Eurasian Journal
of Veterinary Sciences

www.eurasianjvetsci.org

RESEARCH ARTICLE

Factors affecting endoparasitic infections and ectoparasitic infestations of buffaloes in Mymensingh, Bangladesh

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Received:17.11.2021, Accepted: 21.11.2022
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Bangladeş, Mymensingh bölgesindeki mandaların endoparaziter ve ektoparaziter enfeksiyonlarını etkileyen faktörler

Eurasian J Vet Sci, 2022, 38, 4, 260-269
DOI: 10.15312/EurasianJVetSci.2022.391

Öz

Amaç: Mandalar, süt ve et talebinin artmasına katkıda bulunurlar. Bununla birlikte, paraziter hastalıkların varlığı, karlı bir hayvancılık üretimi için en büyük tehditlerden biridir. Bu çalışmada, Trishal Mymensingh bölgesindeki mandaların endoparazitik enfeksiyon ve ektoparazitik enfestasyonlarının prevalansını ve ilişkili faktörleri belirlenmeye çalışılmıştır.

Gereç ve Yöntem: Endoparazitlerin tanımlanmasında Modifiye Stoll dilüsyon tekniği kullanılmış ve ektoparazitlere yönelik kalıcı lamlar hazırlanmıştır.

Bulgular: Yedi tür gastrointestinal (GI) parazit (ova/kist/ookist) tanımlandı, bunlardan ikisi trematod, *Paramphistomum cervi* (%28,7), *Fasciola gigantica* (%16,0); Strongyles (%1.3), *Trichuris* spp. (%2,0); bir tür cestod, *Moniezia* sp. (%0,7) ve iki protozoa türü, *Balantidium coli* (%44,0) ve *Eimeria* spp. (%4,7) olarak belirlendi. Aynı zamanda enfeksiyonun yoğunluğu (EPG/OPG/CPG) da belirlendi. EPG/OPG/CPG aralığının parazitler arasında 100 ila 1500 arasında değiştiği gözlendi. Ortalama EPG/OPG/CPG sayısı 252±54,4'tü. GI parazit prevalansı 5 yaşından büyük mandalarda (%80.0), 2-5 yaşındaki genç bufalolara (%42.2) göre anlamlı derecede ($p<0.05$) daha yüksek bulunmuştur. Bu çalışma sırasında mandaların %53,3'ü R*hipicephalus (Boophilus) microplus* (%13,3) ve *Haematopinus tuberculatus* (%52,7) ile enfekte olmuştur. Ortalama parazit yükü de 4,7±2,9 olarak belirlenmiştir.

Öneri: Konağın yaşı, endoparaziter enfeksiyonlar ile anlamlı bir şekilde ilişkiliydi, ancak mandaların yaşı ve cinsiyetinin ektoparaziter istilalar üzerinde önemli bir etkisi bulunamamıştır. Bu çalışma, mandalarda paraziter enfeksiyon ve parazit istilası kontrolüne dikkat edilmesi gerektiğini düşündürmektedir.

Anahtar kelimeler: Faktörler, prevalans, endoparazitler, ektoparazitler, mandalar

Abstract

Aim: Buffaloes contribute in increasing demand for milk and meat. However, parasitism is one of the major threats for profitable livestock production. To do this, we attempted to determine the prevalence and associated factors of endoparasitic infections and ectoparasitic infestations of buffaloes at Trishal, Mymensingh.

Materials and Methods: Modified Stoll's dilution technique was employed for the identification of developmental stages of endoparasites and prepared permanent slides for ectoparasites.

