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Prevalence of Common Gastrointestinal Parasite Infection Under Natural Grazing Condition in Black Bengal Goat of Bangladesh

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Abstract

Among the gastrointestinal (GI) parasites, *Haemonchus contortus* becomes a major impediment to small ruminant and negatively affecting the socio-economic structure worldwide, including in Bangladesh. This study aimed to evaluate the susceptibility of GI parasites alone with *Haemonchus contortus* infection in Black Bengal Goat based on different associated risk factors such as sex, age, breed, region and years (season) under natural grazing condition. A total of 897 Black Bengal goats were examined for three consecutive years. The fecal egg was measured using the McMaster technique. Age, Sex, breed, and body weight were recorded before sample collection and hematological parameter like Pack Cell Volume (PCV) and Haemoglobin (Hg) value was also measured from a blood sample of a goat. Statistical analysis was done after transforming data into $\log_{10}$ (n+1), where n is the number of egg per gram feces, and analysis of variance was done using Generalized Linear Model procedures of the computer package of SAS. The highest prevalence (55.2%) was found for *Eimeria* sp. among overall GI parasitic infections with higher fecal egg count (FEC) (1678.53±154.62epg). FEC was significantly differed between sexes ($P<0.01$), among breed and years ($P<0.001$). Among the GI nematode, *Haemonchus contortus* showed the highest prevalence (47.1%) with the highest FEC (355.09±18.54epg). In the case of the breed, Black Bengal Hilly Low (BBHL) goat showed the highest prevalence (76.1%) and Black Bengal Hilly High (BBHH) goat showed lower prevalence (33.3%) with lower FEC (220.00±12.31). This study suggested that the identified risk factors influencing GI parasites and BBHH goat were less susceptible to GI parasites, especially *Haemonchus contortus* infection.

Keywords: Fecal egg count, gastrointestinal parasites, Goat, *Haemonchus contortus*.

Introduction

Gastrointestinal (GI) parasitic infection is a serious threat to small ruminant production across its habitat agro-ecological zones throughout the world. Among all helminths, GI nematodes considerably affect the production system of small ruminant due to decreasing voluntary feed intake which cause reduced weight gain, impaired digestive absorptive efficiency and thus provokes anemia, hypoproteinemia and even mortality in case of massive infestation (Kakar *et al.* 2013; Raza *et al.* 2014; Babják *et al.* 2017). Parasitic infestation also leads to lower body immunity and increases the susceptibility to other pathogenic infections (Garedaghi *et al.* 2011) and this problem is more severe in tropical countries. Helminthes parasites have become a significant impediment to small ruminant production due to favorable environmental conditions for helminths transmission, poor nutrition of animal, and poor sanitation in rural areas but the majority of infected animal do not show clinical signs due to the chronic nature of the disease (Raza *et al.* 2014).

The animal on pasture, mixed GI nematodes infections commonly occur. These are Haemonchosis, Strongyloidosis, Ostertagiasis, Oesophagostomiasis, and Trichostrongylosis. Their impact on a host depends on the intensity of parasitic burden and host immune response (Singh *et al.* 2013; Souza *et al.* 2013) and control strategies of nematode infections differ between breed to breed based on immunological, behavioral and physiological differences of animals and nematodes (Babják *et al.* 2017). Among those nematode species, *Haemonchus contortus* is one of the most important pathogenic parasites and the degree of infestation depends on the level of parasitic load (Singh *et al.* 2013). *Haemonchus contortus* is an abomasal blood-sucking nematode of small ruminant in the tropical and subtropical area of the world with high fecundity and short generation interval (Omar *et al.* 2016). The prevalence of GI nematodes varies due to diverse geographical conditions and host-parasite biology, agro-climatic and animal husbandry condition, vegetation and livestock density in a particular region (Tariq 2015). Several studies on the prevalence of GI nematodes in goat have been reported worldwide (Bishop & Morris 2007; Chiejina & Behnke 2011; McManus *et al.* 2014).

