

Gastrointestinal helminths of dogs in Western Pomerania, Poland

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ABSTRACT. A total of 763 fecal samples were collected from dogs in Western Pomerania during 2006–2007 to determine the gastrointestinal parasite fauna of dogs in this region. In the city of Szczecin, 648 fecal samples were collected every month in the annual cycle from nine city areas and analysed. Six fecal samples were taken at each collection time from each site. A total of 115 fecal samples from rural areas were investigated. Each fecal sample was dissected with a needle, checked for tapeworm segments and adult forms of nematodes, and examined for parasite eggs using Willis-Schlaff flotation method. The mean prevalence of gastrointestinal parasite infection among dogs in Western Pomerania was 34.84%. The greatest number of samples containing parasites came from the Chociwel commune (46.67%), and the smallest number from the city of Szczecin (23.92%). The greatest number of samples containing parasites from the city of Szczecin originated from the Słoneczne estate (34.72%), and the smallest number from the Kasprowicz Park (13.89%). Dogs' feces were found to contain segments of *Dipylidium caninum* (4.07%) and *Taenia* sp. (3.45%) tapeworms and eggs of five species of gastrointestinal nematodes: *Uncinaria stenocephala* (11%), *Toxocara canis* (20.62%), *Toxascaris leonina* (2.91%), *Ancylostoma* sp. (4.61%), and *Trichuris vulpis* (0.27%). The highest prevalence of endoparasite infection among dogs was found in July (42.60%) and the lowest in February (5.56%). Both single- and multi-species infections were observed. In the area of Szczecin, single-species infections were the most common (18.83%).

Key words: dogs, intestinal parasites, parasite fauna, Western Pomerania, tapeworms, gastrointestinal nematodes

Introduction

The number of dogs in Polish households is increasing. Dogs may be a threat to human health. The proportion of animals with parasites is high in both urban areas and villages [1–4]. Exposure of the human population to parasite eggs is proportional to the extent of environmental contamination [5–7].

Children are most vulnerable to parasitic infections. They come into contact with animal feces mainly in contaminated sandboxes and playgrounds, but also through direct contact with quadrupeds. The main contributing factor to infection is the lack of hand-washing habit. According to Mizgajska et al. [1], removal of feces from streets and squares is considered effective because eggs are developing into the invasive form for at least 2 weeks. Parasite eggs pass in feces to the soil, where they remain dormant for many years until a new host (including human) is available.

One of the most common cosmopolitan parasite of dogs is the canine roundworm, *Toxocara canis.* Apart from its veterinary importance, this species is responsible for the most widely recognised form of visceral larva migrans (VLM) in man. The global condition occurs most commonly in children, often under 5 years of age, who have had close contact with household pets, or who have frequented areas such as public parks where there is contamination of the ground by infective dog feces. Despite this high risk of exposure to infection, the reported incidence of clinical cases is small. In many cases, larval infection is limited to the liver, and may give rise to hepatomegaly and eosinophilia, but on some

occasions a larva escapes into the general circulation and arrives in another organ, the most frequently noted being the eye. Control of visceral larva migrans is based on the anthelmintic regimen described above, on the safe disposal of dog feces in houses and gardens, and on the limitation of access by dogs to areas where children play, such as public parks and recreation grounds [8].

Whipworms (*Trichuris vulpis*) live in the intestine with their ends embedded in epithelial cells. Because this species produces large amounts of eggs, they are highly abundant in the host's feces, which facilitates transmission of the parasite. *Trichuris vulpis* life cycle involves only one host. Infestation occurs after ingesting the eggs excreted in feces. Infections may occur without symptoms or cause diarrhea and anemia. Trichuriasis may be life threatening to animals, especially where mass invasions occur [9].

In addition to roundworms, hookworms of the family Ancylostomatidae (*Ancylostoma caninum* and *Uncinaria stenocephala*) are the most common parasites found in dogs. Hookworms suck large amounts of blood from their hosts and while infected animals may look healthy in the first week of life, they can develop a rapidly severe, often fatal, anemia [10]. Humans can become infected with hookworms through ingestion of infective larvae or through direct penetration of the skin [11]. When infective larvae penetrate the skin, they undergo a prolonged migration that causes a condition known as cutaneous larva migrans. These larval migrations are characterized by the appearance of progressive, intensely pruritic, linear eruptive lesions, which are usually more extensive with *A. braziliense* infections. *A. caninum* larvae may also penetrate into deeper tissues and induce symptoms of visceral larva [12].

