



UNIVERSITI PUTRA MALAYSIA

**PREVALENCE OF INTESTINAL HELMINTHS OF HOUSEHOLD DOGS
AND CATS AND PERCEPTION OF RELATED ZOOSES BY OWNERS
IN IPOH, PERAK, MALAYSIA**

CHONG KEO LEE

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AND CATS AND PERCEPTION OF RELATED ZONOSSES BY OWNERS
IN IPOH, PERAK, MALAYSIA**

CHONG KEO LEE

A project paper submitted to the

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It is hereby certified that we have read this project paper entitled “Prevalence of intestinal helminths of household dogs and cats and perception of related zoonoses by owners in Ipoh, Perak, Malaysia”, by Chong Keo Lee and in our opinion it is satisfactory in terms of scope, quality, and presentation as partial fulfillment of the requirement for the course VPD 4999 – Final Year Project.



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DEDICATION

This thesis is dedicated to my parents, boyfriend and friends for their endless love,
support and encouragement



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ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan kursus VPD 4999 –
Projek Ilmiah Tahun Akhir.

PREVALEN HELMIN USUS DIKALANGAN ANJING DAN KUCING DI KAWASAN IPOH DAN TAHAP KESEDARAN BERKAITAN ZONOSIS PARASIT DIKALANGAN PEMILIK HAIWAN KESAYANGAN

oleh

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Di Malaysia, dengan peningkatan bilangan haiwan-haiwan kesayangan, terdapat peningkatan dalam hubungan antara haiwan-haiwan domestik dan manusia. Kekurangan kesedaran dikalangan pemilik haiwan kesayangan terhadap potensi jangkitan penyakit zoonotik yang dibawa oleh haiwan kesayangan mereka

meningkatkan risiko mereka kepada pendedahan. Kajian ini bertujuan untuk mengemaskini prevalen helmin usus yang zoonotik dikalangan anjing dan kucing di kawasan Ipoh serta untuk mengetahui tahap kesedaran berkaitan zoonosis parasit dikalangan pemilik haiwan kesayangan. Pengenalpastian ova cacing dalam usus dilakukan dengan menggunakan teknik pengapungan.

Kaji selidik daripada 62 anjing dan 17 kucing menunjukkan prevalen untuk helmin usus adalah seperti berikut: Bagi anjing, *Ancylostoma* spp (27.4%), *Toxocara* spp. (8.1%) dan *Trichuris vulpis* (3.2%). Bagi kucing, hanya *Ancylostoma* spp. (47.1%). Prevalens keseluruhan parasitisme dalam kedua-dua anjing dan kucing adalah 38%. Prevalen parasitisme, terutamanya toksokariasis secara signifikannya lebih tinggi dalam kumpulan anjing umur kurang daripada 6 bulan ($p < 0.05$). Prevalen ansilostomiasis adalah kurang dipengaruhi oleh faktor usia. Anjing yang dibawa berjalan oleh pemiliknya adalah lima kali lebih berisiko untuk dijangkiti oleh cacing.

Daripada 79 pemilik yang ditemuramah, hanya 33% haiwan kesayangan mereka dinyahcacing lebih daripada dua kali setahun. Kebanyakan pemilik (33%) menghabiskan masa mereka selama dua jam sehari dengan haiwan kesayangan mereka. Lebih daripada separuh daripada pemilik, membenarkan haiwan kesayangan mereka untuk menjilat atau mencium muka mereka dan memasuki bilik tidur mereka manakala 34% daripada mereka tidur dengan haiwan kesayangan mereka. Akhir sekali, separuh (51%) daripada pemilik sedar tentang parasit zoonotik yang berkait dengan haiwan kesayangan.

Prevalens helmin usus dalam anjing dan kucing di kawasan Ipoh dianggap tinggi manakala tahap persepsi tentang zoonosis dikalangan pemilik adalah sederhana.

Kata kunci: *Ancylostoma* spp., *Toxocara* spp., zoonosis, anjing dan kucing, interaksi social, kesedaran pemilik



ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfilment of course VPD 4999

PREVALENCE OF INTESTINAL HELMINTHS OF HOUSEHOLD DOGS AND CATS AND PERCEPTION OF RELATED ZONOSSES BY OWNERS IN IPOH, PERAK, MALAYSIA

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2015

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In Malaysia, with the increasing number of companion animals, there is more contact between domestic animals and people, exposing humans to various zoonotic agents. The lack of awareness among pet owners on potential zoonotic diseases harboured by their pets puts them in higher risk of exposure. This study was aimed to update the prevalence of zoonotic intestinal helminths in pet dogs and cats in Ipoh area and to know the level of awareness on parasite zoonoses among pet owners. Identification of intestinal helminth ova was done using the simple floatation technique.

The survey of 62 dogs and 17 cats revealed the prevalence rates for intestinal helminths as follow: In dogs, *Ancylostoma* spp. (27.4%), *Toxocara* spp. (8.1%) and *Trichuris vulpis* (3.2%). In cats, only *Ancylostoma* spp. (47.1%). The overall

prevalence of parasitism in both dogs and cats was 38%. Risk calculation revealed that prevalence of parasitism especially toxocariasis was significantly ($p < 0.05$) higher in the less than 6-months age group. Ancylostomiasis prevalence was less affected by the age factor. Dogs which were walked by their owners were five times more at risk of being infected with helminths.

Of the 79 owners interviewed, only 33% dewormed their pets more than twice per year. Most owners (33%) spent two hours a day with their pets. More than half of the owners allowed their pets to lick or kiss their face and enter their bedrooms while 34% of them slept with their pets. Lastly, half (51%) of the owners were aware of pet-associated zoonotic parasites.

The prevalence of intestinal helminths in pet dogs and cats in Ipoh area is considered high while the perception of zoonoses among owners is moderate.

