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Original Research Article

Abattoir-Based Prevalence of *Cysticercus bovis*, Associated Risk Factors, and Community Knowledge, Attitudes, and Practices in Modjo Municipality, East Shoa Zone, Oromia, Ethiopia

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ABSTRACT

Background: Bovine cysticercosis, caused by the larval stage (*Cysticercus bovis*) of *Taenia saginata*, is an important zoonotic disease that affects both livestock production and public health. The disease results in considerable economic losses due to carcass condemnation and reduced meat quality while posing health risks to humans through the consumption of raw or undercooked infected beef. Information regarding the prevalence of bovine cysticercosis and public awareness remains limited in several parts of Ethiopia.

Methods: A cross-sectional study was conducted between November 2024 and September 2025 at Modjo Municipal Abattoir, East Shoa Zone, Oromia, Ethiopia. A total of 384 cattle were systematically selected and examined using routine ante-mortem and post-mortem meat inspection procedures to determine the prevalence and anatomical distribution of *Cysticercus bovis*. In addition, a structured questionnaire survey involving 100 community members was conducted to assess knowledge, attitudes, and practices (KAP) regarding taeniasis and bovine cysticercosis. Statistical analyses were performed using SPSS version 20 to determine prevalence and evaluate associations between selected risk factors and infection.

Results: The overall prevalence of bovine cysticercosis was 7.3% (28/384). Animals with poor body condition showed significantly higher infection rates than those with medium or good body condition. The tongue was the most frequently affected organ, followed by the liver, kidneys, masseter muscles, and heart. The KAP survey indicated that although many respondents had previously heard about taeniasis, misconceptions regarding disease transmission, prevention, and meat inspection remained common. Consumption of raw beef and inadequate public awareness continue to represent important risk factors for disease transmission.

Conclusion: Bovine cysticercosis remains an important veterinary and public health concern in the study area. Improved meat inspection, enhanced public awareness, better sanitation practices, and strengthened disease surveillance are recommended to reduce disease transmission and associated economic losses.

1. Introduction

Livestock production plays a fundamental role in Ethiopia's economy, contributing substantially to agricultural productivity, household income, food security, and employment. The country possesses one of the largest cattle populations in Africa, making the livestock sector a critical component of national economic development. However, infectious and parasitic diseases continue to limit productivity by reducing meat quality, decreasing animal performance, and restricting access to international markets. Among these diseases, bovine cysticercosis remains one of the most economically important food-borne zoonotic infections affecting both the livestock industry and public health.

Bovine cysticercosis is caused by the larval stage (*Cysticercus bovis*) of the beef tapeworm, *Taenia saginata*. Cattle serve as intermediate hosts after ingesting parasite eggs from

environments contaminated with human feces, while humans become infected through the consumption of raw or inadequately cooked beef containing viable cysticerci. This parasite has a complex life cycle involving both humans and cattle, making effective disease control dependent on veterinary inspection, environmental sanitation, and public health interventions.

The disease has important economic implications because infected carcasses frequently undergo condemnation, downgrading, or freezing before marketing, resulting in financial losses for livestock producers, meat processors, and abattoirs. In addition to these direct economic consequences, treatment costs, reduced consumer confidence, and public health burdens further increase its significance in endemic countries.

Ethiopia is considered one of the endemic countries for bovine cysticercosis and human taeniasis. The widespread tradition of consuming raw or undercooked beef dishes, together with inadequate sanitation facilities, open defecation, poor meat inspection practices, and limited public awareness, creates favorable conditions for maintaining the parasite's transmission cycle. Previous investigations conducted in different regions of Ethiopia have reported varying prevalence rates, reflecting differences in management systems, environmental conditions, meat inspection procedures, and cultural practices.

