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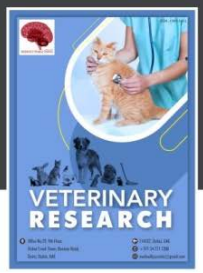

Prevalence of Bovine Cysticercosis and Human Taeniasis in Selected Districts of Eastern Wollega Zone, Western Ethiopia

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Key words: Bovine, Cysticercosis, economic, Taeniosis

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Abstract: Bovine cysticercosis is an infection of cattle caused by Cysticercus bovis, the larval stage of Taenia saginata. This study was conducted in Arjo Gudetu, Sasiga, Nekemte abattoir from November 2019 to April 2020 with the objective of assessing the prevalence, economic loss of abattoir-based Cysticercus bovis and community knowledge, attitudes and perception of taeniasis thorough cross-sectional study design. The study revealed that out of the total 534 cattle examined 16 (3%) were found infected with cysticercus bovis harboring one or more cysticercus. Of the total 36 collected cysts 16 (44.4%) were viable while others 20(55.5%) were degenerated and dead cysts in which it was more prevalent in the shoulder 12(33.3%), liver 8(22.2%), Tongue 6(16.6%), Masseter muscle 6(16.6%), Heart 3 (8.3%) and Diaphragm 1(2.7%). Both male 12/534 (2.22%) and female 4/534(0.78%) were infected in which male more infected than female. Cysticercus bovis infection was found 4/181(2.2%) in adults and 12/353 (3.4%) older aged. Body condition, sex, Origin and age-related infection of the parasite have no statistical significance variation ($p = 0.448$, $x^2 = 0.877$, df =1, $p = 0.768$, $x^2 = 0.423$, df =1, P=0.950, $x^2 = 0.423$, df =2, $p = 0.445$, $x^2 = 0.423$, df =1), respectively. An inventory of pharmaceutical shops revealed that total annual economic loss of 164,110 ETB with an average of 82055 ETB from Taenicidal drug cost was estimated per annum. Out of 300 respondents, 60.91% percentage had contracted Taenia saginata at least once in the past years. The prevalence was significantly higher in males (47.36%) than females (24.17) ($p = 0.000$) in wakefeta (58.33%) than in Orthodox (44.00%), protestant (39.65%) and Muslim (17.14%) communities ($p = 0.008$) and also higher prevalence (50.92%) was observed in respondents that slaughter at their home in grade1- 5(58.02%) than in other level of educations ($p = 0.000$) in raw meat consumers than non- consumers ($p = 0.00$) and there was

a high statical significant associations (p = 0.006) between source of carcasses and prevalence of taeniasis. There was no statistically significant association (p>0.05) observed in the prevalence of Taeniasis between age, latrine usage, marital status and site of respondents. The finding indicated that there was importance of cysticercosis and taenias is both in economic and public health aspects. Therefore, high attention should be given for awareness rising, improvement of public sanitary conditions and strict routinemeat inspection procedures should be undertaken to minimize the impact of Taenia saginata in the study areas.

INTRODUCTION

Livestock are the main stays of the livelihood of the majority of the human population by giving draft power, income to farming communities, means of investment and important source of foreign exchange to the nation. Moreover, livestockare important cultural resources, social safety nets and means of saving and supply for crop production and transport[1]. 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. An animal rearing is an integral part of the agricultural production and estimated livestock population is 56,706,389 Cattle, 29,332,382.56 Sheep, 29,112,963 Goats,7,428,037 Donkeys, 2,033,115 Horses,1,164,106 Camels,400,329 Mules and 56,866,719, Poultry[2].

The livestock sector contributes about 30% of the agricultural GDP and 19% to the export earnings. The potential for Ethiopia to improve the productivity of the livestock sub-sector is clear, however, a number of constraints need to be addressed. Areas in need of attention include animal health and nutrition, availability of quality support services such as extension service, upgrading and dissemination of technology, package to improve animal breeding, marketing and processing and the collection and analysis of baseline data on which to plan development[3].

Taeniasis/bovine cysticercosis is one of the major parasitic diseases which does not only lead to economic loses but also adversely affect public health. The problem of food borne parasitic zoonosis could be further complicated in Ethiopia by lack of efficient inspection at critical control points in abattoirs, lack of awareness and knowledge on the mode of transmission and public health hazard of these diseases as well as due to presence of widespread habit of raw meat consumption both in rural and urban communities. A number of reports in Ethiopia indicated that, certain groups who had easy access to raw meat and meat products (Butchers and abattoir workers) and those people with low level of formal education were reported to be more infected with parasitic zoonosis than those who had low access to raw meat and those with better education. This implies that the frequency of raw beef consumption is higher in these groups of people[4].

The disease caused by this parasite is locally known as "*kosso*" and is mainly related to the cherished and honored tradition of eating raw meat in most parts of the country. The occurrence of the larvae of Taenia saginata in cattle musculature causes *T. saginata* cysticercosis or bovine cysticercosis while the adult worms in human small intestine cause Taeniasis[5].

The life cycle and transmission of the parasite occur most commonly in the environments characterized by poor sanitation, primitive livestock husbandry practices and in adequate meat inspection, management and control policies. In Ethiopia bush defecation and the habit of eating raw beef dishes such as kitfo and *kourt* and backyard slaughter might have contributed for the high prevalence of bovine cysticercosis.Economic losses due to bovine cysticercosis are associated with total condemnation of carcasses with generalized infestation and downgrading of carcasses which are subjected to refrigeration in addition to the cost of refrigeration and extra handling and transport[6].

The treatment cost for human taeniosis and costs of manufacturing of drugs have significant contribution in estimation of economic losses[7]. Although, a number of data have been generated on *T.saginata*/taeniosis and bovine cysticercosis in different parts of Ethiopia[8, 9]. The hygienic status or quality of the meat and the prevalence of meat borne parasitic pathogens and their associated risk factors have not been well investigated in different districts of Eastern Wollega Zone. Thus, there is a need to investigate the level zoonotic significance of parasite and community perception in study area in order to understand the potential public health risks.

General objective was to establish the prevalence, distribution, economic significance and risk factors of *Cysticercus bovis* in cattle slaughtered at municipal abattoir or slaughter house of selected study areas.

Specific objectives were study on the prevalence of *Cysticercus bovis* and its economic significance in cattle slaughtered at municipal abattoir or slaughter house of selected study areas.

Investigation on public knowledge, attitude and practices regarding human taeniasis and its associated potential risk factorsamong communities of selected peasant Association of study area.

Literature review

Historical background: Researchers believe that about 2million years ago, African hominids who scavenged for food or preyed on antelope and other *bovids* were exposed to tapeworm colonization. These worms were using hyena and large cat as definitive hosts and *bovids*as intermediate hosts; these occurred before the origin of modern humans and substantially earlier than the domestication of swine and cattle and the development of agriculture. 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[10].

Taeniasis and Cysticercosis are diseases resulting from an infection with parasitic tapeworms belonging to *Taenia* species. Approximately 45species of *Taenia* have been identified; however, thetwo most commonly responsible for human are *Taenia Solium* and the beef *T. Saginata* tapeworm's. Both species are worldwide in distribution approximately 100 million cases of these cases are *T. saginata* while the other 50 million are *T. solium* related. *Taeniasis* is the intestinal infection of humans with the adult stage of tapeworm of the genus Taenia[11]. The occurrence of the larval of *Taenia Saginata in* cattle musculature causes *T. saginata /cysticercosis* or Bovine cysticercosis, while the adult worms in human small intestine causes *Taeniasis and* Bovine cysticercosis *(beef measles)* 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[12, 13].

