KNOWLEDGE, ATTITUDE, AND PRACTICE OF DOG ECTOPARASITE PREVENTION AMONG DOG OWNERS IN PENANG, MALAYSIA

By

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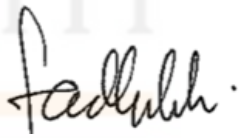

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KNOWLEDGE, ATTITUDE, AND PRACTICE OF DOG ECTOPARASITE PREVENTION AMONG DOG OWNERS IN PENANG, MALAYSIA

ABSTRACT

Ectoparasites are a group of parasites that live outside of their host and infestations can lead to several life-threatening diseases in dogs. Thus, ectoparasite preventatives in dogs including collars, palatable tablets, spot-on, and spray are important to minimize the transmission of ectoparasitic diseases in dogs. However, up to now, there is still no available data on the knowledge, attitude, and practice of ectoparasite preventative among dog owners in Penang, Malaysia. Therefore, this study was conducted to determine the knowledge, attitude, and practice of dog ectoparasites prevention, and the associated risk factors, among dog owners in Penang, Malaysia. The study findings showed that dog owners in Penang had a good knowledge (n=75, 68.18%), attitude (n=101, 91.82%), and practice (n=73, 66.36%) towards dog ectoparasite prevention. Besides, the results indicated that age and the highest level of education were the significant factors that impacted the knowledge, attitude, and practice (KAP) of dog ectoparasite prevention among dog owners in Penang, Malaysia. There were no significant associations between other sociodemographic characteristics such as gender, monthly income, district of residence and management of dogs with the KAP results. In conclusion, KAP of dog ectoparasite prevention is influenced by age and highest level of education and this study can benefit the public by allowing more appropriate ways to be implemented to improve owners' compliance with ectoparasite prevention based on the data collected.

Keywords: Dog Ectoparasite Prevention, Dog owners, Knowledge, Attitude and Practice of Dog Owners, Penang, Malaysia

PENGETAHUAN, SIKAP DAN AMALAN PENCEGAHAN EKTOPARASIT ANJING DALAM KALANGAN PEMILIK ANJING DI PULAU PINANG, MALAYSIA

ABSTRAK

Ektoparasit adalah sekumpulan parasit yang hidup di luar hosnya dan infestasi boleh menyebabkan beberapa penyakit yang mengancam nyawa anjing. Oleh itu, pencegahan ektoparasit pada anjing termasuk kalung, tablet yang boleh dimakan, ubat titik, dan semburan adalah penting untuk meminimumkan penyebaran penyakit yang disebabkan oleh ektoparasit pada anjing. Walau bagaimanapun, hingga kini, tiada data yang tersedia mengenai pengetahuan, sikap, dan amalan pencegahan ektoparasit di kalangan pemilik anjing di Pulau Pinang, Malaysia. Oleh itu, kajian ini dijalankan untuk menentukan pengetahuan, sikap, dan amalan pencegahan ektoparasit anjing, serta faktor risiko yang berkaitan, di kalangan pemilik anjing di Pulau Pinang, Malaysia. Hasil kajian menunjukkan bahawa pemilik anjing di Pulau Pinang mempunyai pengetahuan (n=75, 68.18%), sikap (n=101, 91.82%), dan amalan (n=73, 66.36%) yang baik terhadap pencegahan ektoparasit anjing. Selain itu, keputusan menunjukkan bahawa umur dan tahap pendidikan tertinggi adalah faktor signifikan yang mempengaruhi pengetahuan, sikap, dan amalan (KAP) pencegahan ektoparasit anjing di kalangan pemilik anjing di Pulau Pinang, Malaysia. Tiada hubungan yang signifikan antara ciri sosiodemografi lain seperti jantina, pendapatan bulanan, daerah tempat tinggal dan pengurusan anjing dengan hasil KAP. Kesimpulannya, KAP pencegahan ektoparasit anjing dipengaruhi oleh umur dan tahap pendidikan tertinggi dan kajian ini dapat memberi manfaat kepada masyarakat dengan membolehkan cara yang lebih sesuai dilaksanakan untuk meningkatkan pematuhan pemilik terhadap pencegahan ektoparasit berdasarkan data yang dikumpulkan.

Kata Kunci: Pencegahan Ektoparasit Anjing, Pemilik Anjing, Pengetahuan, Sikap dan Amalan Pemilik Anjing, Pulau Pinang, Malaysia

CERTIFICATION

This is to certify that we have read this research paper entitled **'Knowledge, Attitude, And Practice of Dog Ectoparasite Prevention Among Dog Owners In Penang, Malaysia'** by **Ang Hui Qian**, and in our opinion, it is satisfactory in terms of scope, quality, and presentation as partial fulfillment of the requirements for the course DVT 55204 – Research Project.

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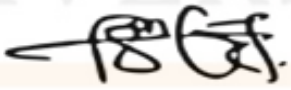

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Dr Mohammed Dauda Goni

My parents & family members

My friends

My pets (Feizaii & Kimbo)

Thank You

DEDICATIONS

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

KAP	Knowledge, Attitude, and Practice
SPSS	Statistical Package for the Social Sciences

LIST OF SYMBOLS

%	Percentage
<	Less than
=	Equal
n	Number
p	Significance level
r	Correlation coefficient

CHAPTER 1

INTRODUCTION

1.1 Research Background

Ectoparasites such as ticks, mites, fleas, and lice are a group of organisms that are found on the surface of skin, in the dermis layer, or even within the hair follicles (Elsheikha, 2017). Ectoparasites living on the surface of the host pose a health threat to dogs as they act as vectors to transmit various types of diseases and lead to life-threatening health issues in dogs. Ectoparasites such as lice cause direct damage by blood-feeding or chewing the skin or hair of the host and act as a vector to transmit diseases such as anaplasmosis (Taylor et al., 2016). Apart from lice, ticks also act as vectors and transmit many infectious diseases to animals and humans including babesiosis, anaplasmosis, and ehrlichiosis in Malaysia (Jing et al., 2017).

According to a study done in the suburban and rural areas in Borneo, Sabah, Malaysia in 2012 regarding the ectoparasite infestation patterns of domestic dogs, 92% of examined dogs found fleas, 42 of the sampled dogs (20 %) found lice and 36 of the sampled dogs (17 %) found ticks (Wells et al., 2012). Another study conducted on the parasite pathogens at Pudu Market and Chow Kit area in Kuala Lumpur reported that all stray dogs were infested by *Rhiphicephalus sanguineus* (Premaalatha et al., 2018). Besides that, a study done that focuses on tick infestation in stray dogs in localities of Malaysia found that 53 out of 64 examined stray dogs (82.8%) were infested by ticks (Yan et al., 2024).

Depending on the type of ectoparasite, the adult ectoparasite such as female ticks that are fully engorged from stray dogs will release their eggs in the environment (Figure 1.1). The eggs in the environment will then molt into nymphs or larvae and eventually grow into adults. Once they become adults, they will start to attach themselves to the host to feed on them (Centers for Disease Control, 2017; Barker et al., 2014). Therefore, with more stray dogs around, ectoparasites can be transmitted more easily which emphasizes the significance of dog owners providing ectoparasite prevention to their dogs.

