Original Article

An Investigation into the Prevalence of Gastrointestinal Helminths in Pigeons from Zabol, Iran

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ABSTRACT

It is not uncommon for pigeons kept for entertainment or competition to be infected with a variety of intestinal parasites, including nematodes and cestodes. Infection by these worms is a risk not only to birds but also to native wildlife and humans. The objective of this study is to assess the prevalence of helminth infections in pigeons in Zabol County, Iran, and to develop strategies for the prevention and treatment of these infections. A total of 220 pigeons were examined for the presence of parasites in their gastrointestinal tracts between 2021 and 2022. The pigeons were categorized according to gender, breed, age, medication, and feed type. The digestive tract contents were scraped and washed with warm water in order to collect intestinal helminths. A variety of techniques employed for the isolation, observation, and identification of nematodes and cestodes. Additionally,the parasites around the esophageal tissue were also examined in this study. A total of 96 positive cases of helminth infection (43.63%) were identified in the 220 samples of pigeon gastrointestinal tracts examined. In addition, 52 pigeons exhibited exclusive cestode infections, 14 had nematode infections, and 31 had co-infections. *Heterakis gallinarum* (*H. gallinarum*), *Eulimdana clava* (*E. clava*), *Hadjelia truncate* (*H. truncate*), and *Ascaridia columbae* (*A. columbae*) were among the nematodes found. Cestode species identified include *Raillietina tetragona* (*R. tetragona*), *Raillietina echinobothrida* (*R. echinobothrida*), *Raillietina cesticillus* (*R. cesticillus*), *Raillietina magninumida* (*R. magninumida*), and *Cotugnia digonopora* (*C. digonopora*). A statistical analysis of data revealed a significant correlation between helminth infection and drug consumption (p=0.001). Infection with nematodes and cestodes is also associated with pigeon age (p=0.00001). T Notably, despite the hot and dry conditions, there was a high prevalence of cestode and nematode infestations in pigeons in Zabol, Iran. It is imperative that a comprehensive control program be implemented to prevent parasite transmission to pigeons and the local avian ecosystem.

Keywords: *Cestode,* Iran, *Nematode,* Parasite, *Pigeon*

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1. Introduction

The Columbidae family, which includes wild and domestic pigeons, exhibits a wide range of colors and breeds.The Rock Pigeons (*Columba livia domestica*), also referred to as the urban pigeon, is a well-known domestic variety (1). The practice of breeding pigeons has become increasingly prevalent in recent years, resulting in a concomitant rise in the number of visits made to veterinary clinics. Since pigeons are frequently located in proximity to poultry farms, there is a possibility that they may be a vector for the transmission of poultry pathogens (2). It is therefore imperative to undertake further research study and to develop suitable treatment options for these birds. It is common for pigeons to be infected with parasites, including helminths and protozoa (3, 4). Pigeons are frequently exposed to single-celled protozoan parasites such as *Trichomonas gallinarum*, helminths, and ectoparasites, as a result of traditional husbandry practices (5). Ectoparasites can act as carriers for other parasites, and traditional husbandry practices often prove inadequate for their effective control (6, 7). Pigeon-borne parasite infections affect pigeons directly and serve as a vector for parasite transmission to other birds, native birds, and even humans (8, 9). Pigeons are particularly susceptible to gastrointestinal helminths, which can lead to nutritional deficiencies, severe enteritis, and intestinal expansion (10, 11). In order toPredict the risk of parasitic infection, it is necessary to consider a number of factors, including the pigeon's age, nutrition, immunity, and livig environment. Pigeons are frequently infected with gastrointestinal helminths, including nematodes, cestodes, and trematodes (12). The occurrence of trematodes is less common because they require snail hosts. The most prevalent cestode families are the *Davaineidae*, *Dilepididae*, and *Hymenolepididae* (13, 14). The objective of this study is to determine the prevalence of gastrointestinal helminth infections in pigeons in Zabol County, Iran, and to generate statistical data to improve the development of prevention and treatment strategies for parasitic diseases.

2. Materials and Methods

2.1. Study Area

Zabol County is located in the southeastern region of Iran's Sistan and Baluchestan province at coordinates 31.0294°N latitude and 61.4974°E longitude. The climate is arid,with scorching summers, temperate winters, and overall dry conditions. As a desert region, Zabol experiences scorching temperatures ranging from a low of between -12°C to a high of 53°C. During July, strong winds from the southwest bring about the formation of sandstorms and dunes.

