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Review on current epidemiological status and public health importance of bovine tuberculosis in Ethiopia

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Abstract
The review conducted in these papers revealed the prevalence estimate of B. tuberculosis in Ethiopia was determined to be 5.8%. Bovine tuberculosis (BTB) is a known endemic illness of cattle in Ethiopia. The prevalence of intensive dairy production systems was higher (3.1-68%) than that of large livestock production systems (3.4-6.2%) and slaughterhouses (3.5-32%) in different regions of the nation. In Holstein-Friesians, the incidence was higher (14.7-30.7%) than in local zebus (3.4-4.9%) and was linked to genetic resistance. In comparison to the prevalence seen in the established dairy belt in the central areas of Ethiopia, particularly in and around Addis Ababa City, the review also revealed comparatively low average prevalence in the rising dairy districts. Because there are currently fewer animals affected in a smaller geographic area, disease control measures like milk pasteurization, meat inspection, raising awareness about the use of raw milk and milk products, regulating animal movement, and selective breeding for resistant traits will therefore be simpler, less expensive, and more effective to implement now than in the future. Finally, this analysis demonstrated therefore, it is recommended that these hotspots be given priority in the design and execution of BTB control methods in Ethiopia in order to lessen the disease's effects on the expanding dairy industry. The economic burden of the disease and the cost-effectiveness of these various control approaches both call for further study.

Keywords: Bovine tuberculosis, breed, prevalence, control, Ethiopia, geographic distribution

Introduction

Tuberculosis is communicable Mycobacterial disease caused by the *Mycobacterium* tuberculosis complex (MTBC) Pal (2014) [62]. According to recent research, *Mycobacterium* TB and *Mycobacterium bovis* have been isolated from bovine tuberculosis-infected humans and cattle, respectively (Zewed, 2014) [100]. Despite differences in host specificity, the members have 99.9% or more similarity at the nucleotide level and nearly identical 16s rRNA sequences (Brosch *et al*., 2002) [26].

According to the OIE (2016) [61], the illness is a contagious chronic disease of cattle that is primarily spread between animals by inhalation, although ingestion is also frequent in cattle that graze on pastures polluted with *M. bovis*. According to Ameni *et al*. (2010) [12] and Ejeh *et al*. (2013) [34], the socioeconomic situation and low level of living in Ethiopia are more conducive to the spread of disease. Human infection occurs primarily as a result of eating undercooked meat and drinking contaminated or unpasteurized raw milk. The likelihood of transmission between cattle and humans is increased by the high frequency of TB in cattle, close contact between cattle and humans, and the custom of consuming raw milk and meat (Shitaye *et al*., 2007) [76].

According to evidence, the disease reduces milk output by 10 to 18% and meat output by 15%, expenses for screening and culling infected animals, and restricts commerce (Müller *et al*., 2013) [57]. Given that people and animals share the same microenvironment and living spaces, particularly in rural regions, disease in humans is currently becoming more and more relevant in poor countries. In nations where pasteurization of milk is uncommon, *M. bovis* is thought to be the cause of 10 to 15% of human tuberculosis cases (Berg *et al*., 2015) [23].

Bovine TB eradication programs are in progress in several developed countries (CFSPH, 2009) [27]. Globally, the prevalence of the disease is estimated to be 9% based on the results of skin tests (Vorder *et al*., 2016) [96] and in Ethiopia reported prevalence ranges from 3.4% (in smallholder production system) to 50% (in intensive dairy productions) and 3.5% to 5.2% in slaughterhouses (Tigre *et al*., 2012) [104]. The available information is limited and fragmented as well as actual prevalence is at national level in the country is not well known due to inadequate disease surveillance program, socio economic impact and lack of better diagnostic facilities and fragmented articles (Asseged *et al.*, 2004) [18]. Consequently, the objective of the current systematic review is to provide.

- Current status and spatial distribution of BTB in Ethiopia based on the available reports
- To give an over view on the impact of bovine tuberculosis

Status of *bovine tuberculosis* in Ethiopia

According to the World Health Organization, Ethiopia is the tenth in the world, third in Africa, among the 27 MDR TB countries, and among the 22 high-burden TB countries, accounting for 81% of estimated cases (WHO, 2015) [105]. BTB in Ethiopia is most frequently detected through tuberculin skin testing, abattoir meat inspection, and rarely through bacteriological techniques. The compiled manuscripts for this review above 57 studies on PPD testing, 22 abattoir surveys paper on which all-peer reviewed were accessible online. Prevalence varies based on geographic regions, breeds, and husbandry techniques (Tschopp and Abraham, 2018) [94].

