Original Research Article

PREVALENCE OF BOVINE CYSTICERCOSIS IN JIGJIGA CITY MUNICIPAL ABATTOIR AND TREATMENT COSTS OF HUMAN TAENIASIS

ABSTRACT

Combination of Cross-sectional and retrospective study was conducted from Jan 2021 up to Jun 2021 in Jigjiga city Municipal abattoir and inventory of pharmaceutical drug shops, with the objectives of determining the prevalence of bovine *cysticercosis* and treatment costs of human taeniasis. Systematic random sampling technique was employed for selecting the study animals, while the Sampling methodology was based on Active abattoir survey and Inventory of pharmaceutical drug shops. From the 520 animals examined at abattoir, the overall prevalence of c*ysticercus bovis* was 2.69% (14/520) with 95% CI of (1.43, 4.29). There was no statistically significant difference in sex, age, body condition score and origin of the animal with the occurrence of *cysticercu bovis* (P>0.05); From 14 infected cattle with cysticercus bovis, 7 (50%) of *cysticercus bovis* were in the triceps muscle, 5 (35.71%) in tongue, 1 (7.14%) in biceps muscle and 1 (7.14%) in masseter muscle. Descriptive statistics revealed that a total of 23,063 doses of taenicidal drugs were used for the treatment of human taeniasis which worth 56,933 ETB in the town. Relatively high dose of Albendazole was used followed by Mebendazole, Praziquantel and Niclosomide respectively. Albendazole and Mebendazole were the most frequently sold drugs for the treatment of taeniasis. The finding indicates the importance of cysticercosis and taeniasis both in economic and public health aspects. Therefore, due attention should be given for awareness rising in the public and strict routine meat inspection should be undertaken to minimize the impact of this parasite.

KEYWORDS: *abattoir, bovis, Cysticercus Jigjiga, prevalence,taeniasis*

1. INTRODUCTION

Human taeniasis is a parasitic disease found in both developed and developing countries, especially in areas where raw or under-cooked beef consumption is a common practice (3). The larval cyst of the zoonotic tapeworm Taenia-*saginata* causes Bovine cysticercosis (1). Humans are the final host for the adult tapeworm and cattle are the common intermediate host for the larval stage (cyst), which plays a major role in the epidemiology of human taeniasis (2). People become infected after they ingest raw or undercooked meat containing the larval cysts. To kill the cysts and to be considered safe for consumption proper cooking of beef to a minimum internal temperature of 60°C is enough. Ingested viable larvae grow into segmented, adult tapeworms of several metres in length and reside in the intestines, where they can survive for many years (3). Most infections are asymptomatic with mild abdominal pain, however, some serious complications such as appendicitis, gangrenous cholecystitis, cholangitis, intestinal obstruction and gall bladder perforation can occur (4).

It is difficult to diagnose Bovine cysticercosis from live cattle, but meat inspectors look for cysts in beef muscle tissue after the slaughter inspection process. Severely affected carcasses are not passed for human consumption. If cysts are found in a specific part of the organs or the tissues, then the affected parts can be removed, and the carcass may enter the food chain post-treatment; which can be freezing at ≤10°C for a minimum of 10 days or heating the carcass throughout to a minimum internal temperature of 60°C (7).

Exposure of cattle to sewage and effluent contaminated with human faeces are known risk factors for causing to develop bovine cysticercosis. Cattle producers can reduce the risk of these infections by providing adequate toilets, hand washing facilities and strictly informing all employees and visitors to use them regularly. Such practices can prevent the contamination of feed bunks, feed storage areas, ditches or other areas with human wastes. In developing countries, however, open or out-side defecation with lack of access to clean water is a major risk factor for bovine cysticercosis (8).

National or regional pooled prevalence estimates based on meat inspection are variable. For example, the prevalence was estimated to be 4.9% in Eastern Europe (9), 7.82% in Western Europe (1), 19% in the Americas (10), 20% in the Middle East and North Africa (11), 29% in West and Central Africa (12) and 13% in Vietnam (13). This disease can pose major obstacles for trade and can cause a substantial financial burden that is linked with carcass condemnation or rejection and an overall reduction in the beef carcass value (9, 14).

