

Prevalence and Causes of Selected Respiratory Infections in Indigenous Gumuz Sheep in Metema District, Northwest Ethiopia

Kifle Nigusu^a, Tsegaw Fentie^{b*}

^a*Department of Agriculture, Jimma zone, Oromia Regional State, Ethiopia*

^b*Faculty of Veterinary Medicine, University of Gondar, Gondar, Ethiopia*

^a *kiflenigusu@yahoo.com*

^b *tsegawfentie2002@gmail.com*

Abstract

A cross-sectional study was conducted from December 2008 to May 2009 to determine the prevalence and causes of respiratory infections in indigenous Gumuz sheep in Metema district, northwest Ethiopia. Faecal samples, nasal swabs and serum samples were collected from a total of 384 sheep of both sex and all age groups. Modified Berman technique, bacteriological methods and competitive-ELISA were used for the identification of lungworms, pasteurella species and Peste des petits ruminants (PPR), respectively. The overall prevalence of respiratory infections was 40.6% (95%CI; 36-46%). The prevalence difference between the study villages was significant ($P < 0.05$). Infection rate of 15.1% (95%CI; 12-19%) for lungworms, 27.6% (95%CI; 23-32%) for pasteurellosis and 26.3% (95%CI; 22-31%) for PPR was reported. Concurrent infection rate was 13.8% for lung worm and pasteurella species, 9.4% for lung worm species and PPR, 14.1% for pasteurella species and PPR and 8.9% for lung worm, pasteurella and PPR infections. This study revealed concurrent infections of lungworms, pasteurella species and PPR responsible for the occurrence of respiratory disease in indigenous Gumuz sheep. Regular vaccinations against ovine pasteurellosis and PPR and strategic deworming against lungworms must be considered for the control of these respiratory infections.

Keywords: Ethiopia; Gumuz sheep; Lungworms; Pasteurellosis; PPR; Respiratory infection

* Corresponding author. Tel.: +251-918-035836; Fax: 251-581-142145
E-mail address: tsegawfentie2002@gmail.com

1. Introduction

Small ruminants in Ethiopia are reared in different livestock production systems ranging from crop-livestock mixed systems in the highlands, to pastoral systems in the arid lowlands [6]. Sheep and goats play a significant role in the nation's economy. Meat and milk are major sources of protein, and hides, live animals, and carcasses account for a significant proportion of exports. The increased demand for sheep meat, cash income and food security has increased their importance in the country [25].

Respiratory diseases caused by concurrent infections have been identified as the leading health problem of small ruminants which accounts for up to 54% of the overall mortality of sheep in Ethiopian central highlands [5]. The cause of respiratory disease in the central highlands of Ethiopia has partly been identified [8,10,15,23] involving multiple agents such as bacteria (*Pasteurella*, *Mannheimia*, *Chlamydia*, *Mycoplasma species*, etc.), virus (*PPR*, *Parainfluenza-3 virus*, *Maedi-visna*, etc.) and lungworms (*Dictyocaulus fillaria* and *Muelleris capillaries*). The predisposing factors are mainly environmental stresses including inclement weather, feed shortage usually assisted by inadequate management and husbandry practices [22].

Bronchopneumonia caused by *Mannheimia haemolytica* and *Pasteurella multocida* develops when the immune system of the animal is compromised by stress factors such as crowding, transportation, draught, and inclement weather. Observation on seasonal occurrence of ovine pasteurellosis in central Ethiopia has shown that it is featured by multi-aetiological agents [8]. Infection with viruses and lungworms can suppress the animal's immune system, allowing opportunistic microorganisms (*M. haemolytica* and rarely *P. multocida*, to colonize the lung and cause pasteurellosis [13].

Peste des petits ruminants (PPR) is an infectious viral disease of small ruminants. Goats are affected severely but sheep undergo a mild form of the disease [17]. Seasonal outbreaks were reported in many parts of the country [7]. Tibbo et al [15] has detected serum antibodies in flocks of sheep with respiratory complex in central Ethiopia. Waret-Szkuta et al. [3] reported a very heterogeneous seroprevalence estimate ranging from 0% to 52.5% in a national survey conducted in different regions of Ethiopia.

Irregular vaccination programs for diseases such as ovine pasteurellosis and PPR, lack of strategic deworming of helminthes such as lungworms have played significant roles in the persistence of respiratory infections in sheep of Ethiopia [8]. Although respiratory diseases have got great importance in the highlands and midhighlands of Ethiopia, information is limited in sheep at lower altitudes. This study was therefore initiated with the aims of determining the magnitude of respiratory infections and establishing the causal agents involved in the development of the disease in indigenous Gumuz sheep.

