

Assessment of Bovine Tuberculosis like Lesions and Its Risk Factors in Cattle Slaughtered at Hawassa University and Municipal Abattoirs, Southern Ethiopia

Keywords: Ante and post mortem examinations; Bovine tuberculosis like lesions; Hawassa abattoirs; Risk factors

Abstract

Background: a cross sectional study was conducted on 753 Cattle, selected using systematic random sampling technique, in Hawassa abattoirs, Southern Ethiopia from December 2015 to May 2016 to investigate the occurrence of Bovine Tuberculosis in animals slaughtered at Hawassa University and Municipal Abattoirs, and to identifying the potential risk factors, Southern Ethiopia. The methods used were ante mortem, to identifying the risk factors, and postmortem examinations, to determining the bovine tuberculosis like lesions.

Result: the overall prevalence of the bovine tuberculosis was 5.8% (95% CI: 4.16-7.52) on the basis of detailed postmortem examination. Multivariable logistic regression analysis identified age, body condition; breed and market were statistically significant. The older cattle above 8 years were eighteen times (OR = 18.25) more likely to have tuberculosis than the younger cattle. The cross breeds were nine times (OR = 9.75) more sensitive to *M. bovis* as compared to local breeds as well as the poor body conditioned cattle forty-one times (OR = 41.21) more likely to have tuberculosis than the cattle have good body condition. Relatively, the occurrence of BTB was higher in cattle brought from Hawassa (OR = 13.17) and Borena (OR = 9.41) markets than Tula market. The lesions were found most frequently distributed in thoracic cavity lymph nodes (75%), which indicated that respiratory route was the main mode of infection in the study area.

Conclusion: Using the gross pathological lesion this study shows that low overall prevalence of bovine tuberculosis in sampled animals.

Introduction

Tuberculosis (TB) is a chronic pulmonary disease which threatens to animal and human causing high morbidity, economic losses and mortality [1-3]. Since TB is a major health threats particularly in developing countries, it has been declared as global emergency by the World Health Organization in 1995 [4]. TB causes death in each year among millions of people as a result it ranked as globally a second leading disease from the infectious disease next to human immunodeficiency virus (HIV) [5]. TB is a leading killer among adults in the most economically productive age groups and people living with HIV, and even those cured from TB can be left with lifetime sequelae that substantially reduce their quality of life [6,7].

Bovine tuberculosis (BTB) is among the principal zoonotic diseases caused by *M. bovis* which affects many vertebrate animals and humans and characterized by progressive development



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of granulomas/ tubercles in tissues and organs [8-15]. Bovine tuberculosis has been widely distributed throughout the world and has been recognized from 176 countries as one of the important bovine diseases causing great economic loss in animal production [16].

Bovine tuberculosis affects broad range of mammalian alian hosts including humans, cattle, deer, pigs, domestic cats, wild carnivores and omnivores [17]; it rarely affects equids or sheep [18,19]. Moreover, human TB of animal origin caused by *M. bovis* is becoming increasingly evident in developing countries [20,21]. The productivity efficiency of the infected animal reduced from 10-25%; the direct losses due to the infection decreases in milk production 10-18% and meat production 15%. BTB has both the effect in animal production and public health importance [22,23].

In developing countries like Ethiopia, the low standard living areas and socio-economic situation for both animals and humans are more contributing in TB transmission between human to human and human to cattle or vice versa [24,25]. Organisms are excreted in the exhaled air, in sputum, feces (from both intestinal lesions and swallowed sputum from pulmonary lesions), milk, urine, vaginal and uterine discharges, and discharges from open peripheral lymph nodes of infected animals [19,26]. Human infection by *M. bovis* is thought to be mainly through drinking of contaminated or unpasteurized raw milk. The potential for transmission of *M. bovis* and other mycobacteria between cattle and humans are the presence of close contact of animal and humans or the rural societies living together with their animals in the same microenvironment and house, raw milk and meat consumption habit, the prevalence of HIV increasing and HIV patient's susceptibility to TB [27]. In the areas where the bovine tuberculosis is common and the milk pasteurization is rare, *M. bovis* cases in human estimated 10-15% [28,29]. Thus, in cattle the main route of infection transmission: aerosol, close contact between animals and ingestion of contaminated products [30-33].

