A seroprevalence study of Contagious Bovine Pleuropneumonia (CBPP) and Assessment of Risk Factors on Indigenous Afar Cattle in Selected Districts of Afar Region, Afar, Ethiopia

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ABSTRACT

Background: CBPP is a transboundary and a leading economically devastating cattle disease prevalent in lowland areas where majority of the country’s cattle population are reared pastoral production system. Influenced by pastoral production systems, CBPP has continued to be productivity impedance in pastoral areas on which many people depend in the lowlands. Studies suggested CBPP to be prevalent in lowlands than mid and highland agro-ecologies. No matter how CBPP is a prime constraint to cattle productivity in the region, research outputs pertaining to CBPP is unavailable compared to other regions in the country. Thus, the objectives of the current study were to determine seroprevalence of CBPP and assess risk factors in selected districts of Afar region.

Methods: A cross-sectional study was conducted on local Afar cattle aged six months and above from February 2018 to January 2019 in selected districts of Dubti, Asaita and Chifra. Technically, of each randomly selected animal, an average of 8ml blood was drawn of jugular vein into plain vacutainer tube using sterile needle. Determined by Thrusfield formula, a total of 420 serum samples were collected. Samples were labeled, packed and transported to Samara University for separation of serum and blood and sera stored at -20°C. Using c-ELISA, antibodies against Mycoplasma mycoides subspecies mycoides small colony (MmmSc) were detected at National Veterinary Institute, Ethiopia. Data were analyzed using Stata 14.0 software.

Results: Using descriptive statistics, prevalence and frequencies were computed. Of 420 samples tested by cELISA, 158 samples found to be positive for CBPP
providing an overall prevalence of 37.6% with 95% CI (32.97-42.27). Of the three risk factors (age, sex and district) assessed by Chi-square ($\chi^2$), only two (age and district) were found to be associated with CBPP (P<0.05). Both age and district were significantly associated with the disease by bivariate logistic regression. However, only district was found to be significantly associated with CBPP by multivariate logistic regression analysis using 95 % CI and P-value less than 5%.

**Conclusion:** The study addressed the current status of CBPP in the study areas to be higher urging prompted and coordinated intervention to be set in place.

**Key words:** CBPP, Cattle, Risk factors, Afar region, Seroprevalence, Bacteria, Mycoplasma
Background

Livestock enterprises and animal production contribute significantly to the world economy, generate household income, food security, source of energy, draft power for crop cultivation or providing services, high quality animal proteins and vitamins (meat, milk), creating job opportunities, manure, raw materials (hides and skins), social assets, cultural and environmental values, and sustain livelihoods (Perry et al., 2003, Bonnet et al., 2011; Naqvi and Sejian, 2011; Metaferia et al., 2011).

Cattle are generally regarded as the most important domestic livestock species in the world (Rushton 2009). The major biological constraints contributing to low productivity of cattle include low genetic potential of the animals, poor nutrition and prevailing diseases (Belay et al., 2012a; Belay et al., 2012b). Among the prevalent diseases, Foot and mouth Disease (FMD), Contagious Bovine Pleuropneumonia (CBPP), lumpy skin disease, trypanosomiasis, external parasites and tick borne diseases are main animal health problems in animal health context.

CBPP is now one of the most important transboundary cattle diseases along with foot and mouth disease (FMD) though its clinical effects on animals are far more severe than foot and mouth disease (Nicholas, et al., 2008). Currently, it is recognized as a priority transboundary disease and has thus been categorized as the only bacterial disease in the OIE list A diseases (OIE, 2000).

