ECTOPARASITE INFESTATION ON DOMESTIC CATS IN IPOH, PERAK

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ABSTRACT. Ectoparasites are the most common parasites that infect domestic cats and can cause few diseases and skin disorders in cats. Therefore, this study was conducted to determine the prevalence of ectoparasite infestation on domestic cats in Ipoh, Perak and also to identify the common species of fleas, lice, and mites infesting the cats based on their morphological characteristics. A study was carried out on the presence of ectoparasites in 102 pet cats presented at government and private clinics around Ipoh, Perak. Fur samples and ear mites' samples were collected from 57 male and 45 female cats aged from 3 months to 14 years old. The results from microscopic examination of samples showed that 56 cats (54.9 %) were infested with ectoparasites. Skin mites (*Lynxacarus radovskyi*, *Notoedres cati*, and *Sarcoptes scabiei*) were the most common ectoparasite found in 33 cats (32.4 %), followed by fleas, *Ctenocephalides felis* in 24 cats (23.5 %), lice *Felicola subrostratus* in 21 cats (20.6 %), and lastly ear mites *Otodectes cynotis* with 1.9 % of infestation on two cats only. It was found that there is no significant difference between ectoparasite infestation and the sex of the cats (P = 0.642, P-value >0.05). This study has shown that ectoparasite infestations were high on domestic cats in Ipoh, Perak. Therefore, it is highly recommended that owners should not allow their pets to roam freely outdoors mingling with other animals as these ectoparasites are commonly transmitted from the environment via the infected hosts.

Keywords: ectoparasites, infestation, cats, Ipoh

INTRODUCTION

The domestic cat (*Felis catus*) originated from an ancestral wild species and 30% of households nationwide have cats as their companion animal (Hu *et al*., 2014; Ahmad, 2013). This is because cats are small and easily maintained as pets in their owner's house. The domestic cats can be found wherever there is human presence for at least 9,500 years (Hu *et al*., 2014). Domestic cats can be classified into stray cats and shelter cats (Che Kamaruddin *et al*., 2020). As we know, domestic cats and humans have been living together and this can cause infestation of ectoparasites for both animal and human health as a zoonoses.

Ectoparasite live on the skin or outgrowth of the surface of other organisms, which is their host for a certain period where they feed on blood meal for their growth and development. Generally, stray cats are infected with parasites, particularly ectoparasites (Jittapalapong *et al*., 2007; Canto *et al*., 2013; Capari *et al*., 2013). Ectoparasites may infect stray cats as they roam freely around poor environments while searching for foods. Parasites prefer to infect stray cats than owned/shelter cats (Spain *et al*., 2001). According to Jittapalapong *et al*. (2007), ectoparasites on stray cats will infect the indoor domestic cats and human through direct contact.

Several other studies on ectoparasites infestations on domestic cats which is owned or pet cats in Malaysia have also been conducted. However, these studies have been limited to a few localities with small sample size of the hosts, and the risk factor analysis was not carried out (Jeffery *et al*., 2012; Han, 2015; Azrizal-Wahid *et al*., 2019). The most common and important cat flea is *Ctenocephalides felis* which can cause skin irritation, allergies and annoyance to the human (Noor Hayati *et al*., 2002). Most of the studies in Malaysia reported highest infestation on *C. felis* (Mohd Zain *et al*., 2013; Azrizal-Wahid *et al*., 2019). *C. felis* is also identified as a potential reservoir and vector for a variety of pathogens including zoonotic agents (Low *et al*., 2017).

The prevalence of ectoparasites on domestic cats and other domestic animals are influenced by the humidity, environmental condition, and temperature of the habitat as stated by Paramasvaran *et al.* (2009). Previous study also confirmed that relocation of infested animal and transportation system can increase the infestation rate of ectoparasites on domestic cats as well as other animals around the area (Nuchjangreed & Somprasong, 2007). There are limited studies conducted regarding the ectoparasites of domestic cats from pet cats. Therefore, this study is conducted to provide the information on ectoparasites prevalence and the infestation of ectoparasites in relation to sex of domestic cats around Ipoh, Perak.

MATERIALS AND METHODS

Study area

This research was conducted within the area of Ipoh, the capital city of Perak. The samples were collected from the government clinic of the Department of Veterinary Services, Perak and other private veterinary clinics around Ipoh.

