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Full Length Research

Gastrointestinal parasites of feral pigeon (*Columba livia* Gmelin, 1789) at two temples of Kathmandu valley

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ABSTRACT: Protozoans, helminths and other gastrointestinal (GI) parasitic infections in Aves are an imperative but often ignored topic in rising nations like Nepal. Accurate inspections of GI parasites in feral pigeons inform pragmatic treatment regimens. In a prospective examination of intestinal parasites in the coprological study of feral pigeons in April 2016, a total of 120 samples were preserved in 2.5% potassium dichromate and examined by microscopy of direct and concentrated faecal sample techniques to detect ova, larvae, and oocysts of parasites. Altogether 109 (90.83%) samples were positive with 6 genera of GI parasites. The study identified one genus of protozoa: *Eimeria* sp. (43.34%) and five genera of helminths: *Capillaria* sp. (51.67%), *Ascaridia* sp. (27.50%), *Heterakis* sp. (19.17%), *Syngamus* sp. (4.17%) and *Tetrameres* sp. (1.70%). The prevalence rate of helminth parasites (83.34%) was higher than the prevalence rate of protozoan parasites (43.34%). The present study revealed a significant difference in the prevalence of helminths and protozoan parasites (χ^2=15.14, $p<0.05$). However, the prevalence of gastrointestinal parasites showed no significant variation with respect to single and mixed infection (χ^2 =1.56, $p>0.05$). The present study examined a higher prevalence rate of gastrointestinal parasites due to a lack of deworming programs in feral pigeons and a lack of sustainable action designs. Therefore, the sustainable action design and its implementation to control parasitic infection and reduce the health hazards of feral temple pigeons were recommended.

Keywords: Feral, helminths, intestinal parasites, Kathmandu, pigeon, protozoans.

INTRODUCTION

Pigeons (*Columba livia*) are worldwide free-living species which are found since ancient times (BC. 3000-5000) and are known to be originated from Europe, North Africa and Asia (Sari *et al.*, 2008). Wild pigeons inhabit almost everywhere except the Sahara Desert, Antarctica and the high Arctic. They have adapted to live in urban, suburban and rural environments and have close communication with humans. In some countries, pigeons are used for human food, hobby, experimental purposes, cultural and religious symbol as well as ornamental purposes, also feral pigeons are used as a bio-indicator of chemical pollution (klein *et al*., 2008; Nam *et al*., 2004). *Columba livia* is descended from wild rock Pigeons that live in Mediterranean Europe (Adang, 1999). Common names of *Columba livia* are the pigeon, dove, blue rock pigeon, rock dove, wild rock pigeon, rock pigeon, and feral pigeon.

These birds feed on grains, such as wheat, maize, seeds of grasses, etc. Normally, they are gregarious. Pigeons are the inhabitants of most of the temples across the country. People are unaware of the possible risks they pose to human health. A pigeon can carry many parasites and pathogens to different flocks (Opara *et al.*, 2012). Pigeons will defecate on the roof, ground, or in bushes, trees, and plants. This has the danger of possibly getting tracked into homes by humans or even pets. With this, any disease or even parasites in those droppings end up right in homes. They can also serve as a source for different zoonotic diseases (Karatepe *et al.,* 2011). Pigeons are mucky birds, causing disease and damage. Their droppings are known for causing human slips and falls, unpleasant to sight. Droppings of pigeons are very acidic and can destroy roofing materials of buildings, monuments, temples and

statues. This makes it crucial to control pigeons in highly trafficked areas.