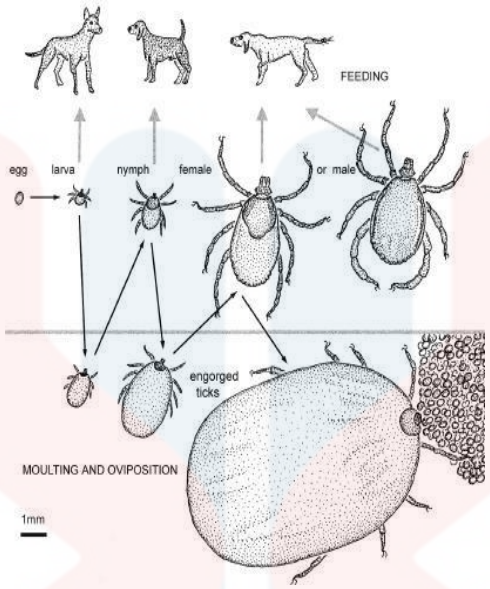

Figure 1.1: Life cycle of a three-host tick (Rhipicephalus sanguineus).

Figure 1.2: Ectoparasite collar

Figure 1.3: Palatable tablets

Dog's ectoparasite preventative measures come in different forms, including collar (Figure 1.2), palatable tablets (Figure 1.3), spot-on (Figure 1.4), and spray (Figure 1.5) (Merck Animal Health, 2019; Rogalski et al., 2018). The preventatives are different in active ingredients and act differently against ectoparasites in dogs. Preventive medicine in dogs is very crucial and is highly recommended as part of pets' wellness programs for life. According to Penang Hyperlocal 2022, there are around 10,000 stray dogs in Penang Island alone and 20,000 stray dogs were reported in Seberang Perai, Penang in 2019 (Nambiar, P., 2019).

Figure 1.4: Spot-on

Figure 1.5: Ectoparasite spray

1.2 Research Problem Statement

Ectoparasite infestations in dogs can lead to several life-threatening diseases in dogs. Some ectoparasitic diseases in dogs even pose a zoonotic risk. Thus, the various ectoparasite preventative measures including collar, palatable tablets, spot-on, and spray are important as to minimize the transmission of ectoparasitic diseases in dogs. However, up to now, there is limited data on the knowledge, attitude and practice of ectoparasite prevention on dogs in Penang, Malaysia. There is also no information currently available regarding the understanding of pet owners to get reliable ectoparasite prevention products to reduce the risk of causing harm to their pets due to several reasons including inappropriate application methods. Therefore, this study is important to gather more data to allow more appropriate actions to be planned to improve the awareness and practices on ectoparasite preventatives to benefit both animal and human society.

1.3 Research Questions

1. What is the level of knowledge, attitude, and practice among dog owners in Penang towards dog ectoparasite prevention?
2. What is the association between sociodemographic factors with the level of knowledge, attitude, and practice among dog owners in Penang towards dog ectoparasite prevention?

1.4 Research Hypothesis

1. Dog owners in Penang have a moderate level of knowledge, attitude, and practice towards dog ectoparasite prevention.
2. There is an association between sociodemographic factors with the level of knowledge, attitude, and practice among dog owners in Penang towards dog ectoparasite prevention.

1.5 Research Objectives

1. To determine the level of knowledge, attitude, and practice among dog owners in Penang towards dog ectoparasite prevention.
2. To determine the sociodemographic factors associated with the level of knowledge, attitude and practice of dog owners in Penang towards dog ectoparasite prevention.

1.6 Significance of Study

Ectoparasites such as ticks and fleas may act as vectors to transmit disease that impacts the dog's health, as well as some ectoparasitic diseases in dogs, pose a zoonotic risk that can affect public health. Thus, the expected research findings are crucial to determine the awareness of the dog owner regarding ectoparasite prevention so that an appropriate way to improve their compliance on ectoparasite prevention can be done to reduce the ectoparasite infestation in dogs, which benefits not only animals but also humans.

CHAPTER 2

LITERATURE REVIEW

2.1 Definition of Ectoparasites and Ectoparasite Infestation

Ectoparasites such as ticks, mites, fleas, and lice are a group of organisms that are found on the skin or in the dermis layer or even within the hair follicles (Elsheikha, 2017), while ectoparasite infestation is the presence of external parasites on the host (Sebento, 2022).

2.2 Dog's Ectoparasites

The common ectoparasites found in dogs are fleas, ticks, mites, and lice (Erwanas et al., 2014). According to the study done by Wells et al. (2012) in Malaysia, ticks found in dogs were *Rhipicephalus sanguineus* and *Haemaphysalis sp*. with an overall prevalence of 17%. In Southeast Asia, dogs are frequently infested with ticks, which act as vectors for various tick-borne pathogens including *Babesia spp*. and *Ehrlichia spp.* are commonly reported in the region (Boost et al., 2017). The risk of tick-borne diseases in Malaysia is heightened by the region's warm, humid climate, which creates favorable conditions for tick survival and reproduction. Besides, fleas are another significant ectoparasite affecting dogs in Malaysia, with commonly found species of *Ctenocephalides orientis* and *Ctenocephalides felis* (Wells et al., 2012). Based on the studies done by Wells et al. (2012), reported a high prevalence of 92% for fleas in dogs. This might be due to the tropical climate in Malaysia being ideal for flea survival and reproduction (Makundi & Kilonzo, 2009). Other than that, lice also contribute to the ectoparasite burden in dogs in Malaysia. According to Wells et al. (2012), *Heterodoxus spiniger*, a type of louse, had a prevalence of 20% in their study. Lice infestations can cause irritation, hair loss, and secondary bacterial infections in dogs, although they are typically less frequent than flea or tick infestations. Lastly, mites particularly *Sarcoptes scabiei* and *Demodex spp.* are also common ectoparasites affecting dogs in Malaysia, which can cause intense itching, hair loss, and skin lesions in infected dogs.

2.3 Prevalence of Ectoparasite Infestation in Dog

In Thailand, a study done regarding the ectoparasite species found in domestic dogs showed that the overall prevalence rate for ticks in domestic dogs was 80.7% and a prevalence rate of 26.5% for fleas. In Malaysia, a study done in the suburban and rural areas in Borneo, Sabah at year 2012 to determine the ectoparasite infestation patterns of domestic dogs showed that 195 out of 212 examined dogs (92%) found fleas, 42 out of the 212 sampled dogs (20 %) found lice and 36 out of 212 sampled dogs (17 %) found ticks (Wells et al., 2012). Besides that, a study showed that 140 ticks were collected from 172 shelter dogs in Peninsular Malaysia (Sipin et al., 2020). Although not much information regarding ectoparasite on domestic dogs in Malaysia has been reported, ectoparasites such as ticks from stray dogs can be easily transmitted to the house dog especially when stray dogs enter a residential housing area or when pet dogs spend time roaming outdoors. This is because adult ectoparasites such as female ticks that are fully engorged from stray dogs will release their eggs into the environment. Depending on the type of ectoparasite, the eggs in the environment will molt into nymphs or larvae and eventually grow into adults (Centers for Disease Control, 2017). Once they become adults, they will start to attach themselves to the host to feed on them. Therefore, with more stray dogs around, ectoparasites can be transmitted more easily which emphasizes the significance of dog owners providing ectoparasite prevention to their dogs.

