PREVALENCE, PUBLIC HEALTH AND ECONOMIC SIGNIFICANCE OF CYSTICERCUS BOVIS IN BANBASI MUNICIPAL ABBATOIR, BENISHANGUL GUMUZ , WESTERN ETHIOPIA

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ABSTRACT: Across-sectional study was conducted on Prevalence, Public Health and Economic Significance of Bovine cysticercosis at Banbasi Administrative Town, Benishangul Gumuz Region, western Ethiopia from October 2024 to June 2025 in Banbasi District local Slaughter House, to estimate the prevalence of Cysticercus bovis, economic impact, and public health significance with respect to knowledge, attitude and practice of beef consuming habit. The overall prevalence of Cysticercus bovis was 19.79% (76/384). There was significant difference (P<0.05) in C.bovis and with origin, age factor, and body conditions. Non- significant difference (P >0.05) was reported in Cysticercosis and risk factor (cyst size, sex, and sanitary condition). Higher Cysticercus bovis cyst occurrence was recorded (28.57%) in greater than 9 years, followed by 21.83% in 5-9 years age. Higher (33.33%) C. bovis occurrence was recorded in poor body conditions, followed by medium (29.41%) and good body condition (12.77%). Based on the origin of cattle, higher C. bovis occurrence was recorded (26.61%) in Banbasi town, followed by 19.48% in Keshmando and around Banbasi (12.26%)(P<0.05). In majority of animals harboring C. bovis, had the tendency to be located more in shoulder (32.89%), heart (22.36%), tongue (17.10%) followed by liver (11.84%), massetor (9.21%) and lung (6.57%). In the present study, the dominant cyst size categories were small size 60 (78.94%), followed by medium 14(18.42%) and large 2(2.63%). Of 76 Cysticercus bovis, 53 (69.73%) were fertile, of these; 25 (47.16%) were viabile and 28(52.83%) were non viable. Besides this, 23 (30.26%) were non - fertile or degenerated cysts, of these; 14 (60.86%) were sterile and 9(39.23%) were calcified cysts. The present questionaire survey indicated that, *Taeniasi*s was a serious zoonotic disease because of raw meat consuming habit, as Kurt, kitfo and Dulet (P>0.05). Hence, consumers‟ preference of these parts of the meat due to palatability, look or other factors has a significant contribution for increasing risk of infection by the parasite. Therefore, the presence of bovine cysticercosis and its public health hazards needs increased awareness on thier knowledge and beef consuming practices and the health impact of the cyst occurrence to safeguard the community.

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1. INTRODUCTION

1.1. Background

Bovine cysticercosis is an infection of cattle with the *metacestode* stage of the tapeworm *Taenia saginata* (Gabriël *et al.*, 2022). Despite its global distribution, the highest numbers of tape worm carriers are observed within communities in developing countries. However, due to the limited public health impact of taeniasis, lack of data on the economic impact of bovine cysticercosis and taeniasis, the existence of other priority diseases and limited resources, *Taenia saginata taeni asis/cysticercosis* remains a neglected zoonosis (Jorga *et al*., 2020).

Cattle become infected with bovine cysticercosis by ingesting materials contaminated with tapeworm eggs originating from human feces (Ncube, 2022). *Taenia saginata* is a parasitic tapeworm with a two-host lifecycle, involving humans as the definitive hosts and cattle as the intermediate hosts (McFadden *et al.,* 2011a). Infection in humans occurs when they consume raw or undercooked beef containing viable cysticerci (Kiermeier e*t al*., 2019). Adult tape worms in the human intestine can grow to 5–10 meters in length and may remain in the host for several years. Each day, approximately 6–9 proglottids are shed either through defecation or through active migration. Each proglottid contains 50,000–80,000 eggs (Edilu *et al.,* 2020), leading to the release of up to 720,000 eggs into the environment daily from a single infected individual.

These eggs can contaminate cattle pasture, feed, or water, leading to infection when ingested by cattle, although direct transmission of eggs resulting from handling of cattle by infected humans has also been rarely reported (Laranjo-González *et al.,* 2016). The oncospheres then penetrate the intestinal wall and migrate to muscles and other tissues, developing into cysticerci BCC (bovine cysticercosis) within 10 weeks. Over time, these cysticerci begin to degen erate and calcify, with a significant reduction in viability after about 9 months (Uslu and Şen lik, 2021).

In humans, *Taenia saginata* infection is usually asymptomatic. However, heavy infections can lead to symptoms such as weight loss, dizziness, abdominal pain, diarrhea, headaches, nausea, constipation, chronic indigestion, loss of appetite, and occasionally intestinal obstruction, which may require surgical intervention (Albertini *et al*., 2020). Severe cases may also cause ileus, pancreatitis, cholecystitis, and cholangitis (Weinstock and Leung, 2022). Cys ticercosis in cattle often goes unnoticed, especially in cases of light to moderate infections, as it typically lacks specific clinical signs (Edilu et al., 2022).

The methods used for inspection and diagnosis of BCC can vary significantly worldwide. Primarily, diagnosis relies on meat inspection techniques that involve palpating and incising spe cific muscles to identify cystic lesion. However, these procedures often lack sensitivity, particularly for carcasses with light infections (Jansen *et al*., 2018). A promising advancement is the recent development of an immunohistochemical assay that detects parasite excretory-se cretory antigens in degenerate Cysticercus bovis lesions, which may improve diagnostic accu racy (Esteves and Alvite, 2022).

To effectively prevent and control bovine cysticercosis, rigorous meat inspection and proper cooking practices are critical; beef should be cooked to an internal temperature of 56-60°C (132.8-140°F) for at least 5 minutes can kill cysticerci (WHO, 2021). For treatment, *Taenia saginata* can be effectively managed with praziquantel (5–10 mg/kg, single administration) or niclosamide, which is dosed at 2 g for adults and children over 6 years after a light breakfast, followed by a laxative two hours later. For children aged 2–6 years, the dosage is 1 g, and for those under 2 years, it is 500 mg. additionally, albendazole is highly effective in treating cattle infections (Dural *et al.,* 2015).

1.2. Statement of the Problem

Cysticercus bovis is a parasitic disease of cattle causing great economic losses from organ condemination and treatment costs; it has also public health implications. The disease is prev alent in Ethiopia due to the consumption of raw or undercooked meat. Many studies about teniasis and cysticercus bovis have been conducted throughout of Ethiopia. According to abattoir surveys, the prevalence of cysticercosis ranges from 2% to 26.25% in different parts of Ethiopia (Kumar and Gebretsadik, 2008; Nuraddis and Frew, 2012; Samuel and Berihun, 2014; Yitagele *et al.,* 2014; Emiru *et al*., 2015; Meseret *et al.,* 2017; Bacha *et al*., 2020; Dhar mawan *et al*., 2020 and Fikadu *et al*., 2020). On the other hand, the prevalence of taeniasis questionnaire surveys in human also ranging from 19% to 64.5% (Abdulaziz *et al.,* 2016; Akalu, 2018; Birhanu *et al.,* 2018; Solomon, 2023). As a result, human health, the esthetic value of meat, and trading of meat and offal are compromised (Webb, 2019).

In Ethiopia, there is insufficient knowledge about the transmission of teniasis; there is also prevalent consumption of raw or undercooked beef dishes such as kourt and kitfo (Chalmers et *al*., 2020; Roba and Tolosa, 2020). However, the effectiveness of meat inspection is compromised by a lack of critical control points in abattoirs, and this contributes to a high prevalence of taeniasis in humans and BCC in cattle. The economic impact is substantialy affecting cattle production and marketing through losses associated with infected carcasses, weight loss, and meat freezing costs (Gabriël *et al*., 2022). The economic burden also extends to human health, with considerable expenses related to the treatment of taeniasis. The estimated cost of taeniasis treatment in Ethiopia is 4,937,583.21 ETB (225,036.97 USD) (Tariku and Adem, 2019). Significant losses are also reported in different regions of the country (Seifu, 2019). In foreign trade, although the country is ideally placed to export live animals to the big markets of the Middle East and substantial markets of North and West Africa, export earnings are relatively low due to Taenia saginata/Cysticercus bovis (Korso, 2019; WHO, 2020).

