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

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Bangladesh Mymensinghs ve Rangpur ilçelerinin güvercinlerinde hemosporidian parazitlerin prevalansı ve mevsimsel dağılımı

Öz
Amaç: Bu araştırma, Bangladeş’in iki bölgesinde (Mymensingh ve Rangpur) güvercinlerde haemosporidiyen parazitlerinin durumu araştırılmak için yapıldı.


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’daki % 24.2 düzeyinde olup, ikinci arasında fark istatistiksel olarak anlamlı bulunmamıştır. Cinsiyet açısından, erkekler % 30.8’, dişiler % 25.3’ü, yetişkinler % 29.5’i, gençler % 19.6’ya sahiptir. Yağış mevsiminde, yaz ve kış ayına göre prevalans anlamlı olduğuna (p = 0.000) bulunmuştur.

Öneri: Bu çalışmayla, Bangladeş’teki güvercinlerde sıtmanın yaygın olduğunu tespit edilmiştir. Bu nedenle, daha geniş bir örneklemle ve kuş sıtma türlerinin moleküler karakterizasyonu kapsayan daha ileri araştırmalar yapılmalıdır.

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 smear 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) 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 infection 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, Haemoproteus 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 Ishaq 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, Mymensingh. 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 (χ2) 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>
<thead>
<tr>
<th>Variables</th>
<th>Protozoa</th>
<th>Total</th>
<th>χ2 value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Haemoproteus spp.</td>
<td>Plasmodium spp.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall (300)</td>
<td>67 (22.3%)</td>
<td>17 (5.7%)</td>
<td>84 (28.0%)</td>
<td>-</td>
</tr>
<tr>
<td>Young (46)</td>
<td>9 (19.6%)</td>
<td>-</td>
<td>9 (19.6%)</td>
<td>1.92</td>
</tr>
<tr>
<td>Adult (254)</td>
<td>58 (22.8%)</td>
<td>17 (6.7%)</td>
<td>75 (29.5%)</td>
<td>1.12</td>
</tr>
<tr>
<td>Male (146)</td>
<td>36 (24.6)</td>
<td>9 (6.2)</td>
<td>45 (30.8%)</td>
<td>-</td>
</tr>
<tr>
<td>Female (154)</td>
<td>31 (20.1)</td>
<td>8 (5.2)</td>
<td>39 (25.3%)</td>
<td>-</td>
</tr>
</tbody>
</table>

*NS not significant (p>0.05)
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 pigeon 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 pigeon malaria was in line with the findings of O’Dell et al (1994) who also reported higher
prevailing 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 pigeon 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 pigeon 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.

Acknowledgements

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References


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