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Investigating Prevalence of Bovine Tuberculosis in Cattle in an Agro-Pastoral Community in Awdal Region, Somaliland

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Abstract

Awdal region is the most northwesterly province of Somaliland. The region is one of the agro-pastoral livelihood zones in Somaliland, where farming and agricultural production are the predominant livelihood sources. IGAD (Intergovernmental Authority on Development) Sheikh Technical University of Science (ISTUS) worked to study the prevalence of Bovine Tuberculosis (TB) among cattle in Awdal region of Somaliland. The aim was to inform public health and Veterinary experts on having one-health approach to infectious diseases among humans and animals. The serum that was stored at −20˚C was transported to IGAD Sheikh Technical University of Science (ISTUS) for further analysis using *BOVIGAM* serological test (Sandwich ELISA). The results indicate that Bovine Tuberculosis is highly prevalent in the study area (10.1%). The high prevalence recorded in the current study could be due to the consumption of raw milk and lack of proper control strategies in place to control the transmission of the disease between animals, between animals and wildlife and between animals and humans. Hence, an awareness creation campaign should be created on bTB transmission and its public health significance to cattle owners, milk and meat consumers and people who are in close proximity to cattle. In addition, testing and eradication programme should be implemented where applicable.

Keywords

Awdal, Bovigam, Bovine Tuberculosis, Cattle, Prevalence

1. Introduction

Bovine TB is a chronic granulomatous inflammatory disease that is predomi-

nantly caused by *M. bovis*, a member of the group known as MTC. While primarily affecting bovines, the pathogen has a broad host range that includes other domesticated species, like goats and camels as well as many wildlife species and also humans [1]. It has been estimated that *M. bovis* causes 10% of the total human TB cases in developing countries and subsequently poses a significant threat to global health [2].

The ingestion of unpasteurized dairy products was reported to be the main mode of transmission of *M. bovis* to humans. However, pulmonary TB caused by *M. bovis* via airborne transmission among people appears possible and deserves further investigation as a source of secondary transmission [3]. Furthermore, bTB is spread through aerosolized droplets or ingestion once it is established in a herd of cattle. The incubation period can range from months to years with the severity depending on the immune system of each individual animal. Infection results in chronic disease; animals typically present with clinical signs during times of increased stress or as they age. The organs that can be affected include the lungs, liver, spleen, lymph nodes and intestines. The clinical signs include moist cough, dyspnoea, weight loss, anorexia, lymphadenopathy and diarrhoea [3].

In addition to being a threat to public health, bTB is also a major economic concern, costing an estimated USD three (3) billion worldwide annually due to losses from reduced cattle productivity, culling and movement and trade restrictions [4].

The risk for zoonotic TB disease increases in areas where bTB is endemic and people live in conditions that favors direct contact with infected animals. *M. bovis* poses an occupational risk throughout the world to farmers, pastoralists, veterinarians, zoo keepers, slaughterhouse workers, butchers and other types of workers with frequent direct contact with animal or animal products [5].

Bovine TB remains a serious problem for animal and human health in many developing countries. From January 2017 to June 2018 of the 188 countries and territories reporting their bovine tuberculosis situation to the OIE, 82 countries (44%) reported the presence of the disease. Although the infection in cattle herd has been controlled in most countries, complete elimination of the disease is complicated by persistent infection of wild animals [6].

Diagnosis of bTB can be accomplished through gross examination, histology, acid-fast staining, culturing the bacteria, and PCR. In the live animal, interferon gamma testing, enzyme linked immunosorbent assay (ELISA) testing, and tuberculin testing can be performed [7].

Bovine TB is reported in neighboring countries of Ethiopia, Kenya and Djibouti; however, its status remains unknown in Somaliland. Therefore, the present study is designed to assess the prevalence of bTB in Awdal region.

Statement of the Problem

In developing countries, especially in rural settings, where dwelling areas may be shared between humans and animals, humans may become infected. This may

occur through the inhalation of cough sprays released by chronic coughing animals [8] or/and by drinking raw milk from infected animals [9].

In Somaliland, most people live in poor conditions that may compromise their hygiene due to their practice of subsistence farming and pastoralism to support their livelihood. Their closer interaction with livestock may increase their vulnerability to zoonotic infections. The social practice of preferring raw milk may also contribute to risk of acquiring TB from bovine. Bovine Tuberculosis has been reported in neighboring countries of Ethiopia and Kenya, however, no research has been dedicated so far to know the status of the disease in Somaliland. Therefore, this research establishes and documents the status of Bovine TB and associated risk factors. In addition, it could be used as a baseline study in future interventions about improving the health of cattle.

