Bovine cysticercosis in Cattle Slaughtered at Jimma Municipal Abattoir, South western Ethiopia: Prevalence, Cyst viability and Its Socio-economic importance

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Abstract

A cross sectional study was conducted during November 2008 to March 2009 to estimate the prevalence of Cysticercosis in animals, Taeniasis in human and estimate the worth of taeniasis treatment in Jimma town. Active abattoir survey, questionnaire survey and inventory of pharmaceutical shops were performed to accomplish the study. Of the total of 500 inspected animals, 22 animals had varying number of C. bovis giving an over all prevalence 4.4% (22/500). Anatomical distribution of the cyst showed that highest proportions of C. bovis cyst were observed in shoulder muscle, followed by tongue, heart and masseter muscle. Of the total of 114 C.bovis collected during the inspection, 49(42.9%) were found to be a live while others (57.0%) were degenerative cyst. Of the total 60 interviewed respondents, 56.7% (34/60) had contracted T.saginata infection, of which, 95% and (5%) cases reported using modern drugs and traditional drugs, respectively. The majority of the respondent had an experience of row meat consumption as a result of traditional and cultural practice. Human Taeniasis prevalence showed significant difference (p<0.05) with age groups, meat consumption, sex and use of spice. Accordingly adult individual (OR=47.4), frequent raw meat consumers (OR=18.4), spice users (OR=7.0) and male (OR=5.0) had higher odds acquiring Taeniasis than children, occasional meat consumer, non spice users and females, respectively. In this analysis there was no significance difference between religion, education status, occupational risks and marital status (p>0.05). An inventory of pharmaceutical shops (pharmacies, drug stores and rural drug vendors) revealed a total of 103,596 adult taeniacidal drug doses worthing a total of 222,706 Eth. Birr (22,270.6 USD) during two years of 2007 and 2008. Vermox and Niclosamide were the most frequently sold drug for the treatment of taeniasis, while Praziquantel was least sold drug. The findings of this study including prevalence of C. bovis, questionnaire survey of taeniasis prevalence and the pharmaceutical shops inventory indicated the importance of Cysticercosis and Taneniasis both in public health and economical aspects. Therefore, due attention should be given to the public awareness and strict routine meat inspection in order to safe guard the public health.

Keywords: Abattoir, C. bovis/Taeniasis, Cattle, Prevalence, Ethiopia

Introduction

Bovine cysticercosis refers to the infection of cattle with metacestodes of the human tapeworm (Oladele et al., 2004). It is a major problem for producers in Sub Saharan Africa. Many cases of taeniasis in human are asymptomatic, except for some anal pruritis due to emerging tape warm segments but with severe infection human beings may experience loss of weight, anorexia, abdominal discomfort, and digestive up-set (Gracey et al., 1999).

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. *T. saginata* occurs in the small intestine of human and the metacestode (*Cysticercus bovis*) is found in cattle. Most incidents in cattle arise as a result of direct exposure to proglottids shed from farm workers, but there have been some reports of large scale outbreaks resulting from sewage-contaminated feed or forage (Wayne et al., 2002).

Globally, there are 77 million human carriers of Taenia saginata out of which about 40% live in Africa. In developed countries, even if the disease has a very low prevalence, the problem with the removal and treatment facilities in their sewage system plays a role in the distribution of eggs, since it was recorded that the egg can survive in sewage. The prevalence of Taeniasis 64.2% reported by Abunna et al. (2007) and

51.1% by Regassa et al. (2008) based on questionnaire survey revealed that it is a well-known disease in Ethiopia. On the other hand the prevalence of Cysticercosis was reported to be 26.3% in cattle slaughtered at Hawassa municipality abattoir Abunna et al. (2008) and 13.3% in Wolita Sodo abattoir Regassa et al. (2008). Therefore, the present study was aimed at estimating the prevalence status of Cysticercus bovis slaughtered cattle at Jimma municipal abattoir and to assess socio-economical significance of T. saginata taeniasis in Jimma town.

