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Epidemiological status of bovine cysticercosis and human taeniasis in Eastern Ethiopia

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ABSTRACT

Bovine cysticercosis and human taeniasis are among the leading cause of economic loss in Ethiopia due to organ condemnation and treatment costs. A cross-sectional study was conducted from September 2017 to July 2018 on randomly selected carcasses from Jigjiga, Babile and Dire Dawa town municipal abattoirs to estimate the prevalence of bovine cysticercosis. Besides, a questionnaire was administered to the human population of these towns to understand risk of human taeniasis. The overall prevalence of *Cysticercus bovis* was 27.3% (302/1108). Among the examined predilection sites, the highest prevalence was observed in the liver (9.6%), and the tongue (8.5%). From the total of 686*C. bovis* cysts collected, 289 (42.0%) were viable, while the other 397 (58.0%) were non-viable cysts. Three predictors, namely study location, age and body condition, were significantly associated with *C. bovis* ($p \leq 0.001$). Among the 900 respondents interviewed, 432 had contracted *Taenia saginata* infection. Risk factors like occupation, sex, marital status, educational status and raw beef consumption habit were significantly associated with *T. saginata* infection ($p \leq 0.001$). The findings of this study indicated the importance of bovine cysticercosis and taeniasis in the study areas. Therefore, attention should be given to public awareness and detailed meat inspection for the safety of the public and promotion of the country's meat industry.

1. Introduction

Bovine cysticercosis is a zoonotic infection of cattle caused by the larval stage (*Cysticercus bovis*) of the human intestinal cestode, *Taenia saginata* (Garcia et al., 2007). Taeniasis, a disease in humans (WHO, 2013), is food-borne and caused by consuming raw or uncooked meat containing viable cysticercus (Gracey et al., 2015). In humans, cysticercus develops into a tapeworm and most of the time, patients are asymptomatic. Nevertheless, symptoms can include nausea, abdominal discomfort, flatulence, epigastric pain, diarrhea, vitamin deficiency, excessive loss of appetite, weakness and loss of weight, digestive disturbances, and intestinal blockage (CDC, 2017). No clinical signs are commonly observed in infected animals. However, a serious infection with a viable cyst may cause myocarditis to heart failure in cattle (Cabaret et al., 2002). In addition, the cyst is responsible for significant economic losses due to the loss of carcass by a cyst that can reach 30% of the animal's value and the cost of freezing for the infested carcass (Chomel, 2008).

Various studies have been conducted on the prevalence of cysticercosis in Ethiopia. The regional prevalence was reported 30.4% in

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Bahirdar (Tamirat et al., 2018), 64.4% in Jimma (Taresa et al., 2011) and 69.5% in Debre Zeit (Tesfaye, 2016) were recorded based on questionnaire surveys. 6.5% in Dale Wabera district of western Ethiopia (Bayou and Taddesse, 2018), 4.7% in Kombolcha (Kassaw et al., 2017) and 19.7% in Harar (Terefe et al., 2014a, 2014b) based on Abattoir investigations. On the other hand, the prevalence of cysticercosis was reported to be 7%the at the national level by meta-analysis of previous studies (Assefa and Bihon, 2019). Furthermore, spatiotemporal analysis based on previous studies conducted by (Hiko and Seifu, 2019) indicated that the prevalence of *C. bovis* had high variability that ranged from 8 to 90% geographically. Furthermore, a more recent systematic review (Jorga et al., 2020) also showed huge regional variation ranging from 2 to 25%. However, the studies conducted were limited to certain parts of the country and there was no information on the prevalence of bovine cysticercosis in Babile and Dire Dawa towns. Besides, no reported results were found on the prevalence of human taeniasis in Jigjiga, Babile and Dire Dawa towns. Thus, the objective of this study was to estimate the prevalence of bovine cysticercosis and human taeniasis in Jigjiga town, Babiletown and Dire Dawa city of eastern Ethiopia.