Prevalence in extensively managed production system and pastoral area

The extensive production system holds about 85% of the total livestock population of the country where as the Pastoral Production System denotes an economy that derives the bulk of its food supply from animals (milk and meat) using a variety of herding practices based on constant or partial herd mobility (oscillatory type of movement) in the low land areas of the country. Despite the presence of a huge livestock population, the actual prevalence of BTB is not known. According to Paulos (2018) [65] difficulties in sampling techniques and animal handling, combined with inadequate veterinary infrastructures are factors that hamper the process of the study. In pastoral areas in particular, the study process can be more complicated by the frequent movement of animals for water (watering points). Among the recently undertaken studies, the prevalence rate of BTB highest in Kombolcha, North shewa Zone whereas, Assella and Woldiya with the lowest. As general it ranges from 0.3 to 22.6% by in a traditionally managed extensive production system (Tschopp, 2015) [93] and at national level prevalence of 4.5% (in pastoral/agropastural) and 4.6% (highland extensive) production system in different study area (Sibhat *et al.*, 2017) [77]. The variation may be associated with sample size, accuracy of the test and geographical difference shown below in the table.

Table 1: Prevalence reports of *B. Tuberculosis* detected by tuberculin skin test in extensively managed production system including pastoral area of Ethiopia

Area of study	No of cattle			Reference
	Tested	**Positive**	**%**	
Afar	1087	119	11	Mamo, 2013 [52]
Afar	2550	140	5.5	Sintayehu *et al.*, 2016 [78]
Assella	584	2	0.3	Tschopp, 2015 [93]
Debre-birhan	76	11	14.5	Tadele, 1998 [83]
Bako-Gazer	492	9	1.8	Tschopp, 2015 [93]
Filtu (Somali)	421	8	2	Gumi, 2011 [46]
Woldiya	620	2	0.3	Tschopp, 2015 [93]
Kombolcha	53	12	22.6	Tadele, 1998 [83]
Western Ethiopia	460	19	4.1	Laval and Ameni, 2004 [51]
Dessie	34	4	11.8	Tadele, 1998 [83]
West-wellega	353	12	3.4	Regassa, 2005
North shewa Zone	1041	169	16.2	Regassa, 2005
North shewa (Oromia)	287	27	9.4	Ayana, 2013 [19]
Meskan	624	4	0.3	Tschopp, 2015 [93]
South Ethiopia	894	36	4.0	Spiess, 2011 [81]
Total	9576	574	5.99	

Prevalence in small holder production system

Dairy animals are raised for subsistence and/or commercial milk production purposes in highland areas close to towns, where the small holder production system is predominately used. Studies on BTB prevalence in this industrial system have not been done properly. Few cross-sectional studies conducted at different geographical area of the country by using tuberculin skin tests reported the prevalence rate ranges from 3.5% in Assela (Redi, 2003) [69] to 50% in Dirediwa (Kemal, *et al.*, 2019) [49] and the study conducted by Sibhat *et al.*, (2017) [77] at the national level shows prevalence rate of 4.6%. The prevalence in this production system increases in a chronological order which is associate with the expansion of exotic or cross breeds over the Bos tuars which agrees with Allen *et al.*, (2010) [9]. Statement Zebus are more resistant to BTB than high-producing European breeds, according to Benkirane (1998) [22], who also claimed that 48% of the variation seen in response to *M. bovis* infection is caused by host genetic diversity (Table.1).

Table 2: Based on a tuberculin test, the prevalence of *B. Tuberculosis* in small-scale dairy farms

Study Area	No of cattle			Reference
	Tested	Positive	%	
Harar	224	25	11.2	Kemal *et al.*, 2019 [49]
Dirediwa	58	29	50	Kemal *et al.*, 2019 [49]
Jigijiga	33	10	30.3	Kemal *et al.*, 2019 [49]
Gonder town	109	9	8.3	Shewatatek, 2015 [74]
Mekele town	480	54	11.3	Fikre *et al.*, 2014 [39]
Gonder zuria	180	14	7.78	Shewatatek, 2015 [74]
Guto Gidda District/E/wellega	295	24	8.14	Disassa *et al.*,2016 [32]
Dilla town	440	19	4.3	Romha *et al.*,2014 [72]
Holleta	381	25	6.4	Teshome,.1995 [90]
Selale	1528	18	5.1	Teshome,.1995 [90]
Wolayta-sodo	416	59	14.2	Regassa, 2005
Fiche	235	31	4.2	Gemta, 2000 [44]
Wuchale-jida	263	60	7.9	Ameni *et al.*,2003 [102]
Assella	514	18	3.5	Redi, 2003 [69]
Total	5156	395	7.7	