Bovine cysticercosis is food-borne parasitic zoonosis caused by the larval stage of the tapeworm. *Taenia saginata* commonly referred to as the beef tapeworm. This larva is meat-borne and human infection results from the ingestion of raw or undercooked beef[14]. *Taenia saginata* in the small intestine of man absorbs digested food and its proglottids migrate to different organs causing different signs[15]. Adult Taenia saginata can live up to 30-40 years in the small intestine of its human host. Most humans who carry an adult tapeworm are asymptomatic. Patients may intermittently pass proglottids either with their stool (*T. solium*) or spontaneously (*T. saginata*)[16].

The economic losses due to bovine cysticercosis are associated with total condemnation of carcasses with generalized infestation[17]. 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 such as "*Kosso*" and others[7].

Poor hygiene and common occurrence of bovine cysticercosis reflect heavy losses. Attempts to reduce the prevalence of *T. saginata* in humans and their cysticerci in cattle may have a considerable impact on the finances of meat production industries. Cysticercosis in cattle is a significant food safety problem and causes economic loss in food production. This will be particularly important where export industries are involved, since, most importing countries have stringent regulations designed to prevent the importation of infected meat[18].

Etiology: Bovine cysticercosis is a disease that affects the musculature of cattle and is caused by the metacestode stage of human intestinal cestode; T. Saginata[19]. *Taenia saginat*a and its metacestode, Cysticercus bovis, the un armed beef tapeworm is classified under the kingdom of Animalia, phylum of Platy helminths, class of Cestoda, order of Cyclophylidea, family of Taeniidae, genus of Taenia and species of *T. saginata*[15].

The adult tapeworm, *Taenia saginata* is a large ribbon shaped, multi segmented, white flat worm usually 4-15m long consisting of thousands of segments (proglottids) arranged in a chain[20]. The head or scolex bearing attachment organs, a short un segmented neck and chain of segments. The chain is known as strobilla and each segment as proglottids. The proglottids are continually budded from the neck region and become sexually mature as they pass down the strobilla. Each proglottid is hermaphrodite with one or two sets of reproductive organs. Gravid segments usually leave the host singly and often migrate spontaneously from the anus[21].

Taenia eggs passed in the feces or discharge from ruptured segments are sub spherical to spherical in shape and very resistant, remaining viable for 6 months in pasture and vegetables, 5 weeks in water, 10 weeks in stool or hay and 12 weeks in sludge. Taenid eggs measure about 30-45 µm in diameter; hyacinth contain embryo) bearing three oncosphere pairs of hooks have a thick, brown, radially striated embryophore or shell composed of hooks with outer oval membranous coat, the true egg shell that is lost from fecal eggs. The cysticerci or larval stage is formed over a period of 3-4 months, after egg is ingested by intermediate host and may viable in the intermediate host for up to 9 months or even up to the entire life of the host[22].

The infestation in the intermediate host with the larval stage is referred to as bovine cysticercosis. In the

bovine animal, the mature cysticercus is grayish white, small, pea-sized oval, about 0.5 cm-1.0×0.5 cm. Long and filled with fluid in which the scolex is usually clearly visible[19]. Epidemiology of taeniasis occurs throughout the world with variable degree of prevalence. Its prevalence could be classified into three groups: high prevalence with taeniasis exceeding 10%, moderate infection rates (0.1-10%) and low infection rate <0.1%[16].

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. Geographic distribution and status of the taeniasis is considered a serious in the developing countries but less recognized for public health problems. Bovine cysticercosis cosmopolitan in distribution and is very common Africa[16]. It is endemic in areas of Central and East African countries like Ethiopia, Kenya and Zaire[23].

The custom of eating undercooked beef dishes such as: kourt, lebleb, kitfo 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 Ethiopia. The higher prevalence of cysticercosis in developing countries is associated with poor infrastructure, low awareness and improper disposal of sewage which pertains to Ethiopia where the wide spread habit of eating raw meat is an additional risk factor[24].

In Ethiopia, the rural communities mainly raise cattle under extensive husbandry practice. 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 localities. Relatively, lower prevalence of 3.1% in Central Ethiopia and higher 30% from different abattoirs in the country[25].

Host range: Cattle are the preferred intermediate hosts and humans are the only final hosts of *T. 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)[10].

Transmission: In humans, it is the ingestion of undercooked beef (*T. Saginata*) containing the larval cyst. Intermediate host such as cows and pigs are infected with the tapeworm when they come in contact with the feces of infected humans[26]. Human taeniosis occurs when a person ingests *T. Saginata* infected beef raw meat. 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 Cystcercosis (autoinfection), and can contaminate others in the family. In the central nervous system or the eye rather than when develop in voluntary muscles[26].

Man cannot spread taeniasis to his own species. Management of animals in their natural environment predisposes them to infection. Cattle grazing commonly have a higher risk of picking up *T. saginata* eggs as they are frequently in contact with the human feces compared to commercial herds. The risk of cattle coming into contact with *T. saginata* eggs is much higher when cattle are at pasture[27].

Life cycle: Humans get infected by eating inadequately prepared beef that is contaminated with viable cysts[28, 29]. A single cyst is normally sufficient to establish an infection but multi- infections do occur[30]. There are estimates that one infected bovine carcass could infect on average 8-20 human individual[31]. The adult tapeworm will develop in the small intestine of its human host. These tapeworms reach maturity in two to three months and can be quite remarkable in size with a length of 3.12 m[32].

In the absence of treatment, the tapeworm can occupy human intestines for 20-25 years[33]. Adult tapeworms will release gravid proglottids that contain 30,000-50,000 eggs[34]. Between three and seven proglottids are released every day[29]. These proglottids will leave the body of host by active migration through the anus or within the stools. In the stools proglottids are usually locate on the surface of the faces[35].

The released eggs contain oncosphere (a larva) that is infective immediately after being released by the host. Cattle become infected by grazing on a contaminated pasture. The pasture can become contaminated directly with human feces containing Taenia eggs or indirectly via sewage sediment or flooding[36]. Eggs hatch in the digestive system of cattle and the oncospheres are released. They penetrate though the intestinal wall and start circulating in lymphatic system and in the blood. After the migration in the body the larvae will develop into cysts. This will take place in 8-10 weeks, after what they are already infective to humans[34].

The cysts lodge itself in to the smooth muscle tissue including heart, masseter muscles, tongue and diaphragm[36]. Approximately nine months after infection most cysts have died and calcified but some remain viable

in the muscles. After eating raw beef that is containing 12 viable cysts humans get infected and the cycle begins again[36].

Pathogenesis: Human Taeniasis is manifested as mild non-specific gastrointestinal illness including symptoms of abdominal pain, digestive disturbance, nausea, diarrhea and Anorexia. The tapeworm utilizes nutrition of man thus causing great loss of nutrient in the hosts. Presence of large number of *T. saginata* causes enteritis. *Cysticercus* does not cause clinical signs in cattle even in heavy infections[37].

