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TREND OF *CYSTICERCUS BOVIS* PREVALANCE IN CATTLE SLAUGHTERED AT ADDIS ABABA ABATTOIR ENTERPRISE ITS PUBLIC HEALTH SIGNIFICANCE

MVSc THESIS

BY

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JULY, 2024

BISHOFTU, ETHIOPIA

TREND OF *CYSTICERCUS BOVIS* PREVALANCE IN CATTLE SLAUGHTERED AT ADDIS ABABA ABATTOIR ENTERPRISE ITS PUBLIC HEALTH SIGNIFICANCE

A thesis submitted to the College of Veterinary Medicine and Agriculture of Addis Ababa University in partial fulfillment of the requirements for the degree of Master of Veterinary Science in Veterinary Public Health

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As MVSc research advisor, I certify that I have read and evaluated the thesis prepared under my guidance by Yitagesu Belachew Sendafa entitled: **"Trend of *Cysticercus bovis* Prevalance in Cattle Slaughtered at Addis Ababa Abattoir Enterprise its Public Health Significance."** I recommend that it be accepted as fulfilling the thesis requirement for the degree of Master of Science in Veterinary Public Health.

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As members of the examining board of the final MVSc open defense, we certify that we have read and evaluated the thesis prepared by Yitagesu Belachew Sendafa entitled: "**Trend of *Cysticercus bovis* Prevalance in Cattle Slaughtered at Addis Ababa Abattoir Enterprise its Public Health Significance.**" And recommend that it be accepted as fulfilling the thesis requirement for the degree of Master of Science in Veterinary Public Health.

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STATEMENT OF THE AUTHOR

First, I declare that this thesis is my bona fide work and that all sources of material used for this thesis have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirements for an advanced MSc degree at Addis Ababa University, College of Veterinary Medicine and Agriculture and is deposited at the University/Colleg e library to be made available to borrowers under rules of the library. I solemnly declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma, or certificate.

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BIOGRAPHICAL SKETCH

The author was born on April 29, 1983 in Huruta town, East Arsi, Oromia regional state, Ethiopia; He attended his Elementary and secondary school education at Huruta Elementary school, Huruta Junior secondary School and Huruta senior Secondary School respectively. He joined then Addis Ababa University, Faculty of Veterinary Medicine and graduate with DVM degree in Veterinary Medicine in August, 2007. He has over 14 years of professional experience as a field Veterinarian at Benishangul Gumuz and Oromia regions, as well as instructor at Dandii Boru University of Ethiopia. Currently he has been working at Sude district Agricultural office Arsi Zone, Oromia regional state as Veterinar Epidemiologist until he joined Addis Ababa University college of Veterinary M edicine and Agriculture VPH MSc program.

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LIST OF ACRONYMS

BCC	Bovine Cysticercosis
GDP	Gross Domestic Product
MDA	Mass Drug Administration
WHO	World Health Organization
WOAH	World Organization for Animal Health

ABSTRACT

A cross-sectional investigation conducted during October, 2023 to February, 2024 in order to ascertain the prevalence of *C.bovis* and the frequency as well as cyst distribution in infected cattle which is supported by a retrospective study for the last ten years in the abattoir. Out of the 602 carcasses that were inspected 5 (0.83%) had *Cysticercus bovis* infections. Of the 6 cysts, 3(50%) were viable. The cysts were found in different organs and muscles (The triceps muscle, the liver, tongue, and masseter muscle).Triceps muscle was the most affected tissue. According to a questionnaire survey; *Taenia .saginata* taeniasis is still a human health problem in Addis Ababa city. Of 110 respondents, 47(42.73%) had experienced *Taenia saginata* a minimum of once in the past. 67% of the respondents were aware that eating raw beef can spread the zoonotic disease *Taenia. sag inata* taeniasis. The prevalence of *Taenia saginata* taeniasis had a statistically significant correlation between the sex, occupation, source of information, knowledge about transmi ssion and prevention ($p<0.05$).Theresearch area's yearly taenicidal medicine treatment cost for the year 2022/23 was estimated to be 2,310,965 ETB; it is comparable to 41,597.37 USD. The drug inventory made it very evident how important *Taenia saginata* is economically to the Addis Ababa. In line with the study's findings showed that the current methods for inspecting meat were insufficient to stop *Taenia saginata* cysticerci-infected carcasses from getting into the hands of consumers. It is important to focus on improving meat inspection practices and educating the public to reduce the problem.

Key words: Abattoir, Addis Ababa, Beef cattle*, Cysticercus bovis, Taenia saginata*

1. INTRODUCION

Africa's highest livestock population is thought to reside in Ethiopia. The country's livestock industry has been making a significant economic contribution and continues to hold promise for the nation's economic growth. It is essential that animal proteins required to improve people's nutritional status are provided by livestock products and by-products, such as meat, milk, honey, eggs, cheese, and butter. Ethiopia has Seventy million cattle, forty-nine million sheep, fifty-five million goats, two million horses, ten million donkeys, thirty-eight million mules, eight million camels, and roughly fifty million poultry (CSA, 2021/22).

The most valuable livestock product is meat, which is also the animal protein of choice for many people since it contains all the necessary amino acids and other micronutrients in the right amounts for humans. This covers all produced or processed items made from animal tissues (Kefale and Satheesh, 2022). Parasitic illnesses, however, are the main determinants that affect the maximum benefit that may be derived from cattle production (Shuramo *et al*., 2022).

According to the WHO (2004), zoonosis accounts for 75% of all emerging pathogens and 60% of all infectious disease pathogens. Based on research conducted so far in different Ethiopian districts, the prevalence of zoonotic parasite illnesses varies between 2.93 and 4.4 % (Muhammed and Birhanu, 2020). Foodborne trematode diseases, leishmaniasis, zoonotic schistosomiasis, cysticercosis, echinococcosis, and toxoplasmosis are the main causes of the parasitic zoonotic disease burden worldwide (Mahamad, 2021).

The cause of bovine cysticercosis is metacestode stage larvae (*C. bovis*) in the muscle of cattle, while *Taenia saginata* taeniasis is brought on by adult tapeworms in the human small intestine. The health of their respective hosts is dangerously impacted by both the adult and larval forms, either directly or indirectly, along with a number of secondary illnesses, especially in humans (Abdala and Ame, 2022). *C. bovis* is the larval stage of *Taenia saginata*. Cattle are its intermediate hosts, while people are its ultimate hosts An

adult worm that has reached maturity in the small intestine releases 3–7 gravid proglottids, each of which has 30,000–50,000 eggs every day (El-Sayad *et al*., 2021).

According to (Jorga *et al*., 2020), Cysticercosis in Bovines (BCC) is a cattle infection with the tapeworm *Taenia saginata's* metacestode stage. Although tapeworms are found all throughout the world, populations in underdeveloped nations have been found to have the highest numbers of tapeworm carriers. However, *Taenia saginata* taeniasis/bovine cysticercosis is a neglected zoonosis due to the modest public health impact of taeniasis, the absence of economic data burden of BCC and taeniasis, the existence of other priority diseases, and the lack of resources.

The globe is becoming more interested in and concerned about the safety of food. Consumers may be at danger from public health problems associated with food safety at any point in the food chain. Food safety in cattle production is thus one of the World Organization of Animal Health's (WOAH) top priority, according to (Garcia-Diez *et al*., 2023).

One of the illnesses affecting food safety is Bovine cysticercosis (BCC), which is brought on by *Taenia saginata* (Tegegne *et al*., 2018). 77 million people on the planet carry *Taenia saginata*, among which 40% reside in Africa .Cysticercosis has been highlighted as a significant public health issue and a cause of domestic ruminant production losses in Ethiopia. The epidemiological spread of bovine cysticercosis in Ethiopia's many areas has been the subject of numerous investigations (Edao and Korso, 2019).

Statement of the problem

According to Grace *et al*. (2012), Ethiopia ranks second in Africa in terms of the health burden of zoonotic illnesses. It has been observed to have a significant frequency of infections in humans with bovine cysticercosis in several zones of agro-climate. Numerous research on *Taenia saginata* cysticercosis and taeniosis have been carried out in various Ethiopian locations over the past few decades, using various sampling

techniques and frequently subpar diagnostic approaches, with varying degrees of success. Human taeniosis prevalence estimates derived from meat inspection reports range from 1.2% (Dima, 2023) to 32.2% (Biza, 2018). Prevalence estimates derived from questionnaires have been found to range from 19.0% (Bekele *et al*., 2016) to 89.41% (Tembo, 2001).

About 45% of the meat consumed domestically in the country is produced by cattle, which mostly sell live animals for export. Even though the nation is well-positioned to export live animals and animal products to the sizable markets in North and West Africa as well as the Middle East, export earnings are still not very high. This is mostly because there are still a lot of unresolved animal health issues. *Cysticercus bovis (C. bovis)* or *Taenia saginata (T. saginata)* is one that continues to be a serious issue for animal and public health (Biruk, 2017), thus there needs to be enough focus on increasing exports abroad. According to Mohammed *et al*. (2021) inadequate cleanliness, insufficient meat inspection and control procedures, and poor animal husbandry practices are all to blame for Ethiopia's high prevalence of bovine cysticercosis. In addition raw meat consumption habit of our community is high.

Thus, it is imperative that adequate attention be paid to identify ways to enhance the availability and quality of beef for domestic consumption as well as for export. Though some recent studies have been carried out to ascertain the frequency of *C. bovis* in cattle that were butchered in Addis Ababa slaughterhouse Enterprise, the community's perception as well as the financial importance of taeniasis (*Taenia saginata*) in humans in the region and retrospective data of *C.bovis* in cattle slaughtered at this abattoir have not been examined. Therefore, in order to safeguard public health and boost export earnings, research regarding the occurrence of *C. bovis*, public health, as well as the financial importance of *Taenia saginata* must continue.

Research hypothesis

There is a significant association between the occurrence of *C. bovis* at Addis Ababa abattoir Enterprise and its risk factors such as body condition, sex, age and breed of animals.

General objective

- ✓ To asses the prevalance of *C. bovis* in cattle slaughtered at Addis Ababa slaughter house Enterprise, and determine the prevalence, associated risk factors additionally treatment cost of taeniasis within selected areas of Addis Ababa.

Specific Objectives

The specific objectives are:

- ✓ To asses prevalance of bovine cysticercosis in cattle slaughtered at Addis Ababa abattoir Enterprise.
- ✓ To evaluate the prevalanc of *Taenia saginata* and related risk factors and;
- ✓ To asses the economic impact of *Taenia saginata* taeniasis through inventories of pharmaceutical shops.

2. LITERATURE REVIEW

2.1. History of *C. bovis*

According to research, African hominids, who are thought to be our distant ancestors and who hunted antelope and other bovids for sustenance or preyed on them, were exposed to tapeworm colonization some 2 million years ago. Prior to the emergence of modern people and significantly before the process of domesticating pigs and cattle and the establishment of farming, These parasites were utilizing bovids as intermediate hosts, hyenas and huge cats as definitive hosts, and (Dawud *et al*., 2018).

Because the link between Taenia and hominid*s* was established prior to the domestication of these food animals, researchers hypothesized that man gave tapeworms to these domestic animals instead of humans acquiring Taenia from cattle and pigs. This is supported by evidence regarding the rate of molecular evolution between Taenia species. It was not until around 10,000 years ago, with the introduction of agriculture that cattle, pigs, and companion carnivores became intermediate hosts (Dawud *et al*., 2018).

