Praca oryginalna *Original paper*

Prevalence of intestinal parasites detected in routine coproscopic methods in dogs and cats from the Masovian voivodeship in 2012-2015

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Received 26.03.2018 *Accepted 09.07.2018*

Bartosik J., Łojek J., Puchała M., Kaczyk J., Górski P., Długosz E., Zygner W.
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Summary

The aim of the study was to analyse canine and feline infections with intestinal parasites basing on routine coproscopic tests. In total 5,809 results were analysed. Infections with Giardia intestinalis (6.93% – in dogs, 4.56% – in cats) and Toxocara spp. (4.07% – in dogs, 5.42% – in cats) were the most commonly noted. The majority of intestinal parasitic infections were identified more frequently in younger animals (under 1 year of age) as compared to older ones. This study showed the increase in the prevalence of coccidia (from 1% to 2.53%) and whipworms (from 2.6% to 3.07%) in dogs and a decrease in roundworm and hookworm related diseases in comparison to previous reports (years 1974-2002). The results showed changes in infection prevalence of both protozoan species (G. intestinalis and Cystoisospora spp.) both in dogs and cats, which suggests that climate conditions had an influence on the infection prevalence of the mentioned species. Moreover, the age of animals had an influence on the infection prevalence of intestinal parasites in dogs. However, there was no influence of both dogs' and cats' sex on the average infection prevalence of investigated parasites.

Keywords: intestinal parasites, cat, dog, age, sex

The latest comprehensive report on the infection of dogs and cats from Warsaw and its vicinity during 1974-2002 was published in 2004 (11, 13). However climate changes and higher mobility of pets together with their owners might have influenced the composition of parasitic fauna in dogs and cats (21, 22, 27). Therefore the aim of the study was to analyse the current status of the parasitic infections in companion animals basing on the results of coproscopic tests performed in Warsaw during 2012-2015 and also to determine the prevalence of intestinal parasite infections in relation to the age and sex of animals.

Material and methods

The coproscopic studies were conducted from January 2012 to December 2015 in Warsaw. The research material concerning the presented study came from the territory of the Masovian voivodeship (Fig. 1). Fecal samples were transported to the laboratory by couriers in specially marked vehicles. Samples were stored at a temperature of +4°C until analysis within 3 days.

Fig. 1. The origin of probes marked on map of the Masovian voivodeship

Veterinarians ordering a thorough parasitological examination chose one of the following sets of coproscopic tests: flotation method (saline solution, specific gravity 1.2) and the direct smear test for *Giardia intestinalis*, and flotation method (saline solution, specific gravity 1.2) and the quick immunochromatographic test for *G. intestinalis*.

In total 5,809 results of above mentioned sets of coproscopic tests conducted during 2012-2015 were analyzed. The influence of sex and age (under or over 1 year of age) of animals on the prevalence of internal parasites in dogs and cats was determined using the Pearson's chi-square test and Fischer's exact test and the SPSS 21.0 Statistical Package. Two levels of significance were assigned: $P \leq 0.01$ as highly significant and $P \leq 0.05$ as significant.

Results and discussion

Parasites such as: *G. intestinalis*, coccidia of the *Cystoisospora* genus, *Toxocara canis/cati*, *Toxascaris leonina*, *Trichuris vulpis*, nematodes of the Ancylostomatidae family were detected in this research. Only results provided with detailed information on the age and sex of the animal (n = 897 positive tests) were taken into the statistical analysis. Tapeworm infections were not included into statistical analyses because of extremely rare detection in coproscopic examination.

Table 1 presents the infection prevalence of particular species of parasites in dogs and cats during 2012-2015. *T. cati* in cats (5.42%) and *G. intestinalis* in dogs (8.34%) were the most prevalent during the entire examined period. *G. intestinalis* infections in both species of animals showed the highest differences in prevalence when examining each year separately. No differences were observed in the prevalence of the rest of the parasites in period 2012-2015.