Under natural condition, the presence of cysticerci in the muscle of cattle is not associated with clinical signs checked although experiments that calve given massive infection of *T. saginata* eggs developed with severe myocarditis and heart failure associated with developing *cysticerci* in the heart and cause of death between 14 to 16 days[37]. Heavy infection in cattle may results in fever, gastroenteritis, muscle stiffness and weight loss particularly in young animals[38].

Clinical manifestations: In Cattle, *C. bovies* 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. Live cattle having *C. bovies* has no symptoms, however, heavy infestation by the larvae may cause myocarditis or heart failure. Light or moderate cysticercosis in cattle is not usually associated with any defined clinical picture. Heavy infections, those induced experimentally by 200,000 to 1,000,000 *T. saginata* eggs, may give rise to fever, weakness, profuse salivation, anorexia, increase heart and respiratory rate and a dose of one million or more eggs may cause death between 14-16 days due to a degenerative myocarditis[39].

Usually single *T. saginata* tapeworm[30] infects humans. In humans, the adult T. saginata tapeworm lives in the digestive system in small intestine. Most frequently infected people are asymptomatic or suffer from anal pruritis and discharge of fecal proglottids[36]. With voluntary self-infection experiments with *T. saginata* the researchers found that shedding of the proglottids happen spontaneously and actively and humans shed five to fifteen proglottids per day[40]. They also found that this shedding could start as early as ten weeks after infection and by that time the tapeworm was found to be approximately three meters long. Humans can shed taenia eggs with faces even without any symptoms present. Sometimes there is non-specific symptoms present such as vomiting, nausea, diarrhea, epigastric pain and weight loss. Rarely this tapeworm can cause ileus, pancreatitis, cholecystitis or cholangitis[32]. Even more rarely *T. saginata* can cause bowel obstruction[41].

Diagnosis: The routine Meat Inspection is the only diagnostic procedure in use in Ethiopia for the diagnosis of bovine cysticercosis. This method is insensitive and inaccurate and thus the reported prevalence of this infection in different regions of country may be an underestimate. To effectively improve meat inspection, there is a need to increase the area and number of predilection sites observed during inspection procedures[42]. Metacestodes (*C. bovis*) of *T. saginata* usually occur in the striated muscles of cattle (beef measles) but also Buffalo, Reindeer and Deer.

Meat inspection relies exclusively on visual examination of the intact and cut surfaces of the carcass (eye-and knife method) in the slaughterhouse by meat inspectors who follow officially laid-down procedures[43]. The Ministry of Agriculture in Ethiopian Meat Inspection Regulation Notice Number 428 of 1976 lays the following as normal routine inspection of carcasses.Visual inspection, palpation of the surface and a longitudinal ventral incision of the tongue from the tip of the root,One deep incision into the triceps muscles of both sides of the shoulder, extensive deep incision into external and internal muscles of masseter parallel to the plane of the jaw,visualinspection and longitudinal incision of the myocardium from base to apex are performed during inspection of carcass[44].

In human, adult cestodes can be expelled from human using anthelmintic followed by a saline purgative and identified based on the scolex and proglottid morphology. In human beings, the diagnosis is established by examination of the eggs in the stools or gross examination of the proglosttids 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. A person should not be considered uninfected before having three negative tests completed over a 2-3 days interval. *T. saginata* egg can be distinguished from *T. solium* or other tapeworms such as echinococcus by their morphology. However, ELISA and PCR can differentiate the eggs of *T. solium* from *T. saginata* and morphology can be used to distinguish these proglottides[45].

Treatment: Chemotherapy of cattle for bovine cysticercosis is not common in Ethiopia. However, such treatment has been tried in other countries and treatment with a drug was suggested to be economical where prevalence of bovine cysticercosis is very high[27]. Anthelmintic treatment is effective in killing adult tape-

worms but does not kill eggs. Single doses of praziquantel or niclosamide can cure infections in definitive hosts whilemebendazole and albendazole also appear to be effective against adult stages. Praziquantel opensmembrane calcium channels of the worm causing its paralysis, aiding the body in expelling theparasite through peristalsis[46].

In cattle there is no treatment for bovine cysticercosis[47]. Most people, especially rural inhabitants use different types of herbal drugs for self-deworming practices for instance in Ethiopia traditional herbs used in treatment for the cestodes[48].

Control and prevention: Attempts to control and eliminate taeniasis usually interrupt the links between the hosts of the tapeworm via diagnosis and treatment of taenia carriers, education of human to use latrines, avoid eating of raw meat and backyard slaughter, serological test of cattle and postmortem inspection of carcass for presence of *C. bovis*. Cattle older than six weeks are inspected for *Cystcercosis* in skeletal and cardiac muscles; a generalized infection of the carcass is deemed un acceptable for human consumption but a localized infection can be refrigerated for a period of time to be rendered safe[18].

In Ethiopia bush defecation, the habit of eating raw beef dishes such as kitfo and kourt and backyard slaughter might have contributed for the high prevalence of bovine cysticercosis. In developed countries the control of bovine cysticercosis depends on a high standard of human sanitation,on the general practice of cooking meat thoroughly(the thermal death point of *cysticerci* is (57°C) and preventive measures include strict attention of personal hygiene, Environmental sanitation and protection of cattle from contact with human excretion, protection of cattle from grazing on feces or sewage polluted grass,not using untreated human feces as fertilizer for pasture land which may contain segments and ova[49]. Control measures for bovine cysticercosis include confining animals under zero grazing all their live use of clean and uncontaminated feeds and having a healthy workforce. Where possible, certification of the herd through sero-surveillance as free from cysticercosis is recommended[50].

Deep-freezing of meat will kill all *cysticerci* in 24 h but a whole carcass has to be frozen for about 21 days before all parts reach the correct temperature as a meat is a good insulator. The infectiousness of cysts in beef is affected by temperature and other kinds of treatments. Chemotherapy in humans reduces the spread of eggs and infection in cattle. Industries are involved, since, most importing countries have stringent regulations designed to prevent the importation of infected meat[18].

Public health and economic importance of the disease: Human taeniasis is caused by infection with the adult stage of the tapeworms, *T. saginata* and *T. solium* while human *cysticercosis* results from infection with the larvae (*Cysticerci*) of the latter species. Both of these parasites occur in Africa as zoonosis because the usual hosts for the *cysticerci* are cattle and swine respectively from which humans become infected with the adult tapeworm[51]. About 100 million people worldwide may be infected with either *T. saginata* or *T. solium*[52]. *Bovine cysticercosis* is food-borne parasitic zoonosis caused by the larval stage of the tapeworm. Taenia saginata commonly referred to as the beef tapeworm. This larva is meat-borne and human infection results from the ingestion of raw or undercooked beef.

Taenia saginata in the small intestine of man absorbs digested food and its proglottids migrate to different organs causing different signs[15]. Adult Taenia saginata can live up to 30-40 years in the small intestine of its human host. Most humans who carry an adult tapeworm are asymptomatic. Patients may intermittently pass proglottids either with their stool (*T. solium*) or spontaneously (*T. saginata*)[16]. The economic losses due to bovine cysticercosis are associated with total condemnation of carcasses with generalized infestation[53].