Bovine tuberculosis, is an endemic disease of cattle in Ethiopia with prevalence of 1.1%- 24.7% in abattoir and 3.5-50% in crossbreed

farms [27,34-36], like human TB has not received more focus on research and its control strategies plus the test and slaughter control strategies not applied, due to its economic constraints, but its applicable effective method in developed countries [37]. The epidemiology BTB is not well identified in livestock, inadequate comprehensive abattoir surveillance and lack of diagnostic facilities the BTB has limited information and the majority researches were focused at the central part of Ethiopia [38,39]. Hence, the epidemiology of BTB has to be assessed widely in all regions in order to embark the national BTB control program in the future. Therefore, this study was designed to assess the prevalence of bovine tuberculosis based on postmortem examination of slaughtered cattle at Hawassa University and municipal abattoirs and to evaluate the association between the potential risk factors and bovine tuberculosis.

Materials and Methods

Study area

The study was conducted from December 2015 to May 2016 in Hawassa University and municipal abattoir in Southern Nations Nationalities and Peoples Regional state (SNNPRs), Southern Ethiopia. This region has an estimated total area of about 112,323.19 km². Hawassa city is located in Southern part of Ethiopia, in Sidama Zone, on the shores of Lake Hawassa in the Great Rift Valley and located 270 km South of Addis Ababa. The city serves as the capital of the SNNPRs, and its total area is 157.21 square kilometers. It bounded by Lake Hawassa on the West and North-west, Chelelaka swampy area on the East and South-East, Tikur Wuha River on the North and Alamura Mountain on the South. It lies on the Trans-African Highway for Cairo-Cape Town, and has a geographic coordinate of 7°3' N latitude and 38°28' E longitude and an elevation of 1708 m.a.s.l. [40]. The livestock resource of the city is 61,123 cattle, 14,764 sheep, 17,735 goats, 5,544 equines and 56,961 poultry and the total population is estimated about 304,479 [41].

Hawassa city has two abattoirs: one municipality abattoir and second Hawassa University abattoir, in main campus. The Hawassa municipal abattoir supplies the inspected meat to about 304,479 inhabitants and based on the information obtained from personnel working in Hawassa University Registrar Office, the University's abattoir supplies for about 25,000 students (personal communication) [41].

Even though the abattoirs were fenced, the places used to dispose condemned carcasses were not secured since they were easily accessed by hyenas, dogs and other animals. The overall hygiene and the internal facilities including the drainage were not good in the Municipal abattoir whereas the University's abattoir was good. Even though the Municipal abattoir has recently built abattoir inside the compound, currently the slaughtering is performing in the old house. The minimum and maximum numbers of cattle slaughtered per day during the study period in Hawassa city Municipal abattoir were about 75 and 175 heads of cattle, respectively and about 8 and 12 heads of cattle were for Hawassa University abattoir, respectively. Few numbers of female cattle were also slaughtered in both abattoirs. The municipal abattoir was operated by one veterinarian and three assistant meat inspectors but the University abattoir was operated only by one assistant meat inspector (Personal communication to the

responsible bodies).

Study animal

A total of 753 apparently healthy adult cattle slaughtered in the abattoirs (Hawassa city municipal abattoir, n = 369 and Hawassa University abattoir, n = 384) regardless of sex, breed and origin were considered in the study. And the cattle used for this study were mainly originated from different markets (source of cattle); for the municipal abattoir were from Tula, Arsi Negele, Tukru Wuha, Wolayita, Harrar, Borena, Hawassa and Nazeriat (Adama) Markets and for University abattoir the origin were from Borena and Wolayita markets. Basic animal information on each study animals (such as sex, age, breed, body condition score, market) were collected and recorded during ante mortem examination. All the study animals in this study were cross and local breed.

Study design and sampling method

A cross sectional study with systematic random sampling was carried out to examine the carcass and sample suspected TB lesions from cattle slaughtered at Hawassa city municipal and Hawassa University abattoirs.

In these abattoirs, individual heads of cattle to be slaughtered were given identification number for proper recording of ante mortem and post mortem examination results. Selection of cattle population to be involved in the study was based on systematic random sampling, from among those cattle slaughtered each day, which was arranged in a systematic manner with each individual animal constituting a sampling unit. Systematic random selection of animals was made based on the arrangement that the population (cattle slaughtered each day) was first arranged in groups based on sampling interval (batch). This sampling interval was obtained by dividing the total animals slaughtered within that day by the estimated daily sample size. Each individual animal was then selected randomly from the first sampling interval (batch), then, every nth animal from the subsequent batch was included in the sample.

