

Risk Factors and Public Health Significance of Cysticercosis in Cattle and Human in Shire Indasilassie District, Northern Ethiopia

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Abstract: Bovine cysticercosis is an important public health problem and of economic importance particularly in East Africa. A cross-sectional survey on bovine cysticercosis was carried from October 2012 to July 2013 on 400 zebu cattle slaughtered Indasilassie municipal abattoir to estimate the prevalence and potential risk factors to infection. Moreover, 270 residents were sampled for a questionnaire surveys to assess the public health significance of the disease. The prevalence of bovine cysticercosis was found to be 15.60% (95%CI: 12.60, 18.40). The likelihood of acquiring bovine cysticercosis infection was higher in Indabaguna (OR = 2.50, 95% CI: 1.25, 5.0, P = 0.01) than in Shire Indasilassie, animals living in rural area (OR = 3.74, 95% CI: 1.60, 8.80, P = 0.002) than animals living in urban area, animals drunk in river and pond (OR = 2.6, 95% CI: 1.17, 5.84), P = 0.02) than animals drunk tape water. Moreover, a total of 120 cysts were randomly collected of which, 42 (35.25%) were found to be viable while the rest 78 (65%) were found to be non-viable (degenerated) cysts. The anatomical distribution of cysticerci were, 12.99, 14.29%, 25.97%, 23.38%, 11.69%, 6.49%, 1.30% and 3.90% of the cysts were collected from the tongue, masseter muscles, shoulder muscles, thigh muscles, heart, liver, diaphragm muscle and intercostal muscle respectively. The questionnaire survey clearly indicated that place of residents, age, sex, habit of raw meat consumption and religion of the disease were significantly associated with taeniasis infection rates in human (P < 0.05). Therefore, it is concluded that the disease is wide spread in the area and it is highly imperative public health education to build up public awareness about the sources of infection and its control and prevention method in the pastoral area that are at higher risk.

Key words: Bovine • Cysticercosis • Indasilassie • Prevalence • Public Health Significance • Risk Factors

INTRODUCTION

Bovine cysticercosis is an infection of cattle caused by the larval stage, *Cysticercus bovis*, of the human intestinal cestode, *Taenia saginata* [1, 2]. This parasite is more universally distributed, particularly in eastern and western Africa where it causes an important economic loss due to condemnation of meat [1, 3]. As per an estimate, 50 million cases of such infestation occur worldwide with 50,000 people dying from this problem annually [4]. Bovine cysticercosis and taeniasis are common where hygienic conditions are poor and the inhabitants traditionally eat raw or insufficiently cooked or sun-cured meat [5]. The epidemiology of the disease

is associated with the cattle rearing system, age of cattle, meat inspection practice and habit of consumption of raw and under cooked meat. Low awareness and poor hygiene and sanitary infrastructures may facilitate transmission of the disease between animals and human beings in the rural areas [6].

Due to the habit of eating raw or undercooked beef dishes such as “*kourt*” and “*kitffo*”, taeniasis in human is common in Ethiopia. A high (89.41%) prevalence of human infection in different agro-climatic zones of the country has been reported [7]. Low availability of taenicides is a constraint and the use of herbal drugs do not eliminate this parasite from human population and the proglottids are passed out with the faecal matter resulting

in cysticercosis in the cattle. Ethiopia is divided into nine ethnically-based administrative regions and three chartered cities and bovine cysticercosis has been reported from different parts of the country [4]. There is no documented in Indasilassie in both animals and human taeniasis. The aim of the study was to determine the prevalence, cyst viability and public health significance of bovine cysticercosis in Indasilassie municipality abattoir.

MATERIALS AND METHODS

November 9, 2013 Study Area: The study was conducted in Shire Indasilassie district of northwestern Tigray from October 2012 to July 2013. It is located a latitude and longitude of 14°8' 18"N 38°24' 10"E with an altitude of 1953 meters above sea level, the rain fall gets 700-1135mm and the temperature ranges 18-34.6°C. Livestock population of the district has a total head of 116092 of cattle, 42567 sheep, 10577 of goats, 8894 of equines, 14832 of chickens and 9714 honey bee colonies [8].