2.4 Zoonotic Potential of Dog Ectoparasites

Ectoparasites such as fleas, ticks, mites, and lice are a group of organisms that are found on the superficial skin, in the dermis layer or even within the hair follicles (Elsheikha, 2017), and are commonly found in domestic dogs. The ectoparasites such as ticks and fleas, not only impact the dog's health, but it may also act as vectors transmitting various diseases that potentially pose a risk to human health. For example, fleas act as vectors for *Dipylidium caninum* infection both in dogs and humans. The infestation begins when an infected dog sheds the tapeworm eggs in its feces. These eggs are then ingested by the larvae of the dog's fleas. Once the dog ingests the flea that is infected with tapeworm larvae, they will then be infected with *Dipylidium caninum*. In the dog's intestine, the tapeworm larvae will develop into adult tapeworm and the proglottids will break off and excreted in the feces. This becomes a zoonotic concern when humans accidentally ingest the infected fleas (Jiang et al., 2017), often through

a close contact with the pets and this condition was reported in at least 24 countries with more than ⅔ of the reported cases happening in small children. This is due to their tendency to handle pets followed by putting their hands into their mouths (Jiang et al., 2017). This flea-borne transmission of dipylidiasis highlights the public health risks posed by ectoparasites in domestic animals, indicating that flea control is important not only for better animal health but also to reduce the potential of human infections (Jiang et al., 2017).

Apart from that, ticks particularly *Rhipicephalus sanguineus* serve as vectors for several zoonotic diseases, posing a threat to both dog and human health. In Malaysia, studies have documented the presence of tick-borne pathogens such as *Anaplasma, Ehrlichia, Babesia*, and other rickettsial infections in both humans and animals (Jing et al., 2017). Besides, one of the most concerning zoonoses associated with ticks is Lyme disease which is caused by *Borrelia burgdorferi*. Although Lyme disease is more common in temperate regions, its occurrence in tropical areas, such as Malaysia, has been increasing. This is largely attributed to the movement of infected ticks on migratory birds and through domestic animals such as dogs (Frazior & Leeke, 2023). This raises zoonotic concerns when the adult ticks drop off from the host and start to attach themselves to other hosts. Due to the close contact of dogs and humans in the same environment, it is easy for pathogens to be passed between species. Thus, it is important to practice dog ectoparasite prevention to reduce the potential of human infections.

Moreover, mites, including *Sarcoptes scabiei* and *Demodex* spp., are common ectoparasites of dogs that pose zoonotic threats. *Sarcoptes scabiei* is highly contagious and can be transmitted to humans, causing an intensely itchy condition known as scabies. Although the incidence of canine scabies in humans is rare, there are reported cases of canine scabies in humans (Aydıngöz & Mansur, 2011). Lastly, lice infestations in dogs are less common than fleas or ticks but still present a potential zoonotic risk. The most common lice species found in dogs include *Heterodoxus spiniger* and *Trichodectes canis*, which are host specific (Companian Animal Parasite Council, 2017). Although these lice are host-specific, they can act as vectors for some pathogens that may cause zoonotic diseases. For example, *Heterodoxus springer* is known to transmit *Acanthocheilonema reconditum* (Companian Animal Parasite Council, 2017). Even though lice-related human infections are rare, there is a reported case

of *Acanthocheilonema reconditum* found in the eyes of a 62 years old resident in Australia (Huynh et al., 2001). This rare incident highlights the possibility of zoonotic transmission, thus emphasizes the importance of ectoparasite prevention in dogs to reduce the risk of such infections.

2.5 Dog Population and Ownership in Malaysia

The total dog population in Malaysia including stray dogs is 402,500 as of 2018 (Federation Cynologique Internationale, 2021). The number of dog ownerships in Malaysia as of 2019 are around 398,000 (Pet Fair Southeast Asia, 2021). Besides, according to Standard Insights' most recent Customer Report Malaysia 2023, which collected opinions from over 1,000 Malaysian respondents, more than half of the Malaysians (51.1%) own dogs.

2.6 Ectoparasite Preventative

Dog's ectoparasite preventative comes in the form of collar, palatable tablets, spot-on, and spray (Merck Animal Health, 2019). For the collar method, the collars contain acaricide which will be released at a slow rate to allow the absorption of medication into the oil glands of the skin, which then leads to the distribution of medication all around the body. This method allows protection against fleas and ticks around 7 to 8 months which makes them very cost-effective (Merck Animal Health, 2019 & Elanco, 2022). Besides, collar applications are very easy and less messy when compared to spot-on applications. For palatable tablets, it allows dogs to chew and the active ingredients of the tablets will then be distributed throughout the body and provide protection against ectoparasite by different mechanism of action such as by killing the adult flea or preventing the larvae from hatching (LakeCross Veterinary, 2020). This then protects dog against ectoparasite infestation up to 1 month and the oral preventative were 99.9% effective based on the study done on assessment of owner-administered topicals ectoparasite preventative in a total of 128 dogs (Dryden et al., 2012). Topical spot-on preventative is applied by pouring the pre-measured small volume of liquid containing acaricide onto the skin on the back of the dog's neck. This can prevent the dog from licking off the medication and protects up to 1 month (LakeCross Veterinary, 2020). According to a study done on the assessment of owner-administered topicals ectoparasite preventative in a total of 128 dogs, this ninety-day study found that the topical preventative was 88.4% effective

against fleas (Dryden et al., 2012). Lastly, spray ectoparasite preventative is applied by spraying it on a gloved hand and then gently rubbing it into the dog's skin and coat with another hand. This method has great coverage for preventing ectoparasites and enables the active ingredients to be rapidly dispersed into the dog's skin (Ihrke, 2006).

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Study Design and Area

A cross-sectional study was conducted among dog owners living in Penang, Malaysia. The target population consists of dog owners in Penang who own at least one dog.

3.2 Selection Criteria

3.2.1 Inclusion Criteria

Malaysians living in Penang, 18 years old and above, currently own one or more dogs and are willing to participate in this study.

3.2.2 Exclusion Criteria

Dog owners who aged less than 18 years old and owned dogs in the past.

3.3 Sampling Method

A simple random sampling technique was used for respondent selection. The questionnaire was distributed using Google Forms via online platforms such as WhatsApp, Facebook, and Instagram.

3.4 Sample Size

The number of dog owners in Malaysia as of 2019 are around 398,000 (Pet Fair Southeast Asia, 2021). The sample size was determined by using the Z-formula below, where N is the population size, Z is the Z-score, p is the sample proportion and e is the margin of error.

$$\text{Sample size, n} = \frac{Z^2 \times p\,(1-p)}{N-1+\frac{Z^2 \times p\,(1-p)}{e^2}}$$

It was then estimated that a minimum of 384 individuals should be involved in this study to gain a 95% confidence level, with 0.5 sample proportion and 0.05 margin error. However, due to time restraints, a total of 110 individuals were sampled in this study.

3.5 Questionnaire Design

A newly designed questionnaire was developed and validated solely for this study as there was no available study regarding dog ectoparasite prevention made to be adopted. The questionnaire consists of 4 parts: Part A collected data on social demographic details, Part B assessed knowledge about dog's ectoparasite prevention, Part C evaluated attitude on dog's ectoparasite prevention as well as part D examined the practices of dog's ectoparasite prevention. After that, a pilot test was conducted to ensure the validity and reliability of the questionnaire. Face validation was done on at least three respondents who fulfill the selection criteria for the pretest. Then, content validation was conducted by a panel of experts in the field of veterinary medicine. Lastly, the final version of the questionnaire consisted of four sections of close-ended questions with response options distributed to the respondents by using Google form via online platforms such as WhatsApp, Facebook, and Instagram.

