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Research Article

Sero- Epidemiological Survey on Contagious Caprine Pleuropneumonia (CCPP) in the Pastural Area of Borana Zone, South West Oromia, Ethiopia

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Abstract

Contagious caprine pleuro-pneumonia, or CCPP, is a highly contagious respiratory disease of goats that is considered one of the most severe diseases for this species. Infected animals become very sick, and most will die. The bacteria Mycoplasma capricolum subspecies capripneumoniae causes the disease. A cross-sectional study was conducted in four districts (Yabello, Elwaye, Dubuluk, and Moyale) between September 2022 and November 2023 G. C. The goal was likely to be to assess the prevalence and distribution of CCPP in this important livestock-rearing region. Sero-epidemiological surveys involve testing blood samples using competitive enzyme-linked immunosorbent assays (cELISA) to detect the presence of antibodies against Mycoplasma capricolum, subsp. Capripneumoniae, which indicates prior exposure and infection. Goats that are infected usually show signs including a high fever, coughing, dyspnea, and nasal discharge. The most popular techniques for diagnosis are bacterial isolation from clinical samples, such as lung tissues or nasal swabs, polymerase chain reaction (PCR) tests, and the serological method. A multi-phase random sampling technique was employed, and 1007 samples from non-immunized goats were collected. The overall seroprevalence of CCPP was 39% (393/1007) at the individual animal levels. A multivariable logistic regression analysis revealed that there was no significant correlation between sero-positivity by age category or sex, with odd ratios of OR (95% CI) 0.6 (0.6–9) and 1.3 (.7–2.3), respectively. This type of survey can provide insights into the overall disease burden and dynamics within a population. A study of this nature in the Borana pastoral area would be valuable for understanding the CCPP situation and informing disease control efforts in that region. Pastoralist communities heavily dependent on goat production would be greatly impacted by outbreaks of this economically-important livestock disease. The disease can be effectively reduced by a variety of control methods, including immunization, restricted movement, quarantine, and culling of sick animals.

Keywords

Borena Pastoral Area, CCPP; c-ELISA, Sero- Prevalence, Risk Factors, Goats

1. Introduction

Contagious caprine pleuropneumonia (CCPP) is a highly contagious respiratory disease that affects small ruminants, particularly goats, and is caused by Mycoplasma capricolum subsp. capripneumoniae (Mccp) [1]. Contagious caprine

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pleuropneumonia (CCPP) is a classical transboundary animal disease, included in the list of notifiable diseases of the World Organization for Animal Health [2, 3]. It is one of the most common respiratory diseases of goats and causes huge economic losses to the goat industry [4, 5]. Respiratory droplets are inhaled through close contact with infected goats during watering, grazing, and housing, which facilitates the spread of the disease. Recovered animals become carriers and may live a long time. In naive flocks, morbidity and mortality rates can exceed 100% and 80%, respectively [6]. CCPP causes major economic losses in East Africa and the Middle East, where the disease is endemic [7]. According to the Central Statistical Agency of Ethiopia [8], Ethiopia is one of the countries with the largest livestock population, with over 29.11 heads of goats and 29.33 million sheep. Nowadays, demand for meat and meat products is rising [9], small ruminants are considered a main asset for livestock farmers in East Africa [10], and they play crucial economic and cultural roles in Ethiopia [11, 12].

Since 1983, there has been suspicion that there is CCPP in Ethiopia. Later in 1990, an epidemic of CCPP in Ogaden, Eastern Ethiopia, led to the isolation and identification of Mccp, which verified the presence of CCPP in Ethiopia [13]. Since then, it has been established that the disease is prevalent in a number of the nation's regions [14]. According to [15], reports of the CCPP outbreak have originated from almost every part of the country, mainly from lowland areas that could be categorized as goat-rearing zones. [4] Assert that, considering the substantial socio-economic impact and the frequency of CCPP outbreaks in Ethiopia, this is most likely underestimated.

The Borana rangeland area is home to a vast livestock resource and is one of Ethiopia's notable pastoral areas. Small ruminants are an essential part of livestock and help the pastoralists in the region make a living [16]. Goat health issues have received little attention despite the large population density, which is predicted to be 2.3 million [17]. There is a dearth of well-documented information on the current condition and precise spread of the disease in the area because there hasn't been enough research done on CCPP and economic loss in the area to date.