The parasite bladder Cysticercus was identified later in the 17th century. It was thought to be a distinct creature from the mature *Taenia solium* tapeworm; however it was nonetheless considered to be closely linked to tapeworms because of the way its scolices looked. As a result, a German naturalist gave it the officially recognized as *Taenia cellulosae* around 1800. A dog tapeworm was given its own distinct genus concurrently by another German, Johann Zeder. It was agreed that all Taenia bladder worms belonged to this genus (Del Brutto *et al*; 1998)). It has been customary to refer to the *Taenia solium* larva as *Cysticercus cellulosae*, *Taenia saginata* (the beef tapeworm), the sheep tapeworm (*Taenia ovis*), the ruminant tapeworm (*Taenia krabbei*), the *Cysticercus tarandi*, and the *Cysticercus ovis* (Hulland, 1997).

2.2. Etiology of *Taenia saginata* and Bovine Cysticercosis

Humans are the ultimate host of *Taenia saginata* while cattle serve as its intermediate host. Cysticercosis in cattle is a dietary borne illness brought on through *Taenia Saginata*. *Taenia saginata* infection in humans is brought on by eating meat that is uncooked or undercooked beef contaminated with *C. bovis*, whereas *C. bovis* illness in bovine is brought on by eating *Taenia saginata* eggs. The adult tapeworms in the definitive host (man), the cysticercus or metacestodes larvae in the intermediate host (pigs or cattle), and the eggs in the environment are the three distinct subpopulations that comprise the parasite population of these species (Mussa, 2023).

2.3. Taxonomic Classification

Taenia saginata, the unarmed beef tapeworm, and *C. bovis*, its metacestode, are categorized as belonging to the kingdom Animalia, the family Taeniidae, the genus Taenia, the class Cestoda, the order Cyclophylidea, and the species *Taenia Saginata* (Dawud *et al*., 2018).

According to (Semie *et al*.,2015), the mature worm of *Taenia saginata* tapeworm has the morphology of a huge, multi-segmented, white, flat worm that is ribbon-shaped and has a chain made up of thousands of segments (proglottids). A head, or scolex, is located at the front end. The scolex typically has four suckers, which are not equipped with hooks. It has a short neck that connects it to the remainder of the body or strobila. Each of the proglottids, or segments, that make up the strobila has one or two sets of reproductive organs (male and female), depending on the segment. When pregnant these proglottids which are generated from the neck contain thousands of eggs (Gracy *et al*., 1999).

Taenia eggs are spherical, extremely resistant, gone through the faeces or released from broken segments, remaining for a duration of six months in vegetables and pasture, five weeks in water, ten weeks in hay or stool, and twelve weeks in silage sludge. According to Semie *et al*. (2015), Taenia eggs have a brown, radially striated embryophore or

"shell," three pairs of hooks on an oncosphere (hexacanth embryo), an exterior oval membrane coat that replaces the genuine egg shell that detaches from faecal eggs. The adult cysticercus, *C.bovis*, in the bovine animal is greyish white, roughly diameter of one centimeter and filled with fluid, usually with the scolex being plainly noticeable (Urquhart *et al.*, 1996).

2.4. Transmission

The spread of *Taenia saginata* infections is a result of human feeding practices and lifestyle choices. Human infection is sustained by human traditions and customs of eating plates of raw, sun-cured, and undercooked beef that contain viable bladder worms, such as Ihab in Thailand, Yukhoe in Korea, kourt and kitfo in Ethiopia, shish kebab and tikka in India, shashlik in the former USSR, and steak tartar in Europe. By consuming grass and water tainted with eggs from *Taenia saginata*, cattle become affected (Nigatu, 2004).

People who have the adult tapeworm *Taenia saginata* excrete proglottids, containing the parasites' eggs, in their faeces. The eggs are dispersed by water, wind, animal feet, insects, or a variety of other methods when faeces occur in the fields they pollute the pasture at varied distances. The eggs, when consumed, cause the gastrointestinal tract to release oncospheres or hexacanth embryos. After passing through the intestinal wall, oncospheres develop into metacestodes, which are identified in the typical intermediate host tissues, particularly striated muscles (**Figure 1**) (Symeonidou *et al*., 2018).

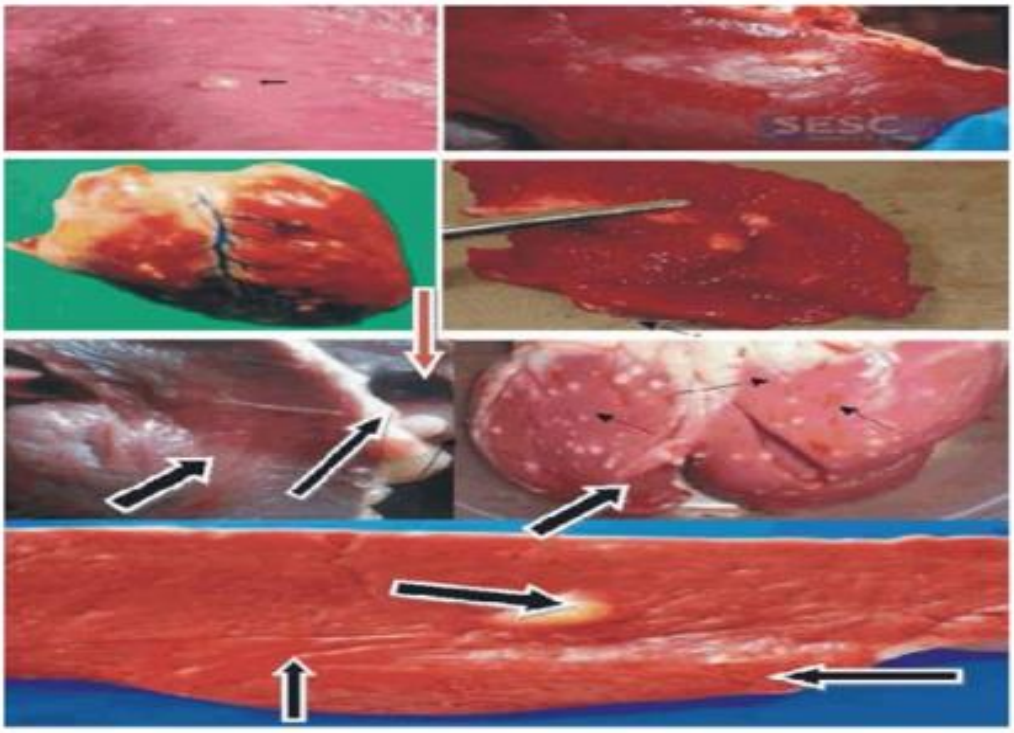

Figure 1*: C.bovis* distribution in different organs(Roba and Tolosa,2022**)**

Taeniid eggs are resilient to the majority of chemical disinfectants and can last for extended periods of time under the right circumstances. Eggs appear to survive longer at lower temperatures than at higher temperatures because sufficient moisture appears to be the most crucial condition to sustain viability. For instance, *Taenia saginata* eggs can survive for longer than 168 days at 4-5 ^{0}c, according to certain researchers (Hird and Pullen, 1979).

2.5. Life Cycle

The beef tapeworm, *Taenia saginta*, is extremely endemic in South America and Africa, where it can be found in some regions where the prevalence exceeds 90%. The first stage of the life cycle involves the introduction of human faeces containing Taenia eggs into animal feed or pastures. The cattle consume the eggs, which hatch in the intestine. They pass through the lymphatic and circulatory systems before becoming cysticerci in the

tissues. The lungs, heart, liver, tongue, shoulder muscle, masseter muscle, and diaphragm are the parasite's preferred sites of infection, yet the cyst can form anywhere in striated muscle (Alemneh and Adem, 2017). When undercooked beef containing cysticerci is consumed, the larvae emerge from the cyst and cling to the intestine using four suckers (no hooks). Subsequently, the worms undergo distal strobilation, growing to lengths of 10–25 m. Distal proglottids, each holding up to 80,000 eggs, are shed. Normally, the proglottids, or eggs, pass through and are eliminated from the large intestine. When the proglottids or eggs are consumed by the intermediate host (cattle), the cycle is ended (Held and Chappelow, 2004).

The intermediate stage of the human tapeworm (*Taenia saginata*) life cycle is known as *Cysticercus bovis*. If untreated, an infected person's infection may last for a lifetime. The human must obtain the tapeworm from cattle and vice versa. The human small intestine is home to the tapeworm, which may grow up to 25 meters in length while typically measuring 4 to 8 meters. It has up to 2000 body segments are attached to the intestinal wall via its scolex, same as all other tapeworms. Up to 80,000 eggs are included in each piece. The tapeworm's terminal segments split off and are excreted. They resemble white, meaty capsules that resemble rice grains (Filmer, 2022). **Figure 2** shows the life cycle that has previously been described (image courtesy of CDC-DPDX).

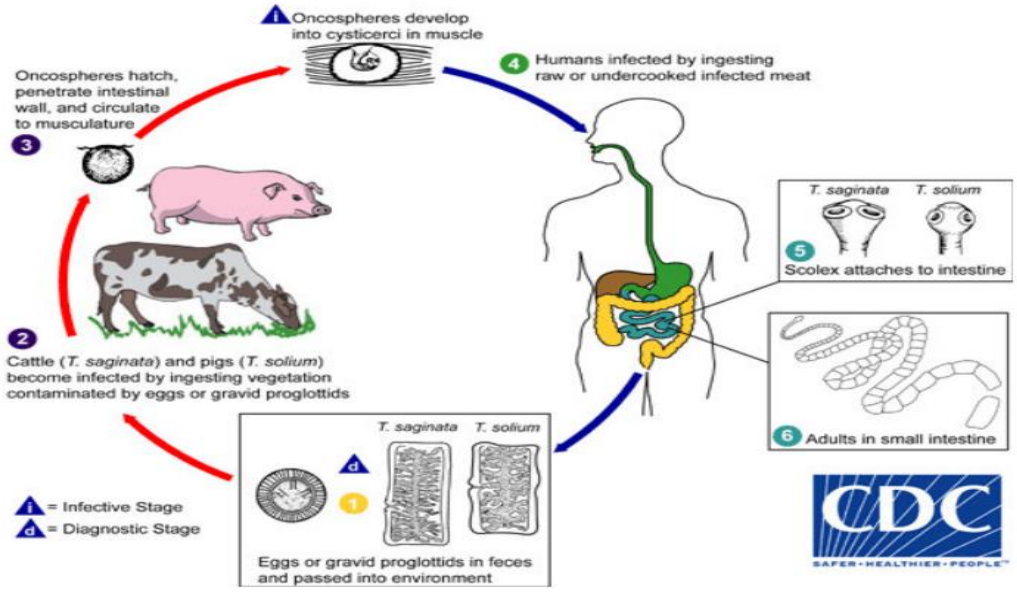

Figure 2: Life cycle of *Taenia solium and Taenia saginata* (CDC, 2015)

2.6. Epidemiology

Taenia solium and *Taenia saginata* are distributed worldwide as it is well known (Krauss *et al*, 2003, Parasitology, 2003, Carabin *et al*, 2005 and Eom *et al*., 2009*). Taenia saginata* is more common in underdeveloped nations with inadequate hygienic conditions and populations that customarily consume raw or undercooked meat (Singh and Umar, 2018). The prevalence of *Taenia saginata* has been divided into three categories by the World Health Organization (WHO, 1983): highly endemic countries or regions, where the organism is present in the human population at a rate greater than 10%; moderate prevalence, where the infection rate is between 0.1 and 10%; low prevalence, where the infection rate is less than 0.1%; or there is no trace of the endemic organism. South American nations are classified as having a moderate prevalence of *Taenia saginata* by the WHO.

