CHAPTER 4

Intestinal Helminths of Dogs and Cats Inhabiting the Orang Asli Communities

4.1 INTRODUCTION

Pet dogs and cats are often considered to be the faithful friends and intimate companions of humans, and enjoy life together with humans. This human-animal bond can provide substantial positive benefits with regards to emotional development, socialization and physiological well-being of humans (McGlade et al, 2003). With the increasing number of companion animal, there is more contact between domestic animals and people, exposing humans to zoonotic agents (Robertson et al, 2000; Lorenzini et al, 2007). Although dogs and cats are often considered family members by their owners, it is important to emphasize that they may play important role as vector for zoonotic diseases to humans (Schantz, 1994; Robertson et al, 2000). Likewise, the potential role of companion animals as reservoirs for zoonotic diseases has been recognized as a significant public health threat of pet ownership worldwide (Schantz, 1994).

While many potentially zoonotic organisms are associated with dogs and cats, enteric pathogens are of particular concern (Robertson et al, 2000; McGlade et al, 2003). Intestinal helminthic infections are one of the most common pathogenic agents in dogs and cats (Papazahariadou et al, 2007; Bridger & Whitney, 2009). Among intestinal helminths, *Toxocara* spp. and hookworm are species of dogs and cats that are most important to public health. These infections receive great attention especially in developing countries and communities that may be socioeconomically challenged (Robertson et al, 2000). They are responsible for some important zoonotic diseases including well-documented diseases such as visceral or cutaneous larval migrans and eosinophilic enteritis (EE) (Despommier, 2003; Prociv & Croese, 1996). These dogs and cats tend to discharge helminth eggs or larvae into general environment that are transmittable to human population (Bridger & Whitney, 2009; Overgaauw et al, 2009). The transmission of these zoonotic agents could be through indirect contact with animal secretions and excretions, contaminated water and food or through direct contact with infected animals since most of these parasites have an oral-fecal transmission cycle (Martinez-Moreno et al, 2007; Overgaauw et al, 2009).

Unlike in the rural communities, the potential role of companion animals as reservoirs for diseases has been recognized as a significant public health problem in urban setting. The subject has received attention, priority and coverage in medical literature of urban communities primarily because of the availability of resources (Traub et al, 2005). The attitudes and economic status of pet owners in these urban areas also ensure that the available veterinary resources are well used (Robertson et al, 2000). However, in rural settings, uncontrolled populations of dogs and cats exist in close proximity with their owners and humans often share a close relationship with them in these settings. In these socioeconomically disadvantaged communities, the poor levels of hygiene and overcrowding, along with a lack of veterinary attention and zoonotic awareness, exacerbates the risks of disease transmission (Traub et al, 2005; Conlan et al, 2011).

In Malaysia, little information on the prevalence of intestinal helminthic infections in rural dogs and cats is available. Most surveys of intestinal helminths conducted in the past have been limited to urban dogs and cats (Shanta et al, 1980; Lee et al, 1993). Until recently, study on diversity and distribution of intestinal helminths is focused on stray cats in major urban cities in Malaysia (Mohd Zain, 2010). While previous studies on the prevalence of intestinal helminths in urban setting yielded important results, it cannot be assumed these results are indicative of the situation among rural dogs and cats. Moreover, close contact between humans, dogs and cats is part of natural living conditions particularly where livestock rising is of economic importance (Soriano et al, 2010), thus at risk of acquiring zoonotic diseases transmitted by dogs and cats. As the potential for zoonotic transmission of intestinal helminths and the human health risks associated with dog and cat ownership are now being increased (Robertson et al, 2000; Overgaauw et al, 2009), there is an urgent need to obtain more-recent parasite data especially in rural setting where humans often share a close relationship with these companion animals.

4.1.1 Objectives of the study

General objective

To determine the prevalence of intestinal helminthic infections in dogs and cats in these Orang Asli communities (i.e., those studied and mentioned in **Chapter 3**).