2. Materials and methods

2.1. Study area

The study was conducted in eastern Ethiopia towns of Jigjiga, Babile and Dire Dawa from September 2017 to July 2018 on randomly selected carcasses and the towns' human population selected by systematic random sampling approach.

Jigjiga town is Ethiopia's Somali region's capital city, found in the Eastern part of Ethiopia, 630 km from Addis Ababa. Jigjiga is situated at an altitude of 1660 m above sea level. Livestock population of Jigjiga was 270,662 cattle, 462,725 sheep, 180,250 goats, 12,116 equine and 934,906 camels (ESRSLPDB, 2014). The total human population of Jigjiga town is 125,876 (CSA, 2015).

Babile town is located about 557 km east of Addis Ababa. The altitude of the district ranges from 950 to 2000 m above sea level. Cattle are the most dominant in population size (56,355 heads) followed by goat (23,020), sheep (12,216) and camel (9704) (BDLDHA, 2015). The district's total human population is 49,585 (CSA, 2015).

Dire Dawa town is located in the eastern part of Ethiopia. The town is situated 515 km east of Addis Ababa. The altitude of the town is about 1200 m above sea level. Livestock populations in Dire Dawa town are cattle (61,420), sheep (37,570), goats (79,880) and camel (11,910) (DDCA, 2017). The Dire Dawa town's total human population is277,000 (CSA, 2015).

2.1.1. Jigjiga, Babile and Dire Dawa municipal abattoirs

The town's agricultural livestock owns Jigjiga and Dire Dawa abattoirs and environmental protection office, while Babile abattoir was owned by woreda municipality, which aims to provide officially inspected and safe meat (beef, camel, goat and mutton) for consumers. The abattoirs have separate compartments to slaughter animals for Christian and Muslim residents. On average, 41, 4 and 50 cattle for Christian and 20, 2 and 22 for Muslims were slaughtered per day in Jigjiga, Babile and Dire Dawa municipal abattoir, respectively. The numbers of slaughtered animals were much higher than the capacity of slaughtering rooms. One animal health assistant provided the routine meat inspection service in Babile and Jigjigaand one veterinarian in Dire Dawa, which the agricultural office recruited. Seven *C. bovis* per organ were set to condemn the organ in Jigjiga and Babile abattoirs, while five cysts per organ resulted in the condemnation of the organ in Dire Dawa abattoir. However, only the cysts were trimmed and allowed to pass for consumption when a cyst was identified in heavy muscles. The abattoir manager wrote letters of confirmation for condemned organs if the organ was judged to be condemned by inspectors (ESRSLPDB, 2014; BDLDHA, 2015; DDCA, 2017).

2.2. Study design and population

A cross-sectional study with an active abattoir investigation was used to estimate the prevalence of *C. bovis* in the study areas. Study populations were all cattle slaughtered between September to November 2017 in Jigjiga, from December 2017 to April 2018 in Babile and between May and July 2018 in Dire Dawa municipal abattoirs.

2.3. Sample size determination

The sample size was calculated using the standard formula described by Thrusfield (Thrusfield, 2007) for the random sampling method.

$$N = \frac{1.962^{*}pexp(1 - pexp)}{\mathrm{d2}}$$

Where: N=Sample size, P*exp* = Expected prevalence and d = desired level of precision.

Since there was no similar previous study in Babile and Dire Dawa towns, 50% expected prevalence, 5% desired absolute precision and 95% confidence level was used to calculate the minimum sample size. Therefore, 384 carcasses were inspected for *C. bovis* in different organs in each town during the study period. While in Jigjiga, there was one study with the expected prevalence of 2.25% (Biruk, 2017), so the sample size required based on the above formula was 34 carcasses. However, to increase the precision of the study, the sample size was increased to 340 carcasses.

The questionnaire survey sample size was calculated using $N = \frac{0.25}{\mathrm{SE2}}$ (Arsham, 2015). Where: N = sample size, SE (standard error)

=5%.