Part A collected the respondents' demographics including gender, age, highest level of education, district of residence, number of dogs owned, management of dogs, the ectoparasite preventative that they applied for their dogs, and the factors that influenced their choice of ectoparasite prevention methods. Next, to assess the respondents' knowledge of dog ectoparasite prevention, Part B included 10 multiple-choice questions with responses of "Yes," "No," or "I don't know." Each response of "Yes" will be given a score of 1, while a score of 0 is given to those who answered "No" or "I don't know". The dog owners' level of knowledge was classified into poor, moderate, and good, based on their total scores of 0-3, 4-7, 8-10 respectively. Besides, Part C, which measured the owners' attitudes, consisted of 6 questions using a five-point Likert scale: "Strongly Agree," "Agree," "Neutral," "Disagree," and "Strongly Disagree." Scores were assigned as follows: 0 for "strongly disagree", 1 for "disagree", 2 for "neutral", 3 for "agree" and 4 for "strongly agree". The total attitude score of 0-6, 7-17, and 18-24 was graded into poor, moderate and good levels of attitude respectively. Lastly, Part D assessed practices related to ectoparasite prevention using 5 questions, with responses on a four-point Likert scale: "Never", "Rarely", "Sometimes", and "Always". The response was scored 0 for those who answered "never", 1 for "rarely", 2 for "sometimes" and 3 for "always". The practice scores were grouped into poor (0-4), moderate (5-10), or good (11-15) levels.

3.6 Statistical Analysis of Data

The questionnaire data was imported into Microsoft Excel and analyzed by using IBM SPSS Statistics version 27. The categorical variables were illustrated using descriptive statistics for frequency and percentage. Next, Pearson Chi-Square was used to determine the association between the knowledge, attitude, and practice (KAP) scores and the sociodemographic characteristics, and a p-value of <0.05 was considered statistically significant. Lastly, Spearman's rho correlation was performed to measure the correlation between the total knowledge, attitude, and practice score, and the correlation is significant when $p < 0.05$.

CHAPTER 4

RESULTS

4.1 Sociodemographic Characteristics of Respondents

This study was conducted from September 2024 to October 2024 and a total of 110 individuals participated in this study. Female respondents (n=84, 76.4%) constituted a higher percentage than male respondents (n=26, 23.6%). Most respondents were from the age group between 21 to 30 (n=58, 52.7%), while only 5 respondents (4.5%) were from the age group of higher than 60. Besides, most participants had a bachelor's degree education (n= 76, 69.1%), while there was only one participant (0.9%) who had a primary education. Moreover, most of the respondents had an income between RM 5000 - RM 7999 (n=33, 30%), whereas 12.7% (n=14) of them had an income of less than RM 2000. Furthermore, most of the dog owners (n=33, 30%) came from North Seberang Perai of Penang. Besides that, 48.2% (n=53) of the respondents own one dog and most of the dogs are kept indoors (n=46, 41.8%). Other than that, 49.1% (n=54) of the participants prefer to use oral tablets as their ectoparasite preventative practice than spot-on (n=28, 25.5%), spray (n=13, 11.8%) and ectoparasite collar (n=8, 7.3%). Lastly, more than half of the respondents (n=62, 52.4%) consider effectiveness and safety to be more important when considering ectoparasite prevention methods for their dog, while only 5 of them (4.5%) consider duration of protection when choosing the ectoparasite prevention method for their dog. The data is summarized in table 4.1.

Table 4.1 Sociodemographic of the Respondents (n=110)

Sociodemographic characteristics	**Total (n=110)**	
	n	**%**
Gender		
Female	84	76.4
Male	26	23.6
Age		
18 - 20	6	5.5

21 - 30	58	52.7
31 - 40	20	18.2
41 - 50	14	12.7
51 - 60	7	6.4
> 60	5	4.5
Highest level of education		
Primary	1	0.9
Secondary	6	5.5
Pre-university or diploma	19	17.3
Bachelor's degree	76	69.1
Master	7	6.4
PhD	1	0.9
Monthly income		
None	22	20
< RM 2000	14	12.7
RM 2000 - RM 4999	25	22.7
RM 5000 - RM 7999	33	30
> RM 8000	16	14.5
District of residence		
North Seberang Perai	33	30
Central Seberang Perai	25	22.7
South Seberang Perai	12	10.9
Northeast Penang Island	22	20
Southwest Penang Island	18	16.4
Number of dog owned		
1	53	48.2
2	34	30.9
3	12	10.9
4	1	0.9
> 5	10	9.1
Management of dog		
Indoor	46	41.8
Semi-indoor	42	38.2
Outdoor	22	20
What ectoparasite preventative do you practice?		
Oral tablets	54	49.1
Ectoparasite collar	8	7.3
Spot-on	28	25.5
Spray	13	11.8
None	7	6.4
What factors influenced your choice of ectoparasite prevention methods for your dog?		
Convenience	11	10
Cost	14	12.7

Effectiveness & Safety	62	52.4
Duration of protection	5	4.5
Veterinarian Recommendation	18	16.4

4.2 Knowledge of Dog Ectoparasite Prevention

Table 4.2 shows the knowledge of dog ectoparasite prevention among dog owners. Out of 110, 93 of them (84.5%) were aware that tick is an ectoparasite in dogs, while 69.1% of them (n=74) were aware that mite is an ectoparasite. Besides that, 93.6% (n=103) of the respondents knew that flea is an ectoparasite in dogs, and 92.7% (n=102) aware that lice is an ectoparasite in dogs. Furthermore, 89.1% of them (n= 98) knew that cockroaches are not considered an ectoparasite in dogs. Additionally, 92.7% of them (n=106) were aware of the availability of dog ectoparasite preventative and many of them knew that ectoparasite can be applied via various methods including collar, oral tablets, spot-on and spray (n=103, 93.6%). Moreover, dog owners are also mindful that ectoparasite prevention can start as early as 6 weeks old in puppies (n=77, 70%). In addition, 89.1% of them knew that different ectoparasite prevention products have different duration of protection for ectoparasites. Lastly, 97 out of 110 (88.2%) are aware that dogs with ectoparasite can transmit several ectoparasitic diseases.