2. Materials and methods

2.1 Study area and study population

The study was conducted in Metema district of north Gondar zone, Ethiopia. The district has international boundary of more than 60km with Sudan. About 15,675 rural households and 4,991 urban households reside in the district, mainly settlers moved from highlands of Ethiopia. The altitude of the study area ranges from 550 to 1608 meters above sea level while the minimum annually temperature ranges between 22⁰C and 28⁰C. Daily temperature is very high during the month of March to May, where it may get as high as 43⁰C. The mean annually rain fall of the area ranges from about 850 to 1160 mm [16].

The study was conducted on indigenous Gumuz sheep owned by smallholder farmers in two farmer settlement villages; Kokit and Shinfa. The indigenous Gumuz sheep are well adapted to the warm climate of the lowland and they are kept mainly under an extensive traditional management system, involving small household flocks of mixed age. According to the Metema district office of Agriculture, sheep population in the district is estimated at 6224 [11].

2.2 Study design

A cross-sectional survey of respiratory infections was employed from December 2008 to May 2009 in Gumuz sheep in Metema district. Sample size was determined based on 50% expected prevalence at 95% confidence level and 5% margin of error. Since there has been no prevalence report on concurrent respiratory infections in the lowland areas, we used 50% estimated prevalence to obtain maximum sample size. Sample size calculation was performed using the formula for random sampling [14]; $n = tx^2 * P(1-P)/L^2$; Where, n = sample size, tx = student t-value (1.96 at 95%), P = expected prevalence, L = margin of error). A total of 384 animals were included in the study and proportionally taken from the two study villages. The study villages were selected purposively based on availability of sheep and the sample animals were selected by a systematic random sampling technique. Parasitological, bacteriological and serological investigations were undertaken.

2.3 Sample collection and analysis

Faecal samples, nasal swabs and serum samples were collected from 252 female 132 male indigenous sheep of all age groups. All samples were collected aseptically using universal bottles (faeces), sterile swabs in nutrient media and non-heparinized vacutainer tubes. Samples were packed in ice box and transported to the Laboratory in the Faculty of Veterinary Medicine at University of Gondar for analyses. The faeces were processed using Berman techniques as described by Charles [12] for the harvest of larvae of lungworms. Bacterial identification was done based on colony characteristics on blood agar, growth on MacConkey agar, catalase and oxidative tests, urease and carbohydrate fermentation tests. Sera were tested by competitive enzyme-linked immunosorbent assay (c-ELISA) protocol using specific antigens, positive and negative controls for the detection of PPR antibodies.

2.4 Data analysis

The MS-excel spread sheet program was employed to create database and transferred to STATA software version 8.2 for analysis. Prevalence was calculated as the number of positive sheep divided by the total sheep examined. Frequency and percentage were used to display the result. Pearson's chi-square (χ^2) was used to test the significance association of different variables with the respiratory infections. Logistic regression analysis, odds ratio and 95% confidence interval were computed to see the degree of association of location and host related risk factors with infections. P-value <0.05 at 95% confidence level was considered significant.

3. Results

3.1 Prevalence of respiratory infections

The prevalence of respiratory infections is shown in Table 1. The overall prevalence of respiratory tract infections in Gumuz sheep with one or more causal agents was 40.6% (95% CI; 36-46%). Infection rate was varied significantly between the study villages ($P < 0.05$), relatively higher in Kokit (44.9%) than Shinfa (32.3%). Coproscopic examination for lung worm infections revealed a prevalence of 15.1% (95% CI; 12-19%). Among the lungworm species identified in this study, 70.7% (41/58) was due to *D. fillaria* and 29.3% (17/58) due to *M. capillaries*. The prevalence difference was no significant between the villages ($P > 0.05$).

