

Prevalence And Public Health Significance Of *Cysticercus Bovis* In Cattle Slaughtered At Gondar Elfora Abattior

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Abstract: Bovine cysticercosis is an infection of cattle caused by the larval stage, *Cysticercus bovis*, of the human intestinal cestode, *Taenia saginata*. It is an infection of public health significance as eating of raw or undercooked beef results taeniasis in human population and an important cause of economic loss mainly due to condemnation, refrigeration and downgrading of infected carcasses. A cross sectional study was conducted from October 2014 to march 2015 at Gondar ELFORA abattoir with the main objective of determining the prevalence of bovine cysticercosis in animals, taeniasis in human and estimation of the worth of taeniocidal drugs in Gondar city. The abattoir survey was carried out by routine inspection of carcasses and viability test methods. Post mortem examination was taken in 400 slaughtered cattle from randomly selected animals of which 22 (5.5%) were infected with *cysticercus bovis*. Of the total of 44 *Cysticercus bovis* collected during the inspection, (31.8%) were found to be alive while others (68.2%) were degenerative cysts. The tongue, heart, masseter muscles and triceps muscles, were the main predilection sites of the cysts. Anatomical distribution of the cyst showed that highest proportions of *C. bovis* cyst were observed in heart (3.5%) followed by tongue (2.75%), masseter muscle (2.5%), and triceps (2.25%). The prevalence not varied significantly between ($P < 0.05$), between, age groups, origin, body condition and breed of the animals. The proportion of viable cysts in the inspection sites was triceps muscles (44.4%), heart (35.7%), masseter (31.8%), and tongue (18%). Of the total of 130 interviewed respondents, 43(33.07%) had contracted *T.saginata* infection at least once in their life time. Human taeniasis prevalence showed significant difference (P -value <0.05) with habit of raw meat consumption, and level of education. Accordingly raw meat consumers (OR=500, 95% CI [0.001-0.031], and those who had low level of schoolings and illiterates 95% CI [2.02-90.3] had higher odds for acquiring taeniasis than cooked meat consumers and other societies respectively. An inventory of taeniocidal drugs from different private and public pharmacies indicated that drugs worth of 196,558 Ethiopian birr was sold in the past 2013/14. Results obtained in this study confirm that cysticercosis has economic and zoonotic importance, so that routine meat inspection and keeping environmental sanitation should be implemented.

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Key words; Cattle, zoonosis, cysticercosis

1. Introduction

Tapeworm infection has been recorded in history 1500 years ago and recognized as one of the earliest human parasite. *Taeniasaginata* is a worldwide zoonotic cestode whose epidemiology is ethnically and culturally determined with estimation of 50-77 million cases of worldwide annually. Both adult and larval forms hazardously affect health of their respective hosts, either directly or indirectly accompanied with several secondary infections, particularly in human. The occurrence of larvae (*C.bovis*) in cattle musculature causes bovine cysticercosis while the adult worms in human small intestine cause taeniasis [29; 17]. Bovine cysticercosis is a disease caused by the larval infection of *Taenia saginata* in cattle. The adult stage of *Taenia Saginata* occurs in the small intestine of humans who are the final host of this tapeworm. Humans get infected by

eating raw or under cooked meat containing viable cysticerci [3]. Cattle and buffaloes represent the main reservoirs for human infection with *Taenia Saginata* [5]. *Taenia saginata* known as beef tapeworm because beef is the main source of infection and it has a cosmopolitan distribution. Taeniasis, which is the infestation in humans, is a food-borne disease where the consumption of meat containing a viable cysticercus may result in the development of a tapeworm and patients are frequently asymptomatic, however, they may present with mild symptoms of nausea, abdominal discomfort, flatulence, epigastric pain, diarrhoea, vitamin deficiency, excessive or loss of appetite, weakness and loss of weight, digestive disturbances, and intestinal blockage may occur. Variably adult tapeworms release motile distal segments containing eggs and their independent motility is the reason for various disorders such as

appendicitis, biliary tract obstruction anal pruritis [4]. Live cattle having *C. bovis* shows no symptoms, however, heavy infestation by the larvae may cause myocarditis or heart failure [14]. Cysticerci can remain alive in cattle anywhere from weeks to years and such infection in cattle is a public health problem as the infected raw or undercooked beef causes taeniasis in human.