Table 4.2 Knowledge of Dog Ectoparasite Prevention among Dog Owners (n=110)

Knowledge-based item	**Correct**		**Incorrect**	
	n	**%**	**n**	**%**
Q1. Is ticks an ectoparasite in dogs?	93	84.5	17	15.4
Q2. Is mite an ectoparasite in dogs?	76	69.1	34	30.9
Q3. Is flea an ectoparasite in dogs?	103	93.6	7	6.4
Q4. Are lice ectoparasites in dogs?	102	92.7	8	7.2
Q5. Is cockroach an ectoparasite in dogs?	98	89.1	12	10.9
Q6. Are there ectoparasite preventatives available for dogs?	102	92.7	8	7.3

Q7. Ectoparasite prevention can start as early as 6 weeks old in puppies.	77	70	33	30
Q8. Ectoparasite prevention can be applied via various methods including collar, oral tablets, spot-on and spray	103	93.6	7	6.4
Q9. Different ectoparasite prevention products have different duration of protection for ectoparasites.	98	89.1	12	10.9
Q10. Dogs with ectoparasite can transmit several ectoparasitic diseases.	97	88.2	13	11.8

4.3 Attitude on Dog Ectoparasite Prevention

Table 4.3 shows that 80.9% of the respondents (n=89) strongly agree that the use of ectoparasite prevention is important for my dog's overall health, showing that they understand the potential risks associated with untreated ectoparasite infestations that can transmit serious diseases. Besides, most of them (82.7%, n =91) strongly believed that applying ectoparasite prevention is an essential responsibility as a dog owner and only 1 of them (0.9%) strongly disagreed with this statement. Furthermore, 72.7% (n=80) of them had a good attitude towards the use of ectoparasite prevention to prevent the transmission of many vector-borne diseases. In addition, 79.1% (n=87) of the respondents strongly agreed that it is important to follow the proper application of ectoparasite prevention for their dog. 67.3% of the respondents strongly believed that it is important to apply ectoparasite preventatives even if the dog is managed indoors with only 1 of the respondents (0.9%) disagreed with this statement. Lastly, more than half of the respondents (51.8%, n=57) had a good attitude towards ectoparasite prevention which cannot be replaced by good hygiene and environmental control solely against common vector-borne diseases.

Table 4.3 Attitude of Dog Ectoparasite Prevention among Dog Owners (n=110)

Attitude-based item	Strongly disagree		Disagree		Neutral		Agree		Strongly agree	
	n	%	n	%	n	%	n	%	n	%
Q1. I believe that the use of ectoparasite prevention is important for my dog's overall-health.	2	1.8	0	0	2	1.8	17	15.5	89	80.9
Q2. I believe that applying ectoparasite prevention is an essential responsibility as a dog owner.	1	0.9	1	0.9	5	4.5	12	10.9	91	82.7
Q3. I believe that the use of ectoparasite prevention can prevent the transmission of many vector-borne diseases.	2	1.8	1	0.9	2	1.8	25	22.7	80	72.7
Q4. I believe that it is important to follow the proper application of ectoparasite prevention for my dog.	3	2.7	0	0	4	3.6	16	14.5	87	79.1
Q5. I believe that ectoparasite preventatives are important even if the dog is managed indoors.	1	0.9	5	4.5	5	4.5	25	22.7	74	67.3
Q6. I believe that ectoparasite preventative cannot be replaced by good hygiene and environmental control solely to against common vector-borne diseases.	4	3.6	7	6.4	16	14.5	26	23.6	57	51.8

4.4 Practice of Dog Ectoparasite Prevention

Based on Table 4.4, half of the respondents (n=55) will see other dogs in their area when they take their dog out for a walk sometimes. Besides, most of the respondents 54.5% (n=60) will always regularly check for the presence of ectoparasites in their dogs. Furthermore, 40% of the respondents will always enquire with the veterinarian about the type of ectoparasite prevention used on their dogs. Moreover, 49.1% of them (n=54) will always administer ectoparasite prevention on their dog, even though there is no ectoparasite seen. Lastly, most of the respondents (48.2%, n=53) always follow the proper duration to apply ectoparasite prevention for their dog.

Table 4.4 Practice of Dog Ectoparasite Prevention among Dog Owners (n=110)

Practice-based item	Always		Sometimes		Rarely		Never	
	n	%	n	%	n	%	n	%
1. I always see other dogs in my area when I bring my dog out for a walk.	43	39.1	55	50	7	6.4	5	4.5
2. I regularly check for the presence of ectoparasites in my dogs.	60	54.5	43	39.1	6	5.5	1	0.9
3. I always enquire with veterinarians on the type of ectoparasite prevention used on my dogs.	39	35.5	44	40	24	21.8	3	2.7
4. I always administer ectoparasite prevention on my dog, even though there is no ectoparasite seen.	54	49.1	34	30.9	16	14.5	6	5.5
5. Do you follow the proper duration to apply ectoparasite prevention for your dog?	53	48.2	42	38.2	13	11.8	2	1.8

4.5 Respondents' Level of Knowledge, Attitude, and Practice of Dog Ectoparasite Prevention among Dog Owners in Penang, Malaysia

Based on Table 4.5, 68.18% of the respondents (n=75) had good levels of knowledge, whereas 29.09% (n=32) and 2.72% (n=3) showed fair and poor levels of knowledge respectively. In addition, 91.82% of them (n=101) showed a good attitude on dog ectoparasite prevention, while 1.82% (n=2) and 6.36% (n=7) had fair and poor attitudes respectively. For practice, only 1.82% of the respondents had a poor practice of dog's ectoparasite prevention whereas 66.36% (n=73) of them showed good practice on dog ectoparasite prevention. In summary, the results revealed most of the respondents had good knowledge (n=75/110, 68.18%), attitude (n=101/110, 91.82%) and practice (n=73/110, 66.36%) toward dog ectoparasite prevention.

Table 4.5 Total Score of Knowledge, Attitude, And Practice of Dog Ectoparasite Prevention among Dog Owners (n=110)

Variable	Level	Score	n (%)
Knowledge			
	Poor	0 - 3	3 (2.72)
	Fair	4 - 7	32 (29.09)
	Good	8 - 10	75 (68.18)
Attitude			
	Poor	0 - 6	2 (1.82)
	Fair	7 - 17	7 (6.36)
	Good	18 - 24	101 (91.82)
Practice			
	Poor	0 - 4	2 (1.82)
	Fair	5 - 10	35 (31.82)
	Good	11 - 15	73 (66.36)

4.6 Association between Sociodemographic Characteristics and Total Score for Knowledge, Attitude, and Practice of Dog Ectoparasite Prevention among Dog Owners in Penang

Table 4.6.1, table 4.6.2, and table 4.6.3 demonstrated the association between sociodemographic characteristics and the knowledge, attitude, and practice of dog ectoparasite prevention among dog owners respectively. Based on the results, there is a significant association between age (p=0.019) and highest level of education (p=0.001) with knowledge. There were more respondents with bachelor's degree education and within the 21 to 30 age group with good knowledge. Besides, different ages and levels of education also influence the attitude and practice in dog ectoparasite prevention. A well-educated individual is more likely to view their pets as family members rather than property (Dotson & Hyatt, 2008), hence they are more willing to take the necessary steps to protect their pets from potential health threats such as parasites. In terms of age, younger age individuals are more familiar with using technologies including social media to keep up with the latest ectoparasite prevention methods (Kogan et al., 2012).

