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Prevalence of small ruminant coccidiosis in Pawe District, Metekel Zone, Benishangul Gumuz Regional State, Ethiopia

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Abstract

A cross sectional study was conducted from May 2018 to July 2018 in Pawe district, Metekel zone, Benishangul Gumuz Regional State with the objectives of determining prevalence and risk factors associated with small ruminant coccidiosis. A total of 215fecal samples (103 goats and 112 sheep) were collected and examined using fecal floatation technique. The data was analyzed using R software version 4.1.1. The study revealed an overall prevalence of 43.7%; 42 (37.5%)in sheep and 52(50.5%) in goats with no significant difference (p=0.07) between sheep and goats. Sex wise prevalence was 42.2%in male and 44.1% in female animals. Significantly different prevalence of 56.1% in young, 34.8% in adult and 39% in old animals was also revealed. Statistically significant difference in prevalence was observed by body condition, the prevalence being 61.9%, 42.4% and 37.7% in poor, medium and good body conditioned animals respectively. Significantly higher prevalence was also observed in diarrheic animals (70.6%) followed by animals with normal (44.9%) and soft feces (10%). In general, this study revealed higher prevalence of coccidiosis in small ruminants and recommends further studies to identify the pathogenic *Eimeria* species which would be useful for designing appropriate control measures.

Keywords: Coccidiosis. Eimeria, Goats. Prevalence. Sheep

1. Introduction

Livestock systems in less developed countries are characterized by rapid change, driven by factors such as population growth, increased demand for livestock products and urbanization. Livestock accounts for approximately 30 percent of agricultural gross domestic product in developing countries and is the fastest growing sub-sector of agriculture (Umer *et al*., 2017). Sheep and goats are the most common domesticated livestock and they are especially important in the world's

harsher climates. More than two-thirds of the total small ruminant population is found in developing countries, where they frequently provide major contribution to farming enterprises (Shimelis *et al*., 2011; Diriba and Birhanu, 2013).

Ethiopia possess the largest livestock population in Africa, with an estimated population of 59.5 million cattle, 30.7 million sheep, 30.2 million goats, 2.16 million horses, 8.44 million donkeys, 0.41 million mules, 1.21 million camels, 56.53 million Chickens and 5.92 million bee hives with the livestock ownership currently contributing to the livelihoods of estimated 80% of the rural Populations (Husen *et al*., 2018; CSA, 2017).

Despite large population and importance of small ruminants in Ethiopia, the country has reaped little from the resource duet to different problems of which cocidiosis is one of the important factors (Shimelis*et al*., 2011; Diriba and Birhanu, 2013). Coccidiosis is one of the economically important diseases of small ruminants affecting productivity of the animals in Ethiopia caused by unicellular protozoa called *Eimeria*. The diseaseremains a serious threat to sheep and goat health resulting in lower productivity of the animals due to morbidity, mortality, cost of treatment and control measures (Khan *et al*, 2011).

Small ruminant coccidiosis is a contagious protozoal disease that is a worldwide problem primarilyaffecting kids and lambs. Infected small sheep and goats can daily shed thousands of coccidialoocysts in their feces that can contaminate feed, water and soil. Life cycle of *Eimeria*is marked with a patent period of infection that lasts 3 to 10 days depending on coccidian species, host species, infectious dose of oocysts, host condition and age of host.In sheep, 16 species of *Eimeria* have been described.*Eimeria ahsata, E. ovinoidalis*, and *E. bakuensis (ovina)* are considered most pathogenic species to sheep. Among the 15 species of*Eimeria*affecting goats, *E. christenseni, E. arloingi, E.caprina*, and *E. ninakohlyakimovae* areof a major concern (Khodakaram-Tafti and Mansourian, 2008).