As stated by (Gonzalez *et al*., 2016), bovine cysticercosis is present in both developing and industrialized nations. Cysticercosis caused by *C. bovis* may be hyper endemic, endemic, or epidemic. A prominent epidemiological picture in Africa is the hyper epidemic state, which occurs in pastoral regions. For instance, according to some research, bovine cysticercosis is prevalent within the marketplace of Kenya, where livestock are brought back to their homes in the evening after spending most of the day grazing alongside stockmen. As a result of this practice's constant human-cattle contact, their cattle have an extremely high incidence of bovine cysticercosis (Alemneh and Adem, 2017).

Bovine cysticercosis has been linked to the use of sludge or sediment or bacterially digested excrement, as fertilizer on pastures in Australia and Britain. The existence of these 'storms' is not surprising given that Eggs from *Taenia saginata* could live in muck for longer than two hundred days. Utilizing labour migrants from a nation with an elevated rate of infection has been reported from feedlots in some southern states of the USA as one cause of an unexpectedly high rate of infection on specific farms (Urquhart *et al*., 1996).

In nations like Ethiopia, where low hygienic conditions are combined with lax meat inspection procedures and subpar cattle management techniques; *Taenia saginata* taeniasis and bovine cysticercosis are quite common. According to the National Hygiene and Sanitation Strategy Program me, poor hygiene and sanitation contributed to nearly 60% of Ethiopia's illness burden (Tsegaye, 2023).

Humans are the only final hosts of *Taenia saginata*; cattle are its preferred intermediate hosts. Cattle of all ages are susceptible, but the younger age groups are more so. It is infrequently seen that other ruminants, such as sheep, goats, antelopes, gazelles, and buffaloes, display parasitism (Dawud *et al*., 2018).

2.7. Pathogenesis and Clinical Manifestation

2.7.1. Disease in human

According to Krauss *et al*. (2003), a mature *Taenia saginata* in a human host's small intestine can survive for up to 30 to 40 years. The majority of adults' tapeworm carriers in humans are not exhibiting any symptoms (Krauss *et al*. (2003), Parasitology, 2003, Cook *et al*., 2008). The patient may feel the proglottids move naturally through the anus or see the segment in the toilet bowel. Non-specific gastrointestinal symptoms like nausea, anorexia, or epigastric pain could be experienced. Possible symptoms include headaches, dizziness, anxiety, and urticaria. The tapeworm feeds on human nourishment, greatly depleting the hosts' nutritional stores. Enteritis is brought on by a high concentration of *Taenia saginata* in the human body (Dawud *et al*., 2018).

2.7.2. Disease in cattle

Infection can affect cattle of any age (Alberta, 2005). Even in cases of severe infection, bovine cysticercosis does not result in clinical symptoms in cattle (Semie *et al*., 2015). On the other hand, One million or more eggs may cause a progressive myocarditis that

could kill cattle within 14 to 16 days. Experiments using 200 000 to 1,000 000 *T. saginata* eggs can create heavy infections, which can result in fever, weakness, excessive salivation, anorexia, and elevated heart and respiratory rates (Oryan *et al.*, 1998).

2.8. Public Health Importance

Various publications have reported varying rates of *Taenia saginata* taeniasis and bovine cysticercosis prevalence in Ethiopia, ranging from 2.5% to 89.41% and 3.11% to 27.6%, respectively (Tembo, 2001, Dawit, 2004; Hailu, 2005 and Abuna *et al*.2008). The regional prevalence of *Taenia saginata* taeniasis was found to be 64.4% in Jimma (Taresa *et al*., 2011), 69.5% in Bishoftu (Tesfaye, 2016), and 30.4% in Bahir Dar (Tamirat *et al*., 2018) based on questionnaire surveys. Numerous reports from Ethiopia claimed that individuals with less formal education and those who worked in butcheries and abattoirs and had easy access to raw meat and meat products were more likely to get parasitic zoonosis than those with more education and less access to raw meat. This suggests that these populations consume raw beef more frequently (Kebede *et al*. (2009); Tadesse *et al*. (2013); Worku, 2014; Roba and Tolosa, 2022).

It has been noted that human infections are prevalent across the nation's various agro climatic zones. Zoonotic infections are the main obstacle to the growth of livestock productivity in Ethiopia among the common livestock illnesses. In low-income and some industrialized nations, zoonotic disease known as bovine cysticercosis, continues to be a serious public health issue (Netsanet *et al*., 2020). *Taenia saginata* taeniasis in humans and cysticercosis in cattle are widespread in Ethiopia as a result of the practice of defecating in public fields and eating undercooked or raw beef dishes like kitfo and lebleb (Haile, 2021).

With the exception of mild anal pruritus caused by emerging tapeworm segments, most instances of taeniasis in humans are asymptomatic. However, in severe infections, people may experience weight loss, increased or decreased hunger, stomach discomfort, and digestive disturbance. People who consume inadequate amounts of protein, individuals

with an iron shortage, and hookworm sufferers are all adversely affected. Some patients experience appetite loss, which leads to weight loss. According to Emiru and Hiluf (2019), occasionally, the gravid proglottids might move to other organs such as the pancreatic duct, bile ducts, appendix, and nasopharyngeal tubes. In these cases, the affected organs may experience inflammation and obstruction. In addition to harming human health, excessively diseased meat is condemned, export is prohibited, and the expense of human treatment is considerable (Semu *et al*., 2012).

2.9. Prevalance of *Taenia saginata* and Bovine cysticercosis in Ethiopia

2.9.1. Prevalence of bovine cysticercosis

A meat inspection study at abattoirs in Ethiopia was used to ascertain the prevalence of *C. bovis* in the population of cattle in various regions. The national average of 13.7% indicated that *C. bovis* was abundant and widespread across the nation. However, the distribution of prevalence differed from location to location (Abera and Gashe, 2023). Research has demonstrated that standard meat inspection is not as sensitive as antigen detection by ELISA (Ag-ELISA), with results suggesting that this technology could be suggested for epidemiological survey (Roba and Tolosa, 2022).

Because the disease spreads through indiscriminate defecation, consumers of beef are at significant risk of catching the disease, as indicated by the presence of live cysts in the diseased carcasses. Before animals reach the age of grazing, the degree of protective immunity and the infected pasture are the primary determinants of the prevalence and severity of bovine cysticercosis in cattle (Abdurehman *et al.*, 2020).

If lesions are found in two of the standard inspection sites—the masseter muscles, tongue, esophagus, heart, diaphragm, or exposed musculature—as well as in two spots during incisions into the shoulder and into the rounds, the animal is typically deemed highly sick. As per Canadian laws, a generalized infection is defined as the presence of two or three cysts on each cut made into the muscles of the heart, diaphragm, and its

pillars, as well as in muscles that become exposed during dressing procedures. When there is a moderate or light infection with a few dead or deteriorated cysticerci, the carcass is stored for around ten days at -10°C, depending on national requirements (Kassaw *et al*., 2017).

Table 1: Bovine cysticercosis prevalence in various regions of Ethiopia

Study area	Type of study	No of samples	Prevalence (%)	Reference
Addis Ababa	CSS	540	2.8	Mohamed *et al*. (2021)
Asella	CSS	430	1.2	Dima, 2023
Walaita Sodo	CSS	384	3.13	Meku and Tonga, 2022
Kombolcha	CSS	234	8.97	Tegegne *et al*.(2018)
Hadiya zone	CSS	384	7.8	Abera and Gashe, 2023
Bahar dar	CSS	480	4.2	Tamirat *et al*. (2018)
Bishoftu	CSS	330	4.24	Fesseha and Asefa, 2023
Dessie	CSS	384	6.8	Yigizaw *et al*. (2017)
Haramaya	CSS	384	5.5	Abdella and Ame , 2022
Nekemte	CSS	525	2.89	Shuramo *et al*. (2022)
Jigjiga	CSS	340	3.24	Mahamed, 2021
Ghimbi	CSS	400	4.5	Mardasa, 2009
Hawassa	CSS	384	8.3	Gebre *et al*. (2023)
Dilla	CSS	400	4.25	Fikadu *et al*. (2021)
Jimma	CSS	600	2.5	Talu, 2012
Gondar ELFORA	CSS	450	2	Adem and Alemneh , 2016
Tigray	CSS	439	5.2	Belay and Mekelle , 2014
Holeta	CSS	400	12	Hailu, 2021

*** CSS= Cross sectional study

2.9.2. Prevalence of Taenia saginata

Infection with *Taenia saginata* in humans is very common in Ethiopia's various agro-climatic zones, according to reports. It has been linked to inadequate hygiene and regional elements including traditional background, which includes the consumption of raw meat, economic status, and religious convictions, as well as individuals living close to cattle that are raised for companionship or utility with little to no differentiation (Mussa, 2023).

Table 2: *Taenia saginata* prevalence in various regions of Ethiopia

Study area	Species	Type of study	No of samples	Prevalence (%)	Reference
Eastern Ethiopia	Human (*Homo sapiens*)	QS	900	48	Abera *et al.(*2022)
Mekele	Human (*Homo sapiens*)	QS	75	61.3	Yemane and Kumar, 2018
Batu (Ziway)	Human (*Homo sapiens*)	RS	13,591	1.1	Teklemariam and Debash, 2015
West shoa	Human (*Homo sapiens*)	QS	110	63.6	Worku, 2014
Kombolcha	Human (*Homo sapiens*)	RS	31,469	0.07	Tegegne *et al*. (2018)
Holeta	Human (*Homo sapiens*)	QS	70	62.86	Hailu, 2021
Debre Brihan	Human (*Homo sapiens*)	RS	2484	3.9	Yimer and Gebrmedehan, 2019
Bahar Dar	Human (*Homo sapiens*)	QS	69	30.4	Tamirat *et al*. (2018)
Dilla	Human (*Homo sapiens)*	QS	60	57.79	Fikadu *et al*. (2021)
Jimma	Human (*Homo sapiens)*	QS	120	66.6	Talu, 2012
Bishoftu	Human (*Homo sapiens)*	RS	84,035	121	Geinoro and Bedore, 2019
Nekemte	Human (*Homo sapiens)*	QS	103	13.6	Emiru and Hiluf, 2019

** RS=Retrospective survey

***QS=Questionnaire survey

2.10. Diagnosis *Taenia saginata* taeniasis and Bovine cysticercosis

2.10.1. In human

Using anthelmintic and saline purgative, adult cestodes can be removed from humans. The morphology of the scolex and proglottid allows for identification (OIE.2004). In humans, the determination of the cause of a disease comes from looking at eggs found in the faeces or by closely examining the segments or proglottids that have gone through the stool. The diagnosis is made using rectal swabs, faecal examination, and symptoms; however, it is challenging to identify the disease in the first three months. It is not appropriate to declare someone free of infection before three negative tests are finished within two to three days of each other (Abunna, 2006). The shape of *Taenia saginata* eggs is not differentiable from that of *Taenia solium* or other tape worms, including echinococcus. However, the eggs of *Taenia solium* and *Taenia saginata* can be distinguished from one another using ELISA and PCR (Alemneh and Adem, 2017).