In Hawassa city municipal abattoir on average 20 carcasses were decided to be inspected each day (range from 15 to 25) from among those slaughtered cattle whereas in Hawassa University abattoir the whole cattle slaughtered in each day were considered for postmortem examination because the number of slaughter cattle was often fewer (range from 6 to 12) compared the Hawassa city municipal abattoir. The work was carried out in all the weekdays except Wednesday and Friday when animals were not slaughtered due to fasting occasions according to the belief of Ethiopian Orthodox Christianity.

Sample size determination

All animals coming to the abattoirs from different markets during the study period were considered for sampling. The sample size calculation was done by using the Thrusfield formula [42]:

$$n = \frac{1.96^2 \times p_{exp}(1 - p_{exp})}{d^2}$$

Where n = required sample size

p_{exp} = expected prevalence, 8.8% was for the Hawassa city municipal abattoir d = desired absolute precision, 5%

The expected prevalence, P_{exp} , of Hawassa city municipal abattoir was (8.8%) used from the previous works [43]. The calculated sample size for the municipal abattoir was 123 heads of cattle, but to increase the precision of the study this sample size multiplied three times, then $n = 369$ heads of cattle. Whereas the calculated sample size of the Hawassa University abattoir, P_{exp} considered as 50% because there was no previous study on bovine tuberculosis in this abattoir, was 384 heads of cattle. Thereafter, the total animals supervised in both abattoirs were 753 heads of cattle.

Ante mortem examination

Clinical examination was conducted on the study animals before they slaughtered; this included examining of superficial lymph nodes, visible mucus membrane, and other basic parameters [44]. Age determination based on dentition (teeth) as previously described [45,46] and the body condition of each of the study animal was scored using the guidelines established by Nicholson and Butterworth and Maurya et al. [47,48]. Accordingly, on the basis of observation of anatomical parts such as vertebral column, ribs, and spines, the study animals were classified as poor (score, 1 to 3), medium (4 to 6), or good (greater than 6). The breed, sex and source of the animals (markets) were recorded during ante mortem examination.

Post mortem examination

Post mortem examination was carried out according to the OIE and Meat Inspection and Quarantine Division of the Ministry of Agriculture method [49,50]. All lymph nodes, livers, kidney and lungs were visualized, palpated, and incised into a size of 2 mm to facilitate the detection of tuberculous lesion from each animal. These include the mandibular, medial retropharyngeal, cranial and caudal mediastinal, left and right bronchial, hepatic, mesenteric lymph nodes as well as the seven lobes of the two lungs, including the left apical, left cardiac, left diaphragmatic, right apical, right cardiac, right diaphragmatic and right accessory lobes were investigated. The animal was classified as suspected tuberculous lesion when tuberculous lesion was found, and if not as non-lesioned.

The severity of gross lesions in individual lymph node was scored as follows; 0 = no gross lesion, 1 = small lesion at one focus, 2 = small lesions at more than one focus and 3 = extensive necrosis as developed by Vordermeier et al. and Ameni et al. [51,52]. And for organs, the pathological scoring was scored separately as follows: 0 = no visible lesions; 1 = no gross lesions but lesions apparent on slicing of the lobe; 2 = fewer than five gross lesions; 3 = more than five gross lesions; 4 = gross coalescing lesions. The scores for the individual lobes were added up to calculate the lung score. The cut surfaces were examined under bright light for the presence of abscess, cheesy mass, and tubercles [53].

Statistical analysis

Prevalence of BTB was calculated as the proportion of suspected lesion positive animals from the total number of animals sampled [42]. Data related with age, sex, breed, markets source of animals and body conditions scoring of each animal were recorded on a data sheet during ante mortem examination. The recorded data was entered, stored, classified, coded and filtered using Microsoft Excel computer

program and was transferred and analyzed by STATA version 11 (STATA Corp. College station, TX). Presence or absence of TB like lesions and affected tissues (suspected lesions) were recorded during postmortem examination. The variations between different factors were analyzed using logistic regression and chi-square (χ^2) was used for association of different risk factors. P-value less than 5% was considered statistically significant. In cases of estimating the effect of different risk factors in terms of odds ratio (OR), to assess the strength of association of different factors with the prevalence of BTB, with corresponding 95% confidence interval, statistical significance was assumed if the confidence interval did not include one among its values.