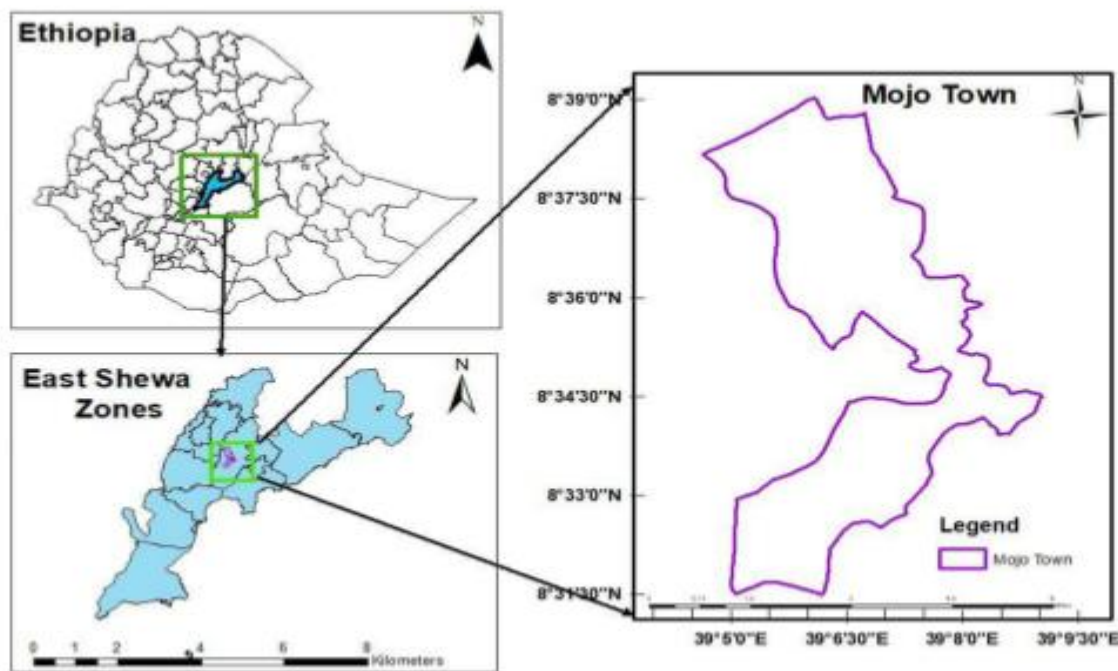
Modjo Municipality, located in the East Shoa Zone of Oromia Regional State, is an important livestock trading center where cattle originating from several surrounding districts are slaughtered for human consumption. Despite the economic importance of livestock production in the area, updated epidemiological information regarding bovine cysticercosis and community awareness has remained limited. Generating reliable data on disease prevalence, associated risk factors, and community knowledge is essential for developing effective prevention and control strategies.

Therefore, this study was conducted to determine the abattoir-based prevalence of *Cysticercus bovis*, identify associated risk factors among slaughtered cattle, and assess the knowledge, attitudes, and practices of the local community regarding bovine cysticercosis and human taeniasis in Modjo Municipality, East Shoa Zone, Oromia, Ethiopia. The findings are expected to contribute to improved disease surveillance, public health education, and evidence-based control programs.

2. Materials and Methods

2.1 Study Area

The study was conducted at **Modjo Municipal Abattoir**, located in Modjo Town, East Shoa Zone, Oromia Regional State, Ethiopia. The town lies approximately 70 km southeast of Addis Ababa and about 25 km from Adama. Modjo is situated at an altitude ranging from 1,730 to 1,890 meters above sea level and experiences a mean annual temperature of 16–17°C with an average annual rainfall of approximately 896 mm. The area supports extensive livestock production, making the municipal abattoir an important slaughter facility serving cattle originating from several surrounding districts, including Adama, Bishoftu, Bote, Koka, and Maki.



2.2 Study Design

A cross-sectional study was conducted between **November 2024 and September 2025** to determine the prevalence of *Cysticercus bovis* in slaughtered cattle, identify associated risk factors, and assess community knowledge, attitudes, and practices (KAP) regarding bovine cysticercosis and human taeniasis.

The investigation consisted of two complementary components:

- An abattoir-based epidemiological survey involving post-mortem examination of slaughtered cattle.

- A questionnaire-based KAP survey among community members residing in Modjo Town.