Keywords : *Ancylostoma* spp., *Toxocara* spp. , zoonotic, dogs and cats, social interactions, owner awareness

INTRODUCTION

In Malaysia, dogs and cats are common pets in many households. With the increasing number of companion animals, there is more contact between domestic animals and people, thus exposing humans to various zoonotic agents. Pet ownership is an important risk factor for the occurrence of many zoonoses (Robertson *et al.*, 2000).

While many potentially zoonotic organisms are associated with dogs and cats, enteric pathogens are of particular concern (Robertson *et al.* 2000). Intestinal helminths are one of the most common pathogenic agents in dogs and cats.

Among intestinal helminths, *Toxocara* spp. and *Ancylostoma* spp. of dogs and cats are most important to public health (Ngu *et al.* 2014). In Malaysia, little information on the prevalence of intestinal helminthic infestations in household cats and dogs is available. As reported by Ngu *et al.* (2014), most surveys on intestinal helminths conducted in the past focused only on stray cats or dogs found either in urban or rural areas. Previous study by Erwanas *et al.* (2014) showed that 31% stray dogs in Ipoh are infected with intestinal helminths, which is considered high. Although previous studies on prevalence of helminth infestation in stray animals revealed significant results, it cannot be assumed that these results are indicative of the condition among household cats and dogs. Moreover, pets have intimate relationship with humans or their owners as compared to strays, thus increasing the chance of transmission of zoonotic diseases. Some close interactions that owners and pets shared put them in higher risk of exposure especially among children and immunocompromised individuals.

In Malaysia, there is no study done on the prevalence of intestinal parasitic infestations together with the possible risk factors associated with lifestyles or interactions that pet owners and pets share. Previous studies mostly focused on prevalence of intestinal parasites alone. Also, the current level of knowledge and awareness of pet owners about pet-associated zoonotic infections is believed to be low although in urban areas, veterinary services are readily available. This study will unfold the potential role of pet cats and dogs as possible reservoirs of pet-associated zoonotic parasite infestation. The level of awareness among pet owners will be known so that client awareness programmes can be planned as a community programme. Therefore, the objectives of this study are;

- i) To study the prevalence of zoonotic intestinal helminth infections of household dogs and cats in Ipoh.
- ii) To study possible risk factors of zoonotic intestinal helminth infections associated with the lifestyles that pet owners and their pets share.
- iii) To study the level of knowledge and the extent to which pet owners are aware of pet-associated zoonotic intestinal helminths.

LITERATURE REVIEW

Pet animals, especially dogs and cats, play a crucial role in societies throughout the world. In Malaysia, there are many households which own both dogs and cats or either one of the species. Although pets offer significant benefits to our society, there are well-documented health hazards associated with owning a pet (Robertson *et al.*, 2000). Besides that, in most rural areas of Malaysia, there are large populations of stray dogs and cats which can act as reservoirs of various disease agents to either pet animals or humans.

There are numerous enteric helminths which have been recognized in dogs and cats, however, not all have the potential for transmission to humans. Of all intestinal helminths, *Toxocara* spp. found in both dogs and cats have high zoonotic potential in humans while *Ancylostoma* spp. from dogs infects humans more readily than those found in cats (Robertson & Thompson, 2002). Parasitological surveys of dogs and cats in the last two decades have indicated that the prevalence of intestinal helminths has declined over the last 20 years in the developed world (Robertson *et al.*, 2000). In recent years, the prevalence of zoonotic pet intestinal helminths has been studied in many parts of the world (Bugg *et al.*, 1999; Robertson *et al.*, 2000; Overgaauw *et al.*, 2009; Lee *et al.*, 2010; Beiromvand *et al.*, 2013; Traub, 2013; Mohd Zain *et al.*, 2013).

In Malaysia, studies of prevalence of zoonotic intestinal helminths were mostly done on stray dogs and cats found either in rural or urban settings. From May 2007 to August 2010, Mohd Zain *et al.* (2013) studied the occurrence of macroparasites from 543 stray cats in four urban cities from west (Kuala Lumpur), east (Kuantan), north (Georgetown) and south (Malacca) of Peninsular Malaysia. Up

to nine species of helminths were recovered with overall high prevalences of infection of 83% in Kuantan, followed by 75.1% in Kuala Lumpur, 71.6% in Georgetown and 68% in Malacca. Of 543 cats, 74.6% (95% confidence limits: 70.7–78.2%) were found to be infected with helminth parasites. The hookworm species, *A. braziliense* (30.8%) and *A. ceylanicum* (29.5%) and the toxascarid nematodes *T. malaysiensis* (28.4%) and *T. cati* (11.0%) were the most prevalent.

Mahdy *et al.* (2012) reported that the overall prevalence of hookworm among 82 dogs in Selangor areas from three different sources was 48% (95%CI; 41.41–54.95). According to Mahdy *et al.* (2012), rural stray dogs had the highest prevalence of 71.4% (95%CI; 61.13–81.49) followed by urban stray dogs, recording 48% (95%CI; 34.15–61.85) and lastly dogs in shelters with 28.7% (95%CI; 19.56–37.84). The distribution of *Ancylostoma* species among dogs based on locations were equal prevalence of *A. ceylanicum* and *A. caninum* in dog shelters, 3.2 times higher prevalence of *A. ceylanicum* compared to *A. caninum* in urban stray dogs and 1.4 times higher prevalence of *A. caninum* than *A. ceylanicum* in rural stray dogs.