Table 4.6.1 Association between Sociodemographic Characteristics and Knowledge of Dog Ectoparasite Prevention among Dog Owners (n=110)

Sociodemographic characteristics	Grade, n (%)			P-value
	Poor	Moderate	Good	
Gender				0.777
Female	2 (1.8)	25 (22.7)	57 (51.8)	
Male	1 (0.9)	7 (6.4)	18 (16.4)	
Age				0.019*
18 - 20	1 (0.9)	2 (1.8)	3 (2.7)	
21 - 30	0 (0)	15 (13.6)	43 (39.1)	
31 - 40	0 (0)	4 (3.6)	16 (14.5)	
41 - 50	1 (0.9)	5 (4.5)	8 (7.3)	
51 - 60	1 (0.9)	4 (3.6)	2 (1.8)	
> 60	0 (0)	2 (1.8)	3 (2.7)	
Highest level of education				0.001*
Primary	1 (0.9)	2 (1.8)	0 (0)	
Secondary	0 (0)	0 (0)	4 (3.6)	
Pre-university or diploma	2 (1.8)	4 (3.6)	13 (11.8)	
Bachelor's degree	0 (0)	24 (21.8)	55 (50)	
Master	0 (0)	4 (3.6)	3 (2.7)	
PhD	0 (0)	1 (0.9)	0 (0)	
Monthly income				0.222
None	0 (0)	7 (6.4)	15 (13.6)	
< RM 2000	2 (1.8)	2 (1.8)	10 (9.1)	
RM 2000 - RM 4999	1 (0.9)	5 (4.5)	19 (17.3)	
RM 5000 - RM 7999	0 (0)	14 (12.7)	19 (17.3)	
> RM 8000	0 (0)	4 (3.6)	12 (10.9)	
District of residence				0.429
North Seberang Perai	0 (0)	12 (10.9)	21 (19.1)	
Central Seberang Perai	0 (0)	6 (5.5)	19 (17.3)	
South Seberang Perai	0 (0)	5 (4.5)	11 (10)	
Northeast Penang Island	2 (1.8)	8 (7.3)	12 (10.9)	
Southwest Penang Island	1 (0.9)	1 (0.9)	12 (10.9)	
Number of dog owned				0.078
1	1 (0.9)	12 (10.9)	40 (36.4)	
2	0 (0)	13 (11.8)	21 (19.1)	
3	2 (1.8)	3 (2.7)	7 (6.4)	
4	0 (0)	1 (0.9)	0 (0)	
> 5	0 (0)	3 (2.7)	7 (6.4)	
Management of dog				0.244
Indoor	1 (0.9)	16 (14.5)	20 (18.2)	

Semi-indoor	1 (0.9)	10 (9.1)	31 (28.2)	
Outdoor	1 (0.9)	6 (5.5)	15 (13.6)	

* p-value is significant when p <0.05

Table 4.6.2 Association between Sociodemographic Characteristics and Attitude of Dog Ectoparasite Prevention among Dog Owners (n=110)

Sociodemographic characteristics	Grade, n (%)			P-value
	Poor	Moderate	Good	
Gender				0.085
Female	2 (1.8)	5 (4.5)	77 (70)	
Male	0 (0)	2 (1.8)	24 (21.8)	
Age				0.021*
18 - 20	0 (0)	1 (0.9)	5 (4.5)	
21 - 30	1 (0.9)	3 (2.7)	54 (49.1)	
31 - 40	0 (0)	1 (0.9)	19 (17.3)	
41 - 50	0 (0)	1 (0.9)	13 (11.9)	
51 - 60	0 (0)	1 (0.9)	6 (5.5)	
> 60	1 (0.9)	0 (0)	4 (3.6)	
Highest level of education				0.049*
Primary	0 (0)	0 (0)	1 (0.9)	
Secondary	1 (0.9)	0 (0)	5 (4.5)	
Pre-university or diploma	0 (0)	3 (2.7)	16 (14.5)	
Bachelor's degree	0 (0)	3 (2.7)	73 (66.4)	
Master	1 (0.9)	1 (0.9)	5 (4.5)	
PhD	0 (0)	0 (0)	1 (0.9)	
Monthly income				0.923
None	0 (0)	2 (1.8)	20 (18.2)	
< RM 2000	0 (0)	1 (0.9)	13 (11.8)	
RM 2000 - RM 4999	1 (0.9)	2 (1.8)	22 (20)	
RM 5000 - RM 7999	1 (0.9)	2 (1.8)	30 (27.3)	
> RM 8000	0 (0)	0 (0)	16 (14.5)	
District of residence				0.284
North Seberang Perai	2 (1.8)	0 (0)	31 (28.2)	
Central Seberang Perai	0 (0)	1 (0.9)	24 (21.8)	
South Seberang Perai	0 (0)	2 (1.8)	16 (14.5)	
Northeast Penang Island	0 (0)	4 (3.6)	18 (16.4)	
Southwest Penang Island	0 (0)	0 (0)	12 (10.9)	
Number of dog owned				0.777
1	0 (0)	3 (2.7)	50 (45.5)	
2	1 (1.9)	3 (2.7)	30 (27.3)	

3	0 (0)	0 (0)	12 (10.9)	
4	0 (0)	0 (0)	1 (0.9)	
> 5	1 (0.9)	1 (0.9)	8 (7.3)	
Management of dog				0.565
Indoor	2 (1.8)	3 (2.7)	41 (37.3)	
Semi-indoor	0 (0)	2 (1.8)	40 (36.4)	
Outdoor	0 (0)	2 (1.8)	20 (18.2)	

* p-value is significant when p <0.05

Table 4.6.3 Association between Sociodemographic Characteristics and Practice of Dog Ectoparasite Prevention among Dog Owners (n=110)

Sociodemographic characteristics	Grade, n (%)			P-value
	Poor	Moderate	Good	
Gender				0.229
Female	1 (0.9)	25 (22.7)	58 (52.7)	
Male	1 (0.9)	10 (9.1)	15 (13.6)	
Age				0.046*
18 - 20	0 (0)	4 (3.6)	2 (1.8)	
21 - 30	0 (0)	15 (13.6)	43 (39.1)	
31 - 40	0 (0)	9 (8.2)	11 (10)	
41 - 50	1 (0.9)	4 (3.6)	9 (8.2)	
51 - 60	1 (0.9)	2 (1.8)	4 (3.6)	
> 60	0 (0)	1 (0.9)	4 (3.6)	
Highest level of education				0.001*
Primary	1 (0.9)	0 (0)	0 (0)	
Secondary	0 (0)	5 (4.5)	1 (0.9)	
Pre-university or diploma	1 (0.9)	6 (5.5)	12 (10.9)	
Bachelor's degree	0 (0)	22 (20)	54 (49)	
Master	0 (0)	1 (0.9)	6 (5.5)	
PhD	0 (0)	1 (0.9)	0 (0)	
Monthly income				0.290
None	0 (0)	7 (6.4)	15 (13.6)	
< RM 2000	1 (0.9)	3 (2.7)	10 (9.1)	
RM 2000 - RM 4999	1 (0.9)	10 (9.1)	14 (12.7)	
RM 5000 - RM 7999	0 (0)	8 (7.3)	25 (22.7)	
> RM 8000	0 (0)	7 (6.4)	9 (8.2)	
District of residence				0.260
North Seberang Perai	0 (0)	9 (8.2)	24 (21.8)	
Central Seberang Perai	0 (0)	10 (9.1)	15 (13.6)	
South Seberang Perai	0 (0)	7 (6.4)	11 (10)	

Northeast Penang Island Southwest Penang Island	2 (1.9) 0 (0)	5 (4.5) 3 (2.7)	14 (12.7) 9 (8.2)	
Number of dog owned 1 2 3 4 > 5	 0 (0) 0 (0) 2 (1.9) 0 (0) 0 (0)	 16 (14.5) 8 (7.3) 5 (4.5) 0 (0) 6 (5.5)	 37 (33.6) 26 (23.6) 5 (4.5) 1 (0.8) 4 (3.6)	0.229
Management of dog Indoor Semi-indoor Outdoor	 1 (0.8) 0 (0) 1 (0.8)	 12 (10.9) 15 (13.6) 8 (7.3)	 33 (30) 27 (24.5) 13 (11.8)	0.136

* p-value is significant when p <0.05

4.7 Correlation between Total Knowledge, Attitude, and Practice Score of Dog Ectoparasite Prevention

Table 4.7 shows the correlation between total knowledge, attitude, and practice score of dog ectoparasite prevention among dog owners in Penang, Malaysia. Based on Spearman's rho correlation test, there was a significant positive fair correlation (r=0.349, p=0.001) between total knowledge and total practice score. Besides, there was a non-significant poor positive correlation (r= 0.158, p=0.099) between total knowledge and total attitude score as well as between total attitude and practice score (r=0.134, p= 0.163).