In Ethiopia, human T. *saginata* and bovine cysticercosis are major concerns due to the habits of consuming raw or under-cooked beef (15), wides-pread defecation in the open fields due to shortage of enough toilets, extensive cattle production system, poor hygienic practices, lack of sanitary infrastructures and lack of access to clean water (16, 17). Recent review on spatio-temporal distribution of bovine cysticercosis and T. *saginata* conducted in Ethiopia showed a

high distribution of bovine cysticercosis with prevalence estimates ranging from 1.9% in Addis Ababa to 26.3% in Hawasa municipal abattoirs. In contrast to that, human taeniasis prevalence ranges from 7.8% in Modjo to as high as 89.4% in Addis Ababa city.

2. OBJECTIVES

2.1. General objective

- ✓ To assess the Prevalence of Bovine Cysticercosis In Jigjiga City Municipal Abattoir and Treatment costs of human taeniasis

2.2. Specific objectives

- ✓ To determine the prevalence of bovine cysticercosis in cattle slaughtered at jigjiga city Municipal abattoir
- ✓ To determine the Treatment costs of human taeniasis in jigjiga city

3. METHODOLOGY

3.1. Study area and period

The study was conducted at jigjig a city municipal abattoir in Somali Regional State, Ethiopia, from Jan 2021 to June 2021, Its geographical coordinates are 9° 21' 0" North, 42° 48' 0" East; this area is inhabited by pastoral and agro-pastoral communities whose livelihood is based on livestock production. Study area has high livestock population density and is major source of livestock for the domestic and export markets. Furthermore human-animal interaction and habit of consumption is very high. Cross-border movement of pastoral communities and their livestock to neighboring countries (Djibouti and Somalia) is common, the city is located in the Jigjiga Zone approximately 106 km east of Harar and 628 km from Addis Ababa. This city has an elevation of 1,609 meters above sea level. The climate of Jigjiga is a subtropical highland climate with the influence of mountain climate, with hot and dry summers and cold winters. This is attributed to the fact that Jigjiga is located on a plain surrounded by mountains and to its distance to the sea and its effects. The average temperature and rainfall range are between 25 to 31 °C and 11 to 712 mm respectively. The % humidity was in the range of 45 to 70%. The Livestock population of the area comprises as follows cattle; 1,413,635 Goats; 2,065,200 Sheep; 2,827,204 (64). In this abattoir on average 20 cattle are slaughtered every day.

3.2. Study population

The study population for this study was included those cattle brought to jigjiga city municipal abattoir for slaughter and passed for ante mortem examination. These animals were brought from different market places found in and around town majority (99%) of them slaughtered in the abattoir were adult male having good body condition and older than 5 years and local zebu cattle (Bos indicus).

3.3. Study design

A cross sectional study was conducted from Jan 2021 up to Jun 2021 to determine the prevalence and of cysticercosis at study area. Whereas, a retrospective type of study was employed for the determination of treatment costs of human taeniasis.

3.4. Sample Size Determination

The total number of cattle required for the study was calculated by using the formula suggested by (60) for systematic random sampling method, by considering 23.17% expected prevalence for hydatidosis from previous studies (59). The Z value of 1.96 is used at 95% CI and margin of error is 5%. Accordingly, sample size was calculated as follows,

$n= [1.96^2 \times p \times (1-p)] / d^2$

Where,

n = Sample size.

p = Expected prevalence

d = Desired level of precision (5%)

The calculated sample size was 274, but to increase precision and tighten the confidence interval a total of 520 animals were inspected by using 5 sampling interval.

3.5. Sampling Methodology

3.5.1. Active Abattoir Survey

Active abattoir survey was conducted during routine meat inspection for systematically selected 520 cattle slaughtered at the abattoir. Abattoir visit was Twice per week and during ante-mortem inspection each study animal was given an identification number and its sex, age and origin was recorded. During post mortem inspection, palpation of the organs followed by incision of organs was made to examine for the presence of C.*bovis*.