Notice *Comparative intra dermal test and **Single intra dermal test

Prevalence in Intensive production system

Although the total number of cattle in this production system is small in comparison to the entire number of animals in the country, it is the primary source of milk for city residents. Better prevalence studies have been conducted in comparison to other production systems, and more frequent instances and greater prevalence rates of BTB have been noted. Taking into account the completed tuberculin skin tests, rate of 24.3% to 65.8% (Ameni *et al.*, 2006) [103], and 22.9% (Ambaw, *et al.*, 2017) [10] and at the national level 16.6% (Sibhat *et al.*, 2017) [77] have been reported as we have analyzed the report on table 3 in Addis Ababa city the prevalence increases with time chronological order which is associated with expansion of dairy farms due to population overgrowth hence increments of milk and meat consumption.

Table 3: Prevalence of BTB detected by CIDT in intensive dairy farms

Area of study	No of cattle			Reference
	Tested	Positive	%	
Sululta district	858	98	11.4	Akililu *et al.*,2014 [7]
Holta state farm	363	83	22.9	Ambaw *et al.*,2017 [10]
Addis Ababa/C. Ethiopia/	2956	887	30	Firdessa, 2013 [42]
Addis Ababa	1132	386	34.1	Tsegaye *et al.*,2010 [95]
Mekele	50	27	38	Abie *et al.*,2017 [2]
Gonder town	28	9	17	Abie *et al.*,2017 [2]
Bahir Dar town	788	10	1.27	Nuru *et al.*,2015 [59]
Hawassa	22	5	11	Abie *et al.*,2017 [2]
Ambo	133	37	27.8	Ameni *et al.*, 2006 [103]
Adama	524	58	11.1	Amin and Erkihun, 2007 [11]
Bako-Gazer	582	5	0.9	Tschopp *et al.*, 2015 [93]
Asella	281	23	8.2	Alemu, 1992
Debre-Birhan	51	3	5.9	Tadele, 1998 [83]
Debre-zeit state farm	114	31	27.2	Ambaw *et al.*,2017 [10]
Debreziet	558	95	17.02	Meseret *et al.*,.2016 [55]
Adaberga state farm	243	5	2.1	Ambaw *et al.*,2017 [10]
Dessie	121	89	73.6	Ameni *et al.*, 2003 [102]
Holleta	70	17	24.3	Ameni *et al.*, 2003 [102]
Kombolcha	197	96	48.7	Tadele, 1998 [83]
Mojo	493	338	68.6	Teshome, 1996 [90]
Fitche	1041	167	16	Regassa *et al.*, 2010 [70]
Repi	481	310	64.4	Anonymous, 1999 [16]
Woldiya	1029	15	1.45	Aylate *et al.*, 2013 [20]
Sebeta	37	4	10.8	Ameni *et al.*, 2006 [103]
Sellale	44	3	6.8	Ameni *et al.*, 2006 [103]
Ziway	205	56	27.3	Ameni *et al.*, 2003 [102]
Eastern Ethiopia	316	64	20.3	Kemal *et al.*, 2019 [49]
Total	12717	2921	23.3	

Prevalence of *Mycobacterium bovis* at Abattoir House

In Ethiopia 20-30% of cattle is slaughtered in municipal abattoirs and thus undergoes a routine meat inspection (Etter *et al.*, 2006) [36]. The visible tuberculosis lesions on infected cattle are observed in order to identify tuberculous lesions; however, the standard of these procedures may differ from location to location and/or abattoir to abattoir within the nation, and studies have shown that not all *M. bovis*-infected cattle have visible tuberculous lesions at slaughter (Teklu *et al.*, 2004) [86]. Despite the fact that the detection of tuberculosis lesions through abattoir inspection is currently the standard practice in Ethiopia, this may restrict the sensitivity of this abattoir detection technique. Prevalence rates range from 3.5% (Akililu *et al*., 2014) [7] to 32.8% (Biffa *et al*., 2010) [24] in the investigations on abattoirs that have been conducted in different abattoirs in the country (Table 4).

