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The Prevalence of *Cysticercus bovis* in Cattle Slaughtered at Shashemene Municipal Abattoir and Community Perception about Taeniosis

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Abstract: A cross sectional study was conducted to determine, the prevalence of *Cysticercus bovis* in cattle slaughtered at Shashemene municipal abattoir, to determine prevalence of *Taenia saginata* taeniosis in human and to assess the significance of potential risk factors using questionnaire survey. From a total of 384 cattle 10 were found positive for *Cysticercus bovis* with an overall prevalence of 2.6%. Of about 49 *Cysticercus bovis* collected during meat inspection, 17 (34.7%) were alive. Viability test revealed that the tongue harbored the highest number of live cysts (64.7%) followed by tricepsbrachi (11.76%), heart (5.88%), liver (5.88%) and masseter (5.88%). Of 200 respondents interviewed about 93 of them contracted *T. saginata* infection with an overall prevalence of 46.5%. The result of questionnaire survey also disclosed that 91.5% of respondents knew reasonable knowledge which is avoiding consumption of raw and undercooked beef. Therefore, due attention should be given to the public awareness and strict routine meat inspection in order to safe guard the public health.

Key words: *Cysticercus bovis* · Taeniosis · *Taenia saginata* · Risk Factors · Prevalence

INTRODUCTION

Bovine cysticercosis is a muscular infection of cattle by the larvae of the human intestinal Cestode *Taenia saginata* commonly referred to as the beef tapeworm. This larva is meat-borne and human infection results from the ingestion of raw or undercooked beef. This condition is associated with tissue infection and the larval stage is referred to as *Cysticercus bovis*. The *Cysticercus bovis* is of great public health significance especially in developing countries where it invades the tissues of the eye as well as brain and spinal cord causing ocular and neurocysticercosis respectively [1-3]. The distribution of *Taenia saginata* is wider in developing countries, where hygienic conditions is poor and where the inhabitants traditionally consume raw or insufficiently cooked or under cured meat [4, 5].

The adult tapeworm, *Taenia saginata* occurs in the small intestine of the definitive host, man and the metacestode (*Cysticercus bovis*) is found in cattle that serve as main intermediate host. Globally, there are 77 million human Taenia carriers, out of which about 40% live in Africa. Meanwhile, its prevalence is high in developing countries particularly in sub-Saharan Africa [6]. In East African countries, prevalence rates of 30-80% have been recorded [7]. In developing countries, the incidence of human infection with *T. saginata* is also usually high, with the prevalence over 20%; whereas in developed countries, the prevalence of cysticercosis is very much lower, usually less than1% [8].

Even though, *T. saginata* has worldwide distribution, its prevalence is particularly high in Sub-Saharan Africa. In Ethiopia several authors have reported its prevalence in a wide range of 2.5 % to 89.41 % and 3.11 % to 27.6 %, respectively [7, 9-11]. It is believed that the cultural habit of eating raw meat in the form of “Kourt”-meat cubes and “Kitfo”-minced meat in Ethiopia, has favored the spread of this disease [7, 9, 12].

The effect of *T. saginata* on human health is considerable and symptoms may be vague or absent [13]. taenia has a debilitating effect on people who live on protein deficient diets suffer from iron deficiency and infected by hookworms [14]. Some patients lose their appetite and thus lose weight [4, 15]. Sometimes, the gravid Proglottids migrate to different organs such as the appendix, pancreatic duct, nasopharyngeal pathways and

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bile ducts producing obstruction and inflammation of the affected organs [4].

Taenia saginata taeniasis has high economic and public health impacts in Ethiopia; as a result control and prevention of the disease has a great importance. One of the prerequisite for implementing control and prevention action is instate information on prevalence and associated risk factors throughout the country.

This study was designed with the following objectives:

- To determine the prevalence of *C. bovis* in Shashemene
- To determine prevalence of *T. saginata* taeniosis and to assess the significance of potential risk factors.