2.10.2. In animal

When identifying metacestodes during a meat inspection or necropsy, the host and their location are typically used to make the diagnosis in animals. When meat and offal are not properly prepared or set to freeze to destroy the live metacestodes, the parasite can be ingested by adults in definitive hosts. Although *Taenia saginata* metacestodes may be felt in the tongue of live animals, tongue palpation is only useful as a diagnostic tool in cattle that have a high level of metacestodes infection (Roba and Tolosa, 2022). The sole diagnostic method for determining Ethiopia's vulnerability to bovine cysticercosis is the regular meat inspection. Because of the inaccuracy and insensitivity of this approach, the stated prevalence of this infection in various parts of the nation may be underestimated. The size and quantity of preference sites seen during inspection processes must be increased in order to improve meat in an efficient manner (Dawud *et al*., 2018).

Heart, tongue, masseters, and diaphragm are locations of predilection, probably because they get the most blood flow. However, cysts can occur in any type of muscle in the body (OIE, 2008).

Ethiopian Meat Inspection Regulation Notice Number 428 of 1972, issued by the Ministry of Agriculture, states the following as standard operating procedures for inspecting carcasses: Visual examination, surface palpation, and a tongue incision made longitudinally from the tip of the root, several deep incisions are made into the shoulder's triceps muscles on both sides, the external and internal masseter muscles parallel to the jaw plane, a visual examination is performed, and a longitudinal incision is made from the base to the apex of the myocardium during the carcass inspection (MOA, 2013).

2.11. Differential Diagnosis

It's important to distinguish *Cysticercus bovis* in cattle from the following parasites:

Cysticercus dromedaries (*C. cameli*)

C. cameli is distinguished from *C. bovis* by the double row of hooks on its lateral invaginated scolex, which is twice as long as *C.bovis* , measuring 12–18 mm in length, and is pearly white in colour (Roba and Tolosa, 2022).

Sarcocystis bovifelis (*Sarcocystis hirusta*)

The soft bradyzoite cyst *Sarcocystis bovifelis*, also called *Sarcocystis hirusta*, is quite large and looks as white streaks running parallel to the muscle fibers visible to the unassisted eye. The cyst is between 0.1 and 5 mm long (Dawud *et al*., 2018).

Onchocerca dukei

Onchocerca dukei forms hard, touchable intramuscular and subcutaneous nodules that have a diameter of 3-6 mm. When these nodules are sectioned, worms are revealed (Semie *et al*., 2015).

Actinobacillosis lesions, particularly those in the tongue, and fat globules need to be taken into account (Gracey *et al*., 1999).

2.12. Treatment, Prevention \and Control

Making sure that meat is fully cooked before consumption is the most effective form of prevention. Maintaining proper hygiene and sanitation significantly lowers the risk of infection linked to fecal-oral transfer. The public health system in endemic countries has long been preoccupied with costs related to chemotherapy and other medical resources, as well as loss of production from intensive attempts to prevent and/or eradicate disease (Pam *et al*., 2015). The elimination of the illness has become a major global health problem in recent times due to a rise in the number of imported cases of cysticercosis in affluent nations (Gredagh *et al*., 2011).

In modern nations, managing cattle, maintaining strict human hygiene standards, fully cooking meat, requiring mandatory meat inspections, and freezing any afflicted carcasses are all necessary to combat cysticercosis. It is usual practice to freeze meat at -10°C for 11 days, which is adequate to kill cysticerci, although it lowers the economic value of the cattle (Taylor *et al*., 2007). Human sewage should only be used as fertilizer in agricultural practices on arable land or in places where animals will not graze for at least two years. Teaching people in underdeveloped countries how to properly prepare meat and maintain hygiene seems to be the most beneficial action currently accessible, even though similar activities might not always be financially feasible (Blate *et al*., 2023).

There are three approaches to use preventative chemotherapy (PC), a treatment for taeniasis, to lower the parasite burden in a particular group. Mass drug administration (MDA) is the practice of treating the whole population of a predefined geographic area on a regular basis, regardless of clinical status. On the other hand, selective chemotherapy screens patients and then treats them based on their clinical status, whereas targeted chemotherapy only treats certain risk groups on a regular basis (Okello and Thomas, 2017).

When intestinal Taenia infection occurs, most patients either show no symptoms at all or very little. Usually, anthelmintic medication (praziquantel or niclosamide) is sufficient if mature tapeworms are found in the stools. Taeniasis patients should be treated since doing so may stop cases of cysticercosis (Medscape, 2018).

Animals can receive therapy with drugs like Praziquantel (50 mg/kg), mebendazole (50 mg/kg), and albendazole (50 mg/kg), but these are not thought to be completely effective. Praziquantel is effective at 50 mg per kilogram every day for four days, although this course of treatment is unaffordable (Roba and Tolosa, 2022). However, owing to elevated costs and the potential public wellness implications within the meat of a dead, hardened cyst, treating animals is currently not an option (Dawud *et al*., 2018). Traditional medicines were utilized in Ethiopia to treat *Taenia saginata* infections. According to Ahmed (1990), the majority of people, particularly those who live in rural areas, regularly practice self-deworming procedures using various traditional herbal medications. **Table 3** lists a few of the conventional medications that are used.

Recombinant vaccines have been developed to prevent infection with *Taenia ovis* in sheep, *Taenia saginata* in cattle, *Taenia solium* in pigs, and *Echinococcus granulosus* in farm animals. The economic value of *Taenia ovis* and *Taenia saginata* vaccinations will determine whether they are a commercial success or failure (Lightowlers, 2006). These parasites are commercially relevant parasites.

There have been conflicting outcomes when it comes to vaccinating calves against *Taenia saginata*; nevertheless, the TSA9/TSA18 vaccine shown remarkable efficacy in preventing infection in calves. However, there are currently no plans to commercialize this vaccine because the available data does not support its viability from a business standpoint (Okello and Thomas, 2017).

Table 3: Main taenicidal plants, listed in decreasing order of potency

Local Name	**Scientific name**	**Parts Used**
Bisana	*Crotonmacrosatchuys*	Bark
Bisana	*Crotonmacrosatchuys*	Seed
Enkoko	*Embelia schimperi*	Fruits
Dubafire	*Cucurbitapepo*	Seed
Kosso	*Hagenica Abssinia*	Flowers
Metere	*Glinus lotoides*	Seed
Wogert	*Silen macrosclen*	Root

Source: Semie *et al*., 2015; Alemneh and Adem, 2017.

Table 4: Conventionally used Taenicidal drugs studied in Ethiopia

Drug studied	**References**
Niclosamide	Vermund *et al.*, 1986
Levels of metals in flowers, seeds and fruits	Amde *et al*., 2013
Praziquantel	Tesfa-Yohannes,1990

2.13. Previous Study Conducted on *C. bovis* at Addis Ababa Abattoir Enterprise

Few researches have been done on the frequency of *C. bovis* at Addis Ababa abattoir Enterprise although it is fragmented and not continuous. **Table 5** shows some of the studies conducted at this abattoir since 2004.

Table 5: Previous study conducted on *C.bovis* at Addis Ababa abattoir enterprise

Study area	**Species**	**kind of research**	**No of samples**	**Prevalence**	**Reference**
AAAE	Bovine	Abattoir survey	500	2.8	Mohamed *et al*., 2021
AAAE	Bovine	Abattoir survey	410	26.83	Tesfaye, 2018
AAAE	Bovine	Abattoir survey	535	3.6	Ibrahim and zerihun, 2012
AAAE	Bovine	Abattoir survey	11227	7.5	Kebede *et al*., 2009
AAAE	Bovine	Serological test	522	28.5	Nigatu, 2004

AAAE=Addis Ababa Abattoir Enterprise

3. MATERIAL AND METHODS

3.1. Description of Study Area

Abattoir survey was conducted at Addis Ababa abattoir Enterprise which is found in Kirkos sub-city while questionnaire survey was carried out at Lemi-kura sub-city of Addis Ababa. Addis Ababa is located at 2500 meters above sea level; it is situated in Ethiopia's central highlands. The city experiences 21^0 C and 1800 mm of precipitation on average temperature and rainfall respectively per year. During the wet season, the proportionate humidity is between 70 and 80%; it fluctuates between 40 and 50% in the dry time of year.

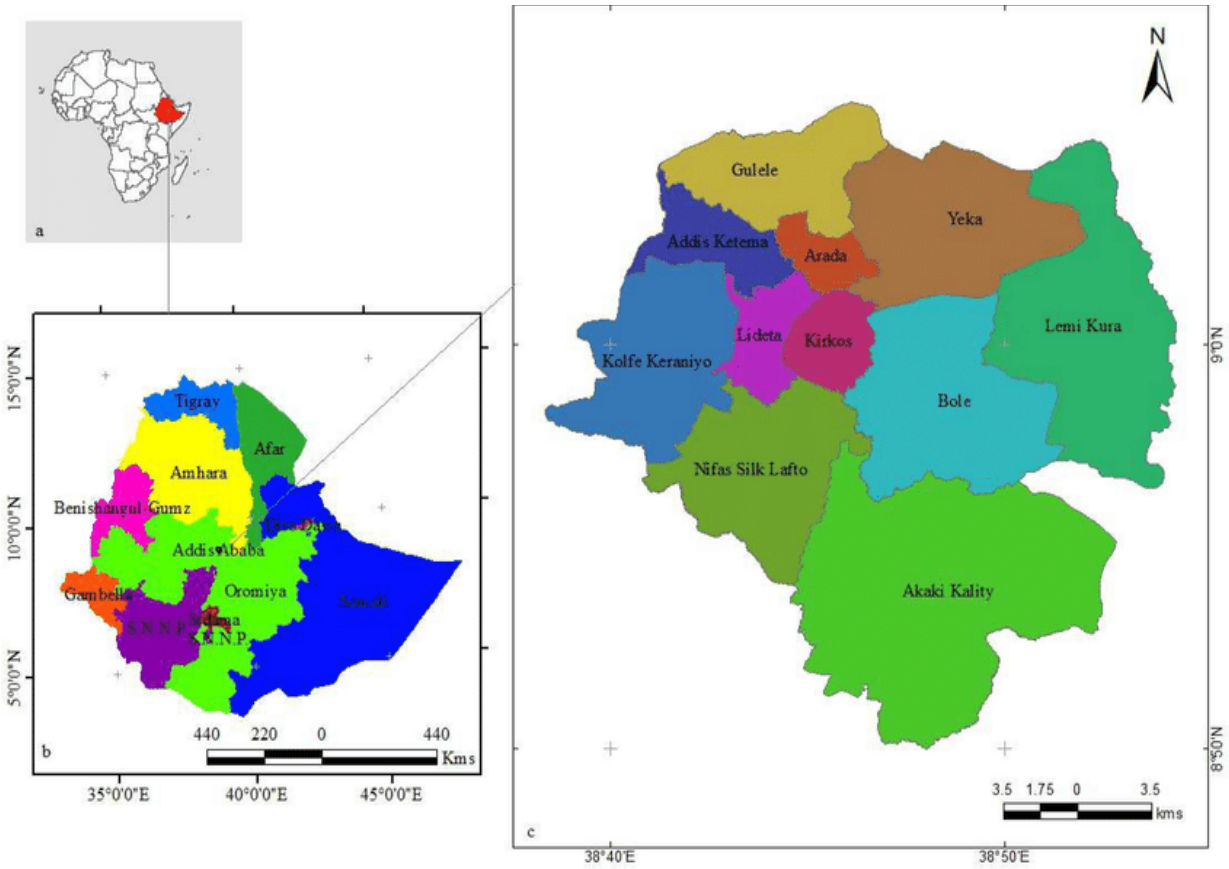

Figure 3: Addis Ababa's map showing the sub-cities. Source: Ethio GIS (2022**)**

Addis Ababa abattoir Enterprise

Separate areas of the abattoir are used for the slaughter of animals for Muslims and Christians. According to data gathered from the abattoir, it can slaughter 200,000 cattle, 56,700 sheep, 46,700 goats, and 200 pigs annually on average. The majority of the cattle that are butchered in the abattoir originate from the countries several agro-ecological zones and geographical areas. The Agricultural office of the Addis Ababa city administration employed 15 DVM, 2 BSc, and 13 Diploma holders as meat inspectors for Addis Abattoir Enterprise which is found at Kirkos sub-city of Addis Ababa, and they are responsible for providing the normal meat inspection service (source:Addis Ababa abattoir enterprise office).