Result

Prevalence and associated risk factors analysis

Upon detailed post mortem examination of 753 cattle, an overall prevalence of BTB was 5.84% (95% CI: 4.58 - 8.42). Out of the total 753 slaughtered cattle in both abattoirs, 675 (89.6%) were local breed and 78 (10.4%) cross breed whereas the prevalence of tuberculous lesion was higher in cross breed, 17.9% than local breeds, 4.4% and this difference in prevalence of BTB was found to be statistically significant ($\chi^2 = 23.18, P = 0.000$). Associations of the risk factors, the difference in prevalence of BTB in relation to body condition score, age, and markets were statistically significant ($\chi^2 = 118.64, p = 0.000; \chi^2 = 54.67, p = 0.000$ and $\chi^2 = 20.9, p = 0.004$) respectively (Table 1).

Table 1: Association of different risk factors with gross pathological lesion of bovine tuberculosis in Hawassa abattoirs, Southern of Ethiopia.

Variables	No of cattle examined	No of positive (%)	χ^2 Value	P-value
BCS				
Good	348	2(0.6)	118.64	0.000*
Medium	318	15(4.7)		
Poor	87	27(31)		
Breeds				
Local	675	30(4.4)	23.18	0.000*
Cross	78	14(17.9)		
Age				
≤ 5 years	210	1(0.5)	54.67	0.000*
>5 - ≤8 years	367	13(3.5)		
>8 years	176	30(17)		
Sex				
Male	664	38(5.7)	0.148	0.700
Female	89	6(6.7)		
Markets				
Tula	115	3(2.6)	20.91	0.004*
Tukur Wuha	59	0(0.0)		
Arsi Negele	62	2(3.2)		
Wolayta	153	9(5.9)		
Borena	305	25(8.2)		
Harrar	32	0(0.0)		
Nazeriat	2	0(0.0)		
Hawassa	25	5(20)		
Abattoirs				
HUA	384	31(8.1)	7.08	0.008*
HCMA	369	13(3.5)		

* = Statistically significant, BCS = body condition score, HUA = Hawassa University abattoir, HCMA = Hawassa city municipal abattoir.

Table 2: Univariate and multivariable logistic regression analysis of bovine tuberculosis lesion with various host related risk factors.

Variables	No. of cattle Examined	Positive (%)	Crude OR (95% CI)	Adjusted OR (95% CI)
BCS				
Good	348	2(0.6)	1	1
Medium	318	15(4.7)	8.56(1.94 - 37.75)*	7.05(1.49 - 33.22)*
Poor	87	27(31)	77.85(18.04 - 335.97)*	41.21(8.27 - 205.29)*
Breed				
Local	675	30(4.4)	1	1
Cross	78	14(17.9)	4.70(2.37 - 9.32)*	9.75(3.34 - 28.47)*
Age				
≤5 years	210	1(0.5)	1	1
>5 - ≤8 years	367	13(3.5)	7.68(0.99 - 59.09)	7.65(0.87 - 67.15)
>8 years	176	30(17)	42.94 (5.79 - 318.45)*	18.25(2.12 - 157.06)*
Sex				
Female	89	6(6.7)	1	1
Male	664	38(5.7)	0.84(0.34 - 2.05)	1.68(0.49 - 5.77)
Market				
Tula	115	3(2.6)	1	1
Tukur Wuha	59	-	-	-
Arsi Negele	62	2 (3.2)	1.24 (0.20 - 7.65)	2.40 (0.31- 18.51)
Wolayta	153	9 (5.9)	2.33 (0.62 - 8.82)	3.89(0.56 - 26.81)
Borena	305	25 (8.2)	3.33 (0.99 - 11.26)	9.41 (1.26 - 69.97) *
Harrar	32	-	-	-
Nazeriat	2	-	-	-
Hawassa	25	5 (20)	9.33 (2.07 - 42.18)*	13.17(1.96 - 88.42)*
Abattoirs				
HMCA	369	13 (3.5)	1	1
HUA	384	31 (8.1)	2.40 (1.24 - 4.67)*	0.45(0.11-1.87)

* = statistically significant, HUA = Hawassa University Abattoir, HMCA = Hawassa City Municipal Abattoir; BCS = Body Condition Score

Multivariable logistic regression analysis identified age, body condition; breed and market were statistically significant (Table 2). The cross-breed cattle (OR = 9.75, 95% CI: 3.34 - 28.47) slaughtered in the abattoirs nine times more sensitive to *M. bovis* than the local breeds and also the cattle brought from Hawassa and Borena markets had more likely bovine tuberculosis lesions thirteen times (OR = 13.17, 95% CI: 1.96 - 88.42) and nine times (OR = 9.41, 95% CI: 1.26 - 69.97) respectively than Tula market (Figure 1). Older cattle above 8 years had eighteen times the odds of being bovine tuberculosis lesion compared with the younger age group (5 or less than 5 years old) (OR = 18.25; 95% CI: 2.12 - 157.06). In relation to sex and abattoirs, there were no statistical significance differences of bovine tuberculosis lesion positive between groups.