2.2. Sampling

In the present study, the gastrointestinal helminths of 220 pigeons in Zabol County, which died from various causes, were collected and examined from 2021 to 2022 Additionally, theesophageal and tracheal tissues were also inspected for the presence of parasites. The sample population for this study was derived from recent investigations into the prevalence of parasite infections in pigeons (15). A total of 220 gastrointestinal tracts from deceased pigeons were examined in Zabol County, Iran. Furthermore, an examination of the esophageal and tracheal tissues was conducted. The digestive tract and stomach were then dissected with scissors, and; the contents were transferred to a container for examination. The entire mucosal was then washed and scraped under warm water pressure (60°C) to remove any residual content, after which it was transferred to the container. To prevent the coiling of nematodes, a hot water solution was applied. The container's contents were rinsed multiple times with a stream of hot water until all particles and debris were removed, and clear water emerged from underneath the sieve. The remaining contents were transferred to a glass bottle containing 70% ethanol. The material was placed in a Petri dish with a black background (black tile) for inspection under light microscopy in order to isolate the worms and digestive contents (16, 17). A light microscope was used to separate the worms, which appeared white. Following their isolation, the worms were transferred to containers containing 70% ethanol. The structure of nematodes was observed under a microscope using glycerin and lactophenol. In orderto diagnose cestodes, lactophenol was used to make a few segments transparent and the specimen was then examined under a microscope with 40× and 10× magnification. When appropriate, the carmine acid method was employed for the identification of Platyhelminthes.

2.3. Statistical Analysis

The pigeons were classified according to the following variables: gender, breed, age, drug consumption, and feeding type. The significance of the study was assessed through Chi-square tests the Chi-square tests. All analyses were conducted using the SPSS software version 21. The threshold for statistical significance inthis study is $p < 0.05$.

3. Results

A total of 220 pigeon gastrointestinal tract samples from pigeons were analyzed. Of these 96 (43.6%) were positive for helminth infection. Of the infected samples, 52 exhibited only cestode infection (23.6%), while 14 had nematode infection (6.4%). Furthermore, 30 pigeons exhibited co-infection with both cestodes and nematodes co-infected (13.6%). The identified nematode species included *A. columbae* in 17 infected pigeons (7.27%) (Figure 1.A), *H. truncata* in 31 pigeons (14.09%) (Figure 1.B), *E. clava* in 5 pigeons (1.81%), and *H. gallinarum* in 2 pigeons (0.9%). The cestodes identified in the study included *R. tetragona*, which was present in 75 infected pigeons (34.09%), *R. echinobothrida* in 22 pigeons (10%), *R. cesticillus* in 1 pigeon (0.45%), *R. magninumida* in 11 pigeons (5%), and *C. digonopora* in 4 pigeons (18.18%); (Table 1).

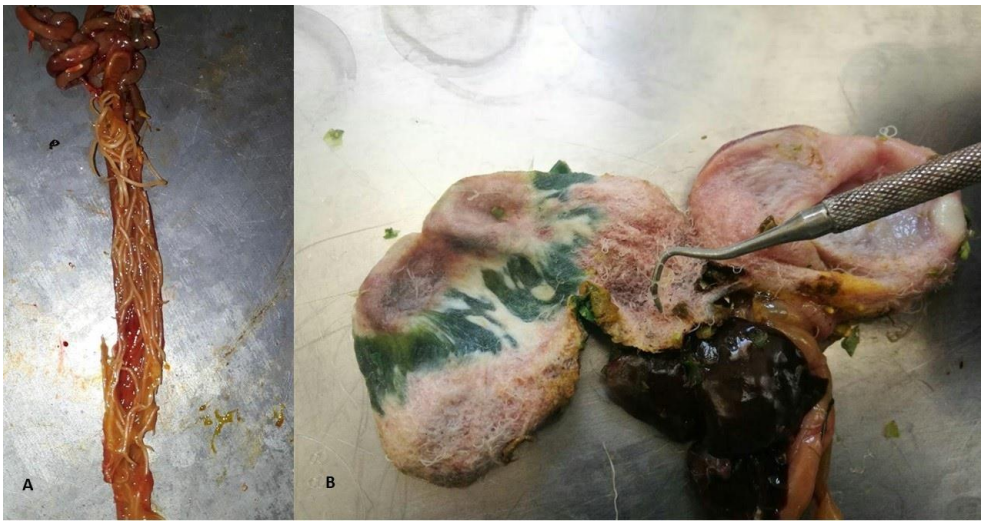

Figure 1. A: The presence of a significant number of *A. gallinarum* nematodes in the small intestine of a pigeon during necropsy. **B:** Observation of a notable number of *H. truncata* nematodes in the gizzard of a pigeon during carcass necropsy.

