

PREVALANCE OF *Taenia saginata* IN HUMAN AND *Cysticercus bovis* INFECTION IN
CATTLE AND PUBLIC HEALTH SIGNIFICANCE AT ADOLA DISTRICT EASTGUJI
ZONE, SOUTHERN OROMIA, ETHIOPIA



MSc Thesis

BY

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HAWASSA UNIVERSITY
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October, 2024

Hawassa, Ethiopia

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HUSSEN CHEMERI BERISO

A THESIS SUBMITTED TO THE FACULTY OF VETERINARY MEDICINE, HAWASSA
UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
DEGREE OF MASTER OF SCIENCE (MSc.) IN VETERINARY EPIDEMIOLOGY

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October, 2024

Hawassa, Ethiopia

APPROVAL SHEET-1

HAWASSA UNIVERSITY FACULTY OF VETERINARY MEDICINE POST GRADUATE PROGRAM IN VETERINARY EPIDEMIOLOGY

This is to certify that the MSc Thesis prepared by Hussen Chemeri Beriso, Study on PREVALANCE OF *Taenia saginata* IN HUMAN AND *Cysticercus bovis* INFECTION IN CATTLE AND PUBLIC HEALTH SIGNIFICANCE At Adola District East Guji Zone Southern Oromia Ethiopia submitted in partial fulfillment of the requirement for degree of Master of Science in Veterinary Epidemiology. It complies with the regulation of the university and meets the acceptance standards with respect to originality and quality.

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We, the undersigned, members of the Board of Examiners of the final open defiance by **Hussen Chemeri Beriso** have read and evaluated this thesis entitled “ Prevalance of *Taenia Saginata* in human And *Cysticercus Bovis* infection In Cattle and public Health Significance At Adola District East Guji Zone, Southern Oromia, Ethiopia,”and examined the candidate. This is, therefore to certify that the thesis has been accepted in partial fulfillment of the requirements for the degree of Master of Science in **Veterinary Epidemiology**.

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BIOGRAPHY

The author was born in Girja district, East Guji Zone of Oromia National Regional State, in January 1980 E.C. He attended elementary school at Oborso elementary school. Then, he followed high school at Meda Walebu Secondary School from 1995-1997 E.C. After successful completion, he took the 'Ethiopian Higher Education Entrance Examination' and fulfilled the requirements for further education and he joined Alage ATVET College 1997-1999 and then Gondar University in 2000 E.C. He graduated from Gondar University with Bachelor Degree in Veterinary Science (BVS) in 2004 E.C. Following graduation he took position at Girja district Livestock development and fisheries office (Guji Zone) as a field Veterinarian and served for eight years. In 2015, he joined Hawassa University, Faculty of Veterinary Medicine to attend a postgraduate program and attain a degree of Master of Science (MSc) in Veterinary Epidemiology.

ACKNOWLEDGMENTS

I express my sincere and deepest gratitude to my academic advisor Professor Jemere Bekele as my advisor, and for his genuine guidance, close supervision at each and every step of the progress. His humble and easily approachable personality always motivated me to work comfortably under his supervision.

Individuals involved in questionnaire are appreciated for their volunteer cooperation. The author also wishes to thank the staff of Adola Health Center and Adola General Hospital workers especially laboratory workers team for their technical and equipment support. The private pharmacies, Abattoir workers and veterinary clinic workers are highly appreciated for providing all-round information and work with me. Finally, my parents deserve special words of credit for their unconditional love and sup

LIST OF ABBREVIATION

ADLRD O	Adola Disstrict Livestock Resource Development Office.
CSA	Central statistics Agency
DNA	Deoxyribo nucleic acid
E	East
ETB	Ethiopian Birr
FAO	Food and Agricultural Organization of the United Nations
GDP	Gross domestic product
KM ²	Kilometer Square
MAO	Ministry of Agricultural Office
MASL	meter above sea level
OIE	Office of International des Epizootics
PCR	Polymerase chain reactions
P-value	Predictive value
USD	United State Dollar
WHO	World Heath Organizations

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ABSTRACT

Taeniasis and bovine cysticercosis are common parasitic infections in developing countries like Ethiopia. The purpose of this study was to assess and estimate the prevalence of *Taenia saginata* in human and *c. bovis* in cattle the public health significance and financial losses due to meat borne parasite in Adola district and surrounding areas of Guji zone, Oromia regional state. This work involved active abattoir survey, Questionnaire survey and Human stool sample examination, sampling and laboratory investigation was carried out in a period from December 2023 to June 2024. While abattoir survey was conducted at Adola municipal Abattoir by applying ante and postmortem inspections. Stool samples were collected from Adola General Hospital and Adola Health center and microscopically examined for the presence of *Taenia* spp egg to obtain required data. Questionnaire surveys were also used to assess the perception and knowledge of community, health professionals and *Taenia saginata* suspected group about taeniasis and *bovine* cysticercosis. From a total of 422 cattle carcass inspected using active abattoir survey, 6.87 % were found positive for *c.bovis*. On basis of Questionnaire survey, of total 95 respondents interviewed through face to face, the prevalence of *Taenia saginata* infection was 72.5% have experience. moreover, out of 384 stool samples examined; the overall prevalence of *Taenia* spp egg was 14.58%. *Taenia saginata* infection was found higher in old age group (17.4%) followed by adult (17.1%) and young age (10.2%) ($P>0.05$). The results of the present study clearly indicated the economic as well as public health significances of the infection due to bovine cysticercosis and taeniasis respectively. Thus, interdisciplinary teamwork between veterinarians and medical personnel is essential to help in the control of this problem.

Keywords: Abattoir, Adola, Cattle, Cysticercus bovis, prevalence, stool sample, Taeniasiasis.

1. INTRODUCTION

Ethiopia has one of the largest inventories in Africa with livestock currently supporting and sustaining the livelihoods of an estimated 80 % of the rural poor. Animal rearing is an integral part of the agricultural production and estimated livestock population is 70 million cattle, 42.9 million sheep and 52.5 million goats (CSA, 2021/22). In Ethiopia, the livestock sector contributes about 30% of the agricultural GDP and 19% to the export earnings (CSA, 2021/22). Animal diseases are one of the most important constraints to increase productivity of food animals in all parts of the world. Parasitism is one of the major problems that affect the productivity of livestock worldwide. Losses from parasitic infections include losses through death, reducing working power, milk yield, hide and skin quality and condemnation carcasses or organs after slaughter.

Among many parasitic problems of domestic animals, tapeworms are an economically important intestinal parasites found all over the world (Radostits *et al.*, 2007). *Taenia saginata* is global distributed in both developed and developing countries. However, it is high reported incidence cases in Africa when compared with other parts of the world (Birhanu *et al.*, 2018).

This parasite epidemiology is ethnically and culturally determined with estimation annually cases and mortality rate around 50-77 million and 50, 000 people, respectively (Abunna *et al.*, 2007). *Taenia saginata*, which is known as beef tapeworm has two stages of development, intermediate host and final host in cattle and human, respectively. Larval stage of this parasite occurs in heart and skeletal muscles of intermediate host and adult worm locates in intestine of final host. Visual inspection of carcass and other organs is the primary detection method of cattle *c.bovis* because commonly found area of carcass are the external and internal pterygoid in differnt muscles, heart, tongue, diaphragm, and esophagus (Oguniren *et al.*, 2004) . Indiscriminate defecation, due to lacking latrine facilities, is common practice especially by the rural community in Ethiopia where more than 80% of the populations reside. The common traditional animal husbandry practices in Ethiopia (free grazing in cattle) mainly allow free access of cattle to the contaminated environment and perpetuate transmission of cysticercosis, due to the fact that cattle become infected by ingestion of pasture/feed or water contaminated with *Taenia saginata* eggs. It is associated with poor hygiene and local factors including cultural background, such as eating meat without proper cooking, economic

condition and religious beliefs, close proximity of humans to cattle kept with little or no distinction between companion or utility functions (Mussa 2023). early livestock husbandry practice and inadequate meat inspection management and control policy are the transmission agents of the parasite (Belachew *et al.*, 2012)

The prevalence reports of cattle *c.bovis* in Ethiopia from several authors, showed variable results with localities. Relatively lower prevalence of 2.93% in Jimma (Tolosa *et al.*,2009), 3.13% in Silte Zone (Mussa 2023), 5.43% at Debre Brihan (Andualem and Belayneh, 2017) 3.24% in Jigjiga and were reported while higher prevalence of 26.25% at Hawassa (Abunna *et al.*, 2008) and 19.5% in East Shoa (Hailu, 2005) were recorded. *Taenia saginata* taeniasis/cysticercosis is high economic and public health impacts in Ethiopia; as a result control and prevention of the disease has great importance. One of the prerequisite for implementing control and prevention action is information on prevalence, known fact and associated risk factors in and around Adola District of East Guji Zone of Oromia Regional State. So that there is information gap about *Taenia saginata* taeniasis/cysticercosis prevalence, public health and economic impact in and around Adola District, East Guji Zone of Oromia Regional State.

Therefore, the aims of this study is to estimate the prevalence of cattle cysticercosis, *Taenia saginata* taeniasis in human, its public health significance, financial loss assessment, identify potential risk factors of the disease and to understand community awareness about the disease transmissions and prevention strategies in the study area.

1.1. Objectives

1.1.1. General objective

To assess and estimate the prevalence of *Taenia saginata* in human and cattle *cysticercosis*, the public health significance and financial losses due to meat borne parasite in Adola district and surrounding areas of East Guji zone, Oromia regional state.

1.1.2. Specific objectives:

- ✓ To estimate the prevalence of *cysticercus bovis* in cattle slaughtered at Adola municipal abattoir and *Taenia saginata* in human at Adola General Hospital and Adola health center.
- ✓ To assess the awareness of people regarding to the public health significance of the parasite.
- ✓ To estimate the financial losses of cattle *cysticercosis* through carcass condemnation of the slaughtered animals and *Taenia saginata* treatment costs for human medications.
- ✓ To identify associated risk factors of taeniasis in human and *cysticercosis* in cattle in the study area.

1.2. Research questions

This Thesis was answer of the following question:

- ✓ .What is the current prevalence of bovine *cysticercosis* in cattle and *Taenia saginata* in humans in the study area?
- ✓ .What is the knowledge and awareness of community and health professionals in the study area?
- ✓ .What is the potential risk factors for taeniasis in human and *bovine cysticercosis* in cattle in the study area?
- ✓ .What are the sources and status of financial losses attributable to *bovine cysticercosis* and human taeniasis in the study area

2. LITERATURE REVIEW

2.1. Historical back ground

Researchers believe that about 2 million years ago, African hominids (our early ancestors), who scavenged for food or preyed on antelope and other *bovis*, were exposed to tapeworm colonization. These worms were using hyena and large cat as definitive hosts and bovid as intermediate hosts. These occurred before the origin of modern humans and significantly earlier than the domestication of swine and cattle and the development of agriculture (Duncan, 1984).

The conclusion was referred from an examination of host and parasites evolutionary histories and from evidence for the rate of molecular evolution between species of *Taenia* rather than humans acquiring *Taenia* from cattle and pigs. Researchers believed man gave tapeworms to these domestic animals, since the association between *Taenia* and hominids was established before the domestication of these food animals. It was not until about 10,000 years ago, with the development of agriculture, that cattle, swine, and companion carnivores become intermediate hosts (Warren and Kenneth, 1993).

Taeniasis and Cysticercosis are diseases resulting from an infection with parasitic tapeworms belonging to *Taenia* species. Approximately 45 species of *Taenia* have been identified however; the two most commonly responsible for human infections are the pork tapeworm's *Taenia Solium* and the beef tapeworm's *Taenia Saginata* (Schantz, 2002). Both species are worldwide in distribution. Approximately 100 million cases of these cases are *Taenia Saginata* while the other 50 million are *T. Solium* related (Markell, *et al.*, 1999). taeniasis is the intestinal infection of humans with the adult stage of tapeworm of the genus *Taenia* (Pam *et al.*, 2015).

