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Original Research Article

Distribution pattern of intestinal helminths in domestic pigeons (*Columba livia domestica*) and turkeys (*Meleagris gallopavo*) in Beni-Suef province, Egypt

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ABSTRACT

Parasitic helminths of pigeons and turkeys are worldwide spread causing mortalities and considerable economic losses. Accordingly, intestinal tracts of domestic pigeons (*Columba livia domestica*) and domestic turkeys (*Meleagris gallopavo*) were examined in Beni-Suef province, Egypt to detect their helminth fauna. A total of 740 intestinal samples from pigeons and 100 from turkeys were investigated during the period from June 2015 to May 2016. The overall prevalence of recovered helminths was 11.76% (87/740) in pigeons. The recovered species were identified as two trematodes, 5 cestodes and 4 nematodes. Digeneans were *Brachylaima cribbi* (1/740; 0.14%) and unidentified *Brachylaima* sp. (0.14%). Cestodal species were identified as *Raillietina echinobothrida* (33/740; 4.46%), *Raillietina cesticillus* (7/740; 0.95%), *Raillietina tetragona* (7/740; 0.95%), *Cotugnia digonopora* (5/740; 0.68%) and *Hymenolepis carioca* (2/740; 0.27%). Among cestodes, *R. echinobothrida* was the most predominant one. Recovered nematodal species were *Ascaridia columbae* (22/740; 3%), *Subulura brumpti* (6/740; 0.81%), *Heterakis gallinarum* (3/740; 0.41%) and *Capillaria* spp. (2/740; 0.27%). *Ascaridia dissimilis* was the only helminth species detected in turkeys (6/100; 6%). The highest prevalence of infection was seen in winter and summer. Tapeworms and round worms were highly prevalent at the summer. The recorded trematodal infection was found in winter. To the best of author's knowledge, adult *Brachylaima* spp. was first recorded from pigeons in Egypt. Veterinarians and workers of poultry industry must be aware towards the potential role of arthropods as vectors of such helminths among both domestic and wild birds.

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1. Introduction

During the past few decades, poultry farming has tremendously developed and become one of the most intensive forms of animal husbandry activities (Puttalakshmamma et al., 2008). Domestic pigeons (*Columba livia domestica*) tend to be closely contact with humans and birds as a source of protein, hobby, and recently as laboratory animals (Cooper, 1984; Harlin, 1994; Radfar et al., 2011).

The effects of parasitism on birds are often severe including malnutrition, retarded growth, low egg production, susceptibility to other infections and death in young birds (Radfar et al., 2012). Parasitic helminths disrupt gastrointestinal tract digestion and absorption of foods (Bahadory et al., 2014).

Domestic turkeys are considered as a major source of social economy in Egypt. They were not only a source of food, but also for important sacrificial offerings, and their bones, feathers, and other byproducts (Thornton et al., 2012). It has been found that bacterial, viral, parasitic and some non-infective agents such as management problems and nutritional deficiencies may lead to intestinal problems in turkeys (Hafez, 2011; Bahadory et al., 2014).

Ecto- and endoparasites of poultry are common in the tropics where the standard of husbandry is poor and climatic conditions are favorable for their existence (Imura et al., 2012; Badparva et al., 2015). The common internal parasitic infections in birds include cestodes, nematodes and coccidia. Free-range scavenging birds come in direct contact with parasite vectors, feces, and soil. The lack of hygiene, direct contact with humans, captivity conditions and the physical environment including rainfall, humidity, and ambient temperature may provide optimum conditions to maintain parasites populations.

Accordingly, the aim of such investigation was to determine the prevalence and biodiversity of intestinal helminths in pigeons and turkeys in Beni-Suef province, Egypt and the effect of seasonal variation in spreading helminthiasis in such birds.

2. Materials and methods

2.1. Study area and sampling

In the current study, intestinal samples from 740 domestic pigeons and 100 turkeys were collected from different local markets to investigate intestinal helminths in Beni-Suef province (coordinates: 29°04′N 31°05′E), Egypt during the period from June 2015 to May 2016.