The economic significance of *Cysticercus bovis* on the livestock industry may be considerable especially in developing countries [5]. Economic losses may be high due to the condemnation of heavily infected carcasses and the necessity to freeze or boil infected meat and losses may also occur from restriction of exports [6]. Globally, there are 77 million human carriers of *Taenia saginata* out of which about 40 percent live in Africa. Cattle get measles from humans, so the occurrence of beef measles in cattle would be indicative of a human health problem [10]. Animals infected with measles do not show any signs [10]. In those induced experimentally by 200,000 to 1,000,000 *Taenia Saginata* eggs, may show rise to fever, weakness, profuse salivation, anorexia, increase heart and respiratory rate and a dose of one million or more eggs may cause death between 14 to 16 days due to a degenerative myocarditis [28]. *Taenia Saginata* /*Cysticercus bovis* is important from the stand point of the health of cattle because of consequences for the

3. Materials And Methods

3.1. Study area Description

The study was conducted in Gondar ELFORA abattoir which is located in Gondar city from November 2014-March 2015, in Amhara regional state. The city is located 750 km north of Ethiopia from Addis Ababa. It is located on 35°7' N and 13°8' E and lies at an altitude of 2200 meter above sea level. The area receives mean annual rain fall of 1172 mm mainly in rainy season with average temperature of 19.7°C. In and around Gondar town there are about 153,914 populations [13].

3.2. Study Population

The study population consists of cattle at different ages, sex, origins, body conditions and breed categories in the study area.

3.3. Sampling Method

The animals in the slaughterhouse were selected by random sampling method and, were selected randomly during ante-mortem examination and each selected animal was given an ear tag (number), and this number was also written on the respective carcasses.

3.4. Sample size determination

The prevalence of cysticercos bovis was expected to be 4.9% [4]: expected prevalence was

meat supply and more importantly, from the direct effects on the well-being of humans who almost universally, consume beef as a source of protein and other minerals. Bovine cysticercosis and taeniasis are common where hygienic conditions are poor and the inhabitants traditionally eat raw or insufficiently cooked or sun-cured meat [12; 17]. Inadequate health education and low availability of taenicides are the major obstacles for the control of such infections [23]. Due to these reasons, taeniasis is more common in developing countries including Ethiopia where meat is an important component of human diet and traditionally it is consumed raw on several occasions. About 45% of Ethiopia's domestic meat consumption comes from cattle, but this income is affected due to various unimproved animal health problems, among which, *T.saginata*/*C. bovis* is one [11]. It is, therefore, important that sufficient emphasis be given to this problem so that quality and quantity of beef may satisfy the domestic requirements, increase the foreign export revenue and improve the public health.

The objective of this study is to control and reduce the distribution of this disease which affects human beings economically, socially and mentally by knowing current prevalence and public health significance of cysticercus bovis in Gondar ELFORA abattoir, and to disclose the result to relevant government staffs and health workers to take measure.

taken as 4.9% and the confidence interval was chosen as 95% and precision 5%. By substituting these values in the formula, the sample size was 72. The sample size was calculated according to [25]. As follows:

$$n = \frac{1.96^2 P_{exp} (1-P_{exp})}{d^2} = \frac{3.84 \times 0.049 (1-0.049)}{(0.05)^2} = 71.59$$

≈ 72

d=absolute precision (usually 0.05)

Where, n=required sample size

P_{exp} =expected prevalence

But to maximize the sample population and to get more accurate result the sample size was multiplied by 5.5, the total sample population examined was 400 animals.

3.5. Study Design

A cross-sectional study was conducted at Gondar ELFORA abattoir from November 2014 to April 2015. Active data were generated from randomly selected cattle with regard to age; breed, sex, body condition, and origin of animal were considered as risk factors to test for occurrence of cysticercosis.