3.5.2. Inventory of Pharmaceutical Shops

An inventory of Jigjiga referral Hospital and Karamara General hospital based pharmaceutical shops for the purpose of determining the cost of taenicidal drugs was conducted, the method of selection was randomly by recording four years (2017– 2020) data of taenicidal drug sales to determine the annual economic loss associated with T. *saginata* treatment in humans.

3.6. Data Management and Analysis

Data collected from ante mortem and post-mortem examination was entered into Microsoft Excel. Descriptive statics was carried out to summarize prevalence of *Cysticercus bovis*, the proportion of the positive organs and anatomical distribution of the cysts in each organ. Chi-square was carried out using STATA 11 statistical software. In all cases the difference between different groups were tested for significance at probability level of 0.05 or less.

3.7. Ethical consideration

Ethical clearance was obtained from the College of Medicine and health science, Jigjig a University Ethical Committee.

4. RESULTS

4.1. Prevalence and Associated Risk Factors

From the 520 animals examined at abattoir, the overall prevalence of c*ysticercus bovis* was 2.69% (14/520) with 95% CI of (1.43, 4.29) and. There was no statistically significant difference in sex, age, body condition score and origin of the animal with the occurrence of *cysticercus bovis* (P>0.05); (Table 1).

Table 1: *Cysticercus bovis* occurrence with various potential risk factors

Factors	No. of examined animals	No. affected Animals (%)	Pearson chi^2	P-Value
Sex				
Male	480	13 (2.7)	0.15	0.70
Female	40	1 (2.5)		
Age				
<6	31	1(3.22)	0.56	0.75
6-8	359	8(2.23)		
>8	130	5(3.84)		
Body condition				

Poor	23	0	0.90	0.64
Medium	346	11(2.89)		
Good	151	3(1.98)		
Origin				
fafam	25	0	7.97	0.54
gursum	42	0		
bambas	161	0		
kebribayah	13	7(53.84)		
Awbarre	75	2(2.7)		
Goljanno	69	1(1.44)		
mulla	11	1(9.09)		
babili	10	1(10)		
ararso	49	1(2.04))		
Degahmadow	65	1(1.53)		

4.2. Proportion of Animal and Organ Affected

From 14 infected cattle with cysticercus bovis, 7 (50%) of *cysticercus bovis* were in the triceps muscle, 5 (35.71%) in tongue, 1 (7.14%) in biceps muscle and 1 (7.14%) in masseter muscle (Table 2);

Table 2: Distribution of *cysticercus bovis* on different organs

Infected organ	No. of infected animal	Relative percentage (%)
Tongue	5	35.71
Triceps muscle and heart	7	50
Biceps muscle	1	7.14
Masseter muscle	1	7.14
Total	14	100

4.3. Inventory of Pharmaceutical Shops

Annual adult taenicidal drugs dose and its worth collected from recorded data and through personal interviews with pharmacists and their assistants. Descriptive statistics revealed that a total of 23,063 doses of taenicidal drugs were used for the treatment of human taeniasis which worth 56,933 ETB in the town. Relatively high dose of Albendazole was used followed by Mebendazole, Praziquantel and Niclosomide respectively.

Table 3: annual taeniacidal drug doses sold during 2017-2020 at different pharmaceutical shops

Drugs	**2017**	**2018**	**2019**	**2020**	**Total Dose**	**Total Cost**
Niclosomide	360	687	355	1,935	3,337	10,011
Praziquantel	690	512	1,145	1,388	3,735	14,940
Albendazole	3,250	2,963	1,638	2,358	10,209	20,418
Mebendazole	1,383	963	1,839	1,597	5,782	11,564
Total					**23,063**	**56,933ETB**

5. DISCUSSION

Prevalence of C. *Bovis* among the carcasses inspected at jigjiga municipal abattoir was 2.69% which is in agreement with the findings of 3.65% at Jimma, (27) 3.11% in different agro climatic zones of Ethiopia, (37) 4.9% at Gondar, (16) 4.4% at Jimma and (63) 5.4% at Konbolcha However, the prevalence of the present study disagrees with the finding of (35) 11.3% in Wolaita Soddo. The difference in the prevalence rate of bovine cysticercosis between the two studies could be due to differences in the origins of animals that were presented for slaughter.

