INVESTIGATION OF DIFFERENT PARASITES OF FARMED PIGEONS AT DINAJPUR SADAR UPAZILA

A Thesis

By

MD. GAUSUR RAHMAN

Student ID. 1605142
Session: 2016-2017
Semester: January-June, 2017

MASTER OF SCIENCE (M.S.)
IN
PARASITOLOGY

DEPARTMENT OF PATHOLOGY AND PARASITOLOGY
HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY UNIVERSITY, DINAJPUR-5200, BANGLADESH

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JUNE, 2017

DEDICATED

TO MY

BELOVED PARENTS

ACKNOWLEDGEMENTS

The author is ever grateful to his creator Almighty ALLAH for His blessings to enable him to carry out this study and complete this thesis.

The author would like to express heartfelt gratitude to his honorable Supervisor, Dr. S. M. Harun-ur-Rashid, Professor, Department of Pathology and Parasitology, Hajee Mohammad Danesh Science and Technology University, Dinajpur for his supervision, scholastic guidance, innovative suggestions, constructive criticism, helpful comment, inspiration and timely instructions throughout the entire period of the study.

The author expresses deep indebtedness to his Co-supervisor, Dr. Md. Haydar Ali, Assistant Professor, and Chairman, Department of Pathology and Parasitology, Hajee Mohammad Danesh Science and Technology University, Dinajpur for his scholastic guidance, untiring assistance and advice in preparing the thesis.

The author is honored to express his deepest sense of gratitude and sincere appreciation to honorable teacher, Dr. Md. Golam Azam, Assistant Professor, Department of Pathology and Parasitology, Hajee Mohammad Danesh Science and Technology University, Dinajpur for his helpful advice and co-operation in providing facilities to conduct the experiments.

The author humbly desires to express profound gratitude and thanks to his all reverend teachers of the Faculty of Veterinary and Animal Science, Hajee Mohammad Danesh Science and Technology University, Dinajpur for their kind help, co-operation, encouragement and valuable suggestions.

The author also express his cordial love to his friends and well wishers, especially Dipa, Teth, Nipun, Koli, Samina, Meraz, Raju, Horidas, Rahib for their inspiration, help and encouraging attitude in the study period.

With due pleasure the author wishes to acknowledge the healthy working relationship of the staff of the Department of Pathology and Parasitology, Hajee Mohammad Danesh Science and Technology University, Dinajpur.

The author deeply expresses cordial thanks to Ministry of National Science and Technology, for funding for this experiment.

Finally, the author is very much grateful to his beloved parents, brother and sister for their sacrifice, inspiration, encouragement and endless love and continuous blessing for educating himself up to the postgraduate level.

June, 2017 *The Author*

ABSTRACT

A cross sectional study was conducted to investigate the different parasites in farmed pigeon at sadar upazila of Dinajpur, Bangladesh during January to June, 2017. A total of 122 pigeons (39 young and 83 adult in which 45 male and 77 female) from different farms were examined by faecal, oral and blood sample examination and postmortem examination for histopathological study. The investigation expressed that the highest overall prevalence was ectoparasites 107 (87.70%) followed by helminthes 96 (78.69%) and protozoa 71(58.20%). In this study, the frequency of *Echinostoma* sp., *Raillietina* sp., *Ascaridia* sp., *Capillaria* sp., *Ornithostrongylus* sp., *Eimeria* sp., *Trichomonas* sp., *Haemoproteus* sp., *Columbicola columbae, Menopon* sp. and *Lipeurus* sp. were found to be 24(19.67%), 46(37.67%), 51(41.80%), 38(31.15%), 15(12.30%), 45(36.89%), 47(38.52%), 39(31.97%), 96(78.67%), 55(45.08%) and 75(61.48%) respectively. The age and sex related prevalence of helminth revealed that adults 68(81.93%) were more susceptible than young 28(71.79%) and females 62(80.52%) were more prevalent than male 34(75.56%) but these were statistically insignificant ($P>0.05$). Further, youngs 25(64.10%) were more prone to protozoa than adults 46(55.42%) and the higher prevalence of protozoa was found in female 50(64.94%) in compare to male 21(46.67%) which were not statistically significant ($P>0.05$). Association of age and sex with ectoparasites indicated that the prevalence of ectoparasites was significantly ($P<0.001$) higher in adult 80(96.39%) than young 27(69.23%) and also significantly ($P<0.05$) higher in female 50(64.94%) than male 21(46.67%) pigeons. The mean intensity of *Echinostoma* sp., *Raillietina* sp., *Ascaridia* sp., *Capillaria* sp., *Ornithostrongylus* sp., *Eimeria* sp., *Trichomonas* sp., *Haemoproteus* sp., *Columbicola columbae*, *Menopon* sp. and *Lipeurus* sp. was 2.50±0.30, 4.30±0.35, 3.80±0.29, 2.53±0.23, 1.92±0.24, 4.38±0.38, 4.53±0.42, 7.82±0.61, 17.32±0.82, 14.47±1.13 and 11.91±0.85 respectively. Histopathologically found that degeneration, distraction and desquamation of papillae, villi and epithelium of intestine. The results indicate that pigeons of this area are very much susceptible to different endo and ectoparasites which cause great economic loss of the farmer.

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LIST OF ABBREVIATIONS

GDP	:	Gross Domestic Product
BLRI	:	Bangladesh Livestock Research Institute
%	:	Percentage
Sp.	:	Species
DPX	:	Distyrene Plasticizer Xylene
SPSS	:	Statistical Package for Social Science
et al.	:	Associates
N	:	Number
NS	:	Not Significant
SE	:	Standard Error
Gm	:	Gram
EDTA	:	Ethylene Diamine Tetra Acetic acid
>	:	Greater than
<	:	Less than
=	:	Equal

CHAPTER 1

INTRODUCTION

CHAPTER 1

INTRODUCTION

Bangladesh is a developing country where poultry industry is a rising sector. It plays an important role in the rural economy (Nath *et al.*, 2014). This poultry sector employs about 5 million people & has experienced a long-term growth rate of about 4.50%, which is highest in the economy (BLRI report, 2009). Poultry producers are searching for some substitute of meat, which will come in the form of pigeon meat to contribute towards the increase in Gross Domestic Production (GDP) through livestock sector. Pigeon rearing is an integral part of many farming systems and increasing day by day in Bangladesh. In Bangladesh, pigeon is used for meat production and ornamental purposes. It provides one of the main sources of income for the farmers of Bangladesh. Pigeons are probably the most common nuisance bird. They have adapted to life in the city and they seem to be everywhere in urban environments (Bahrami *et al.*, 2012).

Pigeon farming is very interesting, profitable and pigeons are very popular domestic bird. Pigeons are considered as the symbol of peace. Almost all types of people who have facilities, love to raise some pigeon in their home. Pigeon farming require less labor and low investment. The meat of baby pigeon (squab) is very tasty, nutritious and restorative. Squabs also have huge demand and price in the market. On the other hand pigeon farming can be a great source of some extra income and entertainment. Rearing of pigeons using modern methods is very profitable than traditional way. Pigeons are domesticated birds which widely distributed the entire world. They have adapted to life in urban, suburban and rural environment and have close communication with humans (Khezerpour and Naem, 2013). Pigeons (*Columba livia*) are among poultry species kept in the Bangladesh where they are a part of subsistence farming done by most poor families (Begum and Sehrin, 2012).

Pigeons are a source of food, used as pets, and are cultural and religious symbols. They also make good laboratory animals, for instance in diagnosis of fowl cholera (Cooper, 1984). Therefore, the importance of pigeons can not be overemphasized. The veterinary relevance of pigeons has been reviewed in detail by Cooper (1984) and Zwart (1986, 1993).

Usually, the domestic pigeons (*Columba livia*) are highly susceptible to infection with a large number of internal parasites and cause heavy economic losses in the form of related growth, decreased production. They feed on the wide range of food items including grains, slugs, earthworms and insects that in many instances may carry infective stages of intestinal parasites. Several health problems can affect pigeons but parasitic infections play a major role. They constitute a major source of infection and transmission of diseases (Marques *et al.,* 2007).

Pigeons are major source of infection and transmit of diseases from one generation to next generation. They are often cause for repulsion and nuisance due to the accumulation of fecal droppings and to disruptive noise associated with their presence. They have a role in spreading some Zoonoses to the people and being a reservoir of many parasitic diseases for poultry. They have the potential for transmission of over 30 diseases to human and domestic animals (Shaikh *et al*., 2016). Human are infected by inhaling fecal dust from cages or from sites that have been contaminated with dry feces, urine and other droppings (Eljadar *et al*., 2012), this usually occurs among breeders, Veterinary doctors, industrial workers, and cleaning workers (Marques *et al*., 2007).

The close contact of pigeons with other domestic birds increases risk of parasitic infestation in birds and carries a possible zoonotic potential for transmission of diseases to human beings (Cooper, 1984; Kaminjolo *et al*., 1988; Piasecki, 2006; Marques *et al*., 2007 & Sari *et al*., 2008). The diseases are mainly spread through faecal dust from cages contaminated with dry droppings and urine (Marques *et al*., 2007).

The effects of parasitism on birds are often severe, including retarded growth, low egg production and susceptibility to other infections (Dranzoa, 1999). Wide ranges of helminthes are found in the gastrointestinal tract of pigeons, the majority of which are responsible for clinical and subclinical parasitism. Infection results in weight loss, anemia, retarded growth, fertility disturbance, emaciation, gut epithelium complications and reduction in immune responses of host against various diseases (Urquhart *et al*., 2000). Such complications in young pigeons eventually lead to death (Basit *et al*., 2006). Ectoparasites are regarded as the basic causes of retardation in growth, lowered vitality and poor conditions of the birds (Pirali-Kheirabadi *et al*., 2016).

The gastro-intestinal tract of pigeons harbors a wide variety of helminthes, of which nematodes are the most deleterious parasites and are responsible for clinical and sub-

clinical parasitism. During heavy infestation, these nematodes adversely affect the health of birds with loss in the body weight, retarded growth, unthriftiness, damage to the gut epithelium, fertility disturbances, emaciation and death especially in young birds (Basit *et al*., 2006; Urquhart *et al*., 1996).

The prevalence and intensity of parasitic infestations may be influenced by a number of epidemiological factors including host factors such as age, sex and breed and environmental factors such as climatic conditions (Nadeem *et al*., 2007).

In view of above facts, it is assumed that parasitic disease is one of the major problems for the pigeons, but no attention has been paid to investigate the parasitic diseases of farmed pigeon in Bangladesh. Therefore, the present study was undertaken with a view to fulfilling the following objectives:

1. To investigate and identify different parasites of pigeon.
2. To detect the prevalence of parasites in relation to age and sex of pigeons.
3. To know the intensity of parasites in pigeon.
4. To study the gross and histopathology of intestine collected from infected pigeon.

CHAPTER 2

REVIEW OF LITERATURE

CHAPTER 2

REVIEW OF LITERATURE

2.1 Prevalence of parasitic diseases in pigeon

Layla *et al.* (2016) carried out a study to detect the prevalence of parasitic infection among (38) domesticated pigeons (*Columba livia*) and found that 29 (76.3%) pigeons were infected with intestinal parasites and the incidence rates were 5.3% in younger and 71.1% in adult pigeons. The highest rate of helminthic infection about (72.4%) following (48.3%) of infection with protozoa and 20.7% mixed infection with helminths and protozoa. Furthermore, the nematodes (65.5%) were more infected in pigeons compare with cestodes (31%). *Capilliaria columbae* (28.6%), *Ascaridia galli* (16.7%), *Raillietina cesticillus* (14.3%), *Cotugnia digonophora* (7.14) and Eimeria oocyst (33.3%) were identified.

El-Khatam and Laila (2016) confirmed *Trichomonas gallinae* infection in infected birds by microscopical examination of oral swabs, histopathological examination, and PCR of the ITS1/5.8S/ITS2 gene among 3315 pigeons of different ages from the Minoufiya governorate. The prevalence was 1.9%. The parasite was found 2.04% from Ashmoun, 1.66% from Minoof, 1.6% from Quesna, and 2.5% from El-Shohada birds. The infection was mainly detected in squabs 1.8%. The sequence of *T. gallinae* ITS1/5.8S/ITS2 gene from Egypt has high nucleotide sequence identity (up to100%) to *T. gallinae* from pigeon of USA, Austria, Canada, and Spain. The sequence belongs to genotype B of *T. gallinae*.

Sivajothi and Reddy (2015) examined faecal samples of 132 pigeons from four different farms of Y S R Kadapa district of Andhra Pradesh in India for the presence of gastrointestinal parasites by direct smear examination, flotation and sedimentation techniques and observed overall 72.7 % of the birds harbored parasites including *Ascaridia colombae* (33.3%), *Eimeria* spp. (31.0%), *Capillaria colombae* (17.4%) and *Raillietina* (9.0%), mixed infections (36.6%) and high prevalence in adults (75%) than squabs (64.2%).