Historically, CBPP has been known to occur in Europe since the 16th century though it gained a world-wide distribution only during the second half of the 19th century due to increased international trade in live cattle. In Africa, the disease was introduced first into South Africa in 1854 through importations of cattle from the Netherlands, and from where the disease spread to other
countries in the region. CBPP has been eradicated from Australia, most parts of Europe, Asian and America) by the beginning of the 20th century through the application of restrictions to the movement of cattle and using test and slaughter policies combined with compensation for livestock keepers (Andrews et al., 2004). However, the CBPP is yet present in other regions of the world including the Middle East, parts of Asia and, until very recently, Southern Europe. Eradication policies are difficult to apply in most developing countries because of pastoralism, lack of economic resources and fragmented veterinary services (Neiman et al., 2009; Sacchini et al., 2012). The disease is endemic to parts of Africa and in almost all African countries; it is a notifiable endemic disease (Radiostits et al. 2006) and considered to be the most damaging threat to the livestock industry in the region. The Pan African program for the Control of Epizooties (PACE) identified CBPP as the second most important transboundary disease in Africa, after Rinderpest (Tambi et al., 2006). Following the eradication of Rinderpest from Africa, CBPP has become the disease of prime concern in terms of epizooties affecting cattle in the continent (Amanfu, 2009).

CBPP is a highly infectious, acute, subacute or chronic septicaemic cattle disease affecting the lungs, pleura and occasionally joints in calves (Tambi et al., 2006; Radostits et al., 1994) caused by Mycoplasma mycoides subspecies mycoides small colony (OIE, 2008; Terlaak, 1992; Taylor et al., 1992). The principal transmission of CBPP is by the inhalation of infective droplets from active animals or carrier cases of the disease (Radiostits et al., 2008). CBPP is clinically characterized by anorexia, fever, weakness, emaciation, dyspnoea, polypnoea, cough and nasal discharges (OIE, 2002; Egwu et al., 1996). Current advanced techniques available for the diagnosis of CBPP include clinical signs, pathologic lesions (Pleurisy, lung hepatization), identification and isolation of the agent, immunoblotting, serology and PCR techniques (Goffe and Thiaucourt, 1998).

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CBPP causes reduced productivity, disruption of local markets, international trade and commerce, exacerbate poverty, cause pain and suffering to animals, disrupts food supplies system, retards genetic improvement and inhibits sustainable investment in livestock production, increase disease control costs, reduce draft power, cause direct losses (deaths, stunting, reduced fertility, and changes in herd structure), added labor costs and profit losses due to denied access to better markets (Thornton, 2010; FAO 2009; Rushton, 2009; Tambi et al., 2006).

**CBPP status in Ethiopia**

Historically, there is no established document as to when and how the disease exactly entered to Ethiopia (Amanfu, 2009). Viewed economically, CBPP is one of the most important diseases in Africa being widespread in West, Central and Eastern parts of the continent (Thomson, 2005). CBPP is endemic in Eastern Africa including Rwanda, Burundi, Tanzania, Sudan, Ethiopia and Uganda (Lesnoff et al., 2002). According to the OIE (2008), the highest number of outbreaks reported in 20 African countries (2006) were recorded in Ethiopia. An economic loss analysis study conducted by Tambi et al. (2006) in 10 African countries including Ethiopia has estimated an annual loss of 14,987,000 million Euros attributed to CBPP threat.

In Ethiopia, according to reports of various outbreaks, national serosurveillance and research results from 1997 to 2010, CBPP was found to be present in almost all regional states (Tuli, 2010). CBPP has been reported in different regional states of Ethiopia with an overall seroprevalence like 7.13% in Afar, 1.29% in Amhara, 12.05% in Benishangul Gumuz, 19.72% in Gambella, 5.17% in Oromia, 5.44% in Southern Nations Nationalities and People (SNNP), 0.9% in Somali, and 6.11% in Tigray in the year of 2004 (Gulima, 2011). In Ethiopia, CBPP is considered as one of the most important cattle diseases and impediments to livestock development in the country (Atnafie et al., 2015; Amanfu, 2009; Ministry of Agriculture (MOA), 2003).
Studies undertaken on CBPP so far revealed the existence of the disease in different parts of the country with prevalence that range from 0.4% (from bull at finishing phase for export in East Shewa zone that brought from Borena pastoral area) (Alemayehu et al., 2015) to 96% in Western Gojjam (Yigezu and Roger, 1997).