. 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"*[39]. Poor hygiene and common occurrence of bovine cysticercosis reflect heavy losses. Attempts to reduce the prevalence of *T. saginata* in humans and their *cysticerci* in cattle may have a considerable impact on the finances of meat production industries. Cysticercosis in cattle is a significant food safety problem and causes economic loss in food production. This will be particularly important where export industries are involved, since, most importing countries have stringent regulations designed to prevent the importation of infected meat[18].

The financial loss to commercial meat producers can be significant. Meat and offal infested with Taenia cyst of any species (Even those species not infective to man) will most likely to be rejected from the commercial food chain (will not be able to be sold) because of people will not buy it (People are unlikely to eat meat or organs with cyst in them). *T. saginata* cyst should be found in beef or meat, the meat rejection is likely to be doubly enforced, since, the organism is significance to human health. Should that diseased animals be of genetic value (Example good stud bull, high yield dairy cow), then the commercial loss is compounded through the loss of those

productive gene to be future generation of animals. Extra cost will be incurred in replacing the valuable animals[54].

The economic impact of the disease in the cost implications can be broken down in to those involved in treating human taeniosis and cattle carcasses (cost of freezing, boiling) or condemned as well as the costs involved in the inspection procedures amount to millions of dollars[55]. Conventional meat inspection technique is less sensitive (pick only 7-5% of infected cases) and time consuming. Lightly infected carcasses can be easily missed and passed for human consumption; thus, the infection transmission is maintained between human and cattle. Thus *taeniosis* (*cysticercosis*) is remaining a wide spread zoonosis that affects human health and economy through condemnation, quality degradation of frozen meat, cost of refrigeration, cost of human therapy, lowering productivity of infected workers who may be absent from or reduce their working efficiency by creating uneasiness[7].

In Ethiopia, there is a wide usage of both traditional and modern taenicidal drugs which is an indication and Diclorophen production in the drug factories in this country between 1996 and 2000 was 31,814,833 Ethiopian birrs[25]. The cost implication can be broken down into those involved in treating human Taeniasis and cattle carcasses (Cost of freezing, boiling) or condemned, as well as the cost involved in the inspection procedures. The average annual loss due to taenicidal drugs for treatment in Ethiopia was estimated to be 4,937,583 Ethiopian birrs[56].

MATERIALS AND METHODS

Study area: The present study on Taenia saginata taeniosis/bovine cysticercosis was conducted from November 2019-May 2020 in Eastern Wollega zone Oromia region found at 330 km to the West of Finfine. The area lies within altitude of 1650-2,088 m above sea level. The mean annual rainfall of the area ranges from 1500-2,200mm and the average mean temperature is 15°C. From which three selected districts namely, Diga, Sasiga and Guto Gida were considered as potential thematic of the study site. These towns are located at about 12, 18 km and 35 km from the town of Eastern Wollega, Nekemte respectively. The estimated livestock population of the area is 78,178 Cattle; 9,894 Sheep; 6477 Goats; 3287 Donkeys; 1598 Horses and 665 Mules, respectively[2].

Study population: The study animals for the abattoir survey were indigenous beef cattle brought mainly from west of Eastern Wollega zone. They are handled under extensive management system on communal pastureland, which are the main sources of meat supply to Nekemte town.

For the questionnaire surveys, the target populations were residents of Diga, Sasiga and Guto Gida district. Different slaughter houses were selected purposively from each district based on potential of cattle brought to slaughter houses and abattoirs weekly. All of local zebu cattle presented to slaughtering abattoir from different local markets of surrounding district Namely, Diga (Arjo Gudetu), Sasiga (Tsige), Guto Gida (Uke), human patients that was visited the selected health facilities/pharmacies for the compliance of GIT parasitism and abattoir workers will be the target groups of this study through informal consent.

Study design: Across-sectional study design was conducted from November 2019 to April 2020 was done to determine the prevalence of *C. bovis* in the study area. To assess the prevalence, cattle that came to Arjo Gudetu, Tsige, Uke and Nekemte abattoir from different parts of selected study area were used. During my study, meat inspection was made in accordance with the procedures of Ethiopian Ministry of Agriculture Meat inspection Regulation for the detection of *T. saginata*/*Cysticercus bovis.* Similarly, questionnaire type survey were conducted by structured questionnaire to randomly selected individuals with different age group, sex, occupations including farmers are involved to assess community awareness, exposure risk and treatment trends for taeniasis in selected area. Age of respondents was categorized as (young: <15 years of age and adults: >30 years of age). Similarly, religion was broadly classified as Christian, Muslim, Protestant and Waqefata. One-year retrospective drug shop inventory wasalso conducted to estimate the economiclosses due to taeniasis treatments in human cases (Fig. 1).

Sampling size: The sample size for abattoirs and questionnaire surveys were determined using the formula described by Thrusfield at 95% confidence interval and 5% absolute precision. Since, the origins of cattle slaughtered at Nekemte municipal abattoir were mainly comes from those three selected districts, abattoir survey were also conducted on Nekemte abattoir. Hence, the required sample size was 384 cattle presented for slaughter. Even though, the required sample size was 384, accordingly, for each study Woreda, 50 samples were included to increase the precision to determine the prevalence of cysticercosis in the study areas, the actual sampling was done on 150 carcasses making a total sample size of 534 beef cattle examined using routine meat inspection method for the presence of

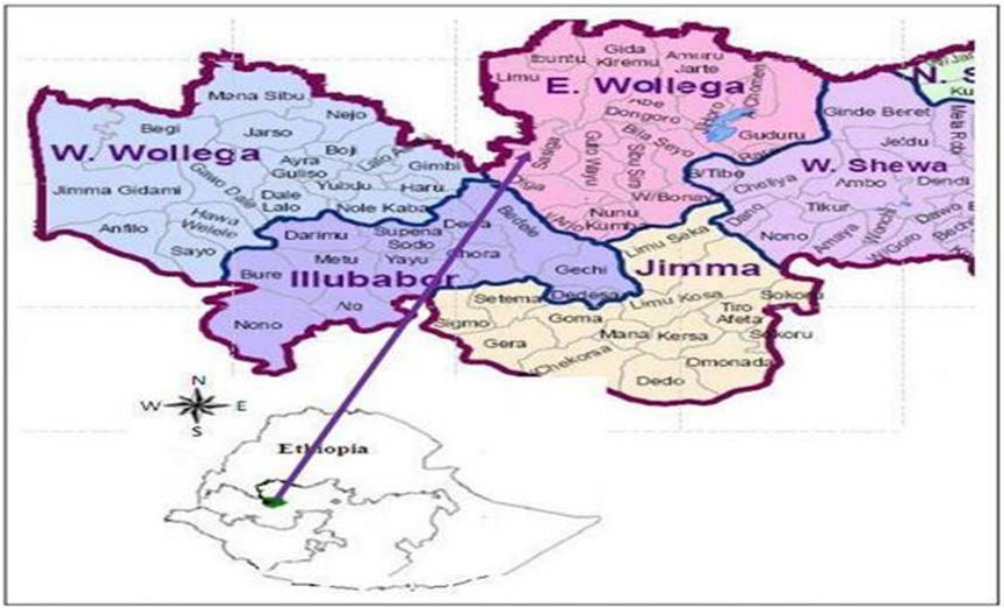

Fig. 1: The map showng the location of the study area in Westren Ethiopia

Cystiercusbovis. Similarly, by using the formula given by Arsham (2002) (0.25/SE2, SE=5%), the sample size for the questionnaire survey was expected to be 100 for each site.