2.3 Study Population

The abattoir survey included cattle presented for slaughter at Modjo Municipal Abattoir during the study period. Both local and crossbred cattle originating from different districts were eligible for inclusion.

For the KAP assessment, community members living in Modjo Town were selected to evaluate public awareness and

behavioral practices related to taeniasis and bovine cysticercosis.

2.4 Sample Size and Sampling Procedure

The required sample size for the abattoir survey was calculated using the formula described by Thrusfield (2005), assuming:

- Expected prevalence: 50%
- Confidence level: 95%
- Desired precision: 5%

This resulted in a total sample size of **384 cattle**.

Animals were selected using **systematic random sampling** throughout the study period.

For the KAP survey, **100 respondents** were selected using simple random sampling to represent different occupations and educational backgrounds within the study area.

2.5 Ante-Mortem Examination

Each selected animal underwent ante-mortem inspection before slaughter. Information including breed, sex, age, origin, and body condition score was recorded.

Age estimation was based on dentition, while body condition was classified as **poor**, **medium**, or **good** according to established veterinary guidelines.

2.6 Post-Mortem Examination

Routine meat inspection procedures were performed following the Ethiopian Ministry of Agriculture meat inspection guidelines.

Each carcass was carefully examined through visual inspection, palpation, and systematic incision of major predilection sites including:

- Tongue
- Masseter muscles
- Triceps muscles
- Heart
- Liver
- Diaphragm
- Neck muscles
- Kidneys

The presence and anatomical distribution of *Cysticercus bovis* cysts were recorded for each positive animal.

2.7 Questionnaire Survey

A structured questionnaire was administered to 100 respondents to assess:

- Knowledge of bovine cysticercosis and taeniasis
- Attitudes toward disease prevention
- Meat consumption practices
- Public awareness

- Sanitation behaviors
- Treatment practices

The questionnaire included both closed-ended and multiple-choice questions designed to evaluate community awareness of disease transmission and prevention.

2.8 Data Analysis

Data collected from both the abattoir survey and questionnaire survey were entered into Microsoft Excel before being analyzed using **SPSS Version 20**.

Descriptive statistics were used to summarize prevalence, frequencies, and percentages.

Associations between *Cysticercus bovis* infection and potential risk factors were evaluated using Chi-square tests and logistic regression analysis.

Odds ratios (ORs) with **95% confidence intervals (CIs)** were calculated to determine the strength of associations.

Statistical significance was considered at **P < 0.05**.

3. Results

3.1 Overall Prevalence of *Cysticercus bovis*

A total of **384 cattle** were examined during the study period.

Among these animals, **28 cattle** were found positive for *Cysticercus bovis*, giving an overall prevalence of **7.3%**.

Variables	Animal tested	Cases	Prevalence (%)	P- value	Odd ratio (95% CI)
Breed					
Local	350	26	7.4	0.741	0.78 (0.177, 3.433)
Cross	34	2	5.9		Reference
Origin					
Adama	49	4	8.2	0.876	1.11 (0.297, 4.151)
Bishoftu	60	3	5	0.566	0.658 (0.158, 2.744)
Bote	93	6	6.5	0.804	0.862 (0.267, 2.786)
Koka	101	9	8.9	0.714	1.22 (0.416, 3.590)
Maki	81	6	7.4		Reference
Sex					
Female	13	1	7.7	0.955	1.06 (.133, 8.475)
Male	371	27	7.3		Reference
Age					
Young	16	1	6.3		Reference
Adult	268	27	10.1	0.000 (0.870)	1.2 (.0151, 9.335)
Body condition					
Poor	18	10	55.6	0.000	2.3 (1.35, 5.672)
Medium	30	11	36.7	0.205	0.46 (0.141, 1.522)
Good	336	7	2.1		Reference

3.2 Distribution According to Risk Factors

Variation in prevalence was observed among cattle originating from different districts.

Higher infection rates were observed among cattle originating from **Koka**, followed by **Adama**, whereas relatively lower prevalence was recorded among cattle from Bishoftu and other study locations.

Although prevalence differed according to origin, body condition was the only variable that showed a statistically significant association with infection.