2.2. Samples preparation

Samples were transferred to the laboratory of Parasitology, Faculty of Veterinary Medicine, Beni-Suef University for necropsy and further investigations. Each Intestinal sample was divided into foregut, midgut and hindgut. Double ligation of each section was done to maintain its contents. Longitudinal incision was made out, and then all unattached tapeworms and nematodes were gently extracted by means of needles in separate Petri dishes. Recovered helminths were thoroughly washed in saline, put in a separate jar and left to settle down for 30 minutes. The supernatant was decanted and the sediment was resuspended again. The process was repeated several times until the supernatant becomes clear. The sediment was separately examined by naked eyes and underwent a dissecting microscopy (Radfar et al., 2012).

2.3. Parasitological investigations

Digeneans and intact proglottids of tapeworms were dorsoventrally compressed, fixed in formalin 10%, dehydrated in ascending grades of ethyl alcohol, stained with acetocarmine stain, and mounted in Canada balsam on clean glass slides with coverslips (Rzad et al., 2013). Scolices were gently compressed between two coverslips to maintain the intact outline of suckers, rostella and hooks. Roundworms were cleared in lactophenol and mounted in glycerol jelly (El-Dakhly et al., 2012). Prepared slides were carefully examined under a light microscopy using different magnifications, and recovered helminths were identified according to Yamaguti (1961) and Soulsby (1982).

The overall prevalence, average abundance and their distribution of collected helminths in the intestinal tract in both pigeons and turkeys were evaluated.

3. Results

3.1. The overall prevalence

The current study revealed that out of 740 examined pigeons and 100 turkeys, 87 (11.76%) and 6 (6%), respectively were infected with intestinal helminths during the period from June 2015 to May

2016. Pigeons were infected by at least 11 species of helminths. Mixed infections were estimated in two birds (one was infected with trematodes and a nematode, and the other harboured a single nematode and a single cestode). Recovered helminths were identified as trematodes (1/740; 0.14%), cestodes (54/740; 7.3%) and nematodes (33/740; 4.5%). The nematode, *Ascaridia dissimilis*, was the only helminth species could be detected in turkeys (6/100; 6%).

3.2. Identification of recovered worms

3.2.1. Pigeon

A total of two trematodal species, 5 cestodal species and 4 nematodal species were recorded. The only detected trematode was *Brachylaima* spp. particularly for the first time in Egypt. The predominant helminth group among examined birds was cestodes (Fig. 1). The most prevalent species was *Raillietina echinobothrida* (33/740; 4.46%) followed by *Raillietina cestcillus* (7/740; 0.95%) (Fig. 2) and *Raillietina tetragona* (7/740; 0.95%).

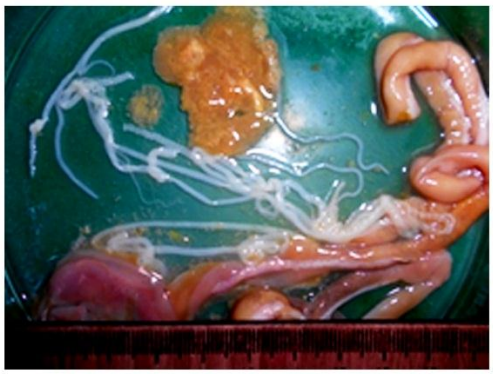

Fig.1. Adult cestodes recovered from intestinal tract of necropsied pigeons.