As per the above formula, the sample size required for the questionnaire survey was 100 for each town. However, to include different risk factors and increase the result's precision, the total number was increased to 900 individuals. Therefore, 300 individuals were interviewed from each of the three towns.

2.4. Data collection methods

2.4.1. Questionnaire-based investigation

The sampling frame was prepared based on information collected from the environment protection authority, the education, health, housing, and capacity building bureaus. 55,510, 30,567 and 12,050 residence houses and four family units per house were estimated in Dire Dawa, Jigjiga and Babile urban towns, respectively, based on the collected information. Respondents were randomly selected every 500-m distance from the first residence houses. Next, residence houses were used if participants opted out. First, however, butchers and food-related merchants (FRM) were purposively interviewed. Every Saturday and Sunday, the interview was done for three months in each town. Twelve to fifteen respondents were interviewed per day. From each participant, age, sex, educational status, the habit of raw meat consumption status, occupation, frequency of cyst observation and other necessary variables were collected through face-to-face interviews.

2.4.2. Active abattoir investigation

A systematic random sampling technique was applied to those cattle that came to the municipal abattoir. Antemortem was done at dawn (5:00 AM - 8:00 AM) in Babile and night (8:00 PM - 1:00 AM) in Jigjiga and Dire Dawa, during which the cattle were slaughtered. The first cattle were randomly selected and then every 10th animal in Jigjiga and Dire Dawa was thoroughly inspected. However, in Babile, every second cattle entering the slaughterhouse after ante mortem inspection was considered and marked. Five to seven cattle were examined on each slaughter day in Jigjiga and Dire Dawa, while three animals were in Babile. The abattoir was visited six days per week in Jigjiga and Dire Dawa during all days of the week in Babile. Before sampling, each selected cattle were given an identification number by writing a code on its head using a permanent marker. Animal's age, sex, body condition score, breed were recorded at the screening stage. Body condition score was graded into three categories: good, medium, and poor. When an animal had fat covering all the ribs, it was categorized as good, while exposed rips with an emaciated body were regarded as poor. In between the two classes were medium-body condition animals. The age of the animals was categorized as young (< 4 years old), adult (4–8 years) and old (>8 years).

Meat inspection was made following the Ethiopian Ministry of Agriculture Meat Inspection Regulation procedures to detect *C. bovis*. For a thorough inspection, multiple incisions were made on the masseter muscle, tongue, heart, liver, kidney, lung, diaphragm, biceps and triceps on the thigh and arm muscle to expose the cysts in the carcass. Careful examination on the study unit's carcass was made through palpation of the organs followed by incision: the surface and substance of the tongue were examined visually, followed by longitudinal ventral incision from the tip of the root. An extensive deep incision was made into external and internal muscles of masseters parallel to the plane of the jaw (parallel to the jaw bone from the lower jaw). Visual inspection and longitudinal incision of the myocardium from base to the apex were made. Examination of kidney, liver, biceps and triceps of thigh and arm, intercostals muscle, diaphragm and the lung also were conducted accordingly by visualization, palpation and incision (MOA, 1972).

2.4.3. Laboratory examination

The cysts were appropriately collected, labeled and brought after seven hours to Jigjiga and Dire Dawa regional veterinary laboratory, after 30 min to Babile veterinary clinic laboratory using an icebox for further investigations. First, the viability of cysts was examined by placing them in a normal saline solution with 30% ox bile and incubated at 32 °C. Evagination of the unarmed scolex in viable cysts usually occurs within 1–2 h (Gracey et al., 2015). The cysts were then identified by microscope as *C. bovis* if they lack hooks and rostellum on the evaginated scolex with four suckers (Opara et al., 2006).