Specific objectives

1. To estimate the prevalence of intestinal helminthic infections in dogs and cats by means of copro-parasitological examination.

2. To assess the potential risk for human acquiring zoonotic infections from infected dogs and cats.

4.1.2 Research hypotheses

1. The prevalence of intestinal helminth infections is expected to be high in dogs and cats.

2. Dogs and cats are definitive hosts for several intestinal helminths species which has the zoonotic potential.

4.1.3 Significance of the study

Although well recognized and studied in developed countries, parasitic zoonoses transmitted by companions animal such as dogs and cats are of low priorities with regards to public health concerns in developing countries including Malaysia. This is particular relevant among socioeconomically disadvantaged communities in rural settings, where conditions are conducive for transmission. The risk of disease transmission is further exacerbated by poor levels of environmental and sanitary behavior, overcrowding, close contact with these companions animal along with a lack of proper veterinary attention and disease awareness. Since dogs and cats live in close proximity with humans and are often considered as part of the family by their owners, understanding the implications and epidemiology of zoonoses parasites harbored by these animals is important to minimize the risk to humans. In Malaysia, there are no published data on the epidemiology of intestinal helminths presents in dogs and cats among poor communities such as Orang Asli inhabiting the rural areas. These communities share a close relationship with their dogs and cats, often allowing them into their houses along with lack of veterinary attention and zoonotic awareness which exacerbates the risk of transmission in these communities. Thus, this particular study serves as a model to provide new insights into the role of dogs and cats as parasitic zoonoses or mechanical transmitter of human parasites such as hookworm, *Ascaris* spp. and *Trichuris* spp. in rural communities. It also allows us to re-assess the veterinary and public health concerns regarding the parasitic infection in these animals and their role as reservoir for zoonotic diseases to human population.

4.2 MATERIALS AND METHODS

4.2.1 Study population

Details of the consent, sampling scheme and village characteristics have been previously described in **Chapter 3**. In brief, dogs and cats are the most common companion animals among the villagers. They play a diversity of roles to their owners. They are involved in companionship, scavenging, hunting and guarding. It has been estimated that about 50 to 100 of dogs and cats live in each of the surveyed areas. Free-roaming dogs and cats are common and were observed to defecate indiscriminately in the areas surrounding property of their owners. The practice of removing animal feces from public areas is not a common habit among the villagers. Due to the lack of awareness and resources, the attitude as well as economic constrain of the owners, these animals are usually given minimal care and the administration of anthelminthics is most unlikely. The villagers have very close contact with these animals, even sharing food from the same plate with them. Occasionally, these animals also slept and defecated indoors.

4.2.2 Fecal sample collection

Fecal samples were collected with the permission and assistance of the owners. A total of 105 fresh fecal samples (i.e., 77 dogs and 28 cats) were collected during the study period. The ages of the animals ranged from 6 weeks to 36 years old, however the history of these animals was not known. The collected fecal samples were put in clean, wide-mouthed container with tight fitting lids and sealed in plastic bags for transportation. Extra care was taken to avoid contamination with soil which might harm existing or introducing free-living organism from the environment. Samples were then labeled according to the type of animal and date of sample collection and brought back to the laboratory at ambient temperature on the same day of collection, preserved in 2.5% potassium dichromate and kept at 4 °C until later analysis.

4.2.3 Parasitological procedure

The collected fecal samples were processed and examined for the presence of intestinal helminths by using direct smear and formalin ethyl acetate concentration techniques, similar to previously described in **Chapter 3** (Appendix B). Briefly, fecal samples were then stained with both normal saline and 0.85% iodine and examined using 10 x magnifications followed by examination under 400 x magnifications with light microscope (Olympus CX40, USA) for both techniques.