The occurrence of the larval of *Taenia Saginata* in cattle musculature causes *Taenia Saginata cysticercosis* or bovine cysticercosis, while the adult worms in human small intestine causes taeniasis and Bovine cysticercosis (beef menseales) is a zoonotic infection of socioeconomic

importance caused by the larval stage of *Taenia Saginata*, and intestinal cestodes of humans that has cattle as intermediate hosts (Boone *et al.*, 2007; Asaava *et al.*,2009).

2.2.Etiology

2.2.1. Taxonomic classification

Taenia saginata and its metacestode *cysticercus bovis*, the unarmed beef tapeworm(Ogunireni *et al.*, 2004; McFadden *et al.*, 2011) belong to the class Cestoda order Cyclophyllidea, Family *Taeniidae* and Genus *Taenia* (OIE, 2000).

2.3.Morphology

2.3.1. Adult worm

Taenia saginata is ribbon-shaped, flattened, multi segmented and hermaphrodite. The body is divided in to three distinct parts of scolex (head), neck and strobili (chain of proglotids). It measures 4-8 m rarely measures up to 15 m in length (Urquhart *et al.*, 1996). Anteriorly, the scolex (head) has four muscular suckers often unarmed, rostellum and hooks, the length and number of these being relatively characteristic of a species. A neck follows the scolex, this is followed by immature and then by mature reproductive segments, and finally gravid segments filled with eggs. Segment structure, although unreliable, can aid diagnosis. *Taenia* species cannot be differentiated by egg structure. The neck is short unsegmented with a germinal structure immediately behind the scolex, which continuously produces proglottids. The number of proglottids is within a range of 700-1000 rarely reaching 1000-2000 (Urquhart *et al.*, 1996).

The gravid segments are 10-20 mm long and are usually shaded singly and may leave the host spontaneously or crawling about the body, clothes and beds of human beings. Self and cross-fertilization between and among proglottids is possible. The gravid proglottids are 15 mm to 35 mm long and 5mm to 7 mm wide filled with eggs, which detach from the strobila singly and leave the

host via anus. This implies that coprological examination has a limited value in the diagnosis of *Taenia saginata* infection (WHO/FAO/OIE, 2005; OIE, 2012).

2.3.2. *The eggs*

Taenid eggs passed in the faeces or discharged from ruptured gravid segments are sub spherical to spherical to spherical in shape. The egg consists of hexacanth (six hooked) embryo (oncosphere), thick dark brown to yellow in color. There is an outer oval membranous coat, the true egg shell, which is voided the faeces. Inside the inner envelope develops into the embryophore, which is made of “Keratin” blocks and gives the egg its characteristic radiated appearance (Gemell *et al.*, 1983), and membrane thick and striated embryophore, and two oncospheral membranes. The mature ova are present only in the terminal 30-50 proglottids, and some immature ova can mature outside the host within about 2 weeks, whereas others fail to mature after two months. The egg is roughly spherical in shape and measures 30-50 by 20-30 micrometers (Urquhart *et al.*, 1996).

2.3.3. Metacestode

The larval stages, or metacestodes also referred to as “*beef measles*”, are found in all striated muscles of the intermediate host. *cysticercus bovis* is a small (pea-sized) oval in shape (O.I.E., 2000), semi-translucent cyst filled with dense white fluid containing an invaginated scolex. The metacestode is morphologically similar to the future adult tapeworm. It measures about 10 mm in diameter and 6 mm in length (Doyle *et al.*, 1997).

2.4. Epidemiology

Taenia saginata occurs where cattle are raised, human feces are improperly disposed of, meat inspection programs are poor and meat is eaten without proper cooking (Radostits *et al.*, 2007). Geographic distribution and status of the taeniasis is considered a serious in the developing countries but less recognized for public health problems. In developing countries, cattle are reared on extensive scale, human sanitation is of comparatively lower standards and the inhabitants

traditionally eat raw or inadequately cooked beef. *bovine* cysticercosis is cosmopolitan in distribution and is very common Africa (Minozzo *et al.*, 2002). It is highly endemic in areas of Central and East African countries like Ethiopia, Kenya and Zaire (Teka, 2006).

Taeniasis/cysticercosis spreads in developed areas of the world through tourists enjoying the consumption of lightly grilled meat, mass migration of labor and the export of meat unreliably passed by ‘*eye or knife*’ inspection or from live animals imported from endemic areas (Ashwani *et al.*, 2011). The parasites appear to be specific to cattle, while wild animals play no part as intermediate hosts (Farah, 1994). In Ethiopia the custom of eating undercooked beef dishes such as: *kourt*, *lebleb*, *kitffo* and the habit of defecating in open fields coupled with the tradition of allowing cattle to grazing fields made cysticercosis of cattle and taeniasis of human common in country (Tolosa *et al.*, 2009).

2.5.Host range

Cattle are the preferred intermediate hosts and humans are the only final hosts of *Taenia saginata*. Cattle of all ages are susceptible however young age groups are more susceptible. Parasitism is sometimes observed in other ruminants (sheep, goats, antelopes, gazelles, buffaloes) (Pawlowiskiz, 1972). But cysticercus development is unlikely. Man cannot spread taeniasis to his own species. Management of animals in their natural environment predisposes them to infection. Cattle grazing communally have a higher risk of picking up *Taenia saginata* eggs since they are frequently in contact with human feces compared to commercial herds, the risk of cattle coming into contact with *Taenia saginata* eggs is much higher when cattle are at pasture (Gabrie and Endow 2015).

2.6.Mode of infection

Human feeding habits and modes of life are responsible for the spread of *Taenia saginata* infections. Man’s customs and traditions of consuming raw, inadequately cooked beef dishes like steak tartar in Europe, shish kebab and *tikka* in India, *shashlik* in the former USSR, *Ihab* in Thailand, *Yukhoe* in Korea and *kourt* and *kitffo* in Ethiopia containing viable bladder worms perpetuate human infection. Cattle are infected by ingestion of pasture and drinking water contaminated with *Taenia saginata* eggs, (Florova, 1985).

According to (Farah, 1994), dispersion of *Taenia saginata* eggs is favored by the following factors: Man's indiscriminate defecation, the use of sewage effluents and sludge as fertilizer on pasture, the use of immigrant Labor from countries with high prevalence of infection in (feedlots, Scavenger birds, Earthworms, dung beetles, blowflies, mites, flooding water).

2.7.Mode of transmission

Tapeworm eggs are spread through food, water or surfaces contaminated with feces. This can happen by drinking contaminated water or food or by putting a contaminated finger into your mouth. Importantly a human tapeworm carrier can infect him or herself with tapeworm eggs, resulting in cysticercosis (autoinfection), and can contaminate others in the family (Clifton and Atlanta, 2010). Cattle grazing commonly have a higher risk of picking up *Taenia saginata* eggs as they are frequently in contact with the human feces compared to commercial herds. (Aswan and Gebre tsadik, 2008)

2.8.Life cycle

The life cycle of *Taenia saginata* is indirect where the definitive host is human and intermediate hosts are cattle (Kebede *et al.*, 2009). Human is infected by the ingestion of raw or undercooked parasitized meat (Gamell *et a.,l* 1983) Only fresh viable *cysticercus bovis* cysts are infective for man (Megersa *et al.*, 2010). An infected human passes millions of eggs daily either free in the stool or as intact segment and each containing 250,000 eggs (Urquhart *et al.*, 1996), and these can survive on pasture for several months. After ingestion by susceptible bovine, the oncosphere remains unaffected in its passage through the first three compartments of the stomach. On reaching the abomasums, it will be attacked by pancreatic secretion on reaching the duodenum and it disintegrates releasing the oncosphere (Farah, 1994). The oncosphere travels via blood to striated muscle where it encysts and matures to be infective to man in about 12 weeks. Once in the animal body, the eggs hatch and the larvae migrate their way into muscle tissue, including that of the heart and other organs fortunately, cattle cannot transmit the diseases among themselves. However, they can ingest eggs from human sewage and excrement that have contaminated water and feed, or by licking soiled utensils and workers' hands and clothing. Eating cyst-laden and incompletely cooked

meat, on the other hand, may infect humans. Like cattle, human cannot spread cysticercosis to their own species (Gamell *et al.*, 1983).

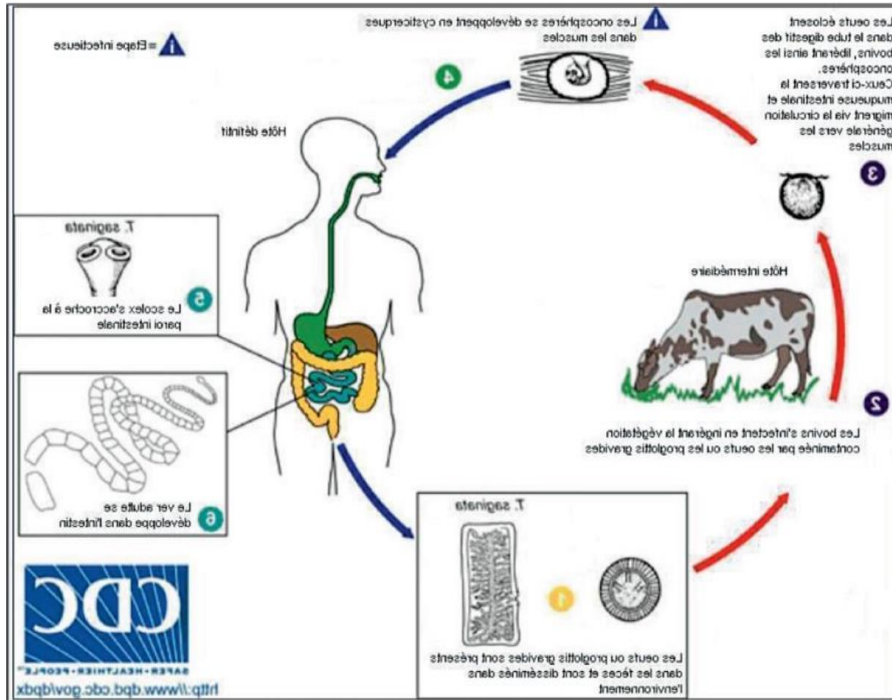


Figure 1: Life cycle of *Taenia saginata*, presented by (Mali *et al.*, 2010)

2.9. Clinical manifestations

In human: there are usually no clinical disturbances except for pruritis ani, the patient being aware of discomfort in the perianal region. But in some cases suffer abdominal pain, nausea, debility, weight loss, flatulence and diarrhea, or constipation may occur. A high percentage of patients experience gastric hypo secretion (Hendrix, 1998). In Animal: cysticercus bovis is not pathogenic for cattle and usually the infection causes no clinical signs, unless a vital organ (e.g. the heart) is massively infected, which is very unusual. In case of massive infections muscle stiffness has been reported. However, heavy infestation by the larvae may cause myo carditis or heart failure (Regessa *et al.*, 2009).

2.10. Diagnosis

In Animals: The routine meat inspection is the only diagnostic procedure in use in Ethiopia for the diagnosis of *bovine* cysticercosis (Nunes *et al.*, 2003). This method is insensitive and inaccurate and thus the reported prevalence of this infection in different regions of country may be an underestimate

In Humans: The diagnosis is based on laboratory examination of the eggs in the stools or gross examination of the proglottids or segments passed in the stool. Diagnosis is based on symptoms, fecal examination and rectal swabs, although it is difficult to discover the disease during the first three months (Hendrix, 1998). Recently researchers are suggesting PCR standardization that can be applied on human stool samples for taeniasis diagnosis by the extraction of deoxyribonucleic acid (DNA) from the sample effective for identifications (Nunes *et al.*, 2003).