2.5. Data management and analysis

The data collected was entered, recorded and stored in Microsoft Excel spreadsheets program version 2010. The data was cleaned, coded and imported to STATA release 14 software (Stata Corp., College Station, Texas) for further statistical analyses. Associations of *C. bovis* and *T. saginata* with risk factors were assessed using odds ratio by logistic regression analysis. All predictors were checked for multi-collinearity in a cross-tabulation using Goodman and Kruskal's Gamma Statistic. Statistical significance level was set at $P < 0.05$ at 95% confidence level to determine whether statistically significant differences between the parameters measured. The backward elimination technique and likelihood ratio test statistics ($p > 0.05$) were dropped from the model based on Wald's test. All the remaining non-collinear variables were used to build the final model. The final model was assessed using the Hosmer and Lemeshow method for the goodness of fit and the receiver operating curve (ROC) for reliability (Dohoo et al., 2009).

3. Results

The overall prevalence of *C. bovis* was found 27.3% (95% CI, 24.6–29.9). From 1108 slaughtered cattle during the visit, 302 carcasses were infested. Regarding the study town, Jigjiga had the highest prevalence, followed by Babile, while Dire Dawa had the least carcass infection level. The differences are statistically significant ($p < 0.05$) (Table 1).

3.1. Risk factors for *C. bovis*

Univariable logistic regression analysis indicated that the prevalence of *C. bovis* was significantly associated with age, town and body condition ($p < 0.05$) (Table 2).

For multivariable logistic regression analysis, collinear predictors, namely, sex and breed category, were dropped from the model. All the remaining non-collinear variables were used to build the final model, and three predictors, namely site, age and body condition, were significantly associated with the prevalence of *C. bovis* ($p < 0.05$). Accordingly, cattle slaughtered in Jigjiga municipal abattoirs were more likely to harbor *C. bovis* in their carcasses than Babile and Dire Dawa municipal abattoirs. In addition, adults and cattle in good body condition were noted to have a higher prevalence than old and poor body condition (Table 3).

Analysis of the active abattoir survey showed a variation in the anatomic location of *cysticercus* in the organs inspected. As indicated in Table 4, the highest proportions of *C. bovis* were observed in the liver, followed by tongue, masseter, shoulder, arm muscle, heart, thigh muscle, and diaphragm. Of the total 686*C. bovis* collected during the study period, 289 (42.0%) were viable, while the remaining were not. Heart, shoulder and thigh muscles had the highest proportions of viable cysts, while masseter, liver and diaphragm had the lowest number of viable cysts (Table 4).

For questionnaire survey, 900 respondents were interviewed in Jigjiga, Babile and Dire Dawa towns. Based on respondents, Babile town had the highest infection with proglottids of *T. saginata* than Jigjiga and Dire Dawa. Of 432 infested respondents' more than half observed *T. saginata* proglottids in their stool, followed by observation of proglottids on their underwear and a small minority were laboratory diagnosed. From positive respondents, 246 infested once per lifetime, 89 twice per lifetime and 97 more than three times. Most of the participants who discovered proglottids self-medicated with drugs they bought prescription-free from the pharmacy, while others used local herbal drugs and only a smaller proportion of the respondents visited health care institutions for treatment (Table 5).

3.2. Risk factors of *T. saginata* in humans

Multivariable logistic regression analysis shows risk factors, namely butchers, FRM, civil servants and driver from the occupation, sex, marital status, educational status and raw beef consumption, were significantly associated with *T. saginata* ($p < 0.05$). Accordingly, butchers, non-educated, male, married and raw beef consumers are highly exposed (Table 6).

4. Discussion

The overall prevalence of *C. bovis* was 27.3% (95% CI, 24.6–29.9). The prevalence of *C. bovis* in the current study was higher than most of the recent and old findings in different areas of the country; 15.5% at Ambo (Bekele et al., 2017), 6.5% at Dale Wabera district western Ethiopia (Bayou and Taddesse, 2018), 4.94% in Kofale (Mekonnen, 2017). This could be due to the strict application of detailed meat inspection in the current study. Experimental studies showed a 5–50 times higher prevalence could be achieved by complete slicing of the predilection sites (Geysen, 2007). However, this study was comparable with the findings at Hawassa 26.3% (Abunna et al., 2008), and 30% from different abattoirs in the country (Solomon, 2012).