MATERIALS AND METHODS

Study Area: The area lies within the mid Rift Valley with altitudes ranging from 1700 to 2600 metres above sea level (masl). It receives an annual rainfall of 700-950 mm with bimodal type of rainfall and has an annual average temperature range of 12-27°C

The study was conducted from December 2013 to April 2014 at Shashemene town. Shashemene is a town and a separate woreda in West Arsi Zone of Oromiya Region and it is located in central Ethiopia. The city lies on the Trans-African high way 4 Cairo Cape Town about 240 kilometers from the capital of Addis Ababa with altitudes ranging from 1700 to 2600 metres above sea level (masl). It receives an annual rainfall of 700-950 mm with bimodal type of rainfall and has an annual average temperature range of 12-27 [16].

Shashemene city has about ten kebeles and population of 824101.988 [17].

Study Population: The study animals for the abattoir survey were beef cattle slaughtered in Shashemene municipal abattoir in Shashemene town. For questionnaire survey the target population was people living in Shashemene town. About 200 individuals were interviewed to assess if they have experienced to eat raw meat/kitfo, infected with *T.saginata* or not from last one year up to the time of interview. The respondents were grouped into butchers, farmers, students and civil servants based on their exposure to raw meat consumption.

Study Design and Sample Size: The study is a cross-sectional type in which active abattoir survey was conducted to determine the prevalence of *C. bovis* and questionnaire were conducted to determine the prevalence of *T. saginata* taeniosis and asses associated potential risk factors. The sample size for both abattoirs and questionnaire survey was determined using the formula described in Thrusfield [18].

$$N = 1.962 \text{ X } Pexp (1-Pexp) / d2 = 384$$

where:

N = Required sample size Pexp = expected prevalence,
d^2 = Desired absolute precision

Data Collection

Abattoir Survey: Prior to sampling, each selected animal was given an identification number and data on each animal concerning sex, age, breed and origin.

During meat inspection, the identified animals and their respective organs were examined strictly separately to avoid mixing of the organs. Meat inspection was made in accordance with the procedures of the Ethiopian Ministry of Agriculture's Meat Inspection Regulation [19] for the detection of *Taenia saginata* cysticercosis. Carcasses of cattle slaughtered were thoroughly and systematically inspected by visual examination, palpation and incision into organs such as the tongue, masseter muscles, myocardium, triceps, thigh muscles, diaphragm, liver, spleen and intestinal mucosa using the methods earlier described by Okafor [20] and Anosike [21]. Cyst viability was ascertained by placing the cysts in a normal saline solution with 30% ox bile and incubated at 37°C for 2 h. The cysts were regarded as viable if the scolex evaginated after the incubation period. Examination of the scolex was performed microscopically to determine whether it was *C. bovis* or other Cestode larvae.

Questionnaire Survey: The questionnaire format comprises a total of 32 questions, with predetermined answers suitable for data processing. The main outcome variable was *Taenia saginata* taeniasis occurrence. The expected risk factors incorporated in questionnaire are: age, sex, religion, occupation, habit of eating beef meat, knowledge about the source and prevention of the disease. The questionnaire survey site was Shashemene town, 4 kebeles were selected based on the relatively high population and 50 individuals from each kebeles were interviewed.

Data Analysis: All collected data were entered into Microsoft Excel 2010 and analyzed by using SPSS (20) versions. The analyses were made at 95% Confidence

interval and 5%precision. The prevalence of *C. bovis*: live, dead and total per organ were summarized using Chi-square (X^2). The questionnaire data such as, relative prevalence of *Taenia Saginata* taeniasis and overall prevalence was calculated. The independent variable; such as sex, age, religion, occupation, eating habit, eating frequency, knowledge about the source and prevention methods were assessed, using Chi-square for possible association with the dependent variable *Taenia saginata* taeniasis occurrence. For these risk factors showed significant association with the *Taenia Saginata* taeniasis or cysticercosis the multivariate logistic regression analysis was performed to know strength of association.