Table 4.7 Spearman's Rho Correlation between Total Scores of Knowledge, Attitude, and Practice of Dog Ectoparasite Prevention among Dog Owners (n=110)

Spearman's rho correlation	TKS		TAS		TPS	
	r	p-value	r	p-value	r	p-value
TKS	1.000	-	0.158	0.099	0.349	0.001*
TAS	0.158	0.099	1.000	-	0.134	0.163
TPS	0.349	0.001*	0.134	0.163	1.000	-

TKS: Total knowledge score ; TAS: Total attitude score; TPS: Total practice score

* p-value is significant when p <0.05

CHAPTER 5

DISCUSSION

This study was conducted to determine the level of knowledge, attitude, and practice among dog owners in Penang towards dog ectoparasite prevention. From the findings, dog owners in Penang had a good level of knowledge about dog ectoparasite prevention, and most of them are from the age group between 21 to 30 with a bachelor's degree education. This may be attributed to the demographic composition in which a portion of respondents with bachelor's degree education falls within the ages of 21 to 30. Individuals between the ages of 25 to 34 were identified to be the most active Internet users, utilizing platforms such as Facebook, Instagram, and TikTok to access the information (Sinar Daily, 2023), which aligns with the findings from Kogan et al. (2012), who identified that younger age have a higher frequency to use online platforms to search for the pet's prevention information compared to other age groups. This suggests that higher levels of knowledge could be due to their active use of the Internet for information, rather than solely due to their level of education.

Other than that, most of the respondents were aware that ectoparasite prevention can be given as early as in 6 weeks old puppies with 30% of them unaware about the age to begin with ectoparasite prevention. Unfortunately, there is no comparable data available about owner awareness of the ideal age of ectoparasite prevention in dogs. However, a need for further educational efforts is indicative to educate the remaining 30% of the owners regarding dog ectoparasite prevention. Based on a study done by Panchim et al. (2024), the result showed that 80.12% of dog owners follow the ectoparasite prevention recommendations and protocols from veterinarians. This highlights the importance of strengthening educational efforts, especially through veterinarians to educate the owners about the significance and ideal time to start ectoparasite prevention. According to Simonson (2024), most of the ectoparasite prevention is crucial to be given in puppies of 6 to 8 weeks old as the immune system of puppies is still developing at this age, which makes them more susceptible to vector-borne diseases such as Babesiosis, Anaplasmosis, and Ehrlichiosis that can cause severe anemia and jaundice in dogs and are fatal in untreated cases. Additionally, ectoparasites such as *Borrelia burgdorferi* (causative

agent of Lyme disease) and *Rickettsia spp*. pose public health concerns. These ectoparasites can infect humans when a dog brings fleas or ticks indoors (Frazior & Leeke, 2023). Based on the studies done by Tamari et al. (2024), the results revealed that the risk of zoonosis is high for pet owners and supported by the findings that they are more likely to find a tick on themselves (Tamari et al., 2024). Thus, this highlights the importance of starting early ectoparasite prevention, in which the risk of these diseases in dogs can be reduced as well as reducing the risk of zoonotic transmission.

For attitude-wise, most of the dog owners (n=101, 91.82%) in Penang showed a good attitude towards dog ectoparasite prevention. Most of them believed that the use of ectoparasite prevention is crucial for their dog's overall health. This aligns with the findings of Panchim et al. (2024), where 88.2% of the respondents agreed that the use of ectoparasite is important for their dog's overall health. These results indicate that dog owners in Penang understand the potential risks associated with untreated ectoparasite infestations that can transmit serious diseases to their dogs. Apart from that, many respondents agreed that they would apply the ectoparasite preventatives even if their dog lives indoors, which reflects that they understand even indoor dogs are at risk of ectoparasite exposure, either through the environment or other animals. However, these findings contrast with a study done by Boost et al. (2017), which reported that 44% of respondents were not using tick prevention despite acknowledging ticks and tick-borne disease, with the reason for rarely taking their dog out for a walk (48%) and 36% of them believed their dog was not at risk of contracting tick fever (36%). This disparity highlights that despite many owners may agree on the importance of prevention, practical factors will still contribute to lack of preventive measures. Thus, there is still a need for further education to ensure that all dog owners, regardless of their dog's lifestyle, apply ectoparasite prevention to maintain their dog's health.

Another concern is that there is a small number of dog owners in this study who disagree that following the proper application for ectoparasite prevention is important. This study's findings aligned with a study in the United States, which showed that only a quarter of dog owners followed the correct duration of ectoparasite prevention application as recommended by veterinarians (Lavan et al., 2020). Thus, this should be concerning as inconsistent application of ectoparasite preventative can then lead to ineffective protection against ectoparasite and thus increases the risk

of parasitic infestations. Therefore, emphasizing the correct application including frequency and method of administration of ectoparasite prevention is required, to ensure the dogs receive maximum protection against ectoparasite infestations.

For practice-wise, dog owners in Penang had a good practice towards dog ectoparasite prevention, where most of the respondents (n=73, 66.36%) scored between 11 to 15. One of the key findings is that most dog owners in Penang regularly check for the presence of ectoparasite in their dogs, which is an important practice because early detection can help prevent the spreading of parasites and thus reduce the risk of becoming severely affected. This suggests that dog owners are aware of the risks associated with ectoparasites and they take preventative measures to identify potential infestations. Besides, a significant number of respondents will seek advice from their veterinarians regarding the types of ectoparasite preventatives that are suitable for their dogs. This behavior aligns with the findings of most dog owners who seek and follow the veterinarian-recommended guidelines for the use of ectoparasite prevention (Panchim et al., 2024). According to Belshaw et al. (2018), dog owners tend to trust veterinary professionals more than alternative sources of information when it comes to selecting preventative medications. This then highlights the important role of veterinarians in providing reliable advice on ectoparasite prevention. However, there is still a small portion of respondents who rarely (21.8%) or never (2.7%) seek veterinary advice on ectoparasite prevention. This might be because they get information from other sources or they may not fully appreciate the importance of seeking advice from veterinarians based on their dog's specific needs on ectoparasite prevention. Fortunately, most dog owners administer ectoparasite prevention on their dogs even when no ectoparasite is observed. This reflects that the dog owners understand that prevention is important even if there is the absence of visible parasites as every dog is at risk of ectoparasite exposure, either through the environment or other animals. Lastly, a significant number of respondents followed the recommended duration for applying ectoparasite prevention products. This is important as overuse or misuse of ectoparasite prevention such as flea products can lead to adverse health effects on dogs (MetVet, 2023). These findings do not align with a study in the United States, which showed that only a quarter of dog owners followed the correct duration of ectoparasite prevention application as recommended by veterinarians (Lavan et al., 2020). In summary, the practice of dog owners in Penang towards dog ectoparasite prevention generally revealed a good practice, but additional education on the

importance of consulting veterinarians and following a proper duration of ectoparasite prevention application can be done to improve the overall efficacy of dog ectoparasite prevention in Penang.