Multivariable logistic regression analysis indicated that *C. bovis* was significantly associated with study town (abattoir), age and body condition of animals ($p < 0.05$). Jigjiga town had the highest prevalence compared to Babile and Dire Dawa town abattoirs. The higher prevalence of *C. bovis* in Jigjiga may be related to cattle access to contaminated water and/or pastures. In addition, poor environmental hygiene, particularly open field defecation, can increase the prevalence of taeniasis (Laranjo et al., 2016).

The carcass of adult cattle had a higher prevalence of *C. bovis* than that of older ones which could be due to the subsequent development of active immunity that negatively affects cyst survival at an older age. Most cysticerci from initial calf hood infection may degenerate or disappear (Gracey et al., 2015). In countries where *T. saginata* is common, the frequency of cattle ingesting tapeworm ova will also increase. However, the survival of the parasite population depends on the intrinsic regulatory mechanisms of the host population as active immunity develops and the prevalence of *C. bovis* decreases progressively with age (Abuseir et al., 2013).

A higher number of non-viable cysts were collected than viable cysts, which could be due to the age of animals slaughtered in the study areas. Most of the animals slaughtered were old with subsequent development of active immunity; most cysticerci from initial calf hood infection might have degenerated. Active immunity develops and the viability and prevalence of *C. bovis* decrease progressively with age (Abuseir et al., 2013). Other cysts can be confused with *C. bovis* when the cyst is not viable. In such scenario, molecular methods are advised (Hailemariam et al., 2014; Terefe et al., 2014a, 2014b).

Table 1
Prevalence of *C. bovis* in Jigjiga, Babile and Dire Dawa municipal abattoirs.

Site	No sampled carcasses	No of positive carcasses	Prevalence (95%CI) *
Dire Dawa	384	69	18.0 (14.0–22.0) [a]
Babile	384	119	31.0 (26.0–35.6) [b]
Jigjiga	340	114	33.5 (28.5–38.6) [b]
Overall	1108	302	27.3 (24.6–29.9)

* Different superscripts within the same column are significantly different ($p < 0.05$).

Table 2
Univariable logistic regression analysis of risk factors for *C. bovis* (Variable with **a** and **b** superscript are collinear).

Variable	Categories	No. of sampling	Prevalence (95% CI)	Odds Ratio (95% CI)	*p*-value
Age	Old	576	22.4(19.0–25.8)	Reference	–
	Adult	532	32.5(28.5–36.5)	1.7(1.3–2.2)	0.000
Sex [a]	Male	611	31.7(28.0–35.4)	Reference	
	Female	497	21.7(18.1–25.4)	0.59(0.4–0.8)	0.000
BCS	Good	873	31.6(28.5–34.7)	Reference	–
	Poor	235	11.1(7.0–15.0)	0.27(0.2–0.4)	0.000
Breed [b]	Local	1064	28.3(25.6–31.0)	Reference	–
	Cross	44	2.3(0.1–12.0)	0.1(0.01–0.4)	0.005
Study town [a b]	Dire Dawa	384	18.0(14.0–22.0)	Reference	–
	Babile	384	31.0(26.0–35.6)	2.0(1.5–2.9)	0.000
	Jigjiga	340	33.5(28.5–38.6)	2.3(1.6–3.2)	

Table 3
Multivariable logistic regression model for potential predictors of *C. bovis.*

Variable	Categories	OR (95%CI)	p-value
Study town	Dire Dawa	Ref.	–
	Babile	1.9(1.3–2.8)	0.000
	Jigjiga	2.5(1.7–3.6)	0.000
Age	Old	Ref.	–
	Adult	2.7(2.0–3.7)	0.000
Body condition	Good	Ref.	–
	Poor	0.3(0.2–0.4)	0.000

Hosmer-LemeshowX^2 = 4.49, p-value = 0.7224, ROC = 0.6803.