RESULTS

Abattoir Survey: Results of abattoir survey revealed that the overall prevalence of cysticercus bovis was 2.6%. The result of abattoir survey showed that there was significant statistical difference between the prevalence of *T.saginata* cysticercosis and body condition of the animals infected. The abattoir survey also revealed there was no significant statistical difference was observed in the prevalence of cysticercosis in relation age, sex, origin and breed of animal (Table 1).

Of 49 cysts encountered during study, 16 (34.78%) were found to be alive, whereas 34 (73.91%) were degenerative cysts after viability test was done. Analysis of the abattoir survey indicated there were major variations in the anatomical distribution of cysts in the organs of infected animals. The abattoir survey also revealed that highest records of cysts were found in the tongue, followed by the tricepsbrachi muscle, heart, liver and masseter muscle (Table 2).

The cattle's with poor body condition are about 20.687 odds (OR=20.687) times higher suffer from *Cysticercosis* than cattle's with good body condition score (Table 3).

Questionnaire Survey: A total of 200 individuals were interviewed in four kebeles of Shashemene town to determine relative risk factors associated with infection by *T.saginata.* Result of questionnaire survey revealed that an overall prevalence of *T.saginata* taeniosis was 46.5% in infected respondents. The study showed that *T.saginata* taeniasis occurred in 21.6% of students, 22.6% of farmers, 6.45% of butchers and 6.45% of civil servants. The study also showed that *T.saginata* taeniosis occurred in about 76.4% of raw meat consumers and 22.6% of under cooked meat consumers. There was no signicant statistical difference between infection with *T.saginata* and sex, age, religion and level of education of the respondents ($p>0.05$). There was significant statistical difference between occupation of the respondents and infection with *T.saginata* ($P<0.001$ and also there was significant statististical difference between raw meat consuming habit of respondents and infection with *T.saginata* ($P<0.001$ $p=0.000$) (Table 4). This study also showed the prevalence of taeniosis in respondents with the age above 25 years was 65.59%and 34.41% in respondents with the age less than 25 years of age.

Table 1: Prevalence of *C. bovis* in cattle slaughtered in Shashemene municipal abattoir.

Variable	Groups	No of animals Examined	Prevalence (%)	Chi square	P value
Sex	Male	346	9(90)		
	Female	38	1(10)	1.090	0.296
Breed	Local	345	8(80)		
	Cross	39	2(20)	0.000	0.987
Age	Young	21	1(10)		
	Adult	363	9(90)	0.408	0.523
Body condition	Good	335	4(40)	23.56	<0.001
	Medium	39	4(40)		
	Poor	10	2(20)		

Table 2: Anatomical distribution and viability of cysts among infected organs

Organs	%positive	Total cysts	Live cysts (%)
Tongue	2.1	31	11(64.7)
Heart	0.5	3	1(5.88)
Liver	0.3	4	1(5.88)
Tricepsbrachi	0.5	8	2(11.76)
Masseter	0.3	3	1(5.88)

Table 3: Logistic regression analysis of body condition for the occurrence of *T.saginata* Cysticercosis in cattle's slaughtered in Shashemene municipal abattoir

Risk factors	χ^2	P value	Odd Ratio	95% CI for Odd Ratio	
Poor	23.56	0.001	20.687	3.297 -	129.810
Medium			2.8	0.339 -	14.095
Good			1	1	

Table 4: Prevalence of taeniosis in infected respondents in relation its risk factors

Risk factors	Category	Prevalence (%)	χ^2	P-value
Sex	Male	53(56.9)	1.175	0.278
	Female	40(43.1)		
Occupation	Students	21(22.6)	21.66	<0.001
	Farmers	21(22.6)		
	Butchers	6(6.45)		
	Civil servants	45(48.4)		
Meat consumption	Raw meat	71(76.4)	89.96%	<0.001
	Kitfo lebleb	22(22.6)		
	Only properly cooked	0(0%)		