The Addis Ababa abattoir's primary goals include breaking down the transmission of zoonotic meat-borne diseases through meat inspection, processing one or more classes of livestock into fresh meat for human consumption, and storing and processing meat and edible by-products in a hygienic manner. Environmental conditions are closely monitored throughout the entire processing process (source:Addis Ababa abattoir enterprise office).

3.2. Study Population

For retrospective study, the study populations were all slaughtered cattle in the abattoir since august, 2013 up to august, 2023.For active abattoir survey the study populations were all cattle of both sexes brought to the Addis Ababa abattoir Enterprise for slaughter from October, 2023 to February, 2024. Local zebu (*Bos indicus*) and crossbreeds, which originated from various parts of Ethiopia, were employed in this study. Additionally, all people living in the Lemi-kura sub-city of Addis Ababa including Butchers and abattoir workers, Food related merchants; Non-food related merchants and students were the target population.

3.3. Design of the Study and Estimation of the Sample Size

Cross-sectional and retrospective studies from October 2023 to February 2024 were included in the study design. Cattle from a range of ages and genders that are permitted for slaughter at the Addis Ababa abattoir Enterprise were included in the study. An abattoir-based survey was conducted from October 2023 to February 2024. Using systematic sampling, animals were selected for inspection and picked at 10-cattle intervals over the course of the three-day abattoir survey within a week. The estimated prevalence of bovine cysticercosis at Addis Ababa abattoir Enterprise, which is 26.83% by (Tesfaye, 2018) at 95% confidence interval and required absolute precision of 5%, was used to calculate the total number of animals included in the study, as per the method provided by Thrusfield, (2018).

$n = 1.96^2 \text{ X P exp } (1 - \text{P exp}) / d^2$

Where n is the necessary sample size, d is the desired absolute precision, and P exp is the predicted prevalence (26.83%). Therefore, 301 cattle was the required sample size according to the above formula; but, in order to maximize precision, we made two fold and so totally 602 cattle were examined. Throughout the study time, every animal was examined both before and after it was butchered, and data was kept.

3.4. Techniques and Protocols for Gathering Data

3.4.1. Retrospective study

Based on a study of daily *Cysticercus bovis* record findings of abattoir examination report of slaughtered animal, a retrospective survey of abattoir data was conducted. The pertinent 10 years' worth of data was taken from the Addis Ababa abattoir Enterprise record book between august 2013 and august 2023.

3.4.2. Active abattoir survey

The survey on abattoir was carried out three days a week for five months and at least ten carcasses were examined per day. The study animals were subjected thorough ante mortem and postmortem examination. A unique number was written on each study animal. The animals' ages, sexes, and body condition scores were noted. The study animals were rated for body condition using the following criteria: poor (hide bound with obvious bony prominences and deep sunk tail base), medium (ribs and other bony prominences noticeable on visual inspection but have fair fleshy background on palpation), or good (bony structures observable only on palpation). This classification was based on Neary and Yager's (2002) methodology. According to DeLahunta and Habel (1986), the teeth of the study animals were used to assess their age. Animals were then be divided into juvenile (<5 years) and adult (≥5 years) groups. The heart, liver, lung, tongue, triceps muscle, masseter muscle, and diaphragm were all visually examined, palpated, and incisions were made in order to look for *Taenia saginata* cysts during post-mortem examination.

The recovered cysticerci were separated with the surrounding tissue, and they were transported to the parasitology laboratory of Addis Ababa University College of Veterinary Medicine and Agriculture for a viability test. There, they were incubated for one to two hours at 37 degrees Celsius in a 40% ox bile solution. The scolex was examined under a stereomicroscope for a viability test. During the incubation period, if the scolex ejaculates, the cysticerci were considered viable (Blate *et al*., 2023) On the other hand, solid or empty cysts were regarded as non-viable or degenerating (Anwar *et al*.,2024). In parallel, it was determined whether or not the scolex was a *Taenia saginata* metacestode by looking at the size of the cysticercus and the absence of a hook on the rostellem of the envaginated cyst (WHO, 1983 and Gracey *et al*., 1999).

3.4.3. Questionnaire study

The questionnaire study was carried out in one of Addis Ababa sub-city (Lemi-kura sub-city).The formula provided by Arsham (2002) was used to determine sample size for questionnaire surveys; n is the sample size, while SE stands for standard error. $n = 0.25/SE^2$, SE is equal to 5%. Consequently, a sample size of 100 was needed for the questionnaire survey. However, 110 respondents were needed overall for the questionnaire survey after accounting for 10% of non-respondents. Based on their desire to engage in the questionnaire survey, respondents were chosen at random. A survey using a questionnaire was used to evaluate the food safety significance of bovine cysticercosis. To diagnose *Taenia saginata* taeniasis, the participant's self-reported experiences were used. In order to gather information for this study, survey respondents were asked questions regarding their consumption of raw meat, frequency of consumption, experience with *Taenia saginata* taeniasis infection, and discovery of proglottids in their pants, faeces. They were also asked about their education level, age, sex, marital status, knowledge of *Taenia saginata,* and accessibility to toilets.

3.4.4. Inventory and questionnaire survey at pharmacy shops

The economic losses resulting from *Taenia saginata* taeniasis treatments in human cases were also estimated using a one-year retrospective drug shop inventory. The number and price of pharmaceuticals sold annually to cure taeniasis in people was checked in the inventories at 23 randomly chosen pharmacy stores from one sub-city in Addis Ababa city. Buyers' age, gender, and residential status (rural or urban) as well as whether or not they have a doctor's prescription was noted. Additionally, the most popular medication sold that year was listed.

Study population for drug inventory

The Lemi-kura sub-city of Addis Ababa is home to 212 commercial pharmacies, 2 government-run pharmacies in Kenema, and 9 health centers, all of which have their own

pharmacies. These individuals made up the study population for the drug inventory (source : Lemi-kura sub-city health office).

3.5. Data Organization and Interpretation

Microsoft Excel was utilized to store the information that was gathered from the active abattoir and the questionnaire survey. STATA version 14.0 was used for the statistical analysis. The number of positive samples divided by the total number of samples was used to compute the prevalence. The correlation between the prevalence of *Taenia saginata* with its risk factors in addition the prevalence of *Cysticercus bovis* with its host-related risk factors was evaluated using binary logistic regression and the Pearson Chi-square ($\chi 2$) test respectively. In all cases the difference between different groups was tested for significance at probability level of 0.05 or less.

3.6. Ethical Clearance and Participation Consent

The Addis Ababa University ethical committees examined and authorized this study (Reference number VM/ERC/02/08/16/2024).All procedures were conducted according to animal research ethics (**Annex III**).The Enterprise administrator of the Addis Ababa abattoir granted permission to perform this study. Before distributing questionnaires, all chosen participants were informed about the study and given the opportunity to provide written consent. Additionally, participants were made aware of their complete freedom to stop taking part in the study or not to. They were also told that any information collected about them would be kept private. Every participant was apprised of the study's aim, which was to gather comprehensive and truthful data from them that would aid policymakers and other relevant organizations in the prevention and management of the illness.

4. RESULTS

4. 1. Retrospective Study of *C. bovis* on Cattle slaughtered at Addis Ababa Slaughter House Enterprise

Over the last ten years as a whole, 2089266 cattle were slaughtered. The largest numbers of cattle slaughtered were in the year 2017/18 (259,632). During these time, carcasses with more than one (1) *C. bovis* at a single incision site were held in deep freeze for ten days before being made available for human consumption; however, carcasses with more than four (4) *C. bovis* at a single incision site were completely condemned. The total number of carcasses detained due to *C.bovis* during these years were 313 in which the largest number was in 2013/14 (125) and the smallest was 2022/23(0). The 10-year retrospective analysis also shows that the majority of the livestock that were slaughtered were male.

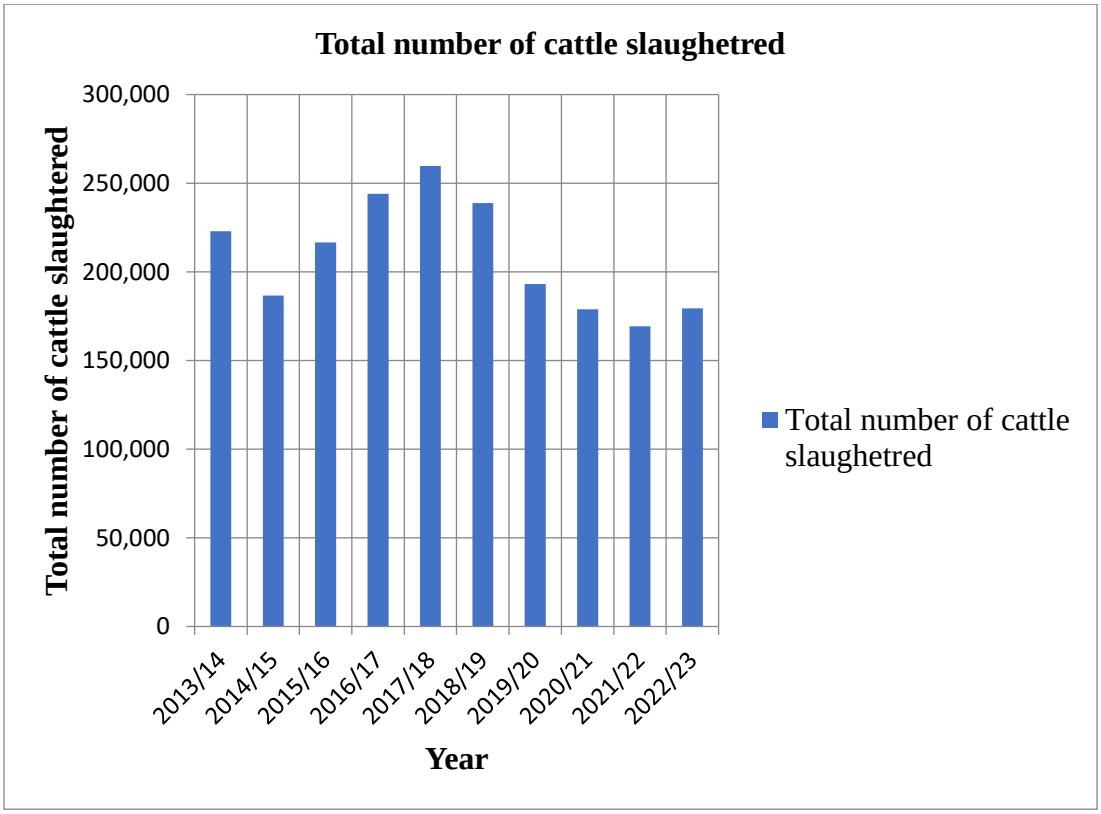

Figure 4: **Total number of cattle slaughtered at Addis Ababa abttoir throughout the last ten years**

According to **Figure 5**, the total numbers of cattle slaughtered were highest in 2017–18 (259,632) and lowest in 2021–2022 (169,349).