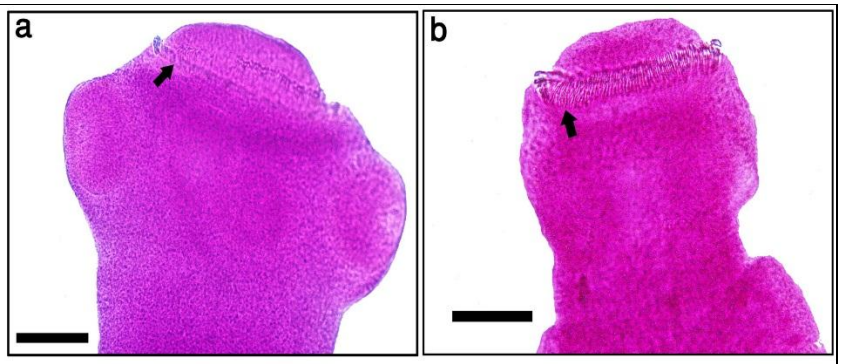

Fig. 2. Scolices of *Raillietina* spp. recovered from examined pigeons. a) Scolex of *Raillietina echinobothrida*. Note that rostellum is armed with 2 rows of hooks (*arrow*). Scale bar= 100 µm. b) Scolex of *Raillietina cesticillus* showing piston-like head armed with hooks (*arrow*). Scale bar= 50 µm.

The least common tapeworms were *Cotugnia digonopora* (5/740; 0.68%) (Figs. 3,4) and *Hymenolepis carioca* (2/740; 0.27%). It has been found that *Raillietina echinobothrida* had the highest intensity among recovered helminths, and *Hymenolepis carioca* showed the lowest one.

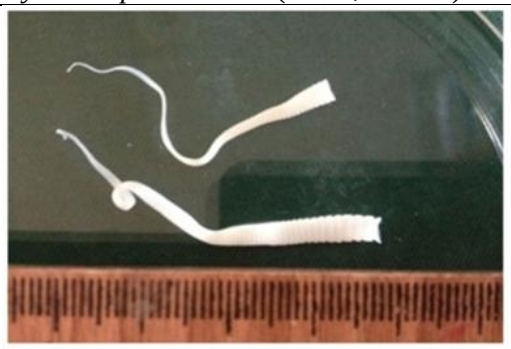

Fig. 3. Adult *Cotugnia digonopora* recovered from necropsied pigeons.

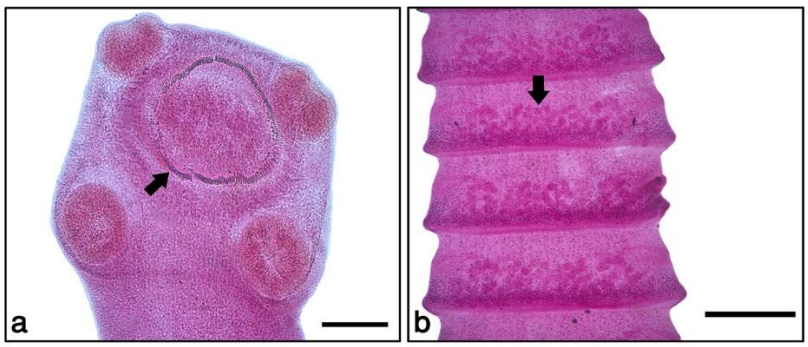

Fig. 4. *Cotugnia digonopora* recovered from examined pigeons. a) Scolex of adult. Note 4 cup-shaped muscular suckers and a well distinct rostellum armed with hooks (*arrow*). Scale bar= 100 µm. b) A series of mature proglottids showing testes concentrated at the posterior part of each segment (*arrow*). Scale bar= 500 µm.

Roundworms were identified in 33/740 (4.5%) pigeons (Fig. 5); among those, the most prevalent species was *Ascaridia columbae* (22/740; 2.97%), *Subulura brumpti* (6/740; 0.81%), *Heterakis gallinarum* (3/740; 0.41%) and *Capillaria* spp. (2/740; 0.27%). *Ascaridia columbae* was the most

abundant. The most prevalent cestodal species was *Raillietina echinobothrida* and *Raillietina cesticillus.* The most common nematode species was *Ascaridia columbae*.

Fig. 5. Adult *Ascaridia* spp. recovered from necropsied pigeons.