Taeniasis has importance both in terms of socio-economic and public health aspects (62). Inventory of Hospital centered pharmaceutical shops which comprises a four years data (2017-2020) in Jigjiga city during study period revealed a total of 23, 063 taenicidal drug dose which worths 56,933ETB from taeniasis treatment in humans. The estimate dose and worth of drug for the disease in this study disagrees from study done at Kombolcha Town, Wollo, Ethiopia which revealed 6998 adult taenicidal drug doses for a cost of 19,621.00 Ethiopian Birr (ETB) (54), but agrees for the drugs most commonly sold which were mebendazole and albendazole. The reason for the difference might be attributed to variation of the size of the population resides in the two areas, the habit of feeding raw meat , culture and religion and also the studied years which were two years data for the kombolcha study.

Study done municipality abattoir at Jimma (36) reported that 222,706 Eth, Birr and 72, 190, 21 Eth. Birr, a total of 7,441,727 Eth. Birr was lost due to taeniasis treatment expenditure in Jimma. In contrast to this study which revealed a total dose of 23,063 doses which worth 56,933ETB for the treatment of human Taeniasis in the town. this difference could indicate so many things like; pharmacies standards and recording ability, difference of prevalence of the disease in the two areas, habit of feeding, people‘s awareness and demand of the taenicidal drugs regardless of the presence of so many traditional medicines.

According to the study done at Adama by Yacob Hailu (63) Niclosamide, Praziquantel, Albendazole and Mebendazole are commonly used for the treatment of T. saginata taeniosis in the area, the cost of taenicidal drugs for three years recorded 2011/12-2013/14 was about 378,609.66 Eth Birr which disagrees for the present study. In addition, this study also disagrees in the case of drugs most commonly used (sold) for taenicidal purpose. The reasons of this difference may be awareness among the communities, recording errors, health facility.

Study done by Dawit T. at Wolaita Soddo, (58) Southern Ethiopia indicated a total of 29,952 adult doses which worth 40,201.8 ETB (2407.2 USD) per annum on average was spent for the treatment of human Taeniasis in the town. But agrees in this study for the order of the most commonly used taenicidal drugs, the number of years included were two years only while this study covers more number of years and the differences shown here agrees for the above discussed studies. Regarding the anatomical distribution of *cysticercus bovis* cyst, some of the previous works (54) mentioned that there was no as such true predilection sites for *cysticercus bovis* as the presence and number of cysts in any predilection sites varied greatly from animal to animal. On the other hand, it was explained that the parasite can migrate via the mesenteric venue to enter systemic circulation and then they filtered out to tongue, heart and masseter muscles as a preferred predilection site (43). Similarly, the present study reported that relatively higher percentage of these organs was affected by *cysticercus bovis*. It was mentioned that the reason for the preference of these organs by this cyst could be due to the fact that there is relatively higher supply of arterial blood to the muscle in these organs (61). Moreover, tongue is conveniently more accessed organ during the slaughtering process than the rest of the organs. This result is in agreement with other study conducted at Jimma municipal abattoir, (16).

Unlike other predilection sites of *cysticercus bovis*, tongue and heart had no limitations upon incision for inspection and this could also be the reason for the slightly higher observed frequency of *cysticercus bovis* on tongue and heart.

The disease results in financial losses caused by the condemnation of infected organs and downgrading of carcasses, and the considerable costs of human treatments. Therefore, strict routine meat inspections should be conducted so that infected carcasses and organs would be condemned accordingly. The prevalence of *cysticercus bovis* among the carcasses inspected at Jigjiga municipal abattoir (2.69%) is in agreement with the findingat at Nekemte town 2.98%. but disagrees the findings at Awassa municipal abattoir, (29) which was conducted at the western part of the country, However, it is lower than the findings of (35) in Wolaitasoddo, 11.3%, (29).

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 pharmaceutical shops which comprises four years record 2017 up to 2020 in Jigjig a city during the study period indicated that a total of 23,063 taenicidal doses which worth 56,933ETB for the treatment of human Taeniasis in the town.