CBPP in arid and semi-arid areas: The case of Afar region

Influenced by mobile pastoralism, CBPP is dominant in the arid and semi-arid areas in the eastern, northeastern and southeastern parts of the country (Tegegne et al., 2009). As studies suggest, CBPP, a great plague, continued to devastate cattle on which many people are dependent in the lowlands (Ministry of Agriculture (MOA), 2003). The persistence of CBPP in pastoral areas could be attributed to the migratory lifestyle of pastoralists leading in turn for uncontrolled movement of cattle with continuous mixing at grazing fields, watering points and difficulty accessing vaccination services (Amanfu, 2009). A regional survey reported by Gulima (2011) indicated the prevalence of CBPP to be 7.13% in Afar region.

Hence, the disease has come to be a major threat to the country as 40% of livestock populations are kept under the pastoral lowland production systems (CSA, 2011). Furthermore, a significantly higher seroprevalence was found in animals in the lowland than highland and mid highland agroecologies (Mamo, 2016). CBPP is reported to be a major constraint to cattle production in the arid and semi-arid pastoral areas (Kairu-Wanyoike et al., 2013), therefore affecting livelihoods of over a hundred thousand households. Furthermore, studies suggested CBPP to be prevalent in lowlands than mid and highland agro-ecologies. No matter how CBPP is a prime constraint to cattle productivity in the region, research outputs pertaining to CBPP is unavailable compared to other regions in the country. Therefore, the objectives of the current study were to determine seroprevalence of CBPP and assess risk factors with the disease.
Methods

Study areas
The study was conducted in three selected districts of Afar region, namely Dubti, Asaita and Chifra. All are situated in Zone one of Afar region. The Afar region is one of the nine federal states of Ethiopia located in the northeastern part of the country. The region is geographically located between 39°34’ and 42°28’ East Longitude and 8°49’ and 14°30’ North Latitude. The region comprises 5 administrative zones, 32 districts and 331 kebeles, 28 towns, and 401 rural and urban kebeles (CSA, 2008).

Study design
A cross-sectional study design was applied to determine the seroprevalence of CBPP and associated risk factors in the selected study sites.

Study population
All indigenous Afar cattle aged 6 months and above reared by pastorals and agropastorals in the selected sites were used for the study.

Sampling technique and sample size determination
Both randomized and purposive sampling techniques were applied for selection of study animals (cattle) and study areas. While study zone, districts and kebeles were chosen purposively, households and study units/individual cattle were selected using simple random sampling technique. As no previous study conducted on CBPP in cattle found in the selected areas, the present study has considered 50% expected prevalence, 95% confidence level and 5% absolute precision or marginal error. Based on these assumptions, the total number of animals to be included in the study got determined using the Thrusfield (2007) formula.

\[ n = \frac{1.96^2 \times P_{exp} \times (1-P_{exp})}{d^2} \]
Where $n =$ required sample size, $d =$ desired absolute precision, \( P_{\text{exp}} = \) expected prevalence (50%).

Based on the formula, the total sample size was computed to be 384 cattle to be selected from all three districts. To minimize chance and increase precision of the outcome, the total number of study animals was increased to 420. Proportionally, a total of 128, 130, and 162 were collected from Asaita, Dubti and Chifra districts, respectively based on density of cattle population in the districts. The ages of the cattle was grouped into young (1 to 2 years), adult (3 to 8 years), and old (>8 years) according to Gatenby (1991) and Abera et al. (2010).

**Methodology**

A total of all 420 sera samples each amounting to 8-10ml of whole blood were collected from jugular vein of cattle into disposable plain vacutainer tubes using 21 Gauge needle. Just following collection, vacutainer tubes were labeled and transported to laboratory and kept overnight at room temperature to allow the blood clot. Correspondingly, each sample was identified along with age, study district and sex. Coded sera were transferred to cryogenic vials and stored in -20°C refrigerator at Samara University Veterinary Medicine Microbiology Laboratory to the time of transportation to National Veterinary Institute (NVI) for sera analysis.