Results: A total of 150 buffaloes were examined, of which 103 (68.7%), were infected with one or more species of endoparasites. Seven species of gastrointestinal (GI) parasites (ova/cyst/oocyst) were identified, of them two species were trematodes, *Paramphistomum cervi* (28.7%), *Fasciola gigantica* (16.0%); two species were nematodes namely strongyles (1.3%), *Trichuris* spp. (2.0%); one species of cestode, *Moniezia* sp. (0.7%) and two species of protozoa namely, *Balantidium coli* (44.0%) and *Eimeria* spp. (4.7%). The intensity of infection (EPG/OPG/CPG) was also determined. The range of EPG/OPG/CPG varied among the parasites from 100 to 1500. Mean EPG/OPG/CPG count was 252±54.4. The prevalence of GI parasites was significantly ($p<0.05$) higher in adult buffaloes (80.0%) aged >5 years than in young buffaloes aged 2-5 years (42.2%). During this study, 53.3% of buffaloes were infested with *Rhipicephalus (Boophilus) microplus* (13.3%) and *Haematopinus tuberculatus* (52.7%). The mean parasitic burden of ectoparasites was also determined (4.7±2.9).

Conclusion: Age of host was significantly associated with endoparasitic infections but age and sex of buffaloes had no significant effect on the ectoparasitic infestations. The present study suggested that an attention should be given to control parasitic infections and infestations in buffaloes.

Keywords: Factors, prevalence, endoparasites, ectoparasites, buffaloes

Introduction

Bangladesh is an agricultural country, and livestock sector is an important part of agriculture. Buffalo (*Bubalus bubalis*) is one of the important species of domestic livestock that contribute to improve the socio-economic status of household farmers of this country by providing nutrition and cash income. Approximately 194.29 million buffaloes are available over 42 countries and about 92.5% of the total buffaloes are found in Asia. Within Asia, only 8.4% of buffaloes are reared in South-East Asia (Habib et al 2017). According to the South Asian Association for Regional Cooperation (SAARC) statistics (2016), the total buffalo population of Bangladesh is 1.457 million (Hamid et al 2016). In general, the water buffalo is considered as more productive, healthier, and more useful than cow, and plays a vital role in poverty alleviation of resource-poor and privilege-deprived people. Buffaloes are multipurpose farm animals, contributing significantly to meat and milk production (Bachal et al 2002). But the efficient and profitable production performance of buffaloes is greatly affected by different factors. Among them, parasitic infections are of great importance.

Different species of gastro-intestinal (GI) parasites such as trematodes (*Fasciola, Paramphistomum, Schistosoma*); nematodes (*Haemonchus, Toxocara, Trichuris, Strongyloides, Capillaria*), cestode (*Moniezia*), and protozoa (*Eimeria and Buxtonella*) are available in Bangladesh and responsible for the severe damage for buffalo production (Biswas et al 2014, Dey et al 2022, Roy et al 2016). The problem due to parasitic infection is ignored due to its chronic and insidious nature (Sanyal 1998). The prevalence and severity of parasitic infections vary considerably depending on the geo-climatic condition such as temperature, humidity, rainfall, vegetation, and management practices. The geo-climatic conditions of Bangladesh favor the development and survival of free living stage of parasites (Dey et al 2020). GI parasitism has great impact in dairy and beef buffalo production in all buffalo breeding countries. The economic losses due to parasitism are in the form of reduced growth, decreased output of work, loss of productivity including milk, meat and reproductive capacity, and cost due to treatment and by employing control strategy (Chaudary et al 2007, Odoi et al 2007, Pedreira et al 2006). Among the parasites, ectoparasites including ticks, namely, *Rhipicephalus (Boophilus) microplus*, *Haemaphysalis bispinosa* and louse, namely, *Haematopinus tuberculatus* are distributed worldwide. They comprise a major veterinary problem because they transmit different viral, bacterial, parasitic, and rickettsial diseases, induce paralysis or toxicosis and cause physical damage to buffaloes (Mamun et al 2010, Rajput et al 2005).

Globally, ticks and tick-borne diseases (TTBDs) have been considered as a main cause of production loss predominantly in tropical and subtropical countries of the world (Okal et al 2020). The annual financial loss caused by ticks and TBDs is estimated as US $14-19 billion (Jabbar et al 2015). Along with tick infestation, lice also have a great impact on buffalo health. Lice infestations in animals develop an unthrifty, anemic condition, discolored greasy hair followed by damage to skin and hide and also transmit different diseases (Nafstad and Gronstol 2001). Though buffalo is an important part of livestock in Bangladesh, there is no noticeable documented research studies so far that investigated the scenario of parasitic infestations in buffaloes in this area. Therefore, the present study was undertaken to determine the prevalence and associated factors of endoparasitic infections and ectoparasitic infestations of buffaloes at Trishal, Mymensingh.