Goat is an important ruminant species in Asia and Africa as 95% of the total population of goat is reared in this part of the globe. It is also an important ruminant species in Bangladesh as it stands second in number next to cattle. Bangladesh possesses 56.08 million goats distributed worldwide, which contributes 5.59% of the total goat population of the world (FAOSTAT, 2017, http//faostat.org). More than 90% of the goat population in Bangladesh is comprised of Black Bengal goat having some variants in color and size; the majority of the remainder is imported Indian breeds and their crosses (Husain 1993; Afroz *et al.* 2010). Black Bengal goat is the only recognized goat breed of livestock in Bangladesh. Geographically and genetically, Black Bengal goats can be divided into three populations, such as Black Bengal West (BBW) found in the Western region of the country, Black Bengal Central (BBC) found in the central part of the country and Black Bengal hilly (BBH) from in the hilly region of Eastern part of the country (Afroz *et al.* 2010; Omar *et al.* 2016). Studies made on the morphology and genotypes revealed that there were differences in morphology and gene constituents in those three populations of Black Bengal goats (Nozawa *et al.* 1988; Faruque 2009; Afroz *et al.* 2010). A plethora of reports on GI nematodes of Black Bengal goat in Bangladesh have been carried out in different part in Bangladesh (Howlader *et al.* 2002; Hassan *et al.* 2011; Akanda *et al.* 2012; Nahar *et al.* 2012), but no study has ever been carried out including populations as mentioned earlier using a large number of samples of Black Bengal goat. Therefore, the present study was designed to investigate the prevalence of common GI nematodes in those populations of Black Bengal goat for three consecutive years.

Material and method

Ethics statement

No ethical committee approval was needed as this present study was conducted on fecal and blood samples of goats. Fecal samples were collected from freshly voided or directly from the rectum of animals and blood samples were collected for veterinary inspection with the prior permission of their owners.

Study area and coordinates

The study was conducted in Natore and Bandarban district of Bangladesh. The GPS coordinates of two locations were N: $24^{0}07.163'$; E: $89^{0}03.997'$ and N: $24^{0}47.523$; E: $091^{0}43.893$ for Natore and Bandarban, respectively. Bandarban district is a hilly region as well as mountain area and Natore is plain land of the country.

Sampling strategy

A cross-sectional epidemiological study was performed to estimate the status of GI nematodes and also to find out the associated risk factors**.**

Sample collection

A simple random sampling was done for sample collection. A total of 897 Black Bengal goats were examined in three consecutive years from May 2014 to August 2016. Age, Sex, breed and body weight were recorded before sample collection. Age of animals was

Table 1. Prevalence and the parasitic load of different GIN of Black Bengal goats.

Parasite Species (Number of samples)	Positive samples	Prevalence (%)	Range	Mean ± SE	
				FEC	TFEC
Haemonchus contortus	422	47.1	50-3250	355.09±18.54	2.41±0.02
Hook worm	142	15.8	50-1000	108.09±9.46	2.07±0.03
Oesophagostomum spp.	128	14.3	50-550	125.20±9.10	2.10±0.24
Strongyloides spp.	144	16.1	50-700	125.74±11.11	2.11±0.03
Moniezia spp.	68	7.6	50-11900	850.00±96.54	2.43±0.07
Eimeria spp.	495	55.2	50-41600	1678.53±154.62	2.92±0.02
Total (897)	**680***	**75.8**	**50-41600**	**1225.99±98.18**	**2.49±0.03**

Note: TFEC= Log_{10} transform fecal egg count; * Total number of animal affected is less than the summation of individual infection because the same animal was infected with or more one gastro-intestinal parasite

confirmed by examining the teeth and/or birth record of animals (Rahman & Hossain 1997) and categorized into 3 groups, those were 4 to 7 months (335 goats, grouping as kid), >7 to 12 months (193 goats, grouping as young) and >12 months (362 goats, grouping as adult). The intensity of gastrointestinal nematode (GIN) infection in goats is categorized as light (50-500epg), moderate (>500-1000epg) and heavy (>1000epg) infection (Menzies *et al.* 2012). According to sex, animals were divided into male (397) and female (500). The populations of Black Bengal goat namely Black Bengal Western (BBW, 376), Black Bengal Hilly High (BBHH, 195), Black Bengal Hilly Low (BBHL, 142) and Black Bengal cross (BB cross, 184) were selected for this study. Also, the weight of animals was measured using electric balance and recorded into the registry book. Blood samples were collected for the hematological parameters like PCV and Hg values were estimated from all the sampled goats.