Feral pigeons harbour at least 110 different human pathogens, but there has been limited evidence of actual human infection with only 230 recorded human infections worldwide (Haag-Wackernagel and Moch, 2004). For example, pigeons can carry or transmit encephalitis, histoplasmosis, Newcastle disease, pigeon ornithosis, cryptococcosis, pigeon coccidiosis, toxoplasmosis, pseudo-tuberculosis and salmonella food poisoning (Rehman, 1993; Opara *et al*., 2012). Also, pigeons can carry fleas, ticks, mites and other parasites (Balicka-Ramisz *et al*., 2007; Rehman, 1993). The effects of parasitism on birds are often severe, including retarded growth, low egg production and susceptibility to other infections (Dranzoa *et al.,* 1999). Parasites often have short life cycles. This gives them the capacity to change genetic composition between generations and hosts need the ability to respond to these changes (Lindstrom, 2000). Feral pigeons have been identified with mycotic, bacterial, protozoal, chlamydial, rickettsial and parasitic diseases as well as dermatosis transmission to humans (Weber, 1979). Apart from a few reports in other parts of Nepal, there was no specific previous information on intestinal parasites of feral pigeon in Kathmandu valley, Nepal. Therefore, this study was carried out in two temples of Kathmandu valley to know the current prevalence of gastrointestinal parasites in feral pigeons (*Columba livia*).

MATERIALS AND METHODS

Study area

Pashupatinath temple is located in Kathmandu District, Bagmati Province between 27°71' 04" North latitude and 85°34' 87" East longitude. Pashupatinath Temple is a Hindu temple dedicated to Pashupati, an incarnation of Shiva and it is located in Kathmandu, Nepal. This temple complex was inscribed on the UNESCO World Heritage Sites list in 1979. The study area has an average annual rainfall of less than 260 mm. Krishna temple of Kathmandu valley is located in Lalitpur District, Bagmati Province between latitude 27°67’ 36” North and longitude 85°32’ 49” East. Patan Darbar Square is inscribed on the UNESCO World Heritage Site. It was damaged by the April 2015 Nepal earthquake and restored in 2018.

Study design and samples collection

The study was designed to assess the gastrointestinal parasitic infection in *Columba livia* at two temples of Kathmandu valley. Collection of fresh fecal sample was done by opportunistic random sampling. Fecal samples were collected in early hour of morning to avoid the crowd of human so that each pigeon was watched very carefully. One hour of time was only spent at t he study area while collecting the samples to prevent the duplication of samples from the same individual host. Of the total samples collected (n=120), Pashupatinath temple and Krishna temple comprised 60 samples in each. The collected faecal samples were preserved in 2.5% potassium dichromate. Each sample was labelled with its corresponding date and location of the host animal. The imperturbable samples were brought to the laboratory of the Central Department of Zoology, Kirtipur, Kathmandu and were processed immediately after their arrival..

Coprological examination

The faecal samples were subjected to coprological examination by concentration techniques (flotation and sedimentation). Approximately 3 g of faecal sample was taken in a beaker and 50 ml of water was poured and mixed thoroughly. The faecal suspension was run through a tea strainer into another beaker. Then the faecal suspension was poured into a centrifuge tube of 15 ml and centrifuged at 2,000 rpm for 5 minutes. The tube’s water was replaced with saturated sodium chloride solution and was again centrifuged. More saturated sodium chloride solution was gently filled leaving a convex meniscus surface at the top of the tube and a coverslip was carefully placed on the top of the tube. Then the tube was allowed to stand for 20 minutes. The coverslip was removed and placed gently on a clean glass slide and examined under the microscope. After the examination of the flotation constituent, the sediment content was placed into the watch glass and stirred gently to mix it. One drop from the mixture was taken on a slide and stained with iodine to examine under the microscope. The eggs and larvae present in the positive faecal samples were identified using a standard key based on their morphological traits as described by Soulsby (1982).

Data management and analysis

The data collected from the study were coded and entered in a Microsoft Excel spreadsheet and, the statistical analysis was performed using “R”, version 3.3.1 software. The percentage was used to calculate the prevalence rate of gastrointestinal parasites. In all cases, a 95% confidence interval (CI) and $p<0.05$ were considered for a statistically significant difference.