Material and Methods

Study period

The study was carried out during the period from January to December 2020.

Study area

Samples were collected from the different areas of Trishal, Mymensingh. Laboratory works were conducted in the department of Parasitology, Bangladesh Agricultural University, Mymensingh.

Sample size

Approximately, the total buffalo population in the study area was 50,000. The sample size for the population survey was calculated by using the *Statcalc* function of EpiInfo v.7.2.3.1 (CDC, Atlanta, USA). Having the expected proportion of 62.0% (Mamun et al 2011, Mamun et al 2010) and 10% margin of error, the estimated sample size was 155 at a confidence level of 95%. A non-response rate of 10% was considered, and thus a total of 172 buffaloes were selected by using disproportionate stratified random sampling. However, the final selection was based on the household owner's willingness to cooperate. Twenty-two owners declined, and therefore, 150 buffaloes were included in the study.

Collection of fecal samples

During collection of samples, age and sex were recorded carefully. The ages of the buffaloes were categorized as young (animals aged with 2-5 years) and adult (animals aged with more than 5 years). The age of buffaloes was determined by the eruption chart of teeth and by interviewing with the farmers. After taking all relevant information such as age and sex, the fecal samples were collected directly from the

rectum of the animals. Before collection, the animals were restrained properly and all possible hygienic measures including the wearing of apron and hand gloves were taken to avoid contamination. Freshly voided fecal samples were also collected from the ground. About 20-25 g of feces were collected from each buffalo. Each sample was kept in a separate zipper bag, labeled correctly, numbered properly with all required information, and brought to the laboratory.

Collection and preservation of ectoparasites

The selected buffaloes were thoroughly investigated by close inspection for the detection of ectoparasites and clinical manifestations relevant to ectoparasitic infestations. Ticks and lice were collected from the different parts of the body of the individual buffalo by hand picking. When required, a small hair brush dipped in ethanol was used for the collection of ticks. The point of attachment was smeared with ethanol. Adequate precautions were taken to preserve the mouth parts and appendages of the ectoparasites during collection. Ectoparasites were preserved in 70% ethanol in clean, well-stopped glass vials and labeled properly.

Examination of fecal samples

The fecal samples were examined by Modified Stoll's Dilution Technique as described previously (Thienpont et al 1986). Briefly, three grams of fecal samples were weighed and taken into a beaker with 42 ml of 0.1% NaOH. A homogenous mixture was prepared and strained through a series of sieves (400, 100, and 45 mm) to remove coarse particles. After stirring the sediment, 0.15 ml suspension was taken on a glass slide, covered with a gridding slide (22X40 mm gridding area), and examined under a compound microscope using 10X objective. Each sample was examined in triplicates. Eggs were identified according to the keys and descriptions given by Soulsby (1982) and Thienpont et al (1986). The number of eggs in a sample was multiplied by 100 to estimate the number of eggs per gram of feces.

Identification of ectoparasites

Collected ectoparasites were processed for permanent mounting using methods suggested by Cable (1967). Ticks and lice were identified following the characteristics described by Walker (2003).

Statistical analysis

Statistical analyses were carried out by Statistical Package for Social Science (SPSS) using F test. To compare the prevalence of parasites in both sexes, data were analyzed by using paired sample t-test (Mostafa 1989). Odds ratio was calculated according to the formula given by Schlesselman (1982).