Treatment

There is no effective treatment for this disease in live cattle. For human the most widely used systemic drugs for the treatment of *T. saginata* in Ethiopia are Neclosamid, praziquantel and mebendazole (Doyle *et al.*, 1997)

In Ethiopia, the majority of the rural inhabitants use traditional herbal dugs in routine self-deworming as a taenicidal herb, as has been topic for researches in Ethiopia (Feseha, 1995)

2.11. Prevention and control

The life cycle of *Taenia saginata* requires contact between man (final host) and cattle. Strict hygiene measures therefore break the life cycle of these parasites (Schantz *et al.*, 1998). The best way to prevent, infection with taeniasis is to eliminate the exposure of livestock to the tapeworm eggs by properly disposing of human feces. The next best strategy is to apply processing .Larval cysts in meat are killed by moderate temperatures of 150F (65oC) or frozen foe at least 12 hours (Megersa *et al.*, (2010) Health education of both farmers/livestock owners and the general public/consumers, especially on the risks associated with eating raw undercooked meat. Improvement of an effective control program has to include actions intervening at various points of the *Taenia saginata* life cycle.

It will require a coordinated approach among all stakeholders: consumers, medical doctors and pharmacists, directors of sewage treatment plants, meat inspectors, veterinary practitioners and farmers (Kyvsgaard and Murrell, (2005) Cheruiyot and Onyango-Abuje, (1984) Gamell, (1983).

2.12. Public health significance

Man is the only final host where the adult *Taenia saginata* resides in the small intestine (Pawloski *et al.*, 1972). The size reached by the adult worm is related to the number of worms present (Maeda *et al.*, 1996). In a single worm infection, a worm can develop longer and produce large number of proglottids (Farah, 1994). Multiple infections up to 20 tapeworms in one host are often occurring in developing countries (Mann, 1984). *Taenia saginata* is computed through the absorption of the digested food and its proglottids migrate to different organs causing different signs (Kebede *et al.*, 2008). The most noticeable symptom is the spontaneous discharge of one or several proglottids, which often show individual muscular activity. These may creep out of the anus onto the perianal skin and even migrate over clothes of the distraught host or on the ground, shedding eggs as they go (Oryan *et al.*, 1998). *Taenia* has a debilitating effect on people who already have live of protein deficient diets suffer from iron deficiency and infected by hookworm (WHO/FAO/OIE, 2005). Generally, (For C.G Epidemiology (2013), stated that adult *Taenia* parasite is located in the intestinal tracts of humans with variety of problems. Man is infected by ingesting raw in adequate cooked beef harboring the viable cyst (Ginsberg, (1960) light owlers *et al.*, 2003).

2.13. Economic importance

While ill-health caused by the adult worms in humans give rise to high medical costs (Fan, 1997) the economic losses due to *bovine* cysticercosis are mainly due to condemnation, refrigeration 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 cost for detained carcasses (Alemneh and Adem,(2017) Grindle, (1978). 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). However, country’s high cattle population, poor hygiene, and common occurrence of *bovine* cysticercosis reflect heavy losses.

2.14. Status of cysticercosis in Ethiopia

In Ethiopia, the rural communities mainly raise cattle under extensive husbandry practices. Existence of higher population density, raw meat consumption, low awareness, poor hygiene and sanitary infrastructures may facilitate transmission of the disease between animals and human beings in the rural areas. The prevalence reports of cysticercosis in Ethiopia showed variable results with national average of 13. 7% (Fikire and Adugna, 2012).

Therefore, attention must be given to routine meat inspection, public awareness on improving personal and environmental hygiene and teaching school children on the danger of raw meat consumption is a reliable means of bringing cultural change in the country.

Table 1: Prevalence of bovine cysticercosis studied in different parts of Ethiopia.

Study area	Prevalence	Author and Year
Addis Abeba	7.5%	Nigatu, 2004
Wolaita Sodo	3.13%	Mussa, 2023
Debrezeite	13.85%	Getachew, 1990
Mekele	7.23%	Hailu, 2005
Debre Brihan	5.43%	AndualemandBelayneh,2017
Bahir Dare	19.4%	Hailu, 2005
Nekemta	21.7%	Ahmed, 1990
Gonder	4.9%	Dawit, 2004
Jimma	2.93%	Tolosa <i>et al.</i> , 2009
Hawassa	26.25%	Abunna <i>et al.</i> , 2008
Dessie	6.8%	Getachew <i>et al.</i> , 2017
East Shoa	19.5%	Hailu, 2005

3. MATERIALS AND METHODS

3.1. Description of the study area

This study was conducted in Guji Zone, Adola district and surrounding area located in the Oromia regional state, southern Ethiopia. Adola woyu town is 475 km away from Addis Ababa. Guji zone is bordered by Sidama regional state in north, Borana zone in south and east Borana zone in east and west Guji in west. Geographically, the zone is located between (38⁰–40⁰ E longitude and 4⁰ - 5⁰ N latitude) and the altitude ranges from 500 up to 3500 meters above sea level. The absolute location of the district is between 5°44'10" - 6°12'38" N latitude and 38°45'10" - 39°12'37" E longitude.

The total area of Adola district is covered by 1401 Km² and district has an altitude ranges from 1500 -2000 meters above sea level. (ADLRDO, 2019). It is characterized by three agro-climatic zones namely; highland 33%, mid-land 47% and lowlands 20%. The mean annual minimum and maximum temperature of the study district is 16°C and 23°C respectively.

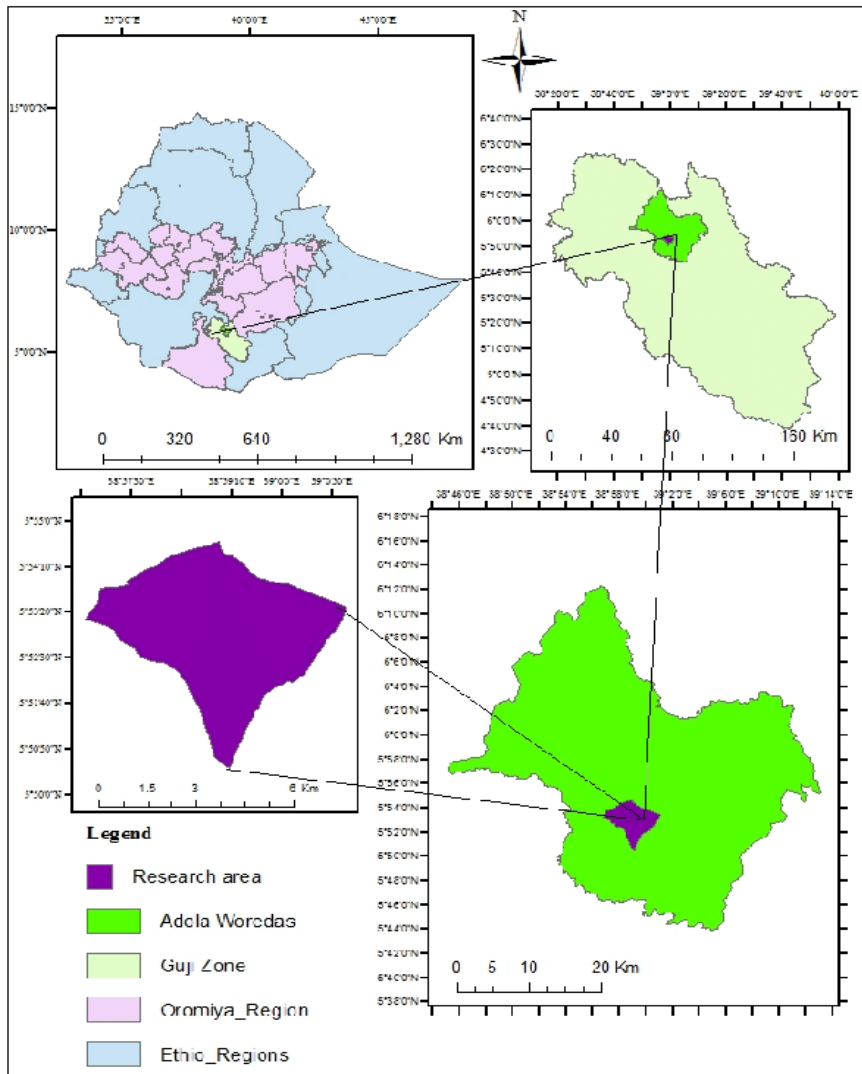
Girja is one of pastoral area which is found at distance of 49 km from zonal town Adola with altitude ranges from 900 to 1200 meters above sea level (masl). The annual rainfall and temperature ranges from 700 - 1000 mm and 28°C - 34 °C. The climatic condition of Girja comprises of Dega 10%, woina dega 20% and the rest 70% kola.

Wadera is one of pastoral area which is found at a distance of 60 km from zonal town Adola woyu the annual rainfall and temperature range from 700 - 1000 meters.

Shakiso is one of Guji zone districts which had the annual rainfall and temperature ranges from 1500 2000 mm and 23°C - 30 °C.

Table 2: The livestock and human population of the study Area

Study area	Cattle population	Human population
Adola	152,481	323,673
Girja	205,797	90,140
Shakiso	824,461	206,372
Wadera	373,057	112,654
Totl	1,555,796	732,839



Source: *Adola District Administrative Office.*

Figure 2: Maps of Guji zone Administration.

3.1.1. Source of population

- The source population for epidemiological study and risk factor assessment were Animals from different localities of Adola district that were brought for slaughter to Adola municipal abattoir.
- The source of population for human epidemiological study and risk factor assessment were all patients who were visiting the health institution for follow up of parasites case related services or medication.
- The source populations for knowledge and perception study were society in the study area, Human patients who had relative case with parasites, all health professionals both human and animals who were working in selected health facilities of Adola district.

3.1.2. Study population

Animal

The study populations were local breeds of cattle brought from different localities (Girja, wadera, odo shakiso, and Adola) to Adola municipal abattoir for slaughtering purposes. The minimum and maximum numbers of cattle slaughtered per day was 20 up to 25. During sampling data on- sex, ages, breed, origin, and body condition of all the sampled animals were recorded for the assessment of risk factors.

Human

the Study populations were residents of Adola District and surrounding localities and patients who were visiting Adola General hospital and Adola health center who were followed up for services or medication with age group above 18 years both female and males.

3.2. Study design

A cross-sectional study was conducted at Adola municipal abattoir and selected health facilities (Adola hospital, Adola health center) in Adola district from December 2023 to June 2024. A

systematic random sampling technique was employed to collect all the necessary data from abattoir survey.

The study also included semi-structured questionnaire survey to assess community awareness and purposively human stool sample collections to detect helminthes parasites.

3.3.Sample size determination

3.3.1. Sample size determination for Animal and human

Animal

Sample size was determined according to Thrusfield (2018), since, there was no previous study in the area, the sample size was calculated by considering 50% expected prevalence with 95% confidence interval and 5% desired absolute precision

$$n = \frac{1.962 \times p \times \exp(1 - p \times \exp)}{d^2}$$

Where, N- Required sample size, P exp - Expected prevalence, d- Desired absolute precision, usually d is 0.05 at 95% confidence level and 5% expected error.

Hence, the sample size was calculated to be 384. However, sample size was increased by one fold to be 422 in order to increase the precision of study and Accuracy of the result.

Moreover, the questionnaire survey sample size was calculated by using the formula:

$$N = 0.22 / SE^2 \text{ (Arsham, 2015).}$$

The sample size required for the questionnaire survey as per the above formula was calculated to be 88 but sample size was increased to 95 respondents.

Human

Since there was no previous study on human taeniasis in the area, the sample size was calculated according to Thrusfield (2015) by considering 50% expected prevalence (P) and 95% confidence interval (Z= 1.96) with a 5% desired absolute precision (d) using the formula $N = (Z)^2 P(1-P)/d^2$

The calculated sample size (N) required was 384 stools taken from volunteer humans at Adola Health facilities.

$$N = 1.96^2 \times p \times (1-p) / d^2 \quad N = 1.96^2 \times 0.5(1-0.5) / (0.05)^2 = \mathbf{384} \text{ peoples.}$$

3.4. Sampling techniques

The systematic random sampling technique was followed for selection of animal, to obtain representative sample from the populations. The sampling interval can be obtained by dividing the total population size to calculated sample size (N/n). Consequently, the first sample was picked randomly and the interval calculated was used to precede further to get the calculated sample size for the presumed study. People, who were visiting those health facilities, were requested to voluntarily be included in the study and chosen purposively to provide stool samples.