Although *Taenia saginata* and bovine cysticercosis are widespread globally, they often receive insufficient attention as neglected zoonoses, particularly in developing countries where the highest prevalence is observed (Edilu, 2022). In Ethiopia, the situation is further aggravated by factors such as inadequate meat inspection procedures, limited public health resources, and cultural practices that include eating raw or undercooked beef (Akalu *et al*., 2022).

Despite the seriousness of the issue, there is a notable lack of detailed information regarding the prevalence of

bovine cysticercosis in Banbasi Administrative Town. Furthermore, there is no data on community knowledge, attitudes, and practices (KAP) related to taeniasis in these towns. This includes the existence of gaps in understanding how the disease is perceived, sources of infection, preventive practices, symptoms, location of cyst in muscle, and the overall health impact of taeniasis. Such information is vital for creating targeted health education and inters vention strategies. Addressing these issues, in general, is essential for developing improved disease management, designing and implementing effective control strategies, enhancing pub-lic health outcomes, and reducing the economic burdens associated with both bovine cysticercosis and taeniasis in the affected areas. Therefore, this study was conducted with the follow ing objectives:

1.3. Objectives

- ✓ To determine the prevalence of Cysticircus bovis in cattle slaughtered at Banbasi manicipal abattoir; Public health Significance and Community Knowledge, Attitude and Practice of Cysticercus Bovis in Banbasi Municipal Abattoir, Western Ethiopia.

1.3.1. Specific objectives

- ✓ To determine the prevalence of Cysticircus bovis in cattle slaughtered at Banbasi manicipal abator; Public health Significance western Ethiopia.
- ✓ To Determine Community Knowledge, Attitude and Practice of Cysticercus Bovis in Banbasi Municipal Abbatoir.
- ✓ To determine community KAP towards Public and Economic impacts of bovine cysticercosis in the study area.

2. MATERIALS AND METHODS

2.1. Description of the Study Area

The study area was one of among the regional states of federal republic of Ethiopia, which is Benshangul Gumuz Regional State that locates 676 km West Addis Ababa. Assosa Zone is one of the three administrative zones. It is found in the southwest part of the region. The study was conducted from Novmber 2024 – May 2025 at Banbasi Adminstrative Town municipal abattoir of Benshangul Gumuz Regional State. Banbasi Adminstrative Town is located at 9.60^0 and 10.45^0 N and 34.20^0 and 34.58^0E longitude. The altitude of Banbasi Adminstrative Town ranges from 580 to over 1544 m.

The total area of the Region is 2317 KM^2 of which is characterized by low land plane agro-ecology according to National Meteorology Service Agency with average annual rain fall of 1316 mm with uni-modal type of rain fall that occurs between April and October . Its mean annual temperature ranges between 16.75 ^{0}c and 37.9 ^{0}c. The total human population of the Banbasi Adminstrative Town is 80,902. Assosa Zone has the livestock population of 65,500 cattle, 23,900 goats, 5,550 sheep, 9860 donkeys and 60,849 poultry, 2,250 dogs (Banbasi Adminstrative Town Agriculture and office and Animal resource development, 2024).

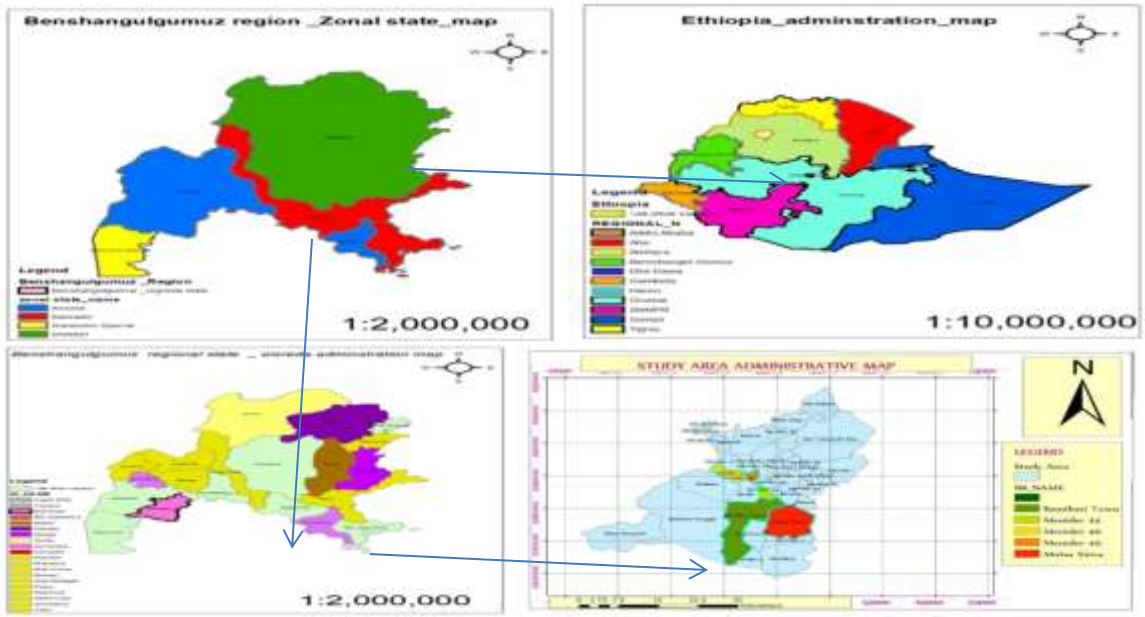

Figure 1. Map of Banbasi Administrative town (B/G/R/S/E /E/B, 2020)

2.2. Study Population

Study populations were all local zebu cattle slaughtered between October 2024 to June 2025 at Banbasi Administrative Town municipal abattoir. For the questionnaire survey, the study populations was volunteer participants drawn from different social groups like drivers, students, merchants, butchers, and civil servants in the study areas.

2.3. Source Population

For Abattoir survey, population source was cattle from Banbasi and Kashmado, and population source for Knowledge, attitude and practices of the communities (KAP) was intervieed in Banbasi administrative Town.

2.4. Study Design

A cross-sectional study was conducted from October 2024 to June 2025 to determine the prevalence of Cysticercus bovis and to explore community knowledge, attitude, and practice towards taeniasis/BCC using a questionnaire survey in the study areas.

2.5. Sample Size Determination

To determine the total sample size for abattoir survey, using an expected prevalence of 50%, a 95% confidence level, a 5% desired level of precision, and the formula provided by (Thrusfield, 2007).

$$n = \frac{(1.96)^2 \, Pexp\,(1-Pexp)}{d^2}$$

Where: n = Sample size ; Pexp = Expected prevalence (set at 0.5 for maximum variability)

d = Desired level of precision (0.05, leading to d2=0.0025)

Using these values, the calculation yields:

$$n = \frac{(1.96)^2 0.5\,(1-0.5)}{0.0025} = 384$$

The calculated sample size for abattor survey was 384 cattle;

For questionnaire survey: for community knowledge on meat hygiene practice the sample size required was calculated by using the formula given by Arsham (2002) as follows:

$$n = 0.25/SE^2,$$

Where: n= sample size, SE (standard error) = 5%. The sample size for KAP survey for the questionnaire survey based on the above formula is **100 respondents** were interviewed using proportional sampling from the households.

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2.6. Sampling Technique

A simple random sampling method was used to select animals at Banbasi administrative municipal abattoirs, which involved selecting animals for observation without any specific criteria, ensuring that every animal had

an equal chance of being included in the study. A total of 384 slaughtered cattle, from Banbasi administrative Town slaughter house was inspected, and the average numbers of slaughtered animals per day was 23 inspected. Active abattoir surveys was conducted in Banbasi administrative Town municipals abbatoir every Saturday, Sunday, and Monday for three months, and out of 23 animals brought to the Banbasi municipal abattoir, carcasses of 10-13 animals was randomly selected and inspected and checked for the presence of Cysticercus bovis.

The Knowledge, Attitudes, and Practices (KAP) questionnaire survey, a systematic random selection method was implemented to select the household. This involved identifying a list of dwelling houses in each town starting at a random point in the list of houses, every nth house (where n is determined based on the total number of houses and the desired sample size) was chosen for the survey. Once the houses were selected, individuals within those residences were chosen using simple random sampling in Banbasi administrative town.

2.7. Data Collection Procedures

2.7.1. Anti-mortem inspection

Before sampling, each animal was assigned a unique identification code that included the owner's name and the cattle's color. The selected animals underwent an ante-mortem inspection (AMI), during which detailed information about their overall health and risk factors including **site, sex, age, breed, and body condition was** recorded on specially designed sheets prior to slaughter.