Eimeria parasites are usually acquired in the first few months of life and small numbers are carried by most young animals, usually causing no ill-effects. However, the disease can occur when the animals are exposed to stress factors such as overcrowding, especially under humid unhygienic environmental conditions. Coccidiosis is most commonly seen in young small ruminants just before weaning or in lambs / kids, in feedlots, and other situations where animals are confined at extremely high stocking rates. Sheep rapidly develop strong and lifetime immunity to coccidia, so coccidiosis is uncommon in adult animals. However, goats do not develop such a strong immunity and infection is commonly seen in goats of all ages (Wormboss, 2018).

The main symptom of coccidiosis is diarrhea which can be hemorrhagic in sheep and non-hemorrhagic in kids. The feaces are watery with clumps of mucus and color changes from brown to yellow or dark tarry. There is also decrease in appetite, weight loss and dehydration Treatment of coccidiosis must be done as early as possible before animals showing no obvious signs that may contaminate the environment. Diagnosis is based on microscopic examination, postmortem examination and symptoms. Finding of a few oocysts in the diarhoea of lamb or kids does not necessarily justify the presence of coccidiosis (Samuel *et al*., 2015).

Anticoccidial products such as sulfonamides, amprolium, ionophores, toltrazuril and diclazuril are drugs used for treatment of coccidiosis. Prevention and control of coccidiosis is achieved through control of hygienic conditions, reduction of stressors, adequate nutrition and use of anticoccidial drugs (Girma *et al*., 2016).

Even though there are few works done on prevalence of small ruminant coccidiosis in some parts of Ethiopia (Ayana*et al*., 2009; Girma*et al*., 2016; Lakew and Seyoum, 2016), there is no previous study carried out on small ruminatcoccidiosis in Pawe district. On the other hand, knowing the current situation of coccidiosis in the area could be basis for the possible control

and prevention of coccidiosis, one of the most economically important disease of sheep and goats.

Therefore, the objectives of the study are;

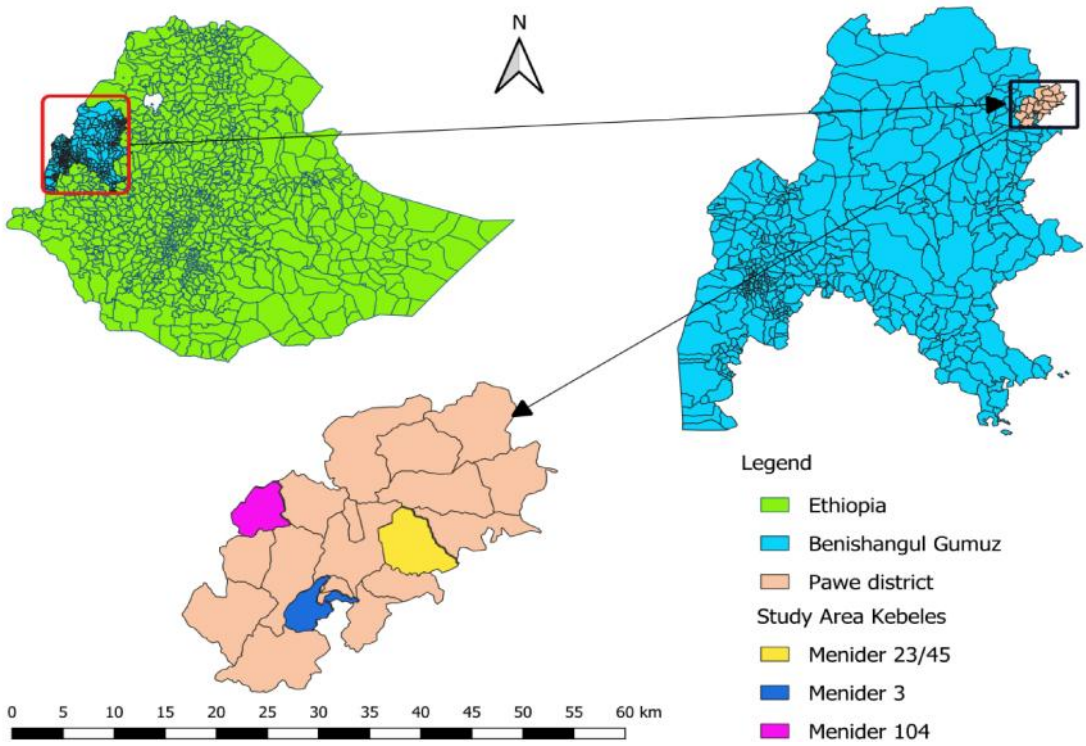
✓ To estimate prevalence of small ruminant coccidiosis in Pawe district

