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RESEARCH ARTICLE

Prevalence and seasonal distribution of haemosporidian parasites in pigeons of Mymensingh and Rangpur districts, Bangladesh

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Bangladeş Mymensingş ve Rangpur ilçelerinin güvercinlerinde hemosporidian parazitlerin prevalansı ve mevsimsel dağılımı

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Öz

Amaç: Bu araştırma, Bangladeş'in iki bölgesinde (Mymensingh ve Rangpur) güvercinlerde haemosporidiyen parazitlerinin durumunu araştırmak için yapıldı.

Gereç ve Yöntem: Toplamda, Ocak-Kasım 2016 tarihleri arasında 300 güvercinin kan örneği incelendi. Kan örnekleri kanat damarından alındı ve bunlardan ince smearlar hazırlandı. Bütün smearlar Giemsa boyası ile boyandı ve mikroskop altında incelendi.

Bulgular: Hemosporidian parazitlerin genel prevalansı, güvercinlerde % 28 (84/300) olarak tespit edilmiştir. Bunlardan % 22.3'ü (67/300) *Haemoproteus* spp.,% 5.7'si (17/300) *Plasmodium* spp., her iki tür ile enfekte olan ise % 2.7 oranında (8/300) bulunmuştur. Prevalans oranı Mymensingh'de % 34.7, Rangpur'da % 24.2 düzeyinde olup, iki ilçe arasındaki fark istatistiksel olarak anlamlı bulunmuştur (p = 0.050). Erkek güvercinler dişilerden, yetişkinlerin de gençlerden enfeksiyona daha duyarlı olduğu tespit edilmiştir. Yağış mevsiminde, yaz ve kış aylarına göre prevalans anlamlı olarak (p = 0.000) daha yüksek bulunmuştur.

Öneri: Bu çalışmayla, Bangladeş'te güvercinlerde sıtmanın yaygın olduğu tespit edilmiştir. Bundan dolayı, Bangladeş'te güvercinlerde daha geniş bir örneklemle ve kuş sıtma türlerinin moleküler karakterizasyonu kapsayan daha ileri araştırmalar yapılabilir.

Anahtar kelimeler: Güvercinler, Sıtma, Prevalans, *Haemoproteus* spp., *Plasmodium* spp.

Abstract

Aim: The present epidemiological investigation was carried out to investigate the status of pigeon haemosporidian parasites in two districts (Mymensingh and Rangpur), Bangladesh.

Materials and Methods: In total, 300 blood samples of pigeons were examined from January to November, 2016. Blood samples were collected from wing vein and thin smears were prepared from them. All smears were stained with Giemsa stain and examined under microscope.

Results: The overall prevalence of haemosporidian parasites was 28% (84 /300) in pigeons. Of those, 22.3% (67/300) of birds were infected with *Haemoproteus* spp., 5.7% with *Plasmodium* spp. (17/300) and 2.7% with both genera (8/300). The prevalence rate was insignificantly (p = 0.050) higher in Mymensingh (34.7%) than in Rangpur (24.2%). Male were more susceptible (30.8%) than female (25.3%). Adults (29.5%) were more prone to infectione than young (19.6 %). The prevalence was significantly (p = 0.000) higher in the rainy season (56.1%) followed by summer (33.8%) and winter (10.0%).

Conclusion: From this study, it was ascertained that avian malaria in pigeons was prevalent in Bangladesh. Therefore, further investigations with a larger sample size and molecular characterization of avian malaria species in pigeons of Bangladesh is warranted.

Keywords: Pigeons, Malaria, Prevalence, *Haemoproteus* spp., *Plasmodium* spp.

Introduction

Pigeons are either reservoir or carrier of various avian malaria species. These parasites significantly prevent pigeon growth, development and productivity, especially in juvenile pigeons (Fatihu et al 1991). Avian haemosporidians include Haemoproteidae, Plasmodiidae, and Leucocytozoidae families, which usually transmitted through blood-sucking dipteran vectors (Valkiunas 2005). Haemosporidia genera of bird (*Plasmodium, Heaemoproteus* and *Leucocytozoon*) share some similar characters with human haemosporidian parasites and all three (but mostly only *Plasmodium* spp.) are referred to as avian malaria (Hellgren et al 2004). But, among them Haemoproteus columbae is widely occurs in pigeons in tropics and subtropics.