2.7.2. Active abattoir survey

According to the guidelines by the Ministry of Agriculture of Ethiopia for the presence of Cysticercus bovis active abattoir surveys was conducted on slaughtered cattle using postmortem examination (MAO, 1972). The examinations was conducted through visualization, palpation, and two longitudinal ventral incisions of the tongue from the tip of the root, one deep incision into the triceps muscles of both sides of the shoulder. A deep incision into the external and internal muscles of the masseter parallel to the plane of the jaw, longitudinal incision of the heart from base to apex, three parallel incisions into the long axes of the neck muscles on both sides and one extensive incision on the diaphragm; visual examination, palpation, and incision of the liver and kidneys. Findings was registered according to the organs inspected. During meat inspection, each organ of an animal was strictly and separately examined to avoid mixing up of organs. The butcher and meat inspector also give due attention to avoid mixing up organs from different animals.

2.7.3. Questionnaire survey

Regarding the questionnaire for the KAP survey, respondents for the questionnaire survey was based on a systematic random selection of dwellers' houses in each town. Respondents were randomly selected from residence houses in every house was used for unwilling household members. However, butchers were purposefully selected.

To obtain the requisite information, a pre-validated questionnaire that adhered to standardized protocols was devised. The questionnaire was divided into four sections; the first part dealt with respondents' **demographic** characteristics such as **gender, age, level of education, occupation, marital status, religion, and income**. The second section of the questionnaire focused on knowledge, which consisted of seven questions, including questions about the transmission of taeniasis from animals to humans, heard about taeniasis, about preventive ways of taeniasis, about symptoms of infection, cysts seen, location of cysts, and eating raw or undercooked meat can transmit diseases from animals to humans. The third section of the questionnaire addressed farmers' attitudes toward Taenia saginata/taeniasis; it included four questions such as think of taeniasis as a serious disease, intend to stop eating raw or undercooked meat, at the risk of being infected. The fourth section also focused on producer's practices; it included 5 questions about eating raw or undercooked meat, frequency of eating raw meat, treatment option when infected, about source of meat, and whether or not they use inspected meat.

Interviews were done done every Tuesday, Wednesday, and Friday in each town. Eleven -sixiteeny (11-16) Banbasi administrative town from April to May 2025 respondents was interviewed per day. Accordingly, prepared questionnaires were administered to 384 randomly selected volunteer respondents in study areas. Following detailed dis cussion on the objectives of the study with each participant, the questionnaires was adminis tered to respondents in the local language. The predisposing risk factors of taeniasis are age (<20 years, 20-48 years, and > 48 years), sex, religion, occupation, income, educational levels (non-educated, primary/high school, college/ university), knowledge, attitude, and practice of Taenia saginata was assessed.

2.8. Data Analysis

All the data obtained from the study was entered into MS Excel data sheets, coded, and ana lyzed using STATA Version 17. After the entry, the second phase of data cleaning was done to ascertain the correct entry of data using a basis of logic checks. The data was described using percentages to determine Cysticercus bovis infection in the examined carcass and to determine KAP of respondents; associations between **categorical variables** were assessed using the **Chi-square test** (χ^2). The **odds ratio (OR)** was used to determine the effect of different risk factors and strength of association. A logistic regression analysis was used to investigate the relationship between each explanatory variable and Cysticercus bovis, as well as knowledge, attitude, practice score, and Hosmer-Lemeshow Test was used to assess model fitness. The statistical significance level was set at $P < 0.05$ at the 95% confidence level to determine whether there are statistically significant differences between the parameters measured. A P-value less than 0.05 was considered significant ($p< 0.05$).

2.9 Ethical Consideration

Ethical clearance letter was obtained from Assosa University College of Agriculture and Veterinary Science (CAVS) ethical review board. Verbal consent was agreed with the Banbasi woreda and its municipal slaughter house. To make this study, public health ethics such as consents and voluteerness of the participants for the study was asked and acknowledged first. The entire moral, cultural believes, religious values of the community were respected. The confidentiality of information and privacy of participants during sample collection and interview was kept. Access to confidential records and computer file were safe guarded.

3. RESULTS

3.1 Abattoir Survey

Prevalence: the overall prevalence of Cysticercus bovis among cattle slaughtered and examined at Bambasi municipality abattoir was found to be 19.79% (76/384). There was significanly association ($P <0.05$) in C. bovis prevalence and risk factor in organ categories, body conditions, age, cyst size, and origin of cattle ($P < 0.05$); whereas, there was no significant association ($P >0.05$) in **C. bovis** prevalence and risk factor (sanitary condition, and sex).

Higher Cyst occurrence was recorded 14/49(28.57%), and 21.83% (50/229) in greater than 9 years old and 5- 9 years respectively, while 12/106(11.32%) in 3- 5 years of age group of cattle which was significant ($P<0.05$). Higher cyst occurrence was recorded in cattle with poor (33.33%) followed by medium (29.41%) and good body condition scores (12.77%), which was slightly significant ($P<0.05$). Based on the origin of cattle, hydatid cyst occurrence was 26.61% in Banbasi town, 19.49**%** in keshmando, 12.26**%** around Banbai (Table 5), the association was significant ($P<0.05$). 21.18% of the banbasi abattoir hygiene/ sanitary/ was good while 12.69% was poor sanitary condition. In majority of animals harboring C. bovis, the cysts had het tendency to be located more in shoulder (32.89%) and heart (22.36%), tongue (17.10%) than in other organs such as masseter (9.21%), liver (11.84%), and lung (6.57%) (Table 5).

Table 5. Occurrence of Bovine Cysticercus bovis associated with risk factors

Variables	Categories	N=384	No. Positive	Prevalence %	CHI2	P-Value	OR	95%CI
Sex	Female	51	8	15.68	0.47	0.58	1.26	0.53-3.01
	Male	333	68	20.42				
Age	3-5years	106	12	11.32	15.70	0.04	1.52	1.01-2.30
	5-9 years	229	50	21.83				
	>9years	49	14	28.7				
BCS	Good	227	29	12.77	4.75	0.01	1.87	1.13-3.11
	Medium	136	40	29.41				
	Poor	21	7	33.33				
Origin	*Banbasi twon*	124	33	26.61	7.42	0.02	0.52	0.35-0.78
	keshmando	154	30	19.48				
	around Banbasi	106	13	12.26				
Sanitary of abattoir	*Good*	321	68	21.18	2.38	0.29	1.56	0.68-3.59
	poor	63	8	12.69				
Cyst size	*Small*	260	60	23.07	6.79	0.03	0.66	0.39-1.13
	Medium	109	14	12.84				
	Large	15	2	13.33				

***Slaughtered breeds was only local zebu cattles**

Table 6. Cysticercus bovis infected organs in relation to risk factor

Variables	Categories	Lung	Shoulder	liver	Heart	Tongue	Massetor	Total
Sex	Male	3	20	5	12	7	4	51
	Female	2	5	4	5	6	3	25
Age	3-5 yeas	1	4	2	2	2	1	12
	5- 9 years	3	17	5	13	8	4	50
	>9years	1	4	2	2	3	2	14
Bcs	poor	3	10	5	12	6	3	**39**
	medium	1	10	3	3	4	2	23
	good	1	5	1	2	3	2	14
Origin	Banbsi town	3	10	5	6	7	2	33
	Keshmando	1	10	2	6	3	2	24
	Around Banbasi	1	5	2	5	3	3	19

3.2 Anatomical Distribution of Cysts and size of Cysticercus bovis (Taeniasis)

Analysis of active abattoir survey showed that, there was variation in the anatomical distribution of cysticerci in organ inspected. Of the organs examined, the highest proportion of C. bovis cysts were observed in the shoulder (32.89%), followed by heart (22.36%), tongue (17.10%), liver (11.84%), masseter (9.21%) and lung (6.57%). From the total of 76 cysts counted, 78.94% (60), 18.42% (14) and 2.63% (2) were small, medium and large, respectively (Table 8).