2. Materials and Methods

2.1. Study Area

The study was conducted between September 2022 and November 2023 in four selected districts (Yabello, Elwaye, Dubuluk, and Moyale) of the Borana pastoral area in the southern ranges of Ethiopia. Borana Zone is under Oromia Regional State and comprises mainly pastoral areas and rarely agro-pastoral areas.

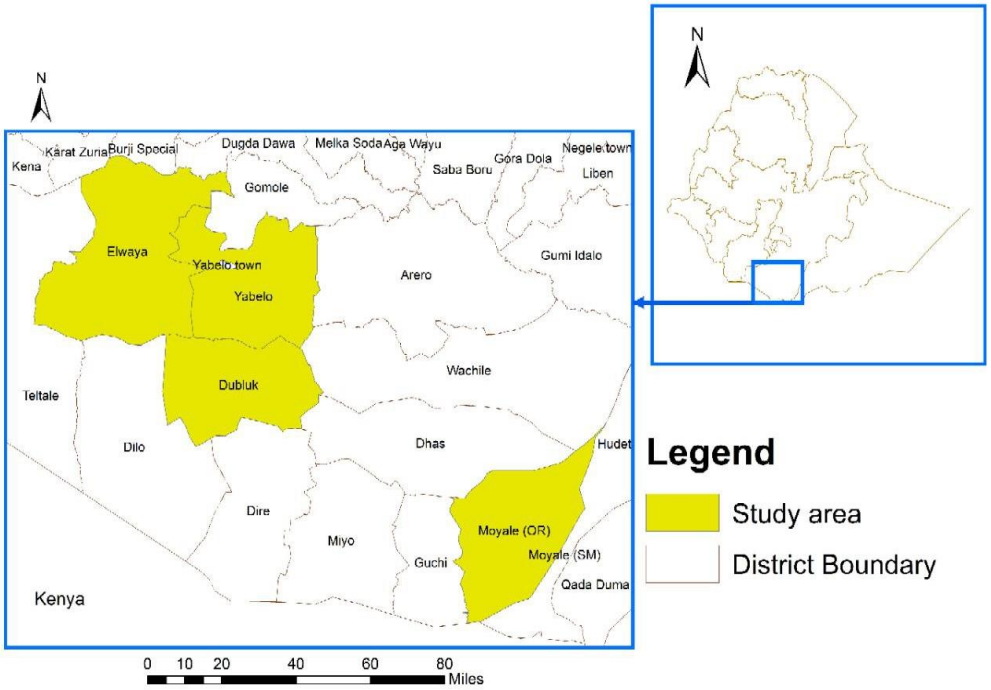

Figure 1. *Map of study area.*

2.2. Study Animals

The study animals were local Borana goat breeds managed under an extensive pastoral production system by the Borana pastoralists [18]. Goats with no history of vaccination for CCPP and above 6 months of age were used as the source of

sera samples for the study. Goats of both sexual categories and different age clusters were sampled. Age of the animals was determined based on owners' information and dental eruption; accordingly, animals were categorized into three age groups: > 6 months and ≤ 2 years (young), >2 years and ≤5 years (adult), and >5 years (old) [19].

2.3. Study Design

Contagious Caprine Pleuropneumonia (CCPP) seropositivity was assessed using a cross-sectional study design from September 2022 to November 2023. The study animals were chosen using multistage random sampling, and the sampling frame included a list of all districts in the zone as well as pastoral associations (PAs) or villages. The four study districts (Yabello, Elwaye, Dubuluk, and Moyale) were selected purposefully based on the export belt. Pastoral associations and villages (locally known as Olla) in each district were considered primary and secondary sampling units used for random sampling, respectively.