Study Animals: The study population includes all local zebu in Indasilassie municipal abattoir brought from various localities and adjacent woreda mainly from Shire Indasilassie, Adi Daero and Indabaguna.

Study Design: A cross-sectional study was conducted from October 2012 to July 2013 to gather information on the epidemiology of *C. bovis* and viability rates of cysts and identify potential risk factors for bovine infection. For this purpose 400 local zebu drawn from different neighboring areas of Shire Indasilassie district and slaughtered each day at Indasilassie municipal abattoir were surveyed. For the questionnaire surveys, 270 participants were administered in the district concerning public health significance of taeniasis.

Methods of Data Collection: Antemortem inspection: Information about individual animals was recorded. Such information include, age (classified as young: less than five and old: greater than five years according to dentation and history [9], origin of the animal (Shire Indasilassie, Indabaguna and Adi Daero), sex, management system (urban vs. rural) and sources of water for animals (tape water vs. river and pond). Postmortem examination: *T. saginata* cysticerci were obtained and collected from carcasses following meat inspection at specified predilection sites according to the guide line by MOA [10]. The tongue, heart, liver,

masseter muscles, triceps, thigh muscles, diaphragm and intercostal muscles of all slaughtered beef cattle were assessed by visual inspection, palpation followed by incisions for the detection of *C. bovis*. For masseter muscle the deep linear incisions were made parallel to the mandible; the tongue was examined from base to top, the hearts were incised from base to apex to open the pericardium and incision was also made in to cardiac muscle for detail examination. Examination of kidney and liver was also conducted accordingly.

Cyst Evaluation (Viability Test): The cyst which was found at meat inspection was removed with the surrounding tissue and taken to laboratory for viability test. The viability of the cyst were examined by placing them in a normal saline solution with 40% ox-bile and incubated at 37°C for 1-2 hours. A cyst was regarded as viable if the scolex evaginated during this period [11].

Questionnaire Survey for Public Health Significance: In order to assess the extent of human taeniasis, 270 voluntary respondents were randomly selected from three distinct areas; namely, Shire Indasilassie, Adi Daero and Indabaguna and interview were made individually using semi-structured questionnaire. The potential risk factors like age, habit of raw meat consumption, religion, sex, marital status, knowledge of the disease and knowledge of the disease was recorded.

Data Management and Analysis: Data obtained from antemortem, postmortem, laboratory and questionnaire results were coded and uploaded into Microsoft Excel 2010 spreadsheet computer program and analyzed using STATA version 11.0 for Windows (Stata Corp. College Station, USA). Univariate logistic regression performed utilizing the same program for the first set of questions included potential risk factors. Odd ratio and 95%CI were computed and the 95% confidence level was used and results were considered significant at $P < 0.05$.

RESULTS

Risk Factors: Overall prevalence of bovine cysticercosis was found to be 15.60% (95%CI: 12.60, 18.40). Univariable logistic regression analysis revealed that the odds of probability acquiring infection was found to be 2.5 times higher in Indabaguna (OR = 2.50, 95% CI: 1.25, 5.0, $P = 0.01$) than in Shire Indasilassie, observation during the survey period also found that the infection rate was found to be statistically higher significant animals living

Table 1: Logistic regression analysis for the risk factors of bovine cysticercosis infection slaughtered at Indasilassie municipal abattoir, northern Ethiopia

Risk factors	Prevalence	OR (95%CI)	P-value
Sex			
Female	13.92	1	
Male	15.74	1.16 (0.59, 2.28)	0.68
Age			
<5 years	12.44	1	
>5 years	17.04	1.45 (0.89, 2.38)	0.14
Origin			
Shire Indasilassie	7.76	1	
Adi Daero	13.12	1.6 (0.8, 3.57)	0.17
Indabaguna	20.15	2.5 (1.25, 5.0)	0.01
Life style			
Urban	5.45	1	
Rural	17.75	3.74 (1.6,8.8)	0.002
Sources of water			
Tap water	7.29	1	
River and pond	17.06	2.6 (1.17, 5.84)	0.02

Table 2: Number of organs infected and distribution of *C.bovis* on different organs of zebu cattle slaughtered in Indasilassie municipality abattoir, north Ethiopia