Table 2. Degree of infection based on EPG count of examined positive samples for GIN infection in goats.

Intensity of infection	EPG	Frequency (%)
Light	50-500	305 (44.9)
Moderate	>500-1000	111 (16.3)
Heavy	>1000	264 (38.8)

Estimation of parasitological and Haematological values

Fecal samples were examined using floatation technique and eggs/oocysts were identified according to the description by Soulsby in 1968. The positive samples were used in modified McMaster's technique to estimate the intensity/load of fecal eggs/oocysts and expressed in eggs per gram (epg) (Zajac & Conboy, 2012). Briefly, 2gm of the fecal sample was mixed with 28ml of saturated salt solution. After sieving, the homogenized mixture was placed in McMaster slide and kept it 3 minutes to float eggs/oocysts properly. Then, the slide was examined under a microscope to count the eggs/oocysts perfectly. The number of eggs per gram of feces was calculated using the following formula:

Egg/gm = [no. of egg counted x (T/V)]/F

Where

T = Total volume of faeces/flotation solution mixture,

V = Volume of aliquot examined in slide,

F = grams of feces used.

The sensitivity was 50 i.e. each egg represented 50 epg. For hematological assessment, blood samples were collected a EDTA coated venoject tube from the jugular vein of animals and the proper cool chain was maintained before analysis. PCV was determined by the Micro hematocrit centrifuge method (Jain 1986) and the result was expressed in percentage (%). Hemoglobin value was determined by using Sahli's acid haematin method (Von Schenck *et al.* 1986; Srivastava *et al.* 2014) and the result was expressed in gram per deciliter (g/dl).

Statistical Analysis

Since the FEC data were not normally distributed, i.e. they were positively skewed, logarithmic transformation was applied before analysis. The descriptive statistics viz., arithmetic mean, variance, standard error and student t-test were performed following the procedure described by Snedecor & Cochran in 1980 after that data was transformed into $\log_{10}(n+1)$, where n is the number of egg per gram feces and analysis of variance was done by using Generalized Linear Model procedures of computer package of SAS (SAS Institute Inc. USA, 1998).

Results

The overall prevalence and parasite load of GI parasites in Black Bengal goats

A total of 897 goat fecal samples were collected and examined to determine the infection status and a degree of infection by different GI parasites under natural

Table 3. Status of GI parasites concerning different variables in Black Bengal goats.

Parameter/Effects		Number	Positive sample (Prevalence %)	FEC Mean ± SE	Level of Significant
Sex					
	Male	397	300 (75.6)	1969.04±282.54	**
	Female	500	380 (76.0)	1036.47±113.43	
Age (Month)					
	4 to 7	335	243 (72.5)	1969.51±187.35	NS
	>7 to 12	193	144 (74.6)	1240.28±124.26	
	> 12	369	293 (79.4)	1481.65±137.97	
Breed/Population					
	BBW	376	288 (76.6)	1563.49±124.13	***
	BBHH	195	131 (67.2)	466.79±27.67	
	BBHL	142	132 (93.0)	2354.55±119.26	
	BB Cross	184	129 (70.1)	1932.25±125.97	
Region					
	Hilly	337	263 (78.0)	1473.29±171.22	NS
	Plain	560	417 (74.5)	1715.86±244.31	
Year					
	2014	311	249 (80.1)	1745.50±140.53	***
	2015	288	235 (81.6)	886.89±85.±86	
	2016	298	196 (65.8)	2329.95±114.95	

Note: FEC= Fecal egg count; NS= Non Significant; ***P*<0.01, ****P*<0.001

grazing pasture. The FEC ranged from 50-41600epg for different GI parasitic infections. *Eimeria* oocyst showed the highest prevalence (55.2%) and parasite load in terms of mean FEC (1678.53±154.62epg). The lowest prevalence (7.6%) was observed for *Moniezia spp* and mean egg count was 850.00±96.54epg and FEC range from 50-11900epg within the positive samples. Low FEC (108.09±9.46 to 125.74±11.11epg) was observed for *Oesophagostomum spp* (125.20±9.10epg), Hookworm (108.09±9.46epg) and *Strongyloides spp* (125.74±11.11epg) with their low level of prevalence rate (14.3 to 16.1 %). Among the nematode, *Haemonchus contortus* showed the highest prevalence (47.1 %) and FEC (355.09±18.54epg) among the positive samples (Table 1).