2. Materials and Methods

2.1. Study Area

Awdal region borders Ethiopia in the north-west and south-west, and Djibouti and the Gulf of Aden in the north. It consists of four districts: Boroma (regional capital), Baki, Lughaya, and Zeylac (Figure 1). The prevailing climate in the region is known as a local steppe climate. The region is warm on June with an average temperature of 24.1˚C, while is cold in January with an average temperature is 17.1˚C. Awdal covers 21,374 km^2, with a human population of 673,264 keeping an estimated 30,000 cattle. It has three topographical zones: coastal, mountainous and plateau zones. Major economic activities of the region are pastoralism, agro-pastoralism, fishing and trade.

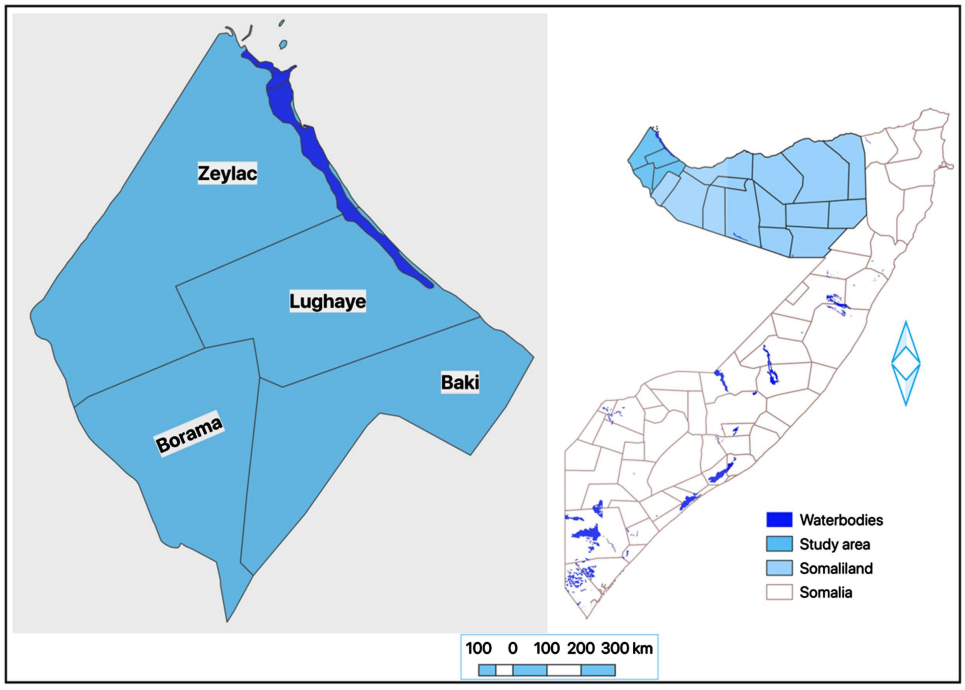

Figure 1. Map of study area.

2.2. Study Animals

The study animals were cattle that were randomly selected for the study. For each village visited (N = 17), 18 households were purposively selected based on the availability of study animal (cattle) and the willingness of animal owners to participate in the study. From each selected household, 1 animal were selected from the herd using simple random sampling technique.

2.3. Study Design

A cross-sectional study design was conducted on 306 cattle and their owners.

2.4. Sampling Method and Sample Size Determination

Since there was no such study conducted in the study area, the expected prevalence was assumed to be 50% and 95% confidence interval at 5% absolute precision was used. The total sample size was determined using the Thrusfield formula given below (Thrusfield, 2005).

$$n = 1.96^2 \times pexp(1 - pexp)/d^2$$

where, n = the required sample size.

1.96^2 = the value of z at confidences level.

$Pexp$ = expected prevalence (50%).

d = desired absolute precision level at 95% confidence interval (=0.05).

Accordingly, 384 animals and their owners were expected to be assessed. However, due to movement of cattle from the expected study sites because of drought only 306 cattle were sampled.

2.5. Blood Sampling

Ten (10) mL of whole blood were drawn from the jugular vein into heparinized vacutainer tubes; the blood were gently mixed and maintained at below 25˚C. The blood was stimulated within 8 hours of collection using Avian and Bovine Purified Protein Derivatives (PPD). The blood was then incubated at 37˚C for 24 hours. It was then centrifuged at 10 minutes and serum collected.

2.6. Blood Sample Testing

Interferon gamma assay (IFN-γ) BOVIGAM®. The assay was performed according to the modified interferon gamma assay previously described by [10]. Detection ofIFN-γ in the plasma will be achieved using the sandwich enzyme-linked immunoassay plates supplied by (Thermo Fisher Scientific, South Africa).

2.7. Measurement and Interpretation

The Optical density (OD) values for the plasma were measured according to the stimulating agent *i.e.* purified protein derivatives (PPD); avian (PPD) (OD av), bovine PPD (OD boy), fortuitum PPD (OD fort), poke weed mitogen (PWM)

(OD pwm) and Roswell Park Memorial Institute Medium 1640 (RPMI) (OD nil). The interpretation of the results for reactor classification were according to the criteria described by [10].