Table 4
Frequency distribution of *C. bovis* in different organs (n = 1108).

Organ inspected	No. of positive organ	Prevalence	Total no of cyst on organ	No. of viability	No. of non-viability	Cyst viability per organ %
Tongue	94	8.5(6.8–10.1)	162	72	90	44.4
Shoulder	48	4.3(3.1–5.5)	93	54	39	58.0
Masseter	56	5.0(3.8–6.3)	89	26	63	29.0
Heart	26	2.3(1.4–3.2)	52	31	21	60.0
Liver	106	9.6(7.8–11.3)	194	50	144	26.0
Diaphragm	4	0.4(0.1–0.7)	5	1	4	20.0
Thigh muscles	20	1.8(1.0–2.6)	40	21	19	52.0
Leg muscles	28	2.5(1.6–3.4)	51	34	17	67.0
Total	382	34.5(25.5–43.1)	686	289	397	42.0

Table 5
Frequency of observing proglottids of *T. saginata* in Babile, Jigjiga and Dire Dawa towns.

Variables	Variable category	Number of respondents	Number of positives	Frequency of observing a tapeworm infection (95% CI)
Study town	Dire Dawa City	300	133	44.3(38.7–50.0)
	Babile town	300	155	51.6(46.0–57.3)
	Jigjiga town	300	144	48.0(42.4–53.7)
Proglottids spotted on	On underwear	432	174	40.3(35.6–45.1)
	In stool	432	228	52.8(48.0–57.6)
	On laboratory	432	30	6.9(4.7–9.8)
Frequency of infection	Once per lifetime	432	246	56.9(52.0–61.7)
	Twice per lifetime	432	89	20.6(16.9–24.7)
	More than three times	432	97	22.4(18.6–26.7)
Treatments	Health centers/hospital/ clinic	432	66	15.3(12.0–19.0)
	Pharmacy	432	222	51.4(46.6–56.2)
	Local herbal	432	144	33.3(28.9–38.0)
	Total	900	432	48.0(44.7–51.3)

Table 6
Multivariable logistic regression model for potential predictors of proglottids of *T. saginata.*

Variable	Categories	Number of infested	OR (95%CI)	p-value
Occupation	Civil servant	110	Ref.	
	Laborer	66	0.9(0.4–2.2)	0.075
	Food-related merchant	137	2.6(1.2–5.9)	0.015
	Student	19	1.0(0.4–2.3)	0.089
	Butcher	38	5.9(1.3–27.4)	0.022
	Non-food related merchants	53	0.4(0.2–1.1)	0.091
	Driver	9	0.02(0.01–0.05)	0.001
Sex	Female	147	Ref.	
	Male	285	3.4(2.1–5.8)	0.001
Marital status	Married	318	Ref.	
	Single	114	0.1(0.07–0.2)	0.001
Education	Elementary	164	Ref.	
	High school	76	0.2(0.1–0.5)	0.001
	College	123	0.4(0.2–0.8)	0.016
	Non-Educated	69	2.7(1.2–6.4)	0.021
Raw beef eating habit	Yes	382	Ref.	
	No	50	0.01(0.01–0.02)	0.001

Hosmer-LemeshowX^2 = 393.68, p-value = 0.6103, ROC = 0.9499.

The commonly inspected organs for *C. bovis* were liver, heart, shoulder muscle, thigh muscle, leg muscle, lung, tongue, kidney, masseter, diaphragm, and intercostal muscles. The highest proportions of *C. bovis* were observed in liver 9.57%, followed by tongue 8.48%, masseter 5.05%, shoulder 4.33%, arm muscle 2.53%, heart 2.35%, thigh muscle 1.81% and diaphragm 0.36%.

