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Metacestodes in Cattle Slaughtered at Shashemene Municipal Abattoir, Southern Ethiopia: Prevalence, Cyst Viability, Organ Distribution and Financial Losses

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Abstract: A retrospective study and active abattoir survey were conducted from December 2011 to May 2012 to estimate prevalence of metacestodes, evaluate organ level distribution of the cysts and estimate associated financial losses in cattle slaughtered at Shashemene Municipal abattoir, Southern Ethiopia. 405 cattle showed a prevalence of 10.1% *C.bovis* and 50.1% hydatid cyst and double infection of 8.4%. Of 78 positive organs for *C. bovis* cyst, 32 were tongue while of 178 recorded *C. bovis* cyst, large number (n=77) was recorded in heart. Laboratory results revealed that, of 157 non-calcified *C. bovis* cysts, 33.7% were viable. Lung was also found to be the preferable organ for hydatid cyst (62.5%, 163/405). Of 1490 recorded hydatid cyst, 813 were non-calcified of which, 75.6% (615/813) were fertile. From 615 fertile cysts, 16.9% were viable and 58.8% were non-viable. The rest 24.4% were sterile. The retrospective data of 17,187 slaughtered cattle during 2010 and 2011 also revealed the prevalence of *C. bovis* to be 11.9% and 10.9%; and *hydatid cyst* 51.3% and 49.5%, respectively. Of 61 interviewed respondents, 45.9% contracted *T. saginata* and there was association between the parasitism and religion (p=0.022, OR=3.6), occupation (p=0.000, OR=32.7) and age (p=0.021, OR=5.3). The overall financial loss due to hydatid cyst was 117,060 ETB (6,727.6 USD). The cost of drugs for the treatment of taeniasis during the three years was 192,071 ETB (11,038.6 USD). The financial loss and the significant distribution of metacestodes in the area need attention as well as intervention by different stakeholders.

Key words: Hydatidosis · Cysticercosis/taeniasis · Prevalence · Cyst viability/Fertility · Shashemene · Ethiopia

INTRODUCTION

Even though Ethiopia owns large number of livestock population, this huge potential wealth is untapped to the livelihood of village farmers and the contribution to national economy at large mainly due to the abundantly occurring infectious and parasitic diseases in the country [1]. Among the parasitic diseases metacestodes of *Taenia saginata* and *Echinococcus granulosus* are the most important ones because they have economic as well as public health significance [2-5]. The clinical effect of Bovine cysticercosis on infected animals is generally not significant but it is more important with regard to high economic losses due to the condemnation of heavily infected carcasses and its public health impact. Most incidents arise as a result of direct exposure to proglottids shed from farm workers, but there have been some reports of large scale outbreaks resulting from sewage-contaminated feed or forage [6]. Globally, there are 77 million human carriers of *Taenia saginata* out of which about 40% live in Africa [7].. The prevalence of Taeniasis was 64.2% [4] and 50.6% [2] while that of Cysticercosis were 26.25% [3] and 11.33% [2]. On the other hand, Jobire *et al.* [5] found prevalence of 46.5%, 25.7% and 24.3% of hydatid cyst in cattle slaughtered in Ethiopia; Debre Zeit, South Omo and Gonder, respectively while Regassa *et al.* [2] reported the prevalence to be 15.42% at Wolaita Soddo. Even though some studies were conducted on the prevalence of cysticercosis and hydatidosis, there is lack of adequate information on the status of these

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metacestodes in the study area which necessitated this study. This study underlines the implications of the diseases status to the country and globally owning to increased human movement and livestock trade. Therefore, it was designed to estimate the prevalence of metacestodes, cyst viability, organ level distribution and related financial losses.

MATERIALS AND METHODS

Study Area: The study was conducted at Shashemene Municipal Abattoir, Oromia Regional State, Ethiopia, which was located at 250 km south of the capital city Addis Ababa. The area lies within the rift valley, with altitudes ranging from 1700 to 2600 masl [8].

Study Type and Animals: The types of study were both retrospective and cross-sectional active abattoir survey. In both cases, study population was cattle that were brought to the abattoir from different areas for slaughtering purpose mainly from the South and South-Eastern regions of the country (Arsi, Kofele and Negelle). The altitudes of these areas also vary from lowland to highland with different agro ecological conditions. On average 45 cattle were slaughtered at the abattoir per day.