2.8. Data Analysis

Data from the sampled animal were entered into Microsoft Excel Spread sheet and analyzed using Microsoft Excel Spread sheet.

3. Results

As the result is indicating, 31 (10.13%) (N = 306) cattle were found to be positive for BOVIGAM test. Of all the villages, Hindhaysa, Qaraaru and Dharaarwaxar had the highest prevalence recorded (22.2%) (N = 18) while Dhidhiid, Old Baki, Cadmadooni and Dacawalay had no positive animals. Table 1 is indicating the results.

4. Discussion

In the current study, the overall prevalence of bTB was found to be 10.13%. The current findings are in line with the result documented by [11] who reported 12% overall prevalence from Mekelle, Ethiopia. However, these findings are

Table 1. BOVIGAM test results.

Village name	Number of Cattle sampled	Positive	Negative
Abuqays	18	1	17
Afcas	18	1	17
Dhidhiid	18	0	18
Garbahaaarey	18	2	16
Hindhaysa	18	4	14
Idhanka	18	3	15
Jufogaliiley	18	2	16
Qaraaru	18	4	14
Sararka	18	3	15
Cadmadooni	18	0	18
Dacawaley	18	0	18
Dharaarwaxar	18	4	14
Duudwayne	18	3	15
Olk Baki	18	0	18
Ruqi	18	1	17
Wacaysdhukur	18	1	17
Waxarawaalisay	18	2	16
Total	**306**	**31**	**275**

much higher than a research conducted by [12] who reported 0.7% overall prevalence from Tanzania; [13] who documented 1.3% and [14] who found 1.3%. In addition, the current findings are slightly lower than a research conducted by [15] in Eritrea who found 14.5 overall prevalence of bTB.

According to [16] the risk for zoonotic Tuberculosis increases in areas where bTB is endemic and people live in conditions that favour direct contact with infected animals. The most common route of infection of *M. bovis* is through the oral route by consumption of contaminated milk or other dairy products [17]. Thus, milk pasteurization plays a crucial role in preventing human infection [18]. Pasteurization of milk, however, is often inaccessible in many low-income countries or in rural communities around the world. Although the boiling of milk at home provides sufficient pasteurization, this requires access to a fuel source [17].

Therefore, the higher prevalence in the study area could be due to the consumption of raw cattle milk and the close proximity of cattle and humans. The high prevalence could also be justified that in the study area there are no or limited control measures for bTB.

The study villages showed difference in prevalence. Hendhaysa, Qaraaru and Dharaarwaxar had the highest number of positive animals (4/18) compared to other villages whereas no positive cattle were reported from Dhidhiid, Old Baki, Dacawalay and Cadmadooni. The higher prevalence shown by these villages could be due to the immigration of wildlife to since they are located near the Ethiopian border. In addition, during the dry seasons cattle are moved to Ethiopia in search of water and feed whereas they can have direct contact with infected animals and wildlife when sharing forage or water resource, and/or indirect contact when grass is contaminated by infected faeces, or urine.

Moreover, factors contributing to the prevalence and spread of bovine tuberculosis include limited veterinary infrastructure, inadequate surveillance systems, movement of animals, and poor bio-security practices.

5. Conclusion and Recommendations

A prevalence rate of 10.13% for bovine tuberculosis would generally be considered high. The current result generally suggests a significant burden of disease within the study population which can have implications for animal health, productivity and potential transmission to humans or other animals. Hence, there is a need to implement control and prevention measures such as improved surveillance and risk management strategies, to reduce the prevalence and mitigate the spread of the disease. Furthermore, the current study recommends a more developed diagnostic tool such as PCR to enhance early detection and surveillance efforts.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

Ethics Approval

Approval was granted by University of Liverpool.

Consent to Participate

Informed consent was obtained from all livestock owners.

Statement of Animal Rights

For the research, authors obtained approval from Somaliland Ministry of Livestock and Fishery Development. Animal rights were strictly observed and always after the consent of the owners.

Availability of Data and Material (Data Transparency)

The datasets generated during and/or analyzed during the current study are not publicly available only because we are not technologically advanced to create software application or custom code.

Author Contributions

Conception and study design was developed by Dr. Abdullahi Sheikh, Dr. Ahmed Mohamed and Dr. Amina Hussein. Material preparation and field data collection was done by Dr. Amina Husein and Dr. Osman Abdullahi and Dr. Mustafa Ahmed. Laboratory investigation was done by Dr. Amina Husein, Dr. Musa Awale and Dr. Osman Abdullahi. Data analysis was performed by Dr. Amina Huesin. The first draft of the manuscript was written by Dr. Amina Husein, reviewed by Dr. Abdullahi Sheihk and Dr. Fred Wesonga.

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