3.5. Study methodology

3.5.1. Active abattoir survey

Systematic random sampling techniques were applied to those 422 slaughtered cattle that come to the abattoir. The first cattle were randomly selected and then every 5th cattle entering the slaughter house after ante mortem inspection was considered and marked.

The Abattoir were visited five days per week and, each selected cattle were given an identification number by writing a code on its rib/back bone using a paint and four to five cattle were examined on each slaughter day.

Animals which are brought to the Abattoir for slaughter purpose was examined in two ways:

Ante mortem inspection (AMI) (10:00 AM - 12:00 AM): Pre-slaughter examination of cattle was conducted in the lairage by grouping the animals based on species, sex, age, body condition score and place of origin.

The age grouping was based on dentition. Those which have not erupted permanent incisor teeth were classified as young, while those with one pair or more permanent incisor teeth erupted were classified as adults (Vatta *et al.*, 2006). The general behavior of the animals, gait, structure, body condition scoring and signs of disease and abnormalities of any type were registered according to the standard of ante mortem examination procedures given by Gracey (2009).

Post mortem examination (PME) (03:00 PM- 05:00 PM): Animals that undergo post mortem examination were those which passed ante mortem inspection. During postmortem inspection liver, lungs, heart, kidney, tongue, brain, muscles and carcasses were thoroughly inspected by visualization, palpation and making systemic incisions where necessary for the presence of cysts, parasites and other abnormalities (MOA, 1972)

3.5.2. *Human stool sample collection*

According to (WHO, 2003) a stool was taken from purposively selected volunteer for immediate examination and identified appropriately. Concentration differential flotation technique was used widely for detecting eggs of cestodes. Larva identification was done on the basis of shape and size of published books, published and unpublished articles, internet sources and standard parasitology manual and guideline.

3.5.3. *Cyst viability test*

The cysts was appropriately collected, labelled and brought after five to seven hours to Adola Central Veterinary Clinic All the cysts from affected organs were carefully trimmed of with surrounding tissues. First, the viability of cysts was examined by placing them in a normal saline solution diluted with 30% ox bile and incubated at 32°C. Envagination of the unarmed scolex in

viable cysts usually occurs within 1-2 hours. The cyst was then identified by microscope as *cysticercus bovis* if they lack hooks and rostellum on the evaginated scolex with four suckers (Taylor *et al.*, 2007).

3.5.4. Questionnaire survey

To investigate Human taeniasis and associated risk factors, 95 volunteer respondents were selected using purposive sampling methods based on willingness to participate on questionnaire survey. The potential risk factors of *Taenia saginata* taeniasis such as habit of raw meat consumption, age, sex, religion, occupation, educational levels, presence and usage of toilet and knowledge of possible sources and prevention methods of *Taenia saginata* taeniasis were assessed.

The questionnaire was constructed in English and translated to Afan Oromo and Amharic language depending on participant and other necessary information was collected through face-to-face interviews with the respondent.

3.5.5. Inventory of pharmaceutical shops for financial impact

Analysis concerning the drug inventory, the relevant five years data was gathered from public drug stores out of the existing 20 private pharmaceutical shops in Adola towns, Inventory on eight (8) randomly selected private pharmaceutical shops was conducted for the amount of drugs and cost of drugs they sale for human to treat the adult stage of human *Taenia saginata*. Accordingly annual adult dose of taenicial drug sales (based on prescription and patient complain) from December 2019 to June 2023 were gathered for analysis on the financial loss assessment of tape worm/taeniasis in the study area.

3.5.6. Estimation of financial loss due to organ condemnation

The total financial loss due to organ condemnation was computed based on the condemnation rate of each type of examined organs, average number of animals slaughtered in the abattoir per year from retrospective data, and condemnation rate of each organ. Accordingly, the total direct financial loss was calculated by the formula given by (Ogunirade, 1980).

$$DAL = \sum AC \times AP \times CR$$

Where:-

DAL = direct annual financial loss due to organs condemnation

AC = annual cattle slaughter rate of the abattoir

AP = average cost of each liver/lung/heart/ tongue and

CR = condemnation rates of liver/lung/ heart/tongue.

3.6.Data management and analysis

The data collected were recorded in Microsoft Excel spreadsheets (Microsoft Corporation) 2010 program and it was filtered, edited and coded before statistical analysis. Descriptive and inferential statistics were computed using STATA Version 14 (stata corp, college station. Texas). The prevalence of *c.bovis* and *T.saginata* was computed by dividing total number of positive total number of studied and then multiplying by 100. The associations of risk factors for both occurrence of *c.bovis* and *T.saginata* infection were analyzed with univariable logistic regression analysis. Those risk factors with $p < 0.25$ were checked for collinearity by using the kruskal gamma statistic. Those variables with gamma values between -0.6 and +0.6 were considered for the multi variable logistic regression analysis. Pearson's chi square test (Fisher's exact) was used to determine existence of any association between Epidemiological study positivity and potential risk factors.

The strength of association was assessed by odd ratio (OR) and For all analyses 95% confidence interval and 5% desired absolute precision were used.

In the final model, a p-value of less than 0.05 ($p < 0.05$) with 95% confidence interval (CI) was used to declare the associated risk factors.

4. RESULT

4.1. Abattoirs survey results

4.1.1. Overall prevalence

Of the total 422 cattle slaughtered and carcasses examined at Adola municipal abattoir in a period from December 2023 to June 2024, 29 animals were found to be infected with meta cestodes of *Taenia sagnata* (*c. bovis*). This makes the overall prevalence of meta cestodes infection in slaughtered cattle to be 6.87% (95% CI: 4.8% - 9.73 %).

4.1.2. Effect of related host factor

The association between origin, age, and sex and body condition of slaughtered cattle with that of the prevalence of cysticercosis was assessed using Pearson's Chi-square test statistic. Between the considered animals characteristics age and sex were significantly associated with the prevalence of *bovine* cysticercosis ($P < 0.05$). Origin of animals and body condition were not significantly associated with prevalence of *bovine* cysticercosis ($p > 0.05$) (Table 3).

Table 3: Association between risk factors and *c. bovis* infection

Risk factor		No. inspected	No. positive	Percentage	P-value
Origin					0.072
	Adola	213	10	4.7%	
	Girja	54	5	9.3%	
	Shakiso	87	11	12.6%	
	Wadera	68	3	4.4%	
Sex	Female	115	14	12.2%	0.008
	Male	307	15	4.88%	
Age	Young	66	3	4.5%	0.000
	Adult	334	20	6%	
	Old	22	6	27.2%	
Body condition	Poor	30	0	0	0.290
	medium	118	10	8.5%	
	Good	274	19	6.93%	

4.2. Risk factors associated with *Cysticercus bovis* infection in Cattle

4.2.1. Univariable logistic regression analysis

The results of univariable analysis show that age and sex of animals were found to have positive association with *c. bovis*. Association of animal origin with *c. bovis* infection was assessed, the univariable logistic regression model showed that there was no significant associations among animals of different origin ($p > 0.05$). The prevalence of infections in animals brought from Shakiso was 3.0× more likely occur with *c. bovis* than animal originating from Girja and Wadera (Table 4).

The probability of acquiring *c. bovis* among old age animals is 7.8 times more likely occur compared to adult age group (Table 4).

Regarding measures of association, Origin and body condition of animals were dropped by univariable logistic regression analysis. In contrast sex and age were fitted into multivariate logistic regression analysis ($P < 0.05$). The variables with the P-value of less than 0.25 in univariable analysis were taken to multivariable analysis to control confounders and to see their Collinearity effect on *c. bovis* (Table 4).

Table 4: The Univariable Logistic regression analysis

Risk factors		Number of Examined	Positive Animals	Prevalence	P-value	COR	95%CI
Origin	Adola	213	10	4.5%		Ref.	
	Girja	54	5	9.3%	0.202	2.0	(0.677-6.33)
	Shakiso	87	11	12.6%	0.018	2.9	(1.19-7.19)
	Wadera	68	3	4.4%	0.92	0.9	(0.25-3.50)
Age	Young	66	3	4.5%		Ref.	
	Adult	334	20	6%	0.007	1.3	(0.385-4.63)
	Old	22	6	27.2%	0.008	7.8	(1.77-34.9)
Sex	Male	307	15	4.8%		Ref.	
	Female	115	14	12.2%	0.011	2.6	(1.25-5.78)
Body conditio n	Good	274	19	6.9%	0.261	Ref.	
	Medium	118	10	8.5%	0.59	1.2	(0.559-2.76)
	Poor	30	0	0%	-	-	-

Key to Abbreviation: COR=Crude Odd Ratio, CI= Confidence Interval, Ref= reference

4.2.2. Multivariable logistic regression analysis of risk factors

For multivariable logistic regression analysis collinear predictors, namely, Sex and age were found to be significantly associated with *c. bovis* ($p < 0.25$).

Out of the total of 307 males and 115 females inspected, female animals with 12.2% had higher infection rate /*c.bovis*/ compared to male animals (4.8%). Although, more males than females were examined, the risk of infections showed significant difference (OR=2.5 P= 0.021).Female animals were 2.5times more likely to have infection rate than male animals and old age animals had 3.0 times more likely to have infection than young animals (Table 5).

Multivariable logistic regression analysis also indicated that, Origin of Animals and body conditions score were not identified as the independent predictors of *c. bovis* infection ($P > 0.05$).

The model goodness of fit was assessed by using hosmer lem show goodness of test by comparison of observed and expected values and approved to be 0.573($p > 0.05$) which is indicates the model goodness fit was better. The predictive ability of the model was assessed by generating (ROC) curve checked to be 72.79% and the output of the test the sensitivity and specificity of the model is 75.2% correctly classified diseased and non diseased animals (Figure 3) ROC.

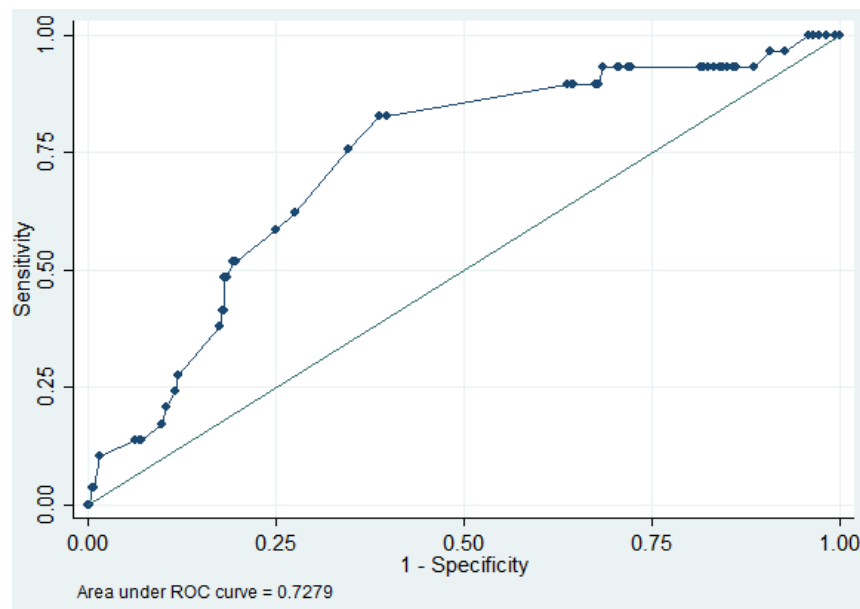


Table 5: Multivariable logistic regression analyses for Risk factors of *c. bovis*

Risk factors	Number Examined	Number positive	Prevalence (%)	P-value	OR 95% CI
Age	422	29	6.87%	0.015	3.02(4.8-9.7 %
Sex	422	29	6.87%	0.021	2.5 (4.8 - 9.7%)

Key to Abbreviation: OR= Odd Ratio, CI= Confidence Interval

4.3.Characterization of cysts

4.3.1. Cyst location

c.bovis was found in different organs which includes heart, tongue, liver, triceps muscles and masseter muscles. In the present study out of the total 114 affected organs, *Taenia saginata cysticerci* occurred in the proportion of 5.4% lungs, 4.7% liver, 4.7% triceps muscles, 4.5% masseter muscles, 4% tongue and 3.5% heart (Table 6).