Table 7. Distribution of Cysticercosis bovis cases across organs, along with their respective counts and percentages

Organ	Number of Cases	Total Inspections (n=384, %)	Proportion (n=76, %)
Shoulder	25	6.51	32.89
Heart	17	4.42	22.36
Tongue	13	3.38	17.10
Liver	9	2.34	11.84
massetor	7	1.82	9.21
Lung	5	1.30	6.57
Total	76	19.79	19.79

Cysticercosis bovis (caused by the larval stage of Taenia saginata) was detected in 76 out of 384 cattle (19.79%) inspected at the Bambasi Municipal Abattoir in Benishangul-Gumuz Regional State, Western Ethiopia. The shoulder muscle had the highest prevalence (6.51%), followed by the heart (4.42%) and tongue muscles (3.34%), and 2.34% in liver. The massetor (1.82%) and lungs (1.3%) showed lower infection rates. This distribution aligns with the predilection sites for cysticercosis bovis, as muscles and organs with high blood flow (e.g., heart, tongue) are commonly affected. The findings highlight the need for improved meat inspection protocols and public health interventions to mitigate zoonotic transmission in the region (Table7).

Table 8. Number and size of bovine Cysticercus bovis observed in different organs

Organ	Large		Medium		Small		Total account	
	No.	%	No.	%	No.	%	No.	%
Lung	0	0	0	0	5	8.33	5	6.57
Shoulder	1	33.33	4	28.57	20	33.33	25	32.89
Heart	1	33.33	3	21.42	13	21.66	17	22.36
Tongue	0	0	3	21.42	10	16.66	13	17.10
Liver	0	0	2	14.28	7	11.66	9	11.84
Massetor	0	0	2	14.28	5	8.33	7	9.21
Total	2	100	14	100	60	100	76	100

3.3 Characterization of Cysticercus bovis

The Viability Tests: of the total 76 cysticercus bovis randomly collected from different organs, at the abattoir during postmortem examination and subjected to viability and sterility testing, 53(69.73%) were found to be fertile (alive), while the rest 23(30.26%) were non-fertile or degenerated cyst; out the fertile cysts, 25 (47.16%) were viable and 28 (52.83%) non-viable; again, among the non-fertile, 14(60.86%) sterile and 9 (39.13%) calcified.

Table 9. Bovine C. bovis : Cyst fertility and Viability in different organs

Organ	**Fertility 53 (69.73%)**		**Non fertility 23(30.26%)**		**Total**
	Viability	non viability	Sterile	calcified	
Shoulder	7	10	6	2	25
Lung	2	1	1	1	5
Heart	5	8	2	2	17
Liver	2	4	2	1	9
Tongue	6	3	2	2	13
Massetor	3	2	1	1	7
Total	**25(47.16%)**	**28 (52.83%)**	**14(60.86%)**	**9 (39.13%)**	**76**

Table 10. Proportions of Viable and non-viable Cyst in different organs inspected

Organs	**No. of cysts**	**Viability/fertitility of cyst**		**Total cases (n=76, %)**	**Non- viability**	
		Viable cysts	**Proportion (%)**		**non viable cyst**	**Proportion (%)**
Lung	5	2	40	2.63	1	20
Shoulder	25	7	28	9.21	10	40
Heart	17	5	29.41	6.58	8	47.05
Massetor	7	3	42.85	3.94	2	28.57
Tongue	13	6	46.2	7.89	3	23.07
Liver	9	2	22.22	2.63	4	44.44
Total	**76**	**25**	**32.89**	**6.51**	**28**	**36.84**

(Majority of the viable cysts were recorded in shoulder (9.21%), followe by tongue (7.89%), 6.58% Heart, 3.94% massetor, 2.63% lung and 2.63% liver as indicated in *Table 10*).

Table 11. Proportions of non fertile/ sterility Cyst (C. bovis) in different organs inspected

Organs	No. of cysts	non fertile/ sterile cyst		Total cases (n=384, %)
		non fertile cysts	Proportion(%)	
Lung	5	1	20	0.26
Shoulder	25	6	24	6.25
Heart	17	2	15.38	0.52
massetor	7	1	14.28	0.26
Tongue	13	2	15.38	0.52
liver	9	2	22.22	22.22
Total	**76**	**14**	**18.42**	**3.64**

As indicated in Table 11, higher sterile cyst(6.25%) was reported in shoulder, followed by Tongue (0.52%), heart (0.52%), and (0.26% , 0.26%) in lung and massetor respectively.

Table 12. Financial loss assessment in Cattle due to Cysticercus bovis

Organ	No. of organ condemned	Price per organ		Total price (ETB)
Shoulder	25	32.89%	50	1,644.5
Lung	5	6.57%	50	328.94
Heart	17	22.36%	50	1,118.42
Liver	9	11.84%	50	592.10
Tongue	13	17.10	50	855
Masseter	7	9.21	50	460.5
Total	76	100		4,999.46

3.4 Economic losses

From the total of 384 cattle examined, 76 (19.79%) were found harboring Taeniasis cysts. Among them, 32.46%, 6.57%, 22.36%, 11.84%, 17.10% and 9.21% of the Taeniasis (C.bovis) cysts were located in the shoulder, lung, heart, liver , Tongue, and massetor respectively. The overall occurrence of cysticercus bovis and percentage involvement of shoulder, massetor, heart, Tongue, liver and lung were used as input to estimate the financial loss attributable to organs condemned in the present study.

In Banbasi town average market price of cattle shoulder, massetor, heart, Tongue, liver and lung , and a kilogram of beef was found to be 50, 50, 50, 50, 50 and 500 Ethiopian Birr (ETB) respectively. The mean annual numbers of cattle slaughtered at Banbasi municipal abattoir during the last two years was 1**800**, and the overall occurrence of cysticercus bovis was found 76/384(19.79%) during the study period.

Hence, **direct financial losses** due to condemnation of organs and **indirect financial losses** due to **carcass weight loss** were calculated as follows on annual basis.

DL = (AS × PSh × CSh) + (AS × Plung × Clung) + (AS × Pliv× Cliv) + (AS × PHr × CHr) +(AS x P Tong x CTong)+ (AS x P mass x Cmass)

(1800 × 50 × 0.328) + (1800 ×50 × 0.066) + (1800 × 50 × 0.118) + (1800 × 50 × 0.224) + (1800 x 50 x 0.171)+ (1800 x 50 x 0.092)

DL = (29,520) + (5,940) + (10,620)+ (20,160)+ (15,390)+(8,280) = 89,910 ETB ($ 599.4 USD).

Where;

DL = direct losses associated with cysticercus bovis

AS = estimated mean annual slaughter;

PLu = percent involvement of the shoulder;

CLu = local retail price of a shoulder;

PLi = percent involvement of the massetor;

CLi = local retail price of a massetor;

PKid = percent involvement of the tongue;

CKid = local retail price of a Tongue;

PHr = percent involvement of the heart;

CHr = local retail price of a heart.

Pliv=percent involment of liver

Cliv= local retail price of liver

Plung=percent involment of lung
Clung= local retail price of lung
Indirect losses (IL) = 5%NAS × PH × CPB × 126 kg (0.05 × 1830 × 0.198 × 500 × 126) = 1,122,660 ETB ($ 7,484.4 USD).
Where 5% = A reduction of 5% in meat production due to cysticercus bovis;
NAS = average number of cattle slaughtered annually;
PH = prevalence of cysticercus bovis;
CPB = current average price of 1 kg of beef at Banbasi;
126 kg is the dressed average carcass weight of adult cattle.
Total economic loss (TL):
The total economic loss can be evaluated by considering both DL and IL as follows:
TL = DL + IL (89,910 ETB ETB + 1,122, 660.4ETB) = 202,176.4 ETB ($ 1,347.84 **USD)**. (Table 10).

3.5 Questionaire set to risk factors related to Taeniasis infestation

As Demographic data of interviewers indicated that, higher 56% of participants were males, 52% of respondents were 20-48 years old, and 64% of participants were Christians, which was statistically significantly associated(P<0.05). Higher (56%) married participants were included in the questionnaire survey and 40% higher participants were illiterate which has chance of getting the infection as compared to educated categories, which was not significantly associated (P>0.05), indicating the risk of getting Taeniasis due to eating habit, and culture of community (Table 12).
The questionnaire data collected were translated to categorical variables, which were assessed for human taeniasis as described in Table 12-15.