3.2.2. Turkeys

Results revealed that out of 100 examined turkeys, 6 (6%) were infected only with nematode helminths. The recorded helminth in turkeys was identified as *Ascaridia dissimilis* (Figs. 6,7).

3.3. The seasonal variation

It has been found that the highest prevalence of worm infection was found in summer 29/160 (18.13%) and in spring (3/21; 14.29%). Meanwhile, the lowest infection recorded in winter (35/309; 11.33%) and in autumn (20/250; 8.0%) (Table 1). Concerning cestodes, it was observed that *Raillietina echinobothrida* and *Raillietina cesticillus* were more prevalent in autumn and winter, however, *Raillietina tetragona* was found in low percent in both summer and winter. *Cotugnia digonopora* was found in autumn, winter and summer in a very low prevalence rate. *Hymenolepis carioca* was detected in autumn only. Meanwhile, the nematodal worm*; Ascaridia columbae* was more predominant in summer and winter. *Subulura brumpti* was more prevalent in summer. *Heterakis gallinae* were recorded in winter and summer. *Capillaria* sp. was only detected in summer. Furthermore, the only detected trematodal worm was *Brachylaima* spp. that was detected in winter (Table 2).

Fig.6. Adult *Ascaridia* spp. recovered from necropsied turkeys.

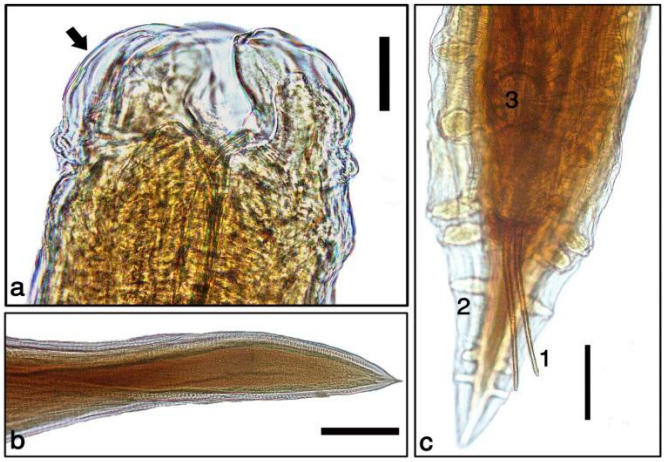

Fig. 7. *Ascaridia dissimilis* recovered from examined turkeys. a) Anterior end showing well distinct 3 lips (*arrow*). Scale bar= 50 µm. b) Posterior end of adult female showing pointed extremity. Scale bar= 200 µm. c) Posterior end of adult male showing more or less equal spicules (1), cloacal papillae (2) and prominent precloacal sucker (3). Scale bar= 200 µm.

Worm burden relative to seasons varied among the examined birds. The highest variation was recorded in both *R. echinobothrida* (it ranged from one to 41 worms/bird) and *A. columbae* (it ranged from one to 171worms/bird) (Table 2).

Table 1. The seasonal prevalence of helminths infection among pigeons in Beni-Suef province, Egypt.

Season / Class	Summer (*n*=160)		Autumn (*n*=250)		Winter (*n*=309)		Spring (*n*=21)	
	Inf.		**Inf.**		**Inf.**		**Inf.**	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Digenea	0	0	0	0	*	0.32	0	0
Tapeworms	13	8.13	17	6.8	22	7.44	One	4.76
Round worms	16	10	3	1.2	11	3.88	2	9.52
Total	29	18.13	20	8.0	33*	11.33	3	14.29

No. referred to number of infected birds. % referred to percentage of infected birds. *Plus the single infection (33), two pigeons had mixed infection (one had a cestode with nematodes and the other harboured trematodes with nematodes).

Table 2. The worm burden among infected pigeons relative to seasons.

