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Parasite species diversity in stray dogs from the city of Sofia

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Abstract: A coprological examination was conducted on stray dogs captured in Sofia as part of other preventive veterinary measures. The animals were divided into three age groups: ≤1 year, 1–5 years, and >5 years. Routine coproscopic methods were employed, including isolation of tapeworm segments, fecal flotation with both sodium chloride and magnesium sulfate, and larvoscopy using the modified Baermann technique. The overall prevalence of parasitic infection in the studied dogs was 81.32%. The results revealed the presence of reproductive stages (eggs, oocysts, larvae, and mature proglottids) of the following helminths and parasitic protozoa: Ancylostomatidae (42.59%), *Trichuris* spp. (28.70%), *Toxocara canis* (27.78%), *Toxascaris leonina* (9.26%), *Dipylidium caninum* (4.63%), *Taenia hydatigena* (1.85%), *Isospora* spp. (1.85%), and *Angiostrongylus vasorum* (0.93%). The highest prevalence of parasitic infection was observed in dogs from the youngest age group (90.91%). These findings confirm that stray dogs in Sofia serve as significant reservoirs and disseminators of parasites, posing a potential risk of transmission to domestic dogs and humans.

Keywords: parasite species diversity; stray dogs; helminths; protozoa; city of Sofia

INTRODUCTION

Stray dogs frequently act as important reservoirs of zoonotic parasites and infectious agents (Otranto et al., 2017). Research indicates that these animals are highly susceptible to infection with a diverse spectrum of parasitic species (Calvopina et al., 2023).

Over the past several decades, the parasite species identified in dogs in our country have been the focus of numerous scientific investigations (Georgieva et al., 1999; Kirkova et al., 2006; Radev et al., 2011; Iliev et al., 2017; Panayotova-Pencheva, 2022).

According to Zurliyski (1983), the predominant helminth type in all dogs in our country (domestic, shepherd, and stray) is *Toxocara canis*.

Tapeworms in stray dogs in Sofia were studied by Stoimenov and Zhelyazkov (1994) and Kanchev et al. (2016), who proved that *Dipylidium caninum* is the most common established tapeworm in them.

Georgieva et al. (1999) identified several helminth species during the necropsy of stray dogs from Stara Zagora. The cestodes identified were *Dipylidium caninum*, *Mesocestoides lineatus*, *Taenia hydatigena*, and *Echinococcus granulosus*, while the nematodes included *Ancylostoma caninum*, *Uncinaria stenocephala*, *Trichuris vulpis*, *Toxascaris leonina*, *Toxocara canis*, and *Dirofilaria immitis*. The same authors are estabilished and protozoa from the genus *Isospora* spp. and *Sarcocystis* spp. in stray dogs from the studied area.

Another study directly related to the nematode *Trichuris vulpis* from Northeastern, Central, and Southern Bulgaria shows an extent of infection with this parasite of 30.00% in hunting dogs, 21.80% in guard dogs from rural regions, 9.00% in dogs from kennels and 6.00% in domestic dogs (Kirkova et al., 2006).

Research by Lalkovski and Sabev (2009) in 114 faecal samples from domestic dogs, 272 from service dogs and 20 from stray dogs from the Sofia region found that 24.88% were-infected with endoparasites. In the infected animals, the predominant infection was *Dipylidium caninum* 25.00%, followed by representatives of the family Ancylostomatidae 18.75% and *Toxocara canis*. The highest extent of parasite infection was found in samples from stray dogs.

According to data from the Northwest region of Bulgaria, the most frequently encountered parasites in stray dogs are nematodes of the family Ancylostomatidae, as well as the species *Toxocara canis*, *Mesocestoides lineatus* and *Taenia hydatigena* (Kamenov et al., 2009).

A follow-up study conducted from Radev et al. (2016) found at the stray dogs in Sofia presence of the following parasitic species - *Ancylostoma caninum* 52.50%, *Toxocara canis* 12.50%, *Uncinaria stenocephala* 15.00%, *Trichuris vulpis* 12.50%, *Dipylidium caninum* 5.00% and *Isospora canis* 7.50%.

Published data regarding the prevalence of gastrointestinal parasites in domestic dogs kept outdoors are reported from Iliev et al. (2020). They report for general prevalence from 64.50%. Accordingly, *Ancylostoma* spp. and *Uncinaria* spp. accounted for 54.10%, *Trichuris vulpis* 15.10%, *Capillaria* spp. 11.00%, *Toxocara canis* 6.40%, *Cystoisospora* spp. 4.10%, *Sarcocystis* spp. 2.30%, *Toxascaris leonina* 1.70%, *Taenia* spp. 1.20%, *Dirofilaria immitis* 0.50% and *Angiostrongylus vasorum* 0.60%.

