goats. Whereas, a questionnaire and retrospective type of study were Based on the formula recommended by Arsham [36] N= 0.25/SE2, S E=5%), N=100, Where N=sample size, SE=standard error assuming the standard error of 5% at a precision level of 0.05 and the confidence interval of 95%. the sample size for the questionnaire survey was expected to be100 for each site.

Sampling Method

Active Abattoir Survey: Active abattoir survey was conducted during routine meat inspection on randomly selected cattle, sheep and goats. During ante-mortem examination of each study animal was given an identification number and its age and origin was recorded. After slaughtering the cattle, sheep and goats, post-mortem examination was carried out using standard procedures recommended by FAO/UNEP/WHO [37,38]. During post-mortem examination, carcasses and their respective organs was carefully examined for the presence of metacestodes. Visual inspection and palpations followed by multiple incisions in livers, kidneys, lungs, hearts, spleens and other organs were made to detect metacestodes.

Cyst fertility and viability test: All the positive samples were transported to Addis Ababa University, College of Veterinary Medicine and Agriculture, Veterinary Parasitology Laboratory for confirmation of cyst viability. The viability of the cysts (*C. bovis*) was examined by using 30% ox bile solution diluted in normal saline and incubated at 37 °C for 1 to 2h. A cyst was regarded as viable if the scolex evaginated according to Gracey [39].

For the case of hydatid cysts, individual cysts were grossly examined for degeneration, then according to the size (not too small) hydatid cysts in cattle, sheep and goats were selected for fertility study. To reduce intracystic pressure, the cyst wall was penetrated, using needle and it was cut with scalpel and scissors. The contents were then without any protoscoices, calcified, non-viable (cysts with dead protoscoices) and viable or fertile (cysts with live protoscoices). To determine viability of the protoscolices, a drop of cyst fluid was placed on a microscopic glass slide and cover slip was applied and observed for the motility of flame cells activity like peristaltic movement. When it becomes doubtful for motility, a drop of 0.1% aqueous eosin solution was added and examined under a light Microscope for taking the dye. Live protoscolices did not take the dye whereas, the dead ones did according to Daryani [40].

Questionnaire survey: To determine the infection rate and associated risk factors of human taeniosis, 100 volunteer respondents from different sex, age, level of education, occupation and religion were selected using random sampling based on willingness to participate in the questionnaire survey.

Data Management and Analysis

The data collected from abattoir and questionnaire was stored into Microsoft excel. Logistic regression was employed to analyze the association of metacestodes cyst occurrence with the potential risk factors using SPSS.ver.20 (USA) statistical software. The degree of risk factors association with the disease occurrence was further analyzed using odd ratios. Chi-square (X^2) test was used to determine the variation in infection, prevalence between species, ages and origins. Questionnaire survey data was summarized using descriptive analysis and important factors were tested with logistic regression for their contribution for the occurrence of taeniosis in human. For the questioner survey we were used Health belief model (HBM) to assess the risk perception level.

Results

Prevalence of Metacestode

In the current study, a total of 1169 animals comprising 384 cattle, 385 sheep and 400 goats slaughtered in Elfora abattoir were examined for the presence of metacestodes. Out of the total 785 small ruminants examined for the presence of hydatid cysts and *C.cerebralis* an overall prevalence of 7.39% and 3.8% was recorded, respectively. Of the total 400 goats examined for hydatid cysts, 27(6.8 %) and *C.cerebralis*, 20(5%) were found positive. Likewise, of the 385 sheep examined, 31(8.1%) and 10(2.6%) were found positive for hydatid cysts and *Coenurus cerebralis*, respectively. Statistical analysis showed that there was no significant difference among the species (P>0.005) (Table 1).

Table 1: Prevalence of hydatid cysts and *C. cerebralis* in sheep and goats.