Organs examined	No. of infected organs	Relative frequency (%)
Tongue	10	12.99
Masseter muscles	11	14.29
Shoulder muscles	20	25.97
Thigh muscles	18	23.38
Heart	9	11.69
Liver	5	6.49
Diaphragm muscle	1	1.30
Intercostal muscle	3	3.90

Table 3: Proportion of viable in different organs of animals slaughtered in Indasilassie municipal abattoir, north Ethiopia

Organs examined	No. of cyst examined	Proportion of viable cysts in each organ (%)
Tongue	16	56.25
Masseter muscles	12	41.67
Shoulder muscles	32	32.25
Thigh muscles	27	33.33
Heart	21	23.81
Liver	12	33.33
Total	120	35

in rural area (OR = 3.74, 95% CI: 1.60, 8.80, P = 0.002) than animals living in urban area, animals drunk in river and pond were 2.60 times higher infection rates (OR = 2.6, 95% CI: 1.17, 5.84), P = 0.02) than animals drunk tap water. Sex and age of the animals were not statistically significant (Table 1).

Table 4: Logistic regression analysis for risk factors of human taeniasis in Indasilassie, north Ethiopia

Risk factors	Prevalence (%)	OR (95%CI)	P-value
Sex			
Female	26.92	1	
Male	51.56	6.68 (3.25,13.74)	0.000
Ages			
<20	12.5	1	
20-40	50	13 (5.56,33.33)	0.004
>40	58.33	23.25 (6.25,58.89)	0.0001
Religion			
Muslim	23.53	1	
Christian	46.62	5.29 (1.65, 16.95)	0.005
Place of residents			
Adi Daero	30	1	
Indabaguna	43.75	2.5 (1.10, 5.63)	0.03
Shire Indasilassie	60	5.27(2.45, 11.33)	0.0001
Habit of raw meat consumption			
Not consume	24	1	
Consume	59.05	3.47(1.83, 6.56)	0.0001
Marital status			
Unmarried	42.86	1	
Married	45.45	1.12(0.68, 2.06)	0.71
Knowledge of the disease			
Yes	42.16	1	
No	46.39	1.37(0.76, 2.48)	0.30

Anatomical Distributions of Cyst: On the predilection sites of the cysts 12.99, 14.29%, 25.97%, 23.38%, 11.69%, 6.49%, 1.30% and 3.90% of the cysts were collected from the tongue, masseter muscles, shoulder muscles, thigh muscles, heart, liver, diaphragm muscle and intercostal muscle respectively (Table 2).

Viability Test: Of the total 120 cysts randomly collected from the different organs, 35.25% were found to be viable while the rest 65% were found to be non-viable (degenerated) cysts (Table 3).

Questionnaire Survey on Taeniasis: Questionnaire data was collected in three districts and out of the total 270 respondents, 44.44% of them said they were infected with human taeniasis. Univariate logistic regression analysis of the questionnaire survey showed that place of residents, age, sex, habit of raw meat consumption and religion were significantly associated with taeniasis infection rates in human (P < 0.05) there was no significance difference (P>0.05) observed in the prevalence of taeniasis between knowledge of the disease and marital status (Table 4).

DISCUSSION

In the current study, prevalence of bovine cysticercosis was 15.60%. The present finding on the prevalence of *C. bovis* is in agreement with earlier reports of 13.3% at Addis Ababa abattoir [12], 11.3% at Wolaita Soddo municipal abattoir [13], 18.49% at Bahir Dar municipal abattoir [14], but it is lower than 26.25% and 22.9% in Awassa [15, 16] and greater than 3.11% in central Ethiopia [7], 5.8% at Nekemte municipal abattoir [17], 7.5% at Addis Ababa abattoir [18], 4.9% at Gondar municipal abattoir [19], 2.58% at Bahir Dar municipal abattoir [20] and 3.6% in Addis Ababa abattoir [21]. Even origin related distribution of bovine cysticercosis indicated higher prevalence in Indabaguna than in Shire Indasilassie and Adi Daero. This is may be associated with low number of incision made at inspection site in the abattoir, habit or culture of raw meat consumption, level of environmental contamination from where animals were bought, inappropriate use of toilet the area and dose and viability of eggs consumed by animal [22, 23].