Study animals

The target study animals in this study are both sexes domesticated cats or pet cats at any age that are sent to various small animal clinics in Ipoh. The pet cats are usually brought to the clinics for routine examination, vaccination, or treatment for some ailments. A total of 58 male cats and 44 female cats were sampled with the permission and assistance of the owners. A total of 102 fur samples and 102 ear swab samples were collected during the study period of three (03) months from November 2020 until January 2021.

Sample collection

Fur samples of the animals were collected with the permission of the owners for routine screening of any disease that the animals may have. The ear mites and fur samples were collected by using cotton bud and fine-tooth comb, respectively. During sampling, data of animal identification, age, sex, vaccine status, deworming information, and reason of their visit at the clinic were recorded for each of the animal.

Examination of ectoparasites

Collected fur samples were soaked in 10 % potassium hydroxide (KOH) for 24 hours, and then skin mites were placed on glass slide. A drop of Hoyer's medium was placed on the glass slide before being covered with cover slip for it to dry at room temperature. For ear swab sample, the cotton buds were scrapped onto a clean glass slide, approximately three to five drops of glycerol were dropped and covered with coverslip. The prepared slides of the mounted ectoparasites were examined with compound microscope (Olympus CX31) under 10x, 40x and 100x magnification. Species identification was conducted using published keys, described morphological characteristics, microscopic diagrams, and related published articles such as Soulsby (1968), Wall and Shearer (2001), Bowman (2014), Mathison and Pritt (2014), and Colella *et al*. (2020).

Statistical analysis

The prevalence of the ectoparasites was calculated according to the formula by Thrusfield (2005). To compare the ectoparasite infestation between male and female cats, the Pearson's chi-square test was utilized. Thereafter, statistical analysis was conducted using SPSS 25.0 software package (IBM Corporation, New York).

RESULTS

Prevalence of ectoparasites infestation on domestic cats

A total of 56 (54.9 %) out of 102 cats examined were found to be infected with ectoparasites. Out of this number, 24 cats (23.5 %) were found to be infected by *Ctenocephalides felis* fleas, while 21 cats (20.6 %) were infected by *Felicola subrostratus* lice. There were two cats (1.9 %) infected by *Otodectes cynotis* ear mite. Meanwhile, 33 cats (32.4 %) were found to be infected by skin mites. The results are as shown in Table 1. Among all the ectoparasite found, three of them which are *C. felis, S. scabiei*, and *N. cati* have zoonotic potential.

A total of 36 (35.3 %) cats were found to be infested with single infestation (with one species of ectoparasites infesting the host). Multiple infestations (of more than two species of ectoparasites infesting one host) of ectoparasites were detected in 20 cats (19.6 %). Table 2 shows the number of positive cats with single and multiple infestations.

Table 1. The number of positive cats according to the ectoparasites (n=102)

Ectoparasites		Species	Positive cats, n (%)
Fleas		*Ctenocephalides felis*	24 (23.50)
Lice		*Felicola subrostratus*	21 (20.50)
Mites	Ear mites	*Otodectes cynotis*	2 (1.96)
	Skin mites	*Sarcoptes scabiei*	1 (0.98)
		Notoedres cati	2 (1.96)
		Lynxacarus radovskyi	30 (29.40)

Table 2. The number of positive cats with single and multiple infestations

Infestation	Ectoparasites	Positive cats, n (%)
Single	Fleas	*13 (12.7)*
	Lice	8 (7.8)
	Skin mite	15 (14.7)
	Ear mite	0 (0)
Multiple	Flea + Lice	*2 (2.0)*
	Flea + Skin mite	*6 (5.9)*
	Flea + Ear mite	*0 (0)*
	Lice + Skin mite	*8 (7.8)*
	Lice + Ear mite	*0 (0)*
	Flea + Lice + Skin Mite	*2 (2.0)*
	Flea + Skin mite + Ear mite	*1 (1.0)*
	Lice + Skin mite + Ear mite	*1 (1.0)*

