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Risk factors associated with flea infestation on cats

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Abstract. Fleas are the common cause of skin disorders in cats. They are well-known for transmitting various pathogens to both cats and humans. Accordingly, this study was conducted to gain insights on the risk factors associated with flea infestation on cats. Flea combing conducted on 426 cats from four distinct regions in Peninsular Malaysia revealed a relatively high rate of flea infestation on 306 cats (71.83%). A total of 651 fleas were collected, all of them were identified as *Ctenocephalides felis* with the total intensity of 2.13 and abundance of 1.53. The sex ratio of fleas was female-biased at 2.5:1 (♀=464, ♂=187). Statistical analysis of the data revealed that flea infestation was significantly ($P<0.05$) associated with several risk factors including region, age, weight, status (stray, sheltered, pet), body condition, and hair length. Higher flea prevalence was also observed in female cats (77.99%), big-sized cats (91.76%), stray cats (84.94%), cats with clean body condition (73.35%), and cats with long hairs (78.38%) as compared to their contemporaries within the same comparison variables. The high infestation of fleas in this study is indicative of cats as a flea reservoir particularly *C. felis*. Thus the findings of this study and the knowledge gained on the risk factors can be used to develop and improve control measures and management of flea infestations.

INTRODUCTION

Fleas, lice, mites and ticks are ectoparasites that can be found infesting cats and dogs (Jittapalapong *et al*., 2008; Salant *et al*., 2013). Fleas, particularly the genus *Ctenocephalides* are the most common ectoparasites (Farkas *et al*., 2009) and are of veterinary and public health importance because they can act as reservoirs and potential vectors for a variety of pathogens, including zoonotic agents (Low *et al*., 2017). Specifically, the cat flea *Ctenocephalides felis* (Bouché) (Siphonaptera: Pulicidae) is a vector for *Bartonella henselae*, *Bartonella clarridgeiae* and *Rickettsia felis*, the causative agents of cat scratch disease, endocarditis and cat flea typhus, respectively (Dryden & Rust, 1994). The cat flea is also a known intermediate host of *Dipylidium* tapeworm, which can be transmitted to pets and humans (Guzman, 1984; Low *et al*., 2017). Additionally, flea infestation can also cause flea allergic dermatitis (FAD) (Dryden, 1993).

Previous studies elsewhere have reported that the cat flea (*C. felis*), dog flea (*Ctenocephalides canis*) and the human flea (*Pulex irritans*) to be the common species infesting cats (El-Seify *et al*., 2016; Farkas *et al*., 2009; Koutinas *et al*., 1995). However, the prevalence of the flea species varies across different geographic regions (Chee *et al*., 2008) and can be influenced by the risk factors associated with their host. Flea control is of great veterinary and public importance. Therefore, efficiency of current control measures should be improved by carrying out appropriate entomological

studies to obtain information on the risk factors associated with the occurrence of fleas on cats.

A wide range of studies have been undertaken on flea-host interactions on cats (Hajipour *et al.*, 2015; Canto *et al.*, 2013; Borji *et al.*, 2011), dogs (Tavassoli *et al.*, 2010; Bond *et al.*, 2007), and small mammals (Oguge *et al.*, 2009; Visser *et al.*, 2001). Notably, the risk factors such as age, sex, body weight and size of the host (Jittapalapong *et al.*, 2008; Hajipour *et al.*, 2015; Mohd Zain *et al.*, 2013; El-Seify *et al.*, 2016) and regional and seasonal variations of the host (Akucewich *et al.*, 2002; Tavassoli *et al.*, 2010) have been well documented.

In Malaysia, surveys on prevalence and abundance of fleas have been largely understudied. Several studies related to fleas in Malaysia were conducted mainly emphasizing the potential role of fleas as vectors of the pathogenic bacteria *Rickettsia* and *Bartonella* (Mokhtar & Tay, 2011; Tay *et al.*, 2014; Low *et al.*, 2017). Several other surveys on ectoparasites infestations on cats in Malaysia have also been conducted (Amin-Babjee, 1978; Shanta *et al.*, 1980; Mohd Zain *et al.*, 2013). However, these studies have been confined to a few localities with small sample size of the hosts, and the risk factor analysis was not carried out. Accordingly, the present study aims to investigate the prevalence, abundance and intensity of fleas on cats, and thereby attempting to determine their associated risk factors of infestation. This study represents the most comprehensive flea survey on cats from four distinct geographic regions (Northern, Southern, Western and Eastern) of Peninsular Malaysia.