Distribution of gross pathological lesions

Gross pathological lesions were observed in lymph nodes and organs of the slaughtered cattle; the majority of the lesions were considered typical of tuberculous lesions which characterized by central round, oval, or irregular, often coalescing areas of caseous necrosis and mineralization (calcification) (Figure 2). Large encapsulated nodules containing thick yellowish cheesy material were mostly observed in the thoracic lymph nodes. Whenever gross lesions of suggestive pathological lesions of TB noticed in any tissue; the tissue was classified as positive for TB.

According to the anatomical site, 75% (33/44) of the gross lesions were sampled from thoracic cavity followed by abdomen cavity and head region 13.64% (6/44) and 15.91% (5/44) respectively. 70.45% (31/44) of the gross lesions were collected from Mediastinal lymph nodes whereas only 11.36% (5/44) where obtained from mesenteric lymph nodes (Table 3 and Figure 3).

The pathological scoring analysis of the lymph nodes and organs described by the mean severity of lesion; retropharyngeal lymph nodes (3±0.408) was higher followed by mediastinal lymph node

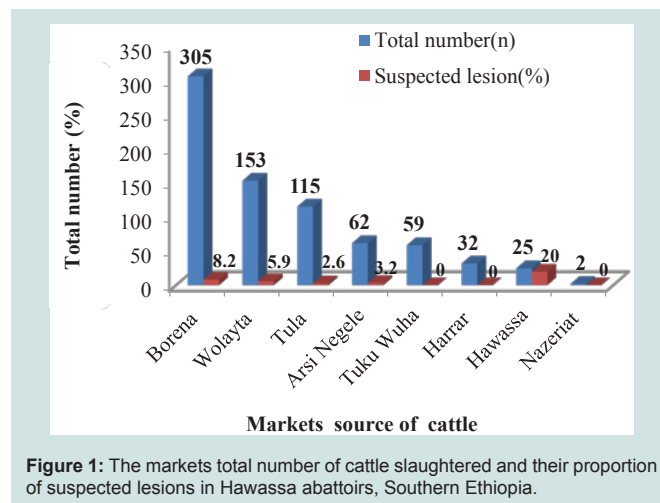


Figure 1: The markets total number of cattle slaughtered and their proportion of suspected lesions in Hawassa abattoirs, Southern Ethiopia.

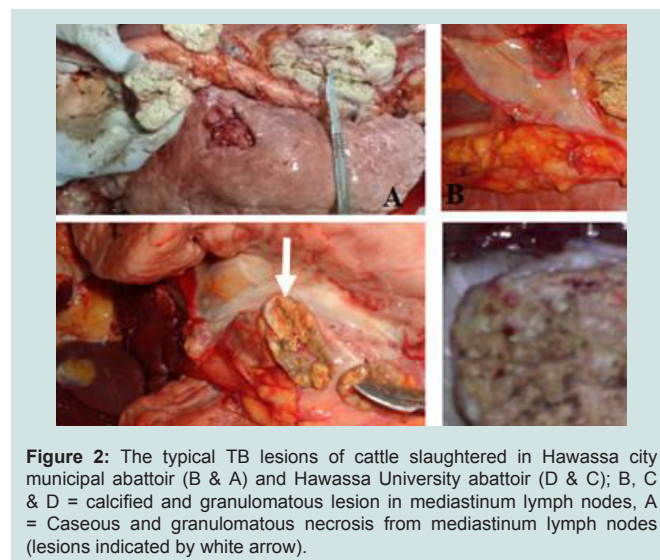


Figure 2: The typical TB lesions of cattle slaughtered in Hawassa city municipal abattoir (B & A) and Hawassa University abattoir (D & C); B, C & D = calcified and granulomatous lesion in mediastinum lymph nodes, A = Caseous and granulomatous necrosis from mediastinum lymph nodes (lesions indicated by white arrow).