Results

In the present study, a total of 150 buffaloes were examined through fecal sample examination, of which 103 (68.7%), were found to be infected with one or more species of endoparasites. A total of seven species of GI parasites (egg/cyst/oocyst) were identified, of them two species were trematodes, namely, *Paramphistomum cervi* (28.7%), *Fasciola gigantica* (16.0%); two species were nematodes namely strongyles (1.3%), *Trichuris* spp. (2.0%); one species of cestode such as *Moniezia* sp. (0.7%) and two species of protozoa namely, *Balantidium coli* (44.0%) and *Eimeria* spp. (4.7%). Among the identified species, prevalence of *Balantidium coli* (44.0%) was the highest whereas *Moniezia* sp. (0.7%) was the least (Figure l). The intensity of infection (EPG, Egg per gram of feces) was also determined and varied among the parasites from 100 to 1500. Mean EPG count was also highest in case of *B. coli* (353.02±18.3) followed by *F. gigantica* (183.33±57.9), *P. cervi* (176.74±50.5), *Trichuris* spp. (133.33±57.3) and *Eimeria* spp. (114.29±37.8). A low parasitic burden (100±0) was found in case of both *Moniezia* spp. and strongyles (Figure 2).

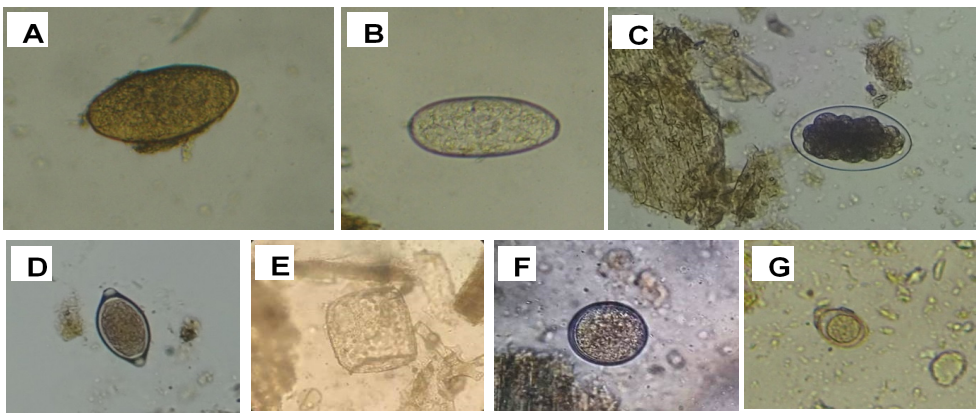

Figure 1. Egg, cyst and oocyt detected in the study. The identified parasites were egg of *Paramphistomum cervi* (A), egg of *Fasciola gigantica* (B), egg of strongyle (C), egg of *Trichuris* spp. (D), egg of *Moniezia* spp., (E), cyst of *Balantidium coli* (F) and oocyst of *Eimeria* spp. (G)

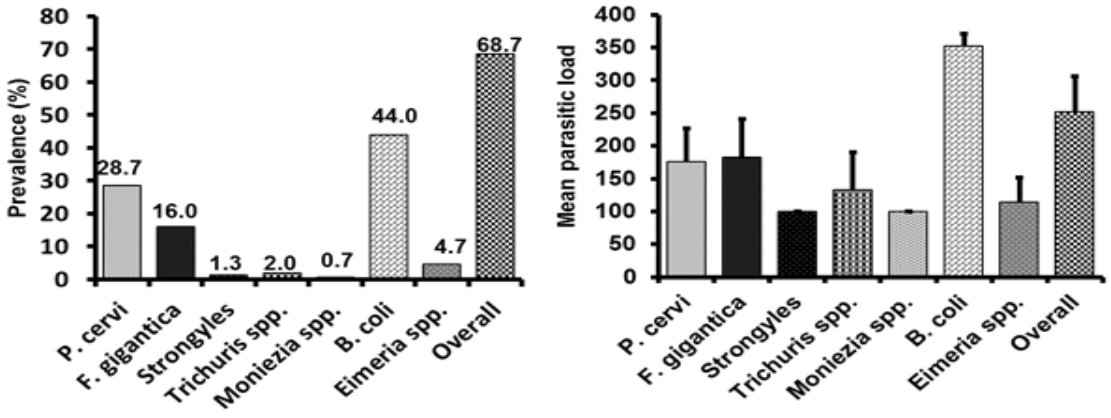

Figure 2. Overall prevalence and mean EPG/CPG/OPG of endoparasites in buffaloes

The prevalence of GI parasites was significantly ($p<0.05$) higher in adult buffaloes (80.0%) aged >5 years than in young buffaloes aged 2-5 years (42.2%). Calculated odds ratio implied that older animals were 4.37 (95% CI, 2.08-9.20) times more susceptible to infections than young animals. *B. coli* possessed the highest infections in both age groups. *Moniezia* spp. was recorded only in adult animals (Table 1).