Doosti *et al.* (2014) determined the prevalence of *Haemoproteus columbae* in Iranian pigeons by examining blood sample of 220 pigeons from September 2012 to April 2013

obtained from wing vein by a molecular technique (PCR) and reported that the prevalence rate of *Haemoproteus columbae* was 23.18%.

Abed *et al.* (2014) examined blood samples for blood parasites, oral cavity and intestine examined for trichomonas and helminthes respectively in 95 pigeon obtained from local market of Al-Dewniya city and recorded 29.47% with blood parasites (*Haemoproteus* spp.), 66.31% pigeons were parasitized with tape worms 19(20%) belongs to *Cotugnia* spp, and 46.31% belongs to *Raillietina* spp., 38.94% with nematodes (*Ascaridia* spp.), 10.52% with Trichomonas and 7.36% apparently clean.

Nath *et al.* (2014) examined a total of 100 pigeons and 100 chickens from four (4) selected districts of Bangladesh (Khagrachari, Bandarban, Sylhet and Sunamgonj) during the period of January to December' 2011 and reported that overall 2% pigeon and 12% chicken were found to be infected by *Leucocytozoon* sp.

Ghosh *et al.* (2014) examined a total of 100 pigeons for the presence of ecto and gastrointestinal (GI) parasitic infections) in Chittagong Metropolitan area, Bangladesh. He recorded the overall prevalence of ecto–parasitic infestation and gastrointestinal parasitic infections were 67% and 72% (single or mixed) respectively. Among 6 different ecto–parasites, the highest infestation was caused by *Pseudolynchia canariensis* (43%) followed by *Lipeurus caponis* (28%), *Goniodes gallinae* (28%), *Menopon gallinae* (13%) and pediculosis were a common problem. Further, adult pigeons (86%) were more prone to ecto–parasitic infections in compare to squabs (48%), which was statistically significant ($P<0.05$). Among six different species, the highest prevalence was recorded for *Ascaridia galli* (35%) followed by *Capillaria* sp. infection (22%). Adults (74%) were more susceptible to GI parasitic infections in compare to squabs (70%) but it was not statistically significant ($P>0.05$).

Parsani *et al.* (2014) reported that qualitative examination of 78 faecal samples of domestic wild and zoo pigeons in Gujarat, India revealed 71 (91%) with parasitic infections of nematodes (85%), cestodes (31%) and *Eimeria* sp. (77%). There were 200-1600 nematode eggs per gram during the monsoon season, which was high compared to the 200-1000 eggs per gram in winter and summer. In post-mortems 85% had parasitic infections, of nematodes (75%), cestodes (69%) and *Eimeria* sp. (58%). Two species of nematodes (*Ascaridia columbae* and *Capillaria obsignata*) and five species of three

genera of cestodes (*Raillietina echinobothridia, R. tetragona, R. cesticillus, Cotugnia digonophora* and *Hymenolepis* sp.) were identified.

Bahrami *et al.* (2013) examined 250 faecal samples of pigeon by direct smear method, modified Mc Master technique and centrifugal flotation method and recorded the parasitic diseases as *Raillietina* spp, Tetramers, Sygnamus, Capillaria, *Ascaridia colombae* and oocyst of protozoa, Phthiraptera, *Ceratophyllus columbae* and the frequency as 24.24%, 8.08%, 9.09%, 14.14%, 4.04%, 7.07%, 8.08% and 12(6.06%) respectively and 19.19% of pigeon had multiple infection. They also found that the birds above two years (41.91%) show more resistance against worms' infestation than young birds below two years (58.08%).

Bahrami *et al.* (2013) examined fresh faecal samples of pigeons by direct smear method whereas egg per gram (EPG) was counted by modified Mc MasterTechnique and centrifugal flotation method using Sheather's saturated sugar solution and recorded *Raillietina* spp., Tetramers, Sygnamus, Capillaria, *Ascaridia colombae* and oocyst of protozoa, Phthiraptera, *Ceratophyllus columbae* as 29%, 5%, 8%, 15%, 4%, 8%, 2% and 5% frequency respectively.

Islam *et al.* (2013) conducted an exploratory study from January, 2006 to December, 2006 in different areas of Netrokona and Mymensigh district to determine the presence of Haemoproteus spp. in different types of birds. Blood samples were collected from the veins of 57 pigeons (*Columba livia*), 30 chickens (*Gallus gallus domesticus*), 50 ducks (*Anas platyrhynchos domestica*) and 32 quails (*Coturnix japonica*) and smears were prepared. Of all the examined birds, 23.3% (7/30) chickens, 50.9% (29/57) pigeon and 12.5% (4/32) quails were found to be infected with *Haemoproteus* spp. Highest presentage of *Haemoproteus* spp. was observed among older bird in case of both chicken (13.33%) and pigeon (33.33%). Out of 57 pigeon 31.58% female and 19.3% male were tested positive for *Haemoproteus* spp. infection.

Khezerpour and Naem (2013) examined a total of 138 pigeons to evaluate the prevalence and distribution of helminthes parasites of pigeons from May 2011 to March 2012 in different parts of Urmia, Western Azerbaijan, Iran and recorded 23.18% overall parasite prevalence in pigeons with specific prevalence for *Ascaridia columbae* being 13.04% followed by species of *Raillietina echinobothrida* (10.14%), *R. tetragona* (2.89%), *R. magninomida* (1.44%) and *Capillaria* spp. (0.72%). The infection rate in

female and male pigeons was 65.62% and 34.37% respectively which had significant differences (P<0.01). No trematode infection was detected. Highest prevalence of infection was in spring and winter. Among all examined organs jejunum had maximum infection density especially with *R. echinobothridia* and *A. columbae*. Single infection was more common (18.84%) than double (3.62%) and triple infections (0.72%).

Al-Rammahi *et al.* (2013) carried out a research in Babylon province on 138 domestic and wild columbide birds were collected during the period from April to June 2012 and recorded the highest rate of infection with *Trichomonus gallinae*, in wood pigeon 53.33% followed by Rock pigeon, Domestic pigeon, Collared dove and palm dove 40%, 30%, 13.34% and 11.12% respectively. The results revealed that the total rate of infection was 80 (57.97%), with cestodes parasite. A significant differences regarding the type of the birds, the highest prevalence was recorded in wood pigeons 90% followed by rock pigeon, collared dove and domestic pigeons in prevalence rate 83.34%, 40% and 26.67% respectively, while no cestodes recorded in palm dove. A significant differences regarding the type of cestodes parasite. Out of 123 collected cestodes, 64.23% were geuns Raillietina, (18.69%*)* were geuns Aporina and (17.07%) were geuns Cotugnia.

Bahrami *et al.* (2012) carried out an experimental study from May to September 2011 on 250 (168 adults and 82 nestlings) blood and faecal samples randomly collected from suspected pigeons (mostly young) and 25 specific free pathogen birds as control and observed prevalence rate of various helminthes including *Raillietina echinobothridia* (10.4%), *Syngamus trachea* (8.4%), *Capillaria colombae* (6%) and *Ascaridia colombae* (8.4%). and some porotozan infections including *Haemoproteus colombae* (20.8%), *Trichomonas gallinae* (26.8%), *Cryptosporidium* sp. (1.2%) and *Eimeria* sp. (21.6%*)* and also ectoparasites including *Lipeurus* sp. (3.2%), *Menopen gallinae* (15.2%*), Ceratophyllus colombae* (10.4%) and Louse fly (12%).

Begum and Sehrin (2012) reported eleven species of helminth parasites: four species of trematoda: *Echinostoma revolutum* (15%), *E. trivolvus* (5%), *Patagifer bilobus* (5%), *Ehinoparyphium recurvatum* (8.33%); six species of cestoda: *Hymenolepis columbae* (63.33%), *Raillietina echinobothrida* (100%), *R. bonini* (43.33%), *R. cesticillus* (100%), *Cotugnia celebesensis* (68.33%), *C. cuneata* (100%); and one species of nematoda:

Ascaridia columbae (28.33%) in 60 pigeon, *Columba livia* (25 males and 35 females). Females showed slightly higher intensity of infestation than the males**.**

Radfar *et al.* (2012) collected five species of nematodes and cestodes from alimentary canals of pigeons including *Ascaridia colombae* (16.66%) and *Hadjelia truncata* (1.96%), *Cotugnia digonopora* (13.79%), *Raillietina magninumida* (18.62%) and *Raillietina achinobothridia* (32.35%) and fecal examination revealed: *Eimeria* spp. (40.19%) and *Cryptosporidium* oocysts (2.94%); and blood smears showed: *Haemoproteus cloumbae* (47.05%); in mouth, throat and larynx: *Trichomonans gallinae* (57.84%); four species of ectoparasites were collected from feathers and subcutaneous nodules as follows: feathers: *Pseudolynchia canariensis* (63.72%), *Columbicola columbae* (79.41%), *Menopen gallinea* (44.11%); subcutaneous nodules: *Laminosioptes cysticola* (1.96%).

Dadi-Mamud *et al.* (2012) examined 50 *Columbia livia* for the presence of haemoparasites in 2010 in lapai Niger State Nigeria, through the use of blood smears stained with giemsa stain and recorded 78% of the birds were infected with one or more haemoparasite belonging three genera haemoproteus, plasmodium and leucocytozoon. Some of the birds were singly infected while others had multiple infections. For the single infection, plasmodium (30%), Haemoproteus (14%) and leucocytozoon (4%) and for the double infection, haemoproteus and plasmodium (14%), haemoproteus and leucocytozoon (4%) and plasmodium and leucocytozoon (4%) while for triple infection it was (8%).

Eljadar *et al.* (2012) carried out a study to determine endo-parasites in green mountain region from free range pigeons by the examination of fecal samples using the salt flotation technique and blood samples stained with Giemsa collected from different pigeons species and evaluated for the presence of gastrointestinal parasites and heamoparasites. Protozoa (90% for *Eimeria* spp. and 1% for *Haemoproteus* spp.) and nematodes (20% for *Capillaria* spp. and 10% for *Heterakis* spp.) were detected in number of the cases, whereas 5% of the fecal samples were infected by multiple parasites. The presence of coccidian oocysts was revealed in the most of fecal samples.

Bahrami *et al.* (2011) examined 250 faecal samples of pigeon by direct smear method whereas egg per gram (EPG) was counted by modified McMaster technique and centrifugal flotation method using Sheather's saturated sugar solution and recorded

Raillietina spp. (24%), Tetramers (8%), Sygnamus (9%), Capillaria (14%), *Ascaridia colombae* (4%) and oocyst of protozoa (7%), Phthiraptera (8%), *Ceratophyllus columbae* (6%).

Tanveer *et al.* (2011) examined faecal samples of 143 (80 male and 63 female) domestic pigeons to determine the gastrointestinal nematodes of domestic pigeons through qualitative and quantitative faecal examinations. The overall prevalence of gastrointestinal nematodes was 40.5% in domestic pigeons and in males and females was 41.3% and 39.7% respectively. The overall prevalence of *Capillaria obsignata* and *Ascaridia columbae* was found to be 67.2% and 32.8% and in males was 72.7% and 27.8% and in females was 60% and 40% respectively. There was no significant sex related difference seen in the prevalence of *C. obsignata* (P>0.56) and *A. columbae* (p>0.40) in domestic pigeons, respectively.

Begum *et al.* (2011) recorded 10 species of ectoparasites in 60 pigeons, *Columba livia* (25 males and 35 females). The ectoparasite comprised lice: 100% *Menopon gallinae*, 46.66% *Menacanthus stramineus*, 71.66% *Colpocephalum turbinatum,* 100% *Columbicola columbae*, 51.66% *Lipeurus caponis*, 31.66% *Goniocotes gallinae*, 46.66% *Chelopistes meleagridis*; fleas: 8.33% *Echidnophaga gallinacean*; flies: 63.33% *Pseudolynchia canariensis* and 13.33% of mites *Dermanyssus gallinae*. Serious damage was observed in wing feathers (31.74%). The females had a higher intensity (30.11) of infestation than the males (29.04). The ectoparasites were removed from the pigeons throughout the year. The overall intensity of infestation was highest during summer (40.69) and lowest during winter (21.94).

