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Seroprevalence And Associated Risk Factors Of Pesti Des Petitis Ruminitis (Ppr) Disease Of Small Ruminants In Dangur District Of Metekel Zone, North West Ethiopia

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ABSTRACT*:* A cross-sectional study was carried out from November 2019 to November 2020 to determine the seroprevalence and risk factors of PPR in non-vaccinated areas and to assess the perception and awareness of farmers from small ruminants in Dangur District of Metekel zone, North West Ethiopia. Multistage sampling, with three hierarchical stages, was used as sampling strategy. Rural kebeles and individual animal were selected by simple random sampling. A total of 403 serum samples were collected from sheep and goats in the study district. All samples were examined for the presence of antibody for PPRV by competitive Enzyme Linked Immuno Sorbent assays (cELISA). Logistic regression was used to quantify the association between the putative risk factors and sero-prevalence of PPR. PPR outbreak was occurred in the study district with morbidity, mortality and case fatality rates of 29.5%, 10.9%, 37.07% in small ruminants, respectively. The overall seroprevalence of PPR virus antibody was 32.5%. The present study revealed that sex and communal grazing are factors of PPR seropositivity in sheep and goats. Therefore, restriction of animals movement from endemic areas, with strict quarantine and surveillance procedures should be implemented to prevent the spread of the disease and the transmission of the virus to different localities.
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Key words: Etiology; Metekel; Peste des petits ruminant; seroprevalence; small ruminants; Ethiopia

1. INTRODUCTION

1.1. Background and justification

Sheep and goats are vital livestock for supporting food security because of their high reproductive capacity; faster growth rates, greater environmental adaptability and low initial investment, and hence have a unique niche in smallholder agriculture (Maluos Tibbo, 2006). There is an immense opportunity for increased livestock production in Ethiopia with growing human population, urbanization, economic development, domestic and export markets. However, there are several constraints reducing the productivity in this sector. Infectious disease is considered a major problem causing death, decreased production and export constraints (Pradère, 2014).

Peste des petits ruminant (PPR), also known as goat plague, is a viral disease of goats and sheep characterized by fever, sores in the mouth, diarrhea, mucopurulent ocular and nasal discharges, necrotizing and erosive stomatitis, severe enteritis and pneumonia, and sometimes death. Peste des petits ruminant is a transboundary animal disease of significant economic importance, ranking among the top ten diseases affecting small ruminants (Dialo, 2006). Peste des petits ruminant virus belongs to order Mononegavirales, family paramyxovirus, genus Morbillivirus (Sen *et al*., 2010). Because of the strong clinical resemblance between rinderpest, it was suggested that PPR was caused by a variant of rinderpest virus that better adapted to small ruminants that has become less pathogenic to cattle but after different serological tests and cross protection studies, it was recognized definitively as different from RPV (Dialo, 2006).

Peste des petits ruminant was first described in Ivory Coast, West Africa in 1942 and subsequently spread to other regions (FAO, 2009). Currently, the disease is widespread in Africa, Arabia, and the Middle East and in some geographical areas of Asia, including much of the Indian subcontinent. Furthermore, because of outbreaks in Morocco and the existing commercial trade between Morocco and both Algeria and Spain, the situation raised huge concern owing to the increased risk of introduction of the disease into free zones in northern Africa and into Europe (Khalafalla *et al*., 2010).

The disease is mostly present in developing countries which often rely heavily on subsistence farming of small ruminants for trade and food supply (De Nardi *et al*., 2012). Since 2007, more than one billion small ruminants in Africa and Asia have been considered at risk of being infected with the PPRV (FAO, 2009). Because of the dramatic clinical incidence and associated restrictions on animal and product movements, PPR is considered as a disease of major economic impact and has been notified to the World Animal Health Organization (OIE) (Albina *et al*., 2013).

The disease was clinically suspected for the first time in Ethiopia in 1977 in a goat herd in the Afar region, in the east of the country. Clinical and serological evidence of its presence has been reported in 1984 and later confirmed in 1991 with cDNA probe in lymph nodes and spleen specimens collected from an outbreak in a holding near Addis Ababa (Roeder *et al*., 1994). In spite of the fact that PPR disease outbreaks are underreported, due to the poor reporting system in Ethiopia, an increasing trend has been observed in PPR outbreaks between the years 1996 and 2005 (Waret-Szkuta *et al*., 2008). There are reports in different parts of the country such as, 38.8%, 4.6 %, 8% and 1.7% in Afar, Amhara, Benishangul gumuz and Oromia, respectively (Bekele Megersa *et al*., 2011 and Waret-Szkuta *et al*., 2008). Over the last two decades PPR has spread from the now endemic lowland pastoral communities to many districts in the highlands of Ethiopia. As expected, the prevalence was much higher in the lowland pastoral systems as compared to the highland sedentary systems (Waret-Szkuta *et al*., 2008).