3.5.1. Ante-mortem examination

Regular visits were made by the investigator at Gondar ELFORA abattoir in selected days with possible additional visit to conduct ante-mortem examination of slaughter animals. A total of 400 cattle

were examined in Gondar ELFORA abattoir during the survey period which extended from October 2014 to April 2015. During the ante mortem inspection, the age, breed, origin, body condition and type of grazing of each animal was determined. The age of animals was determined by eruption of animals teeth, body condition of each individual animal was assessed and recorded depending on their body condition score, were ranked as poor, medium or good, animal origin was also recorded as the state, from where the animal came.

3.5.2. Post-mortem examination

The study was based on routine meat inspection for randomly selected cattle slaughtered at the abattoir. Visual inspection of all exposed surfaces was done to shoulder muscles, hearts, masseters (cheek muscle), diaphragms, tongues, triceps and livers. This was followed by incision of masseters (cheek muscle), tongues, hearts, triceps, diaphragm and livers to be examined for *Cysticercus bovis* cysts. The incision procedure for each organ was as followed, for the masseter muscle, two deep linear incisions was done parallel to the mandible from its upper muscular insertion, the tongue was incised longitudinally from the apex to the root on the lower surface (also was examined by palpation), the heart was split from the base to the apex and further incisions was carried out into the muscle, the other organs was also examined based on the standard methods of the meat inspection and the findings was recorded. Carcasses which had one cyst or more in any of these organs was introduced to detailed meat inspection (including shoulder muscle).

3.6. Questionnaire Survey

Questionnaire survey was conducted during this study to know the prevalence and awareness of the population about human taeniasis. Selection of respondents for the questionnaire survey was based on random selection of volunteers from Gondar city. The selection was based on different age group, religion, sex, and educational status in Gondar city. Accordingly, 130 volunteer individuals were selected and interviewed. Questionnaire survey on the disease occurrence and risk factors was administered on those 130 volunteers respondent from whom pre-informed consents were obtained. The potential risk factors of taeniasis such as habit of raw meat consumption, age, sex, religion educational status, presence and usage of sanitary facilities especially toilet and knowledge of *T.saginata* were assessed. Specific questions regarding medical history related to traditional and modern taeniocidal drugs use, impact of taeniasis and possible options were included in the questionnaire to estimate the risk factors association with taeniasis.

3.7. Cyst viability test

The viability of the cysts was tested by putting them in normal saline solution and bovine bile, and incubated at 37°C for 1-2 hours in the incubator. In viable cysts evagination of the scolex was observed but in dead (degenerative) cysts no evagination of scolex.

3.8. Pharmaceutical inventory

Regarding the drug inventory, relevant information was gathered from some selected volunteer pharmaceutical shops in Gondar city. Different human drug stores located in Gondar city were inventoried for the amount and costs of drugs sold for treatment of human taeniasis. During the study; inventory was conducted on ten randomly selected pharmaceutical shops and one public health center existing in Gondar city. Accordingly, annual adult dose off taeniocidal drugs sales (based on prescription and patient complaints) in 2013 and 2014 were gathered to analyze the socio-economic impacts of taeniasis in the area.

3.9. Data management and analysis

The data was checked, coded and entered in to Microsoft excel work sheet and was analyzed using SPSS software. Descriptive statistics like percentage was used to express prevalence, while chi-square (χ^2) test was used to compare the association of cysticercosis with different risk factors. In all the cases, 95% confidence level and 0.05 absolute precision errors were considered. A p-value ≤ 0.05 will be considered statistically significant.

4. Results

From October 2014 to April 2015, 400 cattle were examined both at the time of ante mortem and postmortem examination. Out of the total 400 cattle, 171 were from highland while 229 cattle originated from lowland areas. Out of the total 400 cattle examined, 22 were found positive for the presence of *C. bovis* giving a percent positivity of 5.5 %. There was no statistically significant difference ($P > 0.05$) in prevalence of bovine cysticercosis in between origin and body condition of animals. The highest prevalence was observed from Makisegnit (9.0%) followed by Chilga (7.8%), Dabat (5.9%), Dembia (3.2%) and Koladiba (1.5%). The prevalence rate was also assessed based on the aim of body condition and breed (Table 1).