✓ To determine associated risk factors of small ruminant coccidiosis.

2. Materials and Methods

2.1 Study Area Description

The study was conducted from May 2018 to July 2018 in Pawe district, Metekel zone, Benishangul Gumuz Regional State. The district has 20 kebeles covering an area of 64,300 hectare with estimated 59,127 (50.76% male) inhabitants. Pawe is located at latitude of 11^0 and 15' 24.7''N and longitude of 36^0 and 23'10''E. It has altitude of 1064m above sea level. The area experiences a temperature ranging from 19.4 °C to 37.6°C and an annual rain fall of 1186 to 1977 mm. The livelihood of the society largely depends on mixed farming system (Asmamaw and Getachew, 2016; Birhanu *et al*., 2018). The district have livestock population of 69,171,8 Cattle, 5362 Goat, 6890 Sheep, 1059 Equines, 29378 Poultry and 3076 beehives (PAO, 2018).



2.2 Study Animals and Sampling Methods

The study animals were sheep and goats randomly selected from three peasant associations (PAs)of the district namely; Mender 3, Mender 23/45 and Mender 104.The PAs were purposively selected from the district based on their accessibility to transport and life stock potential. Sheep and goats of all age, sex and body condition were considered in the study.

2.3 Study Design

A cross-sectional study involving fecal examination was conducted from May 2018 to July 2018 to determine prevalence of small ruminant coccidiosis and associated risk factors in Pawe district.

2.4 Sample Size Determination

The sample size for the study was determined at 95% confidence interval and 5% desired absolute precision by using 13.7% expected prevalence (Abebaw *et a*l., 2017) based on the formula described by Thrusfield (2005).

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

Where N= required sample size, Pexp= expected prevalence and d=desired absolute precision. Accordingly, the minimum sample size required for the study was 182. However, the sample size was increased to 215 to increase precision of the study.

2.5 Study Methodology

Fecal sampleswere collected into clean and dry universal bottles using sterile glove. The samples were then labeled and transported to Pawi Agricultural Research Center for examination. Ten percent (10%) formalin was used to preserve the samples until processing. Species, age, sex, body condition scoreand fecal consistency were recorded during sample collection. Age of the animals was determined by asking the owners and dentition and categorized as young (<1 year), adult (1-3 year) and older (>3) (Husen *et al*., 2018). Body condition score of the animals was determined according to ESGPIP (2008) and categorized as poor, medium and good (Umer *et al*., 2017). The samples were subjected to qualitative flotation technique using saturated sodium chloride (Nacl) following a procedure described by Hansen and Perry (1994).Briefly, saturated sodium chloride floatation fluid was prepared by saturating 400g sodium chloride in 1000ml water at specific gravity of 1.200 (Foreyt, 2001). A3-5g fecal pellet was weighed using sensitive balance and crushed using mortar and pestle. Subsequently, 50 ml saturated Naclsolution was added to the mortar and mixed thoroughly with the crushed samples. The resulting fecal suspension was sieved into a beaker using tea strainer and poured into test tubes until convex meniscus was formed. Following this, the coverslip was placed on the top of the test tubes and allowed to stand for 20 minutes. Finally, the coverslips were carefully lifted off the test tubes, mounted on clean microscope slides and examined under 40 x microscopes for coccidian eggs.