Materials and Methods

Study area: The study was conducted at Jimma municipal abattoir. Jimma zone is located at the south western part of the county in Oromia regional state. The town is located at about 352 K.M south west of Addis Ababa, the capital of Ethiopia, geographically located at 70 13' and 80 56' N latitude and 350 52' and 370 E longitude. The area has an altitude ranging between 880 and 3358 meter above sea level. The annual rainfall is ranging between 1200 to 2000 mm with minimum and maximum and annual temperature of 70c to 300c respectively. Jimma district has livestock population of 18354 bovine; 1846 caprine; 3310 ovine; and 1490 equine (CSA, 2003). Slaughter animals are coming to Jimma municipal abattoir from different areas surrounding the town. The livestock production is characterized by extensive production system in which indigenous cattle are kept under traditional management.

Study design and study animals: The study is a across sectional type in which active abattoir survey, questionnaire and drug shop inventory were conducted. Study population were cattle presented to the abattoir for slaughtering and routine meat inspection. From those animals that daily came to the municipal abattoir, study animals were randomly selected and routinely inspected for *T.saginata* cysticercosis.

Sample size determination: The total numbers of cattle required for the study was calculated based on the formula given by Thusfield (1995) using random sampling method. In this study, 50% prevalence was considered to calculate the sample size using the following formula.

N= 1.962xpexp (1-pexp) d2

Where n=required sample size

Pexp= expected prevalence

d2 =desired absolute precision

n= 1.962x 0.5(1.0.5)/ (0.05)2 = 384 animals

Actually 500 animals were sampled and inspected during the study period for the presence Cysticercus bovis cyst in inspected organs. Animals selected during this study were all male animals of local breed.

Study methodology

Active Abattoir survey: The cross sectional study, which was based on the active abattoir survey, was conducted during detail meat inspection on randomly selected 500 cattle slaughtered at Jimma municipal abattoir. Before inspecting the animals ante-mortem inspection was carried out and the tag number of each animal was recorded. During post mortem inspection, palpation of the organs followed by incision of organs was made to examine for the presence *C. bovis,* according to the guideline by Ministry of Agriculture (1972), for masseter muscle, deep linear incision were made parallel to the mandible; the heart were incised from base to apex to open the pericardium and incise also made in the cardiac muscle for detail examination. Deep, adjacent and parallel incisions were made above the point elbow in the shoulder muscle. Examination of the kidney, liver, and the lung was also conducted accordingly. All positive samples were transported to the parasitology laboratory in Jimma University, College of Agriculture and Veterinary Medicine for confirmation of cyst viability. The cysts were incubated in ox bile at 37 0C for 1-2 hr using 40% ox bile solution diluted in normal saline for 1-2hrs. After this, the scolex was examined under microscope by pressing between two glass slides. The cysts were regarded as viable if the scolex envaginates during the incubation period at the same time the scolex was checked whether it is *T. saginata* metacestode or other based on the size of cysticercus, absence of hook on the rostellem of the envaginated cyst (WHO, 1983).

Questionnaire survey: Identification of respondents for questionnaire survey was based on random selection of volunteers from Jimma town. The selection was based on different age, sex, and working conditions. Accordingly, 60 volunteer individuals were selected and interviewed. Questionnaire survey on the disease occurrence and risk factor was administered on those 60 volunteer respondents from whom pre-informed consents were obtained. The potential risk factors of taeniasis such as habit of raw meat consumption, age, sex, religion, occupation, educational levels, presence and usage of sanitary facilities especially toilet an knowledge of T.saginata. Specific questions regarding medical history related to use of traditional and modern taeniacidal drugs, impacts of taeniasis and possible option were included in the questioner to estimate the risk factors association with taeniasis. By doing so risk factors associated for the occurrence of the disease in human and public impact of the disease was assessed.