Msoffe *et al.* (2010) conducted a study to assess the prevalence of parasites of domestic pigeons in Morogoro Municipality, Tanzania. 100 nestlings and 100 adult pigeons were examined for the presence of ecto and endoparasites. 159 pigeons (79.5%) were infected with one or more species of gastrointestinal helminthes, 62% had one or more ectoparasites and 37% was infected with haemoparasites. The 3 subfamilies represented two cestodes and one nematode, whereas no trematodes were found. Three species of helminthes *Raillietina tetragona* (6%), *Raillietina echinobothrida* (63%) and *Ascaridia galli* (15.5%) were identified. Three different species of ectoparasites such as *Pseudolynchia canariensis* (61.5%), *Menocanthus stramineus* (0.5%) and *Menopon gallinae* (0.5%), and 1 haemoparasite species *Haemoproteus columbae* were identified.

Prevalence of gastrointestinal worms was significantly higher ($P < 0.001$) in adults than in nestlings. Nestlings appeared to be less susceptible to gastrointestinal cestodes but more susceptible to nematodes compared with adults. *P. canariensis* were found in both nestlings and adults pigeons while *M. stramineus* and *M. gallinae* were found in adult only. Prevalence of ectoparasites was not statistically significant ($P < 1$) between the two age groups. The prevalence of *H. columbae* was statistically higher ($P < 0.001$) in adults.

Dey *et al.* (2010) found that 44% pigeons were infected with blood protozoa, *Haemoproteus* sp. (20%) and *Leucocytozoon* sp. (24%) among 75 pigeons from different areas of Mymensingh district of Bangladesh during July to December, 2007 which was higher in male (28%) than female birds (16%) and male pigeons were 2.57 times more susceptible than the female pigeon.

Adang *et al.* (2009) examined a total of 30 (20 males and 10 females) Speckled Pigeons trapped from the wild in Zaria and its environs, Nigeria, for ectoparasites and intestinal helminths, to determine the prevalence, intensity and mean intensity of infestation and infection and reported eighteen (60.0%) of the birds were infested by three species of ectoparasites as follows 56.7% *Menopon gallinae*, 60.0% *Columbicola columbae* and flies: 30.0% *Pseudolynchia canariensis*. Single, double and triple infestations were found in 3.3%, 26.7% and 30.0% respectively, though the difference was not significant ($P>0.05$). The sex-specific infestation rate was 60.0% in males and 60.0% in females. 56.7% birds were infected by helminthes represented by four species of cestodes recovered from the gastrointestinal tract. The cestodes were represented by *Raillietina* (3.3%), *Raillietina cesticillus* (26.7%), *Amoebotaenia cuneata* (13.3%) and *Hymenolepis carioca* (13.3%). Single infection was the only infection type observed. The sex-specific rate of infection was 55.0% in males and 60.0% in females.

Natala *et al.* (2009) collected samples from 250 domestic pigeon from a major slaughter slab in Zaria and recorded the prevalence of protozoa including *Eimeria* sp., *Haemoproteus columbae*, *Leucocytozoon* sp., *Plasmodium relictum* as 49.2%, 15.6%, 6.4%, 0.8% respectively and helminth including *Raillietina tetragona, Raillietina cesticillus, Raillietina echinobothridia*, *Ascaridia columbae, Ascaridia galli* and *Capillaria anatis* as 4.9%, 3.0%, 7.6%, 1.2%, 1.2% and 0.8% respectively while *Pseudolynchia canariensis* (17.6%) was the only ectoparasites.

Borghare *et al.* (2009) examined 30 samples to investigate the helminthic infection in captive wild pigeons (*Columba livia*) at Maharajbagh Zoo, Nagpur and reported the incidence of *Capillaria* sp., *Ascaridia* sp. and *Hetarakis* sp. as 56.66%, 76.66%, 16.66% respectively, mixed parasitic infection in around 17 samples with either *Ascaridia* sp. and *Capillaria* sp. or with *Ascaridia* sp. and *Heterakis* sp. and cysts of *Balantidium coli* in one sample.

Adang *et al.* (2008) reported five species of ectoparasites in 177(73.8%) pigeons among 240 (127 males and 113 females) domestic pigeons. The ectoparasites comprised lice: 6.3% *Menopon gallinae*, 63.8% *Columbicola columbae* and 10.8% *Goniodes* sp.; flies: 37.1 *Pseudolynchia canariensis* and 2.5% of mites (*Dermanyssus gallinae*). 30.8% of the domestic birds had single infestation, 39.6% had double infestation and 2.9% had triple infestation. The difference between single and mixed infestation was not statistically significant (P>0.05). The females had a higher prevalence (74.3%) than the males (73.2%). There was however no significant difference (P>0.05) in the infestation rates between the sexes. Ectoparasites were removed from the birds throughout the year with highest prevalence (95%) in August. *Columbicola columbae* and *Pseudolynchia canariensis* were collected throughout the year.

Sari *et al.* (2008) examined faecal samples from 251 pigeons (136 domestic pigeons and 115 wild ones) through the centrifugal flotation method using Sheather's saturated sugar solution and a modified acid-fast staining method. Coccidia oocysts were detected in 81 (59.6%) domestic pigeons and in 35 (30.4%) wild pigeons. Coccidian species identified in domestic pigeons were as follows: *Eimeria labbeana* (58.1%); *E. columbarum* (30.9%); *E. columbae* (22.1%) and *Isospora* sp. (18.4%). In wild pigeons, the oocysts of the following species were detected: *Eimeria labbeana* (28.7%), *E. columbarum* (10.4%), *E. columbae* (5.2%), and *Isospora* sp. (13.0%). Helminth eggs were found in faeces of 23.5% domestic pigeons and in 4.3% wild pigeons. The following helminth species were identified: *Capillaria* sp. (19.9%) *Ascaridia columbae* (5.1%), and *Heterakis* sp. (3.7%) in domestic pigeons; and *Capillaria* sp. (4.3%) and *Syngamus* sp. (1.7%) in wild pigeons.

Shinde *et al.* (2008) examined the pigeons (1000 carcasses) in urban localities of Mumbai city for prevalence of parasitic fauna revealed nematode species like *Capillaria obsignata* and *Ascaridia columbae,* cestode species like *Raillietina tetragona, R.*

echinobothrida, R. cesticillus and Cotugnia digonopora, coccidian species were *Eimeria columbae* and *E. labbeana and* the ectoparasites were *Pseudolynchia canariensis, Goniocotes bidentatus* and *Columbicola columbae.* Majority of pigeons showed mixed infections of ecto and endoparasites. *Haemoproteus columbae* was recorded in 35 out of 60 live pigeons on blood smear examination.

Begum *et al.* (2008) examined 300 pigeon during July 2007 to June 2008 in different areas of Mymensingh district. Prevalence of *Trichomonas gallinae* was higher in female pigeon (70.9%) than male pigeon (63.8%). Adult pigeons aged >3 months were comparatively more affected (75%) than the squab aged <30 days (72.1%) and the younger aged between 30 days to 90 days (64.7%). *T. gallinae* infection was significantly (P<0.01) lower in summer (48.4%) than rainy (69.8%) and winter (69.3%) seasons.

Marques *et al.* (2007) conducted a study to determine the prevalence of ectoparasites and endoparasites in 58 free-living pigeons (*Columba livia*) in urban areas of Lages, in the state of Santa Catarina, Brazil. The blood samples were examined through the use of blood smears stained with Quick Panoptic and Giemsa methods and fecal samples of pigeons were analyzed using Sheather's method. The Quick Panoptic and Giemsa methods detected 67.24% (39/58) and 46.55% (27/58) of *Haemoproteus* sp. respectively. The prevalence of gastrointestinal parasites was 74.14% (43/58). Protozoa (100% for *Eimeria* sp.) were detected in 86.05% of the cases and nematodes (*Ascaridia* sp. and *Capillaria* sp.) in 32.56%, whereas 20.93% of the pigeons were infected by multiple parasites. The fly *Pseudolynchia canariensis* was found beneath the feathers of all pigeons.

Stenzel and Koncicki (2007) conducted a study to evaluate the occurrence of parasitic invasions in domestic pigeons in the Northern Poland. In years 2005/2006, 55 lofts of carrier pigeons and 11 lofts of fancy pigeons were examined. One hundred and three individual dropping samples collected during pigeon exhibitions were also investigated. The study revealed that 56.4% of carrier pigeons lofts and 90.9% of fancy pigeon's lofts were infected by coccidia. *Ascaridia columbae* was found in 5.5% lofts of carrier and 15.5% of fancy pigeons on the exhibitions. Eggs of *Capillaria* (*C.*) *obsignata* were found in 3.6% carrier pigeons and in 36.4% fancy pigeon's lofts. *Trichomonas columbae* were observed in 61.8% of carrier pigeons and in 100% of fancy pigeon's lofts**.**

Senlik *et al.* (2005) demonstrated that 74% pigeons harboured helminth infections including *Baruscapillaria obsignata* (63%), *Ascaridia columbae* (42%) and *Raillietina echinobothrida* (1%). There were no significant differences in the prevalence of *B. obsignata* and *A. columbae* by host age and sex. Significantly the highest prevalence rate of *A. columbae* was observed in the autumn months, but there was no significant difference in the seasonal prevalence of *B. obsignata*. The mean intensity of *B. obsignata* and *A. columbae* was higher in adults than in young pigeons but it did not differ significantly between the two sexes. The highest mean intensity rate of *B. obsignata* was observed in the autumn, while there was no significant difference for *A. columbae* with regard to season.

Mushi *et al.* (2000) examined twelve adult domestic pigeons from Sebele, Gaborone, Botswana for the presence of helminth parasites and observed the cestode genus Raillietina and two species of nematodes, *Dispharynx spiralis* and *Ascaridia columbae*.

Mushi *et al.* (2000) recorded the following parasites in apparently healthy pigeons kept in Sebele: a haemoprotozoan, *Haemoproteus columbae* (80 %); endoparasite metazoan nematodes, *Ascaridia columbae* (30 %) and *Dispharynx spiralis* (10 %); a cestode, *Raillietina* sp. (80 %) and coccidian oocysts (40 %); 2 ectoparasites, *Pseudolynchia canariensis* (50 %) and *Columbicola columbae* (30 %).

Dranzoa *et al.* (1999) examined 34 pigeons to investigate parasites from October, 1996 to March, 1997 and recorded the ectoparasites, *Pseudolynchia canariensis* was the most prevalent parasite (100%) followed by *Columbicola columbae* (94.1%) and *Menopon gallinae, Menacanthus stramineus* and *Chelopistes meleagridis* , cestodes (23.5%) and Haemaproteus (76.5%).

2.2 Pathological changes produced by parasites in pigeon

Shaikh *et al.* (2016) observed histopathological findings of helminth infected pigeon including architechtural designtegration of muscularis layer, destruction of crypt and Brurnner's glands, serosal necrosis, migratory tunnels formed along with fibrosis, villus atrophy and necrosis and infiltration of mononuclear (lymphocytes and macrophages) inflammatory cells in lamnia propria in the duodenum of intestine.

El-Khatam and Laila (2016) studied the histopathological changes of *T. gallinae* in crop, liver, larynx, and trachea as poorly eosinophilic bodies with severe inflammatory cell infiltration

Nisar *et al.* (2015) conducted a study to observe histopathological changes in intestines of *Columba livia* artificially infected with *C. digonopora* and *C. cuneata* observed infiltration of inflammatory cells in lamina propia, some portion of worm in muscular layer and necrotic serosa in *C. digonopora* infested pigeon and migratory tunnels formed along with fibrosis, necrosis and villous atrophy in *C. cuneata* infested pigeon.

Abed *et al.* (2014) studied histopathological changes including ulceration and sloughing of epithelial lining of intestine mucosa, distraction and degeneration of villi, desquamation of epithelium, destruction of secretary glands, infiltration of inflammatory cells and atrophy of villi. Liver of pigeon show severe necrosis and infiltration of inflammatory cells also there is vaculation of hepatocytes , congestion , hyperplasia of hepatocytes and some hepatocytes undergone fatty changes.

Bahrami *et al.* (2013) reported mild congestion in the tissue of small and large intestine of old pigeon infected with parasites. Histopathological changes including degenerative changes in the epithelial tissues of the intestine were observed in pigeons below 2 years old in comparison with above 2 years old birds.

Bahrami *et al.* (2013) studied histo-pathological effects of different arthropod, oocyst and worms infestation on the naturally infected wild pigeon and reported that degenerative changes in the epithelial tissues of the esophageal and proventriculus gland as well as destructive changes in the epithelium of the esophagus, duodenum and cecum of the pigeons infected with different worms and protozoa. Massive congestion was seen in tissue of pancreas & trachea.

Dey *et al.* (2010) observed pathological lesions in case of *Leucocytozoon* sp. and *Haemoproteus* sp. The suspected organs such as liver, lungs, kidney and heart were apparently normal. Microscopically, there were degeneration and dissolution of vascular endothelial cells in the heart was seen in case of Leucocytozoon infection. Comma shaped organism were detected in both cases and also infiltration of inflammatory cell. Schizonts were observed in liver parenchyma.