Ethiopia developed a strategy for the progressive control of PPR that builds upon the lessons learnt from rinderpest eradication. A progressive control campaign based on repeated inoculation of all susceptible small ruminants is unaffordable to be implemented. Hence, an epidemiologically based targeting of endemic populations and high-risk zones will be essential. Despite an expansion of PPR to previously unreported area, very little work exists in the country to clearly reveal the epidemiology of the disease (Gopilo Abraham *et al*., 1991; Gopilo Abraham *et al*., 2005; Waret-Szkuta *et al*., 2008; Bekele Megersa *et al*., 2011; Delil *et al*., 2012). Therefore, additional epidemiological study is needed to support the current Ethiopian initiative towards controlling the disease.

These laboratory tests can be divided into those that look for the virus (PCR or immunocapture ELISA [ic-ELISA]), used to detect acute infection, and those that look for antibodies against the virus (competitive ELISA [cELISA]), used for serum surveillance studies and to estimate how widespread infection has been in a flock or area (Baron, *et al.*, 2011).

The most effective way to control PPR is mass immunization of small ruminants as often, farmers in areas where the virus is endemic are unable to afford and implement the strict sanitary control measures, including the stamping out policy, required to contain the virus. Therefore, the control of PPR requires an effective vaccine and for this purpose several vaccines including both homologous and recombinant vaccines have been developed (Abubakar *et al*., 2011a).

1.2. Statement of problem

Dangur District has a suitable agro climatic condition for raising small ruminants that play an important role in the economy and livelihoods of farmers. This sector serves as a financial reserve for period of economic distress such as crop failure as well as primary cash income. Despite its large population of small ruminants, productivity is very low in the study areas. Although, there are multi-directional factors including poor nutrition, reproduction insufficiency and management constraints for low productivity of small ruminants, and the presence of infectious disease takes the dominant role (Ayele Taddese *et al*.,2012). Among these, peste des petits ruminants (PPR) holds dominant factors by causing direct losses, such as death and decreased production. Dangur District is one of the most prone areas for PPR infection. It shares border with Amhara region where there is frequent and uncontrolled movement of livestock along the border, which predisposes small ruminants to PPR. This showed the area is important to PPR distribution due to geographical location and the communities suffered massive losses due to the disease which makes PPR control relevant. So far, according to the regional office report, there is no researches carried out about the status of peste des petits ruminants (PPR) disease in the study area This situation creates a great limitation to understand the burden of the disease and the immunity of animals as herd level and hence to undergo effective and strategic control measurements. So, this study fills the gap by revealing the overall status of the disease and indicates the effective control measurements in the area.

1.3. Objectives

1.3.1. General objective

To determine the epidemiology of PPR in unvaccinated sheep and goats and identifying possible risk factors for the occurrence of the disease in Dangur district of Metekel zone,

1.3.2. Specific objectives

- To estimate the seroprevalence of PPR in non-vaccinated sheep and goats.
- To identify possible risk factors for the occurrence of the disease.
- To assess the perception and awareness of farmers about PPR disease.

1.4. Research questions

1. What is the prevalence of PPR in Dangur District?
2. Is there an association between possible risk factors and PPR?
3. Has the community an awareness of PPR disease and its clinical signs?

2. MATERIALS AND METHODS

2.1. Description of the study area

The study was carried out at Dangur district of Metekel zone, Benishangul Gumuz region, North Western Ethiopia. The study district included the valley of Blue Nile located in the Northern part of Benishangul Gumuz region which encompasses the lowlands of Awi zone of North Western Amhara region. Dangur district is one of the largest of all districts in Metekel Zone of Benishangul Gumuz region. Dangur has 29 kebeles with approximately 837,700 hectares of land. The agro-climate of the district alternates between a longer summer rainfall (from June to September) and a dry season (from December to March). The district gets more annual rainfall than other districts found in Metekel Zone with a mean annual rainfall ranging from 900 to 1400 mm. of Dangur is one of the hottest places in Ethiopia with a minimum annual temperature of 30 ^{0}c that can go as high as 38ºC during the hottest season of the year. The district livestock population of the district can be estimated of 15251 cattle, 11723 sheep, 29871 goats, 2438 equines, 46119 poultry and 13212 beehives (CSA, 2015).