Species	No of examined	Hydatid positive	Prevalence (%)	C.cerebralis positive	Prevalence (%)
Sheep	385	31	8.1	10	2.6
Goat	400	27	6.8	20	5
Total	785	58	7.39	30	3.8

The risk of exposure to *C.cerebralis* based on different origin and age groups of both species were examined. Higher prevalence *C.cerebralis* was found in young of both sheep and goats compared adult groups. There was no significant difference in the prevalence of *Coenurus cerebralis* in sheep at different age groups and in both species due to geographical origin. However, young goats found significantly affected by Coenurosis. Prevalence of Hydatid cysts revealed significant variation in the origin of both species of small ruminants (Tables 2-4). There was statistically significant difference in origin and age of the goats (p<0.05). where old goats by far had higher opportunities of obtaining hydatid cyst than young ones. More Hydatid infected sheep were found in Negelle (17.6%) where as 11.7 % of goats with Hydatid cyst was found in Yabello zone. In General, the prevalence of HC in sheep were higher compared with goats but not significance difference(P>0.05) Table 5.

Organ distribution hydatid cyst revealed that lung and liver were found frequently infected. Out of 49 sheep with hydatid cysts,

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28 (57.1 %) harbored hydatid cysts in lung, 18 (36.7 %) in liver,1(2.04%) in kidney and 2(4.08 %) in muscle. Similarly, in goats, out of 42 with hydatid cysts, lungs accounted for 30 (71.4 %), liver 10(23.81 %), kidney 1(2.38 %) and 1 (2.38 %) harbored hydatid cysts in muscle (Table 6). In sheep, a total of 49 cysts were examined to identify cyst fertility or viability. From those 12 (24%), 10(20%), 14 (28%) and 14 (28%) were identified as fertile, non-viable, sterile and calcified, respectively. Fertile cysts were mostly detected in lung which were 8 (66.7 %) of the whole fertile cysts. However, most of cysts in the liver 8 (66.7%)) were found calcified (Table 7). Viable cysts were higher in lungs compared to liver although not statistically significant ($p > 0.05$). In goats, a total of 42 cysts were examined to identify cyst fertility. From those 6 (14.29 %), 11 (26.19 %), 8 (19.05 %) and 17 (40.48 %) were identified as fertile, non-viable, sterile and calcified, respectively. From a total of 27 lung cysts there was no fertile cyst detected in goats. Rather non-viable cysts in goats were found mostly in lungs which were 11(40.74 %) of the whole cysts (Table 6).

Table 2: Logistic regression analysis of risk factors associated with the occurrence of *C. cerebralis* in carcass inspected at Elfora abattoir.

Risk factor	Total number	Number of positive	Prevalence (%)	X2	P-value	CI	OR
Sheep							
Age							
Young	147	4	2.7	0.14	0.905	(0.257-0.333)	0.925
Adult	238	6	2.5				
Origin							
Negelle	86	2	2.3	0.375	0.829	(0.104-0.085)	0.951
Yabello	120	4	3.3				
Konso	179	4	2.2				
Goats Age							
Young	163	9	5.5	0.005	0.944	(1.413-2.587)	1.033
Adult	237	11	4.6				
Origin							
Negelle	130	7	5.4	0.341	0.952	(0.016-0.144)	0.397
Yabello	128	7	5.5				
Konso	142	6	4.2				

Table 3: Logistic regression analysis of risk factors associated with the occurrence of Hydatid cysts in carcass inspected at Elfora abattoir.

Risk factor	Total Number (N)	Number of positive	Prevalence (%)	X^2	P-value	CI	Crude OR
Sheep Age							
Young	147	9	6.1	1.196	0.274	(0.699-3.491	1.562
Adult	238	22	9.2				
Origin							
Negelle	91	16	17.6	14.782	0.001		
Yabello	116	5	4.3				
Konso	178	10	5.6				
Goats							
Age							
Young	163	6	3.7	4.117	0.042	(1.003-6.450	2.544
Adult	237	21	8.9				
Origin							
Negelle	130	8	6.2	8.584	0.014		
Yabello	128	15	11.7				
Konso	142	4	2.8				

Table 4: Distribution of hydatid cysts in different organs of infected sheep and goats.

