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Prevalence and Intensity of Gastrointestinal Parasitic Infestation of Goats in Belo Sub Division, Boyo Division, North West Region of Cameroon

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Authors' contributions

This work was carried out in collaboration between all authors. Authors TET, YC, VKP, NACN and MM designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors EK and LM managed the analyses of the study. Authors EK and LM managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The study aims to investigate the prevalence and intensity of gastrointestinal (GI) parasitic infections in goats.
Study Design: A study was conducted in Belo Sub Division from July 2016 to October 2016. A total of 499 faecal samples were randomly collected directly from the recta of 499 goats in six villages and analyzed for the detection of any parasitic ova or oocysts using standard saturated sodium chloride flotation technique, while faecal egg/oocyst count was estimated using the modified McMaster technique.

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Results: The study found that all 499 goats with a mean EPG value of 494,3 ± 374,8) were found to harbor at least two gastrointestinal parasites. The prevalence and intensity of various parasites encountered respectively were: *Eimeria spp* (86%), (455.2 ± 400.8), *Haemonchus spp* (74.5%), (1282.9 ± 1244.4), *Toxocara spp (*72.5%) (953.3 ± 814.3), *Charbertia spp* (55.9%), (448.2 ± 416.0). *Fasciola spp* (45.4%), (475.0 ± 338.1), *Moniezia spp* (42.2%), (828.6 ± 793.9), *Oesophagostomum spp* (33.1%), (638.3 ± 463.5), *Strongyloides spp* (32.5), (200.0 ± 00), *Trichostrongylus spp* (28.3%) (200.0± 00), *Trichuris spp* (23.7%) (200.0± 00), *Teladorsagia spp* (14.6), (200.0 ± 00) and *Nematodorius spp* (8.1%), (50.0 ± 0,0). There was no significant difference in prevalence (100%) in the different age groups, type of husbandry management system and locality (P>0.05) except for gender where there was significant difference.
Conclusion: Gastrointestinal parasitic infections in goats from Belo Sub Division are common, with a very high prevalence. This high prevalence of gastrointestinal parasitism among the goats possibly reflected grazing, low immunity due to malnutrition and lack of anthelminthic treatment programs.

Keywords: Prevalence; intensity; gastrointestinal parasites; goats; Belo sub division.

1. INTRODUCTION

Livestock increases economic status of the rural population and plays a crucial role in the economic well-being of populations Worldwide. Goats are the oldest domesticated animals by man [1]. Evolutionary biology indicates that goats were domesticated about 10,000 years ago at the dawn of the Neolithic age [2]. The West African dwarf goats are popular as hobby goats due to their easy maintenance resilience and small stature. In rearing them, they do not require as much space as the larger dairy goat counterparts. Their gentle and friendly natures make them good companion pets [3]. Goats are important to man in different spheres and aspects of life. They provide milk which is more easily digestible than cow milk [4]. Their milk is also used in industries in the production of cheese .The rearing of goats provides employment and income to rural populations. In order to rear goats, a minimum investment of money is required, even without specific arrangement for housing and homemade supplied feed. Grazing is mostly done on road-side grass lands and fields [5].

According to Gadahi et al. [6], improper care, unhygienic environment, extreme climate and close contact with infected animals, goats get infected with a variety of parasites Parasitism in goat is a substantial problem plaguing farmers across the nation and it has a highly detrimental effect on the goat industry [7]. Production potential of livestock development programs is plagued in tropical and subtropical areas by prevalence of helminthiasis which causes high mortality and great economic losses [8].