There are two species of *Taenia* sp. tapeworms in dogs: *Taenia hydatigena* and *Taenia pisiformis.* The adult form lives in the small intestine, and uterine proglottids containing eggs are released in feces. The intermediate host becomes infected by ingesting eggs that hatch into larvae. These larvae develop into their second stage known as the cysticercus. The final host becomes infected by ingesting the intermediate host together with cysticerci. Infections in the final host generally occur without symptoms. Much more serious are infections in intermediate hosts. Cysticerci localized in organs such as the spinal cord or brain severely disrupt bodily functions [13].

Table 1. Mean prevalence of gastrointestinal parasite infection among dogs

Region	Mean prevalence of infection (%)
Chociwel	46.67
Mieszkowice	42.10
Ostrowiec	26.67
Szczecin	23.92
Mean	34.84

Another tapeworm harmful to health in humans and animals is *Dipylidium caninum*. Predators are usually the final host. Cysticerci develop in the flea, which is the intermediate host. When the flea is ingested by the final host, the parasite's adult form develops in the digestive tract. *Dipylidium caninum* tapeworms can develop in the alimentary canal of humans, mainly children, after a larval form (cysticercoid) of a crushed flea (*Ctenocephalides canis*, *Ctenocephalides felis*, *Pulex irritans*) or biting louse (*Trichodectes canis*) gets into the oral cavity of a child playing with a dog.

Most dog owners are not aware of the danger and fail to clean up after their dogs in the belief that this problem does not concern them.

The aim of the study was to determine the gastrointestinal parasite fauna of dogs from Western Pomerania.

Materials and methods

A total of 763 fecal samples, collected from dogs in the city of Szczecin, the Chociwel commune (75 samples), the Mieszkowice commune (25 samples) and Ostrowiec (15 samples) were examined.

In the city of Szczecin, 648 fecal samples were collected every month in the annual cycle from nine city areas (Osów, Warszewo, Gocław, Kasprowicz Park, Żeromski Park, Pogodno, Słoneczne estate, Podjuchy, Dąbie) and analysed. Six fecal samples were taken at each collection time from each site. A total of 115 fecal samples of dogs from rural areas (Chociwel – 75 samples, Ostrowiec – 15 samples, Mieszkowice – 25 samples) were examined.

Each fecal sample was dissected with a needle, checked for tapeworm segments and adult forms of nematodes, and examined for parasite eggs using Willis-Schlaff flotation method. Endoparasites were detected and identified using Willis-Schlaff flotation method. Species composition of parasite fauna was determined based on data from the handbook of helminth fauna identification [14,15].

Table 2. Mean prevalence of parasite infection among dogs

Region	Prevalence of infection (%)						
	Trichuris vulpis	*Ancylostoma* sp.	*Toxocara canis*	*Toxascaris leonina*	*Uncinaria stenocephala*	*Dipylidium* sp.	*Taenia* sp.
Chociwel	0	5.33	29.33	9.33	16.00	9.33	5.33
Mieszkowice	0	0	40.00	0	8.00	0	8.00
Ostrowiec	0	0	6.67	0	20.00	0	0
Szczecin	1.08	13.12	6.48	2.31	0	6.93	0.46
Mean	0.27	4.61	20.62	2.91	11.00	4.07	3.45

Table 3. Mean annual prevalence of endoparasite infection among dogs in different regions of Szczecin

Region	Mean annual prevalence of infection (%)
Osów	15.28
Warszewo	27.78
Gocław	16.67
Kasprowicz Park	13.89
Żeromski Park	16.6
Pogodno	27.78
Słoneczne estate	34.72
Podjuchy	9.17
Dąbie	33.33

Results

Mean prevalence of gastrointestinal parasite infection among dogs in Western Pomerania was 34.84%. The greatest number of samples containing parasites came from the Chociwel commune (46.67%), and the smallest number from the city of Szczecin (23.92%). (Table 1).

Dogs' feces were found to contain segments of *Dipylidium caninum* (4.07%) and *Taenia* sp. (3.45%) tapeworms and eggs of five species of gastrointestinal nematodes: *Uncinaria stenocephala*, *Toxocara canis*, *Toxascaris leonina*, *Ancylostoma* sp., and *Trichuris vulpis*. The analysed dogs from Western Pomerania were most often infected with *Toxocara canis* and least often with *Trichuris vulpis* (Table 2).

Dogs from the city of Szczecin were found to be infected with *T. canis, Ancylostoma caninum*, *T. leonina*, *T. vulpis*, *Taenia* sp. and *D. caninum*.