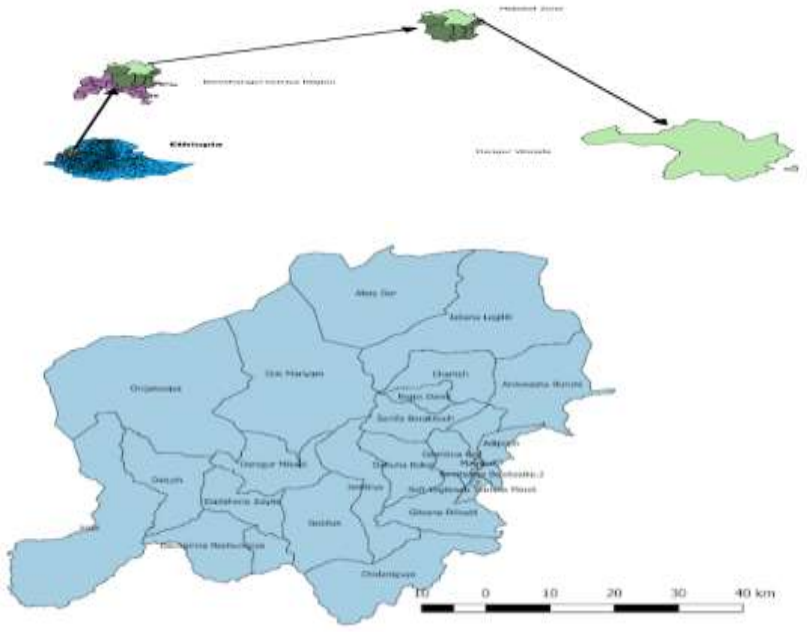

Figure 1: Map of Dangur district

2.2. Study population

The study populations were sheep and goats that are kept under traditional farming system of the area in Dangur district of Metekel zone, Benishangul Gumuz region. The sampling frame includes those sheep and goats that have no history of vaccination against PPR. History of previous vaccination was carefully documented in order to eliminate the possibility of sero-positivity due to vaccinal antibodies. Moreover, small ruminants younger than five months of age were excluded from sampling to avoid sero-positivity due to maternal antibodies as a confounder.

2.3. **Study design**

A cross-sectional study design was used, and data collection was completed from November 2019 to November 2020 to estimate seroprevalence of peste des petits ruminants (PPR). Questionnaire survey was administered to gather data on social perception of major sheep and goat diseases in the study area.

2.4 **Sample size determination**

The sample size was calculated using the formula described by Waret-Szkuta *et al*.,(2008). Statistical considerations during sample size determination include 95% confidence interval and 5% desired absolute of precision.

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

Where n= required sample size, p=expected prevalence d= desired absolute precision

Where: z = 1.96, Pexp = 0.5 and d = 0.05 (the desired level of precision or accuracy).

Based on the above formula, the required sample size was calculated to be 384 small ruminates (sheep and goats), which can be equally distributed as at least 96 small ruminants from each rural kebeles. However, due to the difference in population size of small ruminants among the selected rural kebeles, sample size was allocated proportionally based on existing sheep and goat population per kebeles. Therefore, 30.02% (n=121) samples were randomly drawn from Ankasha- Burji kebele and 22.58% (n=91) samples were randomly drawn from Manbuk 01. Likewise, about 27.54% (n=111) samples were randomly selected from Java kebele and 19.85% (n=80) samples were randomly drawn from Kota kebele. Based on the above proportions, a total of 403 small ruminants were selected for the study.

For the questionnaire survey, it is assumed that about 20% of the flock owners recognize the PPR since it is unrecognized and frequently confused with other diseases that cause respiratory problems and mortality of small ruminants. Therefore, considering a 95% confidence level and a 5% desired absolute precision, a sample size of 228 small ruminant owners was interviewed for the study (Thrusfield, 2007).

Table 2: Study kebeles and number of small ruminants sampled

Kebeles	Population		No. of Gotes selected	No. of sample taken
	Goat	Sheep		
Ankash- burji	2360	470	6	121
Manbuk 01	301	772	4	91
Java	6983	977	5	111
Kota	446	34	4	80
Sum	10090	2253	19	403