Sample Size and Sampling Method: The sample size was calculated using the formula given by Thrusfield [9] and 405 animals were included in this study with the intention of maximizing the sample size to increase precision. The sampling procedure was carried out using systematic random sampling [9]. The number of slaughtered animal during the 6 months of the year 2010 was calculated to be 5400, as our current study period was also 6 months. The sampling interval was 13 (5400/405). Then the first animal was chosen randomly from the first 13 animals after which every 13 cattle was included in the sample during the slaughter operation.

Study Methodology: In the retrospective study, two years data of 17,187 cattle (8057 in 2010 and 9130 in 2011) were collected from the abattoir record from which the number and percent positive proportions of the affected cattle were summarized. The assessment of organ level distribution and area prevalence of hydatid cyst and *Cysticercus bovis* were made. Additionally, the estimated direct financial loss due to hydatid cyst by the condemnation of the affected organs was also calculated from the record.

In the case Cross-sectional active abattoir survey, both ante mortem and post mortem inspections were carried out in accordance with the procedures of Ethiopian Ministry of Agriculture [10. Detailed post mortem examinations of the organs and carcasses were carried out and pathological lesions were differentiated and judged in accordance with the guideline for meat inspection for developing countries [11]. The results were recorded and the decisions were classified as totally approved, partially approved, conditionally approved as fit for human consumption and totally condemned as unfit for human consumption [12].

During inspection, each predilection sites of the cysts in interest were carefully inspected. From each cyst positive carcass and organs, samples were collected for further laboratory tests. In line with this, for *Cysticercus bovis* cyst all types of cyst encountered were recorded and further the non-calcified cysts were taken to Veterinary Parasitology Laboratory at Hawassa University for viability test. *Cysticercus bovis* cysts were incubated at 37°C for 1-2hrs in a 40% ox bile solution diluted in normal saline. After this the scolex was examined under microscope by pressing between two glass slides. The cysts were regarded as viable if the scolex evaginate during the incubation period [13].

Cysts were examined macro- and microscopically. The non-calcified cysts were transported to the laboratory to confirm their fertility or sterility. Fertility was determined by microscopic detection of protoscoleces in aspirated cyst fluid. Sterile or degenerated (calcified or caseated) cysts were classified as infertile. The presence (known as fertile cyst) and absence (known as infertile cysts) of brood capsule containing protoscolices in hydatid fluid is important for this classification. Fertile cysts were also further subjected for viability test and classified as dead or alive. The viable protoscolices should completely or partially exclude the dye while the dead one takes it up [14].

The diameters of the cyst were classified into three categories: small (<5cm), medium (between 5-10cm) and large (>10cm). The cyst volume was also classified into three categories based on the content: low (volume < 6ml), medium (between 6-20ml) and high (>20ml) according to the Oostburg *et al.* [15]. In addition, the monthly and annual occurrences of these parasitic infections were summarized for the study period.

Questionnaire Survey: This was conducted to assess the occurrence of taeniasis and associated risk factors and hence, 61 volunteer respondents were interviewed.

The potential risk factors such as sex, age, religion, education, occupation and resident were recorded. Occupationally high risk groups were those who had a strong relationship with meat, meat products and animals, such as, abattoir workers, butcher men, meat inspectors and farmers; whereas, the low risk groups were arbitrarily selected as those who do not have such a strong relationship such as other government and private workers. In this study the less educated group includes those who attend the informal and elementary education; and more educated ones those who attended high school and college level educations.

Different human pharmaceutical shops (drug stores) located at Shashemene town were invented for the amount of drugs sold and cost of drugs they sold for the treatment of human taeniasis. This is, annual adult dose of taenicidal drug sales (based on prescription and patient complaints) during 2009 to 2011 were gathered to analyze the socio-economic impacts of taeniasis in the area.

Data Management and Analysis: The collected data from records and from the active abattoir survey were entered in to Excel spread sheet. Then descriptive statistics were conducted to determine the prevalence of *C. bovis* and hydatid cyst, the proportion of the positive organs, anatomical distribution of the cysts and percentage of viable, sterile and fertile cysts. The outcome variables for the active abattoir survey and the retrospective study were cases of *C.bovis* and hydatid cyst detected during detail postmortem inspection at the abattoir and from the record, respectively. Questionnaire survey data were summarized using univariate and multivariable logistic regression analysis using STATA 9.0 statistical software [16]. For pharmaceutical inventories data were coded and analyzed. For total prevalence of animals examined, $P<0.05$ was considered statistically significant in all cases.