Association between sex of cats and ectoparasites infestation

Among 58 males and 44 female cats, 33 (32.4 %) male cats and 23 (22.5 %) female cats were infested with ectoparasites (Figure 1). Single infestation with one species of ectoparasites found in 19 (18.6 %) male cats and 17 (16.7 %) female cats. Multi infestations were found in 14 (13.7 %) male cats and in 6 (5.9 %) female cats. The highest infestations of ectoparasites in male cats were caused by flea which can be found in 9 (8.9 %) cats. Meanwhile, the highest infestations in female cats were skin mite which were found in 8 (7.8 %) cats. The percentage of ear mite infection in male cats was 2.0 %. However, there was no infestation in female cats detected. The Pearson's chi-square test showed that there is no significant difference ($p=0.642$, p-value>0.05) between male and female in the infestation of ectoparasite.

Morphological identification of ectoparasite

In this study, the most common flea infestation on domestic cats is *Ctenocephalides felis*. They are wingless and females are larger than the males. As shown in Figure 2, *flea C. felis* has both genal ctenidia (A), pronotal ctenidia (B) and flat head (C). Lice identified in this study is *Felicola subrostratus* as shown in Figure 3, which has triangular and pointed anteriorly head. It also uses the mandible to chew debris or faeces on the body of the host. Presented in Figure 4 is an ear mite, *Otodectes cynotis* from the family of Psoroptidae that was found in this study. It has third pair of legs and has long and whip like setae (A) on both sexes. The other mites found in this study are the skin mites, *Sarcoptes scabiei, Notoedres cati,* and *Lynxacarus radovskyi*. The first and the second legs of both female and male of *S. scabiei* have small suckers on the long plain

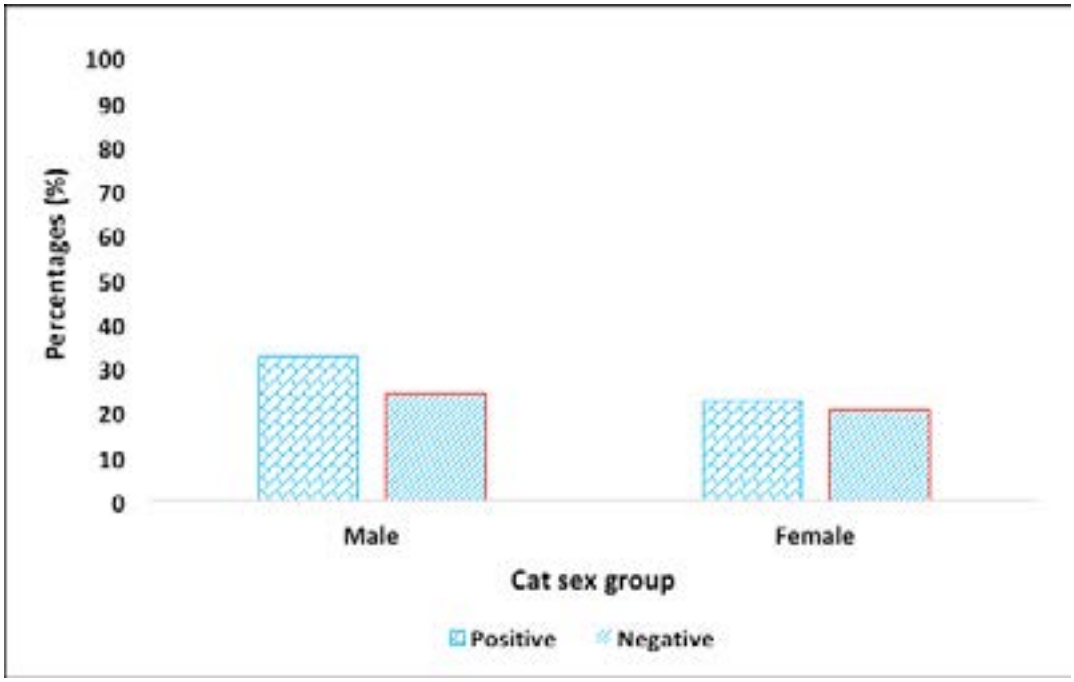

Figure 1. Positive ectoparasites infestation (fleas, lice, ear mite, and skin mite) based on sex group (n=102)

pedicels (A) and have non-jointed pedicels (B) as shown in Figure 5. *N. cati* can clearly identify by its concentric 'thumb print' striations and absence of spines as in Figure 6. *L. radovskyi* developed propodosomal plate (A) present in both female and male. The head is covered with plates and the body is striated (B) as shown in Figure 7.