4.3.2. Viability tests

An overall proportion of 3(2.6%) viable and 18 (15.8%) non-viable cysts were identified during the present survey (Table 6). The viable cysts were obtained from the masseter muscles, Triceps muscle, and liver respectively. Majority of the non-viable cysts were encountered in the Tongue, Lung, masseter muscles, Triceps muscle, liver and heart (Table 6).

Table 6: Status of cysts in different organs of inspected cattle examined (n=422)

Organs inspected	No. positive Organ	Viable Cyst	Dead Cyst	Total cyst
Tongue	17 (4%)	0%	4(3.5%)	4
Lung	23 (5.4%)	0%	3(2.6%)	3
Massetter muscle	19 (4.5%)	1(0.8%)	3(2.6%)	4
Triceps muscle	20 (4.7%)	1(0.8%)	3(2.6%)	4
Liver	20 (4.7)	1(0.8%)	2(1.7%)	3
Heart	15 (3.5%)	0%	3(2.6%)	3
	114 (27%)	3(2.6%)	18(15.8%)	21

4.4. Questionnaire survey results

4.4.1. Questionnaire survey result to assess the community perception

In the selected study area 50 voluntary interviewed respondents of the residents in the surrounding study area who participated in different working environments (farmers, students, merchants, daily laborers and government employers) were included in this particular study to assess the community perception on *Taenia saginata* taeniasis. Socio-demographic information such as; age, sex, religion, occupation, educational level and habit of raw meat consumption were included in this particular study.

Sex

According to the interview conducted there's no statically significant difference between sex and prevalence of taeniasis ($p>0.05$) however, higher prevalence infection in male respondents than females was recorded. In fact the variation in prevalence may be due to difference in raw meat

Consumption status of respondent in which male 34 (85%) and females 6 (60%) of respondent revealed consuming raw meat respectively.

Age

The present study showed that the prevalence of *Taenia saginata* had no significant association with age groups of respondents ($P=0.348$). However, the old age groups had relatively higher prevalence compared to those adult and the young age respondents (Table 7).

Religion

The present study also revealed that there was no significant association ($p>0.05$) between the prevalence of taeniasis and religion of respondents. However, higher report of infection was observed in the Protestant than in Orthodox, Wakefata and Muslim community respondents. This prevalence exposure with in religion basis was evaluated from respondent and it indicates that raw meat consumption high in (87.5%) protestant (71.4%) Orthodox (50%) wakefata and (50%) in Muslims (Table7)

Educational level

Current study showed that education level of respondent do not have statistical significance ($p>0.05$) with the prevalence of *Taenia saginata* with in communities.

Occupation: The interaction of respondent occupation and prevalence of taeniasis was statistical evaluated and had highly significant ($p<0.05$) association. More infection in civil servants and merchants than respondents in other sectors of occupations observed (farmers, students and un employed) (Table7).

Meat consumption habits: The present study showed that majority of the respondents had an experience of consuming raw meat and as a result of they were infected in the past by *Taenia saginata*. The statistical analysis of the raw meat consumption and taeniosis interaction was statically

highly significant ($p = 0.000$). In current study from 40 respondents who ate raw meat 29 (72.5%) of them acquired *Taenia saginata* confirming that 'kurt, kitffo and dullet are all sources of viable cysts of the parasite (Table7).

Marital status: There was no statically significant difference between marital status and prevalence of taeniosis ($p > 0.05$) in which it is relatively higher in married respondents (86%).

Source of beef: For most of the respondents the sources of beef were local butchers (Hotel), home slaughter and few of them don't need from anywhere. Depending on this study, higher prevalence (77.5%) was observed in respondents that obtain meat from local butchers (Hotel) and there was a highly statically significant association ($p = 0.000$) between source of meat and *Taenia saginata* infection. (Table7).

Residence place: In this study there was no statistically significant association between residence place and *Taenia saginata* prevalence infection ($p > 0.05$). Comparatively the higher prevalence was observed in urban settings (62.5%) and lower in rural dwellers (37.5%). (Table7).

Generally, in this study there was no statistically significance between prevalence of taeniasis infection in different sex, age, educational levels, residence, marital status and religion (> 0.05), but statistically significant difference were observed in occupation, source of meat and habit of raw meat consumption in the respondents ($p < 0.05$).

Table 7: prevalence infection of human taeniasis

Risk Factors	No of interviewed	Exposure percentage of taeniasis	P-Value	X ²
Sex			0.077	3.1230
Male	40	34(85%)		
Female	10	6(60%)		
Age			0.409	2.428
Young	24	17(70.8%)		
Adult	22	19(86.3%)		
Old	4	4(100%)		
Occupation			0.017	14.0511
Farmer	12	10(83%)		
Merchant	13	12(93.3%)		
Civil	14	12(85.7%)		
Servant				
Student	7	2(28.5%)		
Un employee	4	4(100%)		
Religion			0.102	6.316
Orthodox	14	10(71.4%)		
Protestant	24	21(87.5%)		
Wakefata	6	3(50%)		
Muslim	6	3(50%)		
Marital Status			0.083	3.0010
Single	15	5(33.3%)		
Married	35	30(85.7%)		
Level of Education			1.00	0.2404
Secondary	32	25(78%)		
Primary	13	11(84.6%)		
Illiterate	5	4(80%)		
Raw meat Consumption			0.000	50.00
Yes	40	80%		
No	10	20%		
Residence	50		0.659	0.195
Rural	15	37.5%		
Urban	25	62.5%		
Source of Beef			0.000	43.94
Hotel	31	77.5%		
At Home	9	22.5%		
No Any	0	0		

4.4.2. Knowledge and Perception of health professionals towards Taenia saginata teniasis

Socio demographic characteristics of health professionals

A total of 31 Health professionals including; Medical Doctors, Nurses, Health Officer, laboratory technicians and veterinarian in the selected health institution of Adola District were surveyed (Table 8). Of these, 24 (77.4%) were males and 7 (22.6%) females. Regarding to age groups 8 were young, 22 Adult and 1 old. Educational status of the health professionals were, 11(35.4%) had diploma, 18 (58 %) had bachelor degree and 2 (6.4%) were medical Doctors. The work experiences of the health professionals with their professions were 22 (73.3%) had 1-5 years, 8 (25.8%) had 6-10 years and 3.2% had above 10 years of work experiences (Table 8).

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Table 8: Socio-demographic characteristics of health professionals

Profession		Medical doctors n=2	HO n=5	Nurse n=4	Laboratory n=11	Veterinarian =9	Tota l	%
Sex	Male	2	4	2	8	8	24	77.4%
	Female	0	1	2	3	1	7	22.6%
Age	Young	0	0	2	4	2	8	25.8%
	Adult	1	5	2	7	7	22	73.3%
	Old	1	0	0	0	0	1	3.2%
Education al status	Diploma	0	0	0	6	5	11	35.4%
	Degree		5	4	5	4	18	58%
	MD	2	0	0	0	0	2	6.4%
Service years	1-5yrs	2	2	2	10	4	22	73.3%
	6-10yrs	0	3	2		4	8	25.8%
	Above 10	0	0	0	1	1	1	3.2%

General knowledge of health professionals towards *Taenia saginata* in human

From interviewed health professionals, 96.8% of them had knowledge towards *Taenia saginata* taeniasis and its public health importance because they are professionals. Most health professionals revealed that human could get parasitic disease of *Taenia saginata* taeniasis from consumption of raw or undercooked meat. More than half (64.5%) of the health professionals had knowledge on the means of transmission of the parasite to humans. But 35% of the interviewed health professions do not have such knowledge about transmission method of *Taenia saginata* taeniasis, this was especially the fact with most of health professions had 1-5 years of work experiences.

In studying the attitudes and practices of health professionals 84 % thought that *Taenia saginata* taeniasis was important parasitic disease that affect human and testing of the parasite case were more advantageous for effectively medications. More than half (61.2%) of the health professionals had knowledge on symptoms of human *Taenia saginata* taeniasis like, abdominal pain, vomiting, loss of appetite and emaciation however, 13% of professionals had no information about symptom and they only consider identification of parasite by microscopy and others 9.7% consider that the main symptom of *Taenia saginata* taeniasis was worm visibility on stool.

In generally health professionals had different perception on symptom of *Taenia saginata* taeniasis.

51.6% of interviewed health professionals' respondent considered avoiding consumption of raw meat as method of prevention for *Taenia saginata* taeniasis. However, 13 % of respondents mentioned that transmission of taeniasis could be prevented by keeping personal hygiene and environmental sanitation. 87% of the health professionals had experience with case of *Taenia saginata* taeniasis in the working area and while 12% of the health professionals did not see the case of *Taenia saginata* taeniasis during their work experiences.

The most common diagnostic method used by health professionals for screening of *Taenia saginata* taeniasis considered by 87% of respondents was microscopy while 13% of the health professionals believe it to be clinical examination.

80.6% of health professionals thought that *Taenia saginata* taeniasis was common parasitic disease known in the area and 19.3% of professionals had no knowledge for common and known disease of this parasite tape worm. More than half (64.5%) of health professionals responded that they can treat case of *Taenia saginata* with exactly known medication. However, 35.5% of them responded that could not do it and only refer to specialists if they come across with cases positive for *Taenia saginata* taeniasis.

Comparing the number of answers according to type of profession, the professionals who are Medical Doctors and Health officer showed the most number of correct answers on the issues of clinical manifestation, prevention and diagnosis, higher than those who are nurses, laboratory worker and veterinarian however nurses had a better experience than laboratory worker and veterinary professionals. In the comparison according to the professions, medical Doctors and nurses had the highest number of correct answers in the diagnostic system and medical treatment. Regarding to prevention method there is significant differences between the health professionals interviewee.

4.4.3. Questionnaire to assess knowledge and perceptions of suspected groups

Socio demographic characteristics.

A total of 14 *Taenia saginata* suspected patients who are visiting at Adola General hospital and Adola health center follow up for services or medication with cases related to GIT parasites those had different occupational categories within communities were interviewed

Knowledge and perception in suspected group

From individuals who had cases related to *Taenia saginata* taeniasis interviewed. 57.1 %, of them had their own livestock keeping for 42.8% income generations, 28.5% for source of food and the rest 28.5% do not keeping livestock. The Keeping of livestock by suspected group for *Taenia saginata* taeniasis was not significantly associated with *Taenia saginata* infections ($p>0.05$). As the respondent mentioned, most of the community do not have latrine use facility in the area of livestock grazing, which easily contaminates the pasture that facilitate the life cycle of *Taenia saginata*.

The meat inspection done during animal slaughter had highly significant association with prevalence of *Taenia saginata* infections in the suspected groups ($P<0.05$). Majority of the respondent told that there were no meat inspection cared out during animal slaughter and consumption of raw meat usually under going on meat which was not inspected. 92.8%, of the respondents revealed that they were advised not to consume raw meat in the past because they could acquire the disease from consumption of raw or undercooked meat. So, advice given by health professionals for suspected group of people had statistically significant associations with prevalence of *Taenia saginata* infections ($p<0.05$).

Generally, in present study there was statistically significance association between prevalence of *Taenia saginata* infection with suspected group with sewage disposal, drug usage in the past, meat inspection and ranking of food stuff (<0.05).