The intensity of GIN infection among 680 positive samples indicate that most of the animals were lightly infected (44.9%) followed by heavy (38.8%) and moderate (16.3%) infection in the total population of goat (Table 2).

In the overall infection, female goats had a higher prevalence rate (76%) in comparison to male goats (75.6%) but significantly (*P*<0.01) higher FEC was observed in males than female goats. In the age groups, the highest prevalence (79.4%) was found in goats of >12 months' age but FEC was not significantly different among different age groups. Among the different age groups of goat, the mean FEC were more in kids 4 to 7 months, (1969.51±187.35epg) compared to young (>7 to 12 months, 1240.28±124.26epg) and adult (>12 months, 1481.65±137.97epg) goats. Among the populations of Black Bengal goat, statistically significant (*P*<0.001) differences were observed in mean egg count (Table 3). The highest prevalence (93.0%) and mean egg count (2354.55±119.26epg) were found in the BBHL population. The mean FEC was higher in the plain region (1715.86±244.31epg) than the hilly region (1473.29±171.22epg) but it was not statistically significant. FEC had significant (*P*<0.001) variation among the three consecutive years. The lowest prevalence rate (65.8 %) but height FEC (2329.95±114.95epg) was observed in 2016. But the prevalence rates were higher and FEC were found lower in the year 2014 and 2015 (Table 3).

Factors affecting the infection of *Haemonchus contortus* in Black Bengal goats

The highest prevalence (48.4%) and FEC (349.71±33.26epg) of *Haemonchus contortus* infection were recorded in female goats compared to male goats. In different age groups, goats aged >12 months, showed the highest prevalence (48.8%) and highest FEC (387.86±32.16epg). Significant (*P*< 0.05) differences were observed among different goat populations,

Table 4. Status of *Haemonchus contortus* concerning different variables in Black Bengal goats.

Parameter/Effects	Positive samples	Prevalence (%)	Mean ± SE		P-value
			FEC	TFEC	
Sex					
Male (397)	180	45.3	327.17±31.19	2.39±0.03	0.164
Female (500)	242	48.4	349.71±33.26	2.40±0.03	
Age (Month)					
4 to 7 (335)	155	46.3	332.26±33.60	2.37±0.03	0.159
>7 to 12 (193)	87	45.1	348.28±26.03	2.43±0.03	
> 12 (369)	180	48.8	387.86±32.16	2.46±0.02	
Breed/Population					
BBW (376)	170	45.2	386.18±38.96	2.41±0.03	0.027*
BBHH (195)	65	33.3	220.00±12.31	2.30±0.02	
BBHL (142)	108	76.1	384.26±25.58	2.47±0.03	
BB Cross (184)	79	42.9	359.49±29.82	2.43±0..03	
Region					
Plain (560)	173	30.9	347.69±0.21	2.39±0.03	0.779
Hilly (337)	249	73.9	322.54±22.36	2.41±0.03	

Note: FEC= Fecal egg count; TFEC= Log10 transform fecal egg count; NS= Non Significant; **P*< 0.05

whereas BBHL showed the highest prevalence (76.1%) and BBW showed highest parasitic load (386.18±38.96epg). Higher prevalence was observed in the hilly region (73.9%), where higher FEC (347.69±20.21epg) was recorded in the plain area in comparison to hilly region goats (322.54±22.36epg) (Table 4).

Status of hematological effects of *Haemonchus contortus* infection in Black Bengal goats

PCV, Hg and body weight (BW) of positive samples infected with *Haemonchus contortus* are presented in Table 5. Hg was higher in male goats than female goats, but the difference was not significant, although the PCV and BW were differed significantly (*P*< 0.05) between the male and female goats. A significant difference (*P*< 0.01) was observed among the different age groups of goat for body weight, but no significant difference found for PCV and Hg value. Among different populations, Hg and BW have significantly differed. Between goats of the plain and hilly region, PCV and BW did not differ significantly but Hg value differed significantly (*P*<0.01) (Table 5).