RESULTS

Prevalence of intestinal parasites in pigeon

All 120 faecal samples of male and female pigeons of different age groups were collected from the study area during the study period. Among the 120 collected and examined faecal samples of the pigeons, 109 (90.83%)

were found to be positive for various protozoan and helminth intestinal parasites (Figure 1).

Area-wise prevalence of intestinal parasites

Sixty (60) samples from each area (Pashupatinath temple and Krishna temple) were taken for examination. A higher prevalence of GI parasites was in the Pashupatinath temple (57 or 95%) and the prevalence in the Krishna temple was 52 (86.67%) (Figure 2). Statistically, the difference in the prevalence of GI parasitic infection between the two study areas was not significant (χ^2=0.24, p>0.05).

Prevalence of specific intestinal parasites

The present study indicated that one species of protozoan and five different species of helminth GI parasites infected the pigeon in the study area. All helminth parasites identified belonged to class Nematoda. The highest prevalence of *Capillaria* sp. (62 giving 51.67%) and the least prevalence of *Tetrameres* sp. (2 giving 1.7%) were found during the period of the study among the pigeons in the study area (Table 1). Statistically, the difference in the prevalence of helminths and protozoan parasites was found to be significant (χ^2=15.14, p<0.05).

Protozoan versus helminths infection

Infection of both protozoan and helminth gastrointestinal parasites was found among the pigeons during the study. Out of the 152 positive faecal samples, 52 (43.34%) samples were found positive for protozoan parasites whereas 100 (83.34%) samples were positive for helminth parasites (Figure 3).

Single and multiple infections

A higher rate of mixed infection was encountered with the prevalence of 61 (50.84%) than the single infection of 48 (40%) (Figure 4). Among the mixed infections, double infection showed the highest rate 53 (86.88%) than the multiple infections 8 (13.12%) in this study (Figure 5). Statistically, the differences in the prevalence of single and mixed infections were not significant (χ^2 =1.56, p>0.05).

DISCUSSION

Feral pigeons (*Columba livia*), also called city doves, city pigeons, or street pigeons, are pigeons that are derived from domestic pigeons that have returned to the wild. There are about 100 different breeds and varieties

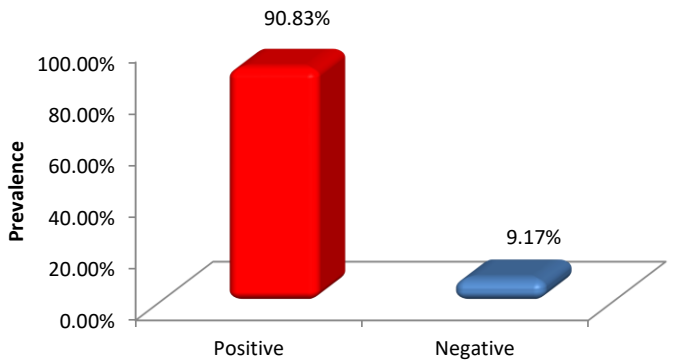

Figure 1. General prevalence of GI parasites.

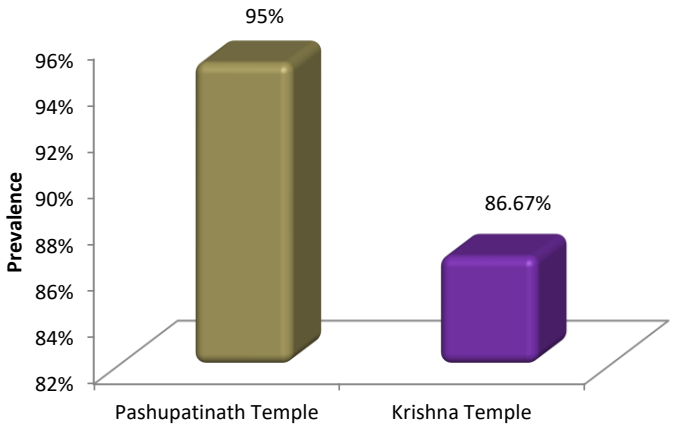

Figure 2. Prevalence of GI parasitic infection among study area.

described. They are primarily grain or seed eaters but also feed on garbage, insects, livestock manure and other food materials. Wild pigeons find the projection of buildings to be a replacement for sea cliffs, have become adapted to urban life, and are abundant in towns and cities throughout most of the world.