Table 5: Logistic regression analysis of potential risk factors associated with the occurrence of *T.saginata* taeniosis

					95%CI of odd ratio	
Risk Factors	Variables	χ^2	P value	Odd ratio	Lower	Upper
Occupation	Students	21.66			0.119	1.249
	Farmers				0.156	1.480
	Butchers		<0.001	0.077	0.22	0.269
	Civil servants					
Meat consumption	Raw meat	89.96	<0.001	2.65	0.496	0.511
	Undercooked			32.1	0.321	0.35
	Only properly cooked					

Regarding religion of respondents this study revealed that the prevalence of taeniosis was 52.69% among Christians, 41.9% among Muslims and 5.4% in other religious respondents. The study also revealed that the prevalence of taeniosis was 49.46%, 12.9%, 25.86% and 11.83% in illiterate, informally educated, elementary school graduate and high school and above graduate respondents.

Being eating of raw meat is about 2.65 odds (OR=2.65) times higher suffer from taeniosis than eating of only properly cooked meat. Being butcher is about 0.077 odds (OR=0.077) times higher suffer from taeniosis than being civil servants (Table 5).

The results of questionnaire survey furthermore revealed the knowledge of respondents about symptoms of taeniosis, source infection and methods of prevention of the disease. There was no significant statistical difference between prevention methods, symptoms of illness and source infection with the occurrence of taeniosis.

Regarding symptoms of the disease about 45.2% of respondents disclosed presence of proglottids in faeces, 41.93% of respondents replied discomfort and about 12.9% of respondents thought excess saliva production. The questionnaire survey also revealed the source of taeniosis in infected respondents as about 91. 4% of them thought that eating raw beef which was satisfactory knowledge and about 6.5% of respondents said drinking raw milk and about 2.1% of them replied eating raw vegetables which are unsatisfactory knowledge about source of taeniosis. In addition the questionnaire survey also indicated about methods of prevention of taeniosis, thus about 70.96%, 18.3%, 2.2%, 4.3%, 4.3% avoid eating raw beef, using latrines, using taenicidal drugs, avoid drinking raw milk and don't know about prevention respectively.

DISCUSSION

Abattoir Survey: The study of abattoir survey revealed prevalence of *C. bovis* was 2.6% which is comparable with findings by Nuraddis and Frew [22] in Addis Ababa Municipal Abattoir 3.6%] and Gomol *et al*. [23]. in Jimma municipal abattoir with prevalence 3.6% respectively, of Tembo [7] in central Ethiopia with prevalence of 3.2% and of Dawit *et al*. [24] in Wolaita sodo Kebede *et al*. [24] in

which the prevalence was 2.59% but lower than the findings of Kebede *et al*. [25] and Nigatu [26] in Addis Ababa abattoir (7.5%), Abunna *et al.* [11] in Hawassa abattoir (26.25%), Kebede [25] in North West Ethiopia (18.49%), Hailu [10] in east Shoa (17.5%). The majority of the findings in Ethiopia were based on surveys carried out on carcasses subjected to routine meat inspection. Hence, the same limitations shared globally with meat inspection were reflected in this study. Accordingly, the lower prevalence of bovine cysticercosis in this study might be attributed to variations in personal and environmental hygiene, religion, culture and feeding habits, including beef breeds and their production systems.

This study showed the most frequently affected organ with the highest number of cysts was the tongue which agrees with findings in Ethiopia, [27]. The viability test of the cysts also revealed that the tongue harbored the highest number of viable cysts (64.7%), followed by the tricepsbrachi (11.76%), followed by heart (5.88 %%) and liver (5.88%) and masseter (5.88%). The proportion of tongues affected with metacestode of *T. Saginata* was 2.1% which agrees with that found in Hawassa (10.4%) Abunna *et al*. [11] and much lower that found in Jimma (40.43%), Megersa *et al*. [28]. The study also revealed sex, breed, origin and age of the animals has no effect on the prevalence of cysticercus bovis which is in agreement with findings of Dorny [29]. The study also revealed that there was the significant statistical difference between body condition score of cattle's and occurrence of *T.saginata* cysticercosis (Table 3). This could be due to the decreased immunity of the infected animal.