Year-wise status of *Hawmonchus contortus* infection in Black Bengal goat

Among the three consecutive studied years (2014, 2015 and 2016) significant variation in *Haemonchus contortus* infection was observed in FEC, TFEC, body weight and PCV of the animals but non-significant in Hg (g/dl) (Table 6).

Discussion

Gastrointestinal nematode (GIN) infections remain a major impediment to small ruminant health and productivity. The effects are more prominent in sheep and goat than other livestock species (Iqbal *et al.* 1993). Globally *Haemonchus contortus* is regarded as the major prevalent GI nematode and causes more economic losses than other nematode species in ruminants but this problem becomes severe in the tropic and sub-tropic region due to their favorable ecological factors for growth, multiplication and transmission of parasites (Gupta *et al.* 2013; Calvete *et al.* 2014). Therefore, this study was mainly focused on finding out the prevalence and parasitic load in the term of FEC of common GIN infection with especial emphasis on *Haemonchus contortus,* the predominant GIN in Black Bengal goats of Bangladesh (Hassan *et al.* 2011; Nahar *et al.* 2012; Omar *et al.* 2016). In this study, samples were collected from three consecutive years from 2014 to 2016, at May to July (end of the rainfall and before de-worming the animals) when the infestation of GI parasites, especially *Haemonchus contortus* is remaining high (Omar *et al.* 2016; Traoré *et al.* 2017).

Black Bengal goats are only recognized native goat breed in Bangladesh which are commonly reared under natural grazing condition throughout the country (Faruque 2009; Omar *et al.* 2016). Many investigators reported that heavy rainfall with high relative humidity, lower the resistance of host and favors to establish the parasite eggs and larvae resulting in heavy infection of animal (Dutta *et al.* 2017; Jena *et al.* 2018; Prakash *et al.* 2018). The

Table 5. Status of effects of *Haemonchus contortus* on pack cell volume (PCV), Hemoglobin (Hg) and Bodyweight in Black Bengal goats

Parameter		Positive Samples	PCV (%)	Hg (g/dl)	Bodyweight (kg)
Sex					
	Male (397)	180	27.03±0.27	7.68±0.08	14.68±0.52
	Female (500)	242	26.82±0.22	7.56±0.09	15.47±0.55
			*	NS	*
Age (Month)					
	4 to 7 (335)	155	26.82±0.26	7.73±0.08	8.73±0.16
	>7 to 12 (193)	87	26.30±0.27	7.57±0.09	14.51±0.34
	> 12 (369)	180	26.59±0.25	7.64±0.08	21.76±0.34
			NS	NS	**
Breed					
	BBW (376)	170	26.99±0.22	7.55±0.08	14.18±0.52
	BBHH (195)	65	26.18±0.21	7.24±0.21	16.25±0.49
	BBHL(142)	108	26.56±0.34	8.20±0.08	15.62±0.50
	BB Cross (184)	79	26.15±0.24	7.47±0.07	17.57±0.57
			NS	***	**
Region					
	Plain (560)	173	27.35±0.20	7.71±0.08	13.99±0.51
	Hilly (337)	249	26.42±0.29	7.84±0.09	15.85±0.49
			NS	**	NS

Note: PCV= Pack cell volume; Hg= Haemoglobin; NS= Non significant; *P<0.05, **P<0.01, ***P<0.001

present study identified different GI parasite species in goat and the highest prevalence (55.2%) was determined for *Eimeria* spp, there are similar findings reported by previous reporters (Shija *et al.* 2014; Zvinorova *et al.* 2016; Singh *et al.* 2017). *Eimeria* spp is a protozoan parasite that results in coccidiosis of small and large intestines of a host. The infection of predominant nematode species *Haemonchus contortus* is common for all the population of goats and the prevalence was found comparatively higher in our study area that also supports our previous report (Omar *et al.* 2016). The prevalence of other parasites infection was light, indicating the presence of infection but not severe that may affect the production of goats. The variation of prevalence findings could be due to different ecological and climatic conditions, sample size and utilized technique, management practices and anthelmintic used along with existing host range (Zajac 2006; Ahmed *et al.* 2017). Goats were infected by different species of parasites with various degrees of infection.