Inventory of pharmaceutical shops: Regarding the drug inventory, relevant information was gathered from volunteer pharmaceutical shops in Jimma town. Different human drug stores located in Jimma town were invented for the amount of drugs sold and cost of

drugs sold for the treatment of human taeniasis. Drug inventory was conducted on 8 randomly selected volunteer pharmaceutical shops out of the existing 18 drug shops. In line with this, annual adult dose of taeniacidal drug sales (based on prescription and patient complaints) in 2007 and 2008 were gathered to analyze the socio-economic significance of taeniasis in the area.

Data management and analysis: Abattoir, questionnaire and drug inventory data were recorded on specially designed forms and preliminary analysis was done in Microsoft Excel. The abattoir data were summarized and prevalence was calculated for the area. Anatomical distribution of *C. bovis* and cyst viability were tabulated. The questionnaire data were also summarized and analysed to assess the association of potential risk factors for taeniasis among different respondents using logistic regression Stata version 9 Special Edition. Data of pharmaceutical inventories were summarized using frequency table.

Results and Discussions

Abattoirs survey: Of the total of 500 inspected animals in Jimma municipal abattoir, 22 animals had varying number of C. bovis with an over all prevalence of 4.4% (22/500).

Analysis of the active abattoir survey showed that there was a significant variation with regard to the anatomical distribution of cysticercus cysts in the organs inspected. As indicated in Table 1, the highest proportions of C. bovis cyst were observed in shoulder muscle, followed by tongue, heart and masseter muscle. A total of 114 cysts were detected during the inspection. Of the total 114 C.bovis collected during the study period 49(42.9%) were found to be a live while other (57.0%) were degenerative cyst (Table 1).

Table -1. Anatomical distribution and viability of cysts among inspected organs

Organ	No.	Positive	Cyst	Viable cyst
Tongue	500	20	47	19
Masseter	500	4	5	1
Liver	500	0	0	0
Lung	500	0	0	0
Heart	500	4	8	4
Shoulder	500	11	54	25
Spleen	500	0	0	0
Kidney	500	0	0	0
Total	4000	39	114	49

Questionnaire survey: Of the total 60 interviewed respondents who participated in this study, 56.7% (34/60) had contracted T.saginata infection, of which, 95% and 5% reported using modern drugs and traditional drugs, respectively. Figure 1 displays proportions of different drugs used by individuals with taeniasis.

The majority of the respondent had an experience of raw meat consumption as a result of traditional and cultural practice. The logistic regression analysis of the risk factors showed significance difference (p<0.05) in the prevalence of taeniasis with different age groups, raw meat consumers, and use of spice, respectively. Accordingly, adult individual (OR=47.4), high meat consumer (OR=18.4), spice users (OR=7.0) and male (OR=5.0) had higher odds acquiring taeniasis than children, occasional meat consumers and non spice users and females, respectively (Table. 2). In this study, there was no significance difference observed between religion, educational status, occupational risks and marital status (p>0.05).

Inventory of pharmaceutical shops: An inventory of pharmaceutical shop (pharmacies, drug stores and rural drug vendors) was conducted in Jimma town. Estimates of yearly adult taeniacidal drugs dose and its worth were collected through personal interview with individuals in charge of pharmacies and using their records for the year 2007 and 2008. This revealed a total of 103,596 adult taeniacidal drug doses were sold for a total worth of 222,706 Eth. Birr (22,270.6 USD) (Table 3). Vermox and Niclosamide were the most frequently sold drugs for the treatment of taeniasis, while Praziquantel was the least sold drug.

Most adult and larval tape worm infections cause little or no disease to animals. However cysticercosis causes economic loss through condemnation of infected meat and offals. 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 downgrading of carcasses in light infections contributing to constraint in food security and safety (Onyango–Abuje et al., 1996). The economic losses as a result of the condemned and downgraded carcasses due to treatment or processing of carcasses for human consumption are substantial (Dorny et al., 2002). In East Africa, *T. saginata cysticercosis* has been reported as a widespread and extremely common (Urqhuart et al., 1996). The results of the present study also reflect both the economic and zoonotic importance of this disease, which is in agreement with the above statements.