The lowest prevalence of parasitic infections was noted in 2012 and 2013 (*G. intestinalis* and *Cystoisospora* in both species of animals, as well as *T. canis* and *T. leonina* in dogs). Interestingly there was a similar trend in infection prevalence values for both protozoan species – *G. intestinalis* and *Cystoisospora* both in dogs and cats. The lowest *G. intestinalis* number was noted in 2012 and *Cystoisospora* in 2013, and the highest – in case of *Cystoisospora* in 2015. The highest prevalence values were identified in dogs during 2015 in case of *G. intestinalis*, *Cystoisospora*, *T. canis* and *T. leonina*. The prevalence of whipworm infection has successively decreased in the investigated years from 4.69% (2012) to 2.59% (2015).

Although some parasites were detected more frequently in males or females, a statistically significant influence of the sex of the animal (cat/dog) on the average frequency of infection in regard to investigated parasite species (Tab. 2) has not been found.

Intestinal parasite infection prevalence in cats and dogs during 2012-2015 was compared in relation to animals' ages. This analysis showed that in dogs the difference was statistically significant (Tab. 3). Protozoan (*G. intestinalis* and *Cystoisospora*) and roundworm (*T. canis* and *T. leonina*) infections were noted much more frequently in pups (Tab. 3) than in dogs over 1 year of age, but only in the case of *Cystoisospora* and *T. canis* was the difference statistically significant. In contrast, the number of hookworm and whipworm infections was 2-fold higher in adult dogs. Differences between *T. vulpis* prevalence were highly significant, and significant in the case of Ancylostomatidae nematodes. Although *G. intestinalis* and hookworm infections were noted more frequently in older cats, and coccidiosis and toxocarosis were more common in younger cats, no statistically significant differences in the prevalence of parasitic infections were noted between both feline age groups.

According to Monis and Thompson (24) the prevalence of *G. intestinalis* infection in dogs in the world ranges from 1.6% to 53%. In Poland it is estimated at 5.1-53.5% (31). The results obtained in this study are different from previous results by Górski et al. (13) and Gajewska et al. (11). Zygner et al. (41) examined the

Tab. 1. Comparison of prevalence of intestinal parasite infections in cats and dogs during 2012-2015 (all results – with and without information on the age and sex of animals)

Species/Family of parasites	Year	Prevalence of infection	
		Cat (%/n)	Dog (%/n)
Giardia intestinalis	2012	3.70/7	4.69/16
	2013	8.15/17	4.92/35
	2014	5.59/44	6.89/74
	2015	4.05/28	8.34/132
Total	2012-2015	4.56/96	6.93/257
Cystoisospora (coccidia)	2012	2.65/5	2.05/7
	2013	2.33/10	1.96/14
	2014	2.54/20	2.14/23
	2015	3.47/24	3.26/50
Total	2012-2015	2.80/59	2.53/94
Toxocara canis/cati	2012	5.31/10	4.39/15
	2013	7.22/31	2.67/19
	2014	4.58/36	4.19/45
	2015	5.36/37	4.55/72
Total	2012-2015	5.42/114	4.07/151
Toxascaris leonina	2012	1.06/2	0.58/2
	2013	0/0	0.56/4
	2014	0/0	0.65/7
	2015	0.14/1	0.82/13
Total	2012-2015	0.14/3	0.70/26
Ancylostomatidae	2012	0/0	2.63/9
	2013	0.46/2	3.51/25
	2014	0.76/7	3.76/40
	2015	1.01/7	2.34/37
Total	2012-2015	0.71/15	2.99/111
Trichuris spp.	2012	–	4.69/16
	2013	–	3.37/24
	2014	–	3.07/33
	2015	–	2.59/41
Total	2012-2015	–	3.07/114

Explanation: n – number of cases in which the infection of particular parasites was identified

Tab. 2. Comparison of frequency of intestinal parasite infections in cats and dogs in relation to sex during 2012-2015 (only results provided with detailed information on the age and sex of the animal)