Table 4: Prevalence of *B. tuberculosis* detected by abattoir meat inspection in cattle

City abattoirs	Examined	Positive	%	Reference
Sululta district	1107	39	3.5	Akililu *et al.*,2014 [7]
Gambella	500	66	13.2	Alemu *et al.* 2016 [8]
Butajira	446	40	9.0	Biratu *et al.*, 2014 [25]
Addis Ababa	509	91	17.9	Biffa *et al.*,2010 [24]
Nekemt	1183	70	5.9	Woyessa *et al.*,2014 [99]
Adama	486	33	6.8	Terefe, 2014) [88]
Yabello	415	18	4.3	Biffa *et al.*,2010 [24]
Hawassa	753	44	5.8	Tekle, 2016 [85]
Woldiya	1029	63	6.12	Tsegaye *et al.*,2010 [95]
Jimma	468	35	7.5	Tesfaye, 2017 [89]
Melge-wendo	1265	60	4.7	Biffa *et al.*,2010 [24]
Hawassa	403	88	21.8	Biffa *et al.*,2010 [24]
Hossana	751	34	4.53	Teklu *et al.*, 2004 [36]
Kombolcha	57965	265	0.46	MoA, 2001 [56]
Nazareth	1125	58	5.16	Ameni and Wudie, 2003 [102]
Wolaita-Sodo	402	32	7.96	Regassa, 2005
Total	68807	1036	7.7	

Prevalence of B. tuberculosis based on breed of animals at the national level

Frequency of BTB in Ethiopian cattle. According to the results section below, prevalence of 21.6% for Holstein-Friesian cattle and 9.9% for crosses were significantly higher than the prevalence of 4.1% for zebu cattle. This supports the idea that genetic factors may influence a cattle's susceptibility or resistance to BTB (Finaly *et al.*, 2012) [40]. Studies done in Ethiopia in this area showed that Holstein-Friesian cattle had higher prevalence and severity of TB lesions than zebu cattle and their crosses kept together on communal pasture in the country's central highlands (Ameni *et al*., 2007 [11] as shown in table 5). Similar results were found in an experimental study comparing the susceptibility of Holstein-Friesian calves to Boran (zebu) calves exposed to low doses of *M. bovis* in South Africa. The study found that while none of the Boran calves developed BTB suggestive lesions, 50% of the Holstein-Friesian calves developed typical lesions. The results showed that zebu breeds, as opposed to the Holstein-Friesian breed, are more likely to be resistant to BTB infection. Zebus may be more resistant to BTB than high-yielding European breeds, according to Benkirane (1998) [22]. The entirety of this study supports the claim made by Allen *et al*. (2010) [9] that 48% of the variance observed in the host's response to *M. bovis* infection is caused by genetic variation.

Table 5: Prevalence of *B.Tuberculosis* based on breed of animals at the national level

Study area	Breed						Reference
	Zebu	Cross	Holstein	Nuer	Felata	Horo	
Ethiopia	4.1	9.9	21.6	-	-	-	Sibhat *et al.*, 2017 [77]
Sululta district	1.8	12.8	-				Akililu *et al.*, 2014 [7]
Gambella	-	-	-	12.9	57.1	10.3	Alemu, 2015
Nekemit	5.7	6.7	-	-	-	-	Woyessa *et al.*, 2014 [99]
Bahirdar town	0.2	2.38	-	-	-	-	Nuru *et al.*, 2015 [59]
Dilla town	1.7	3.8	9.6	-	-	-	Romha *et al.*, 2014 [72]
Gonder town	0	11.7	-	-	-	-	Shewatatek, 2015 [74]
E/wellega	1.75	9.6	-	-	-	-	Disassa *et al.*, 2016 [32]
Hawassa	4.4	17.9	-	-	-	-	Tekle, 2016 [85]
Mekele	2.7	15.8	14.8				Fikire *et al.*, 2014 [39]
Jimma	5.02	43.3	-	-	-	-	Tesfaye, 2017 [89]