Animals	No. Examined	Lung	Liver	Kidney	Muscle
Sheep	385	28(57.1%)	18(36.7%)	1(2.04%)	2(4.08%)
Goats	400	30(71.4%)	10(23.81%)	1(2.38%)	1(2.38%)

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Table 5: Classification of hydatid cysts collected from sheep and goats slaughtered in Elfora abbator based on viability of cysts.

Organs	Viable		Non-Viable		Sterile		Calcified		Total	
	sheep	goat	sheep	goat	sheep	goat	sheep	goat	sheep%	goat%
Lung	8	3	6	8	9	8	5	11	28(57.1)	30(71.4)
Liver	2	1	4	3	4	0	8	6	18(36.7)	10(23.81)
Kidney	0	1	0	0	1	0	0	0	1(2.04)	1(2.38)
Muscle	2	1	0	0	0	0	0	0	2(4.08)	1(2.38)

Table 6: Distribution of hydatid cysts and *Cysticercus bovis* in different organs of cattle slaughtered in Elfora abbator

Number of cases										
	Hydatid cyst (%)					*C. bovis* (%)				
	Lung	Liver	Kidney	Total	Tongue	Triceps	Masseter	Shoulder	Heart	Total
Cattle (n=384)	75	40	4	**119**	14 (29.7)	11	9	8	5	47
	((63.03)	-33.6	-3.36			-23	-19.1	-17	-10.6	

Table 7: Prevalence of *Cysticercus bovis* in different organs of cattle slaughtered in Elfora abbator

Organ	Viable	Non-Viable	Total
Tongue	6	8	14(29.79%)
Triceps	7	4	11(23.4%)
Masseter	4	5	9(19.15%)
Shoulder	3	5	8(17.02%)
Heart	1	4	5(10.64%)
Total	21(44.68%)	26(55.32%)	47 (100%)

Table 8: Prevalence of hydatid cyst different organs of infected cattle slaughtered in Elfora abbator.

Organ	Viable	Non-Viable	Sterile	Calcified	Total
Liver	5	1	0	34	40(33.6%)
Lung	20	14	15	26	75(63.03%)
Kidney	0	0	4	0	4(3.36%)
Total	25(21.01%)	15(12.61%)	19(15.97%)	60(50.4%)	119(100%)

All 384 cattle inspected were adult males and from similar agro-ecological sites and husbandry systems. Of those, 17 (4.4 %) were infected with cysticerci. A total of 47 cysticerci were collected and occurred in decreasing order, in the tongue 29.79% (14), triceps muscle 23.4% (11), masseter muscle 19.15% (9), shoulder muscle 17.02% (8) and heart 10.64% (5) (Table 7). Out of 47 cysticerci, 21 (44.68 %) were viable and 26 (55.32 %) were non-viable. Viable cysticerci were observed in the triceps (7), tongue (6), masseter (4) shoulder (3) and heart (1) muscles, in descending order. Non-viable cysts were recovered from tongue (8), masseter (5), shoulder (5), triceps (4) and heart (4) muscles, in decreasing order (Table 8). Out of a total of 384 cattle carcasses, 47 (12.2 %) were infected with hydatid cysts, a total of 1 19 hydatid cysts being collected from the infected animals. Of these cysts, 25 (21.01 %) were viable,15(12.61%) non-viable, 19 (15.97 %) sterile and 60 (50.4 %) calcified. Cysts were found in the lungs75 (63.03 %), liver 40 (33.6 %) and kidneys 4 (3.36 %).