**Competitive Enzyme Linked Immunosorbent Assay (c-ELISA)**

As recommended by OIE for CBPP test, c-ELISA technique was applied at National Veterinary Institute (NVI) serology laboratory, based on the manufacturer’s instruction (CIRAD-EMVT, France) (Amanfu et al., 2000). cELISA test is based on a monoclonal anti-MmmSC antibody named Mab 177/5 (OIE, 2014). Technically, using microplates precoated with MmmSC purified lysate, test samples were premixed with the specific monoclonal antibody Mab117/5 in a separate plate and the mix was transferred to the precoated microplate with MmmSC antigen. Any MmmSC specific antibodies present in the sample will form an immune complex with MmmSC antigen.
coated on the microplate competing with Mab117/5 for the specific epitope. Following the wash of unbounded material, an anti-mouse antibody enzyme conjugate was added. In the presence of immune complex between MmmSC antigen and antibodies from the sample, Mab117/5 cannot bind to its specific epitope and the conjugate is blocked from binding to Mab117/5. On the other hand, in the absence of MmmSC antibodies in the test sample, Mab117/5 can bind to its specific epitope and the conjugate is free to bind to Mab 117/5. Unbound conjugate was washed away and enzyme substrate Tetra methyl Benzedrine (TMB) was added. In the presence of the enzyme, the substrate is oxidized and develops a blue color becoming yellow after adding stop solution. Subsequent color development inversely proportional to the amount of anti-MmmSC antibodies in the test sample. In an end, optical density (OD) of individual reactions was measured at 450 nm using a plate reader and samples having OD values greater 50 or more were considered positive.

**Data management and analysis**

Data were coded and fed into Microsoft Excel for further statistical analysis. Applying Stata ver14.0, (Stata Corp, Texas, USA, 2015) descriptive statistics was computed to calculate overall prevalence of CBPP and other prevalence associated with risk factors. Association between risk factors and the disease positivity was assessed using Chi-square ($\chi^2$). Bivariate logistic regression was computed to estimate the magnitude association between risk factors and the disease. Risk factors having significant association with the disease were further analyzed by multivariate logistic regression analysis using 95 % confidence level (CI) and P-value less than 0.05.

**RESULTS**

**Descriptive statistics**

Descriptive statistics was employed to calculate the proportion of risk factors (season, sex, age and district) with respect to test result as summarized in Table 1. The total collected sera were tested using cELISA. Accordingly, the
total number of positive samples for each variable category with its respective percentage has been computed and summarized (Table 1).

**Table 1: Summary of descriptive statistics**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Samples tested</th>
<th>cELISA test result</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Negative (n)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Positive (n)</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>377</td>
<td>234</td>
<td>143</td>
</tr>
<tr>
<td>Male</td>
<td>43</td>
<td>28</td>
<td>15</td>
</tr>
<tr>
<td>District</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dubti</td>
<td>130</td>
<td>89</td>
<td>41</td>
</tr>
<tr>
<td>Asaita</td>
<td>128</td>
<td>59</td>
<td>69</td>
</tr>
<tr>
<td>Chifra</td>
<td>162</td>
<td>114</td>
<td>48</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young</td>
<td>48</td>
<td>29</td>
<td>19</td>
</tr>
<tr>
<td>Adult</td>
<td>249</td>
<td>170</td>
<td>79</td>
</tr>
<tr>
<td>Old</td>
<td>123</td>
<td>63</td>
<td>60</td>
</tr>
</tbody>
</table>

Of all serum samples tested (n=420) by cELISA in search of *Mycoplasma mycoides subspecies mycoides* small colony type (MmmSc) specific antibody, 158 serum samples were found to possess MmmSc specific antibody. Hence, the overall seroprevalence of CBPP over the three study districts was calculated to be 37.6% with 95% CI (32.97-42.27).