Prevalence B. tuberculosis based on Geographical Sites at the national level

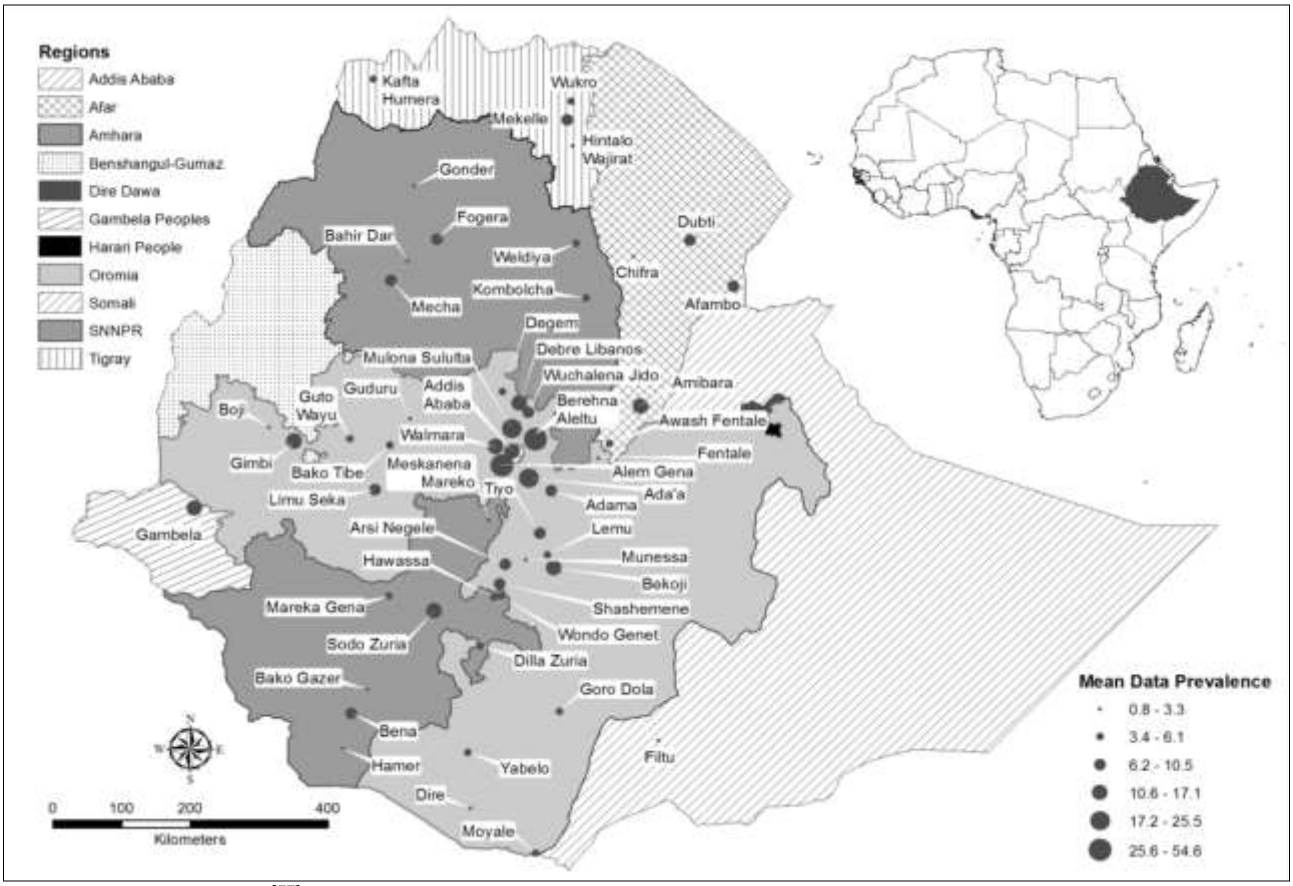
In general, the prevalence of BTB decreased as one moved from the country's center to its periphery in all directions, as well as from easily accessible regional towns to more distant regions where traditional intensive livestock agriculture predominates. The generalization is not unqualified because variations may be seen over close distances or even in the same region, as recorded by various researchers at various times. The prevalence of BTB appears to be highest in the country's center, with Addis Abeba and the adjacent sub-urban areas experiencing the highest intensity. This may be the result of the relatively long history of intensive dairy farming in central Ethiopia using exotic European breeds that were introduced during the previous imperial regime with the aim of supplying dairy products to the expanding human population in Addis Abeba and its surroundings (Ahmed *et al*., 2004) [5]. These regions have a significant concentration of dairy cattle, and they provide the rest of the nation with enhanced dairy animals as well as BTB for the developing ones (Firdessa *et al*., 2012) [41]. It also appears that most studies have been performed in areas adjacent to existing roads, evidently for logistical reasons. Most rural areas further away from road access have not been investigated at all that includes most cross-border areas where there is a high informal animal movement for instance between Ethiopia and Sudan, Kenya or Somalia (Tschopp and Abraham, 2018) [96].