Discussion

The present study revealed that the overall prevalence of cysticercosis in cattle slaughtered at Bishoftu Elfora abattoir was 4.4 %, which is comparable to the prevalence of 4.4% reported from Jimma [41] 7.5% from Addis Abeba [42,43], 8.2% from Tigray region [44], 6.7% from Kombolcha Abattoir [45]. However, it was higher than the reported prevalence of 3% in Zeway [46], 3.11% in central Ethiopia, 3.6% in Addis Abeba [47], 2.98% in Nekemte and 2.93% in Jimma abattoir [48]. The prevalence of *cysticercosis bovis* in this study was relatively lower as compared with previous reports from different abattoirs of Ethiopia, such as 11.3% from Wolaita Soddo [49], 22.9% from Hawassa municipal abattoir [50], 26.25% from Southern Ethiopia Abunna and from other countries 16% from Upper Egypt [51], 72.2% from Nigeria [52] and other endemic areas in Africa and Asia by other authors [53-55].

The variation of prevalence in different study sites may be due to variations in personal and environmental hygiene, religion, culture and feeding habits of the population and their production systems [56]. The difference in prevalence rate could also attribute due to the limitation of conventional method of meat inspection which is less sensitive to pick all animals that are infected with *T. saginata* metacestodes. Experimental studies showed a 5-50 times higher prevalence rates by complete slicing of the predilection sites [57]. Observations indicated that except for dead and degenerated cysts which form white and fibrotic lesions viable cysts pass to human consumption without being detected due to carless meat inspection as described by Dorny & Garedaghi [11,55]. The majority of the findings in Ethiopia were based on surveys carried out on carcasses subjected to routine meat inspection procedures. Hence, the same limitations with which meat inspection shares globally were reflected in the results of the present study. For instance, Onyango-Abuje [58] in low and high-risk areas of Kenya reported 0 and 31.47% of prevalence by meat inspection and 13.33% and 80.42% prevalence by serology respectively.

During inspection, *C. bovis* was found in different organs with higher number of cysts encountered in the tongue (14; 29.79%), followed by triceps muscle (11; 23.4%), masseter muscle (9;

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19.15%), shoulder (8; 17.02%) and heart (5; 10.64%). Other studies carried out elsewhere showed that tongue; heart and masseter appear were the most frequent locations for cysticerci [55]. Further, Abunna & Getachew [59] reported triceps as being frequently affected by the cyst. However, the current study showed that the most frequently affected organ with the highest number of cysts was the tongue which agrees with the report of Bedu & Garedaghi [55]. It is evident from the result that other organs such as triceps, masseter muscle and heart were also frequently affected predilection sites for *C. bovis* which is similar to earlier reports in various endemic areas [60,61]. The results of viability test showing highest proportion of viable cysts in triceps muscles was comparable to the works of Tembo, Shimeles & Emiru [62,63]. Hydatidosis is known to be livestock and public health important disease and for establishment of a control strategy, detailed information on local epidemiology and significance of the disease must be known. The present study showed that the prevalence of hydatid cyst in sheep, goats and cattle were 8.1%, 6.8% and 12.2%, respectively.

The prevalence of hydatidosis in cattle recorded in this study 12.2% agreed with the findings of Belina 9.4% in Harar, Regassa [49] 15.5% in Woliata and Kebede [28] 16% in Wolita sodo. In contrast, the present study disagrees with the reports of Alemayehu [64] 54.8% in Assela, Kebede [29] 48.9% in Debre Markos, Tigist, (2009) 36.58 % in Jimma & Wubet [65] 62.96% in Bale Robe. The prevalence of cystic echinococcosis in cattle in other countries has been reported to be lower than that in the cattle at Elfora Abattoir; for example, studies have quoted prevalence of 8.56% in Tunisia, Lahmar [66] 8.28% in Saudi Arabia, Ibrahim 7.4% in Turkey Sariozkan & Yalcin [67] 6% in Sudan Omer [68] and 4.2% in Arusha Tanzania, Nonga & Karimuribo [69]. This variation in prevalence of cystic echinococcosis among cattle of different areas in Ethiopia and in the countries could be attributed mainly to the strain difference of Echinococcosis granulosus that exist in different geographical location [70] and other factors like differences in agroecology, the times at which studies took place, stocking rates and movements of animals, animal husbandry systems, awareness, culture and religion of the society, and attitude to dog sin different regions of the country [71].