**Table 2: Overall prevalence of CBPP by cELISA**

<table>
<thead>
<tr>
<th>Samples tested</th>
<th>Negative Samples</th>
<th>Positive Samples</th>
<th>Prevalence (%)</th>
<th>95% Confidence Interval (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>420</td>
<td>262</td>
<td>158</td>
<td>37.62</td>
<td>32.97 - 42.27</td>
</tr>
</tbody>
</table>
**Association and bivariate logistic regression analysis**

As an answer to one of the study objectives of assessing the association between the disease and risk factors (age, sex and district) on disease occurrence was computed by Chi-Square ($\chi^2$). As a result, only two risk factors (age, $P<0.05:0.036$) and district, $P<0.05:0.000$) were found associated with CBPP. However, sex has no significant association with CBPP occurrence ($P>0.05:0.696$). Further, using 95% CI and $P<0.05$, bivariate logistic regression analysis was computed for age and district to estimate the magnitude of association (Crude Odds Ratio=COR) with the disease (Table 3).

**Multivariate logistic regression analysis**

Independently analyzed by binary logistic regression, age and district were found associated significantly with the disease. To compute real significant contribution of associated risk factors without compounding effect one on the other, multivariate logistic regression analysis was employed with 95% CI and $P<0.05$ and only district has been associated significantly ($P<0.05:0.000$) with the disease but age has no significant impact on CBPP occurrence among different age group. Taking Dubti district as reference category, those cattle found in Asaita district were 2.54 times more likely at risk of acquiring CBPP as compared to those animals found in Dubti district.
**DISCUSSIONS**

Based on the magnitude of the current overall prevalence observed (37.6%), over the three selected Afar districts, CBPP could be considered as a prime concern for cattle health and productivity in the particular study districts as well in Afar region. It could also be inferred that CBPP is more prevalent in Asaita district (16.4%) as compared to Dubti (9.8%) and Chifra (11.4%) districts.

Nationally in Ethiopia, the prevalence of CBPP varies from the lowest prevalence of 0.4% reported by Alemayehu et al., 2014 in Borena Zone, Ermiyas et al., 2014 in Export quarantine center of Adama by Dele et al.
(2014) in Export quarantine center of Adama to the highest CBPP prevalence in Ethiopia (96%) reported by Yigezu and Roger (1997) from Western Gojam.

The prevalence of CBPP among African countries also differs though the biggest ever prevalence was recorded in Ethiopia (96%). The prevalence of CBPP in 10 African countries included: 8.1% in Sudan (McDermott et al., 1987), 0.29% in Nigeria (Aliyu, et al., 2000), 2.8% in Kenya (Wanyoike, 1999), 4% in Ethiopia (Fikru, 2001), 2.9% in Burkina Faso (Kane, 2002), 5.4% in Mauritania (Kane, 2002), 8.1% in Mali (Sery et al., 2014), 21.05% in Guinea (Soromou et al., 2014), 66% in Gambia (Mbengue et al., 2013) and 0.43% in Senegal (Mbengue et al., 2013). According to reports, Ethiopia is the leading (96%) and being followed by Gambia (66%) and thirdly Mali (21.05%).

Similarly, the magnitude of CBPP prevalence from different parts of Ethiopia varies extremely. According to reports of various outbreaks, national serological surveillance and research results from 1997 to 2010, CBPP has been confirmed to be present in almost all regional states of Ethiopia (Tuli, 2010).

Compared to the current finding in Afar region from the three districts (37.6%), other studies have reported lower CBPP prevalence: 5.1% by Roger and Yigezu (1995) in North Omo, 5.1% by Issa (2004) from Borena pastoral areas reported, a 10.3% by Mekonnen (2004) in Somali region, 4% by Kassaye and Molla (2012) during a period of 2010 -2011 from export quarantine centers in and around Adama, 8.7% by Gedlu (2004) in Bishoftu, 9.4% by Ahmed (2004) in Borena zone and 9.5% by Kassaye and Molla (2013) on Adam export quarantine center, 10% by Molla and Delil (2014) from Dasench district of South Omo, 11.0% by Teshale et al. (2015) from Southern Tigray, 10.3% by Gizaw (2016) from Shinille zone of Somali region, 28.5% by Daniel et al. (2016) from Western Oromia, 31.8% by Tolesa et al. (2015) from Amaro district, SNNP, 28% by Regassa (2001) from Bodji district of Western Wollega, 32.5 by Desta (1998) from Western Ethiopia, 9.1% by
Gashaw (1998) from Northwest Ethiopia, 7.8% by Biruhtesfa et al. (2015) on Abattoirs at Bishoftu and Export Oriented Feedlots Around Adam, 8.1% by Mamo (2016) from Gimbo district, SNNP.