Goat production and rearing in Belo is challenged with gastrointestinal parasitism being one of the main obstacles. The prevalence of gastrointestinal parasites is related to agro-climatic conditions like quantity and quality of pasture, temperature, humidity and grazing behavior of the host [9]. Infestation with gastrointestinal parasites of goats depends on the quantity and species of goats' present, general health, age, nutritional and immunological status of the animal. These infections occur mostly as mixed infections of different GIT parasites. Emaciation, persistent diarrhea and weight loss are usually the main symptoms [10]. Villous atrophy causes impaired digestion and malabsorption of nutrients, leading to decrease in live-weight gain, fiber and milk production as well as reproductive performance of goats and therefore has a serious impact on animal health and productivity. Hence, GIT parasitism of goats represents the greatest economic constraint and the most important limiting factor of small ruminant production [11,12,13].

Monitoring of research on parasitic invasions, particularly have wide biological importance as well as practical. As a result of these studies it is possible to establish the population of infected animals, and in several cases, to determine the composition of species of parasites. Monitoring studies are also useful to determine the prevalence of parasites in ruminants. The invasion of parasites in adult animals runs mainly subclinical form, and are not noticeable to owners of animals and very often also for veterinary services. Adult animals, however, are a source of infection for young animals especially in small ruminants, sheep and goats. Amongst

the gastrointestinal parasitic diseases of greatest importance in goats are: Nematodes (roundworms), Cestodes (tapeworms), Trematodes (liverflukes) and Coccidia [14,15]. Therefore this study was designed to determine the prevalence and intensity of gastrointestinal parasitic infestation of goats in Belo Sub division.

2. MATERIALS AND METHODS

2.1 Study Area Description

This study was carried out in Belo Sub Division, Boyo Division, North West Region, Cameroon from July 2016 to October 2016. Belo Sub Division is located about 50 km from Bamenda. It is found between latitude $6^{\circ}4^{l}$ and $6^{\circ}20^{l}$ North, between longitude $10^{\circ}11^{1}$ and $10^{\circ}30^{1}$ East.

2.2 Characteristics of Sampled Animals

The goats are grazed in open spaces, along the road, yard, and garbage sites and around houses in the municipalities. The age of the goats considered for the study ranged between 0–5 years, characterized as young goats (Less than 6 months old), adult goats (6 to 24 months old inclusive), and old goats (more than 24 months, but Less than 5 years old). Goats of both sexes were involved in the study.

2.3 Parasitological Techniques

2.3.1 Collection of samples

Corprologic analysis was done to have a quantitative and qualitative appreciation of the prevalence of infection of the parasites. For the qualitative analysis, faeces were analysed by the double-centrifugal flotation technique using saturated sodium chloride solution. For quantitative analysis or determination of the number of eggs per gram of faeces, the Mc Master technique [16].

2.3.2 Classification of GI parasitic infections by virtue of mean EPG

The animals were categorized as lightly, moderately and severely (heavily) infected according to their egg per gram of feces (EPG) counts. Egg counts from 50-799, 800-1200 and over 1200 eggs per gram of feces were considered as light, moderate and heavy infection, respectively [17].

2.4 Statistical Analysis

Data was stored in a Microsoft Excel spread, cleaned by checking for errors or missing variables and then exported to SPSS (Statistical Package for Social Science, Version 20) Software for analysis. For the purpose of modelling these data, explanatory variables were first explored for associations between parasites using $\chi 2$ test. The prevalence of helminth parasites was compared between demographic parameters using the chi square test. Non-parametric test of Krustal Wallis was used to compare mean intensity between age group and locality while Mann Whitney was used to comparing intensity with animal gender, breeding system and state of health. Before comparison of the intensity of infection (EPG), the non-infected host was discarded. EPG of each parasite was used as a variable and breeding system, gender, state of health of animal, age group and locality as a factor. They were all tested at 5% significance level.

3. RESULTS

3.1 Overall Prevalence and Intensity of Gastrointestinal Parasites

The analysis of fecal samples (Table 1) revealed that all 499 samples examined, were positive with mixed gastrointestinal parasite infections. There was an overall prevalence of 100 percent and a mean EPG value of (494.3 ± 374.8).