The prevalence of *C. bovis* among the carcasses inspected at Jimma municipal abattoir was 4.4% in agreement with the findings of Dawit (2004) (4.9%) at Gondor and Tembo (2001) (3.1%) in the central Ethiopia. However, it is less than the findings of other authors such as 26.3% by Abunna et al. (2008) in Hawassa, 17.5% by Hailu (2005) in East Shoa, 13.8% by Getachew (1990) at Debre Zeit, 13.3% by Regassa et al. (2008) at Wolaita. The majority of the findings in Ethiopia were based on surveys carried out on carcasses subjected to the routine meat inspection

Table – 2. Potential risk factors for Taeniasis prevalence among the interviewed respondents

Variables	No	Cases	%	OR (95% CI)	P -value	Adjusted OR (95%CI)
Age						
< 15 yr	5	2	40.0	1.0		1
16- 30 yr	40	19	47.5	1.4 (0.2 - 9.0)	0.752	5.8 (0.2 - 156.0)
> 30 yr	15	13	86.7	9.8 (1.0 - 99.9)	0.055	292.0 (.87 - 98576)
Sex						
Male	31	21	67.7	1		1
Female	29	13	44.8	0.39 (0.14-1.11)	0.076	0.14 (.02 - .81)
Religion						
Christian	23	14	60.9	1.5 (0.5 - 4.4)	0.472	1.8 (.30-10.8)
Muslim	37	20	54.1	1		1
Occupation						
Low risk	51	26	51.0	1		1
High risk	9	8	88.9	7.7 (0.9 - 66.0)	0.063	0.40 (.01-14.7)
Education						
Elementary	17	11	64.7	1		1
High School	31	18	58.1	0.8 (0.2 - 2.6)	0.653	0.99 (.10 – 9.3)
College	12	5	41.7	0.4 (0.1 - 1.8)	0.224	0.66 (.04-10.5)
Marital status						
Single	43	20	46.5	1		1
Married	17	14	82.4	5.4 (1.3 - 21.4)	0.017	0.38 (.01-14.8)
Raw meat consumption						
Less	4	1	25.0	1		1
Medium	40	20	50.0	3.6 (03 - 31.3)	0.359	1.8 (.05 - 56.9)
High	16	13	81.3	17.2 (1.0 - 172.9)	0.052	18.4 (1.1 - 695.1
Use of spice						
No	14	4	28.6	1		1
Yes	46	30	65.2	4.7 (1.3 - 17.3)	0.021	7.9 (1.4 - 45.4)

procedures. Hence, the same limitations with which meat inspection shares globally were reflected in this study. Accordingly, the lower prevalence of bovine cysticercosis in this study might be attributed to the variation in the personal and environmental hygiene, religion, culture and feeding habit of the population and their production system. The majority of animal producers (farmers) around Jimma from where slaughter animals are originated are predominantly Muslims who do not consume raw meat. This may contribute less contamination of grazing land by human excreta containing *T. saginata* eggs. There may be subsequent reduction of chance of infecting the intermediate host, cattle. Furthermore, low prevalence of the present finding could be partly due to practical limitations to the number of incisions allowed and many infestations could be undetected as already demonstrated by other authors (Wanzala et al., 2003).. As gross mutilation lowers the marketability of carcasses and introduce contamination, owners do not allow multi incisions for the detail investigation. It is also now recognized that local breeds are resistant to parasitic disease infections (Gracey et al., 1999).

Regarding the anatomical distribution of the cysts, the organs affected in order of the proportion of the cysts were shoulder, tongue, heart and masseter. The most frequently affected organ with the highest number of cysts was the shoulder. In cattle throughout Africa, important predilection site are the muscle of the shoulder (muscules triceps brachii), a reason advanced for the frequent involvement of these muscles, being the increased blood supply due to the long journeys undertaken by these animals (Gracey et al., 1999). Viability test of the cysts revealed that it was the heart which harboured the highest number of viable cysts (50%) followed by shoulder (46.3%), tongue (40.4%), and masseter (2.0%). The proportion of shoulder muscles affected with *C. bovis* was 46.3% which is in agreement with the reports of Carlos et al. (2002) (46%). However, the present finding is greater than the findings of Hailu (2005) and Regassa et al. (2008) who recoded shoulder cyst proportion of 32% and 27%, respectively. Generally, the method of meat inspection, the ability of the meat inspector to identify the cases, difference in the management, sample size and sampling method, the number of cuts, and other factors can contribute for the variation of prevalence of bovine cysticercosis.