The overall prevalence rate of GI parasites in the present study was found to be 90.84%. The differences in the prevalence of gastrointestinal parasitic infection between the two study areas were not significant. It might be a result of similar climate, food habits and environment. The prevalence rates of helminths and protozoan parasites were significantly different. It may be because pigeons have high antibody titers to the protozoan parasite (Mushi *et al.*, 2000). The high prevalence of helminth infections recorded in this study could be an indication of a high incidence of the infective stages and intermediate hosts of the parasites in places where these pigeons are reared. The intermediate hosts of these parasites; beetles, pill bugs, ants, earthworms' cockroaches and snails which form part of the diet of pigeons (Adang, 1999).

The prevalence of gastrointestinal parasites in pigeons is generally influenced by the source of food and as far as

Table 1. Prevalence rate of specific intestinal parasites.

S.N.	Class	Name of parasite	Positive cases	Positive per cent (%)
1.	Conoidasida	*Eimeria* sp.	52	43.34
2.		*Capillaria* sp.	62	51.67
3.		*Ascaridia* sp.	33	27.50
4.	Nematoda	*Heterakis* sp.	23	19.17
5.		*Syngamus* sp.	5	4.17
6.		*Tetrameres* sp.	2	1.70

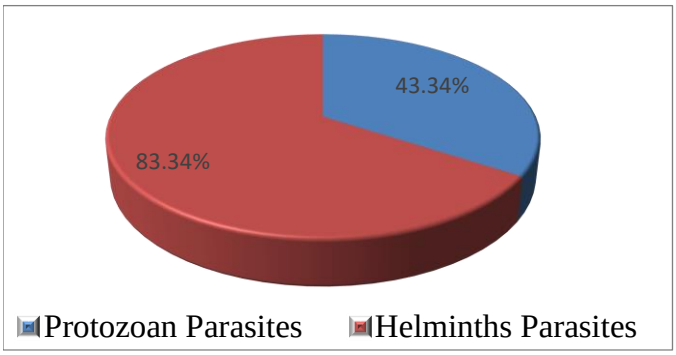

Figure 3. Prevalence of different helminth and protozoan parasites.

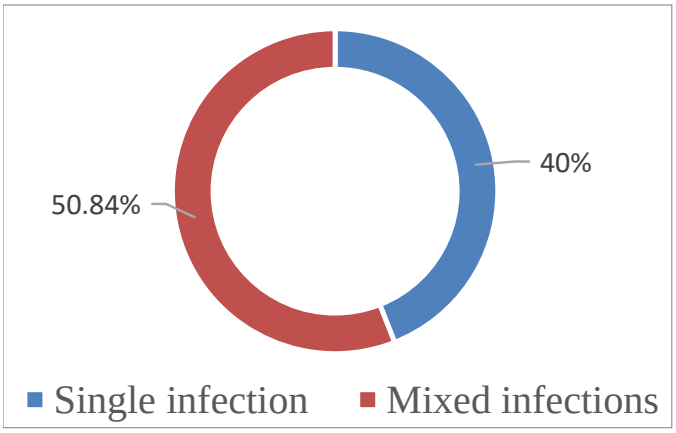

Figure 4. Prevalence of single and mixed infections.