3.2 Influence of Gender on Prevalence and Intensity Infections

Globally, out of the 499 goats examined, 236 were males, while 263 were females both sexes each had 100% prevalence of GI parasitic infections with statistical significance difference ($P<0.05$). Multiple infections were more prevalent in female goats than male goats (Table 2). Female goats had the highest mean EPG value of 526.5 ± 388.3 compared to 462.0 ± 283.6 in male goats with no significant difference ($P>0.05$) (Table 3).

3.3 Influence of Age on Prevalence and Intensity of Infection

Table 4 shows the prevalence of infection by age group of the goats examined.70 were young goats, 303 were adults goats, while 126 were old goats. A prevalence of 100% was recorded in

each of the 3 age groups with no significance difference (P>0.05). Multiple infections were more prevalent in adult goats than young and old goats Table 5 shows the intensity of GI parasites by age group of the study. The highest mean EPG was recorded by the young goats (558.1 ± 331.2), followed by the adult goats (529.3 ± 349.5) and old goats (463.0 ± 330.7) with no significant difference (P>0.05).

3.4 Influence of Husbandry Systems on Infection

The prevalence of GI parasites by type of husbandry management system of the goats is shown in (Table 6). 210 goats were on free range, while 289 goats were tethered. Both types of husbandry management systems recorded each 100% prevalence of GI parasitic infections with no significant difference (P>0.05). Multiple infections were more prevalent in tethered goats than free range goats. The highest mean EPG value (513.5± 412.4) was recorded by tethered goats compared to (446.2 ± 333.1) on free range system with no significant difference (P>0.05) (Table 7).

3.5 Influence of Locality on Prevalence and Intensity of GI Parasite Infections

The spectrum of gastrointestinal parasites presented in Fig. 1 shows the prevalence of GI parasites by locality of sampled goats. 62 goats were examined from Anjin, 219 from Belo, 60 from Baingo, 47 from Kitchu, 90 from Mbessa, and 21 from Njinikejem. All 6 Villages recorded 100% prevalence each with no significant difference (P>0.05) of GI-parasitic infections. Multiple infections were also more prevalent in Belo goats than goats in the other village. The highest mean EPG value was recorded in Belo with no significance difference (p>0.05).

4. DISCUSSION

4.1 Prevalence and Intensity of GI Parasite Infections

Goats harbor a variety of gastrointestinal (GI) parasites. Data from this study indicated that gastrointestinal parasitic infections in goats from Belo Sub Division were common, with an overall prevalence of 100%. All the 499 goats examined were infected with at least two gastrointestinal parasites amongst which were *Haemonchus spp, Nematodirius spp*, *Oesophagostomum spp, Chabertia spp, Strongyloides spp,Teladorsagia spp, Toxocara spp, Trichostrongylus spp,Trichuris spp,Moniezia spp*. *Fasciola spp*. and coccidian (*Eimeria spp*) giving a total of twelve parasites (9 Nematodes, 1 cestode, 1 trematode and 1 protozoan). Sathaporn et al. [18], Nuraddis et al. [19] and Choubisa et al. [20] also reported slightly similar types of GI parasites. The gastrointestinal parasitic infection rate of 100% recorded in goats during this study agrees with the 100% prevalence reported by Dogo et al. [20] in Vom and 90.4 reported by Ntonifor et al. [21] in Jakiri. This is higher than the (87.2%) prevalence reported by Nuraddis et al. [19] and (72%) reported by Paul et al. [22] in Maiduguri. This is quite high and shows that the agro-ecological and geo-climatic conditions of the study area favor the growth and multiplication of these parasites. Climatic conditions, particularly rainfall, are frequently associated with differences in the prevalence of GI parasitic infections, because free-living infective stages (eggs, larvae, cysts, and oocysts) survive longer in moist conditions [19]. Belo Sub Division expereinces about eight months of rainy season from mid March to mid November and about four months of dry season from mid November to mid March. Since the study was conducted from July to October towards the end of the rainy season, higher parasitic infections might be related to the availability of browse and a longer browsing time in the warm-rainy season by the host, sufficient moisture and optimum temperature.These create favorable conditions allowing for the larval development, oocyst sporulation and survival of the infective larvae stage [23]. The high prevalence in this study could also be attributed to illiteracy on the side of the goat keepers and their ignorance or avoidance tendency of preventive measures [24]. For example, effective pasture management, applied knowledge about host-parasite interactions and interrelations building the base for low pasture infection rates for grazing animals,stocking rate reduction and regular intensive monitoring of animal condition that can help optimize animal health status and anthelmintic treatments [25]. The overall higher prevalence of GI parasitic infections in this study area could also be attributed to lower immunity of hosts as a result of malnutrition [23,24]. Among other factors that may have further contributed to these discrepancies observed are host breeds and different husbandry practices. The physiological status of the animals like parturition, lactation stage and pasture contamination can also influence the prevalence of GI parasites in different areas [23].