Begum *et al.* (2008) reported that pathological lesions of *Trichomonas gallinae* were confined in the crop, proventriculus and liver. There was an accumulation of greenish fluid and/or cheesy material in the crop and proventriculus. At necropsy, yellowish to grayish necrotic lesions were evident in the crop and proventriculus. On the other hand, the liver became congested where congestion of sinusoids and focal accumulation of heterophils in the parenchyma were found. But, no microscopic lesions were seen in the crop and proventriculus although gross lesions were more prominent in these two organs.

CHAPTER 3

MATERIALS AND METHODS

CHAPTER 3

MATERIALS AND METHODS

3.1 Study area and duration:

The study was conducted for a period of six months starting from January to June'2017. During this investigation, a total of 122 birds (83 adult and 39 young in which 45 male and 77 female) were considered from different farms of Sadar upazila of Dinajpur district ($50^0$37´ N. latitude and $88^0$39´ E longitude on the eastern bank of the river Punarvhaba), Bangladesh.

3.2 Selection and examination of bird:

A questionnaire was designed to collect the objectives oriented data from each bird by the help of the owner or by physical examination. The birds were taken out of the cages and restrained as described by Stone (1982). Age was determined by examining iris color and unmolted feathers and the presence of cloacal sex character and glandular bursa as described by Sol *et al*. (2000) and Silovsky *et al*. (1968) respectively. Sex was determined by general appearance, movement and behavior as described by Kabir (2014) and Hazard (1922). According to age pigeons are divided into two groups: young (1 to 3 months) and adult (>3 months). Examinations of each pigeon for ectoparasites, faecal and blood sampling were made in that order. All the samples were brought to the Parasitology laboratory of Hajee Mohammad Danesh Science and Technology University, Dinajpur.

3.3 Collection and examination of faeces:

Faecal samples were taken into a dry vial at the cloacal orifice by gently squeezing the abdomen and put into different labeled sample bottle containing 10% formalin. Faeces were examined by gross examination, three different types of qualitative tests; namely direct smear, flotation and sedimentation techniques were used to examine the fecal samples to identify the morphological features of eggs, cyst, oocysts (Hendrin and Robinson, 2006; Soulsby, 1982) .

Faeces were grossly examined for the presence of proglottids of cestodes.

The direct smear technique was done for examination of egg of helminthes and oocyst of Eimeria and it was conducted by mixing a drop of water with bit of feces using an applicator stick on glass microscopic slide covered with cover slip and examined at low and high power.

The floatation technique was used for detecting nematode eggs. Faeces were mixed thoroughly in a saturated sodium chloride solution and strained through a wire sieve into a test-tube. Further saline solution was added until a positive convex meniscus appeared and a coverslip applied immediately. It was allowed to stand for 8 to 10 min. The coverslip was then removed, applied to a glass slide and examined under a microscope using a 10X objective.

The sedimentation technique was used to detect trematode eggs. Faeces (5gm) were mixed thoroughly with water in a beaker, strained through a wire sieve into a beaker and the mixture left to stand for 4 min. The supernatant was poured off, and then the procedure was repeated 2 to 3 times until the supernatant was clear. The sediment was then poured into a petridish and then the sediment was examined under the microscope using a 10X objective.

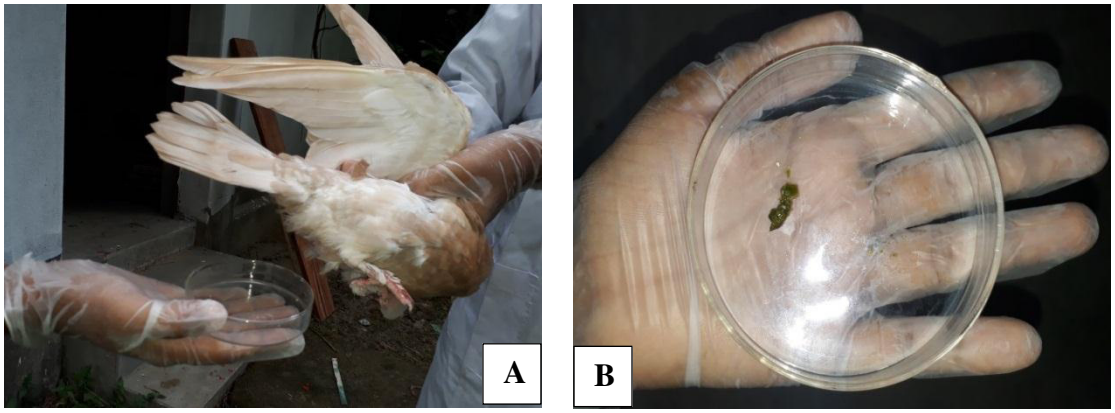

Figure 1: Collection of faeces (A, B)

3.4 Collection and staining of blood and identification of protozoa:

Blood samples were collected from the wing vein with the help of syringe and needle and taken in a vial with sodium salt of EDTA and kept in refrigerator. Cotton wool was placed over the area and pressure applied for haemostasis. The thin smear was made

immediately after the collection of blood. The smears were then air dried, fixed in methanol and stained with Giemsa's stain as per standard method (Cable, 1957). The slides were examined under microscope in higher magnification (40X and 100X) for the detection of blood protozoa. Identification was based on the morphology as described by Levine (1985), Springer (1997) and Soulsby (1982).

Figure 2: Collection of blood from wing vein (A) and preparation of blood smear (B, C)

3.5 Examination of oral swab for *Trichomonas gallinae:*

Fresh scraping from oral mucosa or oral, esophageal swab or swab from crop were taken and examined for the presence of *Trichomonas* gallinae, it was done by preparation of wet mount and confirmed by the motile trophozoites with pear-shaped parasite. **(McDougald, 2003**).

Figure 3: Collection of oral swab

3.6 Collection and examination of ectoparasites:

Each bird was carefully examined. The wings were fully stretched and examined, and all over the body, the feathers were separated so as to expose the skin. The ectoparasites were collected and preserved in 70% alcohol for subsequent processing and examination at the laboratory. Finally, the ectoparasites were identified according to Wall and Shearer (1997); Soulsby (1982); Kettle (1995) & Cheesbrough (1990).

Figure 4: Collection of ectoparasites

3.7 Postmortem and histopathological examination:

Postmortem examination of clinically sick and dead pigeons was performed as described by Fowler (1990). Intestines were collected and fixed in 10% buffered neutral formalin for histopathological studies. Formalin fixed tissue samples were processed, embedded in paraffin wax, sectioned and stained with hematoxylin and eosin as per standard method (Luna, 1968).

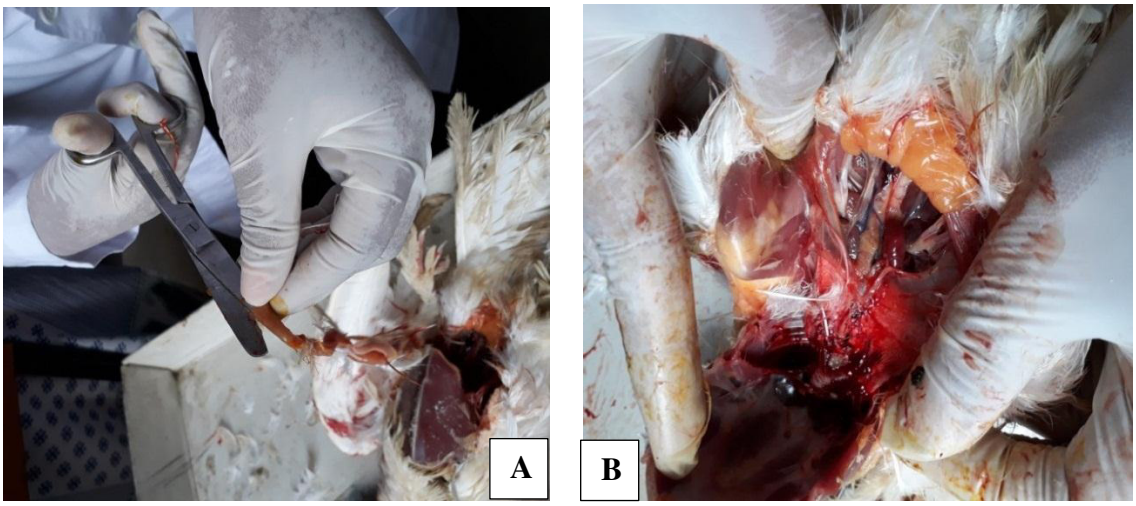

Figure 5: Postmortem examination and collection of sample (A, B)

3.8 Statistical Analysis:

The data were recorded and analyzed statistically by using statistical software 'SPSS' (version 20). Chi–Square Test were performed and the results were expressed in percentage with P–value and significance was determined when $P<0.05$. The mean intensity was calculated and analyzed by F-variance test. Odds ratio was calculated according to the formula Schesselman (1982).

3.9 Instrument and appliances used during this study:

- Study bird (pigeon) sample
- Scissors
- Forceps
- Gloves
- Musk
- Scalpel
- Knife

- A pair of shears
- Cotton
- Petridishes
- Beaker
- Stirrer
- Sieve
- Plastic bottle
- Vial
- Clean slides
- Cover slips
- Microscope

3.10 Chemicals and reagents used during this study:

- 10% formalin
- Chloroform
- Paraffin
- Alcohol
- Tap water
- Xylene
- Mounting media (DPX)
- Giemsa's stain
- Hematoxylin and Eosin stain
- Distilled water
- Lactophenol
- Saturated salt solution (NaCl)
- Acetic acid
- PBS (Phosphate Buffer Solution)
- Sodium salt of EDTA (Ethylene Diamine Tetra Acetic Acid)