Table 6: Retrospective study of *C.bovis* on cattle slaughtered at Addis Ababa abattoir Enterprise for the last ten years

Year	**Sex**		**Age**		**Total No. of cattle slaughtered**	**No. of Carcasses detained due to *C.bovis***
	Male	Female	<5	≥5		
2013/14	123	2	3	122	222,937	125
2014/15	70	1	1	70	186,669	71
2015/16	47	0	1	46	216,509	47
2016/17	26	0	0	26	243,971	26
2017/18	15	0	0	15	259,632	15
2018/19	16	0	0	16	238,807	16
2019/20	6	0	0	6	193,131	6
2020/21	4	0	0	4	178,874	4
2021/22	3	0	0	3	169,349	3
2022/23	0	0	0	0	179,387	0

According to **Table 6**, there were no carcasses detained in 2022–2023 compared to 125 in 2013–2014 as a result of *C. bovis*. The 10-year retrospective analysis also shows that the majority of the livestock that were slaughtered were ≥ five years.

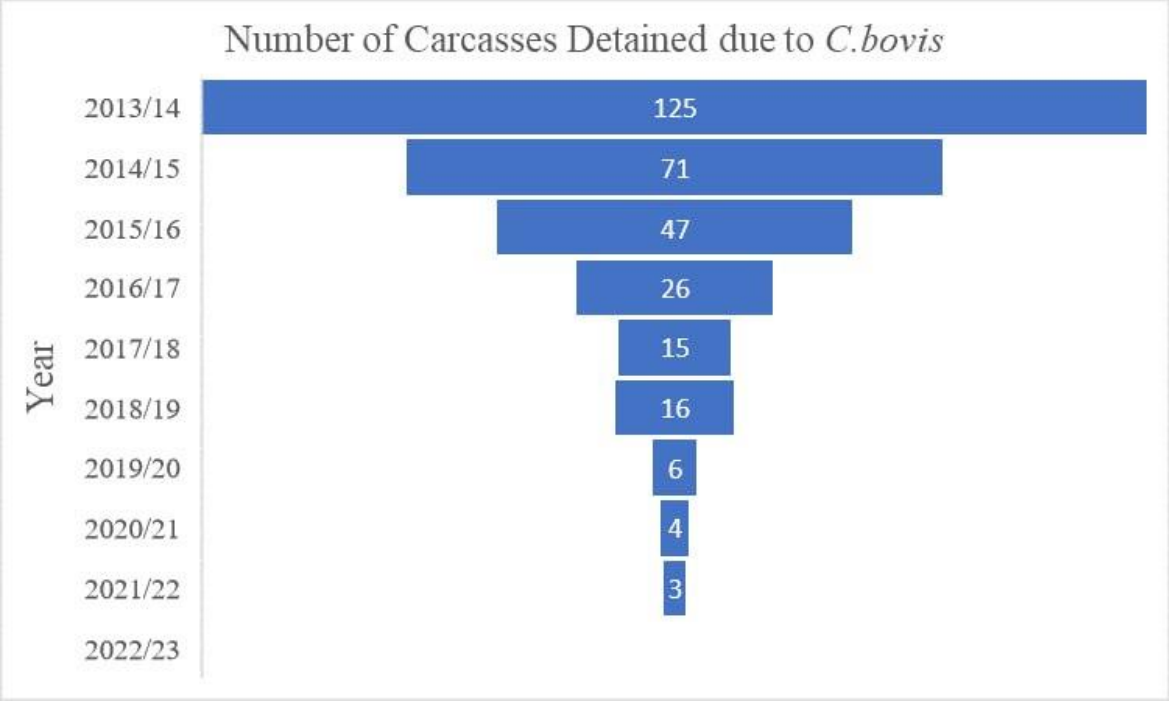

Figure 5: Number of carcasses detained due to *C.bovis* at Addis Ababa abattoir Enterprise during the last ten years

Figure 6's funnel chart illustrates steps in a procedure that shows a steadily declining number of carcasses detained due to *C.bovis* during the course of the 10-year retrospective survey (from 2013/14 to 2022/23).

4.2. Risk factors associated with prevalace *of C.bovis*

At the Addis Ababa abattoir Enterprise, 602 animals had ante-mortem and post-mortem examination during the research period. In order to do the ante-mortem examination, the animal's overall state was assessed visually, and its breed, age, sex, and physical condition were noted. **Table 7** demonstrates the overall prevalence of bovine cysticercosis, which were 5 (0.83%). No significant correlation was found between occurrence of *C.bovis* and animal body score condition and sex, age, or breed. Regardless of the quantity of animals analyzed, the prevalence of *C. bovis* was 0.43% in juvenile and 1.09% in mature animals.

Table 7: Prevance of *C. bovis* with respective to risk factors

Risk factors	Groups	Infected (%)	Negative (%)	χ2	P-value
Sex	Male	5(0.85)	586(99.15)	0.094	0.759
	Female	0(0)	11(100)		
Age in years	Young (<5years)	1(0.43)	234(99.57)	0.768	0.382
	Adult(≥5 years)	4(1.09)	363(98.91)		
Body score condition	Good	1(0.68)	147(99.32)	0.455	0.557
	Medium	3(0.77)	386(99.23)		
	Poor	1(1.54)	64(98.46)		
Breed	Local	5(0.87)	572(99.13)	0.219	0.640
	Cross	0(0)	25(100)		
	Total	5(0.83%)	597(99.17%)		

4.3. Prevalence and Organ Distribution of cysticerci

Of the 602 cattle that were inspected, 5 (0.83%) tested positive for *C. bovis*. A total of 6 cysts were detected. The most contaminated organs were triceps muscle with 3 cases (75%), masseter muscle with 1 case (25%) ,tongue with 1 case (25%),liver with 1 case (25%), respectively. There was no cyst observed in the heart or lung.

The location and characteristics of cysts in the body

At least one cyst was present in the masseter, triceps muscle, liver, and tongue. Three (50%) of the six cysts that were investigated were found to be viable, two (33%) to be non-viable, and one (17%) to be calcified. The cysts that were found in the triceps muscle has the highest relative viability (33%).

4.4. Questionnaire Survey Results

Of the total 110 interviewed respondents from Lemi Kura sub-city of Addis Ababa who participated in this study, 42.73% (47/110) had experienced at least one instance of *Taenia saginata* infection over their lifetime, of which, 74%, 19%, and 4% of respondents, respectively, admitted to using contemporary drugs, traditional drugs, and both types of drugs. Two percent (2%) of infected respondents did not use any of the two types of drugs. By looking for the white segments, or proglottids, discharged at least once in the previous years in their faeces, pants or body, the affirmative respondents verified that they had been exposed to *Taenia saginata* taeniasis. Out of the 110 respondents in this study, 36 admitted to eating raw or partially cooked meat, and only 6 of the female respondents indicated they had *Taenia saginata* taeniasis.

During the interview, the relationship between the prevalence and the respondent's occupation was assessed. As a result, it was discovered that reported cases were more common among butchers and abattoir employees than among individuals in other occupational categories. The majority of respondents reported consuming well-cooked meat, which has a detrimental impact on *Taenia saginata* prevalence. The results of the study indicated that 71% of the participants bought beef from butcher shops that offer legally inspected cattle for human use.

There was a statistically significant correlation between the prevalence of *Taenia saginata* taeniasis and with the sex being higher in male individuals (53.95%) than females (17.65%) (P-value=0.001; $\chi 2$=12.6493), with occupation being higher in workers at butchers and slaughterhouses (66.67%) compared to others occupations (p-value=0.049; $\chi 2$=11.106), with those who herd about taeenisis (52.87%) than those who did not hear about taeniasis (4.35%) aware of cooking meat prevent the disease (50.68%) than other methods (p-value=0.014; $\chi 2$=8.572) ,with finding of proglottids that most of infected respondents observed proglottids in their faeces (39/47) (p=value=0.001; $\chi 2$=110.000), with drug usage in which most infected respondents used pharmaceutical drug (35/47) than herbal medicine and both (p-value=0.001;$\chi 2$=105.977) and with

pharmaceutical drug used ,the most pharmaceutical drug used by infected individuals was praziquantel (6/47) than other pharmaceutical drugs (p-value=0.001 ;$\chi 2$=68.809) in addition most them did not know the type drug they used (22/47), However, there was no statistically significant difference seen among the respondents with respect to age, educational attainment, religion, marital status, meat consumption habit, meat source, or latrine use . (p-value=0.001; $\chi 2$=17.504), with source of information that most of respondents had gotten higher information from health center (69.23%) than other sources (p-value=0.001; $\chi 2$=22.096),with knowledge of transmission in which most respondents knew raw meat transmit *Taenia saginata* (52.7%) than others (p-value=0.002; $\chi 2$=9.195), with Knowledge about prevention in which most of them

Table 8: Factors associated with *Taenia saginata* among respondents: a binary logistic regression analysis

Risk factors	Respondents	Interviewed People	No. of Infected	Exposure risk to taeniasis (%)	$\chi 2$	p-value	OR (95% CI)
Sex	Male	76	41	53.95	12.649	0.001	0.18(0.068-0.492)
	Female	34	6	17.65			
Age (in years)	<18	6	2	33.33	5.567	0.234	0.78(0.113-5.343)
	18-30	49	16	32.65			
	31-40	26	12	46.15			
	41-60	23	13	56.52			
	>60	6	4	66.67			
Education status	Informal Education	1	1	100	3.438	0.487	1.26(0.320-4.939)
	Primary Education	31	13	41.94			
	Secondary Education	40	20	500			
	College Education	22	8	36.36			
	Other	16	5	31.25			
Occupation	Farmer	4	1	25	11.106	0.049	6.00(0.354-101.567)
	Food related Merchant	24	10	41.67			
	NFR Merchant	27	6	22.22			
	Butchers and Abattoir Workers	6	4	66.67			
	Civil servant	47	26	55.32			
	Student	2	0				
Religion	Christian	89	38	42.70	0.001	0.989	1.01(0.385-2.631)
	Muslim	21	9	42.86			
Marital status	Single	55	24	43.64	0.037	0.847	0.93(0.436-1.977)
	Married	55	23	41.82			
	Total	110	47	42.73			

Note: OD: Odd Ratio, CI: Confidence Interval, $\chi 2$: Ch-square, NFR: Non Food Relate

Table 9: Knowledge about the relationship between researched factors and the risk of contracting *Taenia saginata* in the community

Risk factors	Respondents	Interviewed People	No. of Infected	Presence of awareness on taeniasis (%)	χ2	p-value	OR(95%CI)
Habit of meat consumption	Raw meat	23	14	60.87	7.071	0.070	0.37(0.141-0.976)
	Partially cooked	13	7	53.85			
	Well-cooked	71	26	36.62			
	I do not like	3					
Meat source	Local butcher	78	33	42.31	2.319	0.509	1.53(0.535-4.397)
	Abattoir	17	9	52.94			
	Own slaughter	13	5	38.46			
	I do not like	2					
Herd of taeniasis	Yes	87	46	52.87	17.504	0.001	0.04(0.005-0.313)
	No	23	1	4.35			
Source of information	Social media	5	1	20	22.096	0.001	9(0.748-108.310)
	Health center	13	9	69.23			
	Veterinarian	1	1	100			
	Social interaction	68	36	52.94			
	I do not know	23					
Knowledge about transmission	Contact	74	39	52.70	9.195	0.002	0.26(0.103-0,636)
	Raw meat	36	8	22.22			