However, the current finding closely agrees with the reports of Gedlu (2004) who reported 39% prevalence from Somali Regional State. Similarly, the current report also closely agrees with the report of Desta (1998) who reported 32.5% in Western Ethiopia.

However, the current finding was lower than other prevalence reports: From Western Gojam and Awi Zone, Gashaw (1998) has reported 66.3%) in Banja district, 41.7% in Dangila district and 33.3% in Denbecha district. Similarly, Dejene (1996) has reported 56% CBPP prevalence in North Omo, Desta (1998) has reported a prevalence of 48% in Ilu Ababor and Wellega (Western Ethiopia), Roger and Yigezu (1995) reported 46% CBPP prevalence in Konso of SNNP and Yigezu and Roger (1997) reported 74% CBPP prevalence in Borena Zone and 75% prevalence of CBPP in Western Wellega zone.

As indicated by different scholars, the prevalence of CBPP varies from area to area in Ethiopia as well the across African continent in general. The variation of findings on CBPP seroprevalence in different parts of Ethiopia could be due to variation in temporal and spatial distribution of the disease agro-ecological system, animal management (husbandry practices), biological or breed difference, communal grazing areas, production system, cattle population density, herds size, number of examined animals, livestock movement and sensitivity of serological tests used to evaluate the seroprevalence (Daniel et al., 2016; OIE, 2014; Ebisa et al., 2015).

In the current study, district, age and sex were considered as risk factors. Accordingly, their association and strength of association with disease was statistically computed. Based on the statistical computations, study district was found to have statistically significant association (P=0.000, $\chi^2 = 20.924$) with the disease. Similarly, age of animals was also significantly associated
(P=0.006, $\chi^2 = 100.292$) with the disease seropositivity. On the other hand, sex (P=0.696, $\chi^2 = 0.153$) had no significant association with the disease.

The current study has revealed the seroprevalence of CBPP at the districts to be 9.8%, 16.4% and 11.4% for Dubti, Asaita and Chifra, respectively, indicating differences with statistically significant variation (P<=$0.05$; 0.000) in the prevalence of antibodies among the districts. Other studies have reported similar findings: Tesfaye (2016), Tadese (2014), Daniel et al. (2016). The significant variation among study districts might be attributed to the presence of large number of livestock population within the districts, the presence of communal grazing and watering areas, degree of confinement/crowding, husbandry practices, agro-ecologic difference and degree of cattle movements (OIE, 2014).

Referring to Gatenby (1991) and Abera et al. (2010), the age of study animals was divided into three groups: Young, Adult and Old. The current study has indicated infection rates of 4.5%, 18.8%, and 14.3% for young, adult and old age groups, respectively. Unlike sex, age had statistically significant association(P=0.006, $\chi^2 = 100.292$) with CBPP occurrence. However, multivariate logistic regression analysis showed that the significant association of age with disease found by bivariate logistic regression analysis was found to be nonsignificant (Table 3) implying that age has real no contribution to CBPP occurrence.

In the current study, the prevalence of CBPP in young animals was lower than both adult and old animals. In adult animals, the prevalence was observed to be higher than young animals. The higher prevalence in adults would be attributed to the fact that young animals do not move far away from houses; therefore, there is less chance to come into contact with infected animals. In addition, Masiga, Domenech and Windsor (1995) reported that young animals are more susceptible to acute forms of CBPP than adult cattle and thus acutely infected young animals may die of CBPP
and not be available for testing. The current finding agrees with reports of Bashiruddin et al. (2005) who reported that with age variation infection resistance could also vary. According to Bashiruddin et al. (2005) animals less than 3 years of age are less resistant to CBPP by experimental studies. In two separate experiments, it was shown that cattle over 3 years of age were more resistant to CBPP infection than younger animals. In addition, the present result is also in close agreement with previous reports by Swai et al. (2013) and Matua-Alumira et al. (2006) who reported that seropositivity in adults was a bit higher than that in young animals. However, the study made by Kassaye and Molla (2012) and Andrew et al. (2004) contradicts with Bashiruddin et al. (2005) in which both described as calves were less positive to CBPP seroprevalence.