2.4. Sample Size and Sampling Method

The sample size for a serological assay-based epidemiological investigation was estimated using the Thrusfield technique [20]. This strategy took into account an estimated prevalence of 31.2%, a 95% confidence level, and 5% absolute precision [21]. As a result, 330 animals were anticipated to be sampled for this investigation. In an effort to improve accuracy and decrease error, 1007 goat samples were used in the study.

$$N = \frac{1.96^2 \ P_{exp} \ (1-P_{exp})}{d^2}$$

Where:
n = required sample size
Pexp = expected prevalence
d = desired absolute precision

2.5. Study Methodology

To get the necessary sampling units, a multistage sampling procedure was adopted, with the pastoralist association (PAs) as a primary unit, the flock as a secondary unit, and each individual animal as a tertiary unit. Subsequently, 2 PAs were selected from each district, and a total of 8 PAs (2 villages from each PA) were considered for the present study. The total number of samples in each district and PAs was allocated proportionally.

2.5.1. Blood Sample Collection

Blood samples ranging from 5 to 7 milliliters were drawn from the jugular veins of goats that appear to be in good health and have not received a CCPP vaccination in at least a year. Needles and sterilized vacutainer tubes were used to draw blood. In order to separate the serum from the clot, the collected blood was kept at room temperature for the whole night. The serum samples were harvested in sterile cryogenic vials and Age, PAs, sex, date of series and sample ID. were labelled to categorize each sample. Packing the sera samples into an ice box with pre-cut blocks of ice to transport them to the AHI. Until processed, every sample was kept in a deep freezer at -20 ℃ at AHI.

2.5.2. Serological Test

The C-ELISA test was employed using *the Mccp* antibody test kit, which was obtained from CIRAD-IDEXX, France. The pre-coated microplates with a purified Mccp lysate were used. Sera samples were examined for the presence of specific antibodies against *Mccp*. Samples to be tested are premixed with a specific monoclonal antibody (Detection Solution Mab 117/5) in a separate plate (preplate), and 100 µl were transferred into the *Mccp* antigen-coated microplates and incubated for 1 hr. at 37 ℃ with a gentle agitation. When Mccp-unique antibodies are present inside the pattern, they will combine with the Mccp antigen-coated microplates to form an immunological complex that will be computed with the Mab solution for certain epitopes. Immunological complexes between the Mccp antigen and sample antibodies prohibit the conjugate from attaching because the mab is unable to bind to those specific epitopes. Conversely, in the event that the test sample is devoid of Mccp antibodies, the conjugate is free to adhere to the specific epitopes of the mab. Following the addition of conjugate and three washings, the enzyme substrate was added and allowed to sit in a dark place for 20 minutes without being disturbed. Color development was eventually observed upon the addition of a stop solution. To determine the optical density, the plate was read at 450 nm using an ELISA reader (EXL-808).

The percentage inhibition was calculated according to the manufacturer's instructions.

S PI% = 100*(Mean of Mab Control minus Sample Absorbance at 450 (OD)) divided by the mean average of mab control minus the mean control of conjugate. For the assay to be valid, the results of internal quality control were first checked to make sure they were within acceptable ranges. Those samples with a percentage of inhibition greater than or equal to 55% are considered positive for the presence of *Mccp* antibodies [22].

2.5.3. Data Analysis

All collected data were entered into the Microsoft Office Excel 2007 computer program and then summarized first by using a descriptive statistic. All statistical analyses were performed using StataSE-13. The seroprevalence of CCPP percent was calculated as the proportion of the number of cELISA-positive animals to the total number of tested animals expressed in percent. A chi-square test was used to assess the association of the disease with districts, age group, and sex. A p-value less than 0.05 at a 95% confidence interval was considered significant.

3. Results

The study area showed an overall 39% (393/1007) at a 36-42% CI of seroprevalence (Table 1). Moyale district has the highest CCPP seroprevalence of any district at 69.6%, followed by Elwaye at 34.2%. The two districts with the lowest prevalence were Yabello (27.2%) and Dubuluk (27.4%). The CCPP seroprevalence varied significantly (P-value = 0.000) amongst the four districts. When compared to the other three districts, the Moyale district has demonstrated a noticeably higher seroprevalence.

The analysis of the seroprevalence of CCPP concerning sex showed no significant difference (P = 0.365) between male and female goats, which is indicated in (Table 2). Among the age groups involved in the study population, there was no significant variation in sero-prevalence (P = 0.159) (Table 2).