Table 12. Demographic Information

No	Categories	N=25	Percent %	OR	95%CI	X^2	P value
1	**Gender of respondents**						
	Female	11	44%	0.81	0.35,1.86	0.24	0.62
	Male	14	56%				
2	**Age**						
	20 years	4	16%	0.86	0.45,1.62	1.84	0.39
	20-48 years	13	52%				
	48 years	8	32%				
3	**Religion**						
	Christian	16	64%	1.04	0.43,2.52	0.009	0.92
	Muslim	9	36%				
4	**Marital status**						
	Married	14	56%	0.88	0.42,1.82	4.00	0.14
	Single	9	36%				
	Divorced	2	8%				
5	**Education**						
	Illiterate	10	40%	0.93	0.56,1.55	0.52	0.77
	ES/HS	8	32%				
	College	7	28%				
6	Estimated household monthly income range?						
	1000 birr	7	28	0.79	0.42,1.47	1.35	0.50
	1000-5000 birr	14	56				
	5000 birr	4	16				
7	What is the main source of household income						
	Civil servant/ employee	5	20	0.98	0.66,1.45	0.07	0.99
	Merchants	9	36				
	Butchers	5	20				
	Health professional.	2	8				
	Veterinary	4	16				

With regards to knowledge of participants regarding *T. saginata*, 52% of participants were not know where humans acquired taeniasis while 48% of respondent participants know mode of transmission (means of acquiring of *T.saginata in the environments).* 56% of the participants ever seen cysts in meat while 44% did not, which was significantly associated (P<0.05). 16% in lung, 20% in liver, 24% in heart, 36% in muscle (tongue, masseter, shoulder) and 4% in kidney of tapeworms were seen by participants by postmortem examination during the interviews which was statistically significantly associated(P<0.05). Similarly, 60%, 56% of participants heard *T. saginata*, and know the symptoms of *T. saginata* respectively, which was significantly associated (P<0.05). 4%, 44%, 48%, and 4% of participants know symptoms of *T. saginata* as nausea, abdominal pain, diarrhea, headache respectively which was statistically significantly associated (P<0.05).

Consistently, 56% of participants know *as T. saginata* was health impact and also 56% of respondent interviewers experienced of tapeworms, which was not significant (p>0.05). During interviewing, the participants recognized as 24% of tapeworms were detected by saw underwear, 48% recognized by stool observation, and 28% recognized by laboratory examination (Table 12). Besides this, the participants recognize the tapeworms and hence 72% went to health station/ clinic/hospital to get drugs; 20% went to the pharmacy to buy drugs myself; 8% used local herbal drugs for treatment (Table 13).

Table 13. Knowledge regarding *Taenia saginata* (Taeniasis)

No.		(N=25, %)	OR	95%CI	X^2	P –value
1	Do you know from where humans acquire tapeworm?					
A	Yes	12 (48%)	0.34	0.14,0.80	6.2	0.01
B	No	13(52%)				
2	Have you ever seen cysts in meat					
A	Yes	14(56%)	3.57	1.49, 8.57	8.55	0.003
B	No	11(44%)				
3	Where did you see the cysts					
A	Lung	4(16%)	0.22	0.11,0.42	37.06	0.000
B	Liver	5(20%)				
C	Heart	6(24%)				
E	Muscle (Tongue, massetor, shoulder)	9(36%)				
F	Kidney	1(4%)				
4	Have you ever heard of *Taenia saginata*/ Taeniasis/					
A	Yes	15(60%	0.74	0.32,1.76	0.43	0.50
B	No	10(40%)				
5	Do you know the symptoms/ signs of Taeniasis					
A	Yes	14(56%)	1.6	0.67,3.76	1.16	0.28
B	No	11(44%)				
6	What kind of symptoms did you encounter					
A	Nausea	1(4%)	0.22	0.1, 0.46	25.68	0.000
B	Abdominal pain	11(44%)				
C	Diarrhea	12(48%)				
D	Headache	1(4%)				
7	Where did you hear of taenia saginata/ Taeniasis /					
A	From animal health prof.	11(44%)	1.94	0.81, 4.62	25.00	0.000
B	From a human health institution health workers	11(44%)				
C	From media	1(4%)				
D	Others	2(8%)				
8	Do you know the health impact of taenia saginata/ Taeniasis					
A	Yes	14(56%	0.63	0.27,1.47	1.12	0.28
B	No	11(44%				
9	Have you ever experienced a tapworm infestation					
A	Yes	14(56%)	4.09	1.68, 9.92	10.27	0.001
B	No	11(44%)				
10	How did you know that is was taeniasis (detection)					

A	Saw underwear	6(24%)	0.91	0.39, 2.10	0.04	0.82
B	Recognized in my stool	12(48%)				
C	Recognized by lab examination	7(28%)				
11	Recognizing the tapeworm,					
A	Went to health station/clinic/hospital to get drugs	18(72%	1.65	0.58, 4.66	0.91	0.33
B	Went to the pharmacy to buy drugs by myself	5(20%				
C	Used local herbal drugs for treatment	2(8%)				

With respect of attitude towards Taeniasis, 56% of respondents think as taeniasis was a serious disease, 56% of respondents think eating raw or under cooked meat is good practices, 28% of respondents consider themselves at risk of being infected with tapeworm infection, and 60% of participants interviewers intend to stop eating raw/undercooked beef because of taeniasis infection, which was statistically significantly ($p<0.05$) (Table 14)

Table 14. Attitude towards *Taenia saginata* (Taeniasis)

No.		N=25,%	OR	95%CI	X^2	P value
1	Do you think taeniasis is a serious disease		0.82	0.32,2.06	6.2	0.01
	Yes	11(44%				
	No	14(56%				
2	Do you think eating raw or under cooked meat is a good practices					
	Yes	14(56%	0.38	0.14,0.98	8.55	0.003
	No	11(44%)				
3	Do you consider yourself at risk of being infected with tapeworm infection					
A	Yes	7(28%)	2.67	0.97,7.38	3.78	0.05
B	No	18(72%)				
4	Do you intend to stop eating raw and /or undercooked beef just b/se of the tapeworm infection					
A	Yes	15(60%	0.65	0.23,1.85	25.78	0.000
B	No	10(40%				

With regard to beef consumption practices, 76% of the respondent participants practiced in eating raw beef in the community, while 24% of respondents did not eat raw beef. 84% of participants prepare beef in their house and used, while, 16% of respondents did not prepare beef in house, which was statistically non-significant ($P>0.05$).
As respondents in the study area respond, usually beef prepared and eaten in the form of Kurt (36%), kitfo (28%), dulet (24%), and (12%) other traditional preparation was reported, which was statistically non-significant ($P>0.05$). With respect to beef consumption practices, and time period of beef eating practices, 32%, 44%, 24%, and 0% of respondents, eat beef rarely/once a month, 2 times in weeks, occasional/ few times in a month, and never respectively. And also with regards to source of the beef consumed, 52%, 28%,32% and 8% of respondents source of beef for consumption were own cattle, butcher, neighbor/ friend, and other respectively, which was statistically significant ($P<0.05$)(Table 15).

Table 15. Beef Consumption practices

No.		N=25, %	OR	95%CI	X^2	P value
1	Do you eat raw beef					
A	Yes	19(76%)	0.65	0.23, 1.85	0.64	0.42
B	No	6(24)				
2	Do you prepare beef in your house					

A	Yes	21 (84%)	0.90	0.28, 2.87	0.026	0.87
B	No	4(16%)				
3	How is the beef you have eaten usually prepared					
A	As kurt	9(36%)	0.34	0.18,0.65	17.2	0.000
B	As kitfo	7(28%)				
C	As Dulet	6(24%)				
D	Others	3(12%)				
4	Where is the source of the beef that you consume					
A	Own cattle	13(52%)	1.57	0.92,2.67	5.33	0.09
B	Butcher	7(28%)				
C	Neighbour/ friend	3(12%)				
D	Other	2(8%)				
5	How often do you eat beef					
A	Rarely/once a mth	8(32%)	0.38	0.22, 0.68	20.47	0.000
B	2 times in a week	11(44%				
C	Occasionally/few times in a mth	6(24%				
D	Never	0(0%)				