However, A total of 300 individuals were interviewed using structured questioner from each of the three studied districts in order to accommodate the different classifications of risk factors for public health. Efforts were made to include respondents of different age, sex, religion and occupation. Age of respondents was categorized as (young:<15 years of age, and adults:>30 years of age). Similarly, religion was broadly classified as Orthodox, Muslim, Protestant and *Waqefata* whereas occupation was subdivided into farmers, merchants, butchers, abattoir workers and cookers, Government employees and students.Data were also classified according to education levels of the respondents as illiterate (without formal education), literate (elementary up to high school) and graduates (colleges and universities). Data Collection Methods and Techniques

Abattoir survey: Active abattoir survey was conducted crossectionally during detail meat inspection on randomly selected 384 cattle slaughtered at Nekemte municipality abattoir and slaughter slabs of selected districts. In this study, animals were selected during ante mortem examination and the related risk factors such as sex, age, body condition and origin were recorded before slaughtering. Identification number that given by the slaughter house were properly written on the study animal and recorded during ante mortem inspection. Meat inspection during post mortem examination was made in accordance with the procedures of the Ethiopia Ministry of Agriculture Meat Regulation for the detection of bovine cysticercosis

Post-mortem inspection: Prior to sampling, each animal was given an identification code like name of the owner and the color of the cattle. During meat inspection, each organ of the animal was strictly and separately examined to avoid mixing up of organs. The butcher and meat inspector also gave due attention to avoid mixing up of organs from different animals. On visiting days of abattoir, all slaughtered cattle were examined. During post-mortem inspection, examination was made by making an incision on different muscles and organs to assess the presence of *Cysticercus bovis*. The various sites examined were liver, heart, tongue, masseter muscle and diaphragmatic muscle. Palpation and visualization of organs followed by incision of organs was made to examine for the presence of Cysticercus bovis. For masseter muscle, deep line incision was made parallel to the mandible, the heart was incised from base to apex to open the pericardium and incision were made for liver, shoulder muscle, diaphragm and longitudinal incision for tongue[44].

Viability test: For all positive samples, the cysts were carefully dissected and transported toWollega University parasitology laboratory for detection of viability.The viability of cyst were tested by incubating the cysts in a normal saline solution diluted in 40% of ox bile at 37°C for 1-2 h to March 26, 2021allow evagination of the

scolex of the live cysts was examined under microscope to check the metacestode of T.saginata by absence of hook.

Questionnaire surveys on Taeniasis: Questionnaire survey on the disease occurrence and risk factors was administered on those 300 individual respondents from each selected site to obtain the data.The potential risk factors of human taeniasis such as habit of raw meat consumption, age, sex, occupation, religion, educational levels, availability and usage of toilet and back yard slaughter practice were assessed.

Specific questions regarding medical history related to traditional and modern taeniacidal drugs use, impacts of taeniasis and possible prevention options were included in the questionnaire to estimate the risk of the disease in the study areas.

Inventory pharmaceutical shops: Retrospective assessment of 1-year data for the year 2012 EC for taeniacidal drugs frequently supplied by the local pharmacy and different human drug store located at selected districts were assessed in six private pharmacies and drug stores. For the amount of drugs and cost of drugs they sale for human to treat the adult stage of human *T.saginata*, so, the economic impact of the disease were assessed. Inventories of pharmaceutical drug shop vendor in the study area were conducted by recording data yearly taenicidal drug sales and adult doses for treatment. Simaltenasily, annual adult dose of taenicidal drug sold (based on patient complaints and prescription) in 2012 EC were collected and analyzed to estimate the economic loses of Taeniasis in the study area.

Estimation of economic loss: The taeniacidal drugs supplied during the year 2012 inventory were conducted at drug shops. The cost was estimated using yearly adult taenicidal drug doses. The cost incharge of pharmacies from the records (prescription papers and patient complaints) was collected and the total cost of taenicidal drug doses was calculated and estimated at annual cost.

Data management and analysis: The data was collected, coded and entered in to Microsoft excel work sheet and analyzed using SPSS software. Descriptive statistics like percentage were used to express prevalence while chi-square (χ^2) test were used to compare the association of *cysticercosis* with different risk factors. Questionnaire survey data were analyzed using descriptive analysis and important factors were tested with chi-square (x) test for their contribution for the occurrence of taeniasis in human taeniosis. In all the cases,95% confidence level and 0.05 absolute precision errors were considered for significance. A p-<0.05 was used to confirm statistically significance difference of the result.

RESULTS AND DISCUSSION

Abattoir survey on prevalence of Bovine cysticercosis: Out of the 534 inspected cattle carcasses at Nekemte municipal abattoir and slaughter house of three-selected districts, 16/534 animals had varying number of *C. bovis* with an overall prevalence of 3%. Within positive animals, the prevalence of *C. bovis* in shoulder muscle was much higher than in the liver, masseter, heart, tongue and diaphragm.

Current prevalence of C.bovis was not significantly associated (p>0.05) with in sex, age categories,body conditions and origin (p = 0.768,p = 0.445,p = 0.448 and p = 0.950) of the animal, but comparatively, higher prevalence was observed in old (3.4%) male(3.1%) with a medium (4.4%) body condition of animals (3.1%) compared to that of adult (2.2%) female (2.6%) animal of good (2.4%) body condition. Similarly, the distribution of bovine cysticercosis was not significantly (p>0.05) associated (p=0.950) with the origin of the slaughtered cattle. Comparatively similar prevalence rat of 3.5% Arjo gudatu and 3.6% Balo bareda, 2.9% Anger and 2.8% Ukearea, respectively. However, *C. bovis* was not observed in cattle originated from *Gutin* area (Table 1).

This anatomical distribution of cysticerci do not showed significant variation in different predilection sites as observed in the shoulder, masseter, liver, tongue and heart, 43.75%, 18.75%, 18.75%, 12.5% 6.25% respectively. Among inspected carcasses, in average twelve cysts were found in the shoulder of one animal. (Table 2).

Of the total 36 collected cysts 16/36 (44.4%) were viable while others 20/36(55.5%) weredegenerated and dead cysts. The highest number of viable cysts were detected in the shoulder 7(43.75%), followed by both liver and masseter 3(18.75%), tongue 2(12.5%) while much lower viable cysts were observed in the heart 1 (6.74%) were encountered. Over all distribution of C, bovis in different organs of cattle slaughtered at the study abattoirs was shown in (Table 2).Of the total 16 infected cattle, 12 (2.24%) had *C.bovis* in the shoulder, 8(1.5%) in liver, 6 (1.12%) in tongue and masseter muscles,3 (0.6%) in heart while only in 1 animal (0.2%) diaphragm *C. bovis* was observed (Table 2b).