Table 1. *Caprine seroprevalence of CCPP based on geographical location.*

District	No. of animal examined	No. of animal positive	Seroprevalence (%)	OR (95% CI)	P-value
Yabello	257	70	27.2%	*	-
Elwaye	240	82	34.2%	1.4(0.9-2.0)	0.094
Dubuluk	270	74	27.4%	1(0.7-1.5)	0.965
Moyale	240	167	69.6%	6.1(4.1-9.0)	0.000
Total	1007	393	39%		

Table 2. *Caprine seroprevalence of CCPP among host related factors.*

Factors	Category	No. of animal examined	No. of animal positive (%)	OR (95% CI)	P-value
Age	Young	495	208 (42%)	*	
	Adult	321	116 (36.1 %)	0.8(0.6-1.0)	0.094
	Old	191	69 (57.9 %)	0.6(0.6-09)	0.159
Sex	Male	57	19 (33.3)	*	
	Female	940	374 (39.8)	1.3(0.7-2.3)	0.365

4. Discussion

The results of the current investigation showed that goats in the Borena zone had a prevalence rate of CCPP was 39%, which line with [23]. This was higher than the national prevalence estimated from pooled sero-prevalence (25.7%) through a systematic review by [23-25], 32.6% in the Somali region; [26], 32.9% in SNNPR; and [19], 31.6% in the Borena pastoral area. On the other hand, a higher sero-prevalence rate of 44.5%, 47.3%, 51.8%, and 43% were reported from the Dire Dawa, Afar, Oromia, and Tigray regions, respectively [18, 27]. The observed variation in seroprevalence reported by several studies could be attributed to variations in immunization histories, agro-ecological practices, husbandry practices, test methods used, and sample sizes.

The adult age category has shown no significant variation seroprevalence as compared to young animals (208/495; 42%), adults (116/321; 36.1%), and elderly animals (69/191; 57.9%). Age groupings did not significantly differ statistically (P-value >0.000). These results in line with [18, 26, 27], who noted that there was no correlation between age group and the incidence of CCPP, are similarly consistent with our findings. However, the findings of this study contradict with the study [21, 23, 28, 29] who observed the presence of significant variation among age groups.

In this study, there was no significant variation between the animal's sex and seropositivity (p - value = 0.356). This result was in line with studies conducted in different areas by [19, 23. 28, 30]. Furthermore, susceptible goats of both sexes have been shown to be at risk for the fatal and extremely contagious CCPP disease [7].

5. Conclusion and Recommendation

According to this study, CCPP is one of the most common

and extensive diseases affecting goats in the regions that were chosen. Moyale and Elwaye districts showed the highest positive seroprevalence and spread of the illness among the studied districts. Based on the study, animals with access to common grazing and drinking areas are more likely to contract CCPP. Based on our current survey result the following recommendations are forwarded.

1. In order to develop useful management techniques and deepen our understanding of the spatial epidemiological status of pastoral lands, more study on small-scale ruminant husbandry is required.
2. A steady rise in immunization rates and the application of rapid and effective testing methods.
3. Teaching small-scale ruminant farmers about the CCPP, transmission pathways, preventive measures, and control methods; additionally, collaborating at the national, regional, and international levels to develop effective control strategies.
4. Keeping an eye on the CCPP pandemic to guarantee appropriate sampling, isolation, and characterization of the isolate.

Abbreviations

CCPP	Contagious Caprine-pleuropneumonia
cELISA	Competitive Enzyme-linked Immunosorbent Assays
PCR	Polymerase Chain Reaction
CI	Confidence Interval
Mccp	Mycoplasma Capricolum Subsp. Capripneumoniae

Author Contributions

Teferi Benti Moti: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Writing – review & editing

Abdela Bulbula: Formal Analysis, Investigation, Methodology, Supervision, Visualization

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Conflicts of Interest

The authors declare no conflicts of interest.

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Research Fields

Teferi Benti Moti: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Writing – review & editing

Abdela Bulbula: Methodology, Supervision, Visualization, Formal Analysis, Investigation

Getachew Kinfe: Formal Analysis, Methodology, Visualization, Investigation, Supervision

Shubisa Abera: Project administration, Supervision, Writing – original draft, Software, Resources, Validation