Regarding organ distribution, the current study showed that lungs (63.03%) were the most preferred predilection site for hydatid cysts followed by liver (33.6%) which agrees with other study in cattle in Ethiopia such as Tolossa and Getaw. This might be 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 lung. It is also possible for the hexacanth embryo to enter the lymphatic circulation and be carried via the thoracic duct to the heart and then trapped in the lungs [72]. Furthermore, the lungs and liver possess the first. great capillaries encountered by the migrating echonocouccss 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 [73]. Our overall finding that 50.4 % of hydatid cysts were calcified, 21.01% fertile (viable), 12.61% sterile and 15.97% non-viable implies that most hydatid cysts from cattle are not infective to the final hosts. This finding supports previous arguments by several investigators in Ethiopia that assume sheep to have a greater role than cattle as an intermediate host of cystic echinococcosis.

The fertility rate among different organs also showed varied proportion. Accordingly, cysts in the lungs took the higher proportion of fertility rate agrees with earlier reports [74]. It has been stated that the relatively softer consistency of the lung tissue allows the easier development of the cyst and this may be aggravated due to reduced immunological compatibility of animals at their older age of infection. However, our finding is in contrast with a report from Tunisia of the higher fertility of hepatic compared with pulmonary cysts in cattle [75] this is most probably because different strains of hydatid cyst occur in the two countries. The high prevalence and fertility of pulmonary cysts in the present study suggests that the lung is the most important organ as a source of infection to dogs of the area. Unlike the case in lungs, relatively higher number of calcified cysts encountered in the liver (24%). The liver is firm in consistency and lack suitable matrix for long term cyst survival and hence the cyst degenerates earlier than the once found in lungs. The higher number of calcified cysts in the liver could also be attributed to relatively higher reticuloendothelial cells and abundant connective tissue reaction of the organ. The variation between tissue resistances of the infected organs may also influence the fertility rate of the hydatid cysts [29].

An overall prevalence of 58(7.4%) hydatid cysts was recorded in examined small ruminants in the prevalence of CE in sheep (8.1%) and goats (6.8%). In sheep 8.52% prevalence was recorded and this value agrees with Assefa & Tesfay, Getachew, Abunna, Azlaf, Dakkak & Elmahdi [76-78], who reported (8.02), (8.52), (8.05), (10.58%) and (10.3%) prevalence in sheep. However, Haridy & Njoroge [79,80] observed lower hydatid cyst infection in sheep; (0.33%) and (3.6%) respectively. On the other hand, the prevalence in goats in the present study was 6.8% which is agreement with the study of Saeed [81] 6.2%, Dalimi [82] 6.3%, Yeshiwork [83] 6.8% and Getaw 6.7% was is not in agreement with the study of Haridy & Njoroge [79,80], who reported 4.5% and 3.4% respectively. This variation probably due to the reason explained in the discussion part of bovine hydatidosis.

The higher prevalence of cystic echinococcosis in sheep than goats in the present study was most probably due to the fact that goats feed mainly by browsing than grazing unlike in sheep and due to the close grazing to the rot of grasses behavior of sheep on pastures contaminated with oncospheres of *E. granulosus* on the pasture [28,29,61]. This finding suggests the importance of sheep as the main reservoir of infection in maintaining and perpetuation of the domestic life cycle of *E. granulosus* in the region [28]. On the other hand, categorical analysis of age in this study demonstrated higher infection rate of cystic echinococcosis in adult sheep and adult goats as compared to their young ones. This can be attributed to two factors: firstly, higher age reflects a much longer period of exposure to infective egg stage in the pasture, and secondly, the

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chances detecting cysts at meat examination are higher in aged animals due to their bigger size. In younger animals, either hydatid cysts are not developed into detectable size, which can be easily missed during post-mortem examination. Indeed, the present study as well many other studies elsewhere [84] have shown higher infestation rates of hydatid cysts in older animals.

