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Sero-Prevalence and Risk Factors of Contagious Bovine Pleuropneumonia (CBPP) in Afgoye District Lower Shabelle Region, Somalia

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Abstract

Contagious bovine Pleuropneumonia (CBPP) is an infectious and highly contagious respiratory disease of cattle and water buffalo, caused by the Mycoplasma *mycoides* subspecies *mycoides*. It induces significant economic losses and leads to a severe livestock production problem, negatively influencing people's livelihoods of affected countries. In Somalia, there is no updated data on the prevalence and distribution of the disease. Hence, a descriptive cross-sectional study was conducted from September 2022 to June 2023 in different villages under the Afgoye District of lower Shabelle region, Somalia. The main purpose of this study is to assess the sero-prevalence and identify the associated risk factors for the occurrence of the disease. In this study, villages, age, sex, breed, and body condition were considered as risk factors. A total of 90 blood samples were collected and tested in the laboratory using the Anti-CBPP Elisa kit test. Out of 90 serum samples from herd cattle, 32 were positive, resulting in an overall prevalence of 35.5%. In addition, we found a statistically significant variation between the prevalence of the disease and factors such as sex, age, body condition and breeds. In summary, the overall prevalence of Contagious bovine pleuropneumonia in this study area is worth to be considered because there is a low quality of health care and less awareness of the Contagious bovine Pleuropneumonia effects on herds, which warrants the official authorities to act and follow appropriate preventive and control measures to reduce the incidence of the disease and generate appro-

priate controlling and prevention measures in all regions of Somalia.

Keywords

Contagious Bovine Pleuropneumonia, Sero-Prevalence, Cattle, Somalia, Mycoplasma, Cross Sectional Study

1. Introduction

Somalia has a significant place in the livestock sector in the Horn of Africa; livestock trade and exports are one of the key economic contributors. Most of the livestock trade happens in the Middle East, especially in the Kingdom of Saudi Arabia, which is one of its biggest importers [1]. The livestock density of Somalia is 7.1 million camels, 4.9 million cattle, 12.3 million sheep, and 11.6 million goats [2]. The cattle of Somalia are mainly the East African Zebu type, of which the following types are recognized: the Somali Boran, Gasara, Dauara, and Surqo [3] [4]. The Somali Boran are believed to be a descendant of the first from West Asia and are thought to have evolved following the migration of Ethiopian cattle into Somalia along the Somalia-Ethiopia border. The Surqo breed is a zenga breed. The zenga breeds are breeds that resulted from zebu-sanga crosses that came about following the introduction of zebu cattle into Africa from Asia. The Surqo breed is a crossbred of the Boran of Somalia or Ethiopia with an unknown sanga population [3] [4].

Contagious bovine pleuropneumonia (CBPP) is an infectious and highly contagious respiratory disease of cattle and water buffalo that is caused by the *Mycoplasma mycoides* subspecies *Mycoides*. It induces significant economic losses and leads to serious livestock production problems, negatively influencing people's livelihoods in affected countries. CBPP is a notifiable disease in almost all African countries [5] [6]. It is an acute, subacute, or chronic disease that affects only cattle and occasionally water buffalo based on typical clinical signs and the presence of sequestra in lung lesions [7]. The incubation period for naturally infected animals can range from 3 weeks to 6 months. The severity of the disease ranges from hyperacute to acute, subacute, and chronic forms [6]. Due to the high economic losses caused by CBPP in endemic regions, the World Organization for Animal Health (WOAH) declared that CBPP is one of the most serious contagious diseases and listed it in the group of notifiable animal diseases of high socio-economic impact and is regarded as one of the major transboundary animal diseases [8] [9]. Contagious bovine pleuro-pneumonia (CBPP) or lung sickness in cattle, caused by Mycoplasma mycoides subsp. mycoides (Mmm), is truly an African disease, long eradicated from the developed world, which represents a considerable burden for cattle owners in many parts of Africa [10], from Senegal and the Gambia in the west through Somalia in the east, and as far south as Namibia and Tanzania [11]. Contagious bovine pleuropneumonia transmission occurs through direct and repeated contact between infected and sus-

ceptible animals. Inhalation of infective droplets is the main route of infection [12]. This disease is endemic in Africa, although it has been eradicated in other parts of the world through the application of restrictions to the movement of cattle as well as test and slaughter policies combined with compensation for livestock owners during the mid-20th century [13].