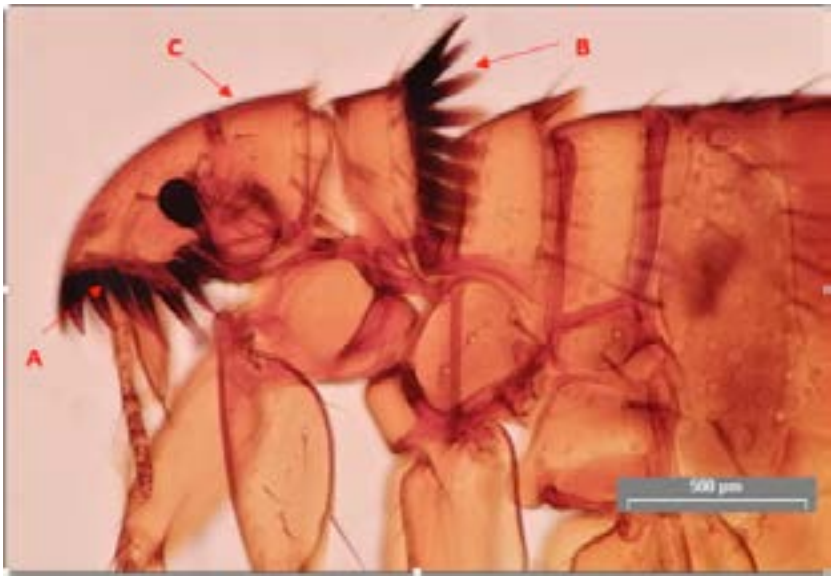

Figure 2. Presence of genal comb (A) and pronotal comb (B) at the body thorax and flat head (C) of *Ctenocephalides felis* (10× magnification)

Figure 3. Triangular head (A) and presence of mandible (B) on the mouthpart of *Felicola subrostratus* (40× magnification)

Figure 4. Third pair of legs with long and whip like setae (A) of *Otodectes cynotis* (40× magnification)

Figure 5. Presence of pedicels (A) and non-jointed pedicels (B) on *Sarcoptes scabiei*

Figure 6. Notoedres cati with narrow and not spine-like setae and presence of 'thumb print' striations (40× magnification)

Figure 7. *Lynxacarus radovskyi* have propodosomal plate (A) and with the body is striated (B) (40× magnification)

DISCUSSION

Based on the results obtained in this study, there is a high prevalence observed for the ectoparasite infection in domestic cats examined from government and private veterinary clinics in Ipoh, Perak. This study shows 54.9 % infestation of ectoparasite in pet cats from Ipoh. This study is considered of high prevalence because the samples were collected from pet cats which have an owner, have access to veterinary care, live indoors, and have close relationship with humans. Out of 102 cats, more than 50 % cats showed evidence of ectoparasite infection. Compared with the study by Azrizal-Wahid *et al*. (2019), the infestation rate shows 29.17% from 72 pet cats sampled. Other study by Jeffery *et al*. (2012) in Taiping, Perak showed lower rate at 5% on only two out of 40 pet cats sampled.

Skin mites *Lynxacarus radovskyi* is the highest at 29.4% (30 cats) in samples collected. A study by Han (2015) also showed that infestation of this species is the most common ectoparasite isolated from cats in Malaysia with a prevalence rate of 71.1% (286 out of 402 samples). The reason for the high prevalence of the *L. radovskyi* mites among the domestic cats is because it is an obligate parasite, which means that this ectoparasite is totally dependent on the host for its nutrition, and thus does not go away from the host for long periods of time. As the ectoparasite keeps a low profile on the host's body, it is often overlooked by veterinary professionals, which later contributes to the high prevalence of infestation (Che Kamaruddin *et al*., 2020). The study also reported incidences of cross infestation in human which can causes small rashes and itching sensations.