Geographical distribution of B. tuberculosis based on administrative state

The frequency of BTB does not significantly differ amongst the various administrative regions of the nation. This is because none of the administrative states have implemented any workable control measures, therefore the epidemiology of BTB is unaffected by animal health operations in any of them. As there are no active regulations limiting animal movement due to biosecurity, the results of this research indicate that intensifying the dairy industry could increase prevalence in any of the locations. This has a negative impact on the dairy industry because traffic in dairy cows was found to be unidirectional in Ethiopia and was often from the region's central regions, where BTB is more common, to the zonal towns and regional cities (Firdessa *et al*., 2012) [41]. The rest regional states have no valid general prevalence which recalls for further studies in these regions.

Table 6: Prevalence reports of *Bovine tuberculosis* administrative state

Administrative state	Prevalence (95% confidence interval)	Reference
Addis ababa	10.6 (6.7-16.4)	Sibhat *et al*., 2017 [77]
Tigray	8.8 (5.8-13.3)	
Afar	6.7 (3.4-12.7)	
Oromia	6.6 (5.5-8.1)	
SNNP	4 (2.9-5.6)	
Amhara	3.6 (2.2-5.8)	



Source: Sibhat *et al*., 2017 [77]

Fig 2: Geographical Distribution of *Bovine tuberculosis* in Ethiopia

Economic and zoonotic importance of *Bovine Tuberculosis* in Ethiopia

Because of differences in epidemiological conditions, livestock systems, natural reservoirs, time horizons, and the absence of generally accepted analytical frameworks, the global economic assessment of loss associated with BTB and cost-benefits analysis from its control were multifaceted. Data obtained from different countries provide variable results. The illness significantly affects the amount of milk and meat an affected cow produces, and it also has an impact on animal reproductive and pulling strength in conventional farming systems (Zinsstagj *et al*., 2006) [101]. Additionally, the economic and financial effects of tuberculosis on society's healthcare expenses. Since 75% of TB patients fall within the 15–54 age range, which is an economically active period, the disease presents a barrier to socioeconomic progress. Globally for Control, surveillance and monitoring costs annual agricultural loss USD 3 billion and BTB eradication in the US did cost 538 million USD between 1917 and 1992 (Nelson 1999) [58] also costing currently in the UK 100 million pound per year (Matthew *et al.*, 2006) [54].

The disease's economic repercussions in Ethiopia have not yet been thoroughly explored or reported. There haven't been many abattoir meat inspection surveillances that reveal the percentage of complete or partial organ and carcass condemnations. Gezahegne (1991) [45] provided evidence that the condemned carcasses and organs from 1.2 million slaughtered cattle in eight export abattoirs resulted in an estimated cost of more than 300,000,000,000 US dollars or 600,000,000 ETB. Recently, Tschopp *et al*. (2012) [106] calculated that between 2005 and 2011, the economic burden of BTB ranged from 500,000 to 4.9 million US dollars in urban livestock production systems and from 75.2 million and 385 million US dollars in vast rural animal production. These numbers showed losses of less than 1% of the livestock's net present value in the rural and 3.9–6.2% in urban livestock production systems per year. (Sibhat *et al*., 2017) [77].

For non-economic reasons, such as concerns over the spread of BTB through the trade of dairy cattle from a system with a high prevalence of the disease to one with a low prevalence of sedentary lifestyles, as well as for public health, Tschopp *et al*. (2012) [106] emphasized the urgent need for control of the disease in the urban production system in Ethiopia. Worldwide, zoonotic tuberculosis in cattle is a problem for public health. High levels of HIV and poverty, particularly in Sub-Saharan nations, are major factors in the developing world. According to Cezar *et al*. (2016) [28], consumption of raw milk or undercooked milk products is the primary cause of non-pulmonary tuberculosis. Risk factors include social-cultural practices, such as the custom of pastoral tribes to consume raw blood, raw milk, raw or undercooked meat, and meat products (Amenie and Wudie, 2003) [102]. According to estimates, 90% of the milk drank in Africa is either consumed raw or fermented, increasing the risk of disease transmission (Ibrahim, 2012). According to Tigre *et al*. (2011) [92], tuberculosis (TB) infects 9.4 million people worldwide and results in 1.4 million annual fatalities. Asia and Africa combined for 55% and 30% of all TB cases worldwide, respectively. Eastern Mediterranean (7%), European (4%), and American (3%), regions saw lower percentages of instances. Following malaria and births as the third and fourth top causes of hospital admissions, it is also the second biggest cause of death. (Regassa *et al*. 2010) [70].