There was also statistically significant difference between infection rate and life style of the animals with higher infection rates of animals living in the rural area. This is in line with the finding of Birhanu [20] in Bahir Dar municipal abattoir. Our finding also suggested that grazing poses a higher risk of *C. bovis* than non-grazing animals. This could be due to the fact that animals have high probability to get eggs from the ground. The current trend in the district shows inappropriate use of toilet in the area and dose and viability of eggs consumed by animal probably attributed for higher infection rates. Animals' good management was less exposure to contaminated pasture with human excreta while the rural cattle breeds were under extensive management system lead to human feces [18].

This study has shown a remarkable variation in the prevalence of *C. bovis* between sources of water. Animals drinking in well, river, pond and stagnant water were at higher risk of infection as compared to those drinking in the tap water. The variation could be associated with the level of environmental contamination from where animals were bought, inappropriate use of toilet in the area and dose and viability of eggs consumed by animal probably attributed for this variation [24]. Tap water is free from eggs when compared river and ponds. In present study there is no statistically significant variation observed between sex in accordance with

report of Mesfin and Nuradddis [16] and Nigatu [18].

Our observations showed that the masseter muscles, tongue, heart muscles, triceps muscles and thigh muscles among others were the preferred organs (predilection sites) for the cysts of bovine cysticercosis similar to earlier reports in various endemic areas [12]. It appears that several factors, such as activity of the muscles, age and the geographical area concerned determine largely the predilection sites in slaughtered cattle [24].

Tongue had highest proportion of viable cysts which harbored 56.25% viable cysts, followed masseter muscle (41.67%), thigh muscles (33.33%) and liver (33.33%). Similar results reported from different authors in Ethiopia [18, 20].

The prevalence of human taeniasis was recorded based on the questionnaire and indicated an overall infection rate of 44.44% which demonstrates the importance of taeniasis in the district. The result of this study was lower when compared to 62.5% from Wolaita Soddo [25], 64.2% from Hawassa [15], 79.5% from East Shoa [26] and 69.2% from Gondar [27].

Taeniasis prevalence was higher among the Christian community than Muslims in the study area. Similar to the reports of [7, 26, 28], taeniasis prevalence was higher among the Christian community than Muslims. Because raw meat consumption is not common in Muslims as in Christians and Christians also celebrate several annual festivals with the tradition of raw meat consumption [29].

This presentation revealed that males were highly affected than females. This observation is similar to the finding of Abunna *et al.* [15] who reported higher prevalence of taeniasis among males than females in Awassa town. The difference in the rate of infection between males and females in the study area could be due to the fact that males enjoy eating raw beef with local drink “*Tella*”. The second reason might be males provide and control the finance and hence, they can eat raw beef in the butcher house.

Taenia saginata was observed among old aged people as compared to young age people. This agrees with [7, 13, 19] observation that the older people greater chance of eating raw beef and hence contracting taeniasis. The place of respondents at the three woredas' survey showed that Shire Indasilassie was the highest infection rates, followed by Indabaguna. The difference of the infection rates in different areas was due to the fact that the difference of cultural, religion and use of latrine.

In Ethiopia, people are eating raw meat in urban area than in rural areas due to the relatively higher income. Shire Indasilassie has more butchers and eating of raw meat is common practices.

There was also no statistically significance difference between proportion of taeniasis in knowledge of the disease. Similar finding was reported by Tesfaye [25] among the various educational statuses or educational levels in Wolayita Sodo town. This could be due to the long time cultural habit of eating raw meat particularly that of *kourt* and *kitfo* in many social groups including those of the educated and even in the health and veterinary professionals.

In conclusion, in Ethiopia bush defecation, the habit of eating raw beef such as *kitfo* and *kourt*, lack of adequate meat inspection, defecation in bushes and backyard slaughter might have contributed for the high prevalence in cattle and human. Therefore, to reduce the transmission, public education is imperative to avoid consumption of raw meat and use of latrines and improved standards of human hygiene were recommended. Construction of sanitary latrines in the rural areas should be encouraged and improve meat inspection procedures with all parts of various carcasses need be considered.

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