3.11 Experimental design:

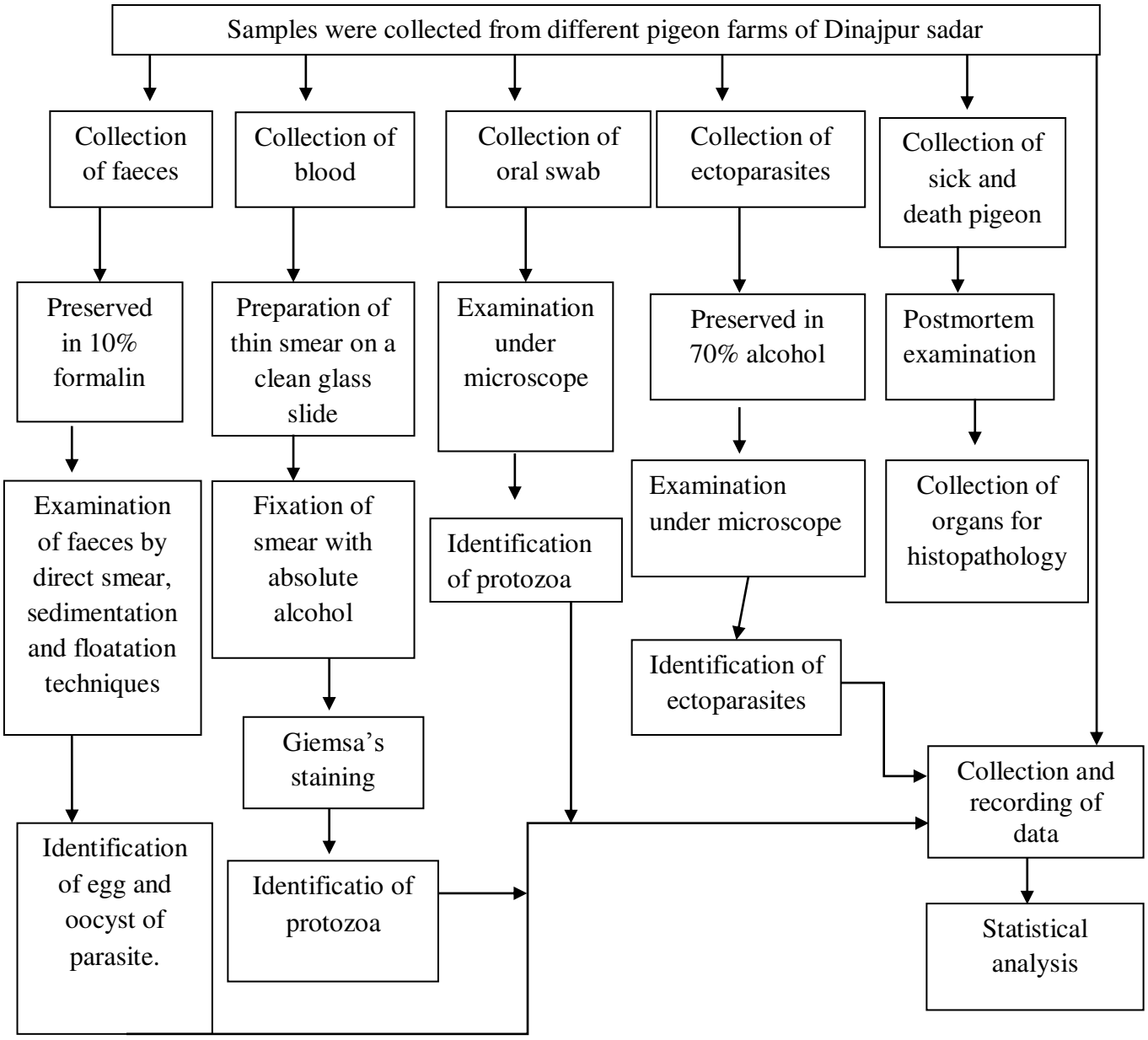

Figure 6: Layout of the experiment

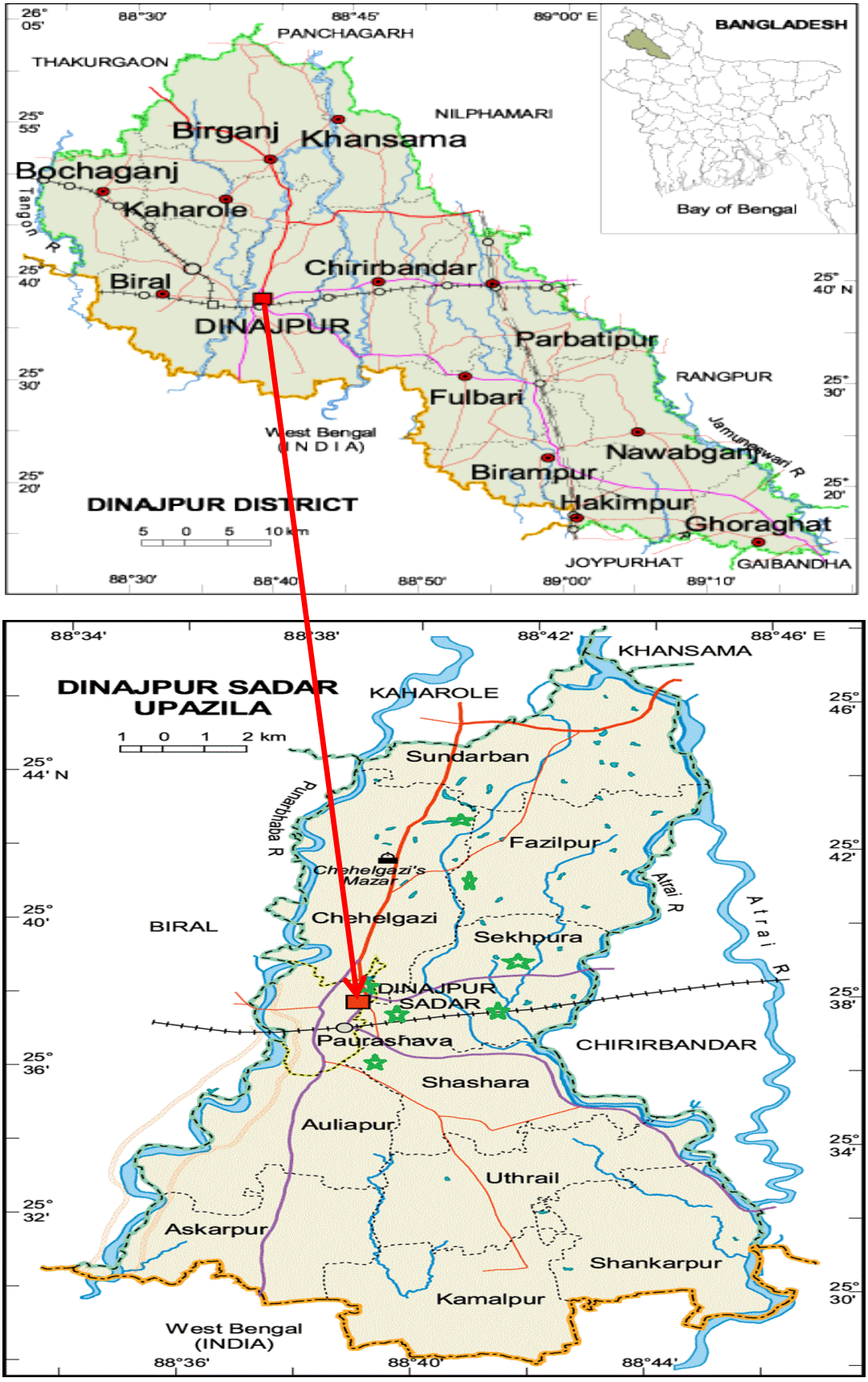

Figure 7: Maps show the study area (Dinajpur sadar, Dinajpur, Bangladesh). Green stars indicate the sites of sample collection.

CHAPTER 4

RESULTS

CHAPTER 4

RESULTS

4.1 Overall prevalence of parasites in farmed pigeon

In this study, a total number of 122 farmed pigeons were examined of which 96 (78.69%), 71(58.20%) and 107 (87.70%) were infected with different species of helminth, protozoa and ectoparasites respectively (Table 1). The present study indicated that the higher prevalence rate of helminthes was *Ascaridia* sp. (41.80%) followed by *Raillietina* sp. (37.67%), *Capillaria* sp. (31.15%), *Echinostoma* sp. (19.67%) and *Ornithostrongylus* sp. (12.3%). The protozoan parasites found in the table 1 were *Eimeria* sp. (36.89%), *Trichomonas* sp. (38.52%) and *Haemoproteus* sp. (31.97%). During this investigation, 3 species of ectoparasites were identified as 78.69%, 45.08% and 61.48% for *Columbicola columbae, Menopon* sp. and *Lipeurus* sp. The prevalence of *Columbicola columbae* was found highest among the ectoparasites.

Table 1: Prevalence of parasites in farmed pigeon at Dinajpur sadar (N=122)

Name of parasites	No. of infected pigeon	Prevalence (%)
Helminthes		
Overall	**96**	**78.69**
Echinostoma sp.	24	19.67
Raillietina sp.	46	37.67
Ascaridia sp.	51	41.80
Capillaria sp.	38	31.15
Ornithostrongylus sp.	15	12.30
Protozoa		
Overall	**71**	**58.20**
Eimeria sp.	45	36.89
Trichomonas sp.	47	38.52
Haemoproteus sp.	39	31.97
Ectoparasites		
Overall	**107**	**87.70**
Columbicola columbae	96	78.69
Menopon sp.	55	45.08
Lipeurus sp.	75	61.48

N= Number of bird examined

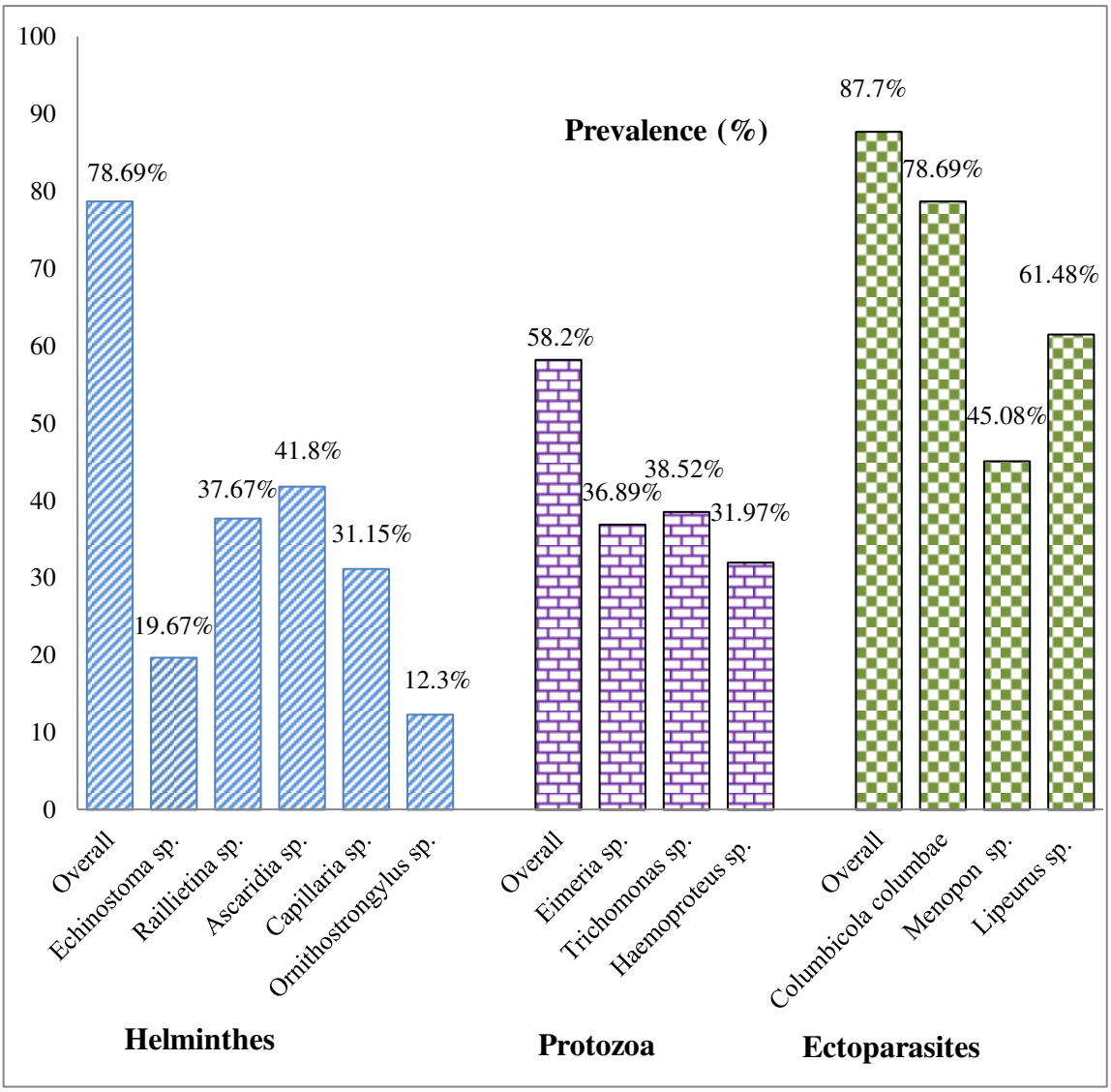

Figure 8: Overall prevalence (%) of different parasites in farmed pigeon.

4.2 Age related prevalence of parasites in farmed pigeon

The overall prevalence of helminth parasites was higher in adult (81.93%) than young (71.79%) pigeon but the difference was not significant. The odd ratio 1.8 implies that adults are 1.8 times more susceptible to helminthes than young. The prevalence of *Echinostoma* sp., *Raillietina* sp., *Ascaridia* sp.,*Capillaria* sp., *Ornithostrongylus* sp. in young and adult was 15.38% and 21.69%, 10.26% and 50.60%, 46.15% and 39.76%, 25.64% and 33.73%, 10.26% and 13.25% respectively (Table 2). The prevalence rate of *Raillietina* sp. was significantly ($P<0.001$) higher in adult than young pigeons but the others were not significant ($P>0.05$) and *Ascaridia* sp. was found higher in young than adult pigeons.

The higher prevalence of protozoan parasites was found in young (64.10%) than adult (55.42%) pigeon but there was no significant difference between age groups. The odd ratio 1.4 implies that youngs are 1.4 times more susceptible to protozoa than adults. The prevalence of *Eimeria* sp. was significantly ($P<0.05$) higher in young (51.28%) than adult (30.12%) pigeon. In case of *Trichomonas* sp., the prevalence was higher in young (48.71%) in compare to adult (33.73%) pigeons. On the other hand, *Haemoproteus* sp. was higher in adult (34.94%) than young (25.64%) pigeons.

The present study revealed that the overall prevalence of ectoparasites was significantly ($P<0.001$) higher in adult (96.39%) than young (69.23%) pigeons. The odd ratio 11.8 implies that adults are 11.8 times more susceptible to ectoparasites than young. The prevalence rate of *Columbicola columbae*, *Menopon* sp., *Lipeurus* sp. in young and adult was 48.72% and 92.39%, 30.77% and 51.81%, 35.90% and 73.49% respectively (Table 2) and all ectoparasites were significantly higher in adult than young pigeons.