4. DISCUSSION

4.1 Prevalence of Cysticercosis

The prevalence of Cysticercus bovis among the carcasses inspected at Banbasi municipal abattoir was 19.79 % which is in agreement with the findings of (Abdulaziz *et al*., 2016) in Halaba Kulito of 19% Taeniasis prevalence; and Abunna *et al*. (2008) (26.25%) of C.bovis at Hawassa. As Compared to the present findings, the lower prevalence of C.bovis was reported by Tegegne *et al*. (2018) (8.97%) in Kombolcha, Moje *et al*. (2014) (10.1%) at Shashamanne; Kebede *et al*. (2009) (7.5%) and Regassa *et al*. (2009) (11.3%) both at Wolaita Soddo abattoirs. Besides this, lower prevalence of C. bovis were registered by Tamirat *et al*. (2018) (4.2%) at Bahir Dar, Ibrahim and Zerihun (2012) (3.6%) at Addis Ababa abattoir, Taresa *et al*.(2011) (3.65%) at Jimma, Dawit (2004) (4.9%) at Gondar, Megersa *et al*. (2010) (4.4%) at Jimma and Bedu *et al*. (2011) (3%) at Zeway. On the other hand, higher prevalence (64.5%) was reported in Werabe Town by (Solomon, 2023) based on questionnaire surveys. The observed difference among these studies could be explained with the agro-climatic conditions of the study areas, the number of incision made during inspection, the ability of the meat inspector to identify the C.bovis, habit or culture of raw meat consumption, sample size and sampling method, level of environmental contamination with the eggs of *T. saginata*, dose and viability of egg consumed (Scandrett *et al*., 2009). Low infection among the inspected animals in the present study area could be due to limited number of incisions made on the predilections sites. This may in turn lead to missing of infected animals as the sensitivity of detecting the parasite will decline with limited number of incisions (Wanzala *et al*., 2003). The presence and number of cysts in any given site varied greatly among animals and demonstrate the absence of any true predilection sites for C. bovis (Scandrett *et al*., 2009).

The prevalence of bovine cysticercosis obtained in this study was 19.79 %, which is relatively comparable to the findings of Hailu (2005), Abunna *et al*. (2008) and Regassa *et al*. (2008) who indicated respectively 17.5% in East Shoa, 26.3% in Hawassa and 13.3% in Wolita Sodo.

However, higher prevalence were reported in many parts of Africa including 20% in Senegal, 27% in Tanzania

and 38-62% in Kenya (Over *et al.*, 1992) where as lower prevalences were reported from developed countries such as 0.26% in Crotia (Zivkovic et al., 1996), 0.48-1.08 in Germany (Abusier *et al*., 2006) and 0.9% in Cuba (Sau‟rez, 2005). Factors like the method and skill of meat inspection, difference in the management and the number of cuts made on each organ during inspection can contribute for the variation of the prevalence (Wanzala *et al*., 2003). The variation may also be associated with poor sanitary infrastructure, low awareness and improper disposal of sewage particularly in developing countries. And the 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 present study showed that tongue, shoulder muscle, Masseter, heart, lung and liver were the predilection sites for the cysts of C. bovis which is similar to the results of Megerssa *et al*. (2010). Regarding the anatomical distribution of the cysts, many researchers come up with different results like Abunna *et al.(*2008) and Getachew (1990) reported triceps as being frequently affected by the cyst, while Mulugeta (1997) found as heart as a preferable organ. However, the present study showed that the most frequently affected organ with the highest number of cysts were the shoulder, heart, and tongue which is in agreement with different studies conducted in different parts of the country (Hailu, 2005; Bedu *et al.*, 2011).
With regards to Cyst fertility and non fertility, overall cyst fertility was 53(69.73%), and non fertility was 23(30.26%). Cyst viability was 25(47.16%) and non viability was 28 (52.83%). Sterility cyst was 14 (60.86%) and calicified cyst was 9(39.13%). 32.89%, 22.36%, 17.10%, 9.21%, 11.84%, and 6.57% of Cysticercus bovis was recorded in offals of shoulder, heart, tongue, masseter, liver and lung respectivelly. A total of 76 cysts were detected during the inspection. Of the total 76 C.bovis collected during the study period 25 (47.2%) were found to be a live while other 28(52.83%) were degenerative cyst.

Viability test of the cysts revealed that it was the shoulder which harbored the highest number of viable cysts were recorded in shoulder (9.21%) ; followed by tongue(7.89), 6.58% heart, 3.94% massetor , 2.63% lung and 2.63% liver. However, the present finding was less than the findings of Lielt *et al*. (2015) and Dejene *et al*. (2017). The present finding was also greater than the finding of Bekele *et al.* (2010) (42.9%). This findings implies, 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. Furthermore, backyard slaughter is practiced in the area reducing the number of animals brought to slaughter in the abattoir. During backyard slaughter infected organs are left unburied in the field accessed for dogs and other carnivores which favor the transmission cycle of cysticercosis. The culture and tradition of inhabitants in the study area favor the keeping of dogs in periurban areas (urban and rural households) often in close association with the family and farm animals. Almost all cattle owners, shepherds and urban dwellers keep at least 1 dog to safeguard their properties from wild carnivores and thieves. These in the areas studied are considered to be conducive to the maintenance and further propagation of cysticercosis (Kebede *et al*., 2010).

4.2 Questionnaire survey of *T.saginata (Taeniasis*)

This study indicated that there was association in age categories of animals and cysticercosis infection rate. This may be due to indiscriminate exposure of animals to risk factors regardless of their sexes and breed. The management of cattle was the same regardless breed and age in an open range land subjected to equal chance of infection. Higher infection of cysticercosis was registered in 5-9 years and >9 years of cattle 21.83% and 28.57% respectively, compared to 3- 5 years (11.32%) with variable number of C. bovis observed among different organs examined which was significant ($P<0.05$).

This is in line with the reports of Zewdu *et al*. (2010) 22.91% old and 6.78% adult; Mandefro *et al*. (2019) 66.1% old and 29.5% adult; Akeberegn *et al*. (2017) 8.71% old and 2.8% adult; Kebede and Mekonnen (2020) 43.4% old and 19.0% adult. The higher C.bovis prevalence in adult and older cattle than the younger ones might be due to the persistence prolonged exposure to C.bovis scolex evaginated (metacetodes), the development of metacestodes of scolex evagination and reduced immune status as a result of longer exposure time to the eggs of the parasite in old than younger cattle. Similar reports were documented by Abunna *et al*. (2008) and Hailu (2005). The possible suggestion for this could be adult people had the habit of raw meat consumption than the younger population owing to the fact that children are not allowed to consume raw meat and adult individuals can financially afford consuming raw meat " Kurt or Kitfo" mainly at butcher houses.

Cattle with poor body condition are highly infected followed by medium and good body conditions and this result is in agreement with the findings of Melaku *et al*. (2012) and Bezuayehu *et al.* (2014). It was agreed with the report of Mesfin and Nuraddis (2012) (good=22.0% and medium=24.0%) but higher as compared with the report of Abdulaziz *et al*., (2016) (good=7.0% and medium=15.9%) and with the study reported by Addisu and Wondimu (2015) (good=1.9% and medium=5.8%). The reason behind of low prevalence in good body condition than medium body condition might be due to the fact that most of the animals slaughtered in the abattoir were brought from fattening systems of the individual farmer, in which animals from such farms were less exposed to eggs of *T. saginata* as they graze on relatively clean defined pasture land; tying system to the pegs and intensive feeding system in the house for fattening purpose and use of anthelminthic drugs.

With regard to the origin of animals, the highest prevalence was observed from cattle of Banbasi town of Assosa zone (26.61%) and followed by 19.49% in Keshmando and the lower in the around Banbasi district (12.26%); the study districts due to the fact that the municipality of Banbasi district was frequently using strychnine poisoning to remove stray dogs in a program to reduce rabies outbreak in the district as well as there was annually mass dog vaccination in the district. This might have resulted in reducing contamination of pasture by stray dogs. This variation of prevalence could be associated with their geographical differences and likely associated with the number of animals brought to the abattoir.