AIM AND OBJECTIVES

The aim of the present study is to obtain up-to-date data on the species composition of endoparasites in stray dogs living in Sofia, as well as on the differences related to the age groups of the animals.

To achieve this aim, the following tasks were set: to collect individual fecal samples from stray dogs inhabiting the territory of Sofia and to examine them for the presence of whole parasites, their body parts, sexual products (eggs or larvae), and protozoan oocysts. Subsequently, the obtained data were analyzed to characterize the parasitic infection in stray dogs from the metropolitan area.

MATERIAL AND METHODS

A total of 108 individual fecal samples collected from stray dogs (*Canis familiaris*) from the area of Sofia during the period January - April 2017 were included in this study. The samples were taken in accordance with the requirements and stored under refrigerated conditions (about 4°C) until the time of the study.

The animals were divided into three age groups: dogs under 1 year (11 samples), from 1 to 5 years (56 samples) and dogs over 5 years (41 samples).

Routine coproscopic methods were used for the study – isolation of tapeworm segments, fecal flotation with sodium chloride and magnesium sulfate, and larvoscopy by the modified Berman test, as described by Kanchev et al. (2016). Identification of the parasitic infections was performed based on the morphological features of the parasites and their sexual products, using a magnifying technique and consulting some modern references (Zajac and Conboy, 2012; Taylor et al., 2016; Kanchev et al., 2016). Metric data for the parasites and their reproductive products were obtained by measuring with an ocular micrometer.

RESULTS

Eggs of three nematode species (*Toxocara canis*, *Toxascaris leonina*, and *Trichuris vulpis*), eggs of nematodes from the family Ancylostomatidae, mature segments of two tapeworm species (*Dipylidium caninum* and *Taenia hydatigena*), oocysts of protozoa from the genus *Isospora*, and larvae of the nematode *Angiostrongylus vasorum* were detected (Table 1).

The established extent of infection in stray dogs from the Sofia region is 81.32%.

The obtained results showed the presence of sexual products (eggs, oocysts, larvae and mature proglottids) of the following helminths or parasitic protozoa: family Ancylostomatidae (42.59%), *Trichuris vulpis* (28.70%), *Toxocara canis* (27.78%), *Toxascaris leonina* (9.26%), *Dipylidium caninum* (4.63%), *Taenia hydatigena* (1.85%), *Isospora* spp. (1.85%) and *Angiostrongylus vasorum* (0.93%) (Fig. 1).

The highest extent of infection was found in dogs under 1 year of age (90.91%), followed by the group over 5 years of age (78.05%) and lowest in animals between 1 and 5 years of age (75.00%) (Fig. 2).

Table 1. Frequency and types of helminths in stray dogs from Sofia city, 2017

Age group	Number of dogs	Infection with nematodes (number of cases)	Infection with tapeworms (percentage value)	Infection with protozoa (percentage value)	Prevalence in %
under 1 year	11	***Toxocara canis* (90.91%); Ancylostomatidae (90.91 %); *Trichuris vulpis* (36.36%); *Angiostrongylus vasorum* (9.09%)**	No	No	**90. 91 %**
1 to 5 years	56	***Toxocara. canis* (25.00%)*; *Toxascaris leonina* (8.93%)*,**; Ancylostomatidae (28.57%)*,**; *Trichuris vulpis* (19.64%)*,***;**	*Dipylidium caninum* (3.57%)*,***; *Taenia hydatigena* (3.57%)*	***Isospora* spp. (3.57%)*, **;**	**75.00 %**
over 5 years	41	***Toxocara canis* (19.51%); *Toxascaris leonina* (12.20%)*; Ancylostomatidae (46.34%)*,**; *Trichuris vulpis* (39.02%)*,**;**	*Dipylidium caninum* (7.32%)*	No	**78.05 %**
Total	**108**	**5 nematode species/types**	**2 tapeworms species**	**1 protozoan genus**	**81.32 %**

*Note: *Data with cases of co-infection of present species with other nematodes; ** Cases of co-infection with tapeworms; *** Cases of co-infection with Isospora spp.*