Table 1. Prevalence and intensity of gastrointestinal parasites

Parasites		Number examined	Number of infested animals	Prevalence % of infestation	Intensity (mEPG/OPD ±SD)*
Nematodes	*Nematodirius spp*		40	8.1	50.0 ± 0.0
	Haemonchus spp		372	74.5	1282.9 ± 1244.4
	Oesophagostomum spp		163	33.1	638.3 ± 463.5
	Chabertia spp		279	55.9	448 ± 416.0
	Trichuris spp	499	117	23.7	200.0 ± 00
	Strongyloides spp		162	32.5	200.0 ± 00
	Teladorsagia spp		73	14.6	200.0 ± 00
	Toxocara spp		362	72.5	953.3 ± 814.3
	Trichostrongylus spp		141	28.3	200.0 ± 00
Trematodes	*Fasciola spp*	499	224	45.4	475.0 ± 338.1
Cestodes	*Monieza spp*	499	208	42.2	828.6 ± 793.9
Protozoa	*Eimeria spp*	499	429	86	455.2 ± 400.8

Table 2. Prevalence of infections by gender

Parasite	Gender						Total N(%)	P-value
	Males			Females				
	N0. examined	N0. infected	Prevalence (%)	N0. examined	N0. infected	Prevalence (%)		
Nematodirius spp		12	2.4		28	7.7	40 (8.1)	0.028
Haemonchus spp		206	41.3		166	33.3	372 (74.6)	0.001
Oesophagostomum spp		31	6.3		132	26.8	163 (33.1)	0.000
Chabertia spp		86	17.2		193	38.7	279 (55.9)	0.000
Trichuris spp		38	7.7		79	16.0	117 (23.7)	0.000
Eimeria spp		194	38.9		235	47.1	429 (86.0)	0.022
Fasciola spp	236	60	12.2	263	164	33.3	224 (45.4)	0.000
Monieza spp		68	13.8		140	28.4	208 (42.2)	0.000
Strongyloides spp		49	9.8		113	22.6	162 (32.5)	0.000
Teladorsagia spp		19	3.8		54	10.8	73 (14.6)	0.000
Toxocara spp		170	34,1		192	38,5	362(72,5)	0.80
Trichostrongylus		43	8.6		98	19.6	141 (28.3)	0.000

Table 3. Gender related intensity (mEPG/OPG)