2.5 Sampling strategy

Multi-stage sampling strategy (Dohoo *et al.*, 2003), with three hierarchical stages(units), was used to select, Dangur district, rural kebeles and sub kebeles (Gote/village). Rural kebeles bordering Amhara regional state were purposively selected in order to address the perceived risk due to either contact with trade or nomadic animals through shared grazing and watering points along the border. Kebeles /villages/ and individual animals were selected through random sampling techniques. In each rural kebeles four to six rural gotes or villages were randomly selected by simple random sampling (lottery method) with a total of 19 Gotes/villages. Study respondents and animals were randomly sampled. Both sexes and above five

months' age groups of shoats were sampled. The ages of individual goats were categorized on the bases of Zahur *et al.*, (2009) into two groups as young (6 months to ≤ 1.5 years old) and adults (> 1.5 years old)

2.6 Methods of data collection

2.6.1 Questionnaire survey

Semi-structured interviews were administered by asking the owners of those small ruminant animal's owners who were willing to participate in the study and willing to collect samples from their animals. From each kebele, 10 to 12 people were interviewed from the selected villages. In each selected rural kebeles, flock owners were interviewed using structured questionnaire in order to generate information on the existing disease of small ruminants with particular emphasis on PPR. The questionnaire was framed that farmers could give information which is recent and easy to recall. The farmers were selected purposively based on their willingness. The respondents have also interviewed to reveal information regarding, their household's flock size, age and sex, clinical signs of disease encountered. Picture which indicates the clinical sign of PPR was used to confirm whether interviewed farmers recognize PPR or not.

2.6.2 Serum Sample Collection

Serum samples were collected from sheep and goats' flocks before and after vaccination. From each animal 10 ml blood was collected aseptically from the jugular vein into a plain tube. Supplementary information on potential risk factors (such as animals age and sex, spesies, herd size, origin, raising type) was also recorded during blood sampling by asking owners of the sampled animals. Samples were labeled accurately in order to easily identify each animal, and the sampled flock. The collected blood was allowed to clot by placing the samples at room temperature for two consecutive hours without shaking the samples, and then samples were stored horizontally overnight at 4°C. The serum was then separated from the clot by centrifugation at 3000 rpm for 10 minutes and transferred to cryovials, further labelled and then transported to the district veterinary clinic in an icebox where it was kept frozen (at -20°C) until analysis. The serological test was carried out at the National Veterinary Institute (NVI), Debre Zeit, Ethiopia.

2.6.3 Active Field Investigation

An observational study on clinical cases was conducted during an outbreak occurred in the study period. Health status data, as part of the observational study, was collected through recording occurrence of enteritis-stomatitis syndrome and respiratory distress, overall number of sick animals (used to compute morbidity) as well as overall and specific deaths associated with observed clinical cases (used to compute crude and case fatality of PPR).

2.7 Laboratory Analysis using cELISA

Serum samples were analyzed at the National Veterinary Institute (NVI) using a competitive enzyme linked immunosorbent assay (c-ELISA) test kit (IDScreen® PPR Competition, Montpellier, France). The analysis was done following the instructions of the manufacturer (FAO reference laboratory CIRADEVMT, Montpellier France) using a corresponding assay protocol. The kit sensitivity and specificity were 100% .

A monoclonal antibody (MAb) based competitive Enzyme Linked Immunosorbent Assay (cELISA) (Diallo *et al*. 1995; OIE, 2013) was used for the detection of antibodies directed against the nucleoprotein of the PPR virus using approved competitive ELISA kit as described by Libeau *et al*. (1995).

Briefly, the ELISA wells were coated with purified recombinant PPR nucleoprotein (NP); the samples to be tested and the controls were added to the microwells. Anti-NP antibodies, if present, form an antibody-antigen complex which masks the NP epitopes. An anti-NP peroxidase (HRP) conjugate was added to the microwells and incubated. It fixes to the remaining free NP epitopes, forming an antigen-conjugate-HRP complex. After washing (to eliminate the excess conjugate), the substrate solution (TMB) was added and the resulting coloration depends on the quantity of specific antibodies present in the sample. Stop solution (sulfuric acid) was added to each well in order to stop the reaction. The microplates were read with ELx800 Absorbance Microplate Reader (Biotek® Instruments, Inc. USA) with an inference filter of 450 nm and connected to a computer loaded with Gen 5TM software for automated reading.

2.8 Data management and analysis

The data obtained was classified, filtered and coded using Microsoft Excel® 2010. The data was then exported to STATA version 14 (Stata Corp. Texas,

USA) for statistical analysis. Descriptive statistics which were used to describe community perception of PPR. Logistic regression was used to evaluate causation and quantify the association between the putative risk factors and sero-prevalence of PPR. All significant variables (P < 0.25) tested in the univariable logistic regression was further tested by multiple logistic regressions to adjust confounding and see their independent effect on PPR sero-positivity. A confidence limit of less than 5% was used to indicate a significant level.