Source: Authors' own elaboration

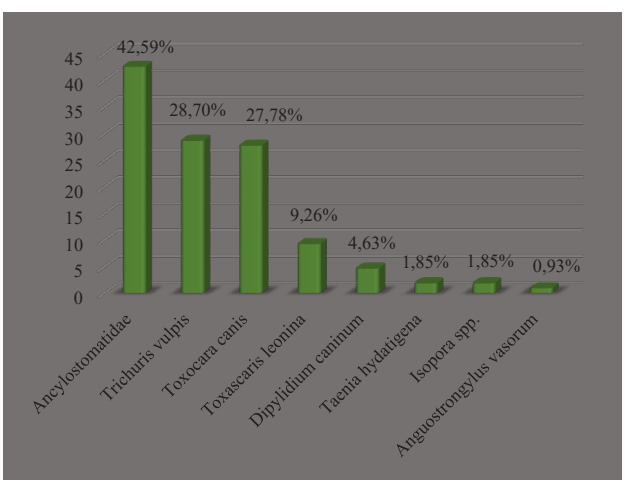


Figure 1. Species composition and prevalence of parasites in stray dogs

Source: Authors' own elaboration

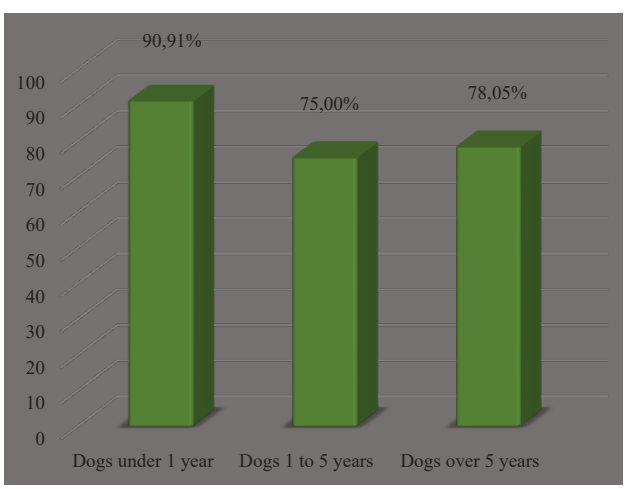


Figure 2. Extent of infection in dogs according to age groups

Source: Authors' own elaboration

DISCUSSION

The composition of the parasite fauna in stray dogs established by the present study confirms the species structure of the causative agents in previous studies related to these animals from the area of Sofia (Stoimenov and Zhelyazkov, 1994; Lalkovski and Sabev, 2009; Radev et al., 2011; Radev et al., 2016; Kanchev et al., 2016), area of Stara Zagora (Georgieva et al., 1999; Kirkova et al., 2006) and Northwestern Bulgaria (Kamenov et al., 2009).

Our findings indicate the presence of larvae of *Angiostrongylus vasorum*, a nematode previously reported by Iliev et al. (2020). Given the parasite's life cycle and its reliance on intermediate hosts (such as snails), its detection in the youngest age group of dogs is consistent with behavioral patterns typical of this group, including the frequent ingestion of various objects from the environment, potentially including invertebrates.

The overall extent of infection in dogs in the present study remains high, with a trend towards increasing percentage values compared to the results of other research teams (Lalkovski and Sabev, 2009; Radev et al., 2016). This can be explained by the fact that, at present, there is no national program for the control of stray dogs in cities in our country, and their population still remains high in the Sofia region. A comparison between our study and that conducted in domestic dogs by Iliev et al. (2017) reveals a significant difference in the percentage values. The husbandry of domestic dogs, including regular treatment against ectoparasites and endoparasites, avoidance by owners of diets including raw meat and internal organs of domestic animals, as well as limited contact with stray dogs, significantly reduces the risk of parasite infection.

The results obtained by the present research team regarding the highest percentages of detected strongylid eggs confirm previous studies by Georgieva et al. (1999), Kamenov et al. (2009) and Radev et al. (2016), but do not confirm those of Zurliyski (1983), according to which the predominant species in dogs is *Toxocara canis*. When comparing results of *Trichuris vulpis* (28.70%) with those of Kirkova et al. (2006), the similar values in hunting dogs (30.00%) and dogs from rural areas (21.80%) are striking. These results once again show that among domestic dogs, those most at risk of endoparasite infection are those that have uncontrolled access to the outdoor environment. These are animals in which regular prophylaxis is often not performed.

The established infections with two tapeworm species in stray dogs (*Dipylidium caninum* and *Taenia hydatigena*) have also been found by other authors (Stoimenov and Zhelyazkov, 1994; Georgieva et al., 1999; Kanchev et al., 2016). The results for the extent of infection with *Dipylidium caninum* obtained by Stoimenov and Zhelyazkov (1994) – 35.48% – do not correspond to the values obtained by us.

The percentage values obtained from the age distribution are very close. The approximately identical living conditions in which the stray dogs live make them equally at risk of endoparasite infection.

CONCLUSIONS

1. In stray dogs from the Sofia region, four nematode species, representatives of an additional nematode family, two cestode species, and one protozoan species were identified.

2. The overall extent of endoparasite infection in stray dogs is 81.32%, making it relatively high.

3. Endoparasites were most frequently detected in dogs up to 1 year of age.

4. A case of *Angiostrongylus vasorum* infection has been proven in a stray dog from the Sofia area.

5. Of the protozoan parasites, only oocysts of the species *Isospora* spp. are found in our study.

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