Questionnaire Survey: The cross sectional study of questionnaire survey revealed that of 200 respondents, 46.5% had contracted taeniasis, which illustrates the significance of taeniasis in the population of Shashemene and agrees with other authors' findings of Adugna *et al*. [30] which is 55.1%, Tilahun, *et al*. [31] 64.2%, Hailu [10] 79.5% and Dawit [9] 69.2%. In this study the prevalence of human taeniasis revealed significant differences ($p < 0.05$) according to occupation and raw meat consumption of respondents which agrees with findings in Yirgalem [32].

Concerning occupation butchers are at higher odds of contracting taeniasis than students, farmers and civil servants. The study revealed that there was highly significant statistical differences ($P<0.001$) among these groups. High-risk groups (butchers) are of course more prone to infection than low-risk groups (students) because they come into contact with meat and meat products frequently. The result of this study agrees with findings of Tembo *et al*. [7], Dawit [9] and Hailu [10].

Analysis of the present study showed that there was a strong significant statistical difference between raw meat consumption and infection by taeniasis ($p=0.000$). Thus, infection of humans by *T. saginata* is mainly due to the habit of eating raw (Kurt) or semi-raw (lebleb kitfo) meat dishes in Ethiopia because of deeply rooted traditions which agrees with findings of Tembo *et al*. [7] Hailu [10] and Abunna *et al*. [11].

The overall proportion of respondents having the knowledge that taeniasis is a zoonotic disease was 97.9%. Raw/undercooked meat consumption as a vehicle for transmission of taeniasis to humans was indicated by 91.4% which agrees with the study conducted at Arsi-Negele district, Southern Ethiopia, by Amenu *et al*. [33] who indicated that 96.3% of the respondents knew that raw meat was a vehicle for disease transmission to humans, while 6.5% of them said raw milk and 2.1% of them indicated raw vegetables can also transmit *T. saginata* which shows lack of knowledge about the disease to some extent. In spite of the relative higher perception of the respondents about the zoonotic importance of taeniasis, the consumption rate of raw meat and also the infection rate of taeniosis are found to be high. This seems to be attributed to the deep rooted culture of raw meat consumption in the country.

In this study respondents having knowledge of the symptom of *T.saginata* taeniosis disclosed as about 45.2% Proglottids in the faces, 41.93% discomfort and 12.9% excess saliva production. This study also indicated the respondents' perception about the methods of preventing the *T. saginata* taeniosis and about 70.96% of them replied avoiding raw meat consumption, 18.3% of them replied using latrines, 2.2% of them replied by using taenicidal drugs, 4.3% of them replied avoiding raw milk consumption and 4.3% of them have no information about the prevention. This could be due to insufficient awareness of the community regarding the prevention methods of the disease. In conclusion populations should be made more aware of general, personal and environmental hygiene and means of disease transmission, so that all consumers avoid consumption of raw meat and are encouraged to use toilets for the control of human taeniosis and cattle cysticercosis.

CONCLUSION

From questionnaire survey the occupation of the respondents and habit of raw meat consumption are the

most important risk factors for the occurrence of taeniosis. Even though this study revealed comparatively lower prevalence than other works in different parts of the country taeniasis/ cysticercosis remained a wide spread zoonosis that affects human and economy through condemnation of edible offal carcasses and cost of human therapy. The study suggests On job-in service training should be offered to meat inspectors to upgrade their skills in detection of *C. bovis* in organs and carcasses. Moreover, populations should be made more aware of general, personal and environmental hygiene and means of disease transmission.

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