The lower prevalence of CBPP in older cattle as compared to adults would probably associate with decreased immunity and resistance of old animals. Conversely, the prevalence of CBPP in older cattle was higher as compared to young animals. This finding agrees with the claim that CBPP is a disease of older animals (Andrews et al. 2004). This might be attributed to long time exposure and life span of the older animals than the younger ones and the persistency of sequestrum for a long period of time in CBPP recovered animals.

In the current study, infection rate by sex was computed to be 3.6% and 34.0% for male and female respectively. However, there was no statistically significant difference with sex ($P=0.696$, $\chi^2 = 0.153$). No matter how there was no statistically significant difference ($p > 0.05$), the higher prevalence of CBPP in female cattle agrees with Schnier et al. (2006) who reported a significantly higher prevalence in female animals. Similarly, Teshale et al. (2015) has also reported a difference in the prevalence of CBPP between male and female. The variation in the prevalence between male and female animals could be due to sampling error or the nonproportionality of samples collected, level of stress and degree of contact with young susceptible
young/calves. Similarly, the current finding agrees with the report of Tesfaye (2016). However, the insignificant (P<0.05) difference of seroprevalence between sex may be due to similar exposure of animals to the disease since the disease is contagious that all animals in the herd can be affected and that a single diseased animal can serve as continuous source of infection to the herd. The disease is mainly transmitted from animal to animal in aerosols. This organism occurs in saliva, urine, fetal membranes and uterine discharges (Radostits et al., 2008). This could play great role in uniformity of infection in both sexes.

CONCLUSION
The current study has provided convincing evidence against CBPP in Afar region. The magnitude of the overall seroprevalence of the disease over the three selected districts suggests higher prevalence indicating the magnitude of economic challenge posed on cattle owners’. Furthermore, the study has identified contributory risk factors for the disease occurrence. Of the three risk factors assessed, age and study sites (districts) have indicated to have significant association with seropositivity of the disease. In conclusion, the study findings strongly urge a prompted and coordinated interventional to be taken forward.

Declarations
Ethics approval and consent to participate

As the work or the research was not experimental, no ethical approval was needed. However, to take blood from animals, the oral consent of the animal owners was obtained.

Consent for Publication: Not applicable

Availability of data and material
The data sets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declared that they had no competing interests.

**Funding: Not Applicable**

**Authors' contributions:**

1. WNM (first author): Contributed by preparing proposal, data collection, data analysis and article write up and paper submission and communication in the publication process.

2. TD (second author): data collection, proposal review and assisted in data analysis

**LIST OF ABBREVIATIONS**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>CBPP</td>
<td>Contagious Bovine Pleuropneumonia</td>
</tr>
<tr>
<td>c-ELISA</td>
<td>Competitive Enzyme linked immunosorbent assay</td>
</tr>
<tr>
<td>CIRAD-EMVT</td>
<td>Centre de cooperation Internationale en recherche agronomique pour le développement- Département élevage et médecine vétérinaire</td>
</tr>
<tr>
<td>CSA</td>
<td>Central statistical Agency</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and agricultural organization</td>
</tr>
<tr>
<td>FMD</td>
<td>Foot and mouth Disease</td>
</tr>
<tr>
<td>MmmSc type</td>
<td>Mycoplasma mycoides subspecies mycoides Small Colony type</td>
</tr>
<tr>
<td>NGOs</td>
<td>Nongovernmental organizations</td>
</tr>
<tr>
<td>NVI</td>
<td>National Veterinary Institute</td>
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<td>OIE</td>
<td>Office of International Des Epizootics</td>
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<tr>
<td>PCR</td>
<td>Polymerase Chain reaction</td>
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<td>PFE</td>
<td>Pastoralist Forum Ethiopia</td>
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