MATERIALS AND METHODS

Flea collection and identification

A cross-sectional study was conducted from February 2017 to March 2018 to determine the infestation rate of fleas on cats in Peninsular Malaysia. The sample size calculation was determined as described by Thrusfield (2007). By taking consideration of expected prevalence, P_{exp} = 50% with 95% confidence level and desired precision of 5%, a minimum number of 384 cats were required. In this study, a total of 426 cats consisting of stray cats from food courts and wet markets, pet cats from residential areas, and sheltered cats were examined for flea infestation. The samplings were conducted in twenty sites representing different districts located in four different regions, namely the Northern, Western, Eastern and Southern regions of Peninsular Malaysia (Fig. 1). To avoid multiple sampling of the same cat, each survey site was located at least 30 km away from each other and was only visited once. The selection of shelter centres for sampling was based on those that housed a minimum number of 20 cats. The pet cats were selected as study samples if there was indication/ record of proper care being taken by their owners such as having frequent baths and visits to the veterinary clinic.

Each individual cat was examined for flea infestation by using a fine tooth-comb. Prior to combing, the cats were fed with food pellets to keep in a calm position. Then, the cat was combed for approximately ten minutes covering all major areas including head, neck, body and tail. The ears and feet of each cat were also checked by hand for the presence of fleas. If fleas were found on the tooth-comb during combing, the comb was immediately put into a sealable plastic bag to prevent the fleas from escaping. The comb in the bag was vigorously shaken until the fleas were dislodged and fell into the bag. Cats were set free immediately after completing the flea examination. Flea specimens were kept in 80% ethanol until further work. Each flea was placed on a glass slide covered with a cover slip and examined under a light microscope, using the ×4, ×10 and ×40 objective lens for species and sex identification. Species identification was performed using published keys, described morphological characters and microscopic diagrams (Linardi & Santos, 2012; Ashwini *et al.*, 2017).

Associated risk factors for infestation on cats

The risk factors of cats associated with flea infestation were recorded including their