Anatomical Distribution of Cysts: Active abattoir survey data showed that there was variation in the anatomical a distributions of *Cysticercus* in organs inspected. The highest proportions of *C. bovis* cysts were observed in heart 14(3.5%), tongue 11 (2.75%), masseter muscle 10 (2.5%) and triceps 9(2.25%) (Table 2). From the total 44 *C.bovis* cysts collected during the study period 14 (30%) were found to be

live while other 30 (70%) were degenerative (dead) cysts (Table 5).

Pharmaceutical inventories

An inventory of pharmaceutical shops was conducted in Gondar city. Estimation of yearly adult *taeniacid* drugs dose and its worth were collected through personal interview with individuals in charge of pharmacies and using their records for the year 2013 and 2014. This revealed that a total of 50,969 adult *taeniacid* drug doses were sold for a total worth of 193,558.5 Ethiopian Birr (Table 3). *Praziquantel* and *Albendazole* were the most frequently sold drugs for the treatment of taeniasis, while *Niclosamide* and *Mebendazole* were the least sold drugs.

Questionnaire survey on taeniasis

The survey result showed that some of individuals surveyed were aware of about taeniasis. Of the total of 130 interviewed respondents who

participate in this study, 33.07% had contracted *T.saginata* infection at least once in their life time. The multiple logistic regression analysis of risk factor showed significant difference (P-value<0.05) in the prevalence of taeniasis with habit of raw meat consumption, and level of education. Accordingly raw meat consumers (OR=0.005, 95% CI [0.001-0.031], and those who had low level of schoolings and illiterates 95% CI [2.02-190.326] had higher odds for acquiring taeniasis than cookedmeat consumers and other societies respectively. The majority of the respondents had an experience of raw meat consumption as a result of traditional and cultural practice and only some of the respondents were non latrine user, the majority of the respondent used latrine. In addition to this many of educated societies were know the transmission, clinical signs and prevention and control of taeniasis.

Table 1: Prevalence of bovine cysticercosis on the bases of age, origin, body condition, breed and sex

Variable	No of animals inspected	No of animals infected	Prevalence	X ²	P-value
Sex					
Male	400	22	5.5%	_____	_____
Female	0	0	----		
Breed					
Local	346	18	5.2%	437	0.509
Cross	54	4	7.4%		
Origine					
Dabat	68	4	5.9%	566	0.226
Chilga	103	8	7.8%		
Koladiba	68	1	1.5%		
Makisegnit	67	6	9.0%		
Dembia	94	3	3.2%		
Bodycondition					
Poor	45	3	6.7%	38.1	0.869
Medium	209	12	5.7%		
Good	146	7	4.8%		
Age					
3-4	32	1	3.1%	38.2	0.826
5-6	68	4	5.9%		
>=7	300	17	5.7%		

Table 2: Frequency of bovine cysticercosis on the basis of age and origin.

Organs affected	Number of affected animals	Percentage (%)	Number of cyst recovered	Percentage (%)
Tongue	11	2.75	11	25
Heart	14	3.5	14	31.81
Triceps	9	2.25	9	20.45
Masseter	10	2.5	10	22.72

Table 3: Annual taeniacid drugs sold during 2013-2014 at different pharmaceutical shops

Drugs	Dose in year		Total dose	Total average cost (ETB)
	2013	2014		
Praziquantel	9,756	8,876	18,632	74,528
Albendazole	5,354	7,997	13,351	66,755
Niclosamide	4,764	4,857	9,621	28,863
Mebendazole	4,467	4,898	9,365	23,412.5
Total			50,969	193,558.5