Table 2: Age related prevalence of parasites in farmed pigeon at Dinajpur sadar

Name of parasites	Age		P value	Odd ratio
	Young (N=39) Positive no. (Prevalence)	Adult (N=83) Positive no. (Prevalence)		
Helminthes				
Overall	**28(71.79%)**	**68(81.93%)**	**0.20**(NS)	**Adult vs Young =1.8**
Echinostoma sp.	6(15.38%)	18(21.69%)	0.41(NS)	
Raillietina sp.	4(10.26%)	42(50.60%)	<0.001***	
Ascaridia sp.	18(46.15%)	33(39.76%)	0.50(NS)	
Capillaria sp.	10(25.64%)	28(33.73%)	0.37(NS)	
Ornithostrongylus sp.	4(10.26%)	11(13.25%)	0.64(NS)	
Protozoa				
Overall	**25(64.10%)**	**46(55.42%)**	**0.37**(NS)	**Young vs Adult =1.4**
Eimeria sp.	20(51.28%)	25(30.12%)	0.024*	
Trichomonas sp.	19(48.71%)	28(33.73%)	0.11(NS)	
Haemoproteus sp.	10 (25.64%)	33(34.94%)	0.30(NS)	
Ectoparasites				
Overall	**27(69.23%)**	**80(96.39%)**	**<0.001**	**Adult vs Young =11.8**
Columbicola columbae	19(48.72%)	77(92.77%)	<0.001***	
Menopon sp.	12(30.77%)	43(51.81%)	0.03*	
Lipeurus sp.	14(35.90%)	61(73.49%)	<0.001***	

N= Number of bird examined

*means significant at 5% level of significance (P< 0.05).

*** (P<0.001) means statistically highly significant.

NS means statistically Not Significant.

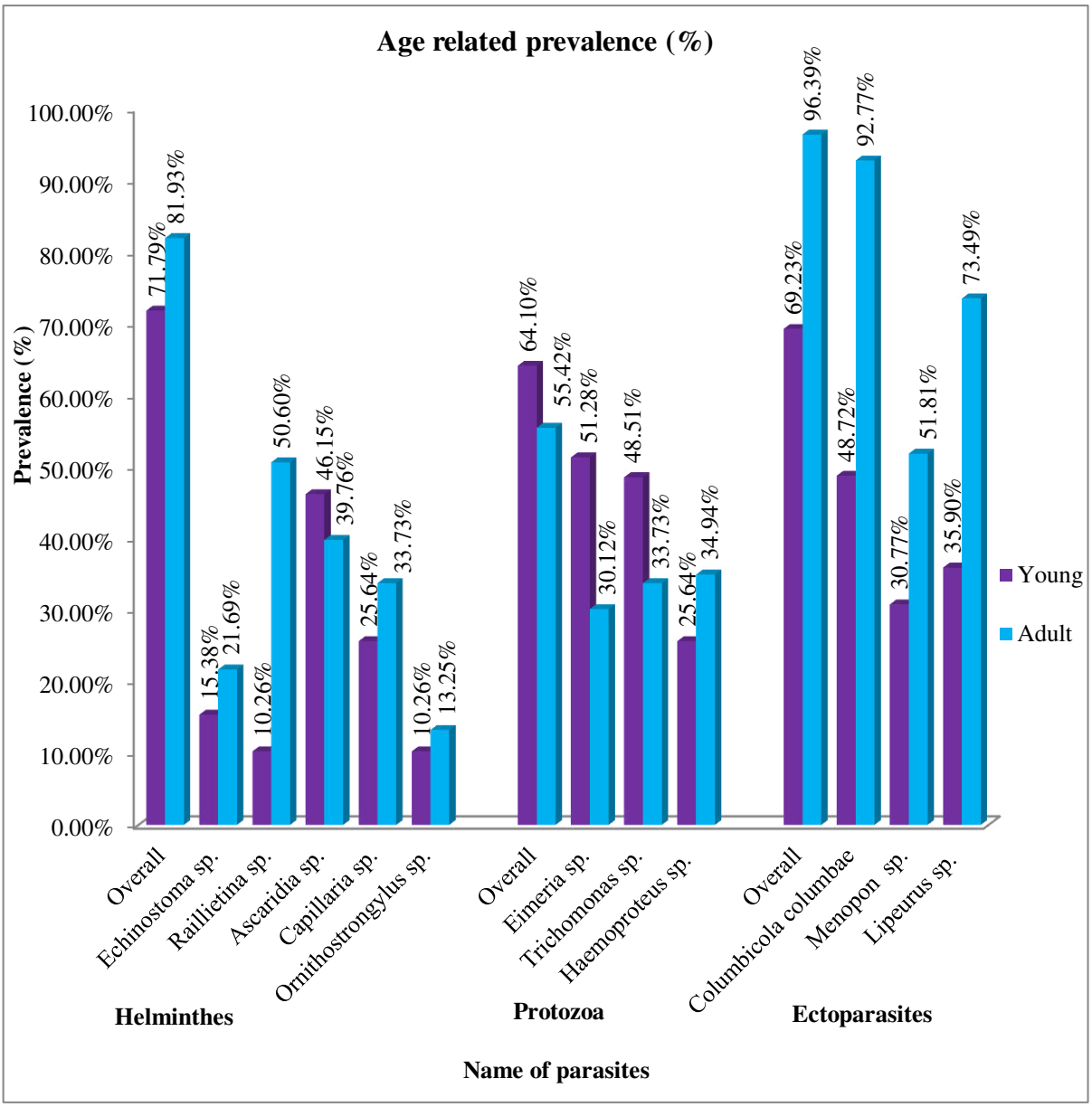

Figure 9: Age related prevalence of parasites in farmed pigeon

4.3 Sex related prevalence of parasites in farmed pigeon

The present study indicated that female pigeons (80.52%) were more susceptible to helminth parasites than male pigeons (75.56%) but it was not statistically significant (P>0.05). The odd ratio 1.3 implies that females were 1.3 times more susceptible than male pigeon. The prevalence percentage of *Echinostoma* sp., *Raillietina sp., Ascaridia* sp.*, Capillaria* sp.*, Ornithostrongylus* sp. in male was 8.89%, 33.33%, 35.56%, 24.44% and 4.44% respectively and in female was 25.97%, 40.26%, 45.46%, 35.04% and 16.88% respectively (Table 3). The prevalence of *Echinostoma* sp. and *Ornithostrongylus* sp. in female were statistically higher than male but others were not statistically significant.

During this investigation, it was found that females (64.94%) were higher in prevalence of protozoa than males (46.67%). The odd ratio 2.1 implies that females were 2.1 times more susceptible than male pigeon. The prevalence of *Eimeria* sp.*, Trichomonas* sp. and *Haemoproteus* sp. in male was 24.44%, 31.11% and 24.44% respectively and in female was 44.16%, 42.86% and 36.36% respectively (Table 3). There was significant (P<0.05) sex related difference seen in the prevalence of *Eimeria* sp..

The present findings showed that the prevalence of ectoparasites was significantly (P<0.05) higher in female (93.50%) than male (77.78%). The odd ratio 4.1 implies that females were 4.1 times more susceptible than male pigeon. The prevalence of *Columbicola columbae*, *Menopon* sp. and *Lipeurus* sp. in male was 64.44%, 37.78%% and 46.67% respectively and in female was 87.01%, 49.35% and 70.13% respectively (Table 3). There was no significant (P>0.05) sex related difference seen in the prevalence of *Menopon* sp. but in case of *Columbicola columbae* and *Lipeurus* sp. females were significantly higher in compare to male pigeons.

Table 3: Sex related prevalence of parasites in farmed pigeon at Dinajpur sadar

Name of parasites	Sex		P value	Odd ratio
	Male (N=45) No. positive (Prevalence)	Female (N=77) No. positive (Prevalence)		
Helminthes				
Overall	**34(75.56%)**	**62(80.52%)**	**0.52(NS)**	
Echinostoma sp.	4(8.89%)	20(25.97%)	0.02*	
Raillietina sp.	15(33.33%)	31(40.26%)	0.45(NS)	**Female vs Male=1.3**
Ascaridia sp.	16(35.56%)	35(45.46%)	0.29(NS)	
Capillaria sp.	11(24.44%)	27(35.04%)	0.22(NS)	
Ornithostrongylus sp.	2(4.44%)	13(16.88%)	0.04*	
Protozoa				
Overall	**21(46.67%)**	**50(64.94%)**	**0.048***	
Eimeria sp.	11(24.44%)	34(44.16%)	0.029*	**Female vs Male=2.1**
Trichomonas sp.	14(31.11%)	33(42.86%)	0.20(NS)	
Haemoproteus sp.	11(24.44%)	28(36.36%)	0.17(NS)	
Ectoparasites				
Overall	**35(77.78%)**	**72(93.50%)**	**0.01***	
Columbicola columbae	29(64.44%)	67(87.01%)	0.003**	**Female vs Male=4.1**
Menopon sp.	17(37.78%)	38(49.35%)	0.22(NS)	
Lipeurus sp.	21(46.67%)	54(70.13%)	0.01*	

N= Number of bird examined

*means significant at 5% level of significance (P< 0.05).

** means significant at 1% level of significance (P< 0.01).

NS means statistically Not Significant.

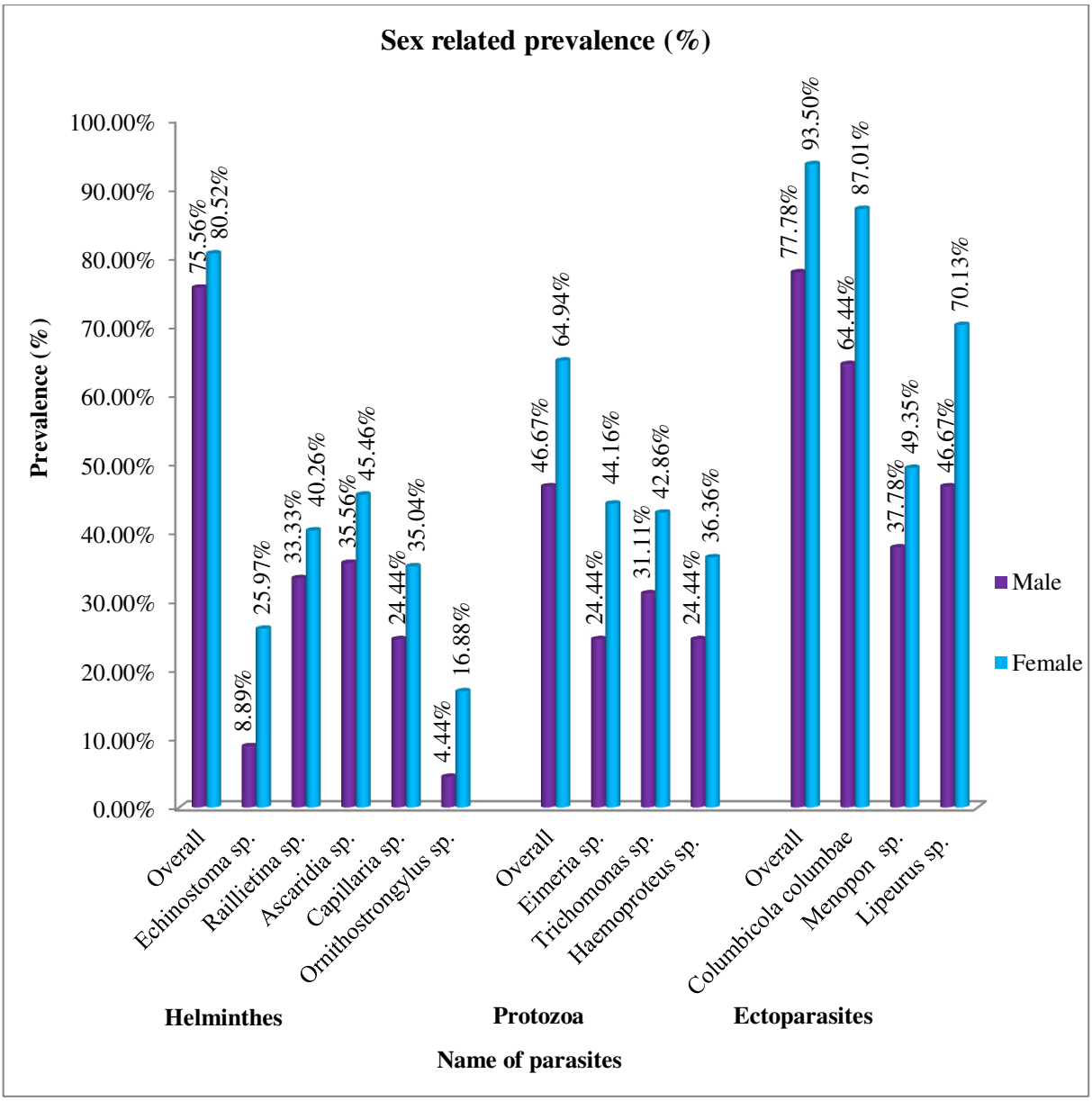

Figure 10: Sex related prevalence of parasites in farmed pigeon

4.4 Overall intensity of parasitic infections in pigeon

The results presented in Table 4 show that the intensity of different parasitic infections in farmed pigeons. The mean intensity of helminth parasites was higher in *Raillietina* sp. (4.30±0.35) followed by *Ascaridia* sp. (3.80±0.29), *Capillaria* sp. (2.53±0.23), *Echinostoma* sp. (2.50±0.30) and *Ornithostrongylus* sp. (1.92±0.24) respectively.