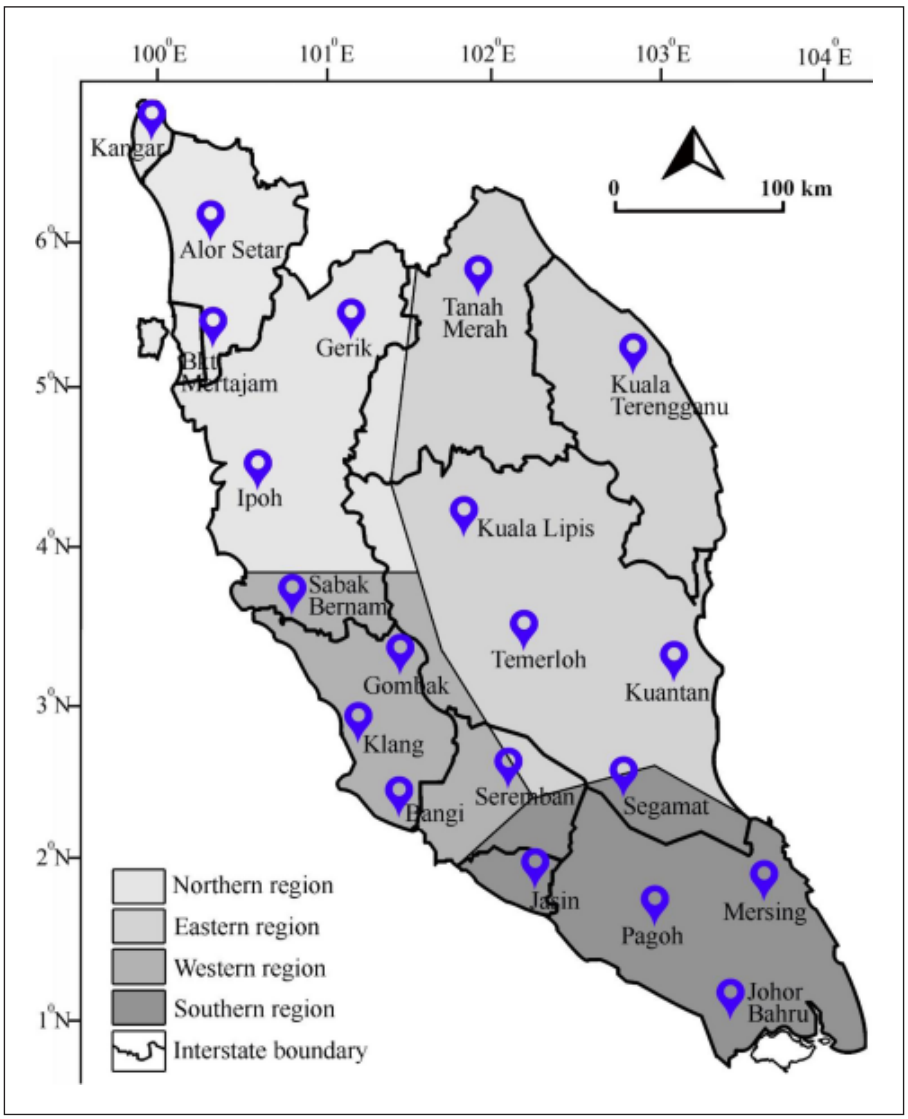

Figure 1. Map of Peninsular Malaysia showing the locations of the twenty districts where samplings were conducted and division of four different regions; Northern, Eastern, Western, and Southern. Both Western and Northern regions were separated from Eastern region by the vertical projection of mountain range of Titiwangsa (the highest peak of Peninsular Malaysia). The separation between Western and Southern regions corresponds to the end of the mountain range.

gender, age, weight, breed, status, habitat, body condition, hair length, hair colour, roaming area, and flock group. The details of variables used for each factor are provided in Table 1. The pregnancy status of female was also recorded.

For age classification, the cats were categorized into two age groups based on their body weight: adult (≥1.5 kg) and juvenile (<1.5 kg), as described by Sharif *et al.* (2007). Breed status was immediately determined as mixed-breed unless there were records stating their pure-breed status. The cat's hair length was measured in triplicate from three body regions (front, middle, back), and averaged for statistical analysis. The hair colour was determined visually where cats with white, orange, light grey or/and light

Table 1. Prevalence of fleas and associated risk factors on cats (n=426) in Peninsular Malaysia

Risk factor	Variable	Sampled cat, n	Infested cat, n	Prevalence, %	P[a]
Region	Northern	102	73	71.56	0.001*
	Western	123	78	63.41	
	Eastern	84	74	88.10	
	Southern	117	81	69.23	
Gender	Male	115	66	67.39	0.176
	Female	268	209	77.99	
	Pregnant female	43	31	72.09	
Age	Juvenile	166	128	77.11	0.002*
	Adult	260	178	68.46	
Weight	0–1 kg	187	115	61.50	0.000*
	1.1–2 kg	154	113	73.38	
	>2 kg	85	78	91.76	
Breed	Pure	23	15	65.22	0.468
	Mixed	403	291	72.21	
Status	Stray	239	203	84.94	0.000*
	Sheltered	115	82	71.30	
	Pet	72	21	29.17	
Habitat	Rural	93	69	74.19	0.584
	Suburban	250	181	72.40	
	Urban	83	56	67.47	
Body condition	Clean	319	234	73.35	0.003*
	Dirty	107	72	67.29	
Hair length	Short, <10 mm	99	58	58.59	0.002*
	Medium, 10–20 mm	179	132	73.74	
	Long, >20 mm	148	116	78.38	
Hair colour	All bright	119	81	68.07	0.611
	¾ bright	109	80	73.39	
	¾ dark	95	67	70.53	
	All dark	103	78	75.73	
Roaming area	Indoor	174	121	69.54	0.382
	Outdoor	252	185	73.41	
Flock group	1–3 individuals	126	85	67.46	0.410
	4–5 individuals	198	145	73.23	
	>5 individuals	102	76	74.51	