Table 9: knowledge and perception of suspected group

Occupations		Butcher	Farme r	Sivil servant	Mer chan t	Total	P- value
							0.267
Having own livestock							
	yes	0	5	1	2	8(57.1%)	
	No	1	0	1	3	5(35.7%)	
Reason for keeping livestock							
	Source of income	0	4	0	2	6(42.8%)	0.367
	Source of food	0	2	2	0	4(28.5%)	
	No keeping	0	1	0	3	4(28.5%)	
Any latrine in area of cattle graze							
	Yes	1	1	2	2	6(42.8%)	0.119
	No	0	5	0	3	8(57.1%)	
Is meat inspection done in area you live							
	Yes	1	0	1	0	2(14.2%)	
	No	0	6	1	5	12(85.7%)	0.033

4.5. Result of stool sample examination

Out of 384 human stools collected and examined at Adola General Hospital and Adola Health Center in the study period from December 2023 to June 2024, 56 people (14.58% 95% CI 11.4%-18.5%) were found to be infected to with *Taenia saginata* confirmed by finding the eggs of this parasite. This prevalence of *Taenia saginata* was 15.1% screened at Adola General Hospital and 12.5% was screened at Adola Health center (Table 10). The prevalence of infections in human stool collected was 17.7% in male and 11.6% in females (Table11). The sex of individuals had no significant association with detection of *Taenia saginata* eggs ($p>0.05$). The occurrence of *Taenia saginata* eggs recorded between age groups was 17.1% in Adult, 10.2 % young and 17.4% in old age categories. There was statistical variations between peoples who consume raw meat and those who do not in detecting the eggs of *Taenia saginata* taeniasis ($P=0.000$).

Table 10: Prevalence of *Taenia saginata* egg in human stool screened at Health Institutions.

Name of Health institutions	stool Examined	sample Number positive	Prevalence %
Adola General Hospital	297	45	15.1%
Adola health Center	87	11	12.6%
Total	384	56	14.58%

Table 11: Univariable logistic regression analyses

Risk factors	Sample	No. positive	No.	Prevalence	χ^2	p- Value	COR	
	Collected	Positive	Negative					
Age					3.5131	0.173	0.83	
Young	146	15	131	10.2%			Ref.	
Adult	192	33	159	17.1%		0.074	1.81	
Old	46	8	38	17.4%		0.200	1.83	
Sex					2.8891	0.0889	1.00	
Male	186	33	153	17.7%				
Female	198	23	175	11.6%		0.091	0.60	
Raw meat Consumption status	Yes	195	48	147	24.6%	32.0099	0.000	7.38
	No	189	8	181	4.2%			

4.5.1. Univariable logistic regression analysis

The results of univariable analysis showed that detection of *Taenia saginata* eggs in stool samples had statistical significant association with consumption of raw or under cooked bovine meat. (χ^2 , =, 32.009; $p=0.000$). The univariable logistic regression model showed that there was no significant associations ($P>0.05$) between sex and age of examined individuals with infection of *Taenia saginata* taeniasis (Table 11).

Final logistic model developed and Evaluated indicates that the model goodness of fit was assessed by using hosmer lem show goodness test and approved to be 0.063 which is ($p>0.05$) validates for model goodness fits.

The predictive ability of the model was assessed by generating (ROC) curve checked to be 71.34% and the output of test sensitivity and specificity of the model is 85.42% correctly classified diseased and non diseased animals (Figure 4) ROC.

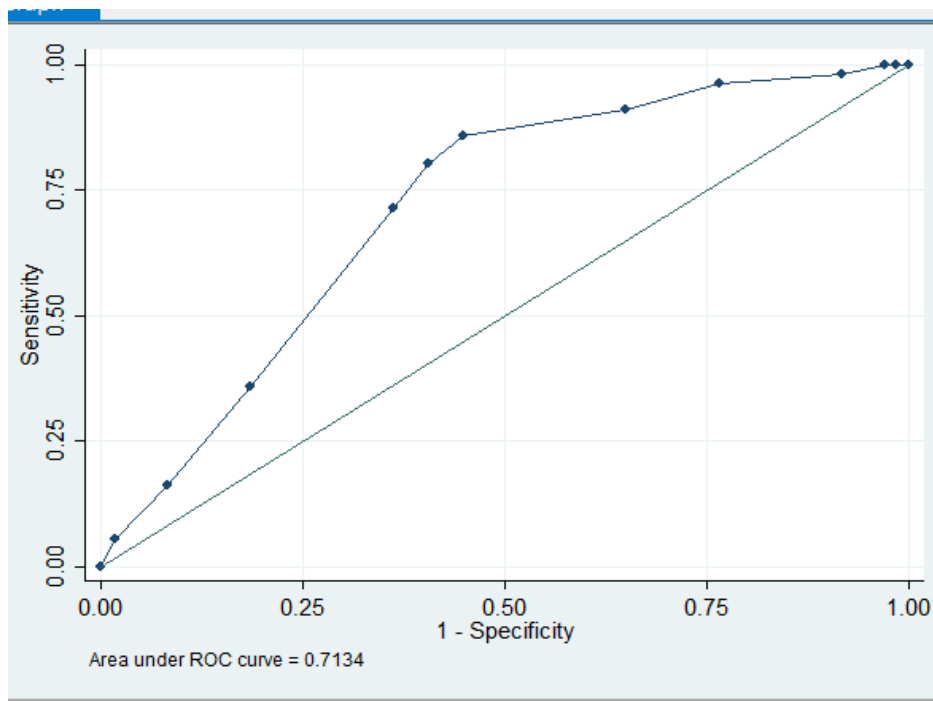


Figure 3: prediction capacity of Final model.

4.6.Inventory of pharmaceutical shops for financial impact analysis

Inventories of pharmaceutical shops in Adola town that covered five years records (2019-2023) data were gathered from public drug stores and Pharmacies, out of the existing 20 private pharmaceutical shops in Adola towns Eight (8) randomly selected private pharmaceutical shops inventory was conducted for the amount of drugs and cost of drugs they sale for human to treat the adult stage of human *Taenia saginata*. financial impact of the disease was assessed based on prescription and patient complain indicated that **327,466** adult *teniacidal* drug doses were sold for a total about **99,957.75USD (8,496,409.5 ETB)** which was spent for the treatment of human taeniasis in the study area.

Relatively high dose of *Albendazole* (44.2%) was used followed by *Praziquantel* (35.8%) and *Mebendazole*(vermoz) (20%) (Table12).This showed that taeniasis impacts on household financial resources were very significant, which could be easily avoided by eating well-cooked meat and keeping personal hygiene and environmental sanitation.

Table 12: Annual adult taenicial drugs sold during 2019-2023

<i>Taenicial</i> Drugs	Year of sales									
	2019		2020		2021		2022		2023	
	Dose	Worth(ETB)	Dose	Worth (ETB)	Dose	Worth(ETB)	Dose	Worth(ETB)	Dose	Worth
<i>Praziquantal</i>	22,270	558,977	19,520	489,952	14,750	370,225	28,530	716,103	32,280	810,228
<i>Menbendazole</i>	7,320	193,248	9,780	258,192	10,770	285,405	16,930	457,110	20,565	544,972.5
<i>Albendazole</i>	23,820	607,410	24,614	627,657	23,710	616,460	32,700	882,900	39,910	1,077,570
Total	53,410	1,359,635	53,914	1,375,801	49,230	1,272,090	78,160	2,056,113	92,755	2,432,770.5

Source: Collected and summarized by investigator (Data from Selected pharmacy).

4.7. Financial Loss Assessment

The total financial loss due to organ condemnation in cattle slaughtered at Adola Municipal abattoir was assessed the, total financial loss due to organ condemnation was computed based on the condemnation rate of each type of examined organs, average number of animals slaughtered in the abattoir per year from retrospective data, and average cost of each organ. in the present study average annual cattle slaughter rate was estimated to be 2160 heads/year and the average market price of each organ lung, Tongue, liver, heart and kidney as 250, 250,900, 500, 270 (pair) Ethiopian Birr respectively (Table13). Out of total examined organs 735 (34%) organs were condemned. The condemned organ were kidney (13.6%) liver (27.2%), heart (20.4%), tongue (16.3%) and lung (22.4%) (Table13).

The total direct financial loss was calculated by the formula given by (Ogunirade, 1982)

$$DAL = \sum AC \times AP \times CR$$

AP = average cost of each liver/lung/heart/ tongue, and

CR = condemnation rates of liver/lung/ heart/tongue).

DAL = direct annual financial loss due to organs condemnation

AC = annual cattle slaughter rate of the abattoir

For Tongue: $DAL = AP \times CR \times AC = 2160 \times 250 \times 16.3 = 8,802,000$ ETB

For Liver: $DAL = AP \times CR \times AC = 2160 \times 900 \times 27.2 = 52,876,800$ ETB

For heart: $DAL = AP \times CR \times AC = 2160 \times 500 \times 20.4 = 22,032,000$ ETB

For kidney: $DAL = AP \times CR \times AC = 2160 \times 270 \times 13.6 = 7,931,520$ ETB

For lung; $AP \times CR \times AC = 2160 \times 250 \times 22.4 = 12,096,000$

Total Grand cost of all organs = **103,738,320** ETB

Table 13: Direct annual financial loss

Organ	Average cattle slaughter	Annual Condemnation rate of each organ annual %	Average price of each organ Eth. Birr
Liver		200(27.2%)	900
Heart		150(20.4%)	500
Tongue		120(16.3%)	250
Kidney		100(13.6%)	270
Lung		165(22.4)	250
Total	2160	735(34%)	

Source: abattoir's health control and marketing director of Adola municipal abattoir.

5. DISCUSSION

The present study was designed to investigate the status of *bovine cysticercosis* in cattle and *Taenia saginata* taeniasis in human, evaluate the risk factors and assess the impacts of the problem and management practices of society in East Guji zone of Oromia region south Ethiopia. The study showed that the overall prevalence of *c. bovis* in cattle slaughtered and inspected at Adola Municipal abattoir in a period from December 2023 to June 2024 is 6.87% (95% CI:4.8-9.7). This finding is comparable to that of Nigatu (2004) in Addis Ababa abattoir (7.5%), Abay and Kumar (2013) in Mekelle (7.23%) and Dawit (2004) in Gondar (4.9%). But it is higher compared to the findings of Mussa (2023) in central Ethiopia (3.11%), (Birhanu *et al.*, 2008) in Jimma (2.93%) and Nuraddis and Firew (2012) Addis Ababa municipal abattoir (3.6%). On the other hand, the present result is lower than that of Alemu (1997) in Bahar-Dar (19.5%), Abunna *et al.*, (2007) in Hawassa (26.25%) and Belachew (2012) in Hawassa (22.9%). This may be due to the fact that the prevalence of *c. bovis* varies from place to place due to difference in the area where cattle are coming, the sanitary status of the environment, the agro-ecology and the expertise capacity detecting the cysts at post mortem examination as well.

Out of the total of 307 males' and 115 females' inspected 12.2% of female animals had higher cyst of *c. bovis* than male animals with 4.8%. Even though more males than females were examined, the prevalence of infections showed a significantly higher infections in females (OR=2.6, $p < 0.05$). This result is agreement with the report of Mussa (2023) in Jimma and Worku (2014) in west shoa zone of Oromia. It is also line with the study result of Ibrahim and Zerihun (2012) and Nurradis and Firew (2012) in Ethiopia. But, the reports of Kebede *et al.*, (2008) in Addis Ababa, Gomol *et al.*, (2011) in Jimma and Nigatu (2016) at Kombolcha Elfora have shown disagreement findings. In this study, assessment was also made with respect to the district of animals originated for the cyst detection and prevalence was 12.6% for Shakiso, followed by Girja (9.3%), Adola (4.5%) and Wadera (4.4%). However, there was no significant association between the origin of animals and the prevalence of *c. bovis* detection ($p > 0.05$). This finding is in agreement with the reports of Teklemariam and Debash (2015) in Batu, Ethiopia, who reported no significant association between the origin of animals and the prevalence of *c. bovis*. This variation in prevalence could be associated

with geographical differences, habits of society toward raw meat consumption and the presence or absence of sanitary problems in area.

The age category of slaughtered cattle had also showed significant relationship ($p < 0.05$) with *C. bovis* detection. Accordingly, higher prevalence of 27.2% was found in old aged cattle as compared to that of adult aged groups of animals (6%). This finding was in agreement with the findings of Gomol *et al.*, (2011), Endris and Haileluel (2011), and Balachew (2012) However, it is contrary to reports of Hailu (2005) and Mussa (2023); This variation might be due to lowered immunity in old age animals than adult aged groups. So, Immunity of an animal had an important role to play in fighting against infection *C. bovis*.