Pharmaceutical drug shops inventories: Inventories of pharmaceutical shops (pharmacies and drug store) were conducted in selected districts of the study area. Estimates of yearly adult taenicidal drug doses and its costs were collected through personal interview with individuals in charge of pharmacies using their records for the year 2012

This revealed a total of 14521 adult taenicidal drug doses were sold for a total cost of 164110ETB (4768.12USD) with an average of 82055 ETB (2384.06USD) per annum.The most preferred drugs

Table 1: Prevalence of *Cysticercus bovis* in relation with risk factors

Variables	No of examined	No of positive	Prevalence	X^2	p-values
Sex					
Male	384	12	3.1%	0.087	0.768
Female	151	4	2.6%		
Age					
Adult	181	4	2.2%	0.582	0.445
Old	353	12	3.4%		
Body condition					
Good	375	9	2.4%	1.570	0.448
Medium	159	7	4.4%		
Arjo gudatu	144	5	3.5%		
Anger	67	2	2.9%	0.707	0.950
Origin					
Balo bareda	56	2	3.6%		
Uke	251	7	2.8%		
Gutin	16	-	-		
Total	534	16	3%		

Table 2: Predilection sites of bovine cysticercosis and post-mortem prevalence

Location of cyst	Total no of examined	Total no. of positive e/Orga n	Prevalen ce/organ No Viable cyst	Dead/de g.cyst	perorgan	Percent of cyst viable	Distribution on perorgan
Tongue	534	6	1.12%	2	4	12.5	6
Diaphragm	534	1	0.2%	0	1	0	1
Heart	534	3	0.6%	1	2	6.25	3
Masseter muscle	534	6	1.12%	3	3	18.75	6
Shoulder	534	12	2.24%	7	5	43.75	12
Liver	534	8	1.5%	3	5	18.75	8
Total	534	36	6.74%	16	20	100	36

Table 3: Cyst distribution and percent of cyst viability per different organs

Inspected organ	Cyst distribution perorgan	No. of viable cyst	Percentage of viable cyst (%)	No. of dead cyst	Percentage of cysy (%)
Tongue	6	2	12.5	4	20
Diaphragm	1	0	0	1	5
Heart	3	1	6.25	2	10
Masseter muscle	6	3	18.75	3	15
Shoulder	12	7	43.75	5	25
Liver	8	3	18.75	5	25
Total	36	16	100	20	100

among customers in the area were Mebendazole (Vermox) and Albenedazole while praziquantel were sold mostly when prescribed by physicians. In general, according to information obtained from pharmacies and other drug stores, Praziquantel, Albendazole and Mebendazole are commonly used for the treatment of (T.saginata) taeniosis in the area. High dose of Mebendazole (36.3%) was sold than Albendazole (35.2%), Praziquantel (25.06% and Niclosamide (3.44%) as indicated in the Table 3.

Questionnaire survey results: Among the 300 voluntary interviewed respondents of the residents in the surrounding study area who were participated on different working environments, farmers, students, merchants, daily laborers, government employers, cookers and slaughter workers were included in this particular study. According to the interview conducted the prevalence of T. saginata was found that sex had highly significant difference ($p = 0.00$) on the prevalence of *T. saginata* taeniosis. Mostlymales were affected compared tofemale respondents. The present study also revealed that there was highly significant association ($p = 0.08$) between the prevalence of taeniasis and religion of respondents, indicating higher prevalence of infection in the *wakefeta* than in orthodox, protestant and Muslim community respondents.

Statistical analysis showed that the prevalence of *T. saginata* had no significant association with different age groups of respondents ($p>0.05$). The aged groups above 30 (41.44%) years had relatively higher infection rates compared to those between the age 15-30 years (37.17%) of respondents. Most of the respondents had an experience of raw meat consumption as a result of this they infected by *T. saginata*. The statistical analysis of the raw meat consumption and taeniosis interaction was statically highly significant ($p<0.05$). Raw meat consumption is the favorite dish for most of the respondents and 174(58%) of the respondents were the raw beef consumers and from these 60.91% had contracted the disease (Table 4 and 5).

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. For

Table 4: Inventory of the taenicdal drugs usage for 2012 year in three districts

Name of drug items	Total adult dose of taenaicidal	Year 2012 Worth (ETB)	Total Worth (ETB)
Praziquantel	3,640 dose/adult	37,564 ETB	37,564 ETB
Niclosomide tabs	500 dose/adult	4,000 ETB	4,000 ETB
Memebedazole(syrup)	1,699 dose/adult	34,583 ETB	34,583 ETB
Membedazole (tabs)	3,566 dose/adult	22,348 ETB	22,348 ETB
Albendazole (syrup)	1153 dose/adult	33,775 ETB	33,775 ETB
Albendazole (tabs)	3963 dose/adult	31,840 ETB	31,840 ETB
Total	14521dose	164,110 ETB	164,110 ETB

*Dose is the amount of drug used to treat one adult human taeniasis case

Table 5: Prevalence of exposure to *T. saginata* in human population in study areas

Variables	No. of interviewed	No. of infected	Percentage (%)	X^2	p-values
Sex					
Male	209	99	47.36	14.17	0.000
Female	91	22	24.17		
Religion					
Orthodox	125	55	44.00	11.7	0.008
Muslim	35	6	17.14		
Protestant	116	46	39.65		
Wakefata	24	14	58.33		
Habit of raw meat					
Yes	174	106	60.91	72.9	0.000
No	126	15	11.90		
Age (year)					
15-30	78	29	37.17	0.4	0.509
>30	222	92	41.44		
Marital status					
Single	122	42	34.42	2.98	0.084
Married	179	79	44.13		
Educational status					
Illiterate	51	20	39.2	25.27	0.000
Grade 1-5	81	47	58.02		
Grade 6-8	95	21	22.10		
Grade 9-12	49	24	48.97		
>12	24	9	37.5		
Use of latrine					
Use latrine	176	74	42.04	0.519	0.471
No latrine	124	47	37.90		
Meat source for consumption					
local butchers	107	42	39.25	10.25	0.006
communal slaug,at village	85	24	28.23		
home slaughtering	108	55	50.92		
backyard slaughter practice					
Yes	223	101	45.29	8.875	0.003
No	77	20	25.97		
Site					
Diga	100	47	47.00	4.848	0.089
Sasiga	100	32	32.00		
Guto gida	100	42	42.00		

most of the respondents the sources of beef were slaughter at their home, some respondents have brought beef from local butchers and few of them get from communal slaughter at village. Based on this study, higher prevalence (50.92%) was observed in respondents that slaughter at their home and there was a high statically significant association ($p<0.05$) between source of carcasses and prevalence of taeniasis. Current study showed that the prevalence of *T. saginata* was highly significant between educational level of respondents ($p<0.05$) showing that respondents of grade 1-5 (58.02%) are much more affected than the other relatively educated groups of individuals. Regarding the prevalence of taeniosis there was no significant difference among the site of respondents ($p>0.05$). Comparatively the higher prevalence was observed at *Diga* site (47%) followed by *Gutogida* (42%) and *Sasiga* (32%) respectively. The variation in prevalence of *Bovine cysticercosis* might be due to the changes in the environmental and epidemiological factors which could affect the rate of transmission of *Taenia saginata*/ *Bovine cysticercosis*. The distribution of *C. bovis* could associate with the breed of cattle involved as intermediate host and their management, body condition score and age of slaughtered animals and other socio-economic related activities such as personal

and environmental hygiene, variation in method and quality of meat inspection practices in different localities of a country.