4.2.4 Data analysis

Detection of intestinal helminths was determined on the basis of morphological characteristic of specific species under microscopic examination. One of each sample was examined and the result was considered as positive when at least one parasite egg or larvae was observed in one of each employed technique. The data entry and analysis was carried out using the SPSS software (Statistical Package for the Social Sciences) program for Windows version 17 (SPSS, Chicago, IL, USA). The prevalence and 95% confidence intervals (CIs) were calculated for each parasite. Pearson's Chi-square and Fisher's exact test was carried out to test for significance between prevalence of parasite by host, species and type of infections. The level of statistical significance was set at $p<0.05$ for each test.

4.3 RESULTS

The total of examined fecal samples were 105, with 77 (73.3%) from dogs and 28 (26.7%) from cats. Of the 105 examined fecal samples, 89 (84.8%; 95% CI=77.9-91.7) were parasitized with, at least one intestinal helminths species (Table 4.1). The overall prevalence of intestinal helminths in dogs and cats were 83.1% (64/77; 95% CI=80.7-95.9%) and 89.3% (25/28; 95% CI=77.8-98.8), respectively. However, there was no significant difference ($p=0.89$) in overall prevalence of intestinal helminths between dogs and cats. A total of eight different intestinal helminths species were detected in both dogs and cats, including *Ancylostoma* spp. (61.9%; 65/105), *Toxocara* spp. (32.4%; 34/105), *Trichuris vulpis* (21.0%; 22/105), *Spirometra* spp. (9.5%; 10/105), *Toxoascaris leonina* (5.7%; 4/105), *Dipylidium caninum* (4.8%; 5/105), *Ascaris* spp. (2.9%; 3/105) and *Hymenolepsis diminuta* (1.0%; 1/105). Besides intestinal helminths, intestinal protozoa were also detected in both animals such as *Entamoeba* spp. (12.4%; 10/105), *Giardia duodenalis* (12.4%; 10/105), *Cryptosporidium* spp. (6.7%; 5/105), *Balantidium* spp. (3.8%; 4/105), *Eimeria* spp. (1.9%; 2/105) and *Isopsora* spp. (1.9%; 1/105) (data not shown).

Taking into consideration the species of intestinal helminths in dogs, *Ancylostoma* spp. (70.1%; 54/77) was the most common species followed by *Toxocara* spp. (28.6%; 22/77) and *T. vulpis* (24.7%; 19/77). The remaining helminths recorded were *Spirometra* spp. (10.4%; 8/77), *T. leonina* (5.2%; 4/77), *D. caninum* (3.9%; 3/77), *Ascaris* spp. and *H. diminuta* (1.6%; 1/77 each) (Table 4.2). As for cats, high prevalence of *Toxocara* spp. (42.9%; 12/28) was recorded, followed by *Ancylostoma* spp. (39.3%; 11/28), *T. vulpis* (10.7%; 3/28), *Spirometra* spp., *T. leonina*, *D. caninum* and *Ascaris* spp. (7.1%; 2/28 each). There was no significant difference ($p>0.05$) in prevalence between dogs and cats for all type of intestinal helminth species with the exception of *Ancylostoma* spp., where the prevalence in dogs was more than double that of cats (X^2=9.1; p=0.003).

Monoparasitism (38.1%; 40/105) were less frequent than poliparasitism (46.7%; 49/105) in both animals. There were high numbers of cats being infected with at least one of intestinal helminths species compared to dogs but this did not differ significantly ($p>0.05$) (Table 4.3). Considering the distribution of intestinal helminths in dogs, 33.8% (26/77) were infected by single parasite species while 49.4% (38/77) were harboring more than one parasites species. In cats, 50.0% (14/28) were harboring only one parasite species while 39.3% (11/28) were found to be infected with more than one parasite species. Likewise, there was no significant difference ($p>0.05$) in prevalence between dogs and cats for both type of infections (i.e., monoparasitism and poliparasitism).