Meanwhile Ngui *et al.* (2014) reported the prevalence of gastrointestinal parasites found in 105 samples of rural dogs and cats in Selangor and Pahang. According to them, a total of seven GI helminths species were detected in both dogs and cats, including *Ancylostoma* spp. (62.9%), *Toxocara* spp. (32.4%), *Trichuris vulpis* (21.0%), *Spirometra* spp. (9.5%), *Toxascaris leonina* (5.7%), *Dipylidium caninum* (4.8%), *Ascaris* spp. (2.9%). Taking into consideration the helminth infections in dogs only, *Ancylostoma* spp. (71.4%) was the most prevalent followed by *Toxocara* spp. (28.6%) and *T. vulpis* (24.7%). The remaining helminths identified were *Spirometra* spp. (10.4%), *T. leonina* (5.2%), *D. caninum* (3.9%),

Ascaris spp. and *H. diminuta* (1.6%). As for cats, very high prevalence of *Toxocara* infection (42.9%) was recorded, followed by *Ancylostoma* spp. (39.3%), *T. vulpis* (10.7%), *Spirometra* spp., *T. leonina*, *D. caninum* and *Ascaris* spp. (7.1%) for each species. In his study, monoparasitism (38.1%) was found less frequently than polyparasitism (46.7%) in both animals.

Erwanas *et al.* (2014) studied the prevalence of parasitism in pets and strays around Ipoh area. The prevalence of zoonotic intestinal helminths in 29 stray dogs was found to be 24.1% with *Ancylostoma* spp. and 3.4% with *Toxocara canis*. While in 38 pet dogs, the prevalence of *Ancylostoma* spp. was 5.3% and there was no case of toxocariasis.

Meanwhile in Universiti Putra Malaysia (UPM), Francis (2002) studied the prevalence of gastrointestinal parasites of 60 dogs from an animal shelter in Selangor and found the following; *A. ceylanicum* (63.8%), *A. caninum* (55.0%), *A. braziliense* (20%), *Trichuris vulpis* (2%), *T. canis* (6.7%), *Spirocerca lupi* (3.3%) and *D. caninum* (3.3%). Apart from that, a study done by Shirley (2001) on endoparasites of cats in an animal shelter in Selangor found the prevalence rates of intestinal helminths as follows; *A. ceylanicum* (58%), *A. braziliense* (30%), *T. malaysiensis* (26%), *T. cati* (16%), *D. caninum* (8%), *T. taeniaeformis* (4%) and *Strongyloides sp.* (2%).

Also in UPM, Lim (1999) carried out a survey to determine the prevalence rates for various intestinal parasites in 50 dogs in Kuching Sarawak and found the following prevalence rates; *Ancylostoma* spp. (24%), *Toxocara* spp. (16%) and *Trichuris vulpis* (2%). A retrospective study of intestinal helminths in UPM done by

Tan (1997) from 1991-1996 showed that hookworms were the most commonly encountered species (46.9%) followed by whipworms (7%) and ascarids (5.2%).

While in SPCA, faecal study revealed that hookworms recorded the highest prevalence rate (65.9%) followed by whipworms (12.2%) and ascarids (4.1%) (Tan, 1997). As for UPM Small Animal Clinic, hookworms were seen in 17.9% dogs. Ascarids and hookworms were most prevalent in young dogs less than 6-months old. However, hookworms maintain a high prevalence in the older age group as well. Whipworms were less prevalent in puppies (< 6-months old).

In conclusion, hookworms recorded the highest prevalence in both dogs and cats in Malaysia. So far, there is no study done on the level of owner awareness on pet-associated zoonoses as well as the risk factors of parasitism in pets.

MATERIALS AND METHODS

This study was carried out in Ipoh Garden Clinic Sdn. Bhd over a period of four weeks. A total of 79 faecal samples of cats and dogs were collected during the study. Fresh faecal samples were collected using glove and lubricant per rectum from pet dogs or cats which were brought to the clinic for veterinary services. The owners were then requested to complete a questionnaire (Appendix I) regarding pet history, management factors, owner-pet social interaction as well as knowledge on pet-associated zoonotic parasites. The faecal samples were then processed using simple floatation technique (Appendix II) within 48 hours of collection. Faeces were kept at 4°C until processed.

All the data collected in this study was subjected to statistical analysis, using IBM® SPSS® Statistic version 20. Multinomial logistic regression and Chi-square test with $\alpha=0.05$ as the acceptable level of significance were carried out. The relative risk ratios of parasitism with respect to host factors and management factors were also analyzed.

RESULTS

I. Prevalence rate

The prevalence of intestinal helminths infestation in dogs was 35.5% while in cats was 47.1%. The overall prevalence of intestinal helminth infestation in both dogs and cats was 38%. (Table 1)

Table 1. Overall prevalence of intestinal helminths in dogs and cats

Animals	Helminths		
	No. of animals	No. of infected animals	%
Dogs	62	22	35.5
Cats	17	8	47.1
Total	79	30	38.0

* In dogs, the prevalence of mono-parasitism was 35.5%, while the prevalence of double-parasitism was 3.2%. In cats, the prevalence of mono-parasitism was 47.0% and there was no case of poly-parasitism (Table 2)

Table 2. Prevalence of intestinal helminths by species in dogs and cats

Helminths	Dogs		Cats	
	n	%	n	%
<i>Ancylostoma</i> spp.	17	27.4	8	47.0
<i>Toxocara</i> spp.	5	8.1	0	0
<i>Trichuris vulpis</i>	2	3.2	0	0
<i>Ancylostoma</i> spp. & <i>Toxocara</i> spp.	2	3.2	0	0

II. How do host (dogs) factors and management factors affect parasitism

Statistical analysis using multinomial logistic regression showed that two factors, that are, age groups and whether owners walk their pets or not significantly affect parasitism in dogs. Hence, the risk of both exposure factors was calculated. (Table 3)

Table 3. Multinomial logistic regression analysis-parameter estimates

Worm_infestation ^a	B	Sig.	95% Confidence Interval for Exp(B)	
			Lower Bound	Upper Bound
Intercept	1.463	.330		
[Deworming=1.00]	-.999	.351	.045	3.001
[Deworming=2.00]	0 ^b	.	.	.
[Do_you_walk_your_pet_in_neighbourhoods=1.00]	2.037	.007	1.738	33.811
[Do_you_walk_your_pet_in_neighbourhoods=2.00]	0 ^b	.	.	.
Positive [Age_groups=.00]	1.966	.042	1.076	47.421
[Age_groups=1.00]	0 ^b	.	.	.
[Types_of_management=.00]	-2.610	.063	.005	1.152
[Types_of_management=1.00]	0 ^b	.	.	.
[Number_of_pets=.00]	.470	.550	.342	7.493
[Number_of_pets=1.00]	0 ^b	.	.	.
[Gender=1.00]	-1.255	.096	.065	1.250
[Gender=2.00]	0 ^b	.	.	.

