

Prevalence of Canine Giardiasis in the Daejeon and Chungnam Area

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Abstract : A total number of 100 fecal samples were examined for the presence of *Giardia intestinalis* infection in dogs using a *Giardia* ELISA kit (SNAP[®] test, IDEXX Laboratories, Inc., Westbrook, ME). 49 males and 51 females were examined for a *G. intestinalis* infection in Daejeon and Chungnam area of South Korea. The overall positive rate of *G. intestinalis* infection was 12.00%. *G. intestinalis* infection resulted to be more prevalent in males (12.24%) than in females (11.76%), and in symptomatic dogs (18.18%) than in asymptomatic dogs (11.54%). There were no significant differences between the two groups. 19.60% being found in the <2-year-old group, 4.08% in the over 2 year-old group. χ^2 analysis revealed a significantly higher prevalence ($p < 0.05$) in the <2-year-old group than in the other, and a significantly higher prevalence in dogs kept in a shared kennel (36.00%, $p < 0.001$). This study is the first survey of *G. intestinalis* infection prevalence in South Korea according to life style (particularly between dogs kept in a shared kennel and that of dogs kept separately) using an ELISA kit, and this study is expected to provide a useful reference for clinicians and breeders.

Key words : *Giardia intestinalis*, prevalence, dog.

Introduction

The intestinal flagellate *Giardia* is a ubiquitous protozoan parasite which has been reported throughout the world and can cause a clinically important gastrointestinal tract disease (4). *Giardia* is commonly found in the small intestine of several domestic and wild animal species as well as in humans (16,17). The actual prevalence of *Giardia* is unknown, but it is simulated to be much higher than its rate of detection (12).

Giardia life cycle consists of two stages: trophozoite and cyst, and is transmitted through the ingestion of viable cysts, which contaminate food and water supplies (6). Motile trophozoites attach to the brush border surface of the mucosal epithelium by means of ventral cup-shaped suction discs or float free within the adjacent mucus layer (6).

Even though *Giardia* is normally considered as non-pathogenic and many infections are asymptomatic, it has been shown that the organism may be a primary pathogen. Its main clinical signs include acute or chronic diarrhea, depression, despite a normal appetite, vomiting and lethargy. Weight loss and poor weight gain are also secondary to maldigestion and malabsorption of nutrients in the gastrointestinal tract (2).

Due to its high prevalence, *Giardia* infection in dogs in puppies can be regarded as possible zoonosis (2,6). Thus, giardiasis in dogs that manifests as serious infections can be considered clinically important for potential zoonosis. For these reasons, there are many epidemiological and therapeutic reports of giardiasis in dogs in the world including our

article (1,3,7,8,11,13).

In South Korea, reports of the prevalence of giardiasis as well as treatment with silymarin for asymptomatic cases in dogs have been reported (2,8). ELISA kit has also been utilized to evaluate the prevalence and the difference between symptomatic and asymptomatic cases of giardiasis in dogs in South Korea as reported by Liu *et al.* (10) Itoh *et al.* (6) reported the prevalence of *Giardia* in dogs in Japan, Capelli *et al.* (3) reported the prevalence in Italy, Jacobs *et al.* (7) reported the prevalence in Canada, Huber *et al.* (5) reported the prevalence in Brazil, Nikolic *et al.* (14) reported the prevalence in Yugoslavia, Bugg *et al.* (1) reported the prevalence in Australia.

Recently, molecular genotyping technology has been employed in many in *Giardia* researchers throughout the world. Jie *et al.* (11) reported the genotype identification and prevalence of *Giardia duodenalis* in Guangzhou, and Louise *et al.* (15) reported the epidemiology of infections with *Giardia* species and genotypes in Germany.

This study is also performed to make a survey on the prevalence of canine giardiasis in the Daejeon and Chungnam areas of South Korea, and to make a comparison between dogs reared together in kennel to that of dogs kept separated through ELISA kit.

Materials and Methods

Sample collection

A total of 100 fecal samples were examined between January 2014 and May 2015 for the presence of *Giardia intestinalis* infections. All cases, 49 male and 51 female dogs con-

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sisted of 16 breeds (Beagle = 3, Bull Dog = 2, Chihuahua = 3, Cocker Spaniel = 3, Dachshunds = 3, German Shepherd Dog = 2, Golden Retriever = 3, Labrador Retriever = 5, Malinois = 5, Pit Bull = 48, Poodle = 2, Pomeranian = 3, Samoyed = 1, Shih Tzu = 2, Yorkshire Terrier = 2 and Mongrel = 13) aged from 2 months to 11 years of age (mean = 2.11 years). Seventy-five dogs were reared in outdoor environment (reside in a backyard kennel), and twenty-five dogs were reared indoor (reside with people in the house). Based on owner account, all dogs received no prophylaxis or treatment for giardiasis.