With regards to the types of poliparasitism detected in dogs and cats, double infections between *Ancylostoma* spp. and *Toxocara* spp. were most prevalent in both dogs (17.2%; 11/64) and cats (16.0%; 4/25) (Table 4.4). Other mixed infections that was reported in dogs including *Ancylostoma* spp. and *T. vulpis* (12.5%; 8/64), *Ancylostoma* spp and *Spirometra* spp. (6.3%; 4/64), *T. vulpis* and *Toxocara* spp. (3.2%; 2/64) and single infection of *Ancylostoma* spp. and *D. caninum* (1.6%; 1/64). As for cats, double infections of *Ancylostoma* spp. and *T. vulpis* (8.0%; 2/25) were the second most frequent poliparasitism detected. Only one double infection of *Ancylostoma* spp. and *Spirometra* spp., *Ancylostoma* spp. and *Ascaris* spp., *T. leonina* and *Toxocara* spp. and *Toxocara* spp. and *D. caninum* (4.0%; 1/25 each) was recorded in cats. In addition, only dogs were infected with more than two intestinal helminth species. Of this, triple infections of *Ancylostoma* spp., *T. vulpis* and *Toxocara* spp. were most frequent detected in dog (7.8%; 5/64).

Table 4.1: Overall prevalence of intestinal helminths in dogs and cats

		Intestinal helminths		
Animals	**N**	**n**	**%**	**95% CI**
Dogs	77	64	83.1	74.73-91.5
Cats	28	25	89.3	77.8-98.8
Total	**105**	**89**	**84.8**	**77.9-91.7**

N = Number of animal examined; n = Number of infected animal; CI = confidence interval

Table 4.2: Prevalence of intestinal helminths by species in dogs and cats

	Dogs			Cats				
Intestinal Helminths	**n**	**%** [a]	**%** [b]	**n**	**%** [a]	**%** [b]	X^2	**p**
Ancylostoma spp.	54	84.3	70.1	11	44.0	39.3	9.1	0.003 [c]
Toxocara spp.	22	34.4	28.6	12	48.0	42.9	1.9	0.167 [c]
Trichuris vulpis	19	29.7	24.7	3	12.0	10.7	2.4	0.120 [d]
Spirometra spp.	8	12.5	10.4	2	8.0	7.1	0.5	0.787 [d]
Toxoascaris leonina	4	6.3	5.2	2	8.0	7.1	0.5	0.490 [d]
Dipylidium caninum	3	4.7	3.9	2	8.0	7.1	0.2	0.701 [d]
Ascaris spp.	1	1.6	1.3	2	8.0	7.1	2.5	0.112 [d]
Hymenolepsis diminuta	1	1.6	1.3	0	0	0	0.4	0.545 [d]

[a] Frequency was calculated based on total of infected animals for each species (n) divided by total of infected animals (64 of dogs and 25 of cats)

[b] Frequency was calculated based on total of infected animals for each species (n) divided by total of animal sampled (77 of dogs and 28 of cats)

[c] Chi-square test

[d] Fisher's exact test

Table 4.3: Prevalence of monoparasitism and poliparasitism in dogs and cats

	N	**%**	**Number of Monoparasitism Cases**		**Number of Poliparasitism Cases**	
			n	**%**	**n**	**%**
Dogs	64	83.1	26	33.8	38	49.4
Cats	25	89.3	14	50.0	11	39.3
Total	**89**	**84.7**	**40**	**38.1**	**49**	**46.7**

Total number of animal examined (77 of dogs and 28 of cats)