Feces of dogs from the Chociwel commune were found to contain segments of *D. caninum* and *Taenia* sp. tapeworms and eggs of four species of gastrointestinal nematodes: *U. stenocephala*, *T. canis*, *T. leonina* and *A. caninum*.

Feces of dogs from the Mieszkowice commune were infected with *U. stenocephala*, *T. canis* and *Taenia* sp.

Table 4. Prevalence of endoparasite infection in dogs from different areas of Szczecin in the annual cycle (%)

Site	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Osów	0	16.70	0	0	0	16.70	66.70	33.30	0	0	50.00	0
Warszewo	33.30	16.70	0	16.70	33.30	50.00	50.00	50.00	16.70	50.00	16.70	0
Gocław	16.70	0	0	33.30	33.30	16.70	16.70	33.30	33.30	0	0	16.70
Kasprowicz Park	0	0	16.70	0	0	33.30	50.00	16.70	16.70	33.30	0	0
Żeromski Park	16.70	0	50.00	16.70	16.70	33.30	16.70	16.70	16.70	16.70	0	0
Pogodno	0	0	33.30	66.70	66.70	33.30	33.30	16.70	33.30	0	33.30	16.70
Słoneczne estate	33.30	0	33.30	16.70	50.00	16.70	33.30	50.00	33.30	66.70	50.00	33.30
Podjuchy	0	0	50.00	16.70	33.30	16.70	50.00	33.30	16.70	50.00	50.00	33.3
Dąbie	50.00	16.70	0	16.70	50.00	50.00	66.70	50.00	0	50	16.7	33.3
Mean	16.70	5.56	20.37	20.37	31.48	29.63	42.60	33.30	18.52	29.63	24.07	14.81

Table 5. Prevalence of infection with different endoparasite species in dogs in the annual cycle in Szczecin (%).

Month	*Ancylostoma* sp.	*Toxocara canis*	*Toxascaris leonina*	*Trichuris vulpis*	*Taenia* sp.	*Dipylidium caninum*
	Mean prevalence of infection (%)					
I	11.11	3.70	3.70	0	0	0
II	3.70	0	0	0	0	1.85
III	16.67	1.85	1.85	0	0	3.70
IV	5.56	7.41	5.56	1.84	0	0
V	24.07	7.41	5.56	0	0	3.70
VI	11.11	12.96	0	3.70	0	3.70
VII	12.96	12.96	0	5.56	1.85	12.96
VIII	18.52	14.81	0	1.85	0	3.70
IX	14.81	0	7.41	0	1.85	7.41
X	18.52	3.70	0	0	1.85	3.70
XI	11.11	9.26	0	0	0	9.26
XII	9.26	3.70	3.70	0	0	5.56
Mean	13.12	6.48	2.31	1.08	0.46	4.63

Only two species occurred in the area of Ostrowiec: *U. stenocephala* and *T. canis.* Mean prevalence of gastrointestinal parasite infection among dogs was 26.67% (Table 2).

The greatest number of samples containing parasites from the city of Szczecin originated from the Słoneczne estate (34.72%), and the smallest from the Kasprowicz Park (13.89%) (Table 3).

The prevalence rate of infection was investigated in the annual cycle in the city of Szczecin area. The highest prevalence of endoparasite infection among dogs was found in July (42.60%) and the lowest in February (5.56%) (Table 4). The mean prevalence of *T. canis* infection in dogs was 6.48%. The highest prevalence of infection was noted in August (14.81%), with no *T. canis* eggs found in the feces analysed in February and September. The mean prevalence of *Ancylostoma* sp. infection in dogs was 13.12%. The highest prevalence of infection was observed in May (24.07%) and the lowest in February (3.70%). This was the most common intestinal parasite of dogs in the city of Szczecin. The mean prevalence of infection with *T. leonina* was 2.31%. The highest prevalence of infection was found in September (7.41%), with no infection found in February, from June to August, and in October and November. The mean prevalence of *T. vulpis* infection was 1.08%. The highest prevalence of infection was observed in July (5.56%), with no infection found in the analysed feces from January to March, in May, and from September to December. The mean prevalence of infection with *D. caninum* was 4.63%. The highest prevalence of infection with this parasite was noted in July (12.96%), with no infection reported in January and April. In our study, the mean prevalence of *Taenia* sp. infection was 0.46% (Table 5).

The present study revealed the incidence of single- and multi-species infections. In the area of Szczecin, single-species infections were the most common (Table 6).