Table 1. The number and prevalence of gastrointestinal helminths found in the pigeon's population in Zabol, Iran.

Helminth/ Host		Infestation number	Prevalence (%)
Nematodes	*Ascaridia columbae*	17	7.27
	Hadjelia truncata	31	14.09
	Eulimdana clava	5	1.81
	Heterakis gallinarum	2	0.9
Cestodes	*Raillietina tetragona*	75	34.09
	Raillietina echinobothrida	22	10
	Raillietina cesticillus	1	0.45
	Raillietina magninumida	11	5
	Cotugnia digonopora	4	18.18

The results of the Chi-square test indicated a significant correlation between pigeon worm infestations and two factors: drug consumption and age. A Chi-square test revealed a significant correlation between the administration of drugs and the incidence of pigeon worm infestation (p=0.001).Moreoverthe older pigeons exhibited significantly higher rates of worm infestation compared to younger pigeons (p=0.00001), However, no significant correlations were observed between worm infestation and gender,breed, or feeding type (P>0.05). When nematode and cestodes infections were considered separately, significant correlations were observed between nematodes and pigeon age (p=0.00008) and between cestodes and both pigeon age and drug consumption (p=0.009). A higher prevalence of nematode and cestode infestations was observed in older pigeons.With a greater incidence of and cestode infestations noted in non-drug-treated birds (Table 2).

4. Discussion

It is a common practice worldwide to keep pigeons for various purposes, including, but not limited to, entertainment and participation in flying competitions. Pigeonsare susceptible to a variety of parasites, including helminths. In addition to causing harm to pigeons, these infections have the potential to spread to native birds and even humans (18). The gastrointestinal tracts of pigeons can be infested with helminths, including nematodes, cestodes, and trematodes (12). The results of this study indicate thatcestodes and nematodes are relatively prevalent in Zabol, Iran.

Table 2. A statistical comparison was performed based on nematode and cestode infections in pigeons categorized based on gender, breed, nutrition, and anthelmintic drug consumption.

Nematode infection / Pigeon sex				P-value	Cestode infection / Pigeon sex			P-value
	Male	Female	Total		Male	Female	Total	
Infected	20	24	44	0.543	36	50	86	0.067788
Non-infected	89	87	176		73	61	134	
Total	109	111	220		109	111	220	
Nematode infection / Pigeon breed				P-value	Cestode infection / Pigeon breed			P-value
	Native	Non-native	Total		Native	Non-native	Total	
Infected	38	6	44	0.2989	69	17	86	0.274266
Non-infected	146	30	176		115	19	134	
Total	184	36	220		184	36	220	
Nematode infection / Feeding				P-value	Cestode infection / Feeding			P-value
	Wheat	Mixed	Total		Wheat	Mixed	Total	
Infected	32	12	44	0.9593	63	23	86	0.156415
Non-infected	140	36	176		109	25	134	
Total	172	48	220		172	48	220	
Nematode infection / Drug consumption				P-value	Cestode infection / Drug consumption			P-value
	Drug used	Drug not used	Total		drug used	Drug not used	Total	
Infected	4	40	44	0.0842	9	77	86	0.009109
Non-infected	38	138	176		33	101	134	
Total	42	178	220		42	178	220	
Nematode infection / Pigeon age				P-value	Cestode infection / Pigeon age			P-value
	Under 6 months	6-12 months	Over 12 months	Total	Under 6 months	6-12 months	Over 12 months	Total
Infected	1	7	36	44	3	21	62	86
Non-infected	33	57	86	176	31	43	60	134
Total	34	64	122	220	34	64	122	220