Animals with poor body condition demonstrated substantially higher infection rates than animals with medium or good body condition.

No statistically significant association was observed for breed or sex.

Variables	Animal tested	Cases	Prevalence (%)	P- value	Odd ratio (95% CI)
Breed					
Local	350	26	7.4	0.741	0.78 (0.177, 3.433)
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3.3 Anatomical Distribution of Cysts

Post-mortem examination revealed that *Cysticercus bovis* cysts were distributed across several edible organs.

The **tongue** represented the most frequently affected organ, followed by:

- Liver

- Kidneys
- Masseter muscles
- Heart

This anatomical distribution highlights the importance of careful inspection of predilection sites during routine meat inspection.

Affected Organs	Frequency	Percent
Tongue	9	2.3
Heart	4	1.04
Liver	5	1.3
Masseter Muscle	5	1.3
Kidney	5	1.3
Total	28	7.3

Table 4. Socio-demographic characteristics of respondents

Variables	Category	No of respondents	Percentage (%)
Marital Status	Married	72	72
	Unmarried	28	28
Livestock Ownership	Yes	69	69
	No	31	31
Age in year	18-30	13	13
	31-45	40	40
	46-60	47	47
Sex	Female	19	19
	Male	81	81
Educational background	Illiterate	14	14
	Primary	23	23
	Secondary	28	28
	Diploma	15	15
	Degree	20	20
Occupation	Gov't Employee	46	46
	Student	19	19
	Merchant	18	18
	Farmer	17	17
Religion	Christian	75	75
	Muslim	25	25

Table 5. Knowledge of respondents regarding taeniasis and bovine cysticercosis in Modjo Town (n = 100).

Variable	Response	Frequency (n)	Percentage (%)
Previously heard about taeniasis	Yes	82	82
	No	18	18
Knowledge of the cause of tapeworm infection	Yes	76	76
	No	24	24
Perceived source of tapeworm infection	Raw beef	60	60
	Raw milk	18	18
	Contaminated water	19	19
	Do not know	3	3
Variable	Response	Frequency (n)	Percentage (%)
History of taeniasis infection	Yes	79	79
	No	21	21
Knowledge of the organ where cysts are found	Tongue	43	43
	All organs	34	34
	Muscle	17	17
	Do not know	6	6
Ability to recognize cysts in meat	Yes	92	92
	No	8	8
Knowledge of how cattle become infected	Eating contaminated grass	58	58
	Drinking contaminated water	18	18

3.4 Community Knowledge, Attitudes, and Practices

The questionnaire survey included **100 respondents** representing different occupations, educational backgrounds, and age groups.

Most respondents reported having previously heard of taeniasis; however, important knowledge gaps regarding disease transmission and prevention were identified.

Although many participants recognized raw beef consumption as a source of infection, misconceptions regarding transmission routes, meat inspection, and preventive measures remained common.

Traditional consumption of raw or undercooked beef was still widely practiced, indicating continued public health risk.

Table 7. Practices of respondents regarding taeniasis and bovine cysticercosis in Modjo Town (n = 100).

Variable	Response	Frequency (n)	Percentage (%)
Do butchers inform customers about cysticercosis?	Do not know	24	24
	Yes	14	14
	No	86	86
Observed symptoms of taeniasis	Yes	47	47
	No	53	53
Symptoms reported	Abdominal pain	30	30
	Decreased appetite	12	12
	Excessive salivation	5	5
	Do not know	53	53
Variable	Response	Frequency (n)	Percentage (%)
Family member working in human or veterinary health services	Yes	32	32
	No	68	68
Availability of a household latrine	Yes	92	92
	No	8	8
Number of family members infected with taeniasis	None	14	14
	One	56	56
	Two	24	24
	Three or more	6	6
Number of times respondents received taeniasis treatment	Once	64	64
	Twice	24	24
	Three or more times	12	12
Traditional taenicial remedies used	Hexo	24	24
	Wogert	14	14
	Benzene	20	20
	Hanqu	14	14
	Do not know	28	28
Source of taenicial drugs	Health station	28	28
	Hospital	9	9
	Pharmacy	51	51
	Herbal medicine	12	12
Awareness of complications associated with taenicial drugs	Yes	54	54
	No	15	15
	Do not know	31	31
Received advice to avoid eating raw beef	Yes	36	36
	No	52	52
	Do not know	12	12
Availability of a sewage disposal system	Yes	73	73
	No	27	27

4. Discussion

The present study investigated the prevalence of *Cysticercus bovis* among cattle slaughtered at Modjo Municipal Abattoir

Table 6. Attitudes of respondents toward taeniasis and bovine cysticercosis in Modjo Town (n = 100).