Parasite	Gender				Total (mEPG/OPG±SD)	P-value
	Males		Females			
	N0 examined	Intensity (mEPG/OPG±SD)*	N0 examined	Intensity (mEPG/OPG±SD)		
Nematodirius spp		50.0 ± 0.0		50.0 ± 0.0	50.0 ± 0.0	1
Haemonchus spp		798.4± 680.1		1767.3±1808.4	1282.9 ± 1244.4	0.00
Oesophagostomum spp		600.0 ± 0.0		676.6 ± 463.5	638.3 ± 463.5	0.47
Chabertia spp		400.0 ± 0.0		496.3 ± 416.0	448 ± 416.0	0.00
Trichuris spp		200.0 ± 0.0		200.0 ± 00	200.0 ± 0.0	1
Eimeria spp	236	463.9 ± 374.8	263	446.4 ± 426.7	455.2 ± 400.8	0.08
Fasciola spp		460.0 ± 393.7		489.9 ± 282.4	475.0 ± 338.1	0.04
Monieza spp		823.5 ± 810.0		833.6 ± 777.8	828.6 ± 793.9	0.57
Strongyloides spp		200.0 ± 0.0		200.0 ± 00	200.0 ± 0.0	1
Teladorsagia spp		200.0 ± 0.0		200.0 ± 00	200.0 ± 0.0	1
Toxocara spp		1148.2 ± 1144.4		758.3 ± 484.2	953.3 ± 814.3	0.02
Trichostrongylus		200.0 ± 0.0		200.0 ± 00	200.0 ± 0.0	1

Table 4. Age related prevalence of infections

Parasite	Age						Total (N) Prevalence (%)	P-value
	Young		Adults		Old			
	N0 infected	Prevalence (%)	N0 infected	Prevalence (%)	N0. infected	Prevalence (%)		
Nematodirius spp	13	2.6	7	1.4	20	4.1	40 (8.1)	0.00
Haemonchus spp	40	8.0	240	48.1	92	18.4	372 (74.5)	0.001
Oesophagostomum spp	33	6.7	86	17.4	44	8.9	163 (33.1)	0.001
Chabertia spp	34	6.8	168	33.7	77	15.4	279 (55.9)	0.23
Trichuris spp	13	2.6	85	17.2	19	3.9	117 (23.7)	0.01
Eimeria spp	44	8.8	291	58.3	94	18.8	429 (86.0)	0.00
Fasciola spp	27	5.5	121	24.5	76	15.4	224 (45.4)	0.00
Monieza spp	20	4.1	130	26.4	58	11.8	208 (42.2)	0.14
Strongyloides spp	21	4.2	98	19.6	43	8.6	162 (32.5)	0.84
Teladorsagia spp	0	0	47	9.4	26	5.2	73 (14.6)	0.00
Toxocara spp	58	11.6	210	4.1	94	18.8	362 (72.5)	0.06
Trichostrongylus	12	2.4	85	17.0	44	8.8	141 (28.3)	0.03

Table 5. Age related intensity of infection

Parasite	Age						P value
	Young		Adult		Old		
	N0 examined	Intensity (mEPG/OPG)	N0 examined	Intensity (mEPG/OPG)	N0 examined	Intensity (mEPG/OPG)	
Nematodirius spp		50.0 ± 0.0		50.0±0.0		50.0 ± 0.0	0.06
Haemonchus spp		1300.7 ±1220.1		1473.9±1434.2		1072.9 ±1079.6	0.001
Oesophagostomum spp		566.7 ± 196.6		1052.2±614.7		296.0 ± 102.0	0.001
Chabertia spp		450.0 ± 227.7		750.0±385.9		509.4 ± 437.8	0.23
Trichuris spp		200 ± 00		200.0±0.0		200.0 ± 0.0	0.07
Eimeria spp	70	404.5 ± 281.2	303	563.2±422.2	126	397.9 ± 499.0	0.00
Fasciola spp		850.2 ± 498.8		418.2±272.0		475.1± 243.5	0.00
Monieza spp		840.0 ±409.3		578.0±594.0		1067.8 ± 972.0	0.14
Strongyloides spp		200.0 ±0.0		200.0±0.0		200.0 ± 0.0	0.84
Teladorsagia spp		200.0 ± 0.0		200.0±0.0		200.0 ± 0.0	0.70
Toxocara spp		1435.6 ± 1140.7		710.6±470.8		714.3 ± 531.4	0.06
Trichostrongylus		200.0 ± 0.0		200.0±0.0		200.0 ± 0.0	0.07