ELISA test

Each stool sample was analyzed by using a commercially available *Giardia* ELISA kit (SNAP[®] *Giardia* ELISA kit, IDEXX Laboratories, USA).

The SNAP[®] *Giardia* ELISA kit is a rapid enzyme immunoassay for the detection of *Giardia lamblia*, otherwise known as *Giardia intestinalis* or *Giardia duodenalis*, the primary species in canine and feline feces. The presence of *Giardia* antigen in fecal samples indicates that the animal either has ingested *Giardia* cysts, may be actively infected, and may be shedding cysts in feces. The kit has a very high sensitivity of 95% and specificity of 99% in dogs (10). All procedures were performed according to the manufacturer's recommendations. Briefly, a negative result is represented by the appearance of a single dot in the positive control area of the membrane. A positive result is indicated by the presence of dots in both the positive control area and the test area of the membrane.

Statistical analysis

The prevalence of *Giardia* in dogs was examined according to sex, breed, age (< 2 year, 2-5 years, and > 5 years old), residence environment (indoor, outdoor), lifestyle (shared kennel, separated) and compared using a χ^2 test with the

IBM SPSS Statistics (Version 22.0, IBM software, USA). Results were considered significantly different with $p < 0.05$.

Results

Overall, a total number of 12 out of 100 (12.00%) fecal samples was found to be positive for *Giardia* antigen. Prevalence rates are shown in Table 1.

Giardia infection resulted to be slightly more prevalent in males (6/49, 12.24%) than in females (6/51, 11.76%), and in symptomatic dogs (4/22, 18.18%) than in asymptomatic dogs (9/78, 11.54%). *Giardia* prevalence was also found to be significantly ($p < 0.05$) higher in outdoor dogs (11/75, 14.66%) than in indoor dogs (1/25, 4.00%), and in younger (< 2 year-old) dogs (10/51, 19.60%) than in older ones (over 2 year-old, 2/49, 4.08%). This study also found χ^2 analysis revealing a significantly higher prevalence ($p < 0.01$) in the group of dogs sharing kennel (9/25, 36.00%) than in the group that was kept separated (2/50, 4.00%).

Discussion

The present study examined the epidemiology of *Giardia* infections in different dog and cat populations, using sensitive ELISA kit for the detection of specific coproantigen. The overall prevalence of the infection was found to be rather high with 12% of animals infected.

Liu *et al.* (10) reported that the positive rate of *Giardia* in South Korea in 2005 was 11.2%, which was found to be almost equal with this study (12.00%). As compared to the universal epidemiological studies of *Giardia* infection, the rate of infection in the present survey is almost similar to that reported in Yugoslavia (2) (14.40%), higher than those from Canada (7) (7.2%) and Brazil (5) (9.7%), but lower than those from Japan (6) (37.4%), Italy (3) (21.3%) and Australia (13) (22.1%). There is no obvious explanation for these

Table 1. Prevalence of dogs with *Giardia intestinalis* infection in the Daejeon and Chungnam areas

	Indoor dogs			Outdoor dogs						All dogs						
	NE	NP	PR(%)	Shared			Separated			Total						
				NE	NP	PR(%)	NE	NP	PR(%)	NE	NP	PR(%)				
Sex																
Females	12	0	0.00	13	4	30.76	26	2	7.69	39	6	15.4	51	6	11.76	
Males	13	1	7.69	12	5	41.66	24	0	0.00	36	5	13.9	49	6	12.24	
Age																
< 2	8	1	12.50	21	8	38.09	22	1	4.54	43	9	20.9	51	10	19.60*	
2-5	5	0	0.00	3	1	33.33	22	1	4.54	25	2	8.00	30	2	6.66	
> 5	12	0	0.00	1	0	0.00	6	0	0.00	7	0	0.00	19	0	0	
Symptom																
Symptomatic	18	1	5.55	3	2	66.66	1	0	0.00	4	2	50.00	22	4	18.18	
Asymptomatic	7	0	0.00	22	7	31.81	49	2	4.08	71	9	12.67	78	9	11.54	
Total	25	1	4.00	25	9	36.00**	50	2	4.00	75	11	14.66*	100	12	12.00	

NE: numbers of examined, NP: numbers of positives and PR: positive rate.