Table 4: prevalence of *T. saginata* in human population of Gondar city

Variables		Number of interviewed	Number of infected	Prevalence (%)	Odd ratio	P-value	95% CI
Age	18-30	50	11	22	1	0.283	
	31-44	42	11	26.19	2.16		0.326-14.386
	>=45	38	21	55.26	0.503		0.8-3.166
Sex	Female	44	11	25	1	0.185	
	Male	86	32	37.21	2.69		0.623-11.608
Religion	Muslim	41	9	21.95	1	0.456	
	Christian	89	34	38.33	1.76		0.397-7.833
Latrine	User	95	27	28.42	1	0.061	
	Non user	35	16	45.71	0.005		0.02-1.093
Habit of raw meat	No	88	8	9.09	1	0.00	
	Yes	42	35	83.33	0.005		0.001-0.031
Education status	College	39	12	30.76	1	0.04	
	High school	41	9	21.95	22.06		2.307-211.004
	Elementary	18	5	27.77	7.56		0.836-68.48
	Illiterate	32	17	53.12	19.60		2.02-190.326
Total		130	43	33.07			

Table 5: Prevalence of *cysticercus bovis* in different organs

Organ inspected	Number of cyst			Prevalence (%)		
	Live	Dead	Total	Live	Dead	Total prevalence (%)
Tongue	2	9	11	18.2	81.8	25
Heart	5	9	14	35.7	64.3	31.8
Triceps	4	5	9	44.4	55.6	20.5
Masseter	3	7	10	31.8	68.2	22.72
Total	14	30	44			

5. Discussion

Taeniasis /cysticercosis occur most commonly in the environments characterized by poor sanitation, primitive livestock husbandry practice and inadequate meat inspection and control. Bovine cysticercosis usually does not cause much morbidity or mortality among cattle, but it does cause serious economic problems in the endemic areas due to the condemnation of meat or down grading of carcasses contribute to constraint in food security and safety [22]. The result of this study also reflect both the economic and zoonotic importance of this diseases,

which is in agreement with the above statements. The prevalence of *C. bovis* is low in developed countries, being less than 1% of carcasses inspected [22]. However, the infection rate is often around 30% in developing countries. In the present study, the occurrence rate of cysticercosis in Gondar ELFOR abattoir was found as 5.5% which is slightly in agreement with the finding of [7]. 4.9% in Gondar [9]. 2.7% in Asela, [26] 3.11% in central highlands (Akaki, Debrezeit, Nazereth). This could be due to the fact that the incidence of *C. bovis* varies from region to region and also reflects the expertise of meat

inspectors. Moreover, in the routine inspection of beef carcasses, there is practical limitation to the number and degree of incisions permissible, for gross mutilation lowers the marketability of the carcass, as a result many infestations remain undetected. The flooding of pastures, use of sewage effluent for pasture irrigation without adequate treatment, free access of cattle to surface water, proximity of wastewater effluent, keeping the animals indoor, farm sanitation, farmer's education about the disease are the other factors that make the difference in prevalence percent of bovine cysticercosis. However, the present study showed that percent positivity of 5.5% is lower than the finding of [19]. from Addis Ababa (7.5%), [15]. from east shoa (17.5%), [2]. from Nekemt (21%) and [3] from Hawassa (25%) and studies in export abattoirs like Mojo, ELFORA, Dukem, Luna, revealed a comparatively higher prevalence of cysticercosis in cattle. The percent positivity in these abattoirs was 17.9%, 13.6%, 19.2%, and 27.6% respectively [8]. In Amhara National regional state, [17] in his study from September, 2005 to February, 2007, showed the presence of *C. bovis* in 824 (18.49%) of 4456 cattle. From these reports, it is evident that there is variation in the prevalence of *C. bovis* in cattle within Ethiopia [19]. viewed that difference in the prevalence of cysticercosis within a country probably reflects the difference in the expertise/or diligence of meat inspectors. In addition to this, the incidence or prevalence of cysticercosis is reported high in modern and export abattoirs which may be due to a thorough meat inspection by incising all organs/muscles and also inspectors in such abattoirs are more experienced and also have awareness to the economic importance of *C. bovis* in the exportation.