Table 6. Influence of husbandry systems on infection

Parasite	Husbandry system				Total N(%)	P-value
	Tethered		Free range			
	N0. infected	Prevalence (%)	N0. infected	Prevalence (%)		
Nematodirius spp	20	4.1	20	4.1	40 (8.1)	0.323
Haemonchus spp	209	41.9	163	32.7	372 (74.5)	0.180
Oesophagostomum spp	104	21.1	59	12.0	163 (33.1)	0.101
Charbertia spp	32	6.4	41	8.2	73 (14.6)	0.008
Trichuris spp	78	15.8	39	7.9	117 (23.7)	0.043
Eimeria spp	239	47.9	190	38.1	429 (86.0)	0.014
Fasciola spp	133	27.0	91	18.5	224 (45.4)	0.756
Monieza spp	109	22.1	99	20.1	208 (42.2)	0.170
Strongyloides spp	71	14.2	91	18.2	162 (32.5)	0.000
Teladorsagia spp	32	6.4	41	8.2	73 (14.6)	0.008
Toxocara spp	196	39.3	166	33.3	362 (72.5)	0.006
Trichostrongylus	95	19.0	46	9.2	141 (28.2)	0.007

Table 7. Influence of husbandry system on intensity of infections

Parasite	Husbandry system				Total Intensity (mEPG/OPG) ±SD	P-value
	Tethered		Free range			
	N0 examined	Intensity (mEPG/OPG)±SD	N0 examined	Intensity (mEPG/OPG)±SD		
Nematodirius spp		50.00±0.0		50.0±0.00	50.0 ± 0.0	1
Haemonchus spp		1283.9±1253.3		1331.9±1237.5	1282.9 ± 1244.4	0.774
Oesophagostomum spp		642.5±485.1		674.1±441.9	638.3 ± 463.5	0.512
Charbertia spp		505.7±445.5		390.7±386.5	448 ± 416.0	0.001
Trichuris spp		200.0±0.0		200.0±0.0	200.0 ± 0.0	1
Eimeria spp	236	591.6±525.1	263	318.8±278.7	455.2 ± 400.8	0.022
Fasciola spp		515.1±345.2		435.1±331.5	475.0 ± 338.1	0.001
Monieza spp		614.7±848.2		1042.5±739.6	828.6 ± 793.9	0.000
Strongyloides spp		200.0±0.0		200.0±0.0	200.0 ± 0.0	1
Teladorsagia spp		200.0±0.0		200.0±0.0	200.0 ± 0.0	1
Toxocara spp		1158.5±1046.5		748.1±582.1	953.3 ± 814.3	1
Trichostrongylus		200.0±0.0		200.0±0.0	200.0 ± 0.0	0.908

