Prevalence of *Giardia intestinalis* and other zoonotic intestinal parasites in private household dogs of the Hachinohe area in Aomori prefecture, Japan in 1997, 2002 and 2007

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An epidemiological study on canine intestinal parasites was undertaken to evaluate changes in the prevalence among private household dogs from the Hachinohe region of Aomori prefecture, Japan, in 1997, 2002 and 2007, using the formalin-ethyl acetate sedimentation technique. The risk of zoonotic transmission from household dogs to humans was also discussed. All intestinal parasites detected in the present study (*Giardia intestinalis*, *Isospora* spp., *Toxocara canis*, *Ancylostoma caninum*, *Trichuris vulpis* and *Strongyloides stercoralis*) showed no changes in prevalence over the past 10 years based on analysis considering canine epidemiological profiles. In particular, prevalence of *Giardia intestinalis* in dogs under 1 year old, derived from pet shops/breeding kennels and kept indoors was unchanged, remaining at a high level of >15.0% at each time point. *Toxocara canis* also showed no changes in the group of dogs under 1 year old, bred by private owners and kept outdoors, and the prevalence was >10.0% every year. The present results indicate that the prevalence of *Giardia intestinalis* and other intestinal parasites in private household dogs has not always decreased, and the potential for direct parasitic zoonotic transmission from dogs to humans may be relatively high level, than from the environment (indoors and outdoors). We recommend careful surveillance of intestinal parasites and aggressive use of anthelminthic in private household dogs under considering the epidemiological factors.

Keywords: dog, *Giardia intestinalis*, intestinal parasites, *Isospora* spp., *Toxocara canis*

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Introduction

Intestinal parasitic agents are commonly recognized in dogs as a cause of gastrointestinal disorders [11]. Canine intestinal parasites have recently become a more important pathogen for humans, as some parasites, e.g., *Giardia* (*G.*) *intestinalis, Toxocara* (*T.*) *canis* and others, have become potential public health hazards due to zoonotic transmission [11]. In particular, private household dogs that have relatively close contact with humans represent a serious potential source of direct parasitic transmission. Although human parasitic diseases are well controlled in Japan, many people are still contract zoonotic parasites [10]. Epidemiological data from dogs can undoubtedly contribute to preventing direct zoonotic transmission from dogs to humans via the control of infectious animals.

In Japan, recent reports have indicated that the prevalence of intestinal parasites in private household dogs kept in the same area has declined in comparison with previous years [1,12-14]. This declining prevalence is probably due to improved sanitary conditions by pet owners. However, the epidemiological background is extremely important for the interpretation of results relating to canine intestinal parasites, since prevalence differs significantly according to the profiles of surveyed dogs [3-7]. Unfortunately, previous long-term surveillance studies in Japan [1,12-14] have lacked data analysis based on multifactorial considerations in regard to epidemiological backgrounds. Previous our reports [3-7] suggest that the considering of high detective factor may be helpful for the comparison of data among differentiated studies. The aim of this investigation was to determine the prevalence of *G. intestinalis* and other intestinal parasites (*Isospora* spp., *T. canis, Ancylostoma* (*A.*) *caninum, Trichuris* (*T.*) *vulpis and Strongyloides* (*S.*) *stercoralis*) in private household dogs of Hachinohe region in Aomori prefecture, Japan in 1997, 2002 and 2007. Data were analyzed based on consideration of epidemiological backgrounds such as canine ages and origin.

Materials and Methods

Fresh fecal specimens were collected from 420, 350 and 335 private household dogs presented to individual veterinary clinics regardless of illness history and living in the Hachinohe area of Tohoku region in Aomori prefecture of Japan, in 1997, 2002 and 2007, respectively. Hachinohe is situated in the northern part of Japan, with approximately 300,000 people living in this area. Parasitic agents in stools were detected using the formalin-ethyl acetate sedimentation technique as previously described [17]. Obtained data was analyzed by considering the high detective factor complex for each parasitic agent, and statistical significance of results was calculated using Fisher's exact probability test. Values of $p < 0.05$ were considered significant. Epidemiological high detective factors for each intestinal parasite of private household dogs have already been described in our previous reports [3-7]. Considering the high detective factor is helpful for the comparison of data among differentiated studies.