In Somalia, the widespread status of contagious bovine pleuropneumonia was ambiguous. Consequently, this research was undertaken to investigate the current state of the disease and its associated factors in the Afgoye district, Lower Shebelle region, Somalia. The study employed the ELISA technique for a comprehensive analysis.

2. Materials and Methods

2.1. Study Area

The Lower Shabelle region covers an area of around 29,761 km. Lower Shabelle borders Banadir (Mogadishu and the surrounding area), Middle Juba, Bay, Bakool, Hiraan, and Middle Shabelle. The region borders on the Indian Ocean to the east. Lower Shabelle is divided into eight districts: WanlaWeyn, Afgooye, Qoryooley, Kurtunwaarey, Marka, Sablale, Barawe, and Audegle (**Figure 1**).

2.2. Study Population

The study population was households and their cattle. Ninety animals were taken as a sample. The study animals were indigenous and cross breeds kept under a traditional extensive management system. Those animals were selected randomly from other villages under the Afgoye district in the lower Shabelle region, Somalia.

2.3. Study Design and Sampling

A descriptive cross-sectional study was used to determine the Sero-prevalence of CBPP and associated risk factors.

Ninety samples of blood were collected from cattle in villages under Afgoye districts, lower Shabelle region of Somalia, using a random sampling technique. 5 ml of blood from the jugular vein of each animal using plain vacutainer tubes

Figure 1. Map of study area.

free of anticoagulant. After that, samples were appropriately labeled and kept in a box containing ice packs at 4˚C and taken into the laboratory of the Abrar Research and Training Centre (ARTC) followed by centrifugation at 1200 rpm for 12 minutes and quick removal of the serum from individual tubes which were then transferred into labeled cryo-vials for processing.

2.4. Test Procedure

An antigen is pre-coated onto a 96-well plate. Contagious Bovine Pleuropneumonia Antibody (Anti-CBPP) ELISA Kit from Abbexa Company in United Kingdomwas bought in a sealed bag as a ready-made kit that contains all the necessary reagents and pre-coated plates. The serological analysis was performed following the manufacturer's protocol and recommendations. Finally, immediately following the addition of the stop solution, the optical densities were read at 450 nm (OD 450).

2.5. Data Management and Analysis

Collected data were entered, coded, and kept in a Microsoft® Excel spread sheet version 2013, before analyzing with The Statistical Package for Social Sciences (SPSS) version 20. Descriptive statistics were presented as tables. The association of CBPP with different independent variables (age, sex, and body condition) was analysed using chi-square test. P-values were calculated separately for each variable, and results were considered significant when $P \leq 0.05$.

3. Results

This study was conducted from December 2022 to August 2023; out of 90 blood samples from cattle, 32 were positive.

Regarding the location with the highest percentage of positive cases for Contagious Bovine Pleuropneumonia was MARKISKA (22.2%). DAARULXADIITH reported an 8% prevalence, while CARBIS and ARBACOW both showed a 2.2% prevalence of the disease. The lowest positive cases were observed in the BUULALOW village (Table 1).

According to the sex, a notably higher percentage of Contagious Bovine Pleuropneumonia was observed in female (31.1%) compared to male (4.4%), demonstrating a statistically significant difference ($p = 0.004$) in the prevalence of the disease between cows and bulls (Table 2).