In this study, the respondents who were questioned disclosed the findings of proglottids in their faeces, underwear, and laboratory diagnosis at health institution which indicates the presence of *T. saginata*. This is based on the WHO (1983) guidelines, which stated that *T. saginata* is known by its more frequent

expulsion through anus than *T. solium.* The supporting evidence for the occurrence of *T. saginata* rather than T. solium among the respondents was that almost all of the residents of the town do not eat pork due to religious cult which confirms the current finding to be *T. saginata*, ruling out possible differential diagnosis of T. solium. The prevalence of *T. saginata* recorded in this study based on the questionnaire survey was 56.6% illustrated the significance of taeniasis in the population of jimma town and agrees with the findings of others, 64.2% by Abunna et al. (2007), 51.1% by Regassa et al. (2008) 79.5% by Hailu (2005), 69.2% by Dawit (2004).

Table – 3. Annual Taeniacidal drugs sold during 2007-2008 at different pharmaceutical shops visited.

Drugs	2007	2008	Total	Cost
Niclosamide Eth.birr	16,745	16,405	33,150	66,300
Vermox Eth. birr	19,207	17,817	37,024	74,048
Dichlorophen Eth. birr	11,978	13,687	25,665	51,330
Praziquantel Eth. birr	3,532	4,225	7,757	31,028

The present study also indicated that there was a significant association between the prevalence of taeniasis and age indicating the higher prevalence of infection in adult people. The possible suggestion for this could be adult people had the habit of raw meat consumption than the younger, as younger are not allowed to consume raw meat and adult individuals have income and afford consuming raw meat "Kurt" which may be expensive for others. Significant association was also observed between taeniasis prevalence and uses of spice. This could be due to the fact that bile is one of the ingredients of the spice (awaze), which may facilitate the envagination of the cyst increasing the risk of infection. Higher prevalence of taeniasis among male individuals could be due to economic reasons and cultural practices in that male do not prepare their dish at home, rather consume at restaurants and butcheries. The study also showed significantly higher prevalence of Taeniasis among individuals who often consume raw meat than those with less frequent raw meat consumption. This is similar to the finding of Abunna et al. (2008) who reported higher prevalence of Taeniasis among raw meat consumers.

Human Taeniasis has importance both in socio economical and health aspects. However, evaluation of the economic aspects is very difficult particularly in developing countries like Ethiopia, where infected people treat themselves with traditional herbal drugs. One of the possible sources of information to evaluate the financial loss is to carry out inventories of pharmaceutical shops, which may not reflect the actual economic impact of the disease. However, inventories

of eight out of about 18 pharmaceutical shops which comprises two years record 2007 and 2008 in Jimma town during the study period indicated that 103,596 adult doses of taeniacidal drugs worthing 222,706 Eth Birr (22,270.6 USD). This indicated that taeniasis diminishes the household financial resources, which could be easily avoided by eating well-cooked meat and using toilets.

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, awareness of patients about the clinical pictures of the disease, variation in personal and environmental hygiene, and other factors related to the variation in the prevalence of taeniasis among countries. In general, *T. saginata* is a medically and economically important cestode parasite, while infection with the cysticercus larval stage in cattle causes economic loss in the meat industry. Therefore, 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 toilets/latrines.

The findings of this study indicated the importance of the disease both from its public health and economical aspects point of view. The disease results in economic loss due to condemnation of infected organs and down grading carcasses, and further more, incurring considerable cost of human treatment. Finally, the finding of the present study reflects the zoonotic and economic impact of the disease which needs serious attention by the various stakeholders in order to safe guard the public health.

Acknowledgements

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