Season / Class	Summer (*n*=160)		Autumn (*n*=250)		Winter (*n*=309)		Spring (*n*=21)	
	Inf.		Inf.		Inf.		Inf.	
	No.	W.B.	No.	W.B.	No.	W.B.	No.	W.B.
***Brachylaima* spp.**	0	0	0	0	1	16	0	0
R. tetragona	2	1-3	0	0	5	1-5	0	0
R. echinobothrida	9	3-40	10	1-35	13	2-41	1	15
R. cesticillus	1	5	3	2-7	3	1-4	0	0
C. digonopora	1	2	2	1	2	2-3	0	0
H. carioca	0	0	2	1	0	0	0	0
A. columbae	9	1-70	2	1-3	9	1-170	2	2-13
H. gallinarum	1	3	0	0	2	18-51	0	0
S. brumpti	4	1-5	1	3	1	3	0	0
***Capillaria* spp.**	2	1	0	0	0	0	0	0

No. referred to number of infected birds. W.B. referred to worm burden among infected birds.

4. Discussion

In Egypt, livestock and poultry production are the most common dietary protein sources. Pigeons can fly long distances, so they can be infected by various parasites and pathogens carrying them to other poultry flocks and humans such as coccidiosis, toxoplasmosis, avian influenza (Adang, 1999). Several internal and external parasites caused morbidity and mortality in such birds (Cheng, 1973; Soulsby, 1982).

In the current study, the overall prevalence of intestinal helminths in pigeons was 11.76% (87/740). However, in Egypt, Khater (1993) and Ahmed et al. (2013) reported prevalence rates of 51.6% and 51.7% in Kalubia and Gharbia provinces, respectively. This might be due changes of topography, environmental conditions, and high population density of intermediated hosts which implicate in the life cycle of helminths. Furthermore, previous literature recorded a high prevalence of intestinal helminths ranging from 23.18% and up to 84.78% in different countries rather than Egypt (Senliket al., 2005; Marques et al., 2007; Adang et al., 2008; Msoffe et al., 2010; Radfar et al., 2012; Khezerpour and Naem, 2013; Sivajothi and Sudhakara, 2015). Such findings might be contributed to the bad management and control in either birds or the surrounding environment (Atsineka and Banke, 2006; Adang et al., 2008). Closely to the present study, Olsen and Braun (1980) recorded prevalence rate of 12.5% in band-tailed pigeons in the USA.

Currently, the total infection rate was the highest in summer (18.13%) and was the lowest in autumn (8.0%). However, in Egypt, Ahmed et al. (2013) found the highest rate of infection in autumn

(67.1%) while the lowest rate was recorded in spring (38.8%). Such variation might be due to the locality.

It has been detected that the prevalence of trematodes was 0.14% recording two specimens of the genus *Brachylaima* Dujardin, 1843 recovered from one domestic pigeons. Brachylaimidae is a large family of digeneans with a global distribution (Suleman and Khan, 2016). *Brachylaima* spp. were found in Columbidae as indicated by Nasir and Rodriguez (1966), Glass et al. (2002) and Taroda et al. (2013). In the present investigation, infection with trematodal species was low. In the authors' opinion, pigeons are kept under closed housing system; therefore, there is a low exposure of them to the free water infested with snails which considered as the known carriers of trematodes.

The prevalence of cestodes was 7.29%. However, Hussien (1991) and Ahmed et al. (2013) found prevalence rates of 34.76% and 30.9% in domestic pigeons in Giza and Gharbia provinces, Egypt, respectively. Furthermore, Ashrafihelan et al. (2010) recorded that the prevalence of tapeworms was 28.13% in domestic pigeons in Iran. The prevalence of *R. echinobothrida* was 4.46% in pigeons. It was lower (17.7%) than those reported by Ahmed et al. (2013) in domestic pigeons, Egypt. Moreover, the current findings go in line with those obtained by Natala et al. (2009) who recorded a prevalence of 7.6% in Nigeria. Previous literature recorded a prevalence of 6.48% to 63% in countries other than Egypt (Msoffe et al., 2010; Borji et al., 2012). Variation could be referred to poor hygienic measures, the presence of intermediate hosts and decreased host immunity. On the other hand, Senlik et al. (2005) recorded that *R. echinobothrida* infection rate was one % in Turkeys.