Discussion

The proportion of dogs with gastrointestinal parasites in Western Pomerania is high in both rural and urban areas. The prevalence of parasite infection depends on the living environment of

Table 6. Incidence of single- and multi-species infections in Szczecin (%)

Infection	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual mean
Single-species	7.41	5.56	14.81	14.81	25.93	25.93	38.89	27.78	9.26	27.78	18.52	9.26	18.83
Double-species	7.41	0	5.56	1.85	1.85	3.70	3.70	5.56	3.70	0	3.70	3.70	3.40
Three-species	1.85	0	1.85	1.85	1.85	0	0	0	1.85	1.85	3.70	1.85	1.39
Four-species	0	0	0	0	1.85	0	0	0	3.70	0	0	0	0.46

dogs. Dogs from the rural areas are more infected with gastrointestinal parasites than urban dogs. Comparison of the percentage of infection with intestinal parasites in dogs with other regions of Poland shows that the prevalence of infection was at a similar level. Studies conducted in other Polish cities showed the prevalence of infection to be 51.9% in Wrocław during 1991–1992 [16], 50.83% in Warsaw in 2000 [17], 21.6–27% in Olsztyn in 1996 [18,19], 25.9% in Poznań during 1981–1982 [20] and 32% during 1997–1998 [21].

Such high prevalence of infection with parasites of intestinal tract of dogs from Western Pomerania may be due, among others, to the fact that many owners subject their pets to no anthelmintic treatment, which makes them a potential source of infection. Other reasons are the insufficient availability of designated areas where walked dogs can relieve themselves and, most importantly, the reluctance of Polish dog owners to clean up after their pets.

In other countries, gastrointestinal parasites of dogs are also a major epidemiological problem. A comparable prevalence of infection to that in Western Pomerania was found by Vanparijs et al. [22] in Belgium (34.2%) and by Borkovcová [23] in the Czech Republic (Moravia, 48.6%). In Prague, Dubna [24] found the mean prevalence of intestinal parasite infection to be lower (17.6%). Much higher prevalence was reported by El-Shehabi et al. [7] in Jordan (70.3%), by Lefebvre et al. [25] in dogs from animal clinics in Ontario (80%), and by Fontanarrosa et al. [26] in Argentina (52.4%).

Some mention should be made of *Toxocara canis*, which is a common roundworm of dogs. Toxocariasis is a dangerous parasitic zoonosis and the human is an incidental host in the life cycle of the parasite. Toxocariasis was the most common infection of intestinal parasites among dogs from Western Pomerania in our study (20.62%), as was the case in the cities of Lublin and Puławy (21.5%) [27]. A much higher rate of infection (31.5%) was reported for the city of Poznań and its surroundings by Luty and Mizgajska [21].

Toxocara canis is the most common canine parasite not only in Poland but also in the world. The infections of this nematode are global and occur in all climatic zones of the world, including both highly developed and Third World countries. Relatively high prevalence of *Toxocara canis* infection was reported in Ancona, Italy [28] and Toulouse, France [29] – 64% and 38%, respectively.

The mean annual prevalence of *Toxocara canis* infection in dogs in Germany was 22.4% during 1999–2002 [30] and 21% in the Free State Province, South Africa [31]. In Szczecin and Ostrowiec, the mean prevalence of infection with *T. canis* was comparable to that reported for Switzerland, where this parasite was found in only 7.1% of the examined dogs [32].

The prevalence of *Uncinaria stenocephala* was also high. This parasite was the dominant species in the parasitic nematode fauna of Ostrowiec. Górski et al. [33] consider *U. stenocephala* to be one of the three most important species of nematodes parasitizing dogs in the Warsaw region. Likewise, in the Kielce region and in village dogs from the vicinity of Wrocław, the prevalence of this species may reach 75% [34]. The prevalence of *U. stenocephala* infection in dogs was found to be 11.4% in Belgium [22] and only 2.6% in Finland [35].

The prevalence of infection with Ancylostomatidae nematodes in dogs from Western Pomerania is considered low (4.61%). Special attention should be given to the high prevalence of this parasite in Szczecin (13.12%). Borecka [36] showed Ancylostomatidae nematodes to dominate in dogs from Warsaw and its surroundings, with as much as 75.8% of shelter dogs being infected. In a study by Gaca [18], the most common nematode observed in dogs was also *Ancylostoma caninum*, which occurred in 18% of the animals. This parasite was also identified in dogs from other countries: Sao Paulo in Brazil – 23.6% [37], Prague in the Czech Republic – 0.4% [24], Columbia – 13.9% [38], Lagos in Nigeria – 41.9% [39] and Brazil – 70.9% [40].