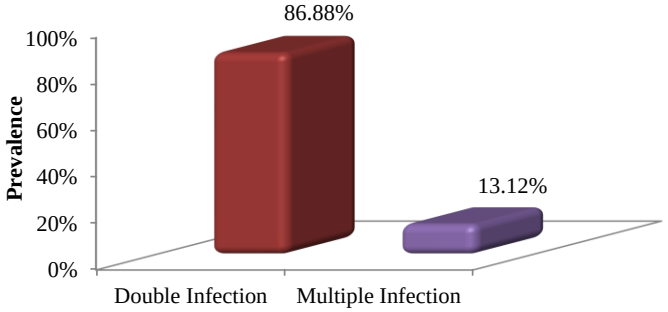

Figure 5. Prevalence of double and multiple infections.

possible the geographical distribution of the area. Basically, the prevalence of gastrointestinal parasites is further influenced by warm and humid climatic conditions which are the main reasons for the prevalence of such parasites. The present study was done to study the GI parasites of feral pigeons at two temples (Pashupatinath and Krishna temples) in Kathmandu valley. In the present study, 109 faecal samples were found to be positive for different gastrointestinal parasites i.e. 90.84%, out of a total of 120 faecal samples collected during the study period. In the present study, one genus of protozoa and five genera of Nematoda were observed. The one genus of protozoa found was *Eimeria* sp. Similarly, the five genera of Nematoda found were *Capillaria* sp., *Ascaridia* sp., *Heterakis* sp., *Syngamus* sp. and *Tetrameres* sp. The prevalence rate of *Capillaria* sp. was found more in pigeons i.e., 51.67% and the least prevalence was shown by *Tetrameres* sp. i.e., 1.70%. The prevalence of gastrointestinal nematodes in pigeons was lower than that obtained for Minas Gerais, in southeastern Brazil (Oliveira *et al*., 2000). On the other hand, the present study is similar to the prevalence rate recorded by the previous study conducted in the Gujarat State of India (Parasani and Momin, 2010). Similarly, the overall prevalence rate (90.84%) of GI parasites in the present study was higher than the prevalence rates of 74.14, 72 and 72.70% obtained by the previous studies (Marques *et al.*, 2007; Sivajothi and Sudhakara, 2015; Ghosh *et al.*, 2014) respectively. Moreover, the prevalence rate of the present study was lower compared to the 100% prevalence rate of another finding (Al-Barwari and Saeed, 2012). The 100% prevalence rate of the previous study (Al-Barwari and Saeed, 2012) was because of the combined prevalence rate of fungi, protozoa, cestodes, nematodes and arthropods. The specific prevalence rate of GI parasites was not given. 100% of parasitic infections may be due to infection or re-infection (directly or indirectly) of parasites which indicates poor management and control efforts in the birds or in the immediate environment (Opara *et al.*, 2012). The variation in results may be due to the different number of sample species, different methodologies used, different climatic conditions or different time periods and seasons of sample collection. The present study thus provides baseline information on the prevalence of gastrointestinal parasites among pigeons.

In the present study, the high (90.84%) parasitic

infection recorded might be due to different factors like the constant source of infested droppings or infested intermediate hosts in the study area. *Capillaria* sp. is one of the most common (51.67 %) helminth species found in the present study. The low prevalence of *Tetrameres* sp. infection (1.70%) is in agreement with the previous findings (Ghosh *et al*., 2014). But it was significantly lower than the finding of Msoffe *et al*., who reported that 79.50% of pigeons in the study were found infected by gastrointestinal parasites (Opara et al., 2012).in the same way all 100% of pigeons were found infected (Al-Barwari and Saeed, 2012). The overall prevalence of gastrointestinal parasites varies greatly among the earlier studies. The diversity of pigeons' endoparasite accumulations may be related to many factors, which may include home range, behaviour, size and roosting habit of the host. This may also be assigned to be contrasted in the geographical areas and period of study. Mixed parasitic infections recorded in the present study might be attributed to food preference at a particular time which determines the establishment of mixed or single infection (Opara et al., 2012).