In this study, livers and lungs were the most frequently infected visceral organs to hydatid cysts in both host species examined. This is explained by the fact that livers and lungs possess the first great capillary sites encountered by the migrating Echinococcus oncosphere (hexacanth embryo) which adopt the portal vein route and primarily negotiate the hepatic and pulmonary filtering system sequentially before any other peripheral organs are involved. The location of cysts and cyst morphology are influenced not only by host factors but also by parasite factors such as the strain of *E. granulosus* involved [85]. The observation in this study that the lungs in both sheep and goats were found to be more commonly infested with hydatid cysts than the liver agrees with previous findings of Marshet & Oryan [86,87]. The lungs are considered of having the first large capillary fields encountered by the blood-borne oncospheres. In addition to this, the presence of greater capillary beds in the lungs than in other organs and soft consistency of the lung might also allow easy growth of cysts. The development of hydatid cyst occurs occasionally in other organs and tissues when oncosphere escapes into the general systemic circulation in both heart and spleen, no cysts were observed from both sheep and goats [88].

The higher viability rates of pulmonary cysts than hepatic cysts in both sheep and goats in the current study agree with those of Kebede & Getachew [29,77]. This might be due to softer consistency of tissues that allows the easier development of cyst and the viability. Among other zoonotic cestodes, coenuruses is endemic in Ethiopia, especially in the highland sheep where 75% of the population is found [89]. The presence of freely roaming dogs on grazing land greatly contributes to the existence of the disease. Dogs are routinely fed on offal, including sheep and goats head are not dewormed. Thus, maintaining the *C. cerebralis -Taenia* multiceps cycle [23].

The findings of the present study revealed that up to 3.78% of sheep and goats slaughtered at Hashim Export Abattoir in Bishoftu were found to be infected with Coenuruses cerebralis with prevalence's of 3.9% in goats and 2.5% in sheep. The result of the current study in sheep is consistent with the report of Abo-Shehada in Jordan (3% in sheep), Varma & Malviya [90] in India (2.88% in sheep). But is slightly lower than Sharma &C hauhan [23] in Ethiopia (5% in sheep) and Oryan [91] in Iran (9.8% in sheep). The most probable reason for the variation of the results in different countries is supposed due to variations in climatic, geographical management of the study animals and the final dog hosts and social conditions.

Higher prevalence of coenuruses was recorded in young 6.8% animals than adult 1.9% small ruminants. Comparative results were reported by Morris [92], 5% in sheep, Adem & Hayelome [93] 4% in goats and 5.3% in sheep in different parts of Ethiopia. Previous studies show that clinical coenurosis in sheep is common in young animal [94]. This higher prevalence in young sheep and goats is most probably attributed to under developed immunity in young animals thus higher infection rate in these animals whereas the adults have acquired immunity [95].

The prevalence of human taeniosis was recorded based on the and questionnaire survey and indicated an overall infection rate of 41% which demonstrates the importance of taeniosis in Bishoftu town, surrounding kebeles and in the areas of animal origins. The high prevalence of taeniosis recorded in Hawassa 64.2%, Ziway 56.7% Jimma 56.7%. The prevalence of *T. saginata* varies from country to country and even differs within the same country from area to area depending on factors, such as variation in the habit of raw meat consumption, meat inspection procedures practiced, awareness of patients about the clinical pictures and transmission of the disease, variation in personal and environmental hygiene, and other factors related to the variation in the prevalence of taeniosis among countries. Moreover, some individuals in a society may become shy to tell openly about taeniosis infection and that may undermine the true infection rate of the disease.