Species/Family of parasites	Cat (%/n)		Stat. sign.	Dog (%/n)		Stat. sign.
	Male	Female		Male	Female	
Giardia intestinalis	36.8/67	32.2/29	–	38/150	46.1/105	–
Cystoisospora (coccidia)	21.4/39	22.2/20	–	13.9/55	17.1/39	–
Toxocara canis/cati	44/80	52.2/47	–	23.8/94	19.3/44	–
Toxascaris leonina	1.1/1	1.1/1	–	4.3/17	3.9/10	–
Ancylostomatidae (hookworms)	5.5/9	5.6/5	–	19/75	15.8/36	–
Trichuris spp.	–	–	–	20.3/80	14/33	–

Explanations: n – number of cases in which the infection of particular parasites was identified; Stat. sign. – statistical significance, a – $p \leq 0.05$

Tab. 3. Comparison of frequency of intestinal parasite infections of cats and dogs in relation to age during 2012-2015 (only results provided with detailed information on the age and sex of the animal)

Species/Family of parasites	Cat (%/n)		Stat. sign.	Dog (%/n)		Stat. sign.
	Under 1 year of age	Over 1 year of age		Under 1 year of age	Over 1 year of age	
Giardia intestinalis	30.4/21	38.8/12	–	45.2/89	35.5/30	–
Cystoisospora (coccidia)	23.2/16	16.1/5	–	19.8/39	8.3/7	a
Toxocara canis/cati	55.8/38	48.4/15	–	26.4/52	13.1/11	a
Toxascaris leonina	0/0	0/0	–	6.1/12	4.8/4	–
Ancylostomatidae (hookworms)	2.9/2	9.7/3	–	13.7/27	25/21	a
Trichuris spp.	–	–	–	11.7/23	27.4/23	b

Explanations: n – number of cases in which the infection of particular parasites was identified; Stat. sign. – statistical significance, a – $p \leq 0.05$, b – $p \leq 0.01$

faeces of 350 dogs from Warsaw territory and identified *G. intestinalis* cysts in 18 cases (5.14%), yet PCR examination revealed 9.14% positive samples. Bajer (2) proved the presence of this protozoa in 53.5% of investigated dogs, whereas Solarczyk and Majewska (31) in just 2%. Previous study on the prevalence of feline giardiosis in Warsaw showed 3.75% cats infected with the parasite (17). Significantly higher *G. intestinalis* prevalence in animals was identified in Australia (22-63%) and in North America (7.2-36%) (31, 16). In South America and Asia the infection prevalence of this parasite was 12.2% (26) and 20% (35), respectively. During the investigated period (2012-2015) the prevalence of *G. intestinalis* in dogs and cats was identified as 6.96% and 4.56%, respectively. The infections of *G. intestinalis* (with the exception of *T. cati*) in the mentioned studies were identified definitely more frequently as compared to other parasitic infections. *G. intestinalis* was also the most prevalent parasite according to other surveys (4, 10, 40).

Giardia cysts were identified more frequently in the faeces of pups (45.2%) than in adult dogs (35.5%). The obtained results are in line with those published by researchers from Japan and Canada (15, 18). Those studies showed an average *Giardia* prevalence ranging from 15.7% to 61% in younger animals and from 6.9% to 19.8% in older ones. It should be emphasized that the correlation between age and sex and the average infection prevalence of *G. intestinalis* in cats examined during 2012-2015 was the opposite to those observed in dogs.

Coproscopic tests of canine faecal samples conducted in north-eastern Italy showed a rather low prevalence of coccidiosis (5.7%) (30), similarly in Japan (1.2%) (15), the Czech Republic (2.4%) (8) and in the USA 4.4% (19). In this study the infections of coccidia of the genus *Cystoisospora* were identified in 2.8% of cats and in 2.53% of dogs. Coccidia oocysts were more often present in the faeces of young animals (under 1 year of age) as compared to older ones. In female cats (22.2%) and dogs (17.1%) coccidiosis was identified more frequently as compared to males (dogs – 13.9%, cats – 21.4%). The convergent correlations between age and sex and the occurrence of coccidiosis were also observed in previous studies from Albania, Canada and Japan (15, 18, 38).