[a] calculated using Chi-square of Fisher's exact tests.
* statistically significant factors (P<0.05).

brown colours were defined as bright hair colour, while as cats with black, dark grey or/and dark brown colours were defined as dark hair colour. Body condition was classified as dirty if there was a sign of skin scraping, kinky hairs, and the presence of dusts or foreign particles while combing.

Cat status was categorized as stray, sheltered or pet. Stray cats were defined as the cats that roam unattended and with no physical clues such as the availability of collars. Sheltered cats were the cats that have been kept in shelters for a certain period by the authorized centres, while pet cats were cats being owned and were given care by their owners. For habitat status, the urban areas were defined as the areas with high population density of people, equipped with

well-developed infrastructures, many facilities and amenities such as shop premises, shopping malls, trade centres, schools, and having proper landscapes that are well-managed by the District Council. Suburban areas are ~10 km far from the urban areas but still equipped with some facilities and amenities as in urban areas. Rural areas are located far from the city (~30 km), with low population density and lacking urban facilities.

For flock category, small flock group refers to those cats that lived and spent time roaming with only 1–2 individuals, medium flock group with 3–5 individuals, and big flock group with more than 5 individuals. Indoor or outdoor category was based on the area roamed by the cats during the sampling. Outdoor was defined as open area with no physical constructions such as roof, concrete floor or walls.

Statistical analysis

Flea counts were calculated according to the formulas of Krasnov *et al.* (2002) to determine their prevalence, intensity and abundance: Flea prevalence = (number of infested cats / total number of sampled cat) ×100; Flea intensity = (total number of fleas / total number of infested cats); Flea abundance = (total number of fleas / total number of sampled cats).

Statistical analyses of variables were conducted using both descriptive statistics such as percentage and mean, which were used to summarize the proportions of infested and non-infested sampled cats; and univariate analysis which was used to determine the association of risk factors related to flea infestation. For univariate analysis, the data was analysed by using the Pearson Chi-square test (x^2-test) or Fisher's exact test. Statistical comparisons were carried out using SPSS 24.0 statistical software (Chicago, IL, USA). The x^2-test was considered as statistically significant when the probability (P) was lower than 0.05 (P<0.05) at 95% confidence intervals.

Subsequently, a multivariate analysis was performed by including every hypothesized risk factor which had a P-value <0.20 from the univariate analysis. A logistic binary regression with a hierarchic backward stepwise method was used with the last variable category taken as the baseline. Variables were retained as significantly different if the P-value from the logistic regression was <0.05. Model validity and reliability were assessed using the Hosmer-Lemeshow goodness-of-fit test.

RESULTS

Prevalence and risk factors association

Over a 12-month sampling period, a total of 426 cats were examined for flea infestation in Peninsular Malaysia. Of these examined cats, 306 individuals (71.83%) were infested by fleas. A total of 651 fleas were collected and all of them were identified as *Ctenocephalides felis* (100%). Of the 306 infested cats, 92 (30.07%) were infested with single individual flea, followed by two individuals (39.54%, n=121), three individuals (18.30%, n=56), and more than three individuals (12.09%, n=37). Of the 651 fleas, females were more abundant than the males with sex ratio of 2.5:1 (♀=464, ♂=187). Fleas were most prevalent in the Eastern (88.10%), followed by Northern (71.56%), Southern (69.23%), and Western (63.41%) regions of Peninsular Malaysia Flea infestation was found to be significantly influenced by the region (P=0.001).

Twelve risk factors were recorded and analysed in the present study (Table 1). Higher prevalence of fleas was observed in female cats (77.99%) than male cats (67.39%), however gender was not a significant factor for flea infestation (P=0.176). Fleas were found somewhat less prevalent in adult cats (68.46%) as compared to juvenile cats (77.11%). Interestingly, age was the significant factor for flea infestation (P=0.002). Body weight was also a significant risk factor (P=0.000) with fleas more prevalent on big-sized cats (91.76%), followed by the medium-sized cats (73.38%) and least prevalent on small-sized cats (61.50%).