6. CONCLUSSION AND RECOMMENDATIONS

The present study indicated the prevalence of bovine cysticercosis at jigjiga city munipal abattoir which is 2.69% and inventories of pharmaceutical shops which comprises four years record 2017 up to 2020 in Jigjig a city during the study period indicated that a total of 23,063 taenicidal doses which worth 56,933ETB for the treatment of human Taeniasis in the town. Moreover, This infection in cattle with a huge human treatment loss justifies a program of disease control. In conclusion, both abattoir survey and the retrospective study showed that *cysticercus bovis* and the adult parasite was important parasitic disease in the area, Routine Meat Inspection is the only diagnostic procedure in use in Ethiopia for the diagnosis of bovine cysticercosis.

This method is insensitive and inaccurate and thus the reported prevalence of this infection in this city of the country may be an underestimate.

Therefore, based on the above conclusion the following recommendations are forwarded:

- Improved cattle production systems, meat inspection services and public health education are important.
- Meat inspection with proper cooking before consumption could also bring a reduction of the diseases in human and cattle which reduces the associated economic loss.
- Routine meat inspection should be applied in all slaughter houses.
- Latrines in the rural areas should be encouraged and improved meat inspection procedures.
- Restricting animals from the access of surface drinking water and supplying them fresh water instead.
- Improving the working conditions of meat inspectors and up-grading their meat inspection skill.
- Awareness creation about the health and economic significance of the disease

7. REFERENCES

1.Laranjo-González, M., Devleesschauwer, B., Trevisan, C., Allepuz, A., Sotiraki, S., Abraham, A., Dermauw, V. (2017): Epidemiology of taeniosis/cysticercosis in Europe.

2.Dermauw, V., Dorny, P., Braae, U. C., Devleesschauwer, B., Robertson, L. J., Saratsis, A., & Thomas, L. F. (2018): Epidemiology of Taenia saginata taeniosis/cysticercosis.

3.WHO (2005): World Health Organization. WHO/FAO/OIE guidelines for the surveillance, prevention and control of taeniosis/cysticercosis.

4.Silva, V., & Costa-Cruz, J. M. (2010): A glance at Taenia saginata infection, diagnosis, vaccine, biological control and treatment. Infectious Disorders,

7.Okello, A. L., & Thomas, L. F. (2017): Human taeniasis: Current insights into prevention and management strategies in endemic countries.

8.Rossi, G. A. M., Hoppe, E. G. L., Mathias, L. A., Martins, A. M. C. V., Mussi, L. A., & Prata, L. F. (2015): Bovine cysticercosis in slaughtered cattle as an indicator of good agricultural practices (GAP) and epidemiological risk factors

9.Trevisan, C., Sotiraki, S., Laranjo-González, M., Dermauw, V., Wang, Z., Kärssin, A., Devleesschauwer, B. (2018): Epidemiology of taeniosis/cysticercosis in Europe.

10.Braae, U. C., Thomas, L. F., Robertson, L. J., Dermauw, V., Dorny, P., Willingham, A. L., … Devleesschauwer, B. (2018): Epidemiology of Taenia saginata taeniosis/cysticercosis:

11.Saratsis, A., Sotiraki, S., Braae, U. C., Devleesschauwer, B., Dermauw, V., Eichenberger, R. M., Robertson, L. J. (2019): Epidemiology of Taenia saginata taeniosis/cysticercosis.

12.Hendrickx, E., Thomas, L. F., Dorny, P., Bobić, B., Braae, U. C., Devleesschauwer, B. Dermauw, V. (2019): Epidemiology of Taenia saginata taeniosis/cysticercosis.

13.Ng-Nguyen, D., Stevenson, M. A., & Traub, R. J. (2017): A systematic review of taeniasis, cysticercosis and trichinellosis in Vietnam.

14.Blagojevic, B., Robertson, L. J., Vieira-Pinto, M., Johansen, M. V., LaranjoGonzález, M., & Gabriël, S. (2017): Bovine cysticercosis in the European Union: Impact and current regulations, and an approach towards risk-based control.