Table 3: Lesion distribution in different organs and anatomic parts.

Anatomical Site	Affected organs	Frequency (%)	Total (%)
Head	Retropharyngeal LN	4 (9.09%)	6 (13.64%)
	Mandibular LN	2 (4.5%)	
Thorax	Mediastinal LN	31 (70.45%)	33 (75%)
Abdomen	Mesenteric LN	5 (11.36%)	7 (15.91%)
	Livers	2 (4.55%)	
Total		44 (100%)	44 (100%)

LN = Lymph Node

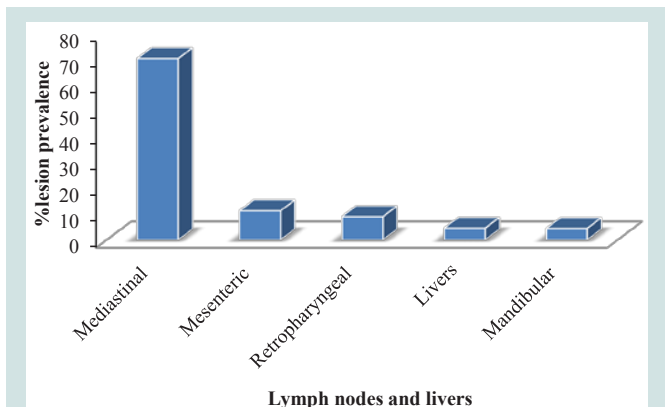


Figure 3: Proportion of lymph nodes and livers of TB suspected in 44 cattle with visible lesions.

Table 4: Mean pathology scoring of lesion from different lymph nodes and livers.

Tissues	Number Examined	Number (%)	Mean ± SE
Retropharyngeal	753	4 (0.53%)	3±0.41
Mandibular	753	2 (0.27)	1.50±0.50
Mediastinal	753	31 (4.12%)	2.9±0.15
Liver	753	2 (0.27%)	2.50±0.50
Mesenteric	753	5 (0.66%)	2±0.45

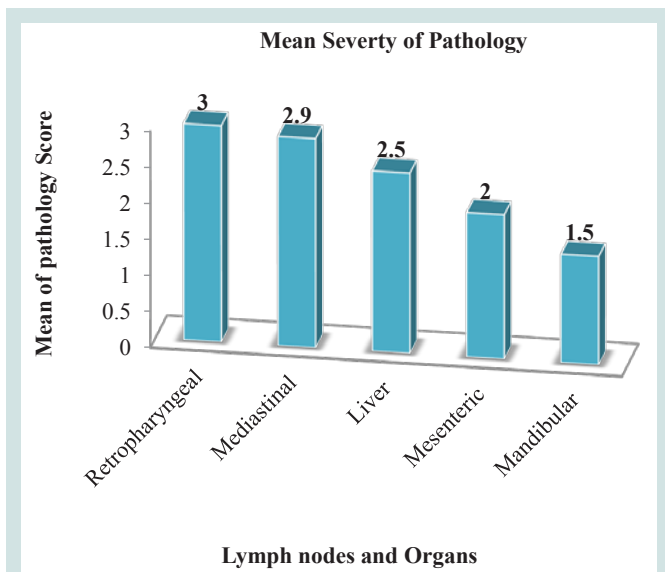


Figure 4: Mean severity of lesion in different lymph nodes and livers.

(2.9±0.149), Liver (2.5±0.50), mesenteric lymph nodes (2±0.447), mandibular (1.50±0.50) (Table 4 and Figure 4).

Discussion

Bovine tuberculosis is a chronic infectious disease of animals characterized by the formation of granulomas in tissues and its detection is carried out most commonly on the basis of tuberculin skin testing, abattoir meat inspection and rarely on bacteriological techniques. Bovine tuberculosis has serious economic significance to the livestock sector and public health hazard to human. Tuberculosis caused by *M. bovis* is clinically indistinguishable from tuberculosis caused by *M. tuberculosis* and the proportion of human tuberculosis caused by *M. bovis* is estimated to 10-15% [28,29].

Bovine tuberculosis, caused by *M. bovis*, is known to be endemic of most developing countries including Ethiopia. This result is consistent although the magnitude varies between livestock production system and breed of animals still nationwide epidemiological surveillance and control activities are often inadequate or unavailable in most developing countries [32,38,52].