The reference category is: Negative.^a

* $\alpha=0.05$

Dogs which were less than 6-months-old were 4.6 times more at risk of contracting parasitism as compared to dogs which were above 6-months-old. (Table 4)

Table 4. Risk (odd ratio) of age group on parasitism

		Worm_infestation		Total
		Positive	Negative	
Age Groups	< 6 months old	6	3	9
	> 6 months old	16	37	53
Total		22	40	62

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Age Groups (< 6 months old / > 6 months old)	4.625	1.027	20.829

Dogs which were less than 6-months-old were at same risk of contracting *Ancylostoma spp.* infestation as compared to dogs which were above 6-months-old. (Table 5)

Table 5. Risk (odd ratio) of age group on *Ancylostoma spp.* infestation

		<i>Ancylostoma spp.</i>		Total
		Positive	Negative	
Age Groups	< 6 months old	3	6	9
	> 6 months old	14	39	53
Total		17	45	62

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Age Groups (< 6 months old / > 6 months old)	1.393	.306	6.333

Dogs which were less than 6-months-old were 42 times more at risk of contracting *Toxocara* spp. infestation as compared to dogs which were above 6-months-old.

(Table 6)

Table 6. Risk (odd ratio) of age group on *Toxocara* spp. infestation

		<i>Toxocara</i> spp.		Total
		Positive	Negative	
Age Groups	< 6 months old	4	5	9
	> 6 months old	1	52	53
Total		5	57	62

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Age Groups (< 6 months old / > 6 months old)	41.600	3.867	447.559

Dogs which were less than 6-months-old were at same risk of contracting poly-parasitism as compared to dogs which were above 6-months-old.(Table 7)

Table 7. Risk (odd ratio) of age group on poly-parasitism

		Mixed infestation		Total
		Positive	Negative	
Age Groups	< 6 months old	1	8	9
	> 6 months old	1	52	53
Total		2	60	62

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
		Odds Ratio for Age Groups (< 6 months old / > 6 months old)	6.500

Dogs which were walked by their owners were 5 times more at risk of contracting parasitism as compared to dogs which were not walked. (Table 8)

Table 8. Risk (odd ratio) of walking pets on parasitism

		Worm infestation		Total
		Positive	Negative	
Do you walk your pet in neighbourhoods	Yes	16	14	30
	No	6	26	32
Total		22	40	62

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Do you walk your pet in neighbourhoods (Yes / No)	4.952	1.582	15.504

Dogs which were walked by their owners were 8.5 times more at risk of contracting *Ancylostoma spp.* infestation as compared to dogs which were not walked. (Table 9)

Table 9. Risk (odd ratio) of walking pets on *Ancylostoma spp.* infestation

		<i>Ancylostoma spp.</i>		Total
		Positive	Negative	
Do you walk your pet	Yes	14	16	30
in neighbourhoods	No	3	29	32
Total		17	45	62

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Do you walk your pet in neighbourhoods (Yes / No)	8.458	2.110	33.902

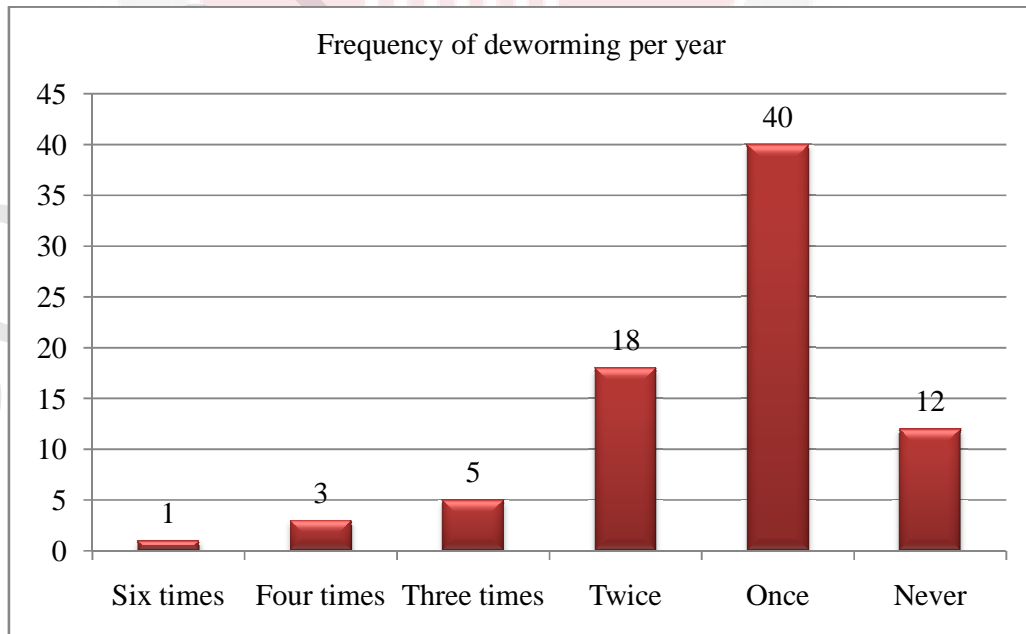
III. Descriptive data of deworming frequency

Half of the owners dewormed their pets once a year. About one-third (33%) of owners dewormed their pets twice or more per year. However, 15% of owners had never dewormed their pets. (Table 10 and Figure 1)