In the present study there's no significant difference between ($p > 0.05$) body condition score of animals. However higher prevalence was recorded in cattle with medium body condition (8.5%) than good body condition (6.93%). This result was higher than the study reported by (Takle mariam *et al.*, 2015) with good 1.9% and medium 5.8% in medium body condition score cattle but lower than the report of Belachew (2012) where it was recorded to be 22.0% good and 24.0% medium.

The reason behind 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 *Teania 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 anti helminthes drugs.

The current study revealed that there was variation in the anatomical distributions of *Cysticercus bovis* in the organs of inspected cattle. The most frequently affected organ with the highest number of cysts was lungs, (5.4%) liver, (4.7%) triceps muscles, (4.7%) masseter muscles, (4.5%) tongue (4.%) and heart (3.5%) respectively. This Finding is partly in agreement with (Tegene *et al.*, (2018) and Hialu (2005) who reported similar records of cyst presence in different organs.

The viability test of the cysts also revealed that the heart harbored that the same number of viable cysts by masseter 0.8% triceps, 0.8% and in liver 0.8%. The variation between organs of the

slaughtered animals might be due to blood kinetics and animals daily activities. Any geographical and environmental factors affecting the blood kinetics in the animal affect the distribution of oncospheres as well and hence the predilection sites varies during meat inspection. The observations showed that the lungs, tongue, masseter muscles, triceps muscle and heart among others were the predilection site for the cysts in bovine similar to earlier reports in various endemic areas (Pawlowski and Schultz, 1972; Okafor, 1988; Moreira *et al.*, 2001; Opara *et al.*, 2006).

The larvae of *Taenia saginata* still cause significant problems in many parts of the world. In Ethiopia the adult parasite in human and the cyst in cattle population is wide spread but differs from region to region (Regassa *et al.*, 2008).

Questionnaire survey carried out along with abattoir study revealed that 29 (72.5%) of the interviewed individuals mentioned contracting of *Taenia saginata* in their life time. This result is in agreement with the findings of (Abunna *et al.*, 2008) who reported 64.2%, Dawit 2004 (69.2%) and Mussa (2023) 68%. On the other hand this finding is greater than the reports of (Wolde michael *et al.*, 1990) 13.5% in Wonji Showa, (Fetene *et al.*, 2014) 58.1% in Jimma town, (Belachew *et al.*, 2012) in Addis Ababa (44%) and (Regassa *et al.*, 2009) 50.6% in Walaita Soddo town. The reason of this variation may be due difference in infection rates of *Taenia saginata* which is mainly due to the habit of eating raw or under cooked infected (measly beef) due to lack of awareness about the disease and deep rooted tradition, inherited from parents.

In the present study there was no significant association between sex and prevalence of taeniasis ($p>0.05$). This result is in line with reports of (Abunna *et al.*, 2008), (Hussein *et al.*, 2011) and (Tsfaye *et al.*, 2012) and opposed report of (Megersa *et al.*, 2010). However, higher prevalence was seen in males than females.

Moreover, the age group of respondents had no statistical significant ($p>0.05$) with the occurrence of *Taenia saginata* infections. However old aged groups had relatively higher infection rate compared to those adult and the young aged respondents. This difference might be due to the fact that the differences in the habit of raw meat consumption, patient awareness, personal and environmental hygiene and public health services Also, this might be related to the habit of raw meat consumption

which increase with age and the higher age group have better income to consume raw meat and more prone to *c. bovis*.

This study also revealed that there was no significant association ($p > 0.05$) between the prevalence of *T. saginata* in human and religion of respondents which is in agreement with the finding of Mussa (2023), Hailu (2005), (Adugna *et al.*, 2013) and (Abunna *et al.*, 2007) in Ethiopia. However, higher infection rate was observed in protestant (87.5%), Orthodox (71.4%), wakefata (50%) and in Muslims (50%) communities.

The study revealed that occupation of the respondents had significant association with that of taeniasis ($p < 0.05$). This result agreed with that reported by Wondimagegni and Belete (2015) in Debrebrhan and Lielt *et al.*, (2015) in Bishoftu. The prevalence of *Taenia saginata* was higher in merchant (93.3%), followed governmental employers (85.7%) farmers, (83%) and students, (28.5%) 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 *Taenia saginata*.

The current study revealed that raw beef consumers had contracted taeniasis infection more frequently than non-raw consumers of raw beef ($P < 0.05$ and $\chi^2 = 50.00$) which is in lined with the report of (Mussa 2023) in Jmma, Worku, (2014) in west Shoa zone and Argaw *et al.*, 2017) in Kombolcha town. The reason is that the consumption of raw meat increases the chance of ingesting *cysticercus bovis* with meat (Geysen *et al.*, 2007).

A questionnaire was also administered to health professionals for the assessment of knowledge attitude and practices to *Taenia saginata* in human on selected health facilities of Adola district.

This confirmed that majority of health professionals 96.8% predict that human contracts disease from consumption of raw or undercooked meat and knew *Taenia saginata* taeniasis. This finding indicates that knowledge and/or awareness of health professionals are adequate.

This study also aimed to investigate the status of taeniasis in human stool samples during the study period. Hence out of 384 human stools examined in Adola General Hospital and Adola Health Center in a period from December 2023 to June 2024, 56 (14.58%; 95% CI: 11.4-18.5%) human were infected with *Taenia saginata* as confirmed by finding eggs. This finding reveals that human

taeniasis is common in Adola district and surrounding areas. Prevalence (14.58 %) recorded in the present study is higher compared to the results of other researchers like that Dawit (2004) in Gondar revealed (4.2 %). Analysis of the results of the present study demonstrate that there was very strong association between raw meat eaters and occurrence of taeniasis ($P=0.000$) that coincide with the findings of Hailu (2005), Dawit (2004), Mussa (2023) and (Abunna *et al.*, 2008). This is due to the fact that those who eat raw or undercooked meat had the chance to easily be infected with *Taenia saginata*.

In this study there was no significant association between individual's age categories in infection rate of *Taenia saginata*. However, Prevalence rate of *Taenia saginata* infection slightly increased with individual's age, relatively the highest prevalence was observed in individuals of old age compared with adult age group. (OR=1.83, $p=0.200$). This finding is in agreement with findings of Abunna (2016), Hailu (2005), Dawit (2004) and Mussa (2023) in Ethiopia, they reported that higher in old age groups compared with young and adults. These findings disagree with (Eke *et al.*, 2014) and (Rodriguez *et al.*, 1999) who reported that more young people were infected with taeniasis. In fact, This might be related to the habit of raw meat consumption increase with age and the higher age group have better income to consume raw meat and more prone to *c. bovis*.

The Current study showed that sex had no significant association with occurrence of *T.saginata* infection in Adola district. This finding is in agreement with (Abunna *et al.*, 2008), (Hussein *et al.*, 2011) and (Tesfaye *et al.*, 2012) who revealed that sex grouping did not play exposure factor to *T.saginata* in humans. However, the reports by (Megersa *et al.*, 2010) did not agree with this finding. This could be due to economic and cultural taboos that discouraged females from eating raw meat in butchers and restaurants as compared to males.

Evaluation of the economic aspects for taeniasis is very difficult, particularly in developing countries like Ethiopia, where infected people treat themselves with traditional herbal drugs. However, the retrospective (five years) drug inventory (from 2019-2023) carried out in the current study at Adola district has shown that *Albendazole* (44.2%), *Praziquantel* (35.8%), *Mebendazole* (vermox) (20%) were the most frequently used drugs at Adola district and surround area. The total dose of taenicidal

drugs used in the Five years period of 2019-2023 was 327,466 worth of 99,957.75USD (8,496,409.5 ETB)

The present finding showed higher compared to reports of (Megersa *et al.*, 2010) in Jimma 111,353 Eth. Birr and (Tesfaye *et al.*, 2012) shows 29,952 doses which worth 40,201.8 Eth .Birr per year in Wolaita Soddo.

c.bovis were the major causes of organs condemnation in cattle slaughtered at Adola Municipal abattoir. From a total of 2160 head cattle slaughtered/year 735 (34%) organs of cattle were condemned because of cysticercus bovis, other diseases and pathological findings. Out of the total organs examined 27.2% was liver, 22.4 %lungs, 16.3% tongue, 13.6% kidneys and 20.4% hearts were condemned due to various causes.

The total financial loss calculated in this study due to organs (liver, lungs, tongue kidney and heart) condemnation was estimated **103,738,320** Ethiopian Birr/year which is greater than financial loss analysis done elsewhere in Ambo (Zewdu *et al.*, 2008) and Sodo Municipal Abattoir (Abunna *et al.*, 2010) which was estimated to be 160,032.23 and 4000 USD. The variation may be due to the variation in the cost of condemned organs and financial inflations from time to time.

6. CONCLUSION AND RECOMMENDATION

The current study showed that *T. saginata/c. bovis* is an important zoonotic parasitic disease in the study areas. Apart from its zoonotic significance taeniasis/cysticercosis causes an economic loss through condemnation of edible offal and whole carcasses as well as incurring cost for therapeutic use for infected humans. The occurrence of the disease both in human and animals is high and poor slaughter processes and meat handling and processing seem to aggravate the situation. The abattoir, questionnaire surveys and human stool laboratory investigation showed that taeniosis/cysticercosis was important parasitic disease in Adola district and surrounding areas.

Moreover, it was determined that the prevalence of metacestodes infection in cattle and taeniasis in human is significantly balanced and made public health implications. Using conventional meat inspection techniques easily miss out detecting cysts in infected carcasses which are subsequently passed for human consumption and thus favoring the infection transmission.

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

- ✓ 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.
- ✓ Strict routine meat inspection of slaughtered animals should be carried out.
- ✓ Infected meat and meat products must undergo the proper process of freezing, boiling or destruction based on the intensity of infection with cysticercus.
- ✓ The community should be intensively encouraged for construction of simple toilet to minimize contamination of pasture with human stool, so that the cycle of *Taenia saginata* interrupted.
- ✓ Moreover, close integration between medical and veterinary service is reliable to reduce the impact of the taeniasis in both human and cattle population in study area.

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8. APPENDIX

Table 1: General knowledge of health professionals towards *Taenia saginata* in human.