Pigeon malaria is usually non-pathogenic, but the age of the bird, strain of the parasite and stress may also play role to increase the harmful effects of blood parasites (Jones 2006). Mortality rate of avian malaria ranges from 50-90 %. Often infected birds are found dead with no premonitory signs (Cannell et al 2013). Liver, spleen, lung, kidneys and gizzards become enlarged owing to haemorrhage as a result of rupture of developmental stage that may develop in all organ and tissues (Morii 1992). In Iran, 50% pigeons are affected by *H. columbae* (Borji et al 2011). According to Ishtiaq et al 2007, prevalence of *Haemoproteus* and *Plasmodium* was 18% and 28% in India whereas in Myanmar it was 40% and 60%, respectively in wild birds. In Nigeria, Karamba et al 2012 recorded 50% prevalence of malaria in pigeons. Few comprehensive studies related to prevalence of haemosporidians have done in domestic and wild/migrating bird in Bangladesh (Dey et al 2010, Islam et al 2013, and Momin et al 2014). But the number of work regarding status or epidemiology of these parasites is very limited.

Pigeons have free and widespread movement in nature and hence they might transmit their parasites to other domestic and wild birds. Therefore, pigeons may contribute to further decline of endangered species of bird by exchanging those parasites. For that reason, it is crucial to know the parasitic spectrum of pigeons.

Considering these points, this study was undertaken to investigate blood parasite specimens from pigeons by using microscope to identify haemosporidian parasites and also to study the prevalence of malaria species in pigeons in relation to age, sex, season and locality.

Materials and Methods

This study was conducted in Rangpur and Mymensingh districts during January to November 2016. Three hundred blood samples were collected from pigeons directly from household of some villages of Rangpur and Mymensingh district. Identification and other study works were performed in the laboratory, Department of Parasitology, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensigh. During collection of blood samples, sex and age of pigeons were recorded according to the owners. According to sex, pigeons were grouped into male and female. They were further divided into young (≤ 6 months) and adult (> 6 months) in accordance with age. Seasons of Bangladesh differentiated into three principal types such as cool- dry winter (November to February), the hot -dry summer (March to June) and hot -wet rainy season (July to October) (Ahmed et al 1989).

Blood samples were collected from the wing vein and thin blood smears were prepared. Blood smears were then dried in room temperature, fixed with absolute acetone free methyl alcohol, stained with Giemsa stain and air dried (Cable 1957). The slides were examined under light microscope in higher magnification (40X and 100X) for the detection of blood protozoa (Zajac and Conboy et al 2012).

Data obtained was analysed using chi-square ($\chi 2$) and z-test through Statistical Package for Social Science (SPSS version 22.0, SPSS Inc., Illinois, USA) to compare the prevalence of haemosporidian parasites in relation to sex, age, locality and seasons of the year. The level of significance was considered as $p<0.05$.

Results

The present study revealed that 28% (84/300) pigeons were infected with one or more species of haemosporidian parasites

Table 1. Prevalence of haemosporidian parasites in pigeons in relation to age and sex

Variables	Protozoa		Total	$\chi 2$ value	p-value
	Haemoproteus spp.	*Plasmodium* spp.			
Overall (300)	67 (22.3%)	17 (5.7%)	84 (28.0%)	-	-
Young (46)	9 (19.6%)	-	9 (19.6%)	1.92	0.167^{NS}
Adult (254)	58 (22.8%)	17 (6.7%)	75 (29.5%)		
Male (146)	36 (24.6)	9 (6.2)	45 (30.8%)	1.12	0.289^{NS}
Female (154)	31 (20.1)	8 (5.2)	39 (25.3%)		

^{NS} not significant ($p > 0.05$)

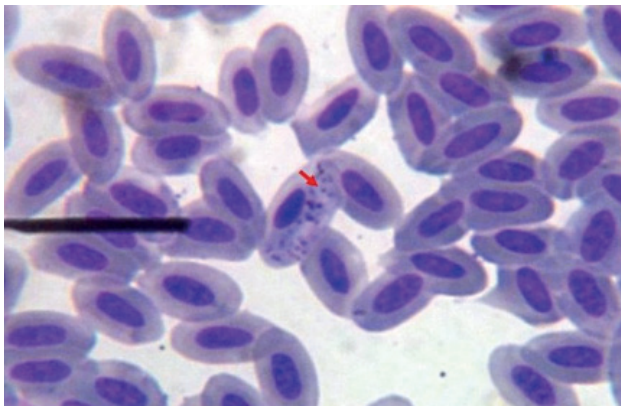

Figure 1a: Developmental stages of *Haemoproteus* spp.

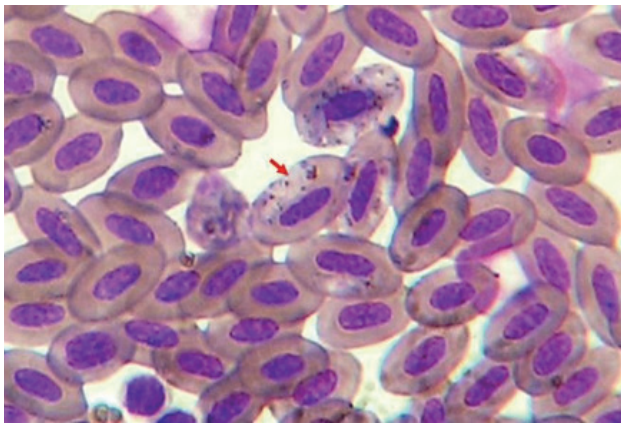

Figure 1b: Developmental stages of *Haemoproteus* spp.