The researchers recognize the consumption of raw or undercooked beef in Ethiopia. Previous reports from Ethiopia indicated that consumption of raw or inadequately cooked beef was strongly associated with *T. saginata* infection. Reports have indicated that the prevalence of *T. saginata* taeniosis may also vary in relation to age, sex, religion, educational status and income of individual. The present study showed that there was strong association between age of the respondents and the prevalence of *T. saginta* infection, which agrees with previous reports by Hailu & Abunna. Taeniosis was more reported from respondents above 20 years of age /adults than from younger respondents. This may imply that the habit of raw meat consumption increases with age. Younger people, mostly students cannot afford to buy beef for raw consumption as most raw meats are consumed at the butcher's house and are more expensive (of high quality) than the one that is taken away for preparation at home. The current result was also supported by Cabaret [12] where he reported a high prevalence of *T. saginata*/cysticercosis in sub-Saharan Africa especially East Africa.

This study has also clearly demonstrated the impact of religion on raw meat consumption. The proportion of taeniosis infection was higher in the Christian respondents than in Muslim respondents. Tibo & Abunna have also reported similar observations in different parts of Ethiopia suggesting that the tradition of raw beef consumption is more important in the Christian community. High prevalence of metacestodes infestation in the present study could be due to high population of carnivores particularly stray dogs in the grazing area of domestic ruminants and lack of proper efforts in segregating domestic and wild carnivores from livestock or their grazing areas. Feeding offal of ruminants to dogs also enhance completion of the life cycle. The results of the present study

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indicate the importance of metacestodes infestation in this area. Their significance is not only because they have great economic importance resulting in losses due to condemnation of the infected organs and downgraded carcasses but it is also because of the zoonotic aspects of some of these infestations such as cysticercosis, hydatidosis and coenurosis. In addition, substantial economic loss due to treatment of human taeniosis remains to be evaluated.

In other countries, the prevalences of 0.5-3% human infestations with *T. saginata* have recently been reported from different parts of Iran [96,97]. In another study Daryani [98] reported that 14% of vegetables imported to and 16% of those cultivated in Ardabil, north-western Iran were contaminated with *T. saginata* eggs. Human cases of hydatidosis are regularly reported from different regions of Iran and it is one of the most important zoonotic diseases prevalent in different parts of this country [99,100]. Population studies on human hydatidosis, using serological and ultrasonographical methodologies, have shown 3.5-5.9% infestation in different areas of Iran [100,101]. Although there are reports of human coenurosis in the world [102-186].

Conclusion and Recommendations

Zoonotic metacestodes are a public health risk and causes considerable economic loss via decreasing livestock production and condemnation of offals in slaughter houses. The current abattoir survey proved that zoonotic metacestodes like hydatidosis, *Cysticercus bovis* and *coenurus cerebralis* are the most and highly prevalent in slaughtered ruminants [187-203]. The retrospective and the question- naire survey showed that taeniosis is a widespread problem with higher prevalence among the resident of Bishoftu town. Religion, open air defecation, presence of backyard slaughtering practices, habit of raw meat consumption, Age, and Sex were identified to be the most important risk factors for the disease occurrence in the study area [204-208].

Based on the above conclusive remarks, the following recommendations are forwarded:

a. Public education is required to avoid the consumption of raw and undercooked meat, keep their self-hygiene, prohibition of backyard slaughter, proper disposal of condemned offal's.

b. Fencing of abattoirs and denying access of stray dogs in to abattoirs must be strictly applied.

c. Sustainable community-based control strategies against zoonotic metacestodes should be designed and implemented.

d. Impact of zoonotic cestodes on meat export market should be further studied in export abattoirs including different species of slaughtered animals

e. Further studies on the prevalence and economic importance of metacestodes in different zones of region involving different hosts (including wildlife) as well as on existing status in human would be mandatory to establish a clear information system for launching a control programme.

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How to cite this article: Muluneh H, Ermias W, Getahun E, Abaysew A. Prevalence Major Metacestodes of Ruminant Slaughtered at Elfora Export Abattoir and Public Health Importance. Dairy and Vet Sci J. 2019; 10(5): 555797. DOI: 10.19080/JDVS.2019.10.555797.

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