In the present study, the overall prevalence of BTB was 5.84% (95% CI: 4.58 - 8.42) which is comparably in agreement with the findings of various researchers who reported prevalence of BTB 4.2% in Yabello municipal, 4.5% in Hosaana abattoir, 5.16% in Adama Municipality abattoir, 5.1% in Nekemte Municipality abattoir, 5% in Kombolcha ELFORA abattoir, 6.4% in Mekelle town municipal abattoir and 6.79% in Adama municipal abattoir as well as it was the same (5.8%) with research report of Romha et al. in western Tigray Zone [43,54-60]. However, the total prevalence of this study was lower than previous studies carried out by other authors; 11.50% by Abdurohman in Butajira, 9% Nemomsa et al. in Butajira abattoir, 8.8% by Biffa et al. in Hawassa municipal abattoir, 7.96% by Regassa in Wolayta, Southern Ethiopia and 24.7% in Adama municipal abattoir [35,61-63]. On the other hand, the finding of this study was higher than the results of Regassa et al. in Hawassa municipal abattoir (1.1%), Gebremedhin et al. in Dilla Municipal Abattoir (2.6%), Asseged et al. in Addis Ababa (1.48%) and Shitaye et al. in Addis Ababa (3.46%) [36,64-66]. This lower prevalence recorded in the present study could be due to the fact that animals slaughtered in the abattoirs were mainly local breeds (Zebu) (675 out of 753) which are relatively resistant to BTB [32]. This the variations in prevalence could be due to the possible difference in the epidemiology of the disease in the animal populations, markets sources of animal (from which they brought to abattoirs either from high BTB prevalent or their local BTB burden), body condition score of the animals and types of production system; The intensive livestock management system could contribute the development of mycobacterial infections than the extensive livestock management system [21,26,32].

The prevalence of BTB among the markets (source of cattle) and between the two abattoirs was statistically significant ($P = 0.004$, $p = 0.008$ respectively). Based on the post mortem inspection, the prevalence of TB lesions showed marked variation between the two abattoirs; the cases recorded in cattle slaughtered in Hawassa university abattoir was higher, 8.1% (31/384) than Hawassa municipal abattoir, 3.5% (13/369). Because most of the animal slaughtered at Hawassa University abattoir were from Boren area which might show

the high prevalence in the source [67]. The abattoirs have no effects in the development of the TB infection within that short period of time since TB is a chronic disease that needs long period of time. For this reason, the statistically significance of the abattoirs indicated that to the prevalence variation of the market source of cattle.

The prevalence of BTB of cattle brought from various markets which were source of cattle to both abattoirs was different; higher prevalence was observed in the cattle come from Hawassa market 20% (5/25); followed by the markets of Borena 8.2% (25/305), Wolayta 5.9% (9/153), Arsi Negele 3.2% (2/62) and Tula 2.6% (2/115) but there was no BTB in the cattle brought from the Tukur Wuha, Harrar and Nazariat markets. The source of cattle for Hawassa University abattoir were from Borena (275/305) and Wolayta (109/153) markets and also the source of cattle for Hawassa city municipal abattoir were from Borena (30/305), Wolayta (44/153), Tula (115/115), Tukur Wuha (59/59), Harrar (32/32) and Nazariat (2/2) markets. The cattle purchased from Hawassa market was (OR =13.17) thirteen times more likely to have the BTB than those cattle bought from Tula market. The infection rate in cattle has been found to differ greatly from place to place and the difference most probably linked to the type of production system (extensive), which is unlikely to favor the spread of the disease in contrast to the intensive dairy farms Grazing on the open field reduces the level of confinement and in turn minimizes the rate of infection in the herd [52,66,68].

The prevalence of bovine tuberculosis in this study showed a statistically significant difference among the age groups ($P = 0.000$). This result is in consistent with the reports of Gebremedhin et al. in Dilla Municipal Abattoir, Nemomsa et al. and Hussein in Butajira abattoir [62,64,69]. The occurrences of TB lesions in cattle were 68.2% (30/44) in the older cattle (greater than 8 years) than younger cattle, 2.3% (1/44) and adult cattle, 29.5% (13/44), age groups; this indicted as the age of the cattle increased the prevalence also increased. The older cattle (OR = 18.25) were eighteen times more likely to have the gross pathological lesions than the younger cattle. The results of the current research also agreed with findings of Barwinnek and Taylor, Ameni et al. Regassa et al. and Biffa et al. that explained as the age of the cattle increases the probability of acquiring TB infection also increases [32,36,70,71]. The reason can be by declining of protective capability in aging animals, have weaker immune system [72]; this is due to the fact that stresses, malnutrition and immunosuppression increase with age [73].