RESULTS

The percentage of animals found with *C. bovis* cyst was found to be 1.7% (7/405) while hydatid cyst infection was 41.7% (169/405) and the infection rate with both parasites (double infection rate) was 8.4% (34/204). Hence, the prevalence of *C.bovis* and hydatid cyst was found to be 10.1% (7+34 = 41/405) and 50.1% (169+34 = 203/405), respectively indicating relatively higher prevalence of hydatid cyst than *C. bovis*. Thus, the overall prevalence of metacestodes in cattle in this study, considering both the sole and double infection, was found to be 51.9% (7+169+34 = 210/405) as indicated in Table1.

The anatomical distribution showed that of the 78 organs positive for *C. bovis* cyst, 32 (41.0%) were tongue indicating it is a preferable predilection site for the cyst followed by heart (30, 38.5%), masseter muscle (15, 19.2%) and kidney (1, 1.3%). However, from the total 178 recorded *C. bovis* cyst, the large proportion (43.3%, n=77) was recorded in heart. Of these 178 cyst, the proportion of calcified cyst was found to be 11.8% (n=21) and the non-calcified cyst were 88.2% (n=157). Of these 157 non-calcified *C. bovis* cysts, 38.2% (60/157) were viable and 61.8% (97/157) were non-viable. From the 60 viable cyst, the highest proportion were recorded in heart (26, 43.3%) followed by tongue (23, 38.3%) and masseter muscle (11, 18.3%) with no viable cyst observed in kidney. Similarly, out of 21 calcified cysts higher numbers were also observed in heart (12, 57.1%) and tongue (9, 42.9%) (Table 2).

Of 261 organs positive for hydatid cyst, 163 (62.5%) were lung followed by liver (56, 21.5%), heart (16, 6.1%), spleen (15, 3.8%) and kidney (11, 4.2%) indicating that lung is a preferable predilection site for this cyst. Of the total 1486 recorded hydatid cyst, 673 were calcified and 813 were non-calcified. Based on the laboratory results, of the 813 non-calcified *hydatid cyst* 75.6% (615/813) were fertile of which 16.9% (137/813) were viable and 58.8% (478/813) were non-viable. The rest 24.4% (198/813) were sterile (Table 3).

Out of the total 813 non-calcified *Hydatid cyst*s, the proportions of cysts with low, medium and high volume based on the volume of the fluid contained in the cyst were 59.7%, 32.6% and 8.2%, respectively. Likewise, the proportions of small, medium and large sizes were 65.6%, 27.7% and 7.3%, respectively (Table 4).

Direct Financial Loss: The positive organs for *hydatid cyst*s around 261, most of them were partially condemned while others were totally condemned based on the extent of the lesion. 9 lungs (n=163) and 9 liver (n=56) were totally condemned while the rest lungs (154/163) and livers (47/56) were condemned partially as that of heart, spleen and kidney. Accordingly, of the total 131.69kg of the condemned weight 46.65kg, 78.46 kg, 3.54 kg, 1.61kg and 1.43kg were liver, lung, heart, spleen and kidney, respectively. There was an overall financial loss of 1535.15ETB (87.68 USD) as indicated in Table 5.

Retrospective study revealed that from the total 8057 and 9130 animals slaughtered in the year of 2010 and 2011, the prevalence of *C. bovis* cyst was found to be 11.9% and 10.9% while that of hydatid cyst was 51.3% and 49.5%, respectively. Based on the two years data, it was

Table 1: Prevalence of *C.bovis* and hydatid cyst in cattle slaughtered at Shashemene town (n = 405)

Parasites Species	Number positive	Infection Proportion	Number positive	Prevalence (95%CI)
C. bovis	7	1.7%	41 (7+34)	10.1 (7.4, 13.6)
hydatid cyst	169	41.7%	203 (169+34)	50.1 (45.1, 55.1)
Double infection	34	8.4%	34	8.4 (6.0, 11.7)
Total metacestodes	210	51.9%	210 (7+169+34)	51.9 (46.9, 56.9)

Table 2: Distribution and viability of *C. bovis* cyst in different organs of the study animals (n=405)

			Number (%) of non-calcified cyst (n=178)		
Organs inspected	No (%) of positive organs (n=405)	Total cyst counted	No (%) Viable	No (%) non-viable	No (%) calcified
Tongue	32 (41.0)	69	23 (38.3)	37 (38.1)	9 (42.9)
Masseter muscle	15 (19.2)	31	11 (18.3)	20 (20.6)	0 (0.0)
Heart	30 (38.5)	77	26 (43.3)	39 (40.2)	12 (57.1)
Kidney	1 (1.3)	1	0 (0.0)	1 (1.0)	0 (0.0)
Total	78 (19.3)	178	60 (33.7)	97 (54.5)	21 (11.8)

Table 3: Fertility and viability status of *hydatid cyst* in different organs (N=405 organs inspected)