Profession	Medical Doctors	HO	Nurse	Laboratory technician	Veterinarian	Total	P-value

Do you Know a disease that human could get from raw meat								
	Yes	2	4	4	11	9	30(96.8%)	0.251
	No	0	1	0	0	0	1(3.2%)	
Do you know tape worm parasite of human teniasis	Yes	2	5	4	11	9	30(96.7%)	
	No	0	0	0	0	0	0	
Does human get parasitic disease from meat	Yes	2	5	4	11	9	30(96.7%)	
	No	0	0	0	0	0	0	
No Comment	1	1	1	1	5		9(29%)	

Doyou know method of transmission parasitic disease of teniasis	Yes	1	5	4	1	9	20(64.5%)	0.000
	No	1	0	0	10	0	11(35.4%)	
Howis Importance of zoonotic parasite teniasis and its testing	Important	2	5	3	9	7	26(83.9%)	0.883
	Not	0	0	1	2	2	5(16%)	

	important a							
Symptom of meat borne parasite of teniasis	Vomiting and abdominal	1	4	3	11	0	19(61.2%)	0.000
	Worm visible on stool	1	1	0	0	1	3(9.7%)	
	loss of appetite and emaciation	0	0	1	0	4	5(16%)	
	No symptom visible	0	0	0	0	4	4(12.9%)	
Can you across case of zoonotic teniasis parasite	Yes	2	4	3	10	8	27(87%)	0.877
	No	0	1	1	1	1	4(12.9%)	
Which age group you across with case of zoonotic parasite	Adult male	2	5	3	7	3	20(64.5%)	
	Adult female	0	0	1	4	6	11(35.4%)	

How it zoonotic parasitic disease diagnosed	Microscopical	2	5	4	8	8	27(87%)	0.96
	Clinical symptom	0	0	0	3	1	4(12.9%)	
How is the disease of teaniasis is common	Common	1	3	2	10	9	25(80.6%)	0.096
	Not common	1	2	2	1	0	6 (19.3%)	
What do you do for positive case of tenia saginata	Medication	2	4	4	10	3	23(74%)	0.026
	Refer to specialist	0	1	0	2	6	9 (29%)	
What are solution to stop zoonotic teaniasis	Stop eating raw meat	1	2	1	9	3	16(51.6%)	
	Education of communities	0	1	0	0	1	2(6.4%)	
	Environmental and personal Hygiene	0	1	2	1		4(12.9%)	
	No Comment	1	1	1	1	5	9(29%)	

9. ANNEXES

Annex 1: Questionnaires

Part 1: Questionnaires to study of suspected group of T saginata

Code_____

Date____/____/____

District_____

Village/Kebele _____

1. In which of the following age categories do you place yourself?

1.18-25

2.26-45

3.45 and above

2. Sex:

a. Female

b. Male

3. Religion

a. Orthodox

b. protestant

c.wakefa

d.Muslim

4. Occupation:_____

5. Do you own livestock? a. yes b.no

6. Reasons for keeping cattle:

A. Source for food_____

B. Source of income _____

C. others_____ (specify?)

7. Are there any latrines in the areas where cattle are grazed? A. Yes B. No

9. Is meat inspection done when you slaughter cattle at home? A. Yes B. No

10. Have you ever been advised in the past not to eat raw beef? A. Yes B. No

11. When did you stop eating raw beef (if applicable)? A. A few months ago B. a year ago C. 2-5 years ago D. more than 5- years ago.

12. Please rank in order of your preference (i.e. 1= best and 8-least), the following foodstuffs (the same rank could be given for more than one time).

- Semi-roasted minced beef (Lab lebKitfo)

B- Properly cooked minced beef (YettepeesKitfo)

C- Raw minced beef (Tibs)

13. Sewage disposal system:

A. Latrine in house

B. Defecations in open are

14. Consumptions of untreated water (water from rivers or non-controlled water sources

A. Yes B. No

15. Have you ever suffered from taeniasis A. Yes B. No

16. Have you observed symptoms of illness whenever you get infected with tapeworms? A. Yes B. No

17. If yes which one (s) of the following symptoms of illness whenever you get infected with tapeworms? A. Diarrhea B. Hunger pain C. Constipation D. Epigastric pain E. Nausea F. Increased appetite G. Decreased appetite H. Chronic headache I. mental disorders J. Epileptic crisis K. Subcutaneous nodules L. Dizziness disturbance by crawling segments _____

18. Which one of the following taenicidal drugs (tapeworm treatments) have you used in the past to treat yourself?

A. From the modern drugs available in pharmacies

B. From the traditional herbs

20. Is meat inspection done when you slaughter cattle at home? A. Yes B. No

21. Which drugs do you think are more effective to treat tapeworm infection(s)?_____

22. Do you know the cause of tapeworm infection(s) A Yes B.No

23. Do you recognize the tapeworm infective form in meat? A. Yes B. No

24. Do you believe that butchers inform their customers on whether the meat is infected or not A. Yes B No

Part 2.Socioeconomic variables of suspected Patient toward parasite

1. Employment status: A. Employed B. unemployed

2. Occupation Type

A. Government employee B. Non-governmental organization C. Farming D others work._____

3 .Monthly Income level: _____ birr

Annex 2: Stool sample collection format

Date ____/____/____

Name of Study Area _____ Name of Health Institution _____

Data code	Sample code	Age	Sex	Raw meat consumption	Stool constant	Toilet		Status of stool	
						Yes	No	Positive	Negative

Annex 3: Questionnaire to assess knowledge and awareness of health professionals

Nurses, Health officers, health extension Workers, pharmacist, public drugstore workers, and meat inspector in selected study area were asked.

Date____/____/____

Part 1: Health professional's identification and demographic questions

1. Code No _____
2. Sex A.M B.F
3. Age (in years) _____
4. Service years/work experiences_____
5. Type of professions_____
6. Where do you work? A. Hospitals B. Health center C.Abattoir
E. Veterinary clinic
7. Educational Status A. Diploma B. Degree

Part 2: Knowledge and awareness Assessment questions.

8. Do you know any disease human could get from Raw Meat? A. Yes B. No
9. Do you know Zoonosis parasite of tape worm? A. Yes B. No
10. Do you know that human could get parasite from Meat? A Yes B. No
11. . Do you know methods of transmission of parasite from Raw Meat to human beings? A. Yes B. No
12. If yes to Question 10 and 11, indicate the methods of transmission of zoonosis parasite to humans
A. Consumption of raw or undercooked meat
B. Contact with raw meat
C. Poor personal hygiene
D. Other
13. Methods of preventing
A. Avoid contact with Raw meat
B. Avoid consuming raw Meat
C. Good Personal hygiene
14. Do you think it is important to be tested for zoonosis parasiteA.Yes B.

15. Do you know the symptoms of Meat borne parasite in any of patients Visit in your health institution? A. Yes B. No

16. If yes to Question 15. What are the symptoms _____

17. In your opinion, how important is zoonosis parasite as a disease in immune competent individuals in your working area? A. Important B. Not important C. Don't know

18. What do you do if a human become positive for zoonosis parasite of T.saginata?

A. Medication

B. Refer to specialist

C. Don't know

19. Have you ever come across case of zoonosis parasite? A. Yes B. No

20. If yes to Question 19,

2. In which type of people? a. Male b. female

3. 2. In which age group? A. Infants b.young c.adults d. older people.

1. How do you diagnose the disease?

A. Clinical symptoms

B. Microscopic diagnosis

C. Serology

D. Histological diagnosis and Molecular diagnosis

E. Other, please specify _____

2. From your experience how common is disease due to zoonosis parasite to human?

A. Common

B. Not common

C. Don't know

3. Please provide us any further comments, if you have any, in relation to zoonosis parasite to human in your working area

4. In your recommendation, what will be the write solution to stop the zoonosis parasite in area _____

Annex 4: Questionnaire Regard to community knowledge and awareness in selected area

Date ____/____/____

Part 1. Community Identification and demographic Knowledge and awareness Assessment questions

1. Code No _____
2. Sex A .Male B. Female
3. Age (in years) _____
4. Type of professions _____
- 5 Religion:
 - A. Orthodox B. Protestant C. Muslim D. wakefata
- 6 Residence Place /Locality: A. Urban B. Rural /Countryside
- 7 Marital Status A. Married B. Single
 1. Level of education
 - A. Tertiary /University B. Secondary School C. Primary school C. Illiterate
8. Do you eat raw meat? A. Yes B. No
- 9 Do you wash hands carefully after handling raw meat? A. Yes B. No
10. Is meat inspection done when you eat raw meat? A. Yes B. No
- 11 Do you know any disease human could get from meat A Yes B. No
- 12 Do you know Zoonosis parasite? A. Yes B. No
- 13 Where do you consume raw meat? A. At Home with family B. Hotel
- 14 Do you suffer from Parasite disease after consuming of raw meat? A. Yes B. No
- 15 If your answer for question No. 14 is **yes**: you get any illness A. Yes B. No
- 16 If your answer for question No. 15 **yes**: what kind of illness A. Stomach pains B. Fever and diarrhea C. Vomiting D loss of body condition E. Heart F. Brain and spinal cord
- 17 If your answer for question No.16 **yes**: do you see any parasite in your stool? A. Yes B. No
- 18 Do you Visit any health institution about this case A. Yes B.N

19 Sewage disposal system:

Latrine in house A. Yes B. No

Defecations in open are A. Yes B. No

20 Which of the following statements best fits your situation with regard to raw meat consumption?

A. Never tasted raw meat used to eat but currently quieted

B. Stopped but restarted, Might decide to stop in the future

C. Never dared to stop and have no intentions to do so

21 Methods of preventing

A. Avoid contact with meat B. Avoid consuming raw meat C. Good Personal hygiene.

Annex 5: Information Sheet read to the respondents

My name is Hussen Chemeri Beriso student of Hawassa University, school of graduate studies faculty of veterinary medicine department of veterinary epidemiology. The aim of the study is to undertake epidemiological study on *Taenia saginata* and *cysticercusbovis*: community awareness and economic loss in cattle at Adola district and surrounding area, southern Oromia, Ethiopia

The laboratory analysis will be conducted at Adola General Hospital and Adola health center. The study will be conducted through analysis of stool samples for parasitological investigation. I would like to interview few question about Epidemiological Significance and Associated Risk Factors. Your cooperation and willingness for interview will be very helpful in identifying the risk factors for Meat borne Zoonosis parasite to Humans.

Your name will not be written in the form and I assure you all the information you give will be kept strictly confidential. Your participations are voluntary and you are not obliged to answer any question that you do not want to answer.

For the successes of our study, we will be asking to give correct answer for respective questions.

Thank you for your support. Continue answering those questions!!

Annex 6: Consent form prepared for study participants

I----- here by giving my consent for giving stool samples as recommended by health personnel for Epidemiology and risk factor assessment. I understand there is no serious invasive procedure at the beginning as well as the end of the study. I understand this study will be used not only for me but also for others human and further study. I believe that at the end of study the result also explain for concerned body only for the purpose of the study.

Signature _____ Date _____

Thank you for helping this important study.

*If you want to request additional information about the study, comments, please contact us through
Mobile phone No: 0920087726*

Annex 7: Abattoir and laboratory Investigation

Equipments and chemicals requirement for laboratory work

Materials requirement are:

Compound microscope,

Filter paper or Cotton

Cover slip

Gloves

Needle and Sticks,

Slides

Vials for sample collection

Centrifuge

Beaker

Tube

Tea strainer

Chemicals requirements are:

2.5% Potassium dichromate solution soap.

0.5% normal saline

Saturated NaCl solution

Methylene blue

Iodine solution

70 % ethanol

Annex 8: Laboratory procedures

Screw vials will give to the people regarding collection of the stool sample, they will give sterile labeled vials and application sticks. An instruction was provided to avoid the contamination of stool. Each of the specimens was checked for its labeling.

All the laboratory works were done in selected site of health institution under the supervision of supervisor and laboratory technologists.

Methods of stool examination

Unstained preparation of stool smear:

- ❖ A (10g) minute portion of stool was taken with the help of small stick and emulsified with normal saline (0.5) and a drop of it was taken on a clean glass slide.
- ❖ Then a cover slip was placed gently over it so as to spread out the emulsion into a thin, fairly uniform and transparent layer and excess of fluid was removed with the help of filter paper
- ❖ The slide was fixed in microscope and examined under low power 10X objective. Observation was starting from one end of the slide to another.
- ❖ When the parasites, eggs were seen then objects were centered and focused under the high power for detailed diagnosis

Stained preparation of stool smear:

- Stained preparation was necessary for the identification and the study of the nuclear membrane
- The iodine stained preparation was used for this purpose which was diluted in the ration of 1:5 with distilled water
- The method was applied for observing the eggs, cyst and larva of parasites.

Concentration methods:

Differential flotation technique

- ✓ This technique was used widely for detecting eggs of nematodes and cestodes. As their eggs are lighter and small, they can float by this method.
- ✓ Approximately 3gm of stool sample was taken in a beaker and added 15ml of saturated sodium chloride solution then stirred properly and solution was filtered by tea strainer.
- ✓ The filtrate was poured into a centrifuge tube of 15ml and tube was filled with more sodium chloride solution and centrifuge at 1000 rpm for 15 minutes.
- ✓ After centrifuge more saturated sodium chloride was added to develop the convex surface at the top of the tube and one drop of methylene blue was added then a cover slip was placed for 5 minutes.
- ✓ Then the cover slip was removed and placed on a slide and examined.
- ✓ The photographs of the eggs, cysts, and larva of parasite was taken and identified on the basis of shape, color and size