Table 10. Deworming frequency

	Frequency	Percent	Valid Percent	Cumulative Percent
Four times per year	3	3.8	3.8	3.8
Three times per year	5	6.3	6.3	10.1
Valid twice per year	18	22.8	22.8	32.9
once per year	40	50.6	50.6	83.5
never	12	15.2	15.2	98.7
Every 2 months	1	1.3	1.3	100.0
Total	79	100.0	100.0	

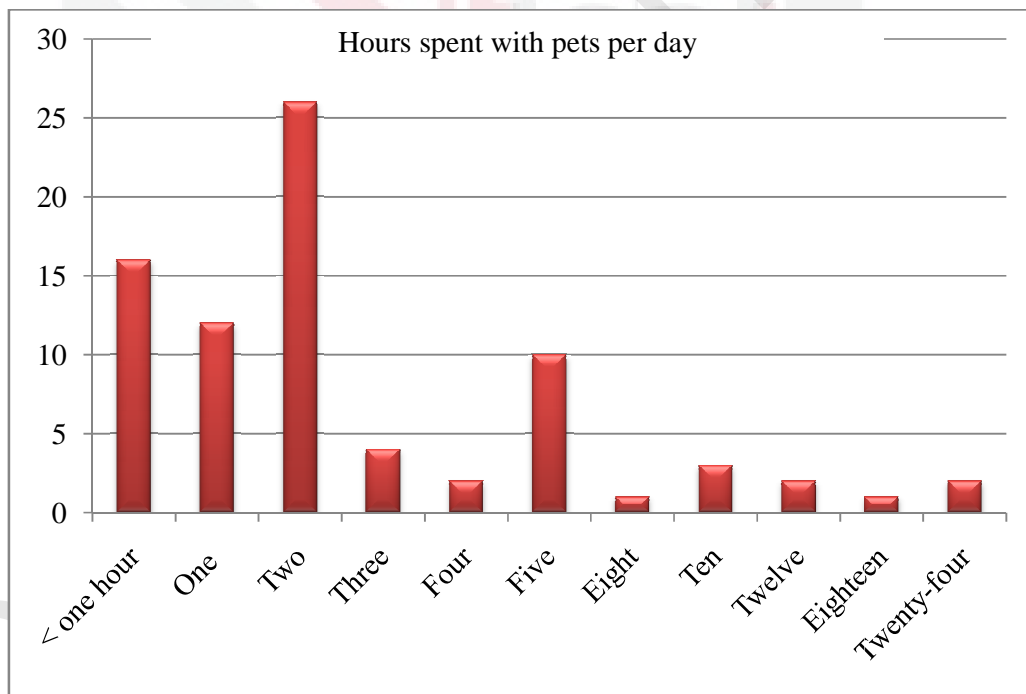
Figure 1. Deworming frequency



IV. Descriptive data of types of owner-pet interactions

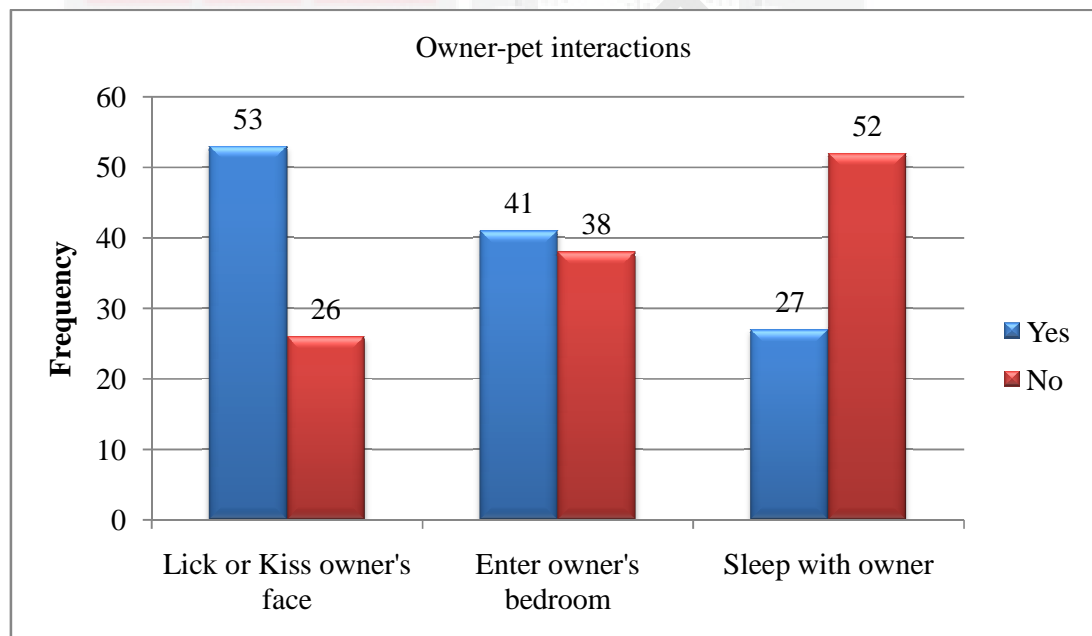
Of the 79 owners interviewed, 89% of them spent less than five hours per day with their pets with one third (33%) of them having 2- hours contact time per day with their pets. The remaining 11% of owners spent more than five hours in a day with their pets (Figure 2).

Figure 2. Hours that owners spent in a day with their pets



Of the 79 owners interviewed, more than half of them (67%) allowed their pets to lick or kiss their face. Meanwhile, more than half of them (52%) allowed their pets to enter their bedrooms. Besides that, around one third of them (34.2%) slept with their pets (Figure 3).