Another possible reason for variation in prevalence may be due to difference in sample size, status of the people in the environment especially related to experience and appropriate use of toilet, habit of the community feeding raw and undercooked meat consumption. The number of viable *T. saginata* eggs ingested by cattle was also some of the reasons for variation of *C. bovis* prevalence indifferent localities.The present study also revealed that there was highly significant association (p = 0.08) between the prevalence of taeniasis and religion of respondents indicating higher prevalence of infection in the wakefeta than in orthodox, protestant and Muslim community respondents. The possible reason of these result may be, the sample size of questioner survey was not comparable. This finding is in agreement with findings by Hailu, Dawit[57], Abunna *et al*.[57] and Regasa *et al*.[39].

Public Health Significance of the disease from Taenia contracted respondents showed the statistical analysis of the raw meat consumption and taeniosis interaction was statically highly significant (p<0.05). Raw meat consumption is the favorite dish for most of the respondents and 174(58%) of the respondents were the raw beef consumers and from these 106(60.91%) had contracted the disease. The economic significance of the disease was conducted on the taeniacidal drugs supplied during the year 2012 inventory at drug shops; the cost was estimated using yearly adult taenicidal drug doses. The cost in charge of pharmacies from the records (prescription papers and patient complaints) was collected and he total cost of taenicidal drug doses was calculated and estimated at annual cost.

Taeniasis is a decisive worldwide food borne cestode parasitic disease with serious public health implications. Man is the final host of *Taenia saginata* while larval stage of this parasite causes muscles infestation in cattle a condition known as bovine cysticercosis. On the other hand, *Taenia* infection in humans is named as taeniasis, caused by adult stage of *Taenia saginata*[16].

In current study, out of 534 inspected cattle carcasses at different slaughter house or abattoirs, overall, 16/534(3 %) cattle were found to be infected to *Cysticercus bovis* through postmortem inspection procedure. There were different results reported on the prevalence of *Bovine cysticercosis* in Ethiopia by many Authors and researchers in different years. This finding is considered higher than the previous finding 2.5% Dawit etc in Wolaita Sodo municipal abattoir, 2.6% Yacob *et al*.[58] in Adama town, 0.2% Dzoma *et al*.[60] in South Africa and 1.05% Leonardo *et al*. (2012) in Brazil. Current finding was lower than 12% Abunna Yirgalem abattoir and26.25% Abunna *et al*.[67] in Hawassa municipal abattoir.

The above differences in the reported prevalence rates are predictable due to various reasons like due to climatic dissimilarity among the localities, management of animals, number of collected samples in addition to control measures and elimination programs in such countries may also the difference in prevalence is due to cysticerci were easily missed as they may not be present on routine cuts considering that most cases of *Cysticercus* are light infections. Moreover, observations indicated thatexcept for the dead, degenerate or calcified cysticercithat usually from white and fibriotic lesions a carless meat inspector could most likely miss out quite a number of viable cysticerci which blend the pinkish red color of the meat and be passed on for human consumption and the variation of personal and environmental hygiene from area to area[62].

There was no statistical significance (p>0.05) in anatomical distribution of *cysticerci* in different predilection sites of inspected organ and tissue. Distribution of *C. bovis* in various organsand tissues of the infected animal was observed with the greater number of *cysts* in shoulder muscle (33.3/534), followed by liver (22.2/534), tongue and masseter muscle (16.6/534), heart (8.3/534) and diaphragm (2.7/534). This finding is in disagreement with the finding report by Teklemariam and Wondimu[63] reported in tongue, Regassa *et al*.[39] reported in heart and[64] reported in tongue. The reason behind, these variations of anatomical distribution of cyst might be depend on a number of factors such as blood kinetics and animal's daily activities. Any geographical and environmental factors affecting blood kinetics and meat inspector preferential for predilection sites during meat inspection in the animal are also affect the distribution frequency of cyst in organs[22].

The current prevalence of *C. bovis* was not significantly associated (p>0.05) with in sex (p = 0.768) but comparatively, higher prevalence was observed in male (3.1%) compared to that of female (2.6%). This finding agrees with Taresa *et al*.[65, 22] in Kombolcha but disagree with report of the Abdulaziz etc. The possible reason for this variation might be that, the sample size of female (80) cattle was not comparable to that of male (304) in study conducted by Abdulaziz etc.

The current prevalence of *C. bovis* was not significantly associated (p>0.05) within age (p = 0.445) but comparatively, higher prevalence was observed in old (3.4%) compared to that of adult (2.2%). This finding agrees with Ibrahim and Zerihun and Frew[66] but contrary with the report by Mesfin and Nuraddis possible explanation for this variation might be due to the fact that any age group of animals has close susceptibility to

T. saginata egg and most of the animals slaughtered in this abattoir were adult or higher prevalence in old animal may be due to age dependent immunity of an animal that has an important role to play in fighting against infestation and re infestation of *Cysticerci* which is supported by report of Wanzala *et al*.[67].

Also, Old animals are likely to have a higher possibility of acquiring infection due to their longer exposure to infection and to lower immunity to combat infection[24].

The current prevalence of *C. bovis* was not significantly associated (p>0.05, p = 0.448) within body condition. In the current study high prevalence was recorded in animals which have medium body condition (4.4%) than good body conditioned cattle (2.4%). This finding was higher than the study reported by Addisu and Dupung *et al*.[31] (good = 1.9% and medium = 5.8%) but lower than the report of Mesfin and Nuraddis (2012) (good = 22% and medium = 24%). The reason behind lower prevalence in good body condition than medium body condition might be due to the fact that most of the animals slaughtered in the abattoir were brought from fattening systems of the individual farmer in which animals from such farms were less exposed to eggs of *T.saginata* as they graze on relatively clean demarcated land (pasture land); tying system to the pegs and intensive feeding system in the house for fattening purpose and use of Anthelminthic drugs.

The distribution of *Bovine cysticercosis* was not significantly (p>0.05) associated (p = 0.950) with the origin of the slaughtered cattle. Comparatively similar prevalence rate of 3.5% Arjo gudatu and 3.6% *Balo bareda* ,2.9% *Anger* and 2.8% Uke area, respectively. However, *C. bovis* was not observed in cattle originated from *Gutin* area. The possible explanation for this might be due to the fact that most of the animals brought to this abattoir have no similar husbandry systems and male sexes are more exposed to the disease in the study area, which leads to un equal exposure of animals to *T. saginata* eggs.