Knowledge about prevention	Hygiene keeping	10	5	50	8.572	0.014	1.03(0.274-3.854)
	Cooking meat	73	37	50.68			
	Meat from abattoir	27	5	18.52			
Latrine	Have	106	46	43.40	0.533	0.465	2.3(0.232-22.838)
	Do not have	4	1	25			
Finding proglottid in their	Faeces	39	39	100	110.000	0.001	2.56(0.115-0.316)
	Underwear	6	6	100			
	Both	2	2	100			
	I have not seen	63	0	0			
Drug used	Pharmaceutical drug	35	35	100	105.977	0.001	0,02(0.002-0.114)
	Herbal medicine	9	9	100			
	Both	2	2	100			
	I did not used	64	1	1.56			
If pharmaceutical drug used what type it is?	Praziquantel	6	6	100	68.809	0.001	0.19(0.103-0.353)
	Niclosamide	2	2	100			
	Albendazole	5	5	100			
	I did not know	22	22	100			
	I did not used	75	12	16			
Total		110	47	42.73			

Note: $\chi 2$: Chi-square, CI: Confidence Interval, and OD: Odd Ratio

4.5. Pharmaceutical Inventories

A survey of medical supply stores was carried out in the Lemi-kura sub-city of Addis Ababa. Estimates of the annual dosages of taenicidal drugs for adults and their associated costs were gathered by means of in-person interviews with pharmacy managers and the examination of their 2022–2023 records. This showed that 2,310,965 ETB or 89,428 adult taenicidal medication doses were marketed for the purpose of treating human *Taenia saginata* taeniasis in the town. Albendazole (53.7%) was taken at a higher dose, followed by praziquantel (25.2%) and mebendazole (vermox) (21.1%) (**Table, 10)**. The medicine inventory made *T. saginata*'s economic importance in the research region very evident.

Table 10: Taenicidal drugs frequently supplied at Lemi-Kura sub-city and their annual cost

Name of modern drug used	**Total number of doses supplied (during 2022-2023***	**Total worth in ETB****
Praziquantel	22,530	675,900
Albendazole (tab)	38,120	648,040
Mebendazole (tab)	18,443	461,075
Albendazole (Syrup)	9,875	493,750
Mebendazole (Syrup)	460	32200
Total	89,428	2,310,965

* Dose is the quantity of medication needed to treat one instance of adult human taeniasis.

**During the study period, 1 ETB was equivalent to 0.018 USD.

5. DISCUSSION

The most common environments for *Taenia saginta* taeniasis/ bovine cysticercosis are those with inadequate meat inspection and control, subpar cattle husbandry practices, and poor sanitation. Although bovine cysticercosis often does not result in significant illness or mortality rates among cattle, it can pose severe economic difficulties in endemic areas because of the stigma attached to meat and the devaluation of carcasses, which can limit food security and safety (Mussa, 2023). Predilection sites in cattle appear to be mostly determined by a number of risk variables, including muscle activity, age, breed, geographic location, and parasite strain (Wabi and Girmay, 2019). The incidence rate varied from 0.01 to 10% in Europe and the Americas, 0.01% to 7% in Africa, and 0.02% to 36% in Asia (Cabaret *et al*., 2002). According to more current studies, tapeworm morphology and molecular techniques support the significant *Taenia saginata* prevalence in Asian nations (Wandra *et al*., 2006); (Van De *et al*., 2014). However, according to Maxwell *et al*. (2006), the infection rate in underdeveloped nations is frequently about 30%.

As per the findings of the present investigation, a 10-year historical analysis revealed that the number of carcasses detained at the Addis Ababa abattoir Enterprise because of *C. bovis* dropped from 125 in 2013–14 to 0 in 2022–23.Cattle are dewormed, housed indoors (in a feedlot or without grazing), more veterinarians and human health extension workers, and enhanced latrine use awareness could all be contributing factors to this. This finding conflicts with that of Padilha *et al*. (2018) in Brazil, which reported a considerable rise in infection rates over time.

The prevalance rate of *C. bovis* in the current study at Addis Ababa abattoir Enterprise were found to be 0.83%, meaning that relatively in line with 2.59% previously reported by Semu, *et al*. (2012) in Walaita soddo, 2.5 %(Talu, 2012) in Jimma , 2.58% Birhanu *et al*. (2013) in Bahar Dar , 2.5% (Worku, 2014) in West Shoa ,2.6% (Teklemariam and Debash, 2015) in Batu, 2%(Adem and Alemneh , 2016) at Gondar ELFORA, 2.08% (Bijiga and Temesgen, 2019) in Nekemte, 2.68% (Emiru and Hiluf, 2019) in Nekemte

,2.8% Mohamed *et al*. (2021) at Addis Ababa abattoir Enterprise ,2.5% Work *et al*. (2021) in West Shoa zone, 2.68% Shuramo *et al*. (2022) in Nekemte , 1.2% Dima (2023) in Assela, 0.11% Zdolec *et al*. (2012) in Croatian abattoir ,1.6% Sungirai *et al*. (2014) in Zimbabwe ,0.21% Cueto González *et al*. (2015) in Northwest Mexico, 1.71% Mirzaei *et al*. (2016) in North west Iran, 0.70% Qekwana *et al*. (2016) in South Africa, and 2.67% Anyango *et al*. (2023) in Kenya.

The positivity rate of 0.83% is, nevertheless, less than that of other developing nations. This could be because the prevalence of *C. bovis* differs between nations and also depends on the level of experience meat inspectors have. Additionally, there is an actual limit to how many as well as how deep incisions can be made during a routine inspection of beef carcasses because too much mutilation makes the carcass less marketable, which implies that a lot of infestations go undetected. Bovine cysticercosis prevalence percentage is also influenced by flooding pastures, using untreated sewage effluent for pasture irrigation, letting cattle freely access surface water, being near waste water effluent, keeping animals indoors (in feedlot or zero grazing), farm sanitation, deworming cattle, proper inspection and control of meat, educating farmers about the disease, and cultural shifts regarding the consumption of raw meat.

On the other hand, several wealthy nations have reported a lower prevalence than the current study, including 0.011% (McBrien and Courcier, 2013) in Northern Ireland. This may be related to the stricter enforcement of meat inspection regulations, control measures, farm employee cleanliness standards, and public health extension policies in those industrialized nations as opposed to Ethiopia. It is well recognized that industrialized nations have superior sanitation systems than developing ones, where a lack of environmental cleanliness raises the prevalence of diseases. The triceps muscle had more cysts than any other organ examined throughout the investigation, indicating that *C. bovis* was distributed throughout the afflicted animal's organs and tissues.

In general, factors that affect the prevalence of bovine cysticercosis might vary, including the method used for meat inspection, the meat inspector's ability to recognize cysts,

variations in animal care, sample size and sampling technique, and the number of incisions.

When conducting both individual and bulk investigations to detect *Taenia saginata* in carrier persons, the quality of the questionnaire is a crucial instrument (Fralova, 1985).

According to microscopy, the prevalence of *Taenia saginata* ranged from 0.2–8.1 percent, and according to copro Ag-ELISA, it ranged from 0.12–19.7 percent. A significant amount of anthelmintic treatments were reportedly sold in towns in Ethiopia, where a high percentage of tapeworm self-reporting (45.0–64.2%) was seen (Dermauw *et al*., 2018).Nearly half (42.73%) of the questionnaire survey respondents in this study stated that they had at least one tapeworm infection in their lifetime. Proglottids were found in their excrement and/or under clothing, which served as a sign of this. In the research regions, as in many other parts of Ethiopia, pork is not consumed due to religious and cultural reasons. As a result, *Taenia saginata* proglottids were most likely the ones seen. The WHO (1983) guidelines, which indicated that *Taenia saginata* is distinguished from *T. solium* by its more frequent evacuation through anus, are also the basis for this.

The total human population of Addis Ababa city (Lemi-kura sub-city) harboring *T. saginata* was 42.73% which is close to the findings of (Belachew and Ibrahim , 2012) which was 44% in Hawassa ,44.5% Tolosa *et al*. (2015) in Adama town , 48% Abera *et al. (* 2022) in Eastern Ethiopia and 44.3% (Dima, 2023) in and around Asella town but lower than the findings of (Talu, 2012) who reported 66.6% in Jimma town,62.5% Semu *et al*. (2012) in Walaita Soddo,62.5% (Gebremichael and Mohammad, 2013) in Shire Indesilassie, Northern Ethiopia , 63.6% (Worku, 2014) in West Shoa Zone,60.7% Terefe *et al*. (2014) in Harari People's National Regional State,64% Lielt *et al*. (2015) in Bishoftu town,59% (Teklemariam and Debash, 2015) in Batu, 68.6% (Geinoro and Bedore, 2019) in Bishoftu,57.79% Fikadu *et al*, (2021) in Dilla town,62.86% (Hailu, 2021) in Holeta town,63.6% Work *et al*. (2021) West Shoa zone, 82.8% (Tsegaye, 2023) in Selected Districts of Northwest Ethiopia and 64.5% (Muss, 2023) in Silte Zone.

Conversely, the present-day occurrence of *Taenia saginata* was higher than the results of earlier authors reported in various regions of Ethiopia, including (Akalu and Amuamuta, 2015) 26% in Farta Woreda, (Bekele *et al*., 2016) 19% within and surrounding the town of Halaba Kulito, (Tamirat *et al*., 2018) 30.4% in Bahar Dar town, (Tegegne *et al*., 2018) 31.8% in Kombolcha town ,(Emiru and Hiluf, 2019) 13.5% in Nekemte, (Netsanet *et al*. 2020) 22.5% in and around Dessie ,and (Abdella and Ame, 2022) 20% in East Hararge Zone. This disparity could be related to the degree of *Taenia saginata* taeniasis awareness in the population, the variations in the incidence of cysticercosis in bovines, the state of consumption of undercooked meat and the methods employed for meat examination.

Additionally, a significant correlation was found between the respondents' sexes and the prevalence of *Taenia saginata* taeniasis (p-value=0.001; $\chi 2$=12.6493). Male respondents (53.95%) reported being more influenced than female respondents (17.65%) (**Table 8**).This result is comparable to (Gebremichael and Mohammed, 2013) in Shire Indasilassie, (Akalu and Amuamuta, 2015) in Farta wereda, Leilt *et al*. (2015) in Bishoftu and Nestanet *et al*. (2020) in Dessie town but disagrees with the reports of Kifle and Shiret (2015) in Debrebrhan, Bekele *et al*. (2016) within and surrounding the town of Halaba Kulito and Tegegne *et al*. (2018) in Kombelcha. The higher incidence of *Taenia saginata* taeniasis in men may be attributed to cultural and economic factors, such as the fact that men consume their meals at restaurants and butcher shops rather than at home. Men also tend to eat more raw beef and drink beer with local beverages like "Tella" and "Tejj" than women do in the area. Similarly, compared to people who consume raw meat less frequently, the study revealed a higher prevalence of *Taenia saginata* taeniasis in those who frequently consume raw meat. This finding is consistent with that of (Abdella and Ame, 2022) and (Tsegaye, 2023) who found that consumers of raw meat had a greater prevalence of *Taenia saginata* taeniasis.