Anatomical distribution of *C. bovis* was recorded at various sites on the infected carcasses. They were present in hearts of 3.5%, tongues of 2.75%, masseter muscles of 2.5%, and triceps muscles of 2.25% cattle. According to [27, 28]. *C. bovis* are commonly found in muscles of mastication, particularly masseter muscles, shoulder muscles, heart, tongue, diaphragm and occasionally in fat, liver, lungs and lymph nodes. In the present study cysts were found in heart, tongue, triceps, and masseter muscles with predominance in the heart showing a positivity of 3.5% of 400 cattle. This is because the butchers and owners usually oppose several incisions on triceps masseter and shoulder muscle due to loss of earnings. As compared to inspection of predilection sites of *C. bovis*, thorough examination of heart and tongue were observed to be the practice at Gondar ELFORA abattoir and this may be reason of reporting positive heart and tongue in higher numbers in this study than the other sites including the striated muscle "as the predilection site. The viability test of the cyst revealed

that it was the triceps muscle which harbored the highest number of viable cysts (44.4%), followed by heart (35.7%), masseter (30%) and tongue (18.18%). The variation in anatomical distribution depends up on a number of factors, such as blood kinetics and animals daily activities. Any geographical and environmental factors affecting blood kinetics in the animal affect the distribution of oncospheres as well and hence the predilection sites during meat inspection [27, 29].

Bovine cysticercosis has its own public health significance. The cysts after ingestion by human beings develop into adult parasite, *T. saginata*, leading to the disease called *taeniasis* manifested by anorexia, loss of weight, abdominal pain, digestive disturbances and insomnia [4]. Human *taeniasis* was a widespread health problem in the study area with the prevalence of 33.07%. And it is relatively lower than the finding of others 64.2% [24]. 51.1% by [1].

This might be due to the awareness of societies about taeniasis and the control measure taken by the government. Significance association was observed between taeniasis prevalence and habits of raw meat consumption of the respondents. The higher the prevalence of taeniasis among habit of raw meat consumers was due to the access of viable cysticerci infected beef than those with less frequent raw meat consumers and no raw meat consumers. Significant association was also observed between taeniasis prevalence and educational status of individuals. The more they educated the less they exposed to taeniasis. This might be due to the knowledge of about transmissions, control and prevention of the disease and, it might be also due to deep rooted tradition of consuming "Kurt", that most probably less educated societies stuck in. Educated societies have less probability of masked in our culture. This is because they cannot escape from westernized hemisphere. In this study no statically significant difference was observed between the proportion of taeniasis in Musilim and Christian community. This result is in line with the finding [26]. The reason behind the similarity of different religion group might be due to they share the same culture and habit of raw meat consumption in the study area regardless of their religion. Significant association was not observed between latrine user, age, and prevalence of taeniasis ($P > 0.05$).

In this study, there was no association ($P > 0.05$) between age, origin, body condition, breed and the prevalence of bovine cysticercosis and this agrees with reports of [26], [15]. One possible explanation for insignificance of variation might be due to the fact that most of the animals slaughtered in this abattoir were adult and having similar husbandry systems (the same type of live stock management), and the owners of

these animals have approximately equal educational status to take care of their animals and have no tradition of bring their animals to veterinary clinic for treatment.

Inventory of eight (8) pharmaceutical shops out of drug shops existing in Gondar city for the year's 2013 and 2014 indicated that, a total of 50,969 adult taenical drugs doses with an estimated cost of 193,558.5 ETB. This indicated that taeniasis diminishes the household financial resource of the society, attention should be taken to safe guard the public health and further promote beef industry in the country.

Conclusion Recommendation

Taenia saginata is a public health and economic important cestode parasite prevalent in Ethiopia. High prevalence rate is associated with raw and under cooked beef consumption, presence of back yard slaughter practices indiscrimination defecation, low level of public awareness and poor waste disposal. From the present study, it can be concluded that bovine cysticercosis was prevalent in Gondar and its adjoining areas and its percent prevalence was comparable to other parts of Ethiopia. However, the prevalence rate was lower than the ones reported by some regions and export abattoirs in this country, there should be a public awareness about the health and economic significance of the disease by strengthening of training with special reference to the danger of raw or undercooked meat consumption and use of latrines.

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