Variable	Response	Frequency (n)	Percentage (%)
Do you think tapeworm infection can be prevented?	Yes	74	74
	No	11	11
	Do not know	15	15
Preferred preventive measure	Avoid eating raw beef	63	63
	Avoid drinking raw milk	19	19
	Drink clean water	18	18
Do you intend to stop eating raw beef?	Yes	14	14
	No	86	86
Preferred beef preparation	Kikil	13	13
	Kurt (raw beef)	34	34
	Milasina Sanber	10	10
	Tibsi	28	28
	Kitfo	16	16
Do you think spices prevent tapeworm infection?	Yes	48	48
	No	42	42
	Do not know	10	10
Can taeniasis affect both humans and animals?	Yes	74	74
	No	26	26
Preferred taenicial drug	Albendazole	26	26
	Mebendazole	21	21
	Do not remember	53	53

and assessed community knowledge, attitudes, and practices regarding bovine cysticercosis and human taeniasis. The findings demonstrate that bovine cysticercosis remains an important veterinary and public health concern in the study area despite ongoing meat inspection practices.

The overall prevalence of **7.3%** observed in this study indicates that *Cysticercus bovis* remains widely distributed among cattle presented for slaughter. This prevalence is comparable to several previous reports conducted in Ethiopia but differs from studies conducted in other regions. Such variation may be attributed to differences in livestock management systems, environmental sanitation, meat inspection procedures, sample size, climatic conditions, and cultural practices associated with raw meat consumption. Similar geographical variations have also been reported in previous Ethiopian investigations, suggesting that the epidemiology of bovine cysticercosis differs considerably among production systems.

The study demonstrated that body condition was the only risk factor significantly associated with infection. Animals with poor body condition exhibited considerably higher infection rates than animals with medium or good body condition. Poor body condition may reflect prolonged exposure to contaminated grazing areas, inadequate nutrition, or underlying health problems that increase susceptibility to parasitic infections. Similar observations have been reported in previous epidemiological studies conducted in Ethiopia, where body condition has consistently been identified as an important predictor of bovine cysticercosis. In contrast, breed, sex, and geographical origin were not significantly associated with infection, suggesting that these factors may play a less important role under the production conditions observed in the present study.

Examination of infected carcasses showed that cysticerci were distributed in several edible organs, with the tongue representing the most frequently affected predilection site. This observation agrees with the biological characteristics of *Taenia saginata*, whose larvae preferentially localize in highly vascular and actively functioning muscles. The tongue, masseter muscles, heart, liver, and kidneys therefore remain essential organs for routine meat inspection. Careful examination of these tissues is necessary to reduce the risk of infected meat entering the food chain and to protect public health.

The questionnaire survey revealed that although a large proportion of respondents had previously heard about taeniasis, important deficiencies remained regarding disease transmission, prevention, and control. Misconceptions concerning the source of infection, recognition of infected meat, and appropriate preventive measures were still common among participants. These findings indicate that awareness alone does not necessarily translate into adequate knowledge or safe practices. Similar observations have been reported in other Ethiopian studies, where limited public education has contributed to the persistence of taeniasis and bovine cysticercosis in endemic communities.

One of the most important findings of this study was the continued practice of consuming raw or inadequately cooked beef. This long-established cultural habit remains one of the principal factors sustaining the transmission cycle of *Taenia saginata* in Ethiopia. Consumption of traditional raw beef dishes, combined with inadequate sanitation, open defecation, and environmental contamination, facilitates continuous transmission between humans and cattle. Effective disease control therefore requires interventions targeting both livestock production and human behavior.