Table 1: Prevalence of respiratory infections in Gumuz sheep in Metema district, northwest Ethiopia

Locality/ Kebele	No. of animals examined	Single infection, n(%)			Mixed infections, n(%)		Total
		Lung- worms	Pasteurell- osis	PPR	Lungworms and Pasteurellosis	Lungworms, Pasteurollosis and PPR	
Kokit	254	35(13.8)	78(30.7)*	62(24.4)	34(13.4)	15(5.9)	114(44.9)*
Shinfa	130	23(17.7)	28(21.5)	39(30)	19(14.6)	19(14.6)	42(32.3)
Total	384	58(15.1)	106(27.6)	101(26.3)	53(13.8)	34(8.9)	156(40.6%)

*P-value<0.05; n = no of positive animals

Bacteriological examination revealed an infection rate of 27.6% (95%CI; 23-32%) for ovine pasteurellosis/manneheimosis. The prevalence distribution had significantly varied between the villages (P<0.05), relatively higher in Kokit (30.7%) and lower in Shinfa (21.5%). The serological investigation using competitive ELISA revealed 26.3% (95%CI; 22-31%) antibody prevalence for PPR with no significant variation between the study villages.

Concurrent infections were investigated in this study. Fifty-three (13.8%) of the 384 study sheep were co-infected with lung worm and pasteurella species; 9.4% (36/384) with lungworm species and PPR; 14.1% (54/384) with pasteurella species and PPR, where as 8.9% (34/384) were co-infected with three disease agents; lung worm and pasteurella species and PPR.

3.2 Distribution of respiratory infections by sex and age

Prevalence distribution of the respiratory infections based on sex and age in sheep is shown in Table 2. Although the variation of respiratory infections among age groups was not significant, infection rate was relatively higher in young animals ≤1 year and older animals of 3 and above years. The prevalence of lungworms among age groups was also slightly higher in young animals aged ≤1year than older animals above 3 years. Although the difference was no significant, the infection rate for pasteurellosis and PPR was slightly higher in older animals above 3 years than young animals. Prevalence of concurrent infection with two or more agents was significantly higher in young animals (P<0.05). Prevalence of respiratory tract infections was not significantly associated with sex of animals.

Table 2. Prevalence distribution of respiratory infections in Gumuz sheep based on sex and age category.

Category		No. of animals examined	Single infection, n(%)			Mixed infection, n(%)		Total
			Lung- worms	Pasteuroll- osis	PPR	Lungworms and pasteurellosis	Lungworms, pasteurollosis and PPR	
Age	≤1year	129	21(16.3)	41(31.8)	38(29.5)	20(15.5)	14(10.8)	55(42.6)
	1-2year	132	17(12.9)	23(17.4)	30(22.7)	15(11.4)	11(8.3)	43(32.6)
	2-3year	88	16(18.2)	27(30.7)	19(21.6)	14(15.9)	7(8.0)	38(43.2)
	>3year	35	4(11.4)	15(42.9)	14(40)	4(11.4)	3(8.6)	17(48.6)
Sex	Female	252	42(16.7)	68(27.0)	67(26.6)	38(15.1)	25(9.9)	103(40.9)
	Male	132	16(12.1)	38(28.8)	34(25.8)	15(11.4)	9(6.8)	53(40.2)
	Total	384	58(15.1)	106(27.6)	101(26.3)	53(13.8)	34(8.9)	156(40.6)

Multivariate logistic regression model was used for the analysis of risk factors (Table 3). Among the predictor variables computed only locality was associated with the infection. Sheep in Kokit are 2.62 times more likely at risk of getting respiratory infections. Sex and age category of sheep were not associated with the occurrence of the respiratory tract infections in Gumuz sheep.

Table 3. Multivariate logistic regression analysis of risk factors for the occurrence of respiratory infections in Gumuz sheep in Metema district

Variable	Category	Odds ratio (OR)	95% CI (OR)	P-value
Locality	Shinfa	1.00	-	-
	Kokit	2.62	1.7 - 4.1	<0.001
Age	≤1 year	1.00	-	-
	1-2 years	0.60	0.4 - 1.0	0.057
	2-3 years	0.97	0.6 - 1.7	0.916
	>3 years	1.90	0.9 - 4.4	0.089
Sex	Male	1.00	-	-
	Female	0.98	0.6 - 1.6	0.996

4. Discussion

The findings of our study revealed that respiratory diseases caused by concurrent infections are important in indigenous Gumuz sheep with an overall prevalence of 40.6% (95% CI; 36%-46%). This investigation indicated lungworms, *Pasteurella* species and PPR virus were responsible for the occurrence of concurrent respiratory infection in the study area.

The 15.1% prevalence of lungworms infection in our study was consistent with previous reports from some parts of Ethiopia; 15.4% in Dessie and Kombolcha [21] and 13% in and around Bahir Dar [2] of Amhara region and 13.24% in and around Mekelle of Tigray region [20]. However, the present finding was lower than the reports of 50% [19] and 40.4% [1] around Dessie and Kombolcha area, 55% around Debre Birhan [8] and 25.6% around Jimma town [4]. The difference in prevalence may be associated with the variation in sample size, agro-ecology, and season of study, management and husbandry practice of animals. It is well understood that the prevalence of lung worm infection is low in dry season and warm climate, where conditions (temperature above 21.1⁰C affects the viability of the larvae) are unsuitable for survival of the larva but raises rapidly in the wet season where most of clinical cases are observed [13].