2.6 Data Analysis

The data collected was entered into Microsoft Excel spread sheet, coded and analyzed by using R software version 4.11. Descriptive statistics was used to determine the prevalence and Pearson's chi- square ($\chi 2$) was used to test the association betweencoccidiosis and the risk factors (species, age, sex, body condition, fecal consistency and PAs). Statistically significant association between the variables was considered to exist if the computed P-value at 95% confidence interval and 5% degree of precision is less than 0.05.

3. Results

Out of 215 (103 goats and 112 sheep) total fecal samples examined 94(43.7%) were found to be positive to *coccidian* eggs. This study showed significant difference in prevalence of coccidiosis between the PAs (p value < 0.05). The highest prevalence was observed in Mender23/45(60.3%) followed by Mender3 (40.6%) (Table1).

Table 1: Over all prevalence of small ruminant coccidiosis by Pas

Kebeles	No. examined	No. Positive (prevalence)	CI	χ2	P Value
Mender 3	64	26(40.6%)	28.8-53.6	13.7	0.001
Mender 104	78	24(30.8%)	21.1- 42.4		
Mender 23/45	73	44(60.3)	48.1-71.3		
Total	**215**	**94(43.7%)**			

Table 2: Prevalence of small ruminant coccidioisis based on species, sex and age

Risk factors		No. examined	No. Positive(prevalence)	CI	χ2	P Value
Species	Goat	103	52 (50.5%)	40.5-60.4	3.17	0.075
	Sheep	112	42 (37.5%)	28.7- 47.2		
Sex	Male	45	19 (42.2%)	28.0-57.8	0.0034	0.95
	Female	170	75 (44.1%)	36.6-51.9		
Age	Young	82	46 (56.1%)	44.7-66.9	8.46	0.015
	Adult	92	32 (34.8%)	25.4- 45.5		
	Old	41	16 (39%)	24.6-55.6		

Prevalence of the coccidiosis was non significantly higher in goats (50.48%) than in sheep (37.5%) (p value = 0.075). It was also more prevalent in females (44.1%) than in males (42.2%) with no significant difference in the prevalence ($\chi2$=0.0034, P value=0.95).Age wise prevalence of the disease indicated significant difference between age groups (P value = 0.015) the prevalence being higher in young(56.1%) and and old (39%) animals than adults (34.8%) (Table2).

Table 3: Prevalence of small ruminant coccidiosis based on body condition and faecal consistency

Risk factors		No. examined	No. Positive (prevalence)	CI	χ2	P Value
Body condition	Poor	42	26 (61.9%)	45.7-76	7.36	0.025
	Medium	59	25 (42.4%)	29.8-55.9		
	Good	114	43 (37.7%)	28.9-47.3		
	Total	215	94 (43.7%)			
Fecal consistency	Normal	178	80 (44.9%)	37.5-52.5	14.34	0.000
	Soft	20	2 (10%)	0.02-0.33		
	Diarrheic	17	12 (70.6%)	44-88.6		
	Total	215	94 (43.7%)			

Prevalence of coccidiosis was significantly higher ((P> 0.05) in small ruminants with poor body condition (61.9%) followed by those with medium (42.4%) and good body condition (37.7%) respectively. There was also significant difference (P= 0.000) in prevalence of the disease between consistencies of fecal samples the prevalence being higher in diarrheic fecal samples (70.6%) than soft and normal fecal samples (44.9%) (Table4).