In this study, it was revealed that male buffaloes (74.4%) were more prone to endoparasitic infections than females (60.0%), and it was not statistically significant ($p>0.05$). Males were 1.92 (0.9-3.91) times more vulnerable to GI parasitic infections than females. In both sexes, the prevalence was the highest in case of *Paramphistomum cervi*, *B. coli* and *F. gigantica* (Table 2).

Table 1. Age-related prevalence of endoparasites of buffaloes at Trishal Upazila, Mymensingh

Age of animals	Name of parasites	No. of animals affected	Percentage (%)	EPG/CPG/OPG		Odds ratio (95% CI)
				Range	Mean±SE	
Young buffalo (N=45)	*Paramphistomum cervi*	10	22.2	100-1000	171.4±48.8	Adult vs young = 4.37 (2.08-9.20)
	Fasciola gigantica	7	15.6	100-700	350.0±38.7	
	Strongyles	1	2.2	100-100	100.0±0.0	
	Trichuris spp.	1	2.2	100-200	200.0±0.0	
	Balantidium coli	18	40.0	100-1500	387.5±66.7	
	Eimeria spp.	2	4.4	100-200	150.0±70.7	
	Sub total*	19*	42.2	100-1500	303.3±96.5	
Adult buffalo 0 (N=105)	*Paramphistomum cervi*	33	31.4	100-1000	175.0±64.7	
	Fasciola gigantica	17	16.2	100-700	152.9±33.4	
	Strongyles	1	0.9	100-100	100.0±0.0	
	Trichuris spp.	2	1.9	100-200	100.0±0.0	
	Moniezia spp	1	0.9	100-100	100.0±0.0	
	Balantidium coli	48	45.7	100-1500	349.0±45.5	
	Eimeria spp.	5	4.7	100-200	100.0±0.0	
	Sub total*	84*	80.0	100-1500	257.0±61.1	
		p value =0.0001				

N, Total No. of animals examined

EPG/CPG/OPG, egg per gram/ cyst per gram/ oocyst per gram of feces, SE: Standard error

*, Total no. of animals affected is less than the summation of individual infections because same animal was infested by more than one type of endoparasites, CI, Confidence interval

Table 2. Sex-related prevalence of endoparasites of buffaloes at Trishal Upazila, Mymensingh

Sex of animals	Name of parasites	No. of animals affected	Prevalence (%)	EPG/CPG/OPG		Odds ratio (95% CI)
				Range	Mean±SE	
Male (N=90)	*Paramphistomum cervi*	27	30.0	100-1000	164.2±90.7	Male vs Female = 1.94 (0.9-3.91)
	Fasciola gigantica	11	12.0	100-700	209.1±50.5	
	Strongyles	2	2.2	100-100	100.0±0.0	
	Trichuris spp.	2	2.2	100-200	150.0±70. 7	
	Balantidium coli	38	42.2	100-1500	328.9±48.3	
	Eimeria spp.	5	5.5	100-200	120.0±44.7	
	Sub total*	67*	74.4	100-1500	235.2±98.3	
Female N=60	*Paramphistomum cervi*	16	26.6	100-1000	187.5±24.7	
	Fasciola gigantica	13	21.6	100-700	161.5±71.2	
	Trichuris spp.	1	1.6	100-100	100.0±0.0	
	Moniezia spp.	1	1.6	100-100	100.0±0.0	
	Balantidium. coli	28	46.6	100-1500	385.7±99.0	
	Eimeria spp.	2	3.3	100-200	100.0±0.0	
	Sub total*	36*	60.0	100-1500	258.7±21.8	
	P value=0.09					