During this study, approximately 43.6% of the sampled pigeons tested positive for parasites, with 23.6% exhibiting exclusive cestode infections, 6.4% nematode infections, and 13.6% co-infections in Zabol County. The prevalence of parasite infections in domestic pigeons was assessed across diverse geographicalregions of Iran.In a study conducted by Ashrafi-Helan et al. (2010) in Tabriz, a variety of parasites were identified. Of these *Capillaria obsignata* was the most prevalent while *A. columbae was* the least common (19). Borji et al. (2012) reported a prevalence of 21.6% for cestodes and 15.3% for nematodes (20). Islami et al. (2012) identified *R. magninumida*, *R. tetragona*, and *Cheilospiura hamulosa* were discovered in pigeons in Ilam by Islami et al. (2012) (21). *A. columbae*, *H. truncata*, and *Raillietina* species were identified in domestic pigeons in another study by Radfar et al. (2012)(22).

In their study of domestic pigeons in Tanzania's Morogoro region, Msoffe et al. (2009) identified three distinct types of intestinal helminths (23). It is possible that environmental factors may have contributed to the increased prevalence of *R. echinobothrida*. The prevalence of infestation was found to be influenced by a number of factors, including a lack of of vector control, poor hygiene practices, and the ineffectiveness of treatment. Cestodes were more prevalent in adult birds, whereas nematodes were more common in nestlings. The study by Parsani et al. (2010) concentrated on fecal examination and identified *A. columbae* and *C. obsignata* in pigeons in Gujarat, India (24). A warm and humid climate may facilitate the development of parasite eggs in the region, whereas a dry environment may reduce the probability of parasite egg survival in Zabol. As stated by Al-Bayati (2011), cestodes (*Aporina delafondi*, *Cotugnia intermedia*, and *Raillientina microcantha*) are

prevalent in Iraq, with a prevalence rate of 0.73% (17). Ashraf et al. (2011) reported that 41.3% of male and 39.7% of female pigeons had *C. obsignata* and *A. columbae* in their feces. The prevalence of *A. columbae* and *C. obsignata* was found to be higher in male subjects. Additionally,Fenbendazole was demonstrated to be a more efficacious treatment for these nematodesthan albendazole (25). As reported by Diakou et al. (2013), cestodes were identified in wild pigeons in Thessaloniki, Greece, including *R. echinobothrida*, *R. cesticillus*, and *R. tetragona*. The prevalence of *R. echinobothrida* and *R. cesticillus* was found to be more prevalent in their study than they were in the present study, whereas the prevalence of *R. tetragona* was found to be less prevalent (26). This discrepancy may be attributed to the absence of specific intermediate host species in Greece. In Gujarat, India, Parsani et al. (2014) conducted a study examining the prevalence of helminth parasites in wild and caged pigeons. They identified nematode species, including *A. columbae* and *C. obsignata*, as well as several cestode species, including *R. echinobothrida*, *R. tetragona*, *R. cesticillus*, *C. digonopora*, and *Hymenolepis* (24). In comparison to the present study, the aforementioned study identified a higher prevalence of nematodes but a lower prevalence of cestodes, which may be attributed to the India's warmer and more humid climate, which promotes the survival of eggs. It is imperative to exercise caution when interpreting variations in parasite prevalence, taking into account factors such as sample size, study design, methodology (necropsy or fecal examination), and geographic location. It is imperative that further research be conducted on the prevalence of gastrointestinal parasites in pigeons and the effects they have on these birds. The results of the current study indicate that parasites belonging to the cestode group such as *R. tetragona* and *C. digonopora* from the cestode group, as well as parasites belonging to the nematode group, including *H. truncata* and *A. columbae*, are more prevalent. Notwithstanding the arid conditions, cestodes and nematodes are relatively prevalent in Zabol. As a consequence of their adaptation to the environment, represent a threat to the health of pigeons. It is therefore imperative that a control and prevention program be implemented to protect pigeons and other native birds against these parasites.

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Authors' Contribution
Conceptualization: [EE], Methodology: [EE/HB], Formal analysis and investigation: [JK/EE], Writing-original draft preparation: [NL/MM]; Writing-review and editing: [NL/MM], Funding acquisition: [EE], Supervision: [EE] All authors checked and approved the final version of the manuscript for publication in the present journal

Ethics
All applicable international, national, and/or institutional guidelines for the care and use of animals were adhered to.

Conflict of Interest
The authors declare they have no conflict of interest.

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Data Availability
The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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