The sero-prevalence of Contagious Bovine Pleuropneumonia (CBPP) was examined based on the sex of the animals. Notably, the lowest prevalence was observed in young animals (8.8%), while adults exhibited a higher prevalence (26.6%). Statistical analysis revealed a significant difference ($p = 0.014$), indicating a discernible effect of age on CBPP prevalence (Table 3).

The prevalence of Contagious Bovine Pleuropneumonia was notably lower in local cattle breeds (13.3%) compared to crossbred cattle (22.2%). This observation suggests a higher susceptibility of crossbred cattle to CBPP in comparison to

Table 1. Sero-prevalence of contagious bovine pleuropneumonia base on villages.

LOCATION	Number of samples	No positive	(%) positive
CARBIS	24	2	2.2
ARBACOW	8	2	2.2
DAARUL-XADIITH	11	7	8
MARKISKA	38	20	22.2
BUULALOW	9	1	1.1
Total	90	32	35.5

Table 2. Sero-prevalence of contagious bovine pleuropneumonia based on sex.

Sex	Number of samples	No. positive	(%) positive	X^2	P-value
Male	28	4	4.4		
Female	62	28	31.1	8.025	0.004
Total	90	32	35.4		

Table 3. Sero-prevalence of contagious bovine pleuropneumonia based on age.

Age	Number of samples	No of positive	(%) positive	X^2	P-value
Adult	52	24	26.7		
Young	38	8	8.8	6.0373	0.014
Total	90	32	35.5		

their local counterparts, where a significant difference (p = 0.000) shows there is an effect between Contagious Bovine Pleuropneumonia prevalence and breed (**Table 4**).

Regarding the body condition of the animals, cattle with poor body condition exhibited the highest prevalence of Contagious Bovine Pleuropneumonia (22.2%) compared to those with medium (11.1%) and good (2.2%) body condition. This observed difference was found to be statistically significant (p = 0.000) (**Table 5**).

4. Discussion

The results of the present study indicated that contagious bovine pleuropneumonia was found to be one of the main problems with cattle health in the Afgoye district, lower Shabelle region, Somalia. A total of 90 serum samples were tested from the five villages under Afgoye district, and the overall sero-prevalence of contagious bovine pleuropneumonia in the study areas was 35.5%. This finding was nearly like other reports such as [14], which reported a sero-prevalence of 28%; [15], which reported a sero-prevalence of 32.5%; [16], which reported a sero-positive of 39%; and [17] who reported a sero-positive of 56%. In addition, [18] researchers reported contagious bovine pleuropneumonia in Khartoum state, Sudan (42.2%), while our study and others mentioned above are against

Table 4. Sero-prevalence of contagious bovine pleuropneumonia based on age.

Breed	No of samples	No of Positive	% of Positive	X^2	P-value
Local breed	57	12	13.3		
Cross breed	33	20	22.2	14.2699	0.0001
Total	90	32	35.5		

Table 5. Sero-prevalence of contagious bovine pleuropneumonia based on body condition.

Body Condition	Number of samples	No. of positive	% of positive	X^2	P-value
Good	3	2	2.2		
Medium	60	10	11.1	36.313	0.00001
Poor	23	20	22.2		
Total	90	32	35.5		

other studies that reported lower prevalence rates. This variation could be attributed to the differences in the types of tests used, year of study, agro-ecological zones, herd size, breed susceptibility, animal management and production system, seasonal herding patterns, and contact patterns. Also, variables include the epidemiology of the disease, movement, the presence or absence of communal grazing and watering areas within locations, and the probability of the introduction of newly purchased animals from the disease-endemic area(s).

There was a difference in contagious bovine pleuropneumonia seroprevalence among the sexes, which was 31.1% in females and 4.4% in males, which was statistically significant (P = 0.004). This study is like the study of [19] that observed females were more sero-reactive than males like that of [20], who reported significantly higher prevalence in females as compared to male animals in Kenya. Our findings disagree with the reported insignificantly higher prevalence of male animals in Ethiopia, as reported by [21].