Based on the seasonal variation, it was detected that *R. echinobothrida* was found in all seasons with a high prevalence in autumn and winter. Such finding agreed with Kennedy (1975). It is worthy to clarify that intermediate hosts, like ants, exist extensively in such seasons. In the current work, the prevalence of *R. tetragona* was 0.95%, while Ahmed et al. (2013) recorded 4.7% in Egypt. Furthermore, infection rates ranging from 2.89% to 27.1% were recorded (Adang et al., 2008; Kezerpour and Naem, 2013). The infection rate of *R. cesticillus* was 0.95% coinciding with those achieved by Adang et al. (2008) in Nigeria (0.45%). However, Natala et al. (2009) and Begum and Sehrin (2012) recorded higher prevalence rates (3% and 100%) in Nigeria and in Bangladesh, respectively. Such discrepancies could be related to the differences in the prevailing environmental conditions at the sampling time and to hygienic measures (Eshetu et al., 2001; Radfar et al., 2012). The infection rate of *Cotugnia* spp. (0.68%) was lower than those recorded by Abed et al. (2014) (20%) in Iraq. Moreover, infection rate of *Hymenolepis carioca* was 0.27%, and it was lower than those detected by Adang et al. (2008) in Nigeria (1.3%).

It was revealed that prevalence of nematodes was 4.5%. Oppositely, Ahmed et al. (2013) in Egypt and Tanveer et al. (2011) in Pakistan recorded infection rates of 14.3% and 40.5%, respectively. The prevalence of *Ascaridia columbae* (3%) was lower than those determined by Nagwa et al. (2013) in Egypt and Bahrami et al. (2012) in Iran recording 12% and 8.4%, respectively. The infection rate was higher than that detected by Natala et al. (2009) (1.2%) in Nigeria. Such findings agreed with Djelmoudi et al. (2014) who recorded 4.2% in Algiers Sahel, Algeria. In the current investigation, the seasonal prevalence of *Ascaridia columbae* was higher in summer and winter. Furthermore, the prevalence of *H. gallinarum* (0.41%) was lower than those showed by Ahmed et al. (2013) in Egypt and Adang et al. (2008) in Nigeria (7.2% and 3.3%, respectively). The prevalence of *Capillaria* spp. (0.27%) was lower than those estimated by Sivajothi and Sudhakara (2015) (17.4%) in India. It was near to which recorded by Khezerpour and Naem (2013) in domestic pigeons in Iran (0.72%).

The worm burden in pigeons ranged from 1-170 worms/bird, closely to Msoffe et al. (2010). A single infection was more common rather than mixed helminths agreeing with those given by Borji et al. (2012). Based on the authors' knowledge, infective dose, availability of intermediate hosts may be indicative to the variability of the worm burdens.

The present study revealed *Ascaridia dissimilis* in domestic turkeys and the prevalence was 6%. However, Maxfield et al. (1963) recorded 66.2, 71.1, and 35.3% in wild, pen raised and domestic turkeys in the USA. Moreover, Opera et al. (2014) found infection rate of 60% in Nigeria. On the other hand, Oates et al. (2005) in Nebraska found that it was 2.6% in wild turkeys.

5. Conclusion

Intestinal tracts of both pigeons and turkeys were investigated in Beni-Suef, Egypt. Pigeons were found to be infected with flukes, tapeworms and roundworms. Cestodal infection (*Raillietina* spp.) was the most predominant one. Turkeys were only infected with a single species of nematodes. It is worthy to mention that the highest infection rates were recorded in summer. To the best of authors' opinion, this is the first record of adult *Brachylaima* spp. in naturally infected pigeons in Egypt.

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