In the present study, prevalence of GI parasites was higher in female goats in comparison to males and this finding also similar with previous investigations (Islam *et al.* 2017; Rizwan *et al.* 2017; Jena *et al.* 2018) but the FEC was observed significantly higher (P<0.01) in male goats compared to female goats. This finding indicates that host sex was an important factor that influences the GI parasitic infection. Age wise GI infection rate of parasites infection showed higher prevalence at >12 months compare to 4 to 7 months and >7 to 12 months. Hassan *et al.* 2011, observed similar results that goats with >24 months were more infected by parasites than aged <24 months. This might be due to those adult animals (>24 months) are frequently come in contact with parasites (free-living stage of the parasite) during grazing on pasture in compared to young. In this study periods, overall infection among the different goat population, BBHL goat population showed higher prevalence with higher FEC compare to that of BBHH, BBW and BB cross population. However, BBHL and BBHH both are morphologically BBH (Black Bengal Hilly) population of Black Bengal goats and distributed in low land and high land respectively. Still, BBHH were showed the lowest FEC among the goat population that is agreement with previous finding (Omar *et al.* 2016). This is might be influenced by an environmental factor as well as the genetic factor. The parasitic load (FEC) was more in the low land of the hilly area than that of high land. The cause might be due to efficiently contamination of postural land by different livestock species rearing together and sheading their contaminated feces within a limitation area that could be a source of the high load of parasite infection. Whereas, in the high land of a hilly area, most goats are moving free with their low density of livestock species and postural sources. The current study explores the significant difference of parasitic load among different years in a term as FEC. The highest prevalence with lowest FEC and lowest prevalence with the highest FEC was in 2015 and 2016

Table 6. FEC, PCV, Hg and Bodyweight of *Haemonchus contortus* infection in Black Bengal goats based on the year.

Parameter	Positive (Prevalence, %)	FEC	TFEC	PCV (%)	Hg (g/dl)	Bodyweight (kg)
		Mean ± SE				
Year						
2014	134 (43.4)	345.90±28.02	2.44±0.02	26.36±0.20	7.62±0.08	14.78±0.51
2015	148 (51.7)	258.65±28.86	2.28±0.03	27.65±0.21	7.58±0.08	14.68±0.54
2016	140 (46.9)	466.07±34.86	2.53±0.03	25.73±0.33	7.77±0.09	17.05±0.53
		***	***	***	NS	**

Note: FEC= Fecal egg count; TFEC= Log10 transform fecal egg count; PCV= Pack cell volume; Hg= Hemoglobin;** P<0.01, *** P<0.001; NS= Non Significant

respectively. This difference in prevalence and parasitic load of GI parasites might be due to genetic variation among population, geographical location, climatic variability, seasonal variation, standard of management, grazing habits (e.g. combined grazing of male, female young and adult animals) and control measures by the use of anthelmintic in animals (Rizwan *et al.* 2017).

Among the GI parasites, *Haemonchus contortus* being the major concern of small ruminants worldwide (Raza *et al.* 2014; Omar *et al.* 2016). This parasite become higher prevalent could be due to its high fecundity mature females are capable to laying several thousands of eggs per day, lead to rapid contamination of pasture and ability to grow resistance to anthelmintic resulting to outbreaks of haemonchosis (Roeber *et al.* 2013; Kotze & Prichard 2016) which lead a serious problem in controlling of animals. In this study, the highest prevalence was observed in *Haemonchus contortus* among the nematode species but this is lower than previous findings (Nahar *et al.* 2012; Nuruzzaman *et al.* 2012) who reported 58% and 57.8% prevalence of *Haemonchus contortus* infection in Black Bengal Goat in Thakurgaon district (Northern part) in Bangladesh, respectively but higher in that reported by (Hassan *et al.* 2011). This difference might be due to variation in sample size environmental conditions of the study area and management system of animals.