Fleas were more prevalent in cats with clean body condition (73.35%) than the cats with dirty body condition (67.29%), and this factor was observed to have significant

difference (P=0.003) towards flea infestation. In addition, status of cats was also associated with flea infestation (P=0.000). Infestation rate was the highest on stray cats (84.94%) followed by sheltered cats (71.30%), and the least on pet cats (29.17%).

With regards to hair length, there was also an association (P=0.002) with flea infestation. Cats with long hair length had higher infestation rate (78.38%) as compared to the cats with medium hair length (73.74%) and cats with short hair length (58.59%). Hair colour, in contrast, was not a significant factor (P=0.631) towards flea infestation. Other risk factors such as habitat (P=0.584), breed status (P=0.468), flock group (P=0.410), and preferable roaming area (P=0.382) were not significantly associated with flea infestation.

The binary logistic regression model of independent variables associated with flea infestation is presented in Table 2. The age, status, weight, body condition, and hair length were confirmed as associated factors with flea infestation in the multivariate analysis. Juvenile cats were 1.07 times more likely to be infested by fleas than the adults. Stray and sheltered cats were respectively 51.8 and 15.5 times more likely to be infested by fleas than the pet cats. Cats with smaller body size of weight <1 kg were 0.02 times less likely to be infested by fleas than the big-sized cat of weight >2 kg, while medium-sized cats of weight 1.1–2 kg were 0.09 times less likely to get infested by fleas than the big-sized cats. Cats with clean body condition were 1.10 times more likely to get infested by fleas than the dirty body condition. Short hair cats (<10 mm) and medium hair cats (10–20 mm) were 0.28 and 0.47 times less likely to be infested by fleas than the long hair cats, respectively.

Table 2. The binary linear regression test of significant association between independent variables and flea infestation on cats

Risk factor[a]	Independent variable	Statistical value				
		OR	95 % CI		SE	P
			lower	upper		
Region	Northern	1.608	0.742	3.483	0.394	0.229
	Western	0.853	0.440	1.656	0.338	0.639
	Eastern	3.626	1.467	8.964	0.462	0.005
	Southern	1[b]				
Gender	Male	3.087	0.652	14.630	0.794	0.156
	Female	5.323	1.133	25.016	0.790	0.034
	Pregnant female	1[b]				
Age	Juvenile	1.072	0.499	2.300	0.390	0.002
	Adult	1[b]				
Weight	0–1 kg	0.024	0.005	0.111	0.787	0.000
	1.1–2 kg	0.089	0.023	0.351	0.700	0.001
	>2 kg	1[b]				
Status	Stray	51.838	19.710	136.336	0.493	0.000
	Sheltered	15.511	6.216	38.704	0.467	0.000
	Pet	1[b]				
Body condition	Clean	1.100	0.339	0.720	0.385	0.005
	Dirty	1[b]				
Hair length	Short, <10 mm	0.277	0.128	0.600	0.393	0.001
	Medium, 10–20 mm	0.469	0.239	0.923	0.345	0.028
	Long, >20 mm	1[b]				

[a] only factors that have *p* value lower than 0.20 from the univariate analysis are included.
[b] the variables have been set as baseline with the odd ratio value of 1.
Hosmer-Lemeshow test (x^2=9.247, P=0.322).
Abbreviation: OR, odds ratio; SE, standard error; CI, confident interval.