Index was calculated for ranking of farmers saying on major goat diseases occurred in the study according to the formula: Index= sum of (3 * number of households ranked first + 2 * number of households ranked second + 1 * number of households ranked third) given for each disease divided by sum of (3 * number of households ranked first + 2 * number of households ranked second + 1 * number of households ranked third) for all disease in a study site.

3. RESULTS

3.1 Sero-Prevalence of PPR

Out of the total 403 samples collected from non-vaccinated sheep and goats 131 (32.5%) were found positive for PPR, respectively. Accordingly, a relatively higher seroprevalence of PPR was observed in Jaba 45.9%, when compared with Ankasha- Burji 33.9%, Manbuk 01 26.4% and kota 18.8%. The result described in Table 3, the seroprevalence of PPR was higher in goat (34.7%) when compared with sheep (28.3%). Also, 33.9% and 30.6% of the serum sample collected from adult and young animals were positive for PPR, respectively. Prevalence of PPR was higher than in male (35.9%) than in female (28%) (Table1).

Table 1: Overall seroprevalence of PPR in Dangur District

Variables	No of examined	No of positive	Percentage
Kebeles			
Ankasha Burji	121	41	33.9
Manbuk 01	91	24	26.4
Jaba	111	51	45.9
Kota	80	15	18.8
Total	403	131	32.5
Species			
Goat	265	92	34.7
Sheep	138	39	28.3
Total	403	131	32.5
Sex			
Male	228	82	35.9
Female	175	49	28
Total	403	131	32.5
Age			
Adult	230	78	33.9
Young	173	53	30.6
Total	403	131	32.5

3.2 Association between sero-positivity and risk factors

By considering sex, age, species, location, rearing system of the animal as possible risk factor, univariate logistic regression analysis was performed to understand the association of each factor with the sero-positivity of PPR. The result described in Table 4 indicated that, there was statistically significant difference observed (p < 0.05) between the seropositivity of PPR with Kebeles, and grazing management type. The PPR seroprevalence recorded in Kota kebele 15 (18.8 %) is significantly lower than in Java kebele 51 (45.9%). There was no significant difference in the seroprevalence recorded in goats (34.7 %) compared to sheep (28.3%).

Higher sero-positivity percentage was recorded in Jaba kebele (45.9 %), in goats (34.7%) that are male (35.9 %) adults (33.9 %). Moreover, a communal grazing (40.9 %) was statistically significant (Table 2).

Table 2: Risk factors associated with PPR seropositivity using univariable logistic regression analysis in Dangur District.

Variable	Number of sampled	Positive	Prevalence (%)	Odds ratio	95% CI of OR	p-value
Kebeles						
Ankasha Burji	121	41	33.9	Ref.		
Manbuk 01	91	24	26.4	0.7	0.4-1.3	0.241
Jaba	111	51	45.9	1.7	0.97-2.8	0.061
Kota	80	15	18.8	0.5	0.23-0.9	0.021 *
Species						
Goat	265	92	34.7	Ref.		
Sheep	138	39	28.3	0.7	0.5-1.2	0.190
Sex						
Male	228	82	35.9	Ref.		
Female	175	49	28	0.7	0.5-1.1	0.091
Age						
Adult	230	78	33.9	Ref.		
Young	173	53	30.6	0.9	0.6-1.3	0.487
Grazing management						
Private (self)	173	37	21.4	Ref.		
Communal	230	94	40.9	2.5	1.6-3.9	0.000 *

Ref.: Reference, CI: Confidence interval, *: Significant

The result of multivariable logistic regression analysis showing an association of incriminated risk factors and the seropositivity of PPR in sheep and goats (Table 3). After removing a variable which were insignificant ($p > 0.25$) from the univariable logistic regression analysis the final model for multivariable logistic regression analysis contains the variable sex, species and grazing management type. The result indicated that, there was statistically significant difference observed ($p < 0.05$) between the seropositivity of PPR with sex and grazing type, which were statistically significant association with the seropositivity of PPR in the univariable logistic regression analysis.

Table 3: Risk factors associated with PPR Seropositivity in Dangur District.