N. cati is another skin mites detected in this study with low percentage (1.96%). Similar with the study by Jittapalapong *et al.* (2008), that study recorded low prevalence at 50% from 575 stray cats in Bangkok. Another study by Ahmad (2013) reported 8.7% prevalence in domestic cats. *N. cati* is zoonotic ectoparasites which generally infests cats. The pet's owner must always be careful when handling the infected cat and treatment should be given accordingly to prevent transmission to the owner (Foil, 2003; Senthil Kumar *et al*., 2008; Sivajothi *et al.*, 2015).

S. scabei is also detected in this current study with only one cat (0.98%). According to Study by Ahmad (2013) reported 10.1% prevalence of this parasite in domestic cats. The parasite is also a highly contagious and can infect human as well as other animals. Severe infestation can lead to emaciation and even death of cats. In this study, ear mites *O. cynotis* is recorded in 1.96% of the domestic cats. Infestation rate is lower compared to another study in Albania with 252 ear swabs collected from domestic cats where 8.3% of the cats were found positive for *O. cynotis* (Knaus *et al*., 2014). This is because the sample size is bigger compared to this study.

The flea (*C. felis*) infestation in this study is found to be the second highest among other ectoparasites. The study by Azrizal-Wahid *et al*. (2019) also revealed high infestation of *C. felis* with 306 out of 426 (71.8%) stray cats, sheltered, and pet cats from four distinct regions in Peninsular Malaysia detected positive through flea combing method. It is important to manage flea infestations as fleas are known vectors for various zoonotic diseases. According to Nelder and Reeves (2005) *C. felis* is a known vector or intermediate host of Acanthocheilonema reconditum, an endoparasite that causes canine filariasis and also a common vector of the pathogenic bacteria *Rickettsia felis*, which causes cat flea typhus in humans (Parola *et al*., 2005; Colella *et al.,* 2020).

This research observes that 21 out of 102 (20.6 %) cats are infected by the *F. subrostratus* lice. A study done by Ahmad (2013) also shows almost similar result, where 21.7% of the

sampled population showed that *F. subrostratus* is a common ectoparasite in cats. *F. subrostratus* is the only known non-bloodsucking biting louse of cats as it is highly species specific and requires direct contact between infected animals or through the sharing of contaminated brushes, combs, and bedding (Scott *et al.*, 2001).

In this research, there is no significant difference between ectoparasite infestations on female and male cats. This finding is similar to a previous study by Che Kamaruddin *et al*. (2020) conducted on stray cats in Kota Samarahan, Sarawak which had higher number of captured male cats compared to female. Prevalence rate of ectoparasite is not influenced by sex but environmental conditions which may affect the growth and survival (Borji *et al*., 2011; Jittapalapong *et al*., 2008). Another important factor for the increase in prevalence of the ectoparasites is socio-economy. When the cost of living is increased, the pet owner's affordability to manage their pet's health, food, and medications lessens (Jittapalapong *et al*., 2008).

Preventive action from pet owners and stray feeders are important to prevent cross infection and lessen the high prevalence of infestation. It is easy to contain and localize infestations as the parasites do not generally leave the host. Regular baths with pyrethrin-based shampoos and sulphur dips can clear infestations, and subcutaneous administration of ivermectin can also help greatly in reducing infestation. Infested cats need to be isolated and treated (Che Kamaruddin *et al.*, 2020). High prevalence of ectoparasite infestation in cats in this study suggests that these cats are not exclusively kept indoors as infestation occurs due to direct contact with another host that was already harbouring the ectoparasites.

As some of the ectoparasites are zoonotic, quick diagnosis by certified veterinarians is very important in order to treat and educate the client on the preventive management. With increasing awareness, all concerned parties should also tackle the stray cat population judiciously such that there is a steady reduction in cross contamination and transmission of infections from stray cat population to pet population as both share common environments.

CONCLUSION

In conclusion, the ectoparasite infestations are high on domestic cats in Ipoh at the point of study. It is obvious that pet cats can harbour a variety of ectoparasites, which are invisible to the naked eye such as mites and fleas unlike viruses and bacteria. Hence it is very important to maintain the health status of pets. Two groups of fleas (*C. felis*) and mites (*S. scabiei* and *N. cati*) are identified to potentially impact public health which are vectors to zoonotic pathogens such as bartonellosis (cat scratch disease) to both human and animal. Further studies need to be undertaken to evaluate the significance of age and compounding factors that may put pets at risk of infection.

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