The finding of 27.6% infection rate of ovine pasteruellosis in the present study was comparable to the report of 31.1% in Debre Birhan [26]. But our result was lower than the reports of Sisay and Zerihun [24] who reported 83% prevalence in Wollo area. The decline in prevalence in this study could be related to the climatic condition where stress due to weather and lung worm infection is relatively low. Ovine pasteruellosis entirely develops when the immune status of an animal is compromised by stress factors such as transportation, exposure to drought and inclement weather and concurrent respiratory infections with virus, mycoplasma species and lungworms [8,13].

The antibody prevalence of PPR (26.3%) in this study is within the national range. Waret-Szkuta and others [3] reported a heterogeneous seroprevalence estimate ranging from 0% to 52.5% in a national survey conducted in 1999 in Ethiopia. The detection of in this study might have been associated with the occurrence of PPR outbreak in sheep flocks prior to the start of this study. Seasonal outbreaks were reported in many parts of the country [7]. Tibbo and others [15] have detected serum antibodies in flocks of sheep with respiratory disease in central Ethiopia. PPR infection rates in enzootic areas are generally high (above 50%) and can be up to 90% of the flock during outbreaks. PPR epidemic can cause mortality rate of 50-80% in naive sheep population [18]. The occurrence of PPR in cyclic trend every 3 years in the study area and the occurrence of mixed infection of lung worm with pasteruellosis would contribute for the increased incidence of respiratory disease.

The prevalence of lungworms and concurrent infections was high in young animals and decreased with increased age of sheep. This result was in agreement with the report of Alemu et al. [19] who reported high prevalence in young animals. According to Urquhart and colleagues [9], susceptibility of sheep to lungworm infection decreases as the age of animals' increases. Radostitis and others [13] suggested that lambs are more susceptible to pasteurellosis during the first few months of life and ewes are more susceptible at lambing. The respiratory infection rate for lung worm and pasteurella species and PPR virus was not associated with the sex of sheep indicating both groups are equally susceptible for respiratory tract infections.

5. Conclusions

This investigation has demonstrated that concurrent respiratory infections involving lungworms, ovine pasteurellosis and PPR are important health problems in indigenous Gumuz sheep in the study area. The regular vaccination against ovine pasteurellosis and PPR should be encouraged in the area to break frequent outbreaks and strategic deworming of sheep against lungworms is recommended.

Acknowledgements

The authors would like to thank the parasitology and microbiology laboratory technicians of the Faculty of Veterinary Medicine in the University of Gondar for their technical assistance.