N= Number of infected animal

Table 4.4: Types of intestinal helminths in poliparasitism dogs and cats

Type of Poliparasitism	**Dogs***		**Cats***	
	n	**%**	**n**	**%**
Double Infections				
Ancylostoma spp + *Toxocara* spp	11	17.2	4	16.0
Ancylostoma spp + *T. vulpis*	8	12.5	2	8.0
Ancylostoma spp + *Spirometra* spp	4	6.3	1	4.0
T. vulpis + *Toxocara* spp	2	3.2	0	0
Ancylostoma spp + *D. caninum*	1	1.6	0	0
Ancylostoma spp + *Ascaris* spp.	0	0	1	4.0
T. leonina + *Toxocara* spp	0	0	1	4.0
Toxocara spp + *D. caninum*	0	0	1	4.0
Triple Infections				
Ancylostoma spp + *T. vulpis* +*Toxocara* spp	5	7.8	0	0
Ancylostoma spp + *T. vulpis* + *T. leonina*	2	3.2	0	0
Ancylostoma spp + *Toxocara* spp + *Spirometra* spp	2	3.2	0	0
Ancylostoma spp + *Ascaris* spp.+ *Toxocara* spp	1	1.6	0	0
Ancylostoma spp + *T. vulpis* + *Spirometra* spp	1	1.6	0	0
Ancylostoma spp + *T. leonina* + *D. caninum*	1	1.6	0	0

* Frequency was calculated based on total of infected animals for each species (n) divided by total of infected animals (64 of dogs and 25 of cats)

4.4 DISCUSSION

The results of this study showed that the prevalence of intestinal helminthic infections among dogs and cats of rural areas in Malaysia was very high (84.8%). Despite strong evidence indicating the endemicity of several zoonotic species as reported in the present study, knowledge of the prevalence associated with zoonotic parasites of dogs and cats in Malaysia is largely lacking. Therefore, it is difficult to compare the prevalence of intestinal helminths in this study with studies within the country as most surveys of canine and feline intestinal helminths conducted in the past have been limited only to urban settings. Worldwide, there is significant variation in the prevalence of intestinal helminths reported in dogs and cats with percentage ranging between 26.0% and 96.0% (Schantz, 1994; Traub et al, 2005; Overgaauw et al, 2009). As many of the identified intestinal helminths can have significant health implications, it is important to have an understanding of regional parasite burdens such that public health effects can be minimized.

The high prevalence of intestinal helminths found in this study was in accordance with studies conducted among dogs and cats in urban setting in Spain (Calvete et al, 1998), Costa Rica (Paquet-Durand et al, 2007), Brazil (Lorenzini et al, 2007) and Belgium (Claerebout et al, 2009), with prevalence ranging between 88.0% and 90.0%. In contrast, studies conducted among dogs and cats in Perth, Australia and Buenos Aires, Argentina have reported a lower prevalence rates than those reported in the present study, which varied from 1.0% to 10.0% (McGlade et al, 2003; Sommerfelt et al, 2006). With regards to dogs, studies of the intestinal helminths in rural dogs in Argentina found that prevalence ranged between 37.9% and 52.4% (Soriano et al, 2010). Similarly, studies conducted among shepherd and hunting dogs in Greece (Papazahariadou et al, 2007) noted prevalence rates of 35.5% and 26.0%, respectively.

In all cases, hookworm infections were found to be the most common parasite species detected in both host. Similar observation have been reported in surveys undertaken among dogs and cats worldwide (Inpankaew et al, 2007; Lorenzini et al, 2007; Papazahariadou et al, 2007; Traub et al, 2008; Scorza et al, 2011). The high prevalence of hookworm infections in dogs and cats among these rural communities could play a significant role in contributing to the occurrence of zoonotic ancylostomiasis such as creeping eruption and eosinophilic enteritis (EE) or less frequently symptoms including localized myositis, erythema multiforme and ophthalmological manifestations to human (Bowman et al, 2010). Although species identification was not carried out in the present study, three hookworm species (i.e., *A. ceylanicum*, *A. caninum* and A. *braziliense*) were believed to be the main aetiological agent in Malaysia. Presently, it is difficult to compare the species-specific of hookworm infections in dogs and cats in Malaysia since there is limited prior documented data. The only studies that have been reported specific species of hookworm was among stray dogs in Kuala Lumpur and Sarawak (East Malaysia) (Yoshida et al, 1973; Choo et al, 2000), where more than 95% of the examined dogs were infected with *A. ceylanicum* based on autopsies examination on the adult worm.