Regarding the anatomical distribution of the cysts, in the present study the organs affected in order of the proportion of the cysts were shoulder, heart, massetors, tongue, lungs, and liver. This is explained by the fact that lungs and livers possess the first great capillaries sites encountered by the migrating cysterci oncosphere (hexacanth embryo) which adopt the portal vein route and primarily negotiate hepatic and pulmonary filtering system sequentially before any other peripheral organ is involved (Kebede *et al*., 2009a, 2009b). In addition, the heart was mostly affected than any other organ (offals) this is most probable due to the fact that ruminants are slaughtered at older age. During this period the liver capillaries are dilated and most cysts directly pass to the lungs. Additionally, it is possible for the hexacant embryo to enter the lymphatic circulation and be carried via the thoracic duct to the heart and lungs in such a way the lungs may be infected before or instead of the liver (Arene, 1985). These are frequently reported important predilection sites for C. bovis; a reason advanced for the frequent involvement of these muscles, being the increased blood supply due to frequent or continuous/rhythmic movement of the body parts (Gracey *et al*., 1999). The proportion of shoulder muscles affected with C. bovis in this study was 32.89 , which is in agreement with the reports of Taresa *et al*. (2011) and Regassa et al. (2008), 27% and 29.82% respectively. However, the present finding is lower than the findings of Megersa *et al*. (2009) and Hailu (2005), who recoded shoulder cyst proportion of 46.3% and 32% respectively.

This finding agreed with Tegegne *et al.*, (2018) reported in liver. This finding was disagreement with the finding of Abdulaziz *et al*., (2016) reported in diaphragm, Addisu and Wondimu, (2015) reported in tongue, Kifle and Shiret (2015) reported in triceps muscle, Regassa *et al*., (2009) reported in heart, Nuraddis and Frew, (2012) reported in triceps muscle and Mesfin and Nuraddis, (2012) reported in tongue. The reason behind, these variations of anatomical distribution of cyst might be due to a number of factors, such as blood kinetics and animal's daily activities. Any geographical and environmental factors affecting blood kinetics and meat inspector preferential for predilection sites during meat inspection in the animal affect the distribution the cysts in different organs of the host (Lielt, E., *et al.*, 2015). Moreover, these organs usually consumed raw or undercooked that could pose public health hazard in contracting taeniasis (Abunna, F *et al*.,2008).

In this study, the prevalence of T. saginata was found non- significantly different between different sex categories of respondents ($p>0.05$). Females (15.68%) were less affected compared to male (20.42%) respondents. The significance association between sex of the respondents and higher prevalence of infection of taeniasis could be due to economic reasons and culture practice in that male do not prepare their dish at home, rather frequently consume at restaurants and butcheries. Similar findings have also been reported previously (Hailu, 2005; Tembo, 2001) in different parts of Ethiopia. Besides this, the present findings were agreed with the reports of Kifle and Shiret (2015) in Debrebrhan, Abdulaziz *et al*., (2016) in Halaba Kulito, Dawit *et al*., (2012) in Wolaita Soddo and Tegegne *et al*., (2018) in Kombelcha but disgreed with that of Lielt *et al*., (2015) in Bishoftu,. This higher prevalence in males could be due to the habit of males consume frequently raw beef at outdoor than females in the study area leading to higher exposure of C. bovis and males usually consume raw meat more often than females while practicing backyard slaughtering. The

present study also revealed that the prevalence of T. saginata was significantly associated with different age groups of respondents (p<0.05).

In the current study, the predominant size of the C. bovis was seen to be small 60 (78.94%). The high proportion of small cysts may indicate late infection of the animals due to immunological response of the host which might preclude expansion of cyst size. The fertility rate of cysts was higher in shoulder, tongue, heart, and liver than lungs due to softer consistency of lung tissue which allows easier development of the cysts and favors their fertility rate (Getaw *et al*., 2010).

In the current study, significant association were detected between different level of educational in which respondents with iliterate (40%) showed higher level of taeniasis compared to (32%) elementary and high school followed by 28%, college level (p>0.05). This contradicted with different researches that got association between raw meat consumption with taeniasis (Abunna *et al*., 2008; Megersa *et al.*, 2010; Bedu *et al*., 2011; Endris and Negussie, 2011).
The prevalence of T. saginata or human taeniasis varies from country to country and even differs within the same country from area to area. This could be due to many factors, such as variation in the habit of raw meat consumption, awareness of patients about the clinical pictures of the disease and variation in personal and environmental hygiene. In the present study, the questionnaire survey respondents disclosed the finding 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.

4.3. Risk of human exposure to Taeniasis

With regards to Demographic information, in the present questionair survey, higher (56%) of respondents were males which responds cysticercosis as it was risk to humans while consuming raw or under cooked meat in the community, which was not statistically significant (p>0.05). This implies males have more risk of getting infection due to its movement habit, community culture and trends in cermoney of eating raw meat in society and chance of acquiring the infection. Consistently, 52% of participants of interviwers were from 20- 48 years old, which were risk of T.saginata by habit of eating raw meat, followed by 32% with age of greater than 48 years old and 16% with 20 years old (P>0.05). This agreed with that of Lielt *et al*., (2015) in Bishoftu, Dawit *et al*., (2012) in Wolaita Soddo and Kifle and Shiret (2015) in Debrebrhan. But, this study disagreed with that report of Tegegne *et al*., (2018) in Kombolcha. This could be explained by the fact that elderly have higher chance to consume C. bovis infected raw meat in different occasions including cultural ceremonies where raw meat is served as one of the major food items while younger, in generally, have no such access.

The study revealed that, occupation of the respondents had not significant association with that of taeniasis (p>0.05). So, the risk of Taeniasis were higher in merchant (36%), followed by 20% in government/civil employers, 20% in Butcher, 16% in veterinary and 8% in health proffesions. This result agreed with that reported of Kifle and Shiret, (2015) in Debrebrhan, Lielt *et al*., (2015) in Bishoftu. However, disagreed with the report of Abdulaziz *et al*., (2016) in Halaba Kulito. The prevalence of T. saginata was higher in governmental employers (35%) followed by farmers (25%), merchant (22%), students (10%) and Private employee (8%). This is due to the fact that the high exposed groups have higher access to contact with meat and meat byproducts. As a result of this there could be a possibility of getting infection with T. saginata.

With regards to knowledge of participants regarding *T.saginata*, 52% of participants had not have awareness, as humans acquire *T.saginata* in meat, whereas 56% of participants ever seen cysts in meat which has significant association with taeniasis (P<0.05). The higher risk of Taeniasis was reported (36%) in muscel (tongue, masseter, shoulder), followed by 24% in heart, 20% in liver, 16% in lung and 4% in kidney, were seen by participants by postmortem examination during the interviewes which was statistically significantly(P<0.05). Similarly, 60%, 56% of participants heard T. saginata, and know the symptoms of T. saginata respectively (P<0.05). Higher (48%) of diarrhea symptoms were reported, followed by 48% of abdominal pain, 44% of nauseas, and 4% of headache (P<0.05). Consistently, 56% of participants know as T. saginata was health impact and also 56% of respondent interviewers experienced of tapeworms, which had not significantly associated with(p>0.05). The present Questionaire survey

indicated that, the dominant participants (48%) recognized T.saginata by stool observation, and followed by 28% by laboratory examination and 24% of tapeworms were detected by saw underwear. Besides this, majority of the participants recognize the tapeworms (72%) and went to health station/ clinic/hospital to get drugs; while (20%) of participants went to the pharmacy to buy drugs ; and 8% used local herbal drugs for treatment.

With respect to attitude towards Taeniasis, majority of participants (56%) think as taeniasis was a serious disease, 56% of respondents think eating raw or under cooked meat is good practices, 28% of respondents consider themselves at risk of being infected with tapeworm infection, and 60% of participants interviewers intend to stop eating raw/undercooked beef because of taeniasis infection, which was statistically significantly ($p<0.05$.

In the present study, the part of the carcass served to consumer for „Kurt or Kitfo" were fore limbs (worch /nebero), Neck muscle including lion muscles (shint), Ribs (godin/ dabit), Hind limbs (talaq), and hump (shagna). Except the hump, most of these sites are commonly preferred residential areas of C. bovis (Dorny *et al.,* 2000). Hence, consumers" preference of these parts of the carcass due to palatability, look or other factors has a significant contribution for increasing risk of infection by the parasite.
Our observations also showed that abattoirs do not disclose information to butcheries on those carcasses found infected by C. bovis. This coupled with the tradition of raw beef consumption exacerbates the magnitude of the problem. Accordingly, by considering only carcasses passing through municipality abattoir at Banbasi, it was possible to show that quite a large number of people consume from a single infected carcass suggesting direct exposure to the infection through raw beef. If the amount of raw beef consumed from back yard slaughter is included, no study has ever addressed this part, then the magnitude of the infection becomes much higher than the present estimate. Majority of the respondents (76%), consume raw meat as kurt and kitifo. wheras 84% prepare consumed beef meat in their house, which was statistically non significant ($P>0.05$). As respondents in the area indicated, usually beef preparation were 36% as kurt, 28% as kitfo, 24% as dulet, and 12% other, which was non significant ($P>0.05$). With respect to beef consumption practices, and time period of beef eating practices, 32%, 44%, 24%, and 0% of respondents, consume beef rarely/once a month, two times in weeks, occasional/ few times in a mth, and never respectively. And also with regards to source of the beef consumed, 52%, 28%, 32% and 8% of respondents' source of beef for consumption were own cattle, butcher, neighbor/ friend, and other respectively, which was statistically significant ($P<0.05$).