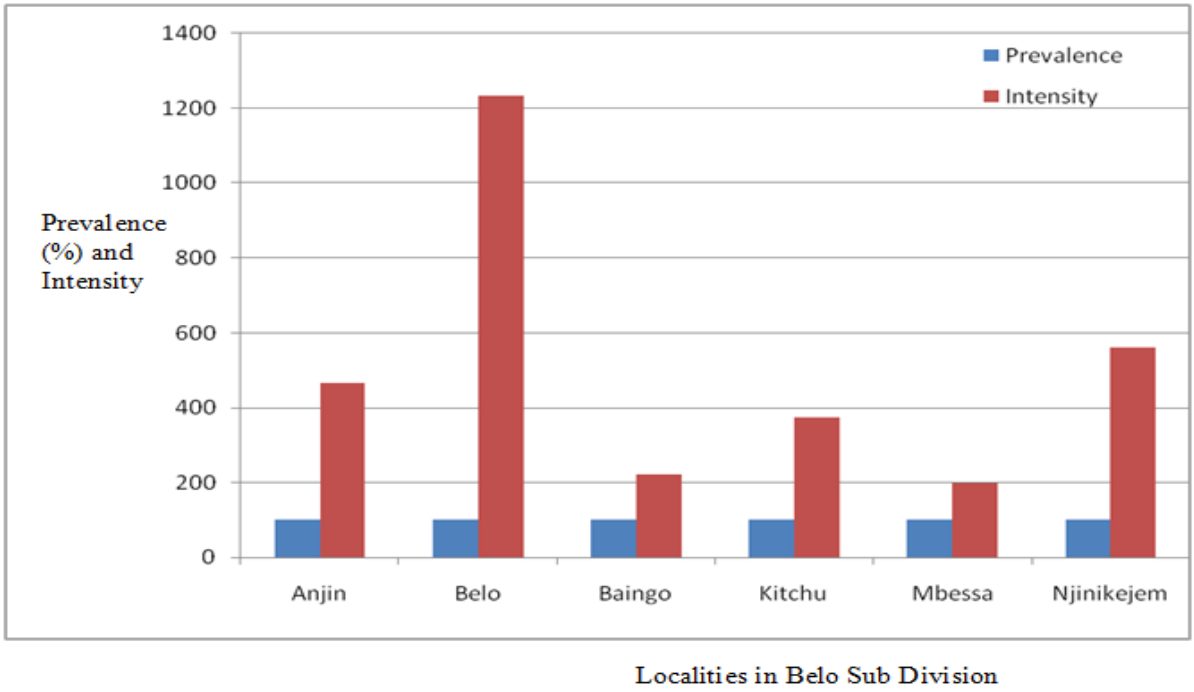

Fig. 1. Prevalence and intensity of GI parasitic infection in some Localities

Most important to the findings of Nuraddis et al. [19] compared to the present study, *Monezia spp*. and *Emeria spp*. were the only cestode and protozoa types found respectively, a finding similar to Kanyari et al. [27] Encountered in this study were *Nematodorius spp and Toxocara spp,* that Nuraddis et al. [19] did not encounter in Jimma, Ethiopia. This difference may be due to variation in climate, parasite evolution or mixed rearing that affect parasitic infection. The most prevalent and commonly observed parasite was *Eimeria spp*,with a significant infection rate of (86%), which is higher compared to the low prevalence (48%) reported by Kanyari et al. [26] in Kenya and (20.6%) reported by Nuraddis et al. [19] in Jimma, Ethiopia. Similarly, low prevalence of (18.6) was reported by Dogo et al. [21], and Gebeyehu et al. [24] for *Eimeria spp* in Daegu, Korea. This high prevalence *of Eimeria spp* in Belo Sub Division may be associated to the fact that *Eimeria* oocysts are much resistant to disinfectants, and can remain in the environment (particularly moist, shady areas) for long periods of time and maintain their infectivity. Stress factors such as tethering, post weaning, dietary changes and other problems can precipitate an outbreak of coccidiosis. In this study, the severity of GI parasitic infection depended on the number of eggs per gram of feces. The intensity of infection measured by fecal egg or oocyst count varied from light to heavy infection. In a high percentage of animals, light parasitic infections were found, while heavy infections were less common. Among these gastrointestinal parasites observed, *Haemonchus spp* had the highest overall mean EPG value of 1445.2± 1594.4 which is higher than that reported by Ntonifor et al. [22].

Female goats had higher multiple infections and mean EPG value than male goats from our study and this agrees with the findings of Paul et al. [23] In a study by Sathaporn et al. [20], male goats actually had a higher prevalence than female goats which disagrees with our findings. This could be because most of the goats that are tethered in Belo Sub Division are females.