Toxocara spp., was the second most common intestinal helminths species detected in both host in the present study. These results were in accordance with parasitic survey of various types of canine and feline conducted in St. Pierre Island (Bridger & Whitney, 2009), Argentina (Sommerfelt et al, 2006) and Spain (Calvete et al, 1998). However, rates were higher than that in Thailand (7.5%) (Inpankaew et al, 2007), Spain (17.7%) (Martinez-Moreno et al, 2007) and Argentina (11.0%)

(Fontanarrosa et al, 2006). Although *Toxocara cati* and *Toxocara canis* were common species infecting canine and feline, it would appear that the *Toxocara* eggs recovered in this study may also be *Toxocara malaysiensis*. This is because in earlier local studies, *T. malaysiensis* was assumed to be *T. cati* or *T. canis* but molecular analysis revealed that these three species were separate distinct species with local prevalence ranging between 20.0% and 50.0% (Zhu et al, 2000). However, species differentiation was not carried out in this current study.

T. vulpis was the third most frequent intestinal helminths detected in these animals. Similar observation was also recorded in Costa Rica with prevalence rates of 15.0% to 26.0% among the surveyed dogs and cats (Paquet-Durand et al, 2007; Scorza et al, 2011). As for their worldwide distribution, the prevalence of *T. vulpis* in dogs and cats varies regionally with rates varying from 3.7% to 49.5% (Katagiri & Oliveira-Sequeira, 2008). Although *Trichuris* eggs detected in this study was morphologically identical to human-specific species (i.e., *Trichuris trichiura*) measurements of the eggs are within the range for *T. vulpis* (approximately 82 x 39 um) which is larger and broader than *T. trichiura* (approximately 55 x 22 um). The fact that *T. trichiura* was the highest soil-transmitted helminth (STH) species detected in human fecal samples in the same study locations as discussed previously in **Chapter 3**. Therefore, the role of the dog as mechanical vector *Trichuris* infection may also seem likely in these rural communities. Necropsy examination to differentiate adult worm morphology on *Trichuris*-positive dogs and cats or molecular tools for species identification of *Trichuris* eggs in fecal sample would be useful in further investigating this hypothesis.

The finding of *Ascaris* eggs in dogs and cats feces suggests that these animals might act as significant mechanical transmitter of ascariasis for human population especially in communities where promiscuous and indiscriminate defecation habit exist.

The role of dogs and cats in the transmission of *Ascaris lumbricoides* for humans has been widely recognized (Traub et al, 2003). Recent study carried out in Egypt suggested that dogs are acting as biological transmitter and reservoir hosts of *A. lumbricoides* as well as environmental contaminators in communities where indiscriminate defecation is common (Shalaby et at, 2010). Likewise, Traub and co-workers (2003) demonstrated that *Ascaris*-positive dogs were 100% homology with the *A. lumbricoides* derived from human fecal sample using molecular based tools in India. In addition, their finding also indicates that positive dog with *Ascaris* belonged to the household where at least one family member was infected with *A. lumbricoides* and defecated outdoor (Traub et al, 2003). These *Ascaris*-positive dogs might ingest the feces of their infected owner, therefore acting as disseminators and environmental contaminators by increasing the net exposure of infective stages in contact with human. Again, since *A. lumbricoides* was the second most frequent STH species detected in human fecal samples as reported in **Chapter 3**, dogs in these communities may play significant role as mechanical transmission of human *Ascaris* infection in these rural communities, a finding that still need further investigation particularly through the use of molecular based tool for specific species identification and discrimination.

Spirometra spp. was also recorded in both of the examined dogs and cats. Although not many studies had reported the findings of this parasite, similar observation have been reported in a survey undertaken among dogs population in India (Traub et al, 2003). The presence of *Spirometra* spp. is a reflection of the fact that most dogs and cats were allowed to roam freely and had access to paratenic hosts as their food sources. The possible source of infection to dogs and cats is that by ingesting raw fish offal fed to them by their owner and therefore acting as important indirect reservoirs of this parasite to human. It would appear that the *Hymenolepis* eggs detected from dog fecal samples was of rodent origin, since none of the human fecal samples were found positive with this species as discussed previously in **Chapter 3**.