Variables	No. sampled	Positive	Prevalence (%)	Odds ratio	95% CI of OR	p-value
Grazing management						
Private (self)	173	37	21.3	Ref.		
Communal	230	94	40.8	2.22	1.2-4.1	0.011*
Sex						
Male	228	82	35.9	Ref.		
Female	175	49	28	0.59	0.37-0.94	0.027*
Species						
Goat	265	92	34.7	Ref.		
Sheep	138	39	28.3	0.7	0.4-1.2	0.188

Ref.: Reference, CI: Confidence interval, *: Significant

3.3 Questionnaire Survey

3.3.1 Community awareness and perception on sheep and goat disease

Pesti des petitis ruminitis, sheep and goat pox and external parasite were the major diseases reported to be prevalent in the study areas (Table 4). The result showed that, 65.4% and 31.7% of the respondents in the study area were aware

of PPR disease and capable of describing the disease based on the clinical picture, respectively. However, 2.9% of the respondents had not recognized PPR

Table 4: Major sheep and goat diseases occurred in the study areas based on respondent's view in Dangur District.

Disease	Local name	Rank					
		R1	R2	R3	Sum	Index	Score
PPR	Yefiyel gunfan	105	30	5	145	39.1	1
Sheep and goat Pox	Agurebrib	45	60	15	120	32.4	2
External parasite	Ekek	30	50	25	105	28.3	3

3.5.2. Community awareness on clinical symptoms of PPR disease

Community members were asked to describe the common clinical symptoms of PPR disease. Different clinical symptoms of suspected PPR cases were reported by livestock keepers in the study community.The symptoms the community identify were nasal discharges, diarrhea, respiratory distress, oral ulcers and nodules, lacrimation and abortion (Figure 2).

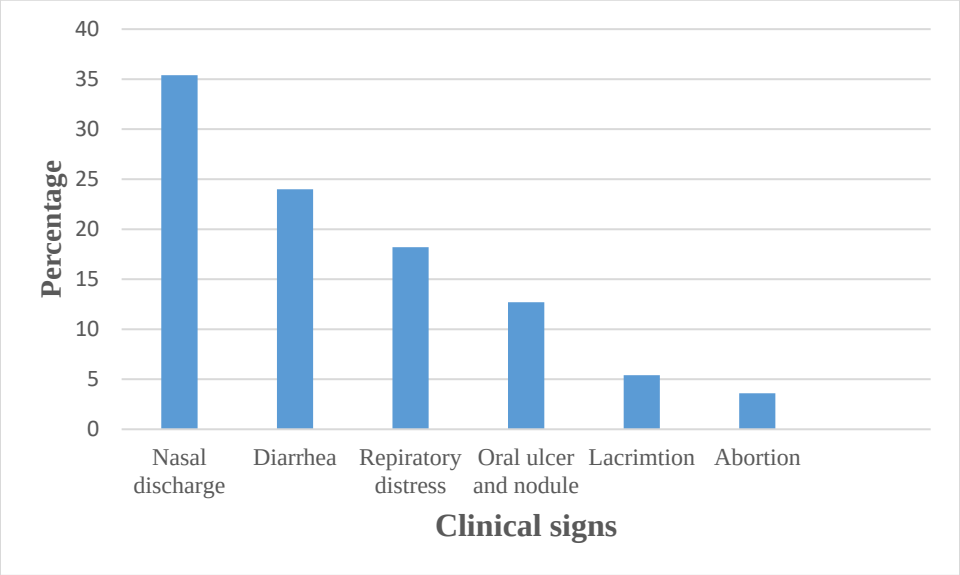

Figure 2: Common clinical symptoms of PPR described by study participants in the study areas

3.6 Observation on clinical signs of PPR and quantifying its magnitude

During the observational study, carful observations of the common signs of PPR were done on a total of 301 small ruminants (sheep and goats). The observation was done in both male and female animals of all age groups in the study kebeles where the out breaks were occurred. The clinical signs included high fever, ocular and nasal discharge, few cases of abortions, respiratory distress and diarrhea. The observed flock was consisted of 66 sheep and 235 goats, and the flock could be regarded as homogeneous with respect to the risk of transmission of infectious diseases. Among the groups under observation, there were 21 sheep and 68 goats that were found to be affected by PPR giving morbidity rates of 31.8 % for sheep and 28.9% for goats. Four sheep and 29 goats were died of the disease through the course of observation with the mortality rates of 6.06 % and 12.3%, respectively (Table 5). The case fatality rate was 19.04% for sheep and 42.6% for goats. The clinical signs and mortality rate were more severe in goats than in sheep. The course of the disease was reported to be between 3 and 11 days. During treatment of affected cases there was satisfactory response to injectable antibiotics with the combination of fluid therapy, especially for diarrheic animal.

Table 5: The mortality, morbidity and CFR during PPR outbreak in Manbuk 01Kebele.