The research findings indicated that there was a marginal statistical significance between the respondents' work and their *Taenia saginata* taeniasis score (p-value= 0.049; $\chi 2$=11.106). This outcome is consistent with the findings of Kifle and Shiret. (2015) in

Debrebrhan ,Lielt *et al*. (2015) in Bishoftu, Teklemariam and Debash , 2015) in and Around Batu , and Nestanet *et al*. (2020) in Dessie but, disagrees with the report of Bekele *et al*. (2016) within and surrounding the town of Halaba Kulito and Tegegne *et al*. (2018) in Kombolcha town. The occurrence of *Taenia saginata* taeniasis was higher in butchers as well as abattoir workers (66.67%) followed by Civil servant (55.32%), food related merchant (41.67%), farmers (25%) and NFR merchant (22.22%) (**Table 8**) . This is because individuals in high-exposure groups are more likely to come into touch with meat and byproducts of meat. This could make it more likely that they will get a *Taenia saginata* infection.

No significant relationship was discovered between proportion of *Taenia saginata* taeniasis with age in line with (Belachew and Ibrahim, 2012), Tolossa *et al*. (2015) , Work *et al*. (2021) in three particularly chosen districts of the Oromia Region's West Shoa zone and (Abdella and Ame, 2022) in East Hararghe Zone of Oromia Regional State, educational level similar to ((Teklemariam and Debash , 2015), Nestanet *et al*. (2020) and (Abdella and Ame, 2022) but disagrees with (Belachew and Ibrahim, 2012) study reported in Hawassa town and Tadesse *et al*. (2013) in south west Shoa zone of Oromia region , religion close to the finding of (Belachew and Ibrahim, 2012), Semu *et al*. (2012) ,(Teklemariam and Debash , 2015), Tolossa *et al*. (2015) and (Dima, 2023). The comparable tradition as well as custom of consuming undercooked meat with in the research region could be the cause of the religious groups' similarities. but disagrees with Tadesse *et al*. (2013), (Mahamad, 2021) and (Abdella and Ame, 2022) who stated that Muslims were less likely than Christians to have *Taenia sagina* taeniosis, marital status ($p>0.05$) in line with (Worku, 2014), (Tesfaye, 2016),(Nestanet et *al*.(2020), (Hailu, 2021),(Mahamed, 2021) and (Mussa, 2023), latrine availability comparable with Tegegne *et al*. (2018),Nestanet *et al*. (2020) , Fikadu e*t al. (*2021) and (Abdella and Ame, 2022). Sixty-six percent of the respondents knew how to prevent the illness. They responded that eating raw or undercooked beef was the primary way for humans to become infected, and that correctly cooking meat was one way to prevent infections.

Despite knowing better, people continued to eat raw beef because of ingrained cultural habits and the belief that the illness was curable with medication taken after consuming the meat. Modern medications from pharmacies and health stations were used by the majority of them. Additionally, some of them made use of indigenous herbs including "*alenquata*," "*kosso*," and "*enkoko*." Even though the drugs' effectiveness and affordability were factors in their decision, the primary factor driving their preference for the medication of their choice was its accessibility.

The prevalence of *Taenia .saginata* varies between nations and even within a single nation between regions based on a variety of factors, including variations in the custom of consuming undercooked meat, patient knowledge of the disease's medical manifestations, variations in environmental and personal hygiene, and other variables associated with the variation in *Taenia saginata* taeniasis prevalence among nations. While infections with the cysticercus cestode parasite, in their larval stage, injure cattle and result in financial losses for the meat industry, *Taenia saginata* is generally a health-related as well as commercially significant cestode parasite.

Taenia saginata taeniasis in people is significant from a socioeconomic and health perspective. Evaluating the economic elements, however, is particularly challenging in impoverished nations like Ethiopia, where individuals with the parasite self-medicate with traditional herbal remedies. Pharmacies' inventory is one potential source of information for estimating the financial loss, but they could not accurately represent the true economic effect of the illness. Nevertheless, an inventory of 23 pharmacies in the Lemi-kura sub-city of Addis Ababa for the year 2022/23 showed that 89,428 adult doses of taeniacidal medication, with an estimated cost of 2,310,965 ETB which is equivalent to 41,597.37 USD, were identified. This estimated price of medications used to treat *Taenia saginata* taeniasis conflicts with the research carried out and reported by (Belachew and Ibrahim, 2012); (Teklemariam and Debash, 2015); Tolossa *et al*. (2015); Bekele *et al*. (2016); Tegegne *et al*. (2018) as well as (Tsegaye, 2023) in Ethiopia. This suggests that *Taenia saginata* taeniasis may reduce household finances, something that can be readily prevented through consuming properly cooked meat and using latrines.

The reasons for the discrepancies could be related to the number of populations living throughout the two regions, the frequency of *Taenia saginata* infections varying across the nation, the degree of raw meat consumption, the price differences between individual medications sold in pharmacies and the degree of use of traditional herbal remedies. Three taenicidal medications were most frequently utilized in the area: praziquantel, albendazole and mebendazole (vermox).

5. CONCLUSION AND RECOMMENDATIONS

The recent investigation evaluated retrospective data and the prevalance of *C. bovis* in cattle slaughterd at Addis Ababa abattoir Enterprise. A 10-year historical analysis revealed that the number of carcasses detained at the Addis Ababa abattoir Enterprise because of *C. bovis* dropped from 125 in 2013/14 to 0 in 2022/23.Although the present finding of *C.bovis* in cattle less than that of other developing nations, the prevalence of *Taenia saginata* among humans was high. Cattle are dewormed, housed indoors (in a feedlot or without grazing), more veterinarians and human health extension workers, and enhanced latrine use awareness could all be contributing factors for decreasing carcasses detained due to *C.bovis*. Eating raw or undercooked beef was highly correlated with a high prevalence of *Taenia saginata* taeniosis.

Based on the aforementioned conclusions, the following t are recommended:-

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- Avoid consuming undercooked or raw meat that has not been inspected by a qualified meat inspectors .
- Back yard slaughtering of cattle should be discouraged.
- More research on developing diagnostic methods on live animal should be conducted and;
- Veterinarian and medical specialists should work closely together to reduce the disease's effects on both humans and animals.

6.1. Limitations of the study

There is a practical limit to the quantity as well as extent of incisions that are allowed during the normal inspection of beef carcasses because excessive mutilation reduces the carcass's marketability, which means that many infestations go unnoticed.

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8. APPENDICES

Annex I: Questionnaire survey collection format

Dear participant of this study,

Greetings,

I am an MSc student in the Veterinary Public Health Program at the College of Veterinary Medicine and Agriculture of Addis Ababa University. I would like to ask your participation in this study by filling this questionnaire format based on your voluntariness. The aim of this study is to assess the Knowledge of participants about *Taenia saginata* (‘Kosso”). There is no apparent risk on you. However, the result of this study will help us improve actions taken in response to the wellbeing of the public. Filling of this questionnaire format may take 10-15 minutes. Do you agree to participate in this study? Yes or No . If yes, please indicate X above and continue filling the remaining questionnaire. If not, don‘t do anything and kindly return the format. If you have any questions, please contact Yitagesu Belachew (DVM), at yitagesu18belachew@gmail.com, +251-948020693.By taking part, you are agreeing that you have read and understood the information about the study described above. Tick your answer with _X‘ in the bracket or write your answers on the space provided!

Risk factors related to Taeniasis infestation rate in humans

1. Sex: A. Male (M) _____ B. Female (F) _____

2. What is your age? A. below 18 years [ ] B. 18- 30 years [ ]

C. 31- 40 years [ ] D. 40- 60 years [ ] E. above 60 years [ ]

3. What is your level of Education? A. Informal Education [ ] B. Primary Education [ ] C. Secondary Education [ ] D. College Education [ ] E. Other (Specify) _____

4. Occupation A. Farmer [ ] B. Food related Merchant [ ] C.NFR Merchant D. Butcher and Abattoir worker [ ] D. Civil servant [ ] D. Student [ ]

5. Religion A. Christian [ ] B. Muslim [ ]

6. Marital status A. Single [ ] B. Married [ ]

7. Habit of raw meat consumption A. Raw meat [ ] B. Partially cooked [ ] C. Well-cooked [ ] D.I do not like [ ]

8. Meat source A. Local butcher [ ] B. Abattoir [ ] C. Own slaughter [ ] D. I do not like [ ]

9. Herd of taeniasis *A.* Yes [ ] B. No [ ]

10. Source of information A. Social media B. Health center C. Veterinarian D. Social interaction [ ] E. I do not know [ ]

11. Knowledge about transmission A. Contact [ ] B. Raw meat [ ] C. I don't know

12. Knowledge about prevention A. Hygiene keeping [ ] B. Cooked meat [ ] C. Meat from abattoirs [ ] D. I do not know [ ]

13. Have seen *Taenia saginata* A. Yes [ ] B. No [ ]

14. Finding of proglottids in their A. Faeces [ ], B. underwear B.[ ] C. Both [ ] D. I have not seen [ ]

15. Latrine A. Have [ ] B. Do not have [ ]

16. Drug used A. Pharmaceutical drug [ ] B. Herbal medicine [ ] C. both [ ] D. I did not use [ ]

17. If pharmaceutical used what type it is A. Praziquantel [ ] B. Niclosamide [ ] C. Albendazole D. I did not know [ ] E. I did not use [ ]

Annex II: Recording sheet for abattoir survey

Date	I.D	B	SX	A	BC	VC	DC	Organs to be inspected	Remark
								H,T, M, LV, L, K, S	

Key: I.D=animal identification number, B=breed, SX=sex, A=age, BC=body condition, VC=viable cyst, DC=dead cyst, H=heart, T=triceps muscle, M=masseter muscle, LV=liver, K=kidney, S=shoulder

Annex III: Ethical clearance

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ADDIS ABABA UNIVERSITY
College of Veterinary Medicine
and Agriculture
Bishoftu

Animal Research Ethical Review Committee

Ethical clearance certificate

Certificate Ref. No: VM/ERC/02/08/16/2024

Name of Applicant: **Yitagesu Belachew (MSc student)**

Address: Department of Microbiology, Immunology and Veterinary Public Health, College of Veterinary Medicine and Agriculture, Addis Ababa University

Title of the project: *Retrospective study and occurrence of Cysticercus bovis in cattle slaughtered at Addis Ababa Abattoir Enterprise*

Date of application:	**December, 2023**
Nature of the project:.	**Abattoir investigation**
Target animal species:	**Cattle**
Number of animals involved:	**602**
Study area:	**Addis Ababa Abattoir**

Minutes No. and date of review: **VM/ERC/02/16/024, 26/03/**

The Institutional Animal Care and Use Committee of the College of Veterinary Medicine and Agriculture of the Addis Ababa University has reviewed the above research project and unanimously approved the application of **Yitagesu Belachew.**

Professor Getachew Terefe (DVM, PhD)
Chairman

Signature

The Federal Democratic Republic of Ethiopia
Addis Ababa University
College of Veterinary Medicine and Agriculture

መልሱን በሚጽፉልን ጊዜ አባክዎን የኛን ደብዳቤ ቁጥር ይጥቀሱልን
Please quote Our Ref. No. When replying

ፋክስ} ስልክ } ፖ.ሣ.ቁ ቢሾፍቱ ኢትዮጵያ
Fax 251-11-4339933 Tel. +251 114338450 P.o.x. Box}34 Bishoftu, Ethiopia

Annex IV: Different pictures at Addis Ababa abattoir Enterprise

1. Ante-mortem examination (self image at Addis Ababa abattoir)

2. Post-mortem examination (self image at Addis Ababa abattoir)