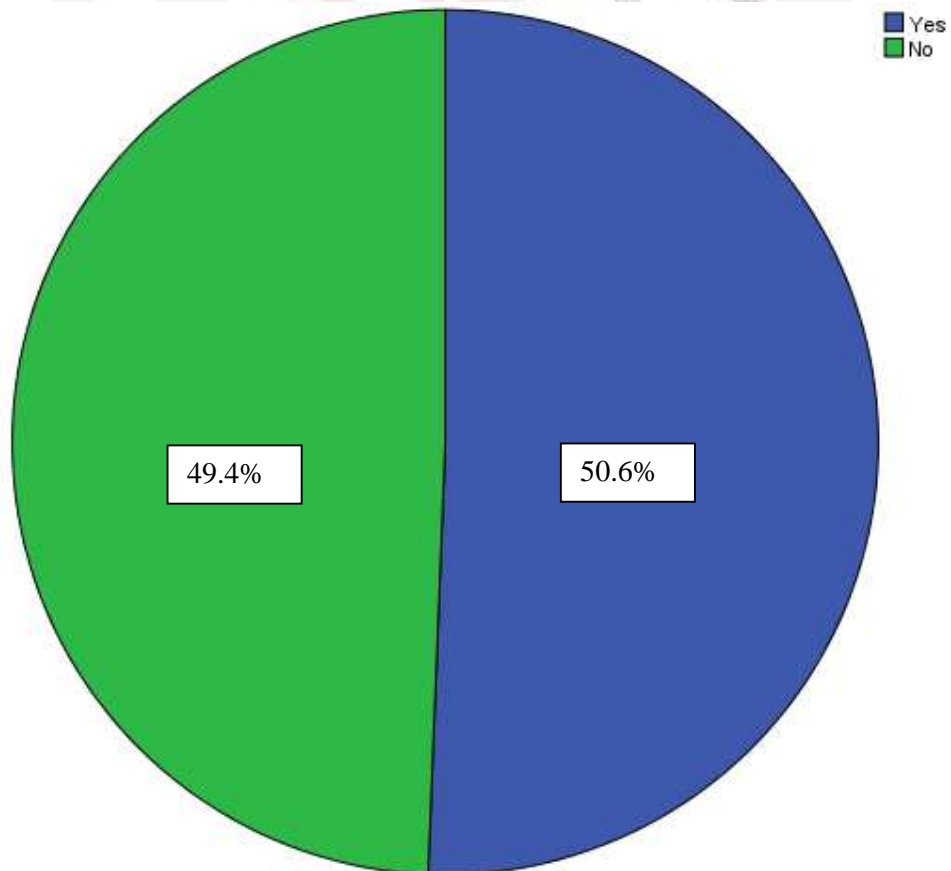
Figure 3. Number of owners who allow their pets to lick or kiss their face



V. Descriptive data of owner perception of zoonoses

Of the 79 owners interviewed, half of them (51%) were aware of zoonotic helminths found in pet dogs and cats (Figure 4).

Figure 4. Owner awareness of dog-and-cat zoonotic intestinal helminths



DISCUSSION

In this study, the prevalence of intestinal helminth infection in 62 dogs was 35.5% while in cats was 47.1%. The overall prevalence of intestinal helminth infestation in both dogs and cats (79 samples) was 38%. These prevalence rates are considered high considering that samples were collected from pet dogs and cats in an urban areas such as Ipoh where veterinary services are readily available.

The prevalence rates for intestinal helminth species of dogs in this study were as follows: *Ancylostoma* spp. (27.4%), *Toxocara* spp. (8.1%), *Trichuris vulpis* (3.2%). These findings were consistent with the findings by Lim (1999) of 50 owned dogs in Kuching Sarawak with the following prevalence rates; *Ancylostoma* spp. (24%), *Toxocara* spp. (16%) and *Trichuris vulpis* (2%). The prevalence of helminth species in sequential order was also similar in those reported by Ngui (2014) with *Ancylostoma* spp. (71.4%) being the most prevalent followed by *Toxocara* spp. (28.6%) and *T. vulpis* (24.7%). Studies done by Tan (1997), Francis (2002) and Erwanas *et al.* (2014) agreed that hookworms recorded the highest prevalence in both dogs.

For cats, only *Ancylostoma* spp. ova was observed in this study with the prevalence rate of 47.1% which was lower than that reported by Shirley (2001) who did a study on 50 cats (60% owned and 40% strays) in an animal shelter in Selangor. Shirley (2001) found that the prevalence rates of intestinal helminths in that shelter were as follows; *Ancylostoma* spp. (58%), *Toxocara* spp. (34%), *Dipylidium caninum* (8%), *Taenia taeniaeformis* (4%) and *Strongyloides* spp. (2%). The lower prevalence rate of *Ancylostoma* spp. and also absence of other helminth species were

most probably due to the small cat sample size (17 cats) and all cats were owned with 82% of the owners who claimed that deworming was done at least once before. Also, 65% of those who had given anthelmintics to their cats claimed that the deworming regime was up-to-date. However, Ngui *et al.* (2014) found that prevalence of *Toxocara* infection (42.9%) in rural owned cats was higher than *Ancylostoma* spp. (39.3%).

Dipylidium spp. was not found in this study mainly because the sampled pets were mostly free from fleas. This happened probably due to the practice of applying insecticides to these animals. As reported by Georgi (1987), dogs and cats become infected with *Dipylidium* spp. by ingesting the intermediate hosts which are fleas that contain encysted juvenile tapeworms called cysticercoids.

Mono-parasitism (36%) was of higher prevalence as compared to poly-parasitism (3%). This finding is similar with the finding reported by Lim (1999) who also collected samples from owned dogs. However, this finding was not consistent with previous studies (Ngui *et al.*, 2014; Francis, 2002; Shirley, 2001) mainly because those studies involved stray animals or owned animals from rural areas whereby anthelmintics administration was rarely practiced.