The mean load of different protozoa was encountered as 4.38±0.38, 4.53±0.42 and 7.82±0.61 for *Eimeria* sp., *Trichomonas* sp. and *Haemoproteus* sp. respectively and various ectoparasites comprising *Columbicola columbae*, *Menopon* sp. and *Lipeurus* sp. was 17.32±0.82, 14.47±1.13 and 11.91±0.85 respectively. The highest intensity was found in *Haemoproteus* sp. and *Columbicola columbae* among protozoa and ectoparasites respectively.

Table 4: Intensity of parasitic infections in farmed pigeons at Dinajpur sadar (N=122)

Name of parasites	No. of birds infected	Intensity		P value
		Range	(Mean±SE)	
Helminthes				
Echinostoma sp.	24	1-7	2.50±0.30^{ab}	<0.001
Raillietina sp.	46	1-10	4.30±0.35^{c}	
Ascaridia sp.	51	1-12	3.80±0.29^{bc}	
Capillaria sp.	38	1-6	2.53±0.23^{ab}	
Ornithostrongylus sp.	15	1-4	1.92±0.24^{a}	
Protozoa				
Eimeria sp.	45	1-10	4.38±0.38^{a}	<0.001
Trichomonas sp.	47	1-10	4.53±0.42^{a}	
Haemoproteus sp.	39	1-15	7.82±0.61^{b}	
Ectoparasites				
Columbicola columbae	96	5-41	17.32±0.82^{b}	<0.001
Menopon sp.	55	3-48	14.47±1.13^{ab}	
Lipeurus sp.	75	2-32	11.91±0.85^{a}	

P <0.001 means statistically highly significant

SE means Standard Error

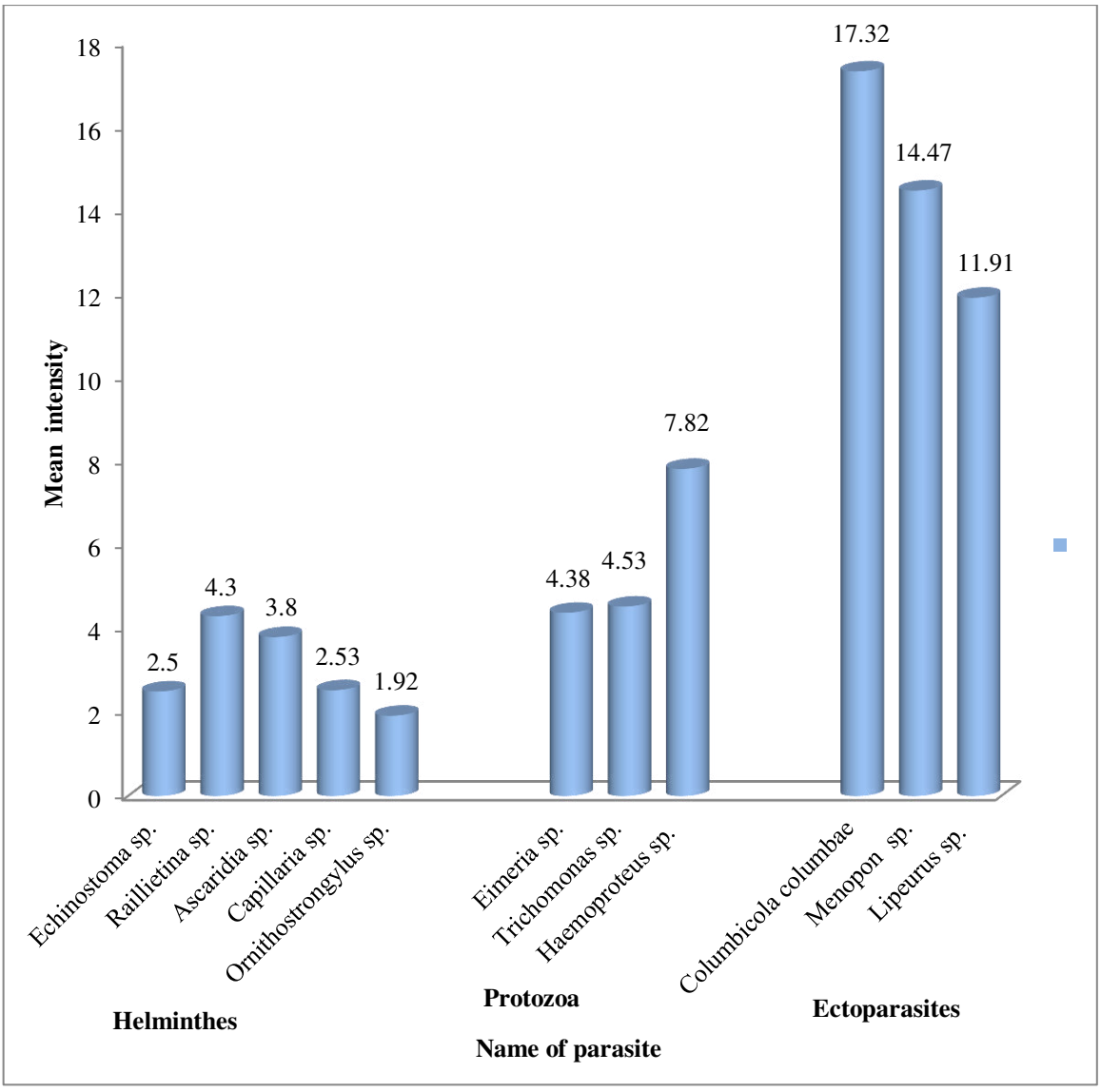

Figure 11: Intensity of different parasites in farmed pigeon

4.5 Intensity of parasitic infections in pigeon according to age

During this investigation, the mean intensity of *Echinostoma* sp., *Raillietina* sp., *Ascaridia* sp., *Capillaria* sp. *Ornithostrongylus* sp., *Eimeria* sp., *Trichomonas* sp., *Haemoproteus* sp., *Columbicola columbae, Menopon* sp. and *Lipeurus* sp. in young was 2.17±48, 2.00±0.41, 3.44±0.46, 2.10±0.31, 1.75±0.48, 3.85±0.57, 4.79±0.70, 8.60±1.38, 13.63±1.55, 10.08±1.22 and 8.57±1.35 respectively and adult was 2.61±0.37, 4.66±0.36, 4.00±0.38, 2.68±0.29, 2.09±0.28, 4.80±0.51, 4.36±0.52, 7.58±0.68, 18.23±0.93, 15.70±1.35 and 12.67±0.97 respectively (Table 5). The present study showed that statistical comparison of mean intensity of different parasites per infected birds between young and adult was not significantly (P>0.05) different for *Echinostoma* sp., *Ascaridia* sp., *Capillaria* sp. *Ornithostrongylus* sp., *Eimeria* sp., *Trichomonas* sp., *Haemoproteus* sp.and *Lipeurus* sp. but the mean intensity per infected pigeons in adult was statistically and significanty higher (P<0.05) than young for *Raillietina* sp., *Columbicola columbae* and *Menopon* sp.. The mean intensity of *Trichomonas* sp., *Haemoproteus* sp., was higher in young than adult pigeons but others were higher in adult than young pigeons.

Table 5: Intensity of parasitic infections in farmed pigeons according to age at Dinajpur sadar

Name of parasites	Age				P value
	Young (N=39) Intensity		Adult (N=83) Intensity		
	Range	(Mean±SE)	Range	(Mean±SE)	
Helminthes					
Echinostoma sp.	1-4	2.17±48	1-7	2.61±0.37	0.54(NS)
Raillietina sp.	1-3	2.00±0.41	1-12	4.66±0.36	0.03*
Ascaridia sp.	1-8	3.44±0.46	1-10	4.00±0.38	0.37(NS)
Capillaria sp.	1-4	2.10±0.31	1-6	2.68±0.29	0.28(NS)
Ornithostrongylus sp.	1-3	1.75±0.48	1-4	2.09±0.28	0.55(NS)
Protozoa					
Eimeria sp.	1-10	3.85±0.57	1-10	4.80±0.51	0.22(NS)
Trichomonas sp.	1-11	4.79±0.70	1-10	4.36±0.52	0.62(NS)
Haemoproteus sp.	2-14	8.60±1.38	1-15	7.58±0.68	0.46(NS)
Ectoparasites					
Columbicola columbae	5-32	13.63±1.55	5-41	18.23±0.93	0.025*
Menopon sp.	3-21	10.08±1.22	4-38	15.70±1.35	0.039*
Lipeurus sp.	2-21	8.57±1.35	2-32	12.67±0.97	0.058(NS)

N means number of pigeon examined. * means significant at 5% level of significance (P<0.05) and NS means statistically Not Significant (P>0.05). SE means Standard Error.

4.6 Intensity of parasitic infections in pigeon according to sex

It was observed that there was no significant (P>0.05) difference between male and female pigeons for the mean intensity of different parasites per infected pigeons. The mean intensity of *Echinostoma* sp., *Raillietina* sp., *Ornithostrongylus* sp., *Eimeria* sp., *Menopon* sp. in male was 3.00±0.71, 4.53±0.50, 2.5±0.50, 5.45±1.07 and 16.40±2.36 respectively which was slightly higher than female pigeons in where the mean intensity was 2.40±0.34, 4.39±0.47, 1.92±0.26, 4.03±0.36 and 13.60±1.25 respectively but in case of *Ascaridia* sp., *Capillaria* sp., *Trichomonas* sp., *Haemoproteus* sp., *Columbicola columbae and Lipeurus* sp., the mean intensity in male was 3.56±0.39, 2.00±0.27, 3.79±0.74, 6.55±1.09, 15.97±1.24 and 10.81±1.87 which was slightly lower than female pigeons in where the mean intensity was 3.91±0.40, 2.74±0.34, 4.85±0.50, 8.32±0.72, 17.91±1.05 and 12.33±0.93 respectively (Table 6). The present study proved that sex is not important in intensity of parasitic infection in pigeons.

Table 6: Intensity of parasitic infections in farmed pigeons according to sex at Dinajpur sadar

Name of parasites	Sex				P value
	Male (N=45) Intensity		Female (N=77) Intensity		
	Range	(Mean±SE)	Range	(Mean±SE)	
Helminthes					
Echinostoma sp.	2-5	3.00±0.71	1-7	2.40±0.34	0.77(NS)
Raillietina sp.	1-7	4.53±0.50	1-12	4.39±0.47	0.47(NS)
Ascaridia sp.	2-7	3.56±0.39	1-10	3.91±0.40	0.58(NS)
Capillaria sp.	1-3	2.00±0.27	1-6	2.74±0.34	0.15(NS)
Ornithostrongylus sp.	2-3	2.5±0.50	1-4	1.92±0.26	0.43(NS)
Protozoa					
Eimeria sp.	1-10	5.45±1.07	1-10	4.03±0.36	0.11(NS)
Trichomonas sp.	1-9	3.79±0.74	1-11	4.85±0.50	0.25(NS)
Haemoproteus sp.	1-14	6.55±1.09	2-15	8.32±0.72	0.19(NS)
Ectoparasites					
Columbicola columbae	5-32	15.97±1.24	5-41	17.91±1.05	0.28(NS)
Menopon sp.	3-32	16.40±2.36	4-38	13.60±1.25	0.26(NS)
Lipeurus sp.	2-21	10.81±1.87	2-32	12.33±0.93	0.42(NS)

N means number of pigeon examined. NS means statistically Not Significant (P>0.05).

SE means Standard Error.

4.7 Pathology of intestine infected with parasites of pigeon

During the postmortem examination, it was grossly found that enlargement of intestinal diameter; blockage of intestinal lumen by parasites.

Histopathological study revealed that the tissue section of intestine shows massive degenerative changes in the epithelial papillae, distraction, sloughing and degeneration of villi and desquamation of intestinal epithelium.