4. Discussion

The present study revealed an overall prevalence of 43.7%coccidiosis in small ruminants. This finding was in agreement with the findings of Kanyary *et al*. (2009) in Kenya (35%) and Moiloa (2017) in Lesetho (50.1%). However, it was lower than the findings of Ayana *et al*. (2009) and Girma *et al*. (2016)who reported a prevalence of 59.6% and 64.1% respectively in Ethiopia. The prevalence was also lower than the finding of Wang *et al*. (2010) who reported prevalence of 90.9% in China. In contrast, the current finding was higher than the findings of Bikila *et al*. (2013), Nuradis *et al*. (2014), Abebaw *et al*. (2017) and Golo *et al*. (2017) who reported a prevalence of 14.6%, 11.7%, 13.7% and14.1% respectively in Ethiopia. Rajarajan *et al*. (2017) also reported lower prevalence of small ruminant coccidiosis (10.5%) in India. This variation might be attributed to the differences in agro-ecology, climatic condition, study sample size, management and husbandry practices of study animals.

The present study showed higher prevalence in goats (50.5%) than in sheep (37.5%). This could be attributed to the fact that goats acquired a lower level of immunity to coccidiosis as compared to sheep. It might also be due to the reason that sheep can develop astrong natural immunity against the disease around 12 months of age (Girma *et al*., 2016).

The current prevalence in goats was in accordance with the findings of Ayana *et al*. (2009) in Ethiopia (44.3%),Rehman *et al*. (2011) in Pakistan (55.99%), Shija *et al*. (2014) in Tanzania(57.4%) and Zvinorova *et al*. (2016) in Zimbabwe (43%). However, itwas significantly lower than the prevalence of82.55% (Gul, 2007), 89.27% (Radfar*et al*., 2011), 91.2% (Cavalcante *et al*., 2012), 89.91% (Kheirandish *et al*., 2014),98.61% (*Silva et al*., 2014), 89.2% (Yusof and Isa, 2016), 86.7% (Sharma *et al*., 2017)and 96.62% (Singh *et al*., 2017). The current finding in goats was also lower than the reports byKimbita *et al*. (2009) in Tanzania (64.2%), Bagde *et al*. (2010) in India (62.66%), Girma *et al*. (2016) in Ethiopia (66.7%) and Mohamaden *et al*. (2018) in Egypt (60%). In contrast, this finding was higher than the reports of Warur*et al*. (2005), Koinari (2013), More *et al*. (2014), Abebaw *et al*. (2017), Das *et al*. (2017), Golo *et al*.(2017), and who reported a prevalence of 28%, 16.4%, 20.03%, 6%, 23.02% and 14.3%, respectively. The variation in the prevalence could be due to difference in agro ecology, sample size, management practice and study season.

Prevalence of coccidiosis in sheep in the present study agrees with the findings of 34.9% (Om *et al*., 2010), 43% (Khan *et al*., 2011) and 30.9% (Yemisrach and Amenu, 2017). However, the prevalence was lower than the findings by Kaya *et al*. (2004) in Turkey (100%), Ayana *et al*. (2009) in Ethiopia (66.8%), Wang *et al*. (2010) in China (92.9%), Hashemnia *et al*. (2014) in Western Iran (91.5%),Girma et *al*. (2016) in Ethiopia (62.9%) and Mohamaden *et al*. (2018) in Egypt (57.7%). On other hand, the current finding was higher than the previous findings in Ethiopia by Fikru *et al*. (2006), Nuradis *et al*. (2014),Lakew and Seyoum (2016), Abebaw*et al*. (2017) and Golo *et al*. (2017)who reported 26.3%, 11.7%, 22.9%, 11.8% and 12% coccidiosis prevalence respectively. Yakhchali and Zarei (2008) in Iran (16.7%), Yakhchali and Zarei (2010) in Iran (23.3%), Koinari (2013) in Guinea (17.3%), Ntonito *et al*. (2013) in Cameroon (28.8%) and More *et al*. (2014) in India (14.12%), have also reported lower prevalence. this variation could be attributed to difference in agro-ecology, climatic conditions and management practices.