Higher prevalence (48.4%) was recorded in female goats for *Haemonchus contortus* infection compared to male goats. Several researchers have also observed a higher prevalence of *Haemonchus contortus* infection in females than male goats (Kakar *et al.* 2013; AL-Hasnawy 2014; Dutta *et al.* 2017; Mushonga *et al.* 2018) in different parts of the world. These findings were also supported by Shahiduzzaman *et al.* 2003 and Nahar *et al.* 2012, who reported a similar result in Black Bengal goat in the Rajshahi district (western part) and Mymensingh (central part) of Bangladesh. Vanimisetti *et al.* 2004, reported that high stress due to reproductive events such as during pregnancy, lactation post parturient period help to establish parasitic infection. These physiological stresses of female animals usually reducing their immunity to infection. Also, the lactating female usually after parturition becomes malnourished which makes the animal more susceptible. Few researchers (Shahadat *et al.* 2003; Nuruzzaman *et al.* 2012) report contrary results where males showed a higher prevalence than the female goat.

In this study, it was found that adults (age >12 months) were more prone to haemonchosis than young (age <12 months). Dutta *et al.* 2017, also report that adult goats above 9 months of aged showed higher prevalence of *H. contortus* than young goats below 9 months. Nahar *et al.* 2012 and Nuruzzaman *et al.* 2012, found dissimilarity from present findings in Rajshahi (western part) and Thakurgaon (northern part) of Bangladesh. More parasite infection in an adult can be explained that adults might be due to grazing on a large area of pasture being contaminated with various parasites.

Among the different populations of Black Bengal goat, the BBHL population showed the highest prevalence and also mean egg count. This result is not agreement with the previous finding reported by Omar *et al.* (2016), samples were collected either on single pollution of goat rearing on the high land of the hilly region (BBHH population) and results were similar with the current study. This is the first time; the samples were collected from the goats of the lower region of the hilly area (BBHL) and compare the susceptibility of nematode infection, particularly *Haemonchus contortus* with the BBHH population. This result demonstrated that goats of the lower region of the hilly area are more susceptible to GI parasitic infection compare to that of the upper area. This difference might be due to environmental factors such as ecological variation, the management system of different livestock species, feeding behavior, and genetic variation. The results of the present study regarding the mean of FEC for BBW and BB cross population in this study also supported the previous findings reported by Nahar *et al.* 2012 and Omar *et al.* 2016. Among different goat population, FEC showed significantly differ ($P<$ 0.05), that indicate goat population is an important factor that influences the *Haemonchus contortus* infection in goat. Hg and body weight were significantly different among the goat population.

Regarding on region, our results showed that goats in the hilly area exposed higher prevalence with comparatively lower FEC than that of a plain area where the incidence was low but FEC was high. This variation is not similar to previous reports by Hassan *et al.* 2011 and Omar *et al.* 2016, and the cause of this difference might be due to the study of the new population (BBHL) that is highly susceptible for parasites infection and could be a good point of the study. As far as a different breed was concerned Hg (P<0.001) and BW (P<0.01) showed significantly differ and the mean value of Hg observed as significantly differ between plain and hilly region. Regions have no significant effect on the occurrence of *Haemonchus contortus* infection in goat. Hemoglobin (Hg) showed significant differs between the two regions. These differences could be responsible for genetic variations and natural resistance among different breeds of goats and some extent factors like geography, climate, grazing habits, management, and use of anthelmintic, high stocking density, leading to more contamination and spread on pasture with parasite egg.

Regarding the year, variation was observed in case of prevalence, mean egg count, PCV, Hg and body weight of animals. Among 2014, 2015 and 2016 years, the difference of the mean of FEC and PCV values were found to be highly significant (P<0.001) but mean value of Hg was not significant whereas the bodyweight of goats among different years was recorded and found differ significantly (P<0.01). Although samples were collected at the same month of each year after the rainy season when the parasite infection, especially *Haemonchus contortus* become sever, this variation in the findings of the study may be due to different climatic condition (relative humidity and total rainfall), differences sample size, breed variation of the study area. Enyenhi *et al.* 1975, also reported that optimal environmental conditions (hot and humid climates) are conducive to the growth and development of parasites.

Conclusion

The results of present study demonstrated that some host factor such as sex, population of goat and year/ season might be significant factors that influence the prevalence rate of gastrointestinal parasite infection and help in better understanding of parasitic control in goats and emphasize on essential based planning of GI parasite control management aimed at ensuring better production.

Competing Interests

The authors have declared that they have no competing interests exist.

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