A study conducted on the territory of Western Pomerania carried out by Tylkowska et al. (36) showed that the average prevalence of *T. canis* infection in dogs reached 20.62%. A similar roundworm prevalence in dogs was noted in Lublin and Puławy (21.5%) (14) whereas in Poznań it was slightly higher (31.5%) (20). Our study showed that the average prevalence of roundworm infections were 4.07% in dogs and 5.42% in cats. The prevalence of roundworms identified by Gajewska et al. (11) was slightly higher. Analyzing the results of coproscopic tests conducted over 27 years they observed 7.8% of dogs infected with *T. canis* and 10.9% of cats infected with *T. cati*. The average *T. canis* infection prevalence in Germany during 1999-2002 was significantly higher: 22.4% of dogs were infected with roundworms (3). Also in Free State Province in South Africa (21%) (23) and north-eastern Iran (29%) the prevalence was higher than in Poland (9). Definitely the highest prevalence of roundworm infection was observed in dogs from Albania where it amounted to 75.7% of the examined animals (38). The decrease of the prevalence of roundworm infection observed in this study may indicate that pet owners are better educated about regular treatment against intestinal parasites. Moreover, since 2006 in Warsaw they are obligated to clean up after their dogs, that might protect the environment against spreading of parasite infections.

Both in dogs and cats the eggs of roundworms were identified more often in young animals than in older ones, which is in line with the results obtained in previous epidemiological studies on the prevalence of the nematodes of the genus *Toxocara*, and it seems obvious that this observation results from intrauterine and lactogenic route of infection (5, 9, 30, 32, 34, 38). Correlations between toxocarosis and the sex of the animals were observed in both dogs and cats, but they were statistically insignificant. *Toxocara* infections were identified more often in female cats than in males, whereas in dogs we observed the opposite relation. The influence of sex on the infection prevalence of roundworms is not unambiguous. Some researchers observe more cases of „toxocarosis" in female dogs than males (9, 38). Others have noted opposite trends (11), which are presumably caused by a greater tendency of males to wander around.

Infections of *T. leonina* are less prevalent as compared to canine and feline roundworm infections. In this study the parasite was identified in just 0.14% of cats and 0.7% of dogs. Tylkowska et al. (36) have shown that overall *T. leonina* prevalence in dogs from the Western Pomerania territory was 2.91%, while in Warsaw the prevalence was only 0.2% (6). A low prevalence of this parasite was also noted in dogs in Germany (1.8%) (3), Slovakia (0.7%) (1), the Czech Republic (0.9%) (8), Albania (0.9%) (38), Japan (0.9%) (15) and Italy (0.64%) (39).

Just like in the case of *T. canis*, *T. leonina* infection was identified more frequently in young dogs (6.1%) than in older ones (4.8%), and also more often in males (4.3%) than in females (3.9%). However, these differences were statistically insignificant. Cases of *T. leonina* infections in cats were not analyzed in detail due to their small number. The results are convergent with those obtained by Gajewska et al. (11). They found that puppies were the most susceptible to infections (75% of examined cases) and cats up to 6 months of age (40.9% of cases). They also observed a higher prevalence in males than in females.

Our analysis of parasite infection prevalence between 2012-2015 showed that hookworm infections were more common in dogs (2.99%) than in cats (0.71%). A much higher prevalence of Ancylostomatidae family nematodes (13.12%) was noted in dogs from Szczecin (36). According to Górski et al. (12) hookworms belonged to one of the most frequent canine parasites in the Warsaw territory. Borecka et al. (6) noted that 75.8% of dogs from shelters in the Warsaw area were infected with nematodes of the family Ancylostomatidae. A similarly high infection prevalence of *Uncinaria stenocephala* was identified in dogs living in rural areas near Wrocław (75%) (25). The average prevalence of hookworm infection in dogs from other European countries was slightly lower than in 1991 in Belgium (11.4%) (37) but similar to results from 2006 from Finland (2.6%) (28).