N, Total animals examined

EPG/CPG/OPG, egg per gram/ cyst per gram/ oocyst per gram of feces, SE: Standard error

*, Total no. of animals affected is less than the summation of individual infections because same animal was infected with more than one type of endoparasites, CI, Confidence interval

During this study, a total of 150 buffaloes were examined, of which 81 were found to be infested with one or more species of ectoparasites with an overall prevalence was 53.3%. Two species of ectoparasites were identified include of which one species was arachnid namely *Rhipicephalus microplus* (13.3%) and one species was insect namely *Haematopinus tuberculatus* (52.7%) (Figure 3). Mean parasitic burden of ectoparasites was also calculated. The range of parasitic burden in the case of *H. tuberculatus* was 1-10 per square inch of the heavily infested area followed by that of *Rh. microplus* (1-3 per square). Mean parasitic burden was also higher in *H. tuberculatus* (5.8±2.4) infestations than followed by that of *Rh. microplus* (1.4±0.6) (Figure 4).

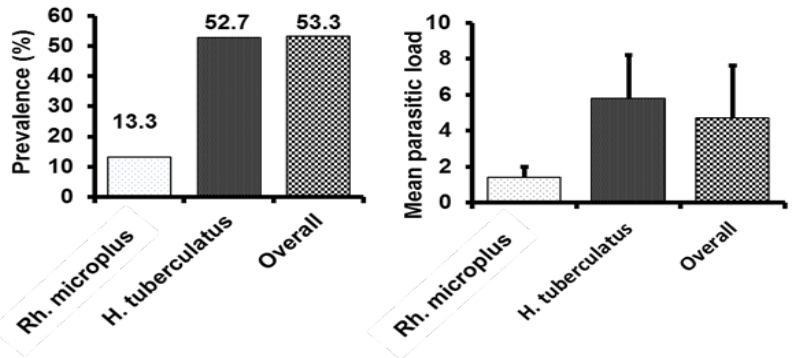

Figure 3. Overall prevalence and mean parasitic load of ectoparasites in buffaloes

Figure 4. The identified ectoparasites *Rhipicephalus microplus* (A) and *Haematopinus tuberculatus* (B).

Table 3. Prevalence of ectoparasites according to age of buffaloes at Trishal Upazila, Mymensingh

Age of animals	Name of parasites recovered	No. of animals affected	Prevalence (%)	Parasitic load		Odds ratio (95% CI)
				Range	Mean±SE	
Young buffalo (N=45)	*Rhipicephalus microplus*	4	8.9	1-3	1.5±0.6	Adult vs young= 1.09 (0.51-2.29)
	Haematopinus tuberculatus	30	66.7	1-10	5.1±2.8	
	Sub total*	30	66.7	1-10	4.6±2.9	
Adult buffalo (N=105)	*Rhipicephalus microplus*	16	15.2	1-3	1.4±0.6	
	Haematopinus tuberculatus	59	56.2	1-10	6.1±2.2	
	Sub total*	72	68.6	1-10	5.1±2.8	
p value = 1.00						

N, Total No. of animals examined

*, Total no. of animals affected is less than the summation of individual infestation because same animal was infested by more than one type of ectoparasites

SE, Standard error, CI, Confidence interval

Table 4. Prevalence of ectoparasites according to sex of buffaloes at Trishal Upazila, Mymensingh

Sex of animal	Name of parasites	No. of animals affected	Prevalence (%)	Parasitic load		Odds ratio (95% CI)
				Range	Mean±SE	
Male (N=90)	*Rhipicephalus microplus*	11	12.2	1-3	1.2±0.4	Male vs Female = 1.16 (0.6-2.25)
	Haematopinus tuberculatus	47	52.2	1-10	5.9±2.4	
	Subtotal*	50	55.5	1-10	3.4±2.8	
Female (N=60)	*Rhipicephalus microplus*	9	15.0	1-3	1.6±1.3	
	Haematopinus tuberculatus	28	46.7	1-10	2.9±1.6	
	Subtotal*	31	51.7	1-10	2.9±2.7	
P value= 0.76						

N, Total No. of animals examined

*, Total no. of animals affected is less than the summation of individual infestation because same animal was infested with by more than one type of ectoparasites, SE, Standard error, CI, Confidence Interval

According to age, ectoparasitic infestations were slightly more in adult buffaloes (68.6%) than young buffaloes (66.7%), and it was not statistically significant (p>0.05). The calculated odds ratio revealed that adult animals were 1.09 times more susceptible to ectoparasitic infestations than young animals. *H. tuberculatus* was prevalent in both age groups (Table 3).