			Non-calcified cysts			
			Fertile cyst			
Organs Inspected	No (%) Positive organs	No (%) of cyst	Viable	Non-viable	Sterile cyst	Calcified cyst
Liver	56 (21.5)	608 (40.9)	12 (2.0)	80 (13.2)	33 (5.4)	483 (79.4)
Lung	163 (62.5)	810 (54.5)	110 (13.6)	365 (45.1)	148 (18.3)	187 (23.1)
Heart	16 (6.1)	27 (1.8)	4 (14.8)	14 (51.9)	8 (29.6)	1 (3.7)
Spleen	15 (5.8)	20 (1.3)	10 (50.0)	7 (35.0)	3 (15.0)	0 (0.0)
Kidney	11 (4.2)	21 (1.4)	1 (4.8)	12 (57.1)	6 (28.6)	2 (9.5)
Total	261	1486	137 (9.2)	478 (32.2)	198 (13.3)	673 (45.3)

Table 4: The volume and size of the *non-calcified hydatid cyst* in the respective organs inspected at Shashemene municipal abattoir (N=817).

		Cyst volume (%)			Cyst size (%)		
Organs	No (%) cyst counted	Low	Medium	High	Small	Medium	Large
Liver	125(15.4)	94 (75.2)	22 (17.6)	9 (7.2)	99 (79.2)	17 (13.6)	9 (7.2)
Lung	623 (76.6)	334 (53.6)	235 (37.8)	54 (8.7)	340 (54.6)	229 (36.8)	54 (8.7)
Heart	26 (3.2)	24 (92.3)	2 (7.7)	0 (0.0)	25 (96.2)	1 (3.8)	0 (0.0)
Spleen	20 (2.5)	16 (80)	4 (20)	0 (0.0)	16 (80)	4 (20)	0 (0.0)
Kidney	19 (2.3)	18 (94.7)	1 (5.3)	0 (0.0)	18 (94.7)	1 (5.3)	0 (0.0)
Total	813	485 (59.7)	265 (32.6)	67 (8.2)	533 (65.6)	225 (27.7)	59 (7.3)

Table 5: Estimated financial loss of organs inspected for hydatidosis at the present study in Shashemene municipal abattoir

Organs inspected	No (%) of organs infected	Partially Condemned (No, weight)	Totally condemned organs (No. weight)	Total Weight of Condemned organs (Kg)	Price (ETB)
Liver	56	47 (19.65)	9 (27.0)	46.65	622
Lung	163	154 (62.46)	9 (16.0)	78.46	784.6
Heart	16	16 (3.54)	_	3.54	47.2
Spleen	15	15 (1.61)	_	1.61	24.15
Kidney	11	11 (1.43)	_	1.43	57.2
Total	261	243 (88.69)	18 (43.0)	131.69	1535.15

seen that the highest prevalence for bovine cysticercosis was recorded in February (14.7%) and June (14.6%) while the highest hydatid cyst occurrence was observed in July (56.3%) and September (53.0%) when the average of both years were considered (Table 6).

Of the total 1,955 *C. bovis* cysts (959 in 2010 and 996 in 2011) observed from the retrospective data, heart was the dominant organ in harboring the highest number of cyst (845, 43.2%) and likewise, out of 8654 recorded cystic echinococcosis (4138 I n 2010 and 4516 in 2011),

Table 6: Monthly prevalence of bovine cysticercosis and hydatid cyst in cattle during the year 2010 and 2011 in the Shashemene Municipal Abattoir, Ethiopia

	Number of slaughtered animals		Number (%) of affected organs by *Cysticercus bovis*		Number (%) of affected organs by Hydatid cyst	
Months	2010	2011	2010	2011	2010	2011
Sept.	905	952	106 (11.7)	76 (8.0)	483 (53.4)	501 (52.6)
Oct	1045	860	112 (10.7)	94 (10.9)	472 (45.2)	406 (47.2)
Nov.	745	729	86 (11.5)	74 (10.1)	392 (52.6)	334 (45.8)
Dec.	723	733	78 (10.8)	84(11.5)	365 (50.5)	395 (53.9)
Jan.	808	896	78 (9.7)	91 (10.1)	402 (49.7)	440 (49.1)
Feb.	273	758	39 (14.3)	113 (15.0)	107 (39.2)	418 (55.1)
Mar.	164	310	14 (8.5)	29 (9.3)	54 (33.0)	148 (47.7)
Apr.	374	549	55 (14.7)	66 (12.0)	168 (45.0)	235 (42.8)
May	817	950	96 (11.7)	102 (10.7)	470 (57.5)	434 (45.7)
June	522	680	84 (16.1)	92 (13.5)	317 (60.7)	296 (43.5)
July	852	933	114 (13.4)	95 (10.2)	482 (56.6)	523 (56.1)
Aug.	829	780	97 (11.7)	80 (10.3)	426 (51.4)	386 (49.5)
Total	8057	9130	959 (11.9)	996 (10.9)	4138 (51.4)	4516 (49.5)