In this study, age factor had significant effect on toxocariasis in dogs. Dogs which were less than 6-months-old were at 42 times higher risk of contracting toxocariasis as compared to dogs which are above 6-months-old. This finding was consistent with previous studies whereby *Toxocara canis* was found more prevalent in young dogs less than one year old (MacAdam *et al.*, 1984; Tan, 1997; Francis, 2002). Toxocariasis is more prevalent in puppies because it can be transmitted via transmammary as well as prenatal route.

The diagnosis of helminth infection was carried out using simple floatation technique which was proven to give more accurate results compared to direct faecal smear which will often miss light infections (Tan, 1997; Lim, 1999; Francis, 2002).

Management factor that was found to have significant effect on parasitism in this study was whether the owner walked their dogs around the neighbourhood whereby strays or other dogs roamed contributing to the availability of infective stages. It was found that dogs which were walked by their owners were at five times higher risk of contracting parasitism as compared to dogs which were not walked. This is probably due to high prevalence of parasitism in strays as reported in previous studies (Tan, 1997; Shirley, 2001; Mahdy *et al.*, 2012; Francis, 2002; Erwanas *et al.*, 2014).

A. braziliense that occurs in both dogs and cats is the predominant species which causes hookworm related cutaneous larva migrans (CLM), however the late larval stage of *A. caninum* has also been implicated in CLM (Urquhart *et al.*, 1996). Previous studies showed that *A. braziliense*, *A. caninum*, *A. ceylanicum* were the three common species of hookworms found in Malaysian dogs and cats (Shirley, 2001; Francis 2002; Mahdy *et al.* 2012; Mohd Zain *et al.*, 2013). The lesions of CLM vary at the penetration site from nil to an erythematous papular or vesicular rash with varying levels of pruritus. This lesion has a characteristic serpiginous track that could grow for weeks to months, and will be intensely pruritic but ultimately self-limiting (Bowman *et al.*, 2010) .

A number of different syndromes have been attributed to *Toxocara* spp. infection: visceral larva migrans (VLM), ocular larva migrans (OLM), and covert toxocarosis (CT) (Overgaauw & van Knapen, 2013). Humans can be infected by

ingestion of larvae in undercooked infected organ or muscle tissues (rare), infective eggs from contaminated soil (gardens, sandpits and playgrounds), from unwashed hands or raw vegetables, or by direct contact with pets (Overgaauw & van Knapen, 2013). There were many studies done regarding potential zoonoses caused by *Toxocara* spp. (Robertson & Thompson, 2002; Overgaauw *et al.*, 2009; Deplazes *et al.*, 2011). In Malaysia, *Toxocara* spp. was the second most prevalent helminth found in local dogs and cats following *Ancylostoma* spp. *T. cati*, *T. canis* and *T. malaysiensis* were the common species encountered (Lim, 1999; Shirley, 2001; Francis 2002; Mohd Zain *et al.*, 2013; Erwanas *et al.*, 2014; Ngui *et al.*, 2014).

Of the 79 owners interviewed, 80% of them spent one hour or more with their pets with 11% of owners spending more than five hours in a day with their pets. This showed that the owners and pets had long contact time which may increase the exposure risk to zoonotic parasitic infection. Besides that, more than half of the owners (67%) allowed their pets to lick or kiss their face. Meanwhile, more than half of the owners (52%) allowed their pets to enter their bedrooms. Apart from that, around one third of them (34.2%) slept with their pets. All these close owner-to-pet interactions put them in higher risk of contracting zoonotic parasitism if no regular anthelmintic regime was practiced. Lastly, the perception of zoonoses among 79 owners interviewed was moderate as half of them (51%) were aware of zoonotic helminths found in pet dogs and cats. Since no data was available on the infection status of the owners, no conclusions can be drawn about the risk for transmission of these pathogens. However, due to the high prevalence of intestinal helminths found in pet dogs and cats in Ipoh and also moderate level of awareness on pet-associated

parasitic zoonoses, education programmes should be implemented to educate owners.



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CONCLUSIONS

This study reiterates that pet dogs and cats are hosts of zoonotic helminths. Level of awareness among owners regarding zoonotic intestinal helminths is moderate and most of the owners are not aware of the parasites' mode of transmission. The veterinary profession is responsible to educate clients about zoonoses as it is a public health concern.



RECOMMENDATIONS

In future, studies should be extended to other areas in Perak so as to compare prevalence rate of zoonotic intestinal helminths as well as level of awareness among owners regarding zoonotic intestinal helminths as Ipoh is a place where veterinary services are readily available. Thus, by comparing the findings, the significance of helminth zoonoses on a wider scale will be known.

Improvements can be made on the questionnaire by asking more detailed questions regarding level of awareness on zoonotic helminths.

The veterinary profession plays a crucial role in educating pet owners regarding zoonotic helminths by giving advice on poopa scooping to reduce availability of parasitic infective stages and ova on public grounds and on proper deworming regime.

For the municipality and authority, control of the stray cat and dog population as well as limiting owned cats and dogs in public areas such as parks and play grounds, is important in reducing availability of parasitic infective stages and ova as from previous studies, strays are known to be the reservoirs of zoonotic helminths.

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APPENDICES

Appendix I.

Questionnaire for Awareness of Pet-associated Zoonotic Parasite Infections

Name (owner): _____, Pet : _____

Contact: _____ (SMS / Call)

Breed: _____ Age : _____ Sex: F / M

1. You own a:
 - a. Cat
 - b. Dog
2. How many cat/dog do you have at home? _____
3. Have your pet got worm/intestinal parasite infestation before?
 - a. Yes; Was treatment done? _____
 - b. No
4. Have you ever dewormed your pet?
 - a. Yes ; medication used : _____
 - b. No
5. How often do you deworm your pet?
 - a. Every month
 - b. 4 times / year
 - c. 3 times / year
 - d. 2 times / year
 - e. 1 times / year
 - f. Never
6. Is the deworming programme up-to-date?
 - a. Yes
 - b. No
7. When do you deworm your pet?
 - a. When you visit the vet
 - b. When your pet has diarrhea