Therefore, the concept of a high detective factor complex was accepted for the evaluation of the results in the present study. The high detective factor complex for each parasite in the present study was as follows: Group 1 (*G. intestinalis, Isospora* spp. and *S. stercoralis*) comprised dogs under 1 year old, derived from pet shops/breeding kennels and kept indoors; Group 2 (*T. canis*) comprised dogs under 1 year old, bred by private owners and kept outdoors; and Group 3 (*A. caninum* and *T. vulpis*) comprised dogs over 2 years old, bred by private owners and kept outdoors.

Results

There were no significant changes in the overall prevalence of individual parasites in the three years except for *Isospora* spp. (Table 1). A significant difference ($p < 0.01$) in *Isospora* spp. infection was found between 1997 (9.5%) and 2007 (4.5%). In all years, all canine intestinal parasites examined in the present study (*G. intestinalis, Isospora* spp., *T. canis, A. caninum, T. vulpis* and *S. stercoralis*) showed significantly higher ($p < 0.05$ or $p < 0.01$, respectively) prevalence in groups with high detective factor complexes compared to others (non-high detective factor complex), except for *S. stercoralis* in 2002. No parasites in either group of high detective factor complexes or others revealed any significant difference related to surveyed years. In particular, the prevalence of *G. intestinalis* in the group with a high detective factor complex was almost unchanged over the 10 years, with high levels ($> 15.0\%$) were recorded every year. *Isospora* spp. and *T. canis* also had no changes in the high detective factor complex group, with the prevalence $> 10.0\%$ every year.

Table 1. Overall and classified prevalence of canine intestinal parasites in 1997, 2002 and 2007

Parasites	Percentage (%) of detected dogs		
	1997	2002	2007
Giardia intestinalis	14.3 (60/420)	10.9 (38/350)	11.6 (39/335)
Group 1[a]	23.7 (54/228)	18.9 (27/143)	26.2 (34/130)
Others[b]	3.1 (6/192)	5.3 (11/207)	2.4 (5/205)
Isospora spp.	9.5 (40/420)[c]	7.4 (26/350)	4.5 (15/335)[d]
Group 1[a]	16.7 (38/228)	18.2 (26/143)	11.5 (15/130)
Others[b]	1.0 (2/192)	0 (0/207)	0 (0/205)
Toxocara canis	4.3 (18/420)	3.1 (11/350)	3.6 (12/335)
Group 2[a]	16.1 (5/31)	12.1 (4/33)	12.5 (4/32)
Others[b]	3.3 (13/389)	2.2 (7/317)	2.6 (8/303)
Ancylostoma caninum	1.0 (4/420)	1.1 (4/350)	1.5 (5/335)
Group 3[a]	4.5 (3/67)	6.0 (3/50)	6.1 (3/49)
Others[b]	0.3 (1/353)	0.3 (1/300)	0.7 (2/286)
Trichuris vulpis	3.8 (16/420)	2.6 (9/350)	1.2 (4/335)
Group 3[a]	13.4 (9/67)	8.0 (4/50)	10.2 (5/49)
Others[b]	2.0 (7/353)	1.7 (5/300)	2.1 (6/286)
Strongyloides stercoralis	1.4 (6/420)	0.6 (2/350)	1.2 (4/335)
Group 1[a]	3.1 (7/228)	1.4 (2/143)	3.1 (4/130)
Others[b]	1.0 (2/192)	0 (0/207)	0 (0/205)

a: high detective factor complex. b: non-high detective factor complex. a vs. b: $p < 0.01$ or $p < 0.05$, except for *S. stercoralis* in 2002. c vs. d: $p < 0.01$.