Table 7: Average direct financial loss due to organs condemnation due to hydatidosis during the 2010 and 2011 at Shashamane Municipality abattoir, Ethiopia (N=10,609 condemned organs)

	2010			2011			
Inspected organs	No. (%) of Positive organs for *C.bovis*	No. (%) of Positive organs for Hydatid cyst	Loss in ETB due to hydatid cyst	No. (%) of Positive organs for *C.bovis*	No. (%) of Positive organs for Hydatid cyst	Loss in ETB due to hydatid cyst	Total loss in ETB due to hydatid cyst in the two years
Tongue	335 (4.2)	0 (0.0)	13400	312 (3.4)	0 (0.0)	-	15600
Masseter	242 (3.0)	0 (0.0)	7260	221 (2.4)	0 (0.0)	-	6630
Heart	382 (4.7)	502 (6.2)	8840	463 (5.1)	484 (5.3)	7,260	14205
Lung	0 (0.0)	2016 (25.0)	20160	0 (0.0)	2223 (24.4)	33,345	33345
Liver	0 (0.0)	972 (12.1)	9720	0 (0.0)	1144 (12.5)	22,880	22880
Spleen	0 (0.0)	472 (5.9)	4720	0 (0.0)	550 (6.0)	6,600	6600
Kidney	0 (0.0)	176 (2.2)	3520	0 (0.0)	115 (1.3)	2,300	2300
Total	959	4138	67,620	996	4516	72,385	101,560

Table 8: Factors associated with the prevalence of human taeniasis at Shashemene town during the six months of the study period.

Risk factors		Number interviewed	Number (%) positive	OR (95% CI)	P-value
Sex	Male	39	28 (71.8)	--	
	Female	22	0 (0.0)	**	**
Age:	<20	22	6 (27.3)	1	
	21-27	15	10 (66.7)	5.3 (1.3, 22.2)	0.021
	28-45	18	8 (44.4)	2.1 (0.6, 80)	0.261
	>45	6	4 (66.7)	5.3 (0.8, 37.1)	0.041
Religion:	Muslim	25	7 (28.0)	1	
	Christian	36	21 (58.3)	3.6 (1.2, 10.8)	0.022
Education:	Elementary & high school	33	14 (42.4)	1	
	College & above	28	14 (50.0)	1.3 (0.5, 3.7)	0.554
Occupation:	Low risk groups	40	9 (22.5)	1	
	High risk groups	21	19 (90.5)	32.7 (6.4, 167.9)	0
Resident:	Urban	48	22 (45.8)	1	
	Rural	13	6 (46.1)	1.0 (0.3, 3.5)	0.02

**All the 22 females had no history of taeniasis while most of the male 28/39 (71.8%) had the infection and as result no software output was observed during the analysis.

Table 9: Inventory of annual prescribed adult taenicidal drugs dose and their worth (2009 -2011) in Ethiopia Birr (ETB) at Shashemene town pharmaceutical shop, Ethiopia

	2009		2010		2011		Total	
Name of the Drug	Dose	Worth	Dose	Worth	Dose	Worth	Dose	Worth
Niclosamide	3272	6544	2748	6870	2329	5822.5	8349	19236
Praziquantel	951	2853	617	2468	507	2028	2075	7449
Albendozole	8393	25179	7847	35311	7817	35176	24057	95667
Mebendazole	9822	19644	9659	28977	7066	21198	26547	69819
Total	22438	54220	20871	73626	17719	64225	61028	192,071

4239 (49%) were observed on lung indicating that heart was the commonest predilection site for *C. bovis* while lung is for hydatid cyst. The calculated cost from the condemnation of 8654 organs due to hydatidosis during the retrospective study was found to be 115,525 ETB (Table 7). The losses due to cysticercosis was not possible to calculated based on the record data as the record could not reveal the condemnation rate due to this cyst.