Although most households reported having access to latrine facilities, a considerable proportion of respondents continued to demonstrate behaviors that increase the risk of disease transmission, including limited awareness of proper meat inspection and inadequate knowledge regarding parasite control. This suggests that improvements in sanitation infrastructure alone are insufficient without accompanying health education and behavioral change programs. Strengthening collaboration between veterinary services, public health authorities, and community education programs would substantially improve disease prevention efforts.

From an animal health perspective, bovine cysticercosis continues to impose significant economic consequences through carcass condemnation, reduced carcass value, refrigeration requirements, and increased inspection costs. For communities that depend heavily on livestock production, these losses directly affect household income and the profitability of the meat industry. Consequently, strengthening surveillance systems and improving meat inspection procedures remain essential strategies for reducing the economic burden associated with this zoonotic disease.

Overall, the findings of the present study emphasize that bovine cysticercosis remains an important zoonotic disease requiring integrated control measures involving veterinary inspection, public health education, environmental sanitation, and improved food safety practices. Continued surveillance and coordinated One Health approaches are essential for minimizing both the public health impact and the economic losses associated with *Taenia saginata* infection in Ethiopia.

5. Conclusion

This study demonstrated that bovine cysticercosis remains an important zoonotic disease affecting both animal production and public health in Modjo Municipality, East Shoa Zone, Ethiopia. The overall prevalence of *Cysticercus bovis* among slaughtered cattle was **7.3%**, confirming the continued occurrence of the disease within the study area. Body condition was identified as the principal risk factor significantly associated with infection, with poorly conditioned animals exhibiting higher prevalence than animals in good condition.

Post-mortem examination revealed that the tongue was the most frequently affected predilection site, followed by the liver, kidneys, masseter muscles, and heart. These findings emphasize the importance of careful inspection of major predilection organs during routine meat inspection to minimize the risk of infected meat entering the food chain.

The questionnaire survey further revealed that although many community members had heard about taeniasis, important deficiencies remained regarding disease transmission, prevention, and safe meat consumption practices. Continued consumption of raw or undercooked beef, together with inadequate public awareness and environmental sanitation, remains an important factor sustaining transmission of *Taenia saginata* in the study area.

Overall, the findings highlight the need for integrated veterinary and public health interventions aimed at strengthening meat inspection, improving sanitation, and increasing community awareness to reduce the burden of bovine cysticercosis and human taeniasis.

6. Recommendations

Based on the findings of this study, the following recommendations are proposed:

1. Routine meat inspection procedures should be strengthened through careful examination of all major predilection sites for *Cysticercus bovis*.
2. Public health education programs should be implemented to improve community awareness regarding the transmission, prevention, and public health significance of bovine cysticercosis and human taeniasis.
3. Community members should be encouraged to avoid the consumption of raw or undercooked beef and adopt safer food preparation practices.
4. Improved sanitation facilities and proper disposal of human waste should be promoted to reduce environmental contamination with *Taenia saginata* eggs.
5. Veterinary and public health authorities should collaborate under a One Health approach to establish regular surveillance and control programs for bovine cysticercosis.
6. Further epidemiological studies involving larger geographical areas and advanced diagnostic techniques are recommended to better understand the distribution and economic impact of the disease in Ethiopia.

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Declarations

Ethics Approval

The study was conducted in accordance with the ethical requirements of Arsi University. Permission to conduct the research was obtained from the relevant institutional and local authorities before commencement of data collection.

Consent to Participate

Informed verbal consent was obtained from all participants involved in the questionnaire survey prior to data collection.

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The authors declare that no external funding was received for this study.

Conflict of Interest

The authors declare that they have no competing interests.

Author Contributions

Abe Reta conceived the study, collected and analyzed the data, and drafted the manuscript. Hissa Dingeta contributed to study design, supervision, and manuscript revision. Biressaw Serda supervised the research, interpreted the findings, and critically reviewed the manuscript. All authors read and approved the final manuscript.

Data Availability

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

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