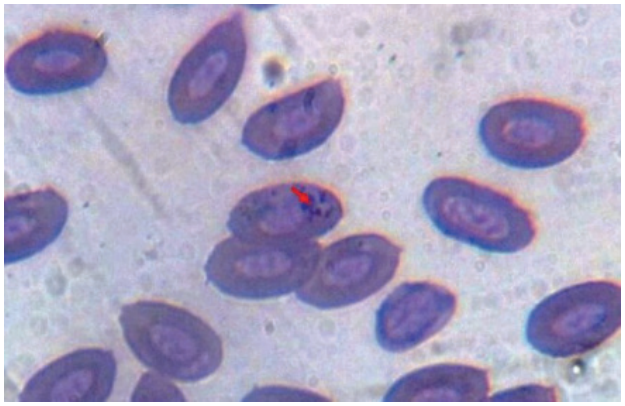

Figure 2a: Developmental stages of *Plasmodium* spp.

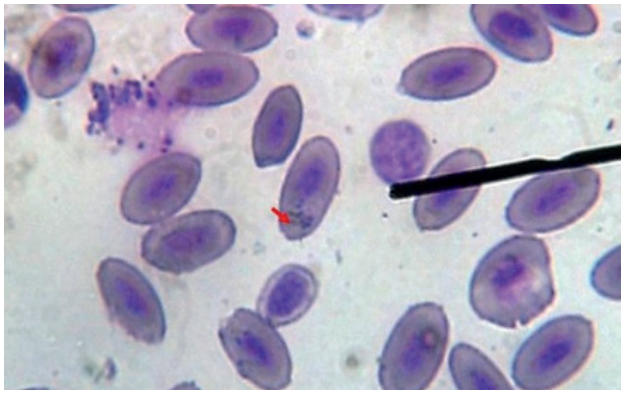

Figure 2b: Developmental stages of *Plasmodium* spp.

in the study areas. The identified protozoa in the current case were *Haemoproteus* spp. (22.3%), and *Plasmodium* spp. (5.7%) (Table 1; Figure 1a, 1b; Figure 2a, 2b). In addition, the rate of mixed infection was 2.7% (8/300). Male pigeons (30.8%) were more prone to infection with haemosporidian parasites than female (25.3%) but it was not statistically significant (p = 0.167). The result showed higher prevalence of haemosporidian parasites in adult (29.5%) than young (19.6%) with no significant difference (p=0.167) (Table 1). Between two localities, higher prevalence was recorded in Mymensingh district (34.7%) in comparison to Rangpur (24.2%), but without significant variations (p = 0.05) (Table 2). The infection rates were also calculated according to different seasons. We found 15 (10.0%), 46 (56.1%) and 23 (33.8%) pigeons were infected with malaria species during winter, rainy and summer season respectively with significant seasonal variations (p = 0.000) (Table 3).

Discussion

The results we obtained in the present case supported by Sehgal et al (2005) in African rainforest birds of Equatorial Guinea and Ivory Coast (28.6%) and Elahi et al (2014) in wetland birds (29.5%) of Bangladesh. Almost similar prevalence was reported by Momin et al (2014) in pigeons at Tangail district in Bangladesh (22.7%) and Ishtiaq et al (2007) in divergent parts of Asia (34.0%). But the variations from the present study were reported by Silva-Iturriza et al (2012) in central Philippine islands (42.0%) and Bennett et al (1991) in Mexico (12.8%). These variations among the present and previous studies may be owing to differences in geographical niches, climatic conditions, breeds of pigeons, management factors, availability of vectors and the method of study.

The prevalence of pgeon malaria species is also different around the globe. However, in line with the current study, more or less alike prevalence rate was observed by Dey et al (2010), Senlik et al (2005) and Raharimanga et al (2002) who recorded 20%, 21% and 19.9% birds were infected with *Haemoproteus columbae* in Mymensingh, Bangladesh, Turkey and Madagascar city, respectively. Meanwhile, Ishtiaq et al (2007) recorded 18% and 28% prevalence for *Haemoproteus* and *Plasmodium* in wild birds of India, but in Myanmar the prevalence rate was 40% and 60%.