Similarly to other intestinal parasite infections, hookworms were identified more frequently in dog males (19%) as compared to females (15.8%), which confirms the observations of other researchers (9, 38). The authors of the study cannot explain the higher prevalence in older dogs in comparison to younger ones. However, it seems probable that drug resistance and the paratenic host's role in the life cycle of the parasite may play a role in this phenomenon (11).

We noted that whipworm prevalence in dogs at a level of 3.07% was close to that found in the case of coccidia and hookworm infections. A much lower prevalence was noted by Gajewska et al. (11). Between 1974-2002 they noted only 70 positive cases of whipworm infection, which was only 0.5% of the examined faecal samples. In other countries the prevalence of *T. vulpis* was slightly higher and amounted to: 7% in Belgium (37), 4.16% to 10.52% in the Czech Republic (7, 8, 33), 5.5% in Sweden (29), and 4.8% in Brazil (26). Whipworm eggs were much more frequently found in the faeces of male dogs (20.3%) as compared to females (14%). Similar tendencies were observed in dogs from Albania (17.2% in bitches, 22.6% in dogs) (38).

Comparing the coproscopic tests of dog and cat faeces conducted between 2012-2015 (5,809 in total) to those examined during 1974-2002 (19,551 in total) (Tab. 4) one can observe an increase in the prevalence of coccidia (from 1% to 2.53%) and whipworms (from 2.6% to 3.07%) in dogs. At the same time the recent analysis showed a clear decrease of roundworm and hookworm infections. The biggest difference is seen in the prevalence of hookworms in dogs. Gajewska et al. (11) have identified it at a level of 15.6% and in own tests at the level 2.99%. A reason for concern is the increase of *G. intestinalis* prevalence during 2012--2015, both in dogs and cats. In the previous research Górski et al. (13) reported only 33 positive results in dogs and 2 in cats, however only a period of 8 months was investigated. During 2012-2015 as many as 353

Tab. 4. Comparison of prevalence (%) of intestinal parasite infections in dogs and cats in own studies and studies of other researchers

Species/Family of parasites	Cat		Dog	
	1	2	1	2
Giardia intestinalis	Few data	4.56	Few data	6.93
Cystoisospora (Coccidia)	6.9	2.8	1	2.53
Toxocara canis/cati	10.9	5.42	7.8	4.07
Toxascaris leonina	2.1	0.14	1.3	0.7
Ancylostomatidae (hookworms)	1.2	0.71	15.6	2.99
Trichuris spp.	–	–	2.6	3.07

Explanations: 1 – infection prevalence of intestinal parasites in dogs and cats – studies conducted during 1974-2002 (11, 13); 2 – infection prevalence of intestinal parasites in dogs and cats – studies conducted during 2012-2015

cases of *G. intestinalis* were noted (96 in cats and 257 in dogs). Both in dogs and cats the majority of internal parasite infections were more frequently identified in young animals (under 1 year of age) than in older ones.

An analysis of the results coproscopic tests conducted between 2012-2015 concerning companion animals makes it possible to assess not only the parasitological situation in the country, but also to trace the dynamics of the infection of particular species of intestinal parasites in relation to age and sex of animals. The majority of tests conducted so far in the country and abroad concerned parasitical infections in dogs. It should be emphasized that cats can also be carriers of many zoonotic parasites and just like dogs should be properly controlled and treated for parasitical diseases.

Conclusions:

1. There is a similar trend in infection prevalence of both protozoan species – *Giardia intestinalis* and *Cystoisospora* – both in dogs and cats, which suggests that climate conditions influence the infection prevalence of mentioned species.

2. There is no influence of both dog's and cat's sex on the average infection prevalence of investigated parasites.

3. The age of animals has an influence on the infection prevalence of intestinal parasites in dogs.

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