High prevalence of intestinal helminths reported in this study must serve as an alert to public health, veterinary authorities and their owners. Monitoring parasite burden in domestic pets should be a continuous task due to the zoonotic aspect of the infections and the potential impact on public health. The accurate prevalence of zoonoses species transmitted to humans from dogs and cats is complicated to estimate as it depends on several factors such as mode of transmission, numbers of infected animals, behavior or knowledge and understanding of the owners on the prevention measures (Scorza et al, 2011). Thus, awareness of the prevalence, mode of transmission and preventive measurement are paramount to the welfare of cats and dogs. The implementation of a chemotherapeutic program to control intestinal helminth infections in dogs and cats in rural communities would not be highly realistic or feasible due to economic constrain of these communities. Alternatively, population control of dogs and cats together with public health education should be implemented in educating the communities about parasites and their hazardous implication that they pose. The practices of non-chemotherapeutic measures such as improvement in education, economic, sanitation and hygiene would also help reduce the prevalence of intestinal helminths in both animal and human hosts.

4.5 CONCLUSIONS

The high prevalence of several potential zoonotic intestinal helminth species found in dogs and cats as reported in the present study should be used to alleviate public health risks. This is particularly important in these socioeconomically disadvantaged communities where they often share a close relationship with their companion animals along with lack of veterinary awareness, thus places them at high risk of acquiring parasitic zoonoses.

The following conclusions are a synopsis of the analysis undertaken through this study in which they were discussed:

1. Of the 105 examined dogs and cats fecal samples, 89 (84.8%; 95% CI=77.9-91.7) were parasitized with, at least one intestinal helminth species.

2. Positive results with the presence of at least one intestinal helminths correspond to 83.1% (64/77; 95% CI=80.7-95.9%) for dog and 89.3% (25/28; 95% CI=77.9-100.8) for cat.

3. In both host, eight different intestinal helminths species were detected including *Ancylostoma* spp. (61.9%; 65/105), *Toxocara* spp. (32.4%; 34/105), *Trichuris vulpis* (21.0%; 22/105), *Spirometra* spp. (9.5%; 10/105), *Toxoascaris leonina* (5.7%; 4/105), *Dipylidium* caninum (4.8%; 5/105), *Ascaris* spp. (2.9%; 3/105) and *Hymenolepsis diminuta* (1.0%; 1/105).

4. In dog, *Ancylostoma* spp. (71.4%; 54/77) was the most frequent parasite recorded followed by *Toxocara* spp. (28.6%; 22/77), *T. vulpis* (24.7%; 19/77), *Spirometra* spp. (10.4%; 8/77), *T. leonina* (5.2%; 4/77), *D. caninum* (3.9%; 3/77), *Ascaris* spp. and *H. diminuta* (1.6%; 1/77 each).

5. In cat, *Toxocara* spp. (42.9%; 12/28) was the most common parasite detected, followed by *Ancylostoma* spp. (39.3%; 11/28), *T. vulpis* (10.7%; 3/28), *Spirometra* spp., *T. leonina*, *D. caninum* and *Ascaris* spp. (7.1% for each species; 2/28).

6. There was significant difference in the prevalence between dogs and cats for *Ancylostoma* spp., where the prevalence in dogs was more than double that of cats (X^2=9.1; p=0.003).

7. Monoparasitism (38.1%; 40/105) were less frequent than poliparasitism (46.7%; 49/105) in both host.

8. As for poliparasitism, double infections between *Ancylostoma* spp. and *Toxocara* spp. were most frequent in both host (17.2% for dogs and 16% for cats).

9. Only dogs were infected with more than two intestinal helminth species. Of this, triple infections of *Ancylostoma* spp., *T. vulpis* and *Toxocara* spp. were the most prevalent in dogs (7.8%; 5/64).