Discussion

Until the present study was performed, the authors believed that the recent regional prevalence of intestinal parasites in private household dogs had decreased compared to 10 years ago, since the knowledge of owners regarding canine intestinal parasites and parasitic zoonoses has been increased provably. Several papers in Japan have actually shown that the prevalence of intestinal parasites in private household dogs had decreased compared to past years [1,12-14]. Unexpectedly, the prevalence of all intestinal parasites studied had not changed over the past 10 years in the present study, when data was analyzed based on the concept of epidemiological high detective factor complex. The present results indicate that profiles in surveyed dogs are important for the interpretation of data from epidemiological studies on canine intestinal parasites.

Although the prevalence of *Isospora* spp. protozoa in the present study outwardly showed a significant decline associated with the studied year in terms of overall prevalence, the real prevalence under the consideration of epidemiological factors showed no changes. False interpretations may occur if canine profiles are neglected. Differentiation of surveyed canine populations may produce different results, as many factors related to dogs are mixed, and comparison under identical conditions is impossible. Data on canine intestinal parasites obtained without considering canine profiles seems to supply only limited information, and sometimes induces meaningless but apparently significant differences among the results. When zoonoses are discussed, epidemiological backgrounds, including information of dog-human contact are more important in public health. Even if the prevalence of zoonotic parasites in dogs is high, the problem will be minimal if contact between infected dogs and humans is infrequent. In contrast, a serious problem is obviously present for humans if there is frequent close contact, even if prevalence is low. Certain indicators are needed to compare epidemiological data on canine intestinal parasites from differential populations. The concept of high detective factor complex, which is supported by the results of previous reports [3-7].

A surprising finding was that the protozoan *G. intestinalis* in the high detective factor complex group (under 1 year old, derived from pet shops/breeding kennels and kept indoors) recorded a high prevalence continuously over the past 10 years, with a peak of 26.2% in 2007. Although there has been no clear evidence of *Giardia* transmission from dogs to humans, there have been reports of suspected human cases of giardiasis from a canine source [2,16]. Moreover, household dogs have the possibility of higher prevalence of *G. intestinalis* infection than seen in the present results. This is because recent previous studies have demonstrated that enzyme-linked immune absorbent assay and polymerase chain reaction techniques are more sensitive to detecting *Giardia* infection than the convenient microscopic examination method such as used in the present study [8,9,15]. However more sensitive methods were unused in the present study, because the certain technique was needed to evaluate the prevalence among the differentiated years. Emphasis should be placed on the fact that *G. intestinalis* infected dogs are often in very close contact with humans, creating a scenario for direct transmission.

T. canis is most famous nematode among the canine intestinal parasites, and the potential for zoonotic transmission is commonly recognized around the world [11]. Since numerous anthelmintic drugs for *T. canis* are sold in pet shops and home centers in Japan, owners are easily able to obtain and treat their animals. However, the prevalence in the group with a high detective factor complex (under 1 year old, bred by private owners and kept outdoors) has been steady ($>$10%) over the past 10 years. The risk of transmission through the contamination of *T. canis* eggs in the field has clearly not been reduced in the area of the present study. The importance of regular fecal examination in household dogs needs to be recognized more among owners and clinical veterinarians.

Although *S. stercoralis* is also a zoonotic nematode [11] in close contact with humans according to the epidemiological profile, prevalence has been low over the past 10 years. *S. stercoralis* was detected to a limited extent in dogs derived from pet shops/breeding kennels under 1 year old. This suggests that *S. stercoralis* transmission may occur continuously among young dogs in pet shops/breeding kennels. This finding is similar to *Isospora* spp. infections, in that the infected dogs were almost all young dogs from pet shops/breeding kennels. *A. caninum* and *T. vulpis* are mainly detected in older outdoor dogs, and the prevalence has not changed over the past 10 years. Contamination of fields via *A. caninum* and *T. vulpis* eggs is suspected to have contributed to the lack of change in the region of the present study.

In conclusion, the present results indicate that the prevalence of *G. intestinalis* and other intestinal parasites in private household dogs has not always decreased, and the potential for parasitic zoonotic transmission from dogs to humans seems to remain at a higher level than we initially presumed. We recommend careful surveillance of intestinal parasites and aggressive use of anthelminthic in private household dogs under considering the epidemiological factors.