The prevalence of *Toxascaris leonina* infection in dogs from Western Pomerania is regarded as very low (2.91%). Earlier research showed the prevalence of this parasite infection in dogs to be 25% in villages near Szczecin. High prevalence (20%) was also found in dogs from Słupsk [41]. Meanwhile, Borecka [42] reported that the prevalence of infection with this parasite in dogs from Warsaw shelters ranged from 0.3% to 14.2%. Postmortem examination of adult dogs revealed *T. leonina* infection in as many as 21.1% of the animals. Similar prevalence of infection with *T. leonina* eggs in dogs was reported by Barutzki and Schaper [30] in Germany (1.8%), by Antolova [43] in Slovakia (0.7%) and by Dubna [24] in Prague, the Czech Republic (0.8%). High

prevalence of infection with this parasite (32.53%) was found by Dalimi et al. [44] in Iran.

The prevalence of infection with *Dipylidium caninum* in Western Pomerania was also found to be low (4.07%). Different results were obtained by Okulewicz and Złotorzycka [34], who showed the level of infection to be 80.05% in rural dogs, 25% in urban dogs, and 2.5% in shelter dogs. In a study conducted in Gorzów Wielkopolski [41] *D. caninum* was found in 29.31% of urban dogs and in 32.5% of dogs from rural areas.

This parasite was also reported in dogs from other countries, with prevalence of 0.7–2.3% in the Czech Republic [23,24], 38.55% in Iran [44], 0.7% in Sao Paulo, Brazil [37] and 0.4–1% in Hungary [45].

In Western Pomerania, the prevalence of infection with *Taenia* sp. was also low (3.45%). Similar finings were reported by Totková et al. [46] in Bratislava (0.4%) and by Fok [45] in Hungary (from 2.4 to 2.8%). In Iran, prevalence of infection was as much as 53.01% for *Taenia hydatigena*, 7.23% for *Taenia ovis* and 4.82% for *Taenia multiceps* [44].

Trichuris vulpis is found sporadically in Western Pomerania and presents no greater threat to dogs. This parasite was only found in the city of Szczecin (1.08%). It was also observed in dogs form other countries: in Belgium – 7% [22], in the Czech Republic – from 4.16% to 10.52% [23,24,47], in Sweden – 5.5% [32] and in Sao Paulo, Brazil – 4.8% [37].

In the city of Szczecin, the highest prevalence of endoparasite infection in dogs was found in July (42.6%) and the lowest in February (5.56%). These results are comparable with those obtained in Brazil by Lorenzini et al. [48], who also found the highest prevalence of infection in summer months (30%) and the lowest in winter months (24.6%). According to Oliveira-Sequeira et al. [37] the prevalence of endoparasite infection in dogs is most often seasonal in regions with moderate climate because of the influence of ambient temperature and air humidity.

In the city of Szczecin, the highest prevalence of infection in the annual cycle was found for *Ancylostoma* sp. The highest prevalence of infection with this parasite was observed in May (24.07%) and the lowest in February (3.7%). A similar relationship was reported by Oliveira-Sequeira et al. [37] in Sao Paulo, Brazil. These authors found the highest prevalence of *Ancylostoma* sp. infection in dogs in May (42%) and the lowest in November (6%). Lorenzini et al. [48] in Brazil and Fontanarrosa et al. [26] in Argentina did not show the seasonality of *Ancylostoma* sp., because the prevalence of infection with this parasite among dogs remained constant throughout the year.

In our study, we found both single- and multi-species infections. In the area of Szczecin, single-species infections were the most common (18.83%). Single-species infections were also the most common in Brazil [42], Argentina [26] and Sao Paulo, Brazil [37] at 23.8%, 35.6% and 87.4%, respectively.

Although in recent decades the infection of dogs with intestinal parasites showed a downward trend [16], they continue to be a major epidemiologic problem.

Conclusions

Dogs originating from Western Pomerania should be regularly screened for parasites and regularly de-wormed if parasites are found. Because parasite eggs are highly resistant to adverse environmental conditions, the best method for reducing environmental contamination with parasites is to prevent dogs from defecating wherever they choose. In areas with high densities of dogs, special containers for dog waste should be provided to reduce the threat to humans.

Parents should be appealed to, and schoolchildren made aware through lectures and presentations of the threat of having non-dewormed household pets, i.e., cats and dogs.

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