Parameters	Sheep	Goat	Total
Population investigated	66	235	301
Morbidity	21(31.8)	68(28.9%)	89(29.5%)
Mortality	4(6.06%)	29(12.3%)	33(10.9%)
Case fatality rate	19.04%	42.6%	37.07%

4. DISCUSSION

For effective control of PPR, accurate diagnostic techniques and timely vaccination of susceptible populations are necessary. Accordingly, a full understanding of the disease epidemiology is imperative. Pesti des petitis ruminitis eradication depends on rapid and accurate diagnosis, and carrying out of prompt control measures. Due to the immense economic impact of PPR, it is absolutely necessary to implement epidemiological surveys of this disease. Therefore, information on the prevalence of this disease helps the policy makers to develop appropriate strategies regarding prevention, treatment and control protocols.

From a total of 403 serum samples collected for sero-prevalence analysis in four kebeles of Dangur district, Metekel zone, Benishangul Gumuz region, 32.5% (95% CI: 27.9, 37.3) of the samples were found positive for PPR. The current finding (32.5%) was higher when compared with the reports of Tesgay Gebre *et al*., (2018) in South West Ethiopia, Tsegaw Fentie *et al*., (2017) in Amhara Region, Gizachew Hailegebreal, (2018) in Siltie and Gurage Zones, Tsegaw Fentie *et al.,* (2018) in Amhara Region and Bekele Megersa *et al.,* (2011) in Pastoral and agro-pastoral system in Ethiopia who have reported prevalence rate of 2.1%, 15.5%, 29.2%, 18.3% and 30.9%, respectively. Comparable findings have been documented in other countries with the overall antibody responses to PPR 33% in India by Singh *et al.,* (2004) and 32.8% by Balamurugan *et al.,* (2012). In contrast to this, Gizaw *et al*., (2018) and Yalew et al., (2019) have reported higher prevalence of PPR in Afar region (41.5%) and in Asosa Zone (75.5%). The difference in the prevalence of PPR observed in the different settings in Ethiopia could be attributed to the differences in the small ruminant management practices, agro-ecology and geographical locations in the different parts of Ethiopia. Different levels of immunity, diagnostic test, sampling procedures used could also have contributions for the inconsistency in the seroprevalence of antibodies to PPRV in different areas of the country (Singh *et al.,* 2004). With regards to possible risk factors for PPR infection, using multivariate logistic regression the current study identified that grazing system and sex to be associated with PPR infections.

This study has found that communal grazing has significant association with the spread of PPR virus infection among sheep and goats than private grazing management in the study districts. Zahur *et al.,* (2008) and Biruk Alem, (2014) reported a parallel correlation of disease to communal grazing. Communal grazing and watering can increase the probability of sharing water points with other domestic animals, which might increase the transmission of the virus from other domestic animals as well.

Likewise, sex wise seroprevalence of PPR in the study area revealed that the prevalence was higher in male (35.9%) when compared with female (28%) animals, by which the variation was statistically significant ($p = 0.023$). The current finding was similar with the reports of Gizachew Hailegebreal (2018) who have reported the seroprevalence of PPR was higher in male animals. This could be attributed to the fact that the high demands of male animals for meat purpose driven them to the market and exposed to the higher infection rate than in females which are relatively maintained at home for breeding purpose. However, Tsegaw Fentie *et al*., (2017), Tsegay Gebre *et al.,* (2018) and Tsegaw Fentie *et al*., (2018) reported that the seroprevalence was higher in female animals and contrary to the current finding. The variation observed in the different studies might be due to the difference in sample size between different studies. It is due to the fact that off-take of male small stock for social economic activities is higher. Therefore, males having been in the herds for a shorter period and they are less likely to have been in contact with PPR virus. However, females which end up staying in the herds for longer periods for productive purposes females (Singh *et al*., 2004). The differences could be also related to the physiological differences where females reveal some degree of predominance infection as a result of production and reproduction related stresses (Bekele Megersa *et al.,* 2011)

Though the seroprevalence of PPRV among age group was not statistically significant, the highest prevalence of PPR was observed in adults (33.9%) compared to young age (30.6 %). This result was in agreement with the finding by Tsegaw Fentie *et al.,* (2018) and Almeshay *et al*., (2017) where animals age was reported to not associated with seropositivity of PPR. It has been suggested that sheep and goats exposed to natural infection to PPRV at a very young age may carry antibodies for 1-2 year following exposure and remains positive for a long time (Ozkul *et al*., 2002).