Bovine tuberculosis Control options

Bovine tuberculosis is listed under the OIE terrestrial animal health code, and control should be aimed at reducing prevalence in animals in order to prevent transmission to humans. In Ethiopia, control measures cannot be adopted in practice due to a variety of factors, including: lack of knowledge on the actual prevalence of the disease, the existing technical and financial limitations, a lack of veterinary infrastructures, cultural and/or traditional beliefs, and geographical barriers.

Control in the Cattle Populations

Due of the numerous vulnerable species, diverse pathophysiology, and poor efficacy of currently used methods for wild animals, *M. bovis* is challenging to control. Applying the following management strategies needs an awareness of the epidemiology of infection within the ecological system, which might involve both domestic and wild animal species (Cousins, 2001) [30]. The only method that guarantees eliminating up to testing every three months to eliminate individuals in the herd that can spread infection is the test and slaughter method. It is beneficial to take routine hygiene precautions such cleaning and disinfecting polluted areas, food, and water troughs. According to Aiello *et al*. (1998) [6], cattle under poor management were more likely to contract tuberculosis than cattle under competent management. In developing nations, which cannot afford a test and slaughter control program, particularly in nations with a wild life reservoir of *M. bovis* infection, vaccination against tuberculosis is expected to become a major disease control method. Significant advancements have been made in the creation and testing of TB vaccines for cattle and a variety of wild animals over the past ten years (Edelsten, 1999) [33].

Control in the human populations

In general, the BCG vaccine and the use of chemotherapy can reduce the risk of both humans and animals contracting tuberculosis. The common anti-tuberculosis medications, including ionized, rifampicin, pyrazinamide, thiacetazone, and ethambutol, are used to treat patients and stop the disease from spreading. The length of the treatment program might be either brief (two months) or standard (six to eight months). Only 76% of new patients in the 2002 cohort experienced treatment success, which is significantly less than the maximum recorded success rate of 80% for Ethiopia (WHO, 2005) [107]. Additionally, health education is being used as one of the key methods for controlling through sanitization and raising community understanding of the epidemiological characteristics of the disease. Other efficient steps are also being taken to enable improved access across the nation.

Conclusion and recommendation

In comparison to the prevalence seen in the established dairy belt in the central areas of Ethiopia, particularly in and around Addis Ababa City, this review revealed comparatively low average prevalence in the emerging dairy districts. According to the findings of skin tests, the estimated prevalence of B. tuberculosis in Ethiopia was determined to be 5.8%, which is lower than the estimated global prevalence (9%) of the disease. Due to the current lower number of infected animals in a more constrained geographic area, implementing a control program in these cities could be simpler, cheaper, and more effective to do so now than in the future. Test and slaughter programs at this stage are not economically feasible nationwide in Ethiopia. There is an urgent need to investigate alternative cheaper options for BTB control such as milk pasteurization meat inspection, awareness regulation in animal movement control and selective breeding program for resistant traits are optional. More research is warranted regarding the economic impact of the disease (productivity losses in animals, public health impacts, social impacts, household micro-economics, and market losses) and cost-efficiency of these different control options. On the basis of these, review the following recommendations are forwarded

- To know accurate prevalence, distribution and better insight into the transmission scenario of the disease further study on larger sample size, molecular level and nationwide epidemiological survey should be conducted

- In the majority of Ethiopia, animals are housed close to homes and kept in extremely unhygienic conditions, also consume badly processed meat and milk products, so raising awareness of this issue is vital.
- Following applying for insurance, dairy producers may be persuaded to kill their sick cattle after testing for BTB and other economically significant infectious illnesses.
- The diagnosis of tuberculosis lesions requires routine tuberculin skin testing and standard abattoir meat inspection processes, and the outcome can be improved by using Ziehl-Neelsen staining concurrently.

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