Table 3. Infestation indicator, intensity and abundance of fleas (n=651) on 426 sampled cats

Risk factor[a]	Variable	Total infested cat, (n)	Total fleas collected, (n)	Mean intensity[b]	Mean abundance[c]
Region	Northern (n=102)	73	143	1.96	1.40
	Western (n=123)	78	202	2.59	1.64
	Eastern (n=84)	74	157	2.12	1.87
	Southern (n=117)	81	149	1.84	1.27
Age	Juvenile (n=166)	128	282	2.20	1.70
	Adult (n=260)	178	369	2.07	1.42
Weight	0–1 kg (n=187)	115	169	1.47	0.90
	1.1–2 kg (n=154)	113	358	3.17	2.32
	>2 kg (n=85)	78	124	1.59	1.46
Status	Stray (n=239)	203	445	2.19	1.86
	Sheltered (n=115)	82	176	2.15	1.53
	Pet (n=72)	21	30	1.43	0.42
Body condition	Clean (n=319)	234	460	1.97	1.44
	Dirty (n=107)	72	191	2.65	1.79
Hair length	Short, <10 mm (n=99)	58	122	2.10	1.23
	Medium, 10–20 mm (n=179)	132	313	2.37	1.75
	Long, >20 mm (n=148)	116	216	1.86	1.46

[a] only factors that significantly associated with flea infestation from the univariate analysis are included.
[b] number of fleas per number of infested cats.
[c] number of fleas per number of examined cats.

Flea intensity and abundance

The mean intensity of total fleas across four distinct regions of Peninsular Malaysia was 2.13 fleas per infested cat and total abundance was 1.53 fleas per sampled cat. The highest flea intensity was in the Western region (2.59) while Eastern region showed the highest in flea abundance (1.87). The Southern region, in contrast, showed the lowest values for both intensity and abundance, 1.84 and 1.27, respectively (Table 3).

Comparing the flea intensity and abundance on the variables of risk factors, higher flea intensity was observed in both stray cats (2.19) and cats that lived in shelters (2.15), as compared to the pet cats (1.43). Stray cats also were found to have higher flea abundance (1.86) than the others. Between the age groups, the intensity of fleas was higher in juvenile cats (2.20) than the adults (2.07). Meanwhile, fleas were more abundant in juvenile cats (1.70) compared to the adult cats (1.42).

The flea intensity was found higher in medium-sized cats (3.17) as compared to small-sized cats (1.47) and big sized-cats (1.59). Fleas were least abundant in small-sized cats (0.90) but most abundant in medium-sized cats (2.32). Flea intensity (2.37) and abundance (1.75) were also higher in cats with medium hair length. Furthermore, cats with dirty body condition demonstrated higher flea intensity (2.65) and abundance (1.79).

DISCUSSION

Flea infestation

The present study provides new insights into the prevalence and associated risk factors of fleas infesting cats in Peninsular Malaysia. The prevalence rate of 72.71% on cats in Peninsular Malaysia was comparable with previous studies reported in Egypt (85.71%) (El-Seify *et al.*, 2016), Thailand (95.8%)

(Jittapalapong *et al*., 2008), and Iran (92.3%) (Hajipour *et al*., 2015). However, the prevalence rate in the present study was relatively higher as compared to the studies in Central Mexico (53.0%) (Canto *et al*., 2013) and India (26.0%) (Kreceka *et al*., 2010).

In this study, all flea samples were identified as *C. felis* (♀=464, ♂=187), suggesting its host specificity with cats in Peninsular Malaysia. In fact, *C. felis* was known to be the most common flea infesting cats worldwide (Wall *et al*., 1997; Jittapalapong *et al*., 2008; Farkas *et al*., 2009; Gracia *et al*., 2013; Hajipour *et al*., 2015), including Malaysia (Mohd Zain *et al*., 2012; Shanta *et al*., 1980; Amin-Babjee, 1978). Nevertheless, its subspecies *Ctenocephalides orientis* is also prevalent in Asian countries such as India, Thailand and Malaysia (Changbunjong *et al*., 2009; Wells *et al*., 2012). Although this species was not found in the cat populations in the present study, Low *et al*. (2017) reported the presence of *C. orientis* on dogs in Malaysia.

Female fleas were found to be more abundant than males in the present study. Similar observation has also been reported in previous studies (Farkas *et al*., 2009; Kumsa & Mekonnen, 2011; Bahrami *et al*., 2012; Gracia *et al*., 2013; Hajipour *et al*., 2015). The possible reasons could be because of the greater ability of female fleas to evade capture during host grooming and higher female survival rates in both mature and immature stages (Tavassoli *et al*., 2010). In addition, the females usually have a longer lifespan as compared to males. Males also spend more time off the host and prone to predation or starvation (Marshall, 1981).