Questionnaire Survey: Of the total 61 interviewed volunteer respondents at Shashemene town who engaged on various working environment, 45.9% (28/61) had *Taenia saginata* infection previously. Logistic regression analysis revealed the presence of significant differences in the prevalence of taeniasis among age (p=0.021), religion (p=0.022), occupation (p=0.000) and resident (p=0.02). In line with this, adults at age of 21-27 (OR=5.3, 95%CI=1.3, 22.2), Christian community (OR=3.6, 95%CI=1.2, 10.8), higher risk groups (OR=32.7, 95%CI=6.4, 167.9) and rural communities (OR=1, 95%CI=0.3, 3.5) had higher odds of acquiring taeniasis than other age group (<21, >27 years old), Musilims, low risk groups and urban communities, respectively. From this analysis, no significant association was observed between the occurrence of taeniasis and the level of education (Table 8).

During the inventory of pharmaceutical shops and health centers, the modern taenicidal drugs sold in those shops and centers were produced in the country or imported from abroad (Europe, USA, Far East and some other African countries). The total number of annual adult taenicidal drug doses and the respective total amount of worth during the three years were found to be 65,028 doses and 192,071.5 ETB, respectively. This study revealed the relatively high dose of Mebendazole (40.8%) followed by Albendazole (34.0%), Niclosamide (19.0%) and Praziquantel (3.2%) (Table 9).

DISCUSSION

It was recorded that bovine metacestodes had impacts on livestock and also had a zoonotic and socio economic importance. It has been reported to be wide spread and a common disease in Africa [17]. Ethiopia also shares the problem of parasitism on livestock production in the tropics. Bovine cysticercosis usually does not cause much morbidity or mortality among cattle, but it does cause serious economic problems in the endemic areas due to the condemnation of meat or down grading of carcasses [18] contributing to constraint in food security and safety. The economic losses as a result of a condemned and downgraded carcass are substantial [19]. In East Africa *T.saginata* cysticercosis has been reported as a wide spread and extremely common [20].

The 10.1% prevalence of *C. bovis* reported in the present study was found to be in agreement with some of the earlier reports in the country including the 11.3% prevalence from Wolita Soddo and 7.5% from Addis Abeba by Regassa *et al.* [2] and Kebede *et al.* [21]. respectively. On the other hand this finding was slightly higher than the 2.58% in Bahir Dar [22]. 2.98% from Nekemte [23]. 4.4% from Jimma [24]. However higher prevalence were also reported by Abunna *et al.* (26.25%) [3] in Hawassa, southern Ethiopia. These variations in the reported prevalence from different areas could be attributed to the real differences in the prevalence of *C. bovis* from area to area within a country [18]. difference in raw meat consumption habit, dose and viability of eggs and/or larvae consumed at different places [25]. Additionally, as gross mutilation lowers the marketability of carcasses and introduces contamination, in some cases owners do not allow multi incisions for the detail postmortem examination. This difference in the number of incisions made during inspection from abattoir to abattoir could result in this difference [18].

Concerning the anatomical distribution of the *C. bovis* cyst, some of the previous works [25] mentioned that there was no as such true predilection sites for *C. bovis* as the presence and number of cysts in any predilection sites varied greatly from animal to animal. On the other hand, it was explained that the parasite can migrate via the mesenteric venue to enter systemic circulation and then they filtered out to tongue, heart and masseter muscles as a preferred predilection site [26]. Similarly, the present study (both active abattoir survey and the retrospective study) reported that relatively higher percentage of these organs was affected by *C. bovis*. It was mentioned that the reason for the preference of these organs by this cyst could be due to the fact that there is relatively higher supply of arterial blood to the muscle in these organs [27]. Moreover, tongue is a conveniently more accessed organ during the slaughtering process than the rest of the organs. Furthermore, unlike other predilection sites of *C. bovis*, tongue and heart had no limitations upon incision for inspection and this could also be the reason for the slightly higher observed frequency of *C. bovis* on tongue and heart. It also appeared that several additional factors such as age, breed and geographical area and parasite strains determine largely the predilection sites in cattle [25]. Despite the relatively higher number of cysts found in the heart (77/178), majority of the cyst was found to be non-viable. Hence, this study support earlier reports that heart is not a suitable matrix for long term survival of the parasite due to the fact that cysts in cardiac muscle degenerate earlier than in skeletal muscle and degenerating cysticerci in the heart occurs more slowly than other sites. These facts are responsible for high number of degenerating cysticerci in the heart [28].