In age related infections, multiple infections and mean EPG value was higher in adults goats than the old and the young goats similar to the report of Gebeyehu et al. [24] However, this result did not agree with the reports of Kanyari et al. [27], Gwaze et al. [28] and Sathaporn et al. [20] who showed that young goats had higher prevalence of GI parasites than adult goats.This middle age group had a significant higher prevalence of Eimeria spp infections (58.3%) and higher oocyst numbers compared to other age groups in the present study. This did not also agree with Sathaporn et al. [20] in Satun, Thailand who

reported that young goats had a higher prevalence (94.9%) of coccidial infections and higher oocyst numbers in young goats (< 1 year) than older goats (> 2 years). This higher prevalence of GI parasites and of coccidial infections in this age group might be due to the fact that a higher incidence occurs during post weaning stress (since, coccidia is most frequently observed in kids 2 to 4 weeks post weaning), tethering stress and stress related to dietary changes [29,30] in addition to the fact that immunity is low. The low prevalence of coccidial infections in the young goats is probably due to the absence of this stress factors and in old goats probably because of acquired immunity. Although natural immunity develops with repeated exposure [31] younger goats remain highly susceptible. The Institute for International Cooperation in Animal Biologics [32] reported that most ruminants stop shedding *Toxocara spp* eggs by the time they are 2 to 4 months old and that *T. vitulorum* infections can be controlled by eliminating patent infections, which occur only in 3 to 10 week old ruminants. Young goats (<6 months old) had the highest mean EPG value of (630.8± 268.3) than other age groups, with the highest parasitic intensity (2137.9 ± 4493.0) shown by *Toxocara spp* in this age group.This high *Toxocara spp* intensity might probably be due to Transcolostral transmission in the life cycle and sanitation standards related to *Toxocara spp.* [32] This finding even though was not consistent with the reports of Nuraddis et al. [19], was not surprising because naive young and old carriers frequently graze the same areas, coupled with the fact that young goats have low immunity. The intensity of infection is also reportedly related to hygiene level [33].

Goats examined in this study were either on free range or tethered systems all under extensive management (grazing).Tethered goats actually had a higher multiple infections and mean EPG than the free range goats. The highest infection rate of (47.9%) was recorded by *Eimeria spp.* in tethered goats. This high infestation rate and intensity in there goats could be explained by the fact that tethering is a stress factor [29,30]. Again most people in Belo Sub Division tether goats in the same area throughout the tethering period with little rotation. Consequently, the grazing environment becomes contaminated with various GI parasites eggs and oocysts which infect the goats [25].

All Villages recorded 100% prevalence each of GI parasitic infection with no statistical significance. These results differed from those of Sathaporn et al. [20] who reported in Satun, that the prevalence of GI parasites of goats in seven Districts statistically varied from 60% to 86.4% (P< 0.05). Belo had a higher multiple infections and mean EPG of 1233.6± 1145.3 compared to other five villages. Geographical consistence of prevalence in Belo Sub Division might be due to the climatic conditions that are consistent in this area. *Eimeria spp* recorded the highest prevalence of 38.2% and *Haemonchus spp* had the highest mean EPG of 4467.3±4396.2 in Belo. Only Belo town can be classified as being a semi urban town. The rest of the villages are rural. These geographical differences in the prevalence of coccidial infections and other infections and high mean EPG value in Belo might be due to the high population density and unhygienic conditions of the area compared to other Villages, which leads to the high infection rates. Inadequate nutrition, however, which is common in this area, may exacerbate the course of GI parasitic infections. The animals are generally malnourished and suffer from other diseases, and are thus not resistant to nematode infection [34].

5. CONCLUSION

Goats in Belo Sub Division are infested by gastrointestinal parasites. The adult goats recorded higher multiple gastrointestinal parasites and mean EPG value than the young goats and the old goats. Female goats recorded higher multiple gastrointestinal parasites and mean EPG value than male goats. Tethered goats recorded higher multiple gastrointestinal parasites and mean EPG value than free range. Belo recorded higher multiple gastrointestinal parasites and mean EPG value than Njinikejem, Anjin, Kitchu, Baingo, Mbessa. Prevailing agro-ecological and geo-climatic conditions, illiteracy on the side of goat keepers, avoidance tendency of preventive measures and lack of anthelmintic treatments provide an ideal condition for the transmission of the GI parasitic infections.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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