The current finding showed no significance difference between male and female animals. This might be due either to equal likelihood of being exposed to *Eimeria* oocysts or to the absence of differences in protective immunity to the disease between sex groups. The finding was in agreement with the reports by Lakew and Seyoum (2016),Moiloa (2017) and Sharma *et al*. (2017) who reported no significant sex wise prevalence. Even though there was no significant difference in the prevalence, female sheep and goats were found to be more infected in the present study. This finding was in harmony with reports by Yakhchali and Zarei (2008), Khan *et al*. (2011). and Girma *et al*. (2016). However, it was contrary tothe previous study findings byLakew and Seyoum (2016), Abebaw *et al*. (2017), Moiloa (2017) and Sharma *et al*. (2017)who reportedhigher prevalence in male animals.

In this study young animals were found to be more infected bycoccidiosis than adults; the prevalence being 56.1% in young and 34.8% adults. This result was consistent with reports by Girma *et al*. (2016), Moiloa (2017) and Sharma *et al*. (2017). Indeed, Khan *et al*. (2011), Radfar (2011), Rehman *et al*. (2011), Abebaw *et al*. (2016) and Lakew and Seyum (2016) were also reported similar finding. In contrast, study by Cavalcante *et al.* (2012) revealedlower prevalence of coccidiosis in young animals than adults. This could be associated with the immunity of the animals where adult animals have a better immunity due to previous exposure to coccidiosis compared to young animals, which areusually susceptible to initial infections (Ayana *et al*., 2009; Girma *et al*., 2016).

The present study showed significant association between body conditions score and prevalence of coccidiosis. Animals with poor body condition score were found to be highly infected(61.9%) followed by medium (42.4%) and good body (37.7%) conditioned animals respectively. This finding agrees with previous findings by Lakew and Seyoum (2016) in and around Addis-Zemen, Northwest Ethiopia, Khodakaram-Tafti and Hashemnia (2017), Girma *et al*. (2016) in and Around Haramaya, Eastern Hararghe Ethiopia and Khan *et al*. (2011) in Pakistan. The higher prevalence in animals with poor body condition might be due to the weak immune status of the animals resulted from malnutrition and other infections (Lakew and Seyoum, 2016).

Based on consistency of the fecal sample (normal, soft and diarrheic), the prevalence was found to be significantly associated with diarrhoea than with normal and soft fecal samples. This finding agrees with the reports by Yakhchali and Golami (2008), Yakhchali and Zarei (2008), Yakhchali and Rezaei (2010), and Lakew and Seyoum (2016) who reported higherprevalence in diarrhoeic animals. Prevalenece of coccidiosis was also significantly associated with PAs. The highest prevalence was observed in Mender 23/45 (60.3%) followed by Mender 3 (40.6%) and Mender 104 (30.8%). The difference in the prevalence between the PAs could be due to difference management practice of the animals and exposure rate to contaminate communal grazing lands (Yemisrach and Amenu, 2017).

5. Conclusion and Recommendations

Coccidiosis of small ruminants which is caused by *Eimeria* species is the most important disease that causes morbidity and mortality in both sheep and goats. It is self-limiting disease which is widely distributed throughout the world. Coccidiosis incurs economic losses by direct consequences of diarrhea, retarded growth of animals and mortality. The findings of the present study revealed higher prevalence of coccidiosis in small ruminants in the study area. The prevalence was not significantly associated with species and sex of the animals. However, it was significantly associated with age of the animals, body condition, fecal consistency and PAs. Animals which were young and those poor in body condition were highly infected with coccidiosis. The highest prevalence was also found in diarrheic animals when compared to animals with soft and normal feces.

Therefore, based on the above conclusion the following recommendations are forwarded;

- ❖ New born lambs and kids should be feed with sufficient colostrum within 24hr of birth.
- ❖ Stress full conditions (overcrowding, starvation and poor hygiene) should be minimized and sick and diarrheic animals should be separated from the group.
- ❖ Further studies should be undertaken to identify the most pathogenic *Eimeria* species which would be useful for designing appropriate control measures.

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