From this study, it was revealed that the prevalence of ectoparasites was insignificantly (p>0.05) higher in male buffaloes (55.6%) than in female buffaloes (51.7%). The chance of ectoparasitic infestations was 1.16 times more in male buffaloes than in female buffaloes (Table 4).

Discussion

Buffalo is an important element in agricultural production of Asia, Mediterranean and African countries (Barakat and Alhimaidi 2012). World buffalo production is constantly increasing in the regions with hot and humid climate. Buffalo milk contributes 12.75% in world milk production (Pasha and Hayat 2012). The other products such as bones, skins and goods made from their fetch are of great importance. Hence, parasites are of potential health hazard to the buffalo population and produce massive economic losses (Blood et al 1990).

In the present study, 68.7% of buffaloes were infected with one or more species of endoparasites. The result is higher than Mamun et al (2011) and Azam et al (2002) who reported that 61.02% and 64.41% of the buffaloes were positive for GI parasites in Kurigram district, Bangladesh and Pakistan, respectively. However, the prevalence was lower than Biswas et al (2014) and Roy et al (2016) who reported 84.9% and 100% infection in buffalo in Bhola and Bagerhat of Bangladesh, respectively. The difference in prevalence among various studies might be due to environmental factors including flora, fauna, breeding method, animal management practices, level of education, the economic capacity of farmers, anthelmintic use, and availability of intermediate hosts (Raza et al 2007). In Bhola and Bagerhat, animals are reared by extensive system and due to availability of water source and wallowing nature; buffaloes were mostly infected with different developmental stages of parasites.

In the present study, the prevalence of *Paramphistomum* and *Fasciola* in buffaloes was 28.7% and 16.0%, respectively. These prevalences were much lower than Biswas et al (2014) (41.4%, 25.4%) in Bhola and Roy et al (2016) (78.4%, 24.4%) in Bagerhat in Bangladesh. The variation in the prevalences of *Paramphistomum* and *Fasciola* depends on the aquatic and semi-aquatic environment including drainage, furrow, slow-moving streams, temporary moist areas, and bank of rivers that are essential components for the vector snail of these parasites to complete their lifecycle.

The mean EPG of *Paramphistomum* and *Fasciola* in buffaloes were 176.7±50.5 and 183.3±57.9, respectively. The present findings are more or less similar with Mamun et al (2011) who reported that the mean EPG of *Paramphistomum* and *Fasciola* in buffaloes were 186.9±119.9 and 201.9±142.2, respectively in Kurigram, Bangladesh. However, the findings are lower than Roy et al (2016) (568.4±17.2, 236.5±17.6) in Bagerhat, Bangladesh. The intensity of infection depends on the prolific nature of adult parasites, availability of vector snails, multiplication rate of developmental stage within the vector snail, management practices, and maintenance of deworming schedule by farmers (Dorchies 2006, Hansen and Perry 1994).

In this study *B. coli* possessed the highest prevalence among the identified GI parasites. *B. coli* is often considered as a neglected pathogen and common in different animals including buffaloes, cattle, sheep, goats and pigs (Dey et al 2021, Dey et al 2014, Islam et al 2017, Paul et al 2019, Roy et al 2016) in Bangladesh due to tropical climatic condition that is suitable for survival, development and reproduction of this protozoa. Moreover, the infective stage of *B. coli* is protected from desiccation and other environmental stress due to its thickened wall (Schuster and Ramirez-Avila 2008) and can survive in the environment for a long period.