The quality of questionnaire is an important tool in individual cases and mass investigation for detection of *T. saginata* in the carrier population [29]. In the present study, the prevalence of human taeniasis was estimated based on the questionnaire. The interviewed respondents mentioned that they observed proglottids in their feces and underwear, which indicates the presence of human taeniasis (*T. sagintata*) [30]. Of interviewed individuals, 45.9% were previously affected with the disease which was slightly lower than the reports from Southern Ethiopia by Regassa *et al.* [2](50.6%) at Wolaita Soddo and Abunna *et al.* [4] (64.2%) in Hawassa town. Higher prevalence of 69.2% was also reported by Dawit [31] in Gondar, Northern Ethiopia and lower prevalence of 9.72% was reported by Abunna *et al.* [23] at Nekemte, Western Ethiopia. The reason of this variation may be related to the difference in habit/culture of consuming raw meat at the different areas.

The observed strong association between the prevalence of taeniasis and religion indicated the higher proportion of infection in the Christian community which is in line with the findings of previous researchers in different parts of Ethiopia. This could be justified by the fact that Christian communities favor raw meat consumption than Muslims of the country. Moreover, Christians celebrate several annual festivals with the tradition of raw meat consumption and these occasions certainly increase the chance of contracting taeniasis. Various reports in Ethiopia and the other reports from different parts of the world recorded the higher taeniasis prevalence in the high risk groups which is attributed to the fact that they usually come in contact with meat and meat products and could have higher possibility of getting infection of taeniasis than the low risk groups [2, 4,23, 31].

The transmission of *T. saginata* infection from animals to humans depends on the habit of eating raw or semi-raw meat dishes like “kitfo” in Ethiopia and in other countries like meat tartar shashlik in USSR [32], Baserterma in near East, Shishkebab and Tikka in India [33]. The significantly higher chance of occurrence taeniasis above age of 21 might be due to the fact that there is higher habit of raw meat consumption than the cooked one and youngsters below this age are not allowed to consume raw meat in most parts of Ethiopian society. From the total 22 interviewed females none of them were contracted taeniasis which indicated that females are less exposed. This result is in agreement with different reports in various parts of Ethiopia [31, 34] who reported that the higher prevalence of taeniasis in males than females. This could be attributed to the fact that there is strong discrimination of females on consumption of raw meat in the study area and other parts of the country. However, Gracey *et al.* [13] reported different finding that females found to be more prone than males in a ratio of 2:1. The significantly higher taeniasis occurrence in the rural communities of this study might be due to the backyard slaughtering system without the detail postmortem inspection in the rural area. Additionally, there is less habit for toilet utilization of the rural community as they use open flied including the grazing lands.

Despite the fact that the pathogenic significance of *C. bovis* is considered to be very low [35], human taeniasis has importance both in socio-economic and health aspects. However, evaluation of the economic aspects is very difficult particularly in developing countries like Ethiopia, where infected peoples use traditional herbal drugs to treat themselves. One of the possible sources of information to evaluate the economic feature is to carry out pharmaceutical shops inventory, which still cannot show the actual economic impact of the disease. In the current study, three years (2009, 2010 and 2011) data of adult taenicidal dose and its worth were collected from pharmaceutical records to estimate its financial loss. Thus, a total of 65,028 adult taeniasis doses and 192,071.5 ETB (11,038.6 USD) were found from the record. This is in agreement with the pharmaceutical shops inventory conducted by Abunna *et al.* [23] in Nekemte town, western Ethiopia from 2006 to 2010 who reported taenicidal drugs of 198,676 doses and 523,112 Ethiopian Birr. On the other hand, it is slightly lower than the four years (2004-2007) record report of 335,772 adult doses and 93.31USD worth by Regassa *et al.* [2] at Wolaita Sodo town, Southern Ethiopia. The differences could be due to difference in the prevalence of *T. saginata* infection from region to region of the country [18], variation in the habit of raw meat consumption, variation in personal and environmental hygiene, difference in the number of invented pharmaceutical shops and taenicidal drugs available in recorded form and variation on the number of years recorded for the drug at respective pharmaceutical shops. Generally, the result of current study and previous reports show that taeniasis diminishes the household financial resources, which can easily be controlled by avoiding raw meat consumption and using toilet.

Cystic echinococcosis, the parasitic zoonosis caused by *Echinococcus granulosus*, is of considerable public health and economic importance in areas where it occurs [5]. The prevalence of *hydatid cyst* in the current active abattoir survey at Shashemene Municipal abattoir was 50.1% (203/405) which is consistent with the findings of Kebede *et al.* [36] (48.9%) in Debre Markos and Jobre *et al.* [5] (46.5%) in Debre-Zeit. However, lower prevalence of 32.1%, 23.17%, 17.4% and 15.42% were reported in Northern [37], Western [23], North-eastern [38] and in Southern [2] parts of Ethiopia.