High prevalence and abundance of fleas in the Eastern region can be related to the demographic and environmental factors that may influence their survival, development and reproduction (Koutinas *et al*., 1995). Eastern region of Peninsular Malaysia is mainly rural, lacks development, has poor terrain and inadequate management by the local authorities, which in turn, provides suitable habitats with high possibility for flea infestation. Moreover, temperature and humidity are the two most important factors influencing survival, development, and reproduction of fleas (Silverman *et al*., 1981). In fact, the Eastern region has high relative humidity and moderate temperature due its highest mean annual rainfall. (Wong *et al*., 2009). These factors can enhance the life cycle of fleas, increase their survival rate, and giving them a longer lifespan to infest the hosts (Koutinas *et al*., 1995).

Risk factors

In the present study, cat gender was not a significant factor for flea infestation, and this conforms with the studies carried out in Egypt (El-Seify *et al*., 2016), Thailand (Jittapalapong *et al*., 2008) and Iran (Hajipour *et al*., 2015). However, higher number of females can be attributed to the characteristic of the population studied. The higher number of female cats over the males was also noticed in a study conducted by Mohd Zain *et al*. (2013) of which 60% of the cats sampled from selected areas in Peninsular Malaysia were females.

The infestation of fleas on the cats was significantly influenced by age, with adult cats having fewer flea infestation compared to the young cats. This result was supported by the studies carried out in Thailand (Jittapalapong *et al*., 2008) and Greece (Sotiraki *et al*., 2001). Most of the young cats in this study were infested by fleas, possibly because of the incapability of the young cats to self-grooming which might reflect the decreased elimination of fleas (Salant *et al*., 2013).

Age also can be related to the body weight and size of the cats, in which, older cats normally have bigger size. In this study, body weight was found to be a significant factor for flea infestation. The infestation was most prevalent in big-sized cats (weight >2 kg), mostly comprised of adults, which were actively foraging or roaming in a wide range of areas. Some of the uninfested cats might have a higher chance to be infested as they are exposed to flea eggs and also come in close contact with other infested cats. Previous study also reported the lower prevalence of ectoparasites on smaller cats (weight ≤1.4 kg) compared to bigger cats (weight >1.5 kg) (El-Seify *et al*., 2016).

Considering the relationship between age and body weight factors, juvenile cats with bigger size tend to get infested with fleas compared to the small-sized juveniles, possibly because of their larger space for attachment by the fleas. On the other hand, small-sized adults which are normally associated with poor physical conditions, are less infested by fleas.

The prevalence of flea infestation was highest in stray cats as compared to the pet cats or cats that lived in shelters. Likewise, similar observations have also been reported in Akucewich *et al.* (2002), Jittapalapong *et al.* (2008), and Gracia *et al.* (2013). Stray cats are free roaming animals that mostly wander outdoors and can be found on the streets, food courts, markets foraging for food (Rust & Dryden, 1997). Thus, these cats are more likely to be exposed to the infested areas or infested cats that may harbour various types of ectoparasites. In addition, stray cats can also be easily infested with ectoparasites due to the lack of hygienic treatment or insecticide application (Jittapalapong *et al.*, 2008). In contrast, the pure-breed cats, mostly comprised of pet cats, that normally received proper care from their owners and stayed indoors thereby reducing the likelihood of ectoparasitic infestation. Furthermore, only about 1–5% of the flea population live on their hosts, while the remainder spread around the roaming areas of the host animal (Beck & Stickel, 2008). This spread is aided particularly by the outdoor floor base either soil or grass that may serve as a potential reservoir for flea eggs (Hajipour *et al.*, 2015).