CHAPTER 5

DISCUSSION

CHAPTER 5

DISCUSSION

5.1 Overall prevalence of parasites in pigeon

The present investigation indicates that about 78.69% pigeons were infected with one or more species of the following helminthes including *Echinostoma* sp. (19.67%), *Raillietina* sp. (37.67%), *Ascaridia* sp. (41.80%), *Capillaria* sp. (31.15%) and *Ornithostrongylus* sp. (12.3%). These results show similarity with the findings of Msoffe *et al*. (2010) and Senlik *et al*. (2005) who found that 79.5% and 74% pigeons were infected with one or more species of gastrointestinal helminth respectively. The observations of Sivajothi and Reddy (2015) nearly support to the present findings who reported 72.7% of gastrointestinal parasitic infection in pigeon of which *Ascaridia columbae* (33.3%), *Capillaria columbae* (17.4%) and Raillietina (9.0%). Layla *et al*. (2016) observed 72.4% pigeons infected with helminthes in which 28.6% *Capillaria columbae* is consenting with the present findings. The overall prevalence of helminthes in this study shows higher than the results of Adang *et al*. (2009) who recorded 56.7% helminth parasites. The similar prevalence of *Ascaridia* sp. was recorded by Senlik *et al.* (2005) who reported that *Ascaridia columbae* was 42%. These results are more or less similar to the findings of some others. Tanveer *et al*. (2011) recorded *Ascaridia columbae* (32.8%) and *Capillaria obsignata* (67.2%) prevalence in pigeons. Begum and Sehrin (2012) reported *Echinostoma revolutum* (15%), *E. trivolvus* (5%) in pigeon. Abed *et al*. (2014) recorded 46.31% *Raillietina* spp. and 38.94% *Ascaridia* spp. Moreover, the highest prevalence of *Ascaridia* sp. infection shows the similarity with the findings of Ghosh *et al*. (2014) who found that the highest prevalence of *Ascaridia galli* (35%) among helminthes and Rabbi *et al*. (2006). Prevalence of *Ascaridia columbae*, *Raillietina* spp. and *Capillaria* sp. in this study shows much higher than the findings of Bahrami *et al.* (2013), Natala *et al.* (2009) and Tongson *et al.* (1975) recorded *Ornithostrongylus quadriradiatus* in domestic pigeon in Philipines.

The present study revealed that the overall prevalence of protozoan parasites was 58.20% of which *Eimeria* sp., *Trichomonas* sp. and *Haemoproteus columbae* were 36.89%, 38.52% and 31.97% respectively. The results are close to the observation of Radfar *et al*. (2012) who reported *Eimeria* sp. (40.17%) and *Trichomonas gallinae* (57.84%) and

Abed *et al.* (2014) and Orajaka and Nweze (1991) who reported 29.47% and 37.5% of *Haemoproteus* sp. respectively and Layla *et al*. (2016) who noticed Eimeria oocyst (33.3%). Higher prevalence of *Eimeria* sp. than the present observation was recorded by Parsani *et al.* (2014) and Eljardar *et al*. (2014) who reported 77% and 90% respectively and the lower prevalence of *Trichomonas* sp. than present study was observed by Abed *et al.* (2014) who found 10.52%. Higher prevalence rate of *Haemoproteus columbae* was reported by Marques *et al.* (2007) and Dranzoa (1999) and lower was observed by Doosti *et al*. (2014), Bahrami *et al*. (2012), Dadi-Mahmud *et al*. (2012), Dey *et al*. (2010) and Natala *et al*. (2009).

The present study revealed that the overall 87.70% pigeons were infested by the three species of ectoparasites including *Columbicola columbae* (78.69%), *Menopon* sp. (45.08%) and *Lipeurus* sp. (61.48%). The present findings are slightly higher than the findings of Adang *et al.* (2008) who reported 73.8% pigeons were infested with ectoparasites. These results are closely related to the results of Radfar *et al.* (2011) who reported *Columbicola columbae* (79.41%) and *Menopon* sp. (44.08%). The prevalence of *Columbicola columbae* and *Menopon* sp. was lower than the findings of Begum *et al.* (2011) who reported that the prevalence of *Columbicola columbae* and *Menopon* sp. was 100% and 100% respectively but the higher prevalence of *Lipeurus* sp. was found in the present investigation than the reports of Begum *et al.* (2011). The present findings differ with the observation of Adang *et al.* (2008) who reported lower prevalence of *Columbicola columbae* (63.8%) and *Menopon* sp. (6.3%) than the present findings. Moreover, the prevalence of *Lipeurus* sp. and *Menopon* sp. was much higher in the present study than the findings of Bahrami *et al.* (2012).

These variations among the present and earlier studies might be due to rearing practice, geographical location, study period, differences in sample collection techniques, and deviation in identification procedure.

5.2 Age related prevalence of parasites in pigeons

It was revealed that there was an effect of age on the prevalence of helminth parasites in pigeon. Among the age group, adult (>3 months) pigeons were comparatively more affected (81.93%) than young (1- 3 months) pigeons (71.79%).The present results are in the line with the findings of Gosh *et al.* (2014) and Sivajothi and Reddy (2015) who reported that adults were more susceptible than squab. Msoffe *et al.* (2010) also reported

that prevalence of gastrointestinal worm was significantly higher in adults than the nestling.

In the present study, it was observed that there was significant difference in the rate of infection in between young and adult pigeons. Under the present study the prevalence rate of ectoparasites was higher in adult (96.39%) than young (69.23%) pigeons. These results support to the findings of Gosh *et al.* (2014) who found that adult pigeons (86%) are more prone to ectoparasites in compare to squabs (48%).

Higher prevalence of such helminthes and ectoparasites in adults might be due to sharing of common premises with others which acts as an important reservoir and transmission media for soil transmitted helminthes (Islam *et al*., 2009) and ectoparasites.

Age had an effect on the prevalence of protozoa in pigeon. Young pigeons (64.10%) are more prone to protozoa than adult pigeons (55.42%). The present findings are in the disagreement with the finding of Kulisic (1989a) who reported that protozoan infections were detected more in adults (31.91%) than young (25%) pigeons. *Eimeria* sp. was found significantly higher in young than adult pigeon which is positively equal to the observation of Sivajothi and Reddy (2015) but differs with the reports of Gosh *et al.* (2014). Begum *et al.* (2008) reported that the prevalence of *Trichomonas gallinae* was more in adult pigeons (75%) than young pigeons (72.1%) which are dissimilar to the present results. The exact cause of higher prevalence of protozoa in young than adult pigeons can not be explained but it can be hypothesized that younger birds have less developed immune system compared to adults.

5.3 Sex related prevalence of parasites in pigeons

The present results showed that sex of pigeon had an influence on the prevalence of helminth parasites. Under the present study the higher prevalence of helminth parasites in farmed pigeon was in female (80.52%) than male (75.56%) which was not statistically significant. The present findings are in the agreement with the findings of Adang *et al.* (2009) reported the sex specific prevalence rate of helminth was 60% in female and 55% in male pigeons. Khezerpour and Naem (2013) who recorded that the prevalence of helminth parasites was significantly higher in female (65.62%) than male (34.47%) pigeons. Abed *et al.* (2014) reported that the prevalence of *Raillietina* sp. and *Ascaridia* sp. was 47.7% and 46% in male and 52.3% and 54% in female respectively which is

positive to the present study. The prevalence of *Ascaridia* sp. was found higher in female (45.46%) than male (35.56%) pigeons which does not support to the observation of Senlik *et al.* (2005) who reported 38.2% in females and 46.7% in males. The present investigation is not related to the results of Tanveer *et al.* (2011) who reported the prevalence of *Capillaria obsignata* was 72.7% in male and 60% in female.

The results revealed that there was an effect of sex on the prevalence of protozoan parasites in pigeon. In the present study the sex related prevalence of protozoan parasites was higher in female (64.94%) than male (46.67%) pigeons. These results are in the line with the observation of Abed *et al.* (2014) who observed that females are more susceptible to *Haemoproteus* sp. and *Trichomonas* sp. than male. The present results are related to the results of Begum *et al.* (2008) who reported that *Trichomonas gallinae* was higher in female (70.9%) than male pigeons (63.8%) and Islam *et al.* (2013) who found that females (31.58%) are more prevalent than male (19.3%) for *Haemoproteus* sp. but in contrast with Al-Barwari and Saeed (2012) who found that male pigeons have more prone to infection than female.

The sex related prevalence of ectoparasites in farmed pigeons showed highest prevalence found in female (93.50%) than male pigeons (77.78%).There was significant sex related difference found in the prevalence of *Columbicola columbae* and *Lipeurus* sp. but no significance difference in case of *Menopon* sp. The present observations support to findings of Adang *et al.* (2008) who reported that female (74.3%) had a higher prevalence than male pigeons (73.2%). Moreover, the equal prevalence rate (60%) of ectoparasites in female and male pigeons was recorded by Adang *et al.* (2009).

The actual cause of higher prevalence of parasites in female pigeons can not be demonstrated but it can be thought that hormonal influence and stress may affect the immunity of female pigeon which may be responsible for more parasitized than male.

5.4 Intensity of parasitic infections in pigeon

The findings of the present study showed that the mean intensity of different parasites in pigeons. The intensity of helminth parasites found in this study is more or less related to the findings of Begum and Sehrin (2012). The highest intensity rate was found in *Raillietina* sp. (4.43±0.35) among the helminth parasites which are similar to the findings of Musa *et al.* (2011) who recorded that the intensity of *Raillietina* sp. (16.08±5.5) was

the highest among helminth parasites. Among the ectoparasites, *Columbicola columbae* was found in higher infestation rate (17.32±0.82) which is very close to the findings of Adang *et al.* (2008) who also recorded the highest intensity of *Columbicola columbae* (17.90±0.78) among ectoparasites. The mean intensity of *Menopon* sp. (14.47±1.13) and *Lipeurus* sp. (11.91±0.85) were slightly higher than the findings of Musa *et al.* (2011) who recorded 9.00±3.00 and 9.5±2.00 respectively.

The present investigation demonstrated that the mean intensity of most of the investigated parasites was not significantly ($P>0.05$) different between young and adult pigeon but there was significant ($P<0.05$) difference for *Raillietina* sp., *Columbicola columbae* and *Menopon* sp. Msoffe *et al.* (2010) reported that there was significant age related difference for *Raillietina echinibothridia* and insignificant difference in case of *Ascaridia galli*.

It was observed that statistical comparison of mean intensity of different parasites per infected birds between male and female was not significantly different for helminth, protozoa and ectoparasites. It was found that differences of mean intensity between male and female were very low. These results are in the line of Adang *et al.* (2008) and Begum and Sehrin (2012) who recorded insignificant sex related difference in the intensity of ectoparasites and helminth parasites respectively. Senlik *et al*. (2005) also reported that the sex of pigeon was not important factor for helminth infections in pigeons.

5.5 Pathology of intestine infected with parasites of pigeon

In the present study, it was found that histopathological findings of parasite infected intestine of pigeon were obliteration of normal structure, degenerative changes in the epithelial papillae of intestine, destruction and degeneration of intestinal villi and desquamation of intestinal epithelium. The present findings are in line with observation by Abed *et al.* (2014) who observed ulceration and sloughing of epithelial lining of intestinal mucosa, distraction and degeneration of villi, desquamation of epithelium, destruction of secretary glands, infiltration of inflammatory cells and atrophy of villi and Bahrami *et al.* (2013) reported degenerative changes in the epithelial tissue of intestine. The histopathological changes might be due to continuous irritation of parasites to the intestinal wall.

CHAPTER 6

CONCLUSIONS

CHAPTER 6

CONCLUSIONS

The prevalence and intensity of different endo and ectoparasites in pigeons of Dinajpur sadar and variation in the prevalence and intensity of parasites in relation to age and sex were studied. In this study, eleven (11) species of both endo and ectoparasites were identified namely *Echinostoma* sp., *Raillietina* sp., *Ascaridia* sp., *Capillaria* sp., *Ornithostrongylus* sp., *Eimeria* sp., *Trichomonas* sp., *Haemoproteus* sp., *Columbicola columbae, Menopon* sp. and *Lipeurus* sp.. It was revealed that age and sex of pigeon had no significant ($P>0.05$) effect on the prevalence of helminthes and protozoa but had significant influence on the occurrence of ectoparasites. However, histopathological changes of infected intestine were also studied. It is recommended that further study should be conducted to determine the effect of parasite on the performance of pigeons and to find out the economic losses, effective preventive and control measures of those parasites. It is concluded that parasitic infestation is the major problem of pigeon farming in this area, so specific precautions must be taken against parasitic infections in farmed pigeons.

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APPENDIX

APPENDIX

QUESTIONNAIRE

Serial No.: ☐

1. **Particulars of the owner:**
   - i. Name …….....
   - ii. Village:…….....
   - iii. Upazila ……..……
   - iv. District…….....……
2. **Particulars of pigeon:**
   - i. Sex:
     - Male ☐
     - Female ☐
   - ii. Age:
     - Young ☐
     - Adult ☐
3. **Sample:**
   - Faeces ☐ Oral swab ☐ Blood ☐ Ectoparasite ☐
4. **Clinical findings:**
5. **Laboratory findings:**.....

…….....

Date: Signature of Investigator

Note: If necessary Bengali version of the questionnaire will be used while interviewing beneficiaries.