- c. When you see worm in your pet's stool
- d. Others (Please State) _____

8. Is your pet managed
- a. Indoor/ in-house
 - b. Outdoor but within house compound (front/back yard, garden)
 - c. Both a & b
 - d. Free roaming (even outside house compound)
9. Do you take your pet for a walk in neighbourhoods where others also walk their pets?
- a. Yes
 - b. No
10. How much time do you spend with your pets in a day? _____Hrs
11. Do you let your pet do the followings ? (✓ for Yes, ✗ for No)
- i) Lick your face or kiss you []
 - ii) Enter your bedroom []
 - iii) Sleep with you []
12. Do you wash your hands every time after touching your pet (especially before meals)?
- a. Yes
 - b. No
13. Do you know that your pet's stomach worms can be transmitted to human and cause disease to human?
- a. Yes
 - b. No
14. Do you know that besides worms, protozoa from pets can also be transmitted to human and cause disease to human?
- a. Yes
 - b. No

Appendix II. Simple Floatation

Apparatus

Plastic containers (100ml capacity)

Spatulas

Tea sieves (60mesh)

Beakers (150ml, graduated with lip)

Glass vials (21ml capacity)

Coverslips (24mm x 24mm)

Glass slides (25mm X 76mm)

Compound microscope

Solutions

Saturated sodium nitrate (SG. 1.30)

Tap water

Procedure

1. Take about 1g of faeces.
2. Break the faeces in 40ml saturated sodium nitrate solution.
3. Emulsify faeces with a spatula.
4. Strain through the tea sieve into a beaker.
5. Allow the filtrate to stand for 1 minute.
6. Pour content into the vial until a meniscus appears at the mouth of the vial.
7. Place a cover slip over the meniscus; avoid overflowing and excessive bubbles.
8. Stand for 20 minutes for dogs and 30 minutes for cats.
9. Lift the coverslip from the vial and place over the slide.
10. Focus under x4 objective and examine under x10 objective of the microscope.
Examine for the whole coverslip if few eggs and oocysts seen or if no ova detected.

Appendix III.

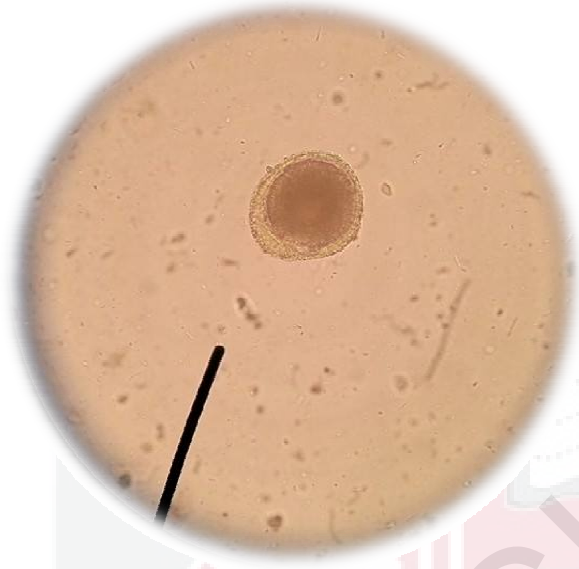


Figure 5. *Toxocara* spp. ova X400

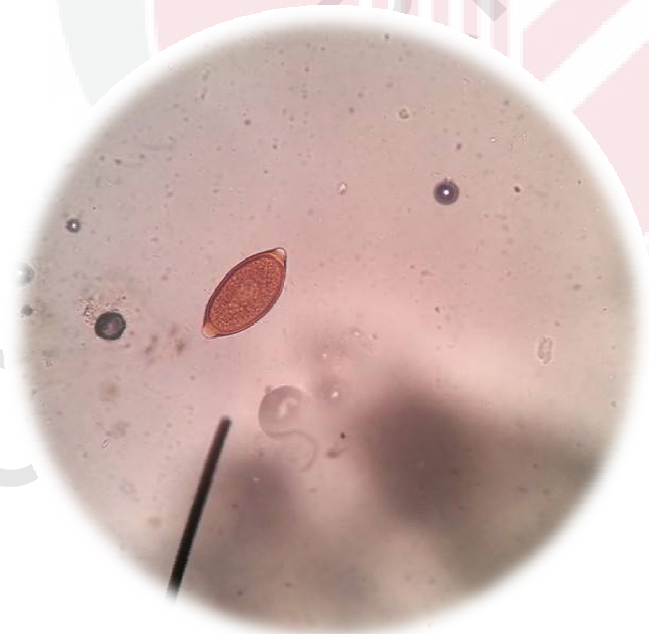


Figure 6. *Trichuris vulpis* ova X400

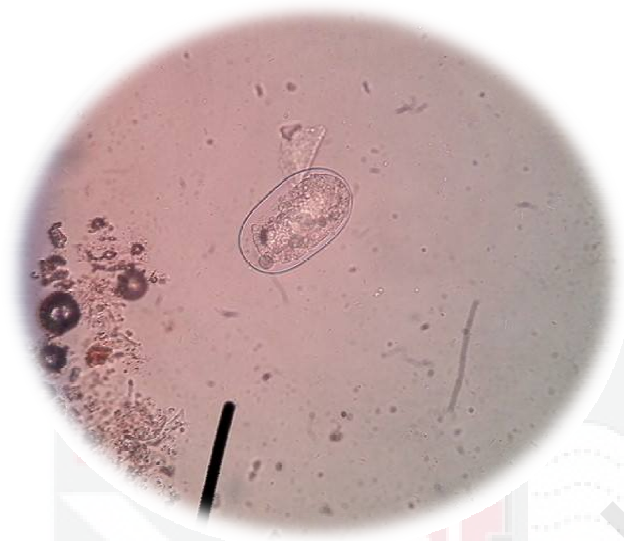


Figure 7. *Ancylostoma* spp. ova X400