The low infestation rate of fleas on cats with dirty body condition may be related to their poor health status which decreases their movement and socialization, thus resulting in less flea infestation. On the contrary, cats with clean body condition having good health status and social activities; they are more likely to encounter the infested animals and become a new host for fleas (Farkas *et al.*, 2009). Considering cat's hair length, this factor was significant ($P<0.05$) towards flea infestation. Long hairs provide more spaces for flea attachment and also great shelters for flea to avoid from getting removed during host self-grooming, making it to be the preferable condition for fleas to infest cats. In contrast, cats with shorter hairs are more effective at self-grooming and more likely to self-remove the flea.

Nevertheless, infestation can also be substantially influenced by number of cats per group. Those cats living in big group will have higher chance to encounter infested cats and get infested given the natural behaviour of fleas that can easily move from one host to another.

CONCLUSION

The high infestation of fleas in this study is indicative of cats as a flea reservoir particularly *C. felis* which was the only species infesting cats in the present study. From factors considered, age, body weight, hair length, skin condition and cat status were the significant risk factors for flea infestation. It is unlikely to eliminate fleas from cat population and its environment, however, continued research on flea infestation and their associated risk factors is of great importance for better understanding of related disease epidemiology. Hence, optimal care must be taken to diminish the risk of flea infestation in animals. The knowledge gained from this study can be used to develop and improve control measures relating to the risk factor management.

Conflict of interest

The authors declare that they have no conflict of interest.

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Associated risk factors for infestation on cats The risk factors of cats associated with flea infestation were recorded including their. 811. Figure 1. Map of Peninsular Malaysia showing the locations of the twenty districts where samplings were conducted and division of four different regions; Northern, Eastern, Western, and Southern.Â infestation is presented in Table 2. The age, status, weight, body condition, and hair length were confirmed as associated factors with flea infestation in the multivariate analysis. Juvenile cats were 1.07 times more likely to be infested by fleas than the adults. Stray and sheltered cats were respectively 51.8 and 15.5 times more likely to be infested by fleas than the pet cats. cats with topical fluralaner. The oral formulations of all agents are expected to be waterproof. Topical fluralaner is expected to be very water resistant after 3 days.20Â Identification of mutations associated with pyrethroid resistance in the para-type sodium channel of the cat flea, Ctenocephalides felis. Insect Biochem Mol Biol 2004;34:1305-1313. Rust MK, Vetter R, Denholm I, et al.Â Efficacy of sarolaner, a novel oral isoxazoline, against two common mite infestations in dogs: Demodex and Otodectes cynotis. Vet Parasitol 2016;222:62-66. Beugnet F, de Vos C, Liebenberg J, et al. Is your cat suffering from fleas? Learn about the symptoms and causes of fleas in cats, and find out the best flea treatment and prevention methods.Â Fleas are the nightmare of every cat owner. Thereâ€™s nothing worse than seeing your beloved cat drive themselves crazy scratching and chewing, trying to rid themselves of those biting pests. And here at Catological, we totally understand how frustrating fleas can be. Sometimes it seems those horrible bloodsuckers just WILL NOT give you and your pet a break. Luckily, there a number of ways you can tackle fleas and send them packing FOR GOOD. The trouble is, how do you know which is best? Handling a flea infestation is a nasty business and it can take a long time to eliminate the insects completely. But waste no time and stop them dead in their tracks. This article will explain you how.Â Never use dog flea preventative on cats, as some of the dog products contain permethrin that can cause death and/or seizures for cats. If you donâ€™t like the idea of treating your pet with chemicals, you may opt for essential oils, such as Citronella, Lavender, and Lemongrass to keep the nasty little bugs away. Domestic cats can be infested by a large range of parasite species. Parasitic infestations may cause very different clinical signs. Endoparasites and ectoparasites are rarely explored in the same study and therefore multiparasitism is poorly documented. The present survey aimed to improve knowledge of the prevalence and risk factors associated with ecto- and endoparasite infestations in owned cats in Europe. From March 2012 to May 2013, 1519 owned cats were included in a multicenter study conducted in 9 veterinary faculties throughout Europe (Austria, Belgium, France, Hungary, Italy, Romania and Spain). For each cat, ectoparasites were checked by combing of the coat surface associated with otoscopic evaluation and microscopy on cerumen samples.