Similarly, lower prevalence of 19.4% [39] in Northern Turkana, Kenya was reported. Likewise, as meat inspection records are among the important sources of data to assess the prevalence of diseases in animals [40], the current retrospective study revealed the prevalence of hydatid cyst to be 51.3% (in 2010) and 49.5% (in 2011) which is in line with the previous studies in the country. The difference in the prevalence of hydatid cyst in different areas might be due to difference in the number of dogs, degree of meat inspection and access of hyenas to condemned organs due to improper disposal of infected organs. Moreover, difference in culture and social activities to dogs in different area may contribute to this variation. The difference might be attributed to the fact that there might be a difference in dog's exposure to the viscera of infected animals in these areas. Additionally problem of the society in having awareness about animals slaughtered at backyard implicit the high prevalence of *cystic echinococcosis* at the area.

Active abattoir survey indicated that *hydatid cyst*s were encountered predominantly in lungs (40.2%, 163/405) followed by liver (13.8%, 56/405) both in terms of the number of organs affected and number of cysts observed per organs. Similarly, the retrospective study showed that lung was the most frequently affected organ by hydatid cyst with 25.0% and 24.4% infection rate during the year 2010 and 2011, respectively. This could be attributed to the fact that lungs and livers possess the first great capillaries which were encountered by the migrating echinococcus onchosphere (hexacanth embryo) which adopt the portal vein route and primarily pass through pulmonary and hepatic filtering system sequentially before any other peripheral organ is involved. However, onchosphers which traverse these areas will reach the systemic circulation and then hydatid cyst can be found in many organs and tissues [21, 35, 36]. Lungs were more infected than liver and from single to 14 cysts were observed in a single lung of inspected study cattle. This was It has been stated that the relatively softer consistency of the lung tissue that allows the easier development of the cyst and this may be aggravated due to reduced immunological compatibility of animals at their older age of infection [36].

Higher numbers of medium (36.8%) and large (8.7%) sized cysts were found in lungs than in the liver while the liver harbored higher number of small sized (9.2%) and calcified (79.4%) cysts. The reason for higher percentage of medium and large sized cysts in lungs might be related to spongy consistency of the lung and allow easier development of the cyst [41] and the calcified cysts in the liver could be attributed to relatively higher reticulo-endothelial cells and abundant connective tissue reaction of the organ. The relatively higher proportion of small cysts in liver may be due to immunological response

of the host that might preclude expansion of cyst size [42]. *Hydatid cyst* condition tended to follow size dependent pattern in that most of the small cysts were calcified. This could be due to the host defense mechanism of dealing more efficiently with parasitic larvae at the early stage of development [43].

Concerning the seasonal occurrence of these parasitic diseases (*C.bovis* and *hydatid cyst*), the retrospective study revealed their existence throughout the year with some variations in the occurrence rate. This could be attributed to the long period of development of the parasites which takes 3-10 months for the infection to be established in the muscle and organs of the animal and the ability of the cysts to survive long periods for about 9 years once established [20].

In the current active abattoir study, an estimated financial loss of 1379.65 ETB (79.3USD) were observed due to by organs condemnation by the effect of hydatidosis. Affected organs were condemned either partially or totally based on the degree of infestation. In this study, except 9 lungs (n=163) and 9 liver (n=56), all others are condemned partially through trimming. The weight of organs condemned as a result of hydatidosis were; 46.7kg for liver, 78.5kg for lungs, 3.5kg for heart, 1.6kg for spleen and 1.4kg for kidney which disrupted the profit obtained and also indicated the significance of the disease at the study area. Examination for the cyst fertility and viability revealed that the fertility rate of cysts was higher in lungs than liver which is in agreement with the result of previous reports in different parts of Ethiopia [22, 36, 37]. The variation in fertility, sterility and calcification rate could be attributed to the strain difference of the parasite, immune status of the animal and longevity of animal infected with the parasite [44]. Likewise, the estimated direct financial loss calculated from retrospective data due to organs and/or carcass condemnation by *hydatid cyst*s was 169,180 ETB (9,7723 USD). This indicated the importance of metacestodes at the area not only from the public health point of view but also from the impact on the economic aspect.

In conclusion, the active abattoir survey and the retrospective study, the drug shop inventory and questionnaire survey result of this study indicated the importance of metacestodes these diseases in the study area. In addition to financial loss from treatment cost and socio-economic impacts of the parasites, the study also revealed a significant financial loss due to condemnation of organs and/or carcass condemnation. The continuous existence of metacestodes in the study area alarm different stakeholders to look and improve methods to control and prevent the disease.

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