The difference in the prevalence of BTB among animals having different body condition scores was statistically significant ($P = 0.000$) and the prevalence was highest in cattle with poor body condition (31%) as compared to cattle with medium body condition (4.7%) and good body condition cattle (4.5%) which is in agreement with study resulted by Nemomsa [62]. The poor body conditioned cattle were (OR = 41.21) forty one times more likely to have the BTB compare to the good body conditioned cattle. This could due to related to the weak protective immune response in poor body conditioned cattle compared to good ones that may result extensive lesions and wasting of the body condition as well as its chronicity nature of the disease. The present result is in consistent with previous reports which indicated that animals with good body condition have relatively good immunological response to the infectious agent than

animals with medium and poor body condition score [22,26,74].

Variation among breeds in susceptibility to tuberculosis has been documented in Ethiopia and elsewhere and the result of this study agreed; was statistical significant between cattle breed and tuberculous lesion ($P = 0.000$) [52,75-77]. The prevalence of the BTB was being highest in cattle cross breed 10.36% (14/78) compared to cattle local breeds, 4.4% (30/675). The cross breeds (OR = 9.75) were nine times more sensitive to *M. bovis* (owned BTB lesions) as compared to local breeds. The finding of lower prevalence in the local/Zebu breed is in line with other previous studies which showed different breeds could result in difference in susceptibility to BTB infections. The difference susceptibility of BTB infection between breeds is likely to be related to differences in management: those genetically improved cattle are more prone to BTB infection than local breeds since they may suffer more severely from deficient housing and malnutrition [22,58,72,78-81].

The difference in the prevalence of BTB lesion between the two sexes was statistically insignificant ($P = 0.700$). BTB suspected slaughtered female and male cattle were 6.7% (6/89) and 5.7% (38/664) respectively. This insignificant result is in consistent with previous studies [33,54,65,76]. The possible reason might be due to in proportionality in the number of female and male animals compared in specific variable; less number of female animals was come to the study abattoir to be slaughtered.

The best evidence of the transmission route of *M. bovis* to cattle is the pattern of lesions observed in slaughtered animals [19]. In the present study, gross tuberculous lesions were found most frequently in lymph nodes of the thoracic cavity, 75% (33/44); followed by the lymph nodes of the head region, 13.64% (6/44) and the lymph nodes of the abdominal cavity 11.36% (5/44). The occurrence of tuberculous lesions in thoracic cavity was lower than the results of previous studies which reported greater than 84% TB lesions occurrence in the respiratory system [54,74,82-84]; whereas it was higher than the report of Dechassa (67.7%), Firdessa (70%), Miliano-suazo et al. (49.2%) and Regassa et al. (50%) [59,85,86,36]. As a result, this study indicated the main route of transmission and infection being respiratory route and this finding agreed with the previous researchers who reported the same route of transmission and infection, respiratory route [19,36,54,55,82,87,88].

Conclusion and Recommendations

The output of this study has indicated that an overall BTB prevalence of 5.8% of which 20%, 8.2%, 5.9%, 3.2% and 2.6% were recorded in these sampled animals come from Hawassa, Borena, Wolayta, Arsi Negele and Tula markets respectively. Even though the overall prevalence was low, high prevalence was found in animals which are older, poor body condition and cross breeds cattle. Similarly, relatively high occurrence of BTB was in cattle brought from Hawassa and Borena markets than Tula market. This could be indicating the presence of BTB infection in certain geographical areas. This research also shown that the respiratory route was the major means of BTB transmission among the cattle population and the higher mean severity of pathology among associated lymph nodes and organs was recorded in retropharyngeal and mediastinal lymph nodes. In conclusion, in this study the

gross pathological lesion findings could indicate the occurrence of BTB in those apparently healthy sampled cattle, a threat to livestock production and also for public health. Basis of findings the present study the following points are recommended:

Further investigation should be done by including wide geographical areas and large sample size to elucidate the epidemiological information on circulating strains, potential risk factors, ways of transmission and molecular diversity of the *M. bovis* strains as well as their zoonotic role in human.

A proper postmortem meat inspection should be practiced efficiently in the abattoirs before taking beef to the retail markets to reduce the public health risk.

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