About 121/300 (40.3%) of studied respondent are both knowledgeable on considered risk factors for infections with taeniasis and have also been exposed to the disease. The present finding 40.3% exposure risk of human taeniasis in the area is similar with 44% in Hawassa Town by Mesfin and Nuradddis, 44.44% in Shire Indasilassie district by Dawit and Temesgen[68] but lower than 64% in Lielt *et al*.[68] 62.5% in Dawit[57], 58% in Firew and Moges[69], 70% by Abunna[7], 56.7% in Zeway by Bedu *et al*.[9], 64.2% in Awassa town Abunna *et al* [10], 59% in and around Teklemariam and Wondms[63] and 56.7% in Jimma town Megersa *et al*.[44], all from Ethiopia showing wide distribution and public Health risk of the diseases. Also, present the finding was lower than in Vietnam Van De[71] with the majority, 76.9 and 42.4% of respondents were aware that the source of infection is raw or undercooked meat. Most of the respondents had an experience of raw meat consumption as a result of this they infected by *T. saginata*. The statistical analysis of the raw meat consumption and *taeniosis* interaction was statically highly significant (p = 0.000). Raw meat consumption is the favorite dish for most of the respondents and 58% of the respondents were the raw beef consumers and from these (60.91%) had contracted the taeniasis

The current prevalence of human taeniasis was significantly associated (p = 0.000) with in sex in which higher prevalence was observed in male (47.36%) compared to that of female (24.17%). This finding is agree with result reported by Tegegne *et al*.[72] in Ethiopia reported a higher prevalence of taeniasis in males than females. The reason for this significantly higher prevalence in males could be due to fact that economical rezones and cultural practices in Ethiopia that adult men groups often enjoy raw beef (kurt) consumption in butchers and restaurants then than women where as a great proportion of women in Ethiopia are housewives and commonly prepare their dishes at home consequently females have lower probability of getting viable cysticerci infection. Similarly, a community-based stool egg examination result showed that the infection rate in males was 1.6% however, *T. saginata* was not detected in females Basem *et al*.[10]. The findings reported by Usip *et al*.[73] in Nigeria showed that higher prevalence of *T. saginata* in males were also in agreement with our report.

Statistical analysis showed that the prevalence of *T. saginata* had no significant association with different age groups of respondents (p>0.05). The aged groups above 30 (41.44%) years had relatively higher infection rates compared to those between the age 15-30 years (37.17%) of 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, public health services and close contact with the animals are attributable to the variation in the prevalence of taeniasis. Also, 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 older peoples also possibly have had more time to be exposed and infected by viable C. bovis cysts[74].

There was no statically significant difference between marital status, among the site of respondents and

prevalence of taeniosis (p>0.05). it is relatively higher in married respondents than un married. This could be due to the fact that the married community had a strong economic power to visit the butchers and restaurants. Comparatively higher prevalence was observed at *Diga* site (47%) followed by *Gutogida* (42%) and *Sasiga* (32%) respectively. This might be due to presence of a difference between them with regarding to raw meat consumption. Another reason for the presence of difference in the prevalence of *Bovine cysticercosis* might be due to many reasons such as time of occurrence, status of the people in the environment, practical limitation of the number of incisions made during inspection (as excessive mutilation of the carcass reduce its market price) and inspection ability of the researchers.

For most of the respondents the sources of beef were slaughter at their home, some respondents have brought beef from local butchers and few of them get from communal slaughter at village. Based on this study, higher prevalence (50.92%) was observed in respondents that slaughter at their home and there was a high statically significant association (p<0.05) between source of carcasses and prevalence of taeniasis. Current study showed that the prevalence of *T. saginata* was highly significant between educational level of respondents (p<0.05) showing that respondents of grade 1-5 (58.02%) are much more affected than the other relatively educated groups of individuals. This could be due to lack of awareness about the disease's transmission.

CONCLUSION

The present finding indicates Bovine cysticercosisis is one of the major zoonotic diseases that remain a major health problem of animals and humans causing serious socio-economic impact. significance of *taeniasis* in the study area based on the questionnaire survey and less significant based on the active data from the abattoir. Although the prevalence found in the current study was relatively low (3%), its significance on the health of both animals and public should not be under estimated. This illustrates the significance of *taeniasis* in the study area based on the questionnaire survey and less significant based on the active data from the abattoir. Therefore, in order to control and prevent *Cysticercus bovis* in the country the following recommendations are forwarded.

RECOMMENDATIONS

Attention must be given to routine meat inspection and competent meat inspection must be strictly implemented at every slaughter house. Public education to avoid consumption of raw meat so as to bring cultural change in the country. Immuno diagnostics must be developed to supplement meat inspection procedures. Cysticercosis free husbandry should be encouraged. Further, studies on prevalence and public health importance of bovine cysticercosis should be encouraged.

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APPENDIX

Annex 1: Body condition score format: The profile of animals like, body condition scores were recorded. an animal was examined at rest and in motion for any abnormalities and lesions. The body condition scoring was classified into three categories as Lean, medium and good according to. According to the author:

Lean: The spinous the processes can be identified individual when touched but feed round rather than sharp. Medium: the spinous processes can only be felt with very firm pressure and area of either of tail head have some fat cover.

Good: Fat cover around tail head is easily seen as slight mounds soft to touch; spinous process can't be felt. The body structure of the animals is no longer noticeable and the tail is almost completely buried in fatty tissue.

Annex 2: Age determination based on dental formula

Age(years)	Characteristic change
$1^{1/2}$	I1 erupt
$2\text{-}2^{1}/2$	I2 erupt
3	I3 erupt
31/2	I4erup
5	All incisors are in wear
6	II is level and the has merged from gum
7	I2 is level and neck is visible
8	I3 is level and the neck is visible may be level
9	I4 is level and the neck visible
10	the dental state is square in II teeth 12 wear
15	The teeth that have not fallen out are reduced to small round pages

De latunta and Hable (1980)

Annex 3: **Questioner format of respondents**

Sex:

Male ☐ Female ☐

Age:

15_30 year ☐ >30 year ☐

Marital status

Single ☐

Married ☐

Occupation

	Mark " ✔ " if
Student	
Merchant	
Farmer	
Daily laborer	
Gov't employee	
Slaughter worker	
Cooker	

Religion

Christian ☐ *Waqefata* ☐

Muslim ☐ Protestant ☐

a. Educational status

Illiterate ☐ Grade 9-12 ☐

Grade 1-5 ☐ > 12 ☐

Grade 6-8 ☐

1. Do you have latrine for human waste disposal?

a) Yes ☐ b) No ☐

If No, Where do you dispose? _____

2. In your opinion, dose taeniasis poses any health risk to meat consumers?

a) Yes ☐ b) No ☐

3. Do you consume raw beef?

a) Yes ☐ b) No ☐

4. Do you observe T .saginata up on yourself? / Past exposure?

a) Yes ☐ b) No ☐

5. What your source of information about the disease taeniasis?

a) Social media ☐ c) Veterinarian ☐

b) Health center ☐ d) Social interaction ☐

6. Do you know the possible routes for transmission of taeniasis?

a) Yes ☐ b) No ☐

If yes, through what?

a) Contact ☐ b) Raw meat ☐ c) I do not know ☐

7. Do you know about prevention options of *T. saginata*?

a) Yes ☐ b) No ☐

If yes, do you list?

a) Hygiene keeping ☐ c) Meat from abattoirs ☐

b) Cooked meat ☐ d) not know ☐

XIV

8. Do you observe the back yard slaughter practice in your locality?

a) Yes ☐ b) No ☐

9. How /Do you understand the existence *of cysticercus bovis*?

a) Very well ☐ c) Moderate ☐

b) Good ☐ d) Poorly ☐

Yes ☐ No ☐

10. Where is the source of meat /carcass for consumption?

a) Local butchers ☐

b) Communal slaughtering at village ☐

c) Home slaughtering ☐

11. How do you consume a meat?

a) Raw meat ☐ c) Only cooked ☐

b) Partially cooked ☐ d) well cooked ☐

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