References

- [1]. A. Regassa, M. Toyeb, R. Abebe, B. Megersa, B. Mekibib, S. Mekuria, E. Debela and F. Abunna. "Lung worm infection in small ruminants: prevalence and associated risk factors in Dessie and Kombolcha districts, northeastern Ethiopia". *Vet. Parasitol.* vol. 19, pp. 144-148, 2010.
- [2]. A. Sisay. "Preliminary study on the prevalence of ovine lung worm infection in and around Bahir Dar", DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University, Ethiopia, 1996.
- [3]. A. Waret-Szkuta, F. Roger, D. Chavernac, L. Yigezu, G. Libeau, D. Pfeiffer and J. Guitian. "Peste des Petits Ruminants (PPR) in Ethiopia: Analysis of a national serological survey". *BMC Veterinary Research* vol. 4, pp.34-47, 2008.
- [4]. D. Woldesenebet and A. Mohamed. "Prevalence of small ruminant lung worm infection in Jimma town". *Global Veterinaria*. vol. 8 (2), pp. 153-159, 2012.
- [5]. E. Mukasa-Mugerwa, A. Lahlou kassi, D. Anindo, J.E. Rege, S. Tembely, M. Tibbo and R.L. Baker. "Between and within breed variation in lamb survival and risk factor associated with major causes of mortality in indigenous Horro and Menz sheep in Ethiopia". *Small ruminant research*. vol. 37, pp. 1-12, 2000.
- [6]. Food and Agriculture Organization of the United Nations (FAO). "Livestock sector development project". Preparation Report, volume 1. FAO, Rome, Italy, 1993, pp: 51.
- [7]. G. Abraham and A. Birhan. "The use of Enzyme Linked Immunosorbent Assay (ELISA) for the diagnosis of rinderpest and Peste des petits ruminants in Ethiopia". *Trop. Anim. Health Prod.* vol. 33(5), pp. 423-430, 2005.
- [8]. G. Ayelet, L. Yigezu, E. Gelaye, S. Tariku and K. Asmare. "Epidemiologic and serologic investigation of multifactorial respiratory disease of sheep in the central highland of Ethiopia". *Intern. J. Appl. Res. Vet. Med.* vol. 2(4), pp. 274-278, 2004.
- [9]. G. M. Urquhart, J. Armour, J.H. Duncan and F.W. Jennings. "Veterinary Parasitology". 2nd ed. Glasgow, Scotland, 1996, pp. 35-61.
- [10]. L. Garedew, G. Ayelet, Y. Roman, A. Zeleke and E. Gelaye. "Isolation of diverse bacterial species associated with maedi-visna infection of sheep in Ethiopia". *Afr. J. Microbiol. Res.* vol. 4 (1), pp. 14-21, 2010.
- [11]. Metema office of Agriculture (MoA). "Annual report for the year 2008, Metema district office of Agriculture", 2008.
- [12]. M.H. Charles. *Diagnostic Veterinary Parasitology*, 3rd ed., Stilson: Elsevier Science, 2006.
- [13]. M.O. Radostits, C.C. Gay, K.W. Cliff and P.D. "Constable Veterinary Medicine. A text book of the diseases of cattle, sheep, goats, pigs and horses". 10th ed. Baillier, Tindall, London, 2007, pp. 1396-1398.

- [14]. M. Thrusfield. "Veterinary Epidemiology". 2nd ed. Black well, Cambridge. 2005, pp. 175-187.
- [15]. M. Tibbo, M. Woldemeskel, G.M. Hart and A. Gopillo. "An outbreak of respiratory disease complex in sheep in Central Ethiopia". *Trop. Anim. Health Prod.* vol. 33(5), pp. 355-365, 2001.
- [16]. National Meteorological Agency (NMA). "Annual Climatological Bulletin for the year 2011". National Meteorological Agency of Ethiopia, 2011.
- [17]. P.C. Lefvere and A. Diallo. "Peste des petits ruminants". *Revue Scientifique Office International des Epizooties.* vol. 9(4), pp. 951-965, 1990.
- [18]. R.P. Kitching. "The economic significance and control of small ruminant viruses in North Africa and west Asia": F.S. Thompson. Increasing small ruminant productivity in semi arid area. ICARDA, 1988, pp. 225-236.
- [19]. S. Alemu, G. Esayas, A. Galegay and Z. Aschalew. "Study on small ruminant lungworm in Northeastern Ethiopia". *Vet. Parasitol.* vol. 142, pp. 330-335, 2006.
- [20]. S. Frewengel. "Prevalence of Ovine lung worm in and around Mekele (Tigray)", DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University, Ethiopia, 1995.
- [21]. S. Tefera. "Prevalence of ovine lungworms around Dessie and Kombolcha". DVM Thesis, Addis Ababa University, Ethiopia, 1993.
- [22]. T. Bekele, T. Woldeab, A. Lahlou-Kassi, G.D. Sherington and J. Demartini. "Factor affecting morbidity and mortality on-farm and on-station in the Ethiopian highland sheep". *Acta Tropica.* Vol. 52, pp. 99-109, 1992.
- [23]. T. Fentie and A. Zerihun. "Serological survey of maedi-visna virus infection in highland sheep at ranches and smallholder farms in eastern Amhara region, Ethiopia". *Bull. Anim. Hlth. Prod. Afr.* vol. 60, pp. 287-295, 2012.
- [24]. T. Sisay and A. Zerihun. "Diversity of *Mannheimia haemolytica* and *Pasteurella trehalosi* serotypes from apparently healthy sheep and abattoir specimens in the highlands of Wollo, Northeast Ethiopia". *Vet. Res. Commun.* 27, pp. 3-14, 2003.
- [25]. Y. Alemu and R.C. Merkel. "Sheep and Goat Production Hand Book for Ethiopia", Ethiopian Sheep and Goat Productivity Improvement Program 17, 2008, pp 2-6.
- [26]. Z. Aschalew. "Ovine pneumonic pasteurellosis in north Shewa". DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University, Ethiopia, 1998.