*Significant differences was observed ($p < 0.05$). **Significant differences was observed ($p < 0.01$).

differences. These may be due to geographical variation or to differences in the number of animals and type of population surveyed, or may be attributed to different rates of sensitivities of diagnostic procedure used (10,14).

Although the prevalence in male dogs (12.24%) is slightly higher than that of female dogs (11.76%), there were no significant gender differences. These results were also similar to studies reported by Bugg *et al.* (1) and Huber *et al.* (5). Mochizuki *et al.* (13) reported that the positive rate of *Giardia* were almost equal in fecal samples obtained from dogs with or without diarrhea. Although there was no evidence of a statistically significant association between the presence of *Giardia* and clinical disease, our study results showed that the prevalence of symptomatic dogs (18.18%) is higher than that of asymptomatic dogs (11.54%). However, the high prevalence of infection with *Giardia* in healthy (asymptomatic) animals raises further considerations.

Capelli *et al.* (3) and Liu *et al.* (10) reported that increased prevalence was significantly associated with outdoor dogs. The results in the present study also revealed that outdoor dogs (14.66%) has a significantly higher prevalence than that of indoor dogs (4.00%).

Most epidemiological studies reported that the prevalence of *Giardia* infections is highest in younger animals (3,6,9,10). In our study, the results showed that the overall positive rate was 12%, 19.6% being observed in the <2 year-old group, and 4.08% being observed in the over 2 year-old group. χ^2 analysis revealed a significantly higher prevalence. This may suggest that specific immunity to *Giardia* infection can be corrected with age, probably as a consequence of one or more exposures.

The present study examined the epidemiology of *Giardia* infections in dog, using sensitive ELISA kit for the detection of specific coproantigen to compare the prevalence during the years 2005 and 2015 in the Daejeon, Chungnam area. The overall prevalence of the infection was still found to be rather high (2005: 8.1%, 2015: 12.00%), and most are found in outdoor dogs, which is higher than indoor dogs. Because of poor sanitation in outdoor kennel settings, *Giardia* transmission occurs most commonly through ingestion of cysts during consumption of food or water contaminated with *Giardia* cyst shed in feces from infected dogs. Effective hygienic management should require close monitoring, veterinary exams, stress reduction, and good sanitation in order to reduce the incidence of *Giardia* infection.

This study is the first survey that used a commercial *Giardia* ELISA kit to analyze the prevalence of *Giardia* in Korea according to life style, and in particular between dogs kept in a shared kennel as that of dogs kept separately. It revealed a significantly higher prevalence in the group of shared kennel (36.00%) than in the group of dogs kept separately (4.00%). Our data could be useful as an investigative reference for clinicians and breeders.

Further studies such as molecular genotyping will be necessary to confirm the zoonotic potential of *Giardia* isolated from dogs in South Korea.

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대전 · 충남지역 개에서 지알디아증 유병률

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요 약 : 본 연구는 한국의 대전과 충남 지역에 있는 개 100마리에서 실내견 (25마리)과 실외견 (75마리)을 구분하여 지알디아증의 유병률을 조사하였다. 모든 샘플은 *Giardia* SNAP 키트(SNAP[®] test, IDEXX Laboratories, Inc., Westbrook, ME)를 이용하여 감염여부를 조사하였다. 지알디아증은 실외견(11/75, 14.66%)이 실내견(1/25, 4.00%) 보다 유의성 있는 높은 유병률은 나타내었다. 또한 자견(< 2yr: 10/51, 19.60%)이 성견(> 2yr: 2/49, 4.08%) 보다 유의성 있는 높은 유병률은 나타내었다. 임상증상을 나타내는 개는 증상이 없는 개보다 높은 유병률을 나타내었으나 (증상: 4/22, 18.18%, 무증상: 9/78, 11.54%) 통계학적으로 유의하지는 않았다. 실외견 중 분리되어 단독으로 기르는 개(2/50, 4.00%)보다 합사하여 여러 마리가 같이 생활하는 개(9/25, 36.00%)에서 높은 유병률을 나타내었다. 세계 여러 나라의 다양한 지역에서 지알디아증 유병률에 대한 조사는 많이 진행되었으나, 사육 패턴에 따른 유병률을 평가한 적은 없기에 본 연구의 의의가 있다.

주요어 : 지알디아증, 유병률, 개