Helminth parasites cause watery diarrhoea, weakness, weight loss, decreased milk production, reduced product quality, mortality and other secondary infections (Soulsby, 1982). The prevalence rate (83.34%) of helminths in the present study was higher than the prevalence rates of 56.10, 48.30 and 42.15% obtained by previous studies (Adang *et al.*, 2009; Adang *et al.*, 2008; Radfar *et al.*, 2011) respectively. The prevalence rates of helminth, 36.90, 33.33, 23.50, 18.70 and 12.50% shown by previous studies (Borji *et al.*, 2012; Musa *et al.*, 2011; Dranzoa *et al.*, 1999; Natala *et al.*, 2009; Olsen and Braun, 1980), respectively were lower than those of the present study whereas the prevalence rates of 84.78, 79.50 and 79.20% obtained by previous studies (Radfar *et al.*, 2012; Msoffe *et al.*, 2010; Bahrami *et al.*, 2013), respectively were similar to the present study. Among the protozoan, 43.34% prevalence rates were recorded in the present study which was lower than 72, 46.27 and 43.13% of previous studies (Natala *et al.*, 2009; Nagwa *et al.*, 2013; Radfar *et al.*, 2011), respectively. The overall prevalence of the various parasites differs greatly among the previous reports as well as when compared with the present observation. This might be due to variances in sample collection methods, sample size and sample examination methods. The diversity of bird endoparasite assemblages may be related to many factors, which may include home range, behaviour, size and roosting habit of the host. This may also be attributed to the difference in the geographical areas and period of study (Begum and Sehrin, 2012).

Among the six different GI parasites identified in the present study, the prevalence rates of *Capillaria* sp. (51.67%) were higher than others. The prevalence of *Capillaria* sp. (51.67%) was higher than 24.20 and 22% of previous studies (Sari *et al.*, 2008; Ghosh *et al.*, 2014), respectively. It was also higher than 17.40, 14.14, 13.20 and 5.55% as compared to other findings (Sivajothi and Sudhakara, 2015; Bahrami *et al.*, 2013; Patel *et al.*, 2000; Borji *et al.*, 2012), respectively. The high prevalence of *Capillaria* sp. in the present study compared with other species may be due to both direct and indirect life cycles of different species of *Capillaria*. The location of the crop and the oesophagus becomes enlarged and swollen, which can make swallowing difficult for affected birds. Fatalities are typical in cases of heavy infections. White rumped vultures and slender billed vultures were reported infected with species of *Capillaria* (Gupta and Pandey, 2007). Similarly, literature is also accessible for buffalo (Mukhia *et al*. 2007) for being infected by *Capillaria* sp. *Capillaria* sp. was also found prevalent in the poultry animals of Kathmandu (ADPCD, 1982).

Helminthiasis has emerged as an important parasitic condition of feral pigeons in this study. Nematodes recorded from this study are well known to harm the host up to some degree but these nematodes from pigeons are not contagious to humans because these are not reported as zoonotic with regard to humans. The higher prevalence of GI parasites was in the Pashupatinath temple with 57 cases (95.00%) than the 52 (86.67%) in the Krishna temple. The present study revealed maximum infection in wild pigeons at two temples in Kathmandu valley. The study indicated that feral pigeons are highly susceptible to GI parasites. Therefore, sustainable action should be designed and implemented to control parasitic infection and reduce the health hazards of these feral pigeons.

Conclusion

The general rate of infection of gastrointestinal parasites among the pigeons of the Pashupatinath temple and Krishna temple were found to be 90.84% with the highest infection by *Capillaria* sp. and the least infection by *Tetrameres* sp. The infection of protozoan parasites among pigeons was also found significant (43.34%). The study indicated that the pigeons in the study area were highly susceptible to gastrointestinal parasites. Therefore, there is a need for a sustainable way of controlling gastrointestinal parasitic infection of pigeons.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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