Comparison of seropositivity between sheep and goat's samples was made and the result showed that seroprevalence was higher in sheep was 28.3% while the prevalence in goats was 34.7%. Even though, higher prevalence was recorded in goats, the difference was not significant (p = 0.189). This finding is in agreement with Biruk Alem, (2014), Kivaria *et al*., (2013) and Bekele Megersa *et al.,* (2011) recorded no association between animal species and seropositivity. This could be due to the fact that sheep and goats are equally exposed to the PPR risk factors such as movement and nutritional stresses Kivaria *et al.,* (2013). This finding is in contrast with other findings that reported significantly higher seroprevalence in goats than in sheep (Waret-Szkuta *et al*., 2008 and Faris Delil *et al*., 2012). These researchers suggested that the higher prevalence of PPR among goats than sheep could be the result of higher proportion of newborn goats within the goat flock each year than sheep, which increases the size of susceptible population.

The surveys' result indicated that owners / keepers of goats and sheep in the study district was familiar about PPR and its clinical signs. Out of those clinical signs mentioned by respondents, most of them were related to clinical signs described by Food and Agricultural Organization (FAO, 2013). The reported clinical signs include nasal discharges, diarrhea, respiratory distress, stomatitis, lacrimation and abortion. The current survey further revealed that PPR the most common disease in the study area, which ranked 1st followed by Sheep pox and external parasite. Even though the frequency of PPR as reported by respondents' as a common disease in the area varies. PPR was reported as the most important diseases in the study area. The variation among study participants on reporting PPR as the most important diseases in the study area could be attributed to farmers' perception and experiences of the diseases including experiences on mortality and morbidity rates of the diseases. However, PPR was prevalent diseases in the study areas and is reported to affect productive and reproductive performance of small ruminants and causing high mortality with an index 0.39, which is in agreement with what was reported by Zelalem Asmare, (2018).

The present epidemiological observational study disclosed that PPR outbreak has been going on during the study period in Dangur district, where clear and vivid clinical signs of the virus were observed in study animals. The clinical signs included high fever, ocular and nasal discharge, few cases of abortions, respiratory distress and diarrhea. The clinical features of PPR observed in the study district are in parallel with several reports made by other researchers (El-Rahim *et al*., 2005; Jindal *et al.,* 2005; Kul *et al*., 2007; Sharma *et al*., 2007; Rita *et al*., 2008; Abubakar *et al*., 2009; OIE, 2013). The disease appears to spread from newly introduced animals through purchased sheep and goat from different market. Study participants described that the animals were brought to the study district by a non-governmental organization (NGO) that donated the animals to farmers. Furthermore, participants affirm that they didn't experience PPR on their vaccinated animals where the few non vaccinated animals were affected. The overall morbidity (29.5%) and mortality (10.9%) due to PPR in sheep and goats was higher than the morbidity and mortality resulted from an outbreak reported by Biruk Alem, (2014) in Eastern Amhara with morbidity 21.9% and mortality 8.4% reports in the area. However, Maluos Tibbo *et al*., (2001) reported a higher morbidity of 76% from a respiratory disease outbreak in sheep in central Ethiopia. In general, in Ethiopia, mortality in susceptible flocks varies from 10 to 100% and morbidity ranges from 50 to 100%. However, this scenario is likely to change drastically once intensive vaccination programs are implemented on targeted species (Balamurugan *et al*., 2012).

5. CONCLUSION AND RECOMMENDATIONS

PPR is one of the most important diseases of livestock in Ethiopia which creates a huge economic burn on livelihood of small holder farmers in the country by affecting small ruminants like sheep and goats and causing sever morbidly and mortality. With the objective of understanding the burden of the diseases in Dangur district, this study attempts to fill the epidemiological gap related to PPR through the application various techniques including sero-positivity tests and observational study while the outbreak occurred. The fact that antibodies of PPR virus were detected in study districts suggests the endemicity of the disease zone. Although the overall

seroprevalence for PPR of was 32.5%, varied antibody levels have been detected among affected animals in all the four rural kebeles. These variations were clearly associated with study variables including sex, age, species and grazing type. It is concluded that these variables can be considered among the important risk factors for the transmission of the diseases.

The following recommendations can be forwarded based on the finding of the study:

- Strategic vaccination activities need to be implemented not only in the studied areas but also in other parts of the country with a history of recurrent PPR outbreaks to prevent the circulation of the virus.
- Well planned control measures and an extensive sero-surveillance for PPRV should be carried out in all endemic areas along with measurement of clinical survey.
- Strict quarantine and surveillance procedure for newly introduce animals especially on animals they came from endemic localities should be implemented.
- Further studies need to be carried out in the study areas in order to identify the virus and lineage of the PPR virus.

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