On the other hand, Dranzoa et al (1999) and Okanga et al (2013) recorded 29.4% and 27% infection rate with *Plasmodium* parasites in rock pigeons and weavers in Uganda and South Africa, respectively. Nonetheless, Beadell et al (2009) reported that 6.8% (29/428) birds in the Australo-Papuan region were infected with both *Plasmodium* and *Haemoproteus*. This disparity might be owing to the abundance of the intermediate host and management system in the study areas.

In this study, sex related prevalence of pgeon malaria was in line with the findings of O'Dell et al (1994) who also reported higher

Table 2: Locality related prevalence of haemosporidian parasites in pigeons

Protozoa	Rangpur (182)		Mymensingh (118)		χ^2 value	Statistical significance p- value
	n	%	n	%		
Haemoproteus spp.	34	18.7	34	28.8	3.94	
Plasmodium spp.	10	5.5	7	5.9		0.050^{NS}
Total	44	24.2	41	34.7		

^{NS} not significant ($p > 0.05$)

Table 3: Season related prevalence of haemosporidian parasites in pigeons

Protozoa	Winter (150)		Rainy (82)		Summer (68)		χ^2 value	Statistical significance p-value
	n	%	n	%	n	%		
Haemoproteus spp.	14	9.3^a	35	42.7^b	18	26.5^c		
Plasmodium spp.	1	0.7^a	11	13.4^b	5	7.4^c	57.36	0.000**
Total	15	10	46	56.1	23	33.8		

^{NS} not significant ($p > 0.05$)

prevalence in male ducks (19.7%) than female (18.0%) in USA. But the result is contrary with the previous report of Gupta et al (2011) in India who reported higher infestation in female pigeons (62.8%). Higher infection rates in male might occur from variation in life history as the male birds do not incubate or may spend more time for foraging and thereby getting more exposure to vector populations (Calero-Riestra and García 2016). According to the report of Hillgarth and Wingfield (1997), higher level of testosterone (sex associated hormone) make the individual (male) more susceptible to infections.

In case of age related prevalence of pigeons, this study was similar to Msoffe et al (2010) in Tanzania (63% and 11%) and El-Magd et al (1988) in Egypt (60.7% and 20%) in adult and juvenile pigeons, respectively. However, in some studies, higher prevalence was reported in young birds than adults (Van Oers et al 2010; Hudson and Dobson 1997). Higher prevalence in adults may be owing to long time exposure to the vectors. Moreover, another cause might be owing to absence of active transmission of haemosporidian parasites from adult to young (Thul and O'Brien 1990).

Furthermore, Dey et al (2010) reported 44% (33/75) infection rate with blood protozoa in pigeons of Mymensingh district. This variation was due to the abundance of pigeons louse fly (*Pseudolynchia canariensis*) in Mymensingh which acts as intermediate host of the haemosporidian parasites.

Moreover, seasonal prevalence of haemosporidian parasites in pigeons was varied in different weather conditions across different countries. Okanga et al (2013) detected higher prevalence in weaver birds of South Africa during summer season (16.0%) than winter (10.0%) with significant seasonal difference. In India, Gupta et al (2011) recorded highest infectivity of pigeon malaria during the summer season (82.9%) followed by spring season (59.4%) and least in the winter season (42.3%). In addition, Jordan (1943) also recorded highest proportion malaria infected birds during summer. Alternatively, highest infection rates of haemosporidians were observed during fall and winters by several authors (Klei and Deguisti 1975; Stabler et al 1977 and Ahmed and Mohammad 1978). However, seasonal peaks of pgeon malaria occurrence during summer and spring are suggested to be due to the physiological changes during reproduction of the host (Dorney and Todd 1960). Actually, Bangladesh has a subtropical monsoon climate with three seasons characterized by hot and rainy summer and a dry winter (Bammi 2010). Rainy season in our country is the combination of hot and moisture type, which is suitable for mosquito reproduction and development. Bashar and Tuno (2014) reported that some *Anopheles* spp. in Bangladesh was peaked during monsoon season (July-September). Additionally, Ahmed et al (2007) recorded reduced mosquito population due to low rainfall. Therefore, we found highest prevalence in rainy season. These variations might be due to the abundance of insect vector population during summer and rainy seasons.

Conclusion

Utterly, this study demonstrates the prevalence of pgeon malaria through blood smear techniques only. But, seroprevalence and molecular analysis may provide better understanding on the prevalence of haemosporidian parasites in pigeon of Bangladesh. Also, vector surveillance study of pigeon haemosporidian parasites is still not conducted in Bangladesh. Therefore,

molecular characterization of pigeon haemosporidian parasites along with vector surveillance study is necessary.

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Ethical statement; during carrying out this research, no animals were harmed or unethically injured/killed. Also, the authors tried to maintain highest possible ethical standards in their works. The study was approved by the ethical committee, Bangladesh Agricultural University (Approval no: 02/AWEC/2018).

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