In this study there were statistically significance difference between Taeniasis in different participants' knowledge, attitude and beef meat consumption practices which was statistically associated ($P<0.05$). Previous reports from Ethiopia indicated that consumption of raw or inadequately cooked beef was strongly associated with T. saginata infection. In this study from 32 respondents who ate raw or inadequately cooked beef 13(40.62%) acquired T. saginata, confirming that 'kurt, kitffo and dullet' are all sources of viable cysts of the parasite, as found in previous studies (Endris, J. and Negussie, H. (2011), Bedu, H., *et al*.,2011, Megerssa, B. et al.,2010; and Abunna, F., *et al.,* 2008). It is therefore good to focus strongly on those edible parts of the carcass used for the preparation of these traditional dishes during meat inspection and public education.

In case of educational level similar findings were reported in other studies in different year (Megerssa, B *et al*., 2016; Addisu, D. and Wondimu, D. (2015) and indicating insignificant infection rate among the various educational statuses. However, disagreed with studies reported in Hawassa town (Mesfin, B. and Nuradddis, I. (2012)) and in Southwest Shoa zone of Oromia Region (Adugna, T *et al*.,2013). This could be due to the long-time cultural habit of eating raw meat particularly that of 'kurt' and 'kitifo' in any social groups including those of the educated and even in the medical and veterinary professionals.

4.2 **Economic Impact**

The total annual economic loss was estimated to be 202,176.4 ETB ($ 1,347.84 **USD**) which is important to establish a health center in one district. The indirect economic loss in this study was significantly higher than direct economic loss indicating the widespread nature of Cysticercosis and moderate degree of livestock infestation rate in Banbasi town. Backyard slaughter, poor veterinary services, resistance to the commonly used anthelmintics (Schantz et al., 1982; Enrico Brunetti, 2023), the abundant nature of stray dogs, and wandering of animals in an open pasture allowing contact with dogs might be associated as major reasons for the exaggerated economic loss documented in the current study.

Bovine Cysticercosis has little effect on animal health, but it is economically important disease as it causes carcass condemnation arising from heavy infestation with the cysticerciof Taenia saginata as well as the cost of inspecting meat, the necessity to freeze or boil infected meat and losses may also occur from restriction of exports of live animals and animal products (Belachew and Ibrahim., 2012).
Evaluation of the economic impact of taeniasis / cysticercosis is very difficult particularly in developing countries like Ethiopia, where necessary information is so scant and considerable proportions of infected people treat themselves with traditional herbal drugs like "kosso" and others. (Abuna *et al*., 2007). While ill-health caused by the adult worms in humans gives rise to high medical costs, the economic losses due to bovine cysticercosis are mainly due to condemnation, treating beef and downgrading of infected carcasses. Economic losses from cysticercosis are determined by disease prevalence, grade of animals infested, potential markets, prices of cattle and treatment costs for detained carcasses. For the African continent, an annual loss was reported to be US$ 1.8 billion under an overall infestation rate of 7% (Kumar and Tadesse, 2011).

Khaniki *et al*., (2010) reported that the economic losses of infected carcasses were calculated from the treatment of carcasses and the carcasses condemnations. The costs of carcasses treatment included the expenses of freeze storage and the weight loss during freezing. The economic impact of the disease in the cost implication can be broken down in to those involved in treating human taeniosis and cattle carcasses (cost of freezing, boiling) or condemned, as well as the costs involved in the inspection procedures amount to millions of dollars (Nunes, 2003). In the meat industry, economic losses are closely associated with the status of infection. In a heavy infestation or generalized cysticercosis carcass must be totally condemned. Light infection or localized cysticercosis leads to condemnation of the infected parts, furthermore, the carcass must be kept in cold storage at a temperature not exceeding-7°C for up to 3 weeks to inactivate existing parasites (Abuseir *et al*., 2006).

In Ethiopia Megersa *et al*. (2010) 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. The economic loss calculated for six months period of study by Kumar and Berhe. (2008) due to condemnation of carcass/organs account about 31952 Birr.

Different economic losses regarding bovine cysticercosis were also reported from different parts of Ethiopia (Zewdu et al., 2010), 160,000.00 ETB at Ambo Municipal abattoir (Terefe et al., 2012), 19,847,704.50 ETB at Addis Ababa abattoirs enterprise (Bizuwork et al., 2013), 920,378 ETB at Debra Tabor Municipal abattoir (Nasr and Pal, 2016), 1,848,849.765ETB at Kombolcha abattoir; (Hussen *et al*., 2017), 12,590.00ETB at Shashemene Municipal abattoir and Mandefro *et al*. (2019) reported an annual total loss of 894,505.612 ETB at Adama Municipal abattoir. These differences in various abattoirs or regions may be due to variation in the occurrence of the disease, mean annual slaughtered cattle in different abattoirs and differences in the retail market price of liver, lungs, heart, kidneys and beef.

5. CONCLUSION AND RECOMMENDATIONS

Taenia saginata is a medically and economically important cestode parasite in humans, while infection with the Cysticercus larval stage in cattle causes economic loss in the beef / meat industry. This study indicated that taeniasis is a widespread problem with higher prevalence in Banbasi town and adjoining areas. The overall prevalence of the bovine cysticercus bovis in this study area was 19.79%. Shoulder, Heart, masseter, tongue, liver, and lung were the major organs harboring C. bovis than other visceral organs and most of the cysts were found to be fertile 53(69.73%). Among the study variables considered, age, body condition and origin of animals were identified as important risk factors for the occurrence of cysticercosis in cattle. And there is deep rooted tradition of raw meat consumption which magnifies the public health hazards of taeniasis. Moreover, occurrence of fertile cysts in examined organs was high suggesting that cattle play an important role in the life cycle of this serious zoonosis and the presence of potential risks of transmission to other intermediate hosts.
Besides this, the economic losses due to bovine cysticercosis was estimated to be 202,176.4 ETB ($ 1,347.84 USD). Hence, cattle husbandry practice should be improved such as zero-grazing, establishment of policy on dog keeping and handling including registration, treatment and elimination of stray dogs, promoting construction of abattoirs with their appropriate disposal pits and conduct an obligatory meat inspection services and further detailed investigation into genetic characterization and the basic local epidemiological factors governing the spread of cysticercosis in the region to establish regional control strategy are recommended.

5.1 Recommendations

Therefore; based on the above conclusion, the following applicable strategic points were recommended:

- Attention must be given to routine meat inspection. Meat inspectors should be vigilant to detect C.bovis in beef carcasses.
- Public should be made aware to use latrines, not to contaminate the environment with proglottids or Taenia eggs by defecating on pastures where cattle graze.
- Taenia saginata shall be considered as a notifiable disease and mechanism should be put in place to deworm Taenia carriers
- Avoid of raw meat consumption habit due to risk of Taeniasis
- Public education should be given at all levels to increase public awareness and bring cultural changes so as to avoid the consumption of raw beef.
- Awareness creation of public health/ zoonotic disease and economic importance of *T.saginata*.
- Break lifecycle reflects the circulation of cysticercosis and taeniasis in cattle and human,
- Control of pasture, sewage contamination by human infected feces
- Improving livestock farming techniques
- Awareness should be created in the public with regard to the zoonotic importance of bovine cysticercosis and the risk of raw meat consumption to taeniasis.
- The community should be intensively encouraged for construction of simple toilet to minimize contamination of pasture with human stool, so that the cycle of T. saginata interrupted.
- Further studies on the prevalence of Cysticercosis and Taeniasis should be encouraged.

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