References

1. **Asano K, Suzuki K, Matsumoto T, Sakai T, Asano R.** Prevalence of dogs with intestinal parasites in Tochigi, Japan

in 1979, 1991 and 2002. Vet Parasitol 2004, **120**, 243-248.

2. **Eligio-García L, Cortes-Campos A, Jiménez-Cardoso E.** Genotype of *Giardia intestinalis* isolates from children and dogs and its relationship to host origin. Parasitol Res 2005, **97**, 1-6.

3. **Itoh N, Itoh S.** Survey on nematode in the digestive tract of adult dogs reared in Hachinohe area, Aomori prefecture. J Jpn Vet Med Assoc 1999, **52**, 649-653.

4. **Itoh N, Muraoka N.** Detection of *Isospora* oocysts in household dogs. J Jpn Vet Med Assoc 2002, **55**, 21-25.

5. **Itoh N, Muraoka N, Aoki M, Itagaki T.** Prevalence of *Giardia* lamblia infection in household dogs. Kansenshogaku Zasshi 2001, **75**, 671-677.

6. **Itoh N, Muraoka N, Aoki M, Itagaki T.** Prevalence of *Strongyloides* spp. infection in household dogs. Kansenshogaku Zasshi 2003, **77**, 430-435.

7. **Itoh N, Muraoka N, Aoki M, Itagaki T.** Prevalence of *Toxocara canis* infection in household dogs. Kansenshogaku Zasshi 2004, **78**, 114-119.

8. **Itoh N, Muraoka N, Aoki M, Itagaki T.** Detection of *Giardia* antigen in puppies using enzyme-linked immunosorbent assay. J Jpn Vet Med Assoc 2004, **57**, 579-582.

9. **McGlade TR, Robertson ID, Elliot AD, Thompson RCA.** High prevalence of *Giardia* detected in cats by PCR. Vet Parasitol 2003, **110**, 197-205.

10. **Nakamura-Uchiyama F, Hiromatsu K, Ishiwata K, Sakamoto Y, Nawa Y.** The current status of parasitic diseases in Japan. Intern Med 2003, **42**, 222-236.

11. **Robertson ID, Thompson RC.** Enteric parasitic zoonoses of domesticated dogs and cats. Microbes Infect 2002, **4**, 867-873.

12. **Saito T, Hashiguchi M, Shimatani K, Miyano S, Yamaashi K, Yamaguchi H, Yoshida K, Ikeda F, Kuya M, Utsnomiya K, Tongu Y.** Infection rate of parasites in domestic dogs and cats in Fukuyama city, Hiroshima prefecture in 2002. J Vet Med (Tokyo) 2004, **57**, 11-14.

13. **Saito T, Morishige K, Tongu Y.** Parasites of pet dogs and cats in Fukuyama city. Kisechugaku Zasshi 1995, **44**, 149-153.

14. **Saito T, Yamaguchi H, Yoshida K, Kusaura J, Wada E, Morishige K, Tongu Y.** Infection rate of parasites in domestic dogs and cats in Fukuyama city in 1995. J Vet Med (Tokyo) 1998, **51**, 889-892.

15. **Schunk M, Jelinek T, Wetzel K, Nothdurft HD.** Detection of *Giardia* lamblia and Entamoeba histolytica in stool samples by two enzyme immunoassays. Eur J Clin Microbiol Infect Dis 2001, **20**, 389-391.

16. **Traub RJ, Monis PT, Robertson I, Irwin P, Mencke N, Thompson RCA.** Epidemiological and molecular evidence supports the zoonotic transmission of *Giardia* among humans and dogs living in the same community. Parasitology 2004, **128**, 253-262.

17. **Young KH, Bullock SL, Melvin DM, Spruill CL.** Ethyl acetate as a substitute for diethyl ether in the formalin-ether sedimentation technique. J Clin Microbiol 1979, **10**, 852-853.