The present findings revealed that the prevalence of GI parasitic infection in adult buffaloes was higher than those in young buffaloes. This finding is in accordance with previous studies (Biswas et al 2014, Yadav et al 2004). However, it is inconsistent with other researchers (Mamun et al 2011, Raza et al 2007) who reported a higher prevalence of helminth infections in younger buffaloes. The variation might be due to an exhausted immune system, or different grazing areas and management practices for the animals.

Interestingly, it is noted that the prevalence of GI parasitic infections was higher in males compared to female buffaloes. This result is not in line with the previous findings of Bachal et al (2002) and Biswas et al (2014) who reported higher prevalences of helminths infection in females (48.30% and 87.53%) than in males (45.12% and 84.37%), respectively. Normally, females are assumed to be more heavily infected due to stress during pregnancy and parturition (Lioyd 1983). According to Roy et al (2016) and Maqbool et al (2002), there is no sex variation in endoparasitic infections in buffaloes. Therefore, it is difficult to explain the exact cause of host-sex differences on GI parasitic infections in buffaloes.

In the present study, we noticed that more than half of the buffaloes were infested with different species of ectoparasites. Among them, 52.7% and 13.3% buffaloes were affected by *H. tuberculatus* and *Rh. microplus,* respectively. These findings are in accordance with Mamun et al (2010) who reported 51.27% and 13.98% prevalences in Kurigram

district, Bangladesh. Islam et al (2006) also recorded a 12.5% prevalence of *Rh. microplus* in Bangladesh. However, according to Islam et al (1992), 34.6% of the buffaloes were infested with *H. tuberculatus*. The geo-climatic conditions of Bangladesh are conducive to a wide range of parasites including ticks and lice (Islam et al 2006). The highest concentration of ectoparasites are found around the ears, base of horns, side of the neck, around the scrotum or udder, and especially at the tip of the tail.

From this study, it was revealed that buffaloes of either age group were more or less equally infested with ectoparasites. According to Soomro et al (2014), buffalo calves (35.1%) are more susceptible to ectoparasitic infestations than young (18.0%) and adults (18.1%). Sajid et al (1999) and Manan et al (2007) also reported that age has no significant association with ectoparasitic infestation. The hairy coat of animals, less attention of the farmer, and unhygienic conditions are the predisposing factors for the growth, development, reproduction, and survival of parasites.

From this study, it was revealed that male buffaloes were more prone to ectoparasitic infestations than that of females. Similar findings were also reported by Wasihun and Doda (2013) in Ethiopa and Atif et al (2012) in Punjab, Pakistan. This could be due to strong innate and adaptive (humoral and cellular) immune responses in females compared to males resulting in more parasitic infections in male (Ortona et al 2019). However, the present finding is in contrast with Bilkis et al (2011) and Kabir et al (2011) who noted a higher prevalence rate in female buffaloes. According to Lioyd (1983), high levels of prolactin and progesterone hormone make the female individuals more prone to any infection.

Conclusion

In conclusion, endoparasites and ectoparasites were prevalent in buffaloes. Among the endoparasites, *B. coli* possessed the highest infection rate. Age had significant effects on endoparasitic infections in buffaloes. *Rh. microplus* and *H. tuberculatus* were also common in buffaloes in the study area but they had no significant association on age and sex of buffaloes. Furthermore, an extensive study on epidemiology and molecular aspects should be conducted to develop cost-effective sustainable control strategies against these parasites.

Conflict of Interest

The authors did not report any conflict of interest or financial support.

Funding

The study was funded by Ministry of Science and Technology (Project No.: 2019/40/MoST) of Bangladesh.

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Ethical Approval

Authors maintained highest possible ethical standards in the research works. No animals were harmed or unethically injured or killed. The study was approved by Animal welfare and ethical committee of Bangladesh Agricultural University (AWEEC/BAU/2022(2)).

CITE THIS ARTICLE: *Numan AA, Hoque MR, Siddiqui TR, Alam MZ, Chakraborty M, Dey AR, 2022. Factors affecting endoparasitic infections and ectoparasitic infestations of buffaloes in Mymensingh, Bangladesh. Eurasian J Vet Sci, 38, 4, 260-269*