The results of the present research document that there is significant variation in the disease among the age groups. Higher sero-prevalence was recorded in adult animals (26.7%) than in young animals (8.8%), which was statistically significant (0.014) ($p < 0.05$) and agreed with the study of [22] in southeastern Ethiopia. In contrast, there are different studies that reported insignificant associations between age groups, such as [21] and [7] . A higher prevalence in adults could have resulted from repeated exposure to the disease than in younger ones. Also, this difference between the two age groups could be attributed to the fact that young animals are usually tied within the home when adult cattle go out to graze, thereby saving the young from the exhaustion experienced by older animals that cover long distances in search of good pasture and water and where they interact with herds from other owners. With this kind of practice, young animals do not normally have direct contact with other herds other than those of their dams, and therefore, there is less chance to encounter infected animals.

This study found the lowest prevalence in the local breed of cattle (13.3%) compared to the cross breed of cattle (22.2%), indicating that cross breeds are more susceptible to contagious bovine pleuropneumonia. Furthermore, this was a statistically significant (0.0001) $p < 0.05$ of the effect between disease prevalence and breed. As reported in previous studies, European breeds and their crosses are more susceptible to the disease than local African breeds [12]. This study found the highest sero-prevalence of contagious bovine pleuropneumonia in cattle with poor body condition (22.2%) compared to those with medium (11.1%) and good body condition (2.2%). Similar findings were found by such authors as [23] [24] [25] and [26]. This could result from the weak protective immune response in poor-body-conditioned cattle compared to the medium and good ones. A weak body condition is one of the signs of the presence of this infection in the animal. Chronic cases of the disease are carrier animals and become emaciated because of the clinical characteristics of the disease. Besides, animals with good body condition have a better immunological protective response to the infectious agent than animals with medium and poor body condition scores [12]. In conclusion, this study reveals evidence that Contagious Bovine Pleuropneumonia infection is prevalent in the area of study; Due to high economic losses caused by disease in endemic regions, The World Organization for Animal Health declared that Contagious bovine pleuropneumonia is one of the most serious contagious diseases and listed it in the group of notifiable animal diseases of high socio-economic impact and is regarded as one of the major transboundary animal diseases hence, coordinated efforts from farmers, veterinarians, and the government to develop and implement successful policies to eradicate the disease are needed, including: improvements of cattle movement control, strengthening epidemic surveillance networks, and vaccination. Tracing the source of infected cattle and enforcing strict rules for livestock movement can aid in controlling the disease in the area.

According to the findings, we suggest these recommendations:

- Implementing prevention and control of the disease with the help of official authorities in the endemic area.
- Improving the awareness of animal owners towards the disease.
- It must be done to further investigate the disease in different areas of the country.

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Ethical Approval Statement

This study was approved by the ethical committee of Abrar University, Somalia (reference number AUEC10822). All cattle owners gave consent to sample their animals. The handling of the animal was made in strict respect of animal welfare.

Data Availability

The raw data supporting the conclusions of this paper will be available by the authors, without undue hesitation.

Authors' Contributions

AAO, AMA, and SHA conceived, designed the study, and drafted the manuscript. AMA, and SHA undertook the data collection. AAO, AMA, and SHA carried out the serological testing. AAO, and MAManalyzed and interpreted the data. All authors read, revised, and approved the final version of the manuscript for publication.

Conflicts of Interest

There are no conflicts of interest in this research work.

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Abbreviations

CBPP	Contagious bovine pleuropneumonia
FOA	Food and agricultural organization
ICPALD	IGAD Centre for Pastoral Areas and Livestock Development
WOAH	World Organization for Animal Health
WAHIS	World Animal Health Information System
ELISA	Enzyme-linked immunosorbent assay
ARTC	Abrar Research and Training Centre
Mmm	*Mycoplasma mycoides subsp. mycoides*