Among the 900 respondents interviewed in Jigjiga, Babile and Dire Dawa towns, 432, 48.0% (95% CI, 44.7–51.3) had contracted *T. saginata* infection throughout their lives. Socioeconomic and cultural practices such as backyard slaughter and consuming "Wosla" might contribute to the higher prevalence of *T. Saginata.* Wosla is the traditional food mainly consumed by Somali and eastern Oromo populations in which the whole muscles were allowed to be cooked without cutting or chopping. Sometimes deep-rooted cysts in the muscle may pass undercooked and result in contracting an infection in humans. In France, it was estimated that one undetected carcass could potentially infest between eight and 20 humans (Dupuy et al., 2014).

Multivariable logistic regression analysis indicated that *T. saginata* was significantly associated with occupation (Butchers, food-related merchants (FRM), civil servant and Driver), sex, marital status, educational status, age, and raw beef consumption behavior ($p < 0.05$). We found that butchers had six times higher odds of exposure and food-related merchants had 2.6 times higher odds of infection for *T. saginata* than civil servants. Furthermore, non-educated participants had 2.7 times higher odds of exposure than educated groups with the prevalence of 70.4% non-educated, 62.1% elementary, 42.5% high school, 34.3% college/university. Education can be considered one of the critical factors influencing continued involvement in preventing and controlling cysticercosis (Elizandro and Maria, 2016). Regarding sex males had 3.4 higher odds of exposure than females, which can be due to the cultural and social factors in which the males are usually involved in slaughterhouses and butchery and access to hotel meals (Deressa et al., 2012). Furthermore, married individuals had ten times higher odds of exposure than singles, which can be due to married people having the strong economic power to visit the butchers and restaurants mostly than singles (Bekele et al., 2017). Also, raw beef consumers had a 77% higher rate of exposure than raw beef non-consumer. Previous reports from Ethiopia also indicated that consumption of raw beef was strongly associated with *T. saginata* infection.

Most of the positive respondents witnessed infection once per lifetime in their stool and underwear. Respondents confirmed that they do not consume pork meat due to religious purposes, so the proglottids observed were doubtless to be of *T. saginata* and also, *T. saginata* is known for its more frequent anal expulsion than *Theridion solium* (WHO and FAO, 2005). In the present study, self-medication was higher than consulting health professionals to treat the infection they observed, which have to be prohibited to avoid the development of drug resistance. Even though half of positive respondents were aware of human taeniasis and its transmission mode, they still consume raw beef dishes like *kurt* and *kitfo,* which contributed to the higher burden of the disease in the country.

5. Conclusions

The current study assessed the prevalence of *C. bovis* and *T. saginata* in cattle and human populations, respectively. The prevalence of *C. bovis* in cattle and *T. saginata* in humans were high. The prevalence of *C. bovis* was associated with age, body condition and site, while the prevalence of *T. saginata* in humans was associated with occupation, educational status, marital status and raw beef consumption habits. Poor meat inspection procedures and raw and undercooked meat consumption were common in the study area. Slaughter rooms are small, government enforcements are weak and backyard slaughtering was practiced. Besides, large numbers of animals were inspected with one meat inspector. The practice of self-medication was high in positive respondents than consulting health professionals for treatment complicating the disease's impact further to drug resistance. To reduce the impact of the disease, a coordinated one health intervention is highly advised. Behavioral change in human consumers and also limiting human sewage reaching cattle to breaking the life cycle of *T. Saginata* is necessary to lower the impact of the disease in the country.

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Author's contribution.

AA, designed the study, did part of the fieldwork, laboratory works, drafted the manuscript and participated in the write-up. BS, analyzed the data, supervised the study, enriched the manuscript. AA, analyzed the data, wrote the manuscript. All authors have read and approved the manuscript.

Conflict of interest

The authors declare that they have no conflict of interest.

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