15.Seleshe, S., Jo, C., & Lee, M. (2014): Meat consumption culture in Ethiopia. *Korean Journal for Food Science of Animal Resources.*

16.Megersa, B., Tesfaye, E., Regassa, A., Abebe, R., & Abunna, F. (2010): Bovine cysticercosis in cattle slaughtered at Jimma municipal abattoir, south western Ethiopia: Prevalence, cyst viability and its socio-economic importance. Veterinary World.

17.Yacob, H. T., Ahmed, T., Getachew, T., & Tariku, J. (2015): Bovine cysticercosis and human taeniosis in Adama town, Oromia region, Ethiopia. *Journal of Veterinary Science and Technology*.

27.Tembo A (2001). "Epidemiology of Taeniasaginatataeniasis and Cysticercosis in Three Selected Agro-climatic Zones in Central Ethiopia. M.Sc thesis, Faculty of Veterinary Medicine, Addis Ababa University; ."

29.Abunna F, T. G., Megersa B, Regassa A, Kumsa B. (2008): Bovine cysticercosis in cattle slaughtered at Awassa municipal abattoir, Ethiopia: Prevalence, cyst viability, distribution and its public health implication. *Zoonoses Public Health.*

35.Regassa, A. Abunna, F. Mulugeta, A, and Megersa, B. (2008): Major Metacestodes in Cattle Slaughtered at Wolayta Soddo Municipal abattoir, Southern Ethiopia: Prevalence, Cyst Viability, organ distribution and socio economic implications. *Tropical Animal Health Production.*

36.Megersa, B. Tesfaye, E. Regassa, A. Abebe, R. Abunna, F. (2009): Bovine cysticercosis in Cattle Slaughtered at Jimma Municipal Abattoir, South western Ethiopia: Prevalence, Cyst viability and Its Socio-economic importance, Veterinary World.

37.Dawit, S. (2004): Epidemiology of T.saginata and cysticercosis in North Gondar Zone, Northwest Ethiopia. DVM Thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit.

43.Minozzo,J.C., Gusso, R.L.De Castro, E.A. Lago, O and Soccoi, V.T. (2002): Experimental Bovine Infestation with Taenia saginata eggs: Recovery rate and cysticerci location. Brazilian Archive of Biology and Technology.

54.Scandrett B, Parker S, Forbes L, Gajadhar A, Dekumyoy P, Waikagul J, Haines D. (2009): Distribution of Taenia saginata cysticerci in tissues of experimentally infected cattle. *Vet. Parasitol.*

58. Dawit T., Tewodros S. and Tilaye D. *et al.* (2011): Public Health and Economic Significance of Bovine Cysticercosis in Wolaita Soddo, Southern Ethiopia

59. Abunna, F., Ayala, D., Regassa, A., Bekele, J., and Debela, E. (2011): Major Metacestodes in Cattle Slaughtered at Nekemte Municipal Abattoir, Western Ethiopia: Prevalence, Cyst Viability, Organ Distribution and Socio economic Implications *BIOMIRROR.*

60. Thrusfield, M. (2007): Veterinary Epidemiology, Government Department of Navy, Bureau 3 UK Black well science Ltd.

61. Paniker, C. (2002): Cyclophyllidean Tapeworm: Text books of Medical parasitology, 5th ed, Tape Brothers Medical Publisher, New Delhi, India.

62. Wanzala, W., J. Onyango-Abuje, E. Kang`Ethe K. Zessin, N. Kyule, M. Bauman,H. Ochanda and L.Harrison, 2003. Analysis of Post-Mortem Diagnosisof Bovine Cysticercosis in Kenyan Cattle, Onderstepoort *J. Veterinary Research*.

63. Alula,A., 2010. Major Metacestodes in Cattle Slaughtered At Kombolcha ELFORA Abattoir, NorthEast Ethiopia: prevalence, cyst viability, organ distribution and socio economic implication.

64. CSA, 2003. Central statistical authority. LivestockPopulation of Ethiopia, Central StatisticalAuthority, Addis Ababa, Ethiopia.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.