Other than that, this current study shows that the age and level of education of dog owners influence their knowledge, attitude, and practice of dog ectoparasite prevention. Based on the results, most of the respondents with good knowledge, attitude, and practice in dog ectoparasite prevention have a bachelor's degree education. This is because educated pet owners were more likely to utilize preventive health care services, including parasite control. After all, they could understand the risks and the importance of these measures better. Apart from that, well-educated individuals were more likely to view their pets as family members rather than property (Dotson & Hyatt, 2008), and therefore, more willing to take the necessary steps to protect their pets from potential health threats such as parasites. Besides education, the results also revealed that younger dog owners between 21 to 30 years of age had good knowledge, attitude, and practice in dog ectoparasite prevention. This might be because they are more familiar with technologies including online veterinary platforms and social media to learn about the latest ectoparasite methods. This is supported by the findings from Kogan et al. (2012), who identified an inverse relationship between age and frequency of searching for health and prevention information, where the younger the age, the higher the frequency of using online platforms to search for the prevention information. For other sociodemographic characteristics such as gender, monthly income, district of residence, and management of dogs, they showed no significant associations with the KAP results.

Moreover, there was a significant positive fair correlation (r=0.349, p=0.001) between total knowledge and total practice score based on Spearman's rho correlation test results. This reflects that having more knowledge will lead to a better improvement in the practice of dog ectoparasite prevention. Apart from that, there was a non-significant poor positive correlation (r= 0.158, p=0.099) between total knowledge and total attitude score. This suggests that having more knowledge did not influence owners' attitudes on ectoparasite prevention. Similarly, the correlation between the total attitude and practice score was weak and not significant (r=0.134, p= 0.163), which indicates that a positive attitude towards ectoparasite prevention does not necessarily lead to a better dog's ectoparasite prevention.

CHAPTER 6

CONCLUSION

In conclusion, the findings of this study revealed the majority of dog owners in Penang had a good level of knowledge, attitude, and practice towards dog ectoparasite prevention. Besides, there is a significant association between age (p=0.019) and highest level of education (p=0.001) with knowledge. However, it is important to note that these findings do not reflect the entire population of dog owners in Penang as the study did not reach the target sample size due to time limitations.

For future recommendations, it is important to ensure the target sample size is achieved as this will provide a better reflection of the entire population of dog owners in Penang. A larger and more diverse sample size would provide a better understanding of the KAP towards ectoparasite prevention among dog owners in Penang. Additionally, the questionnaire could be enhanced by expanding the questions in the practice section. This would then enable a more detailed assessment of the level of practice of dog owners on ectoparasite prevention. By improving the questionnaire, future studies could then provide more precise recommendations to promote effective ectoparasite prevention.

Lastly, additional efforts such as educational campaigns such be implemented to raise awareness about the importance of ectoparasite prevention. This can be done via social media, websites, and posters. Besides educational campaigns, veterinarians also play a crucial role in delivering accurate and reliable information to provide expert guidance to dog owners to improve the quality of life and reduce the potentially life-threatening diseases associated with ectoparasites.

APPENDIX- QUESTIONNAIRE FORM

KNOWLEDGE, ATTITUDE AND PRACTICE OF DOG ECTOPARASITES PREVENTION AMONG DOG OWNERS IN PENANG, MALAYSIA.

Dear respondents,

I am Ang Hui Qian, a fourth-year student from the Faculty of Veterinary Medicine, University of Malaysia Kelantan (UMK). I am conducting this survey to study the knowledge, attitude and practice of dog ectoparasite prevention among dog owners in Penang, Malaysia.

This survey is intended for dog owners living in Penang, Malaysia and owning at least one dog. This questionnaire will take about 5 to 10 minutes to complete. All the information collected will be strictly confidential and used solely for research purposes only. Your honest response will be highly appreciated for our research. Thank you!

If you have any questions regarding this questionnaire, please contact:

Ang Hui Qian (d20a0051@siswa.umk.edu.my)

Responden yang dikasihi,

Saya Ang Hui Qian, merupakan pelajar tahun empat dari Fakulti Perubatan Veterinar, Universiti Malaysia Kelantan (UMK). Saya menjalankan tinjauan ini untuk memahami pengetahuan, sikap dan amalan pencegahan ektoparasit anjing dalam kalangan pemilik anjing di Pulau Pinang, Malaysia.

Tinjauan ini ditujukan kepada pemilik anjing yang tinggal di Pulau Pinang, Malaysia dan memiliki sekurang-kurangnya seekor anjing. Soal selidik ini akan mengambil masa kira-kira 5 hingga 10 minit untuk dilengkapkan. Semua maklumat yang dikumpul akan dirahsiakan dan digunakan untuk tujuan penyelidikan sahaja. Respons jujur anda amat dihargai untuk penyelidikan kami. Terima kasih!

Jika anda mempunyai sebarang soalan mengenai soal selidik ini, sila hubungi:

Ang Hui Qian (d20a0051@siswa.umk.edu.my)

尊敬的受访者，

我是洪慧倩，是一名来自马来西亚吉兰丹大学（UMK）兽医系的大四学生。我正在进行这项研究，以了解马来西亚槟城的狗主人对预防狗体外寄生虫的知识、态度与实践。

本次调查对象主要适用于居住在马来西亚槟城并至少拥有一只狗的狗主人。本次调查问卷大约需要 5 至 10 分钟完成。所有收集到的信息将严格保密并仅用于研究目的。我们将非常感谢您实城的回答。谢谢！

如果您对此调查问卷有任何疑问，请联系：

洪慧倩 (d20a0051@siswa.umk.edu.my)

Consent form / Borang Persetujuan / 同意书 *

By continuing with this survey,

1. You understand the purpose of this survey and agree to participate in this survey based on the information provided.

2. You understand that your participation is voluntary and you are able to withdraw at any time without any consequences.
3. You understand all the information collected will be kept confidential and used solely for research purposes only.

Dengan meneruskan tinjauan ini,

1. Anda memahami tujuan tinjauan ini dan bersetuju untuk mengambil bahagian dalam tinjauan ini berdasarkan maklumat yang diberikan.

2. Anda faham bahawa penyertaan anda adalah secara sukarela dan anda boleh menarik diri pada bila-bila masa tanpa sebarang konsekuensi.

3. Anda memahami bahawa semua maklumat yang dikumpul akan dirahsiakan dan digunakan semata-mata untuk tujuan penyelidikan sahaja.

若您决定继续参与这项调查，

1. 您了解本次调查的目的，并根据所提供的信息同意参与本次调查。

2. 您理解您是自愿参与并可以随时退出而不会产生任何后果。

3. 您了解所收集的所有信息将均属保密并仅用于研究目的。

Mark only one oval.

◯ I agree / Saya bersetuju / 我同意

Section A: Dog Owner's Demographics

Bahagian A: Demografi Pemilik Anjing

A 部分：狗的主人的人口统计

1. Gender / Jantina / 性别 *

Mark only one oval.

- ◯ Male / Lelaki / 男性
- ◯ Female / Perempuan / 女性

2. Age / Umur / 年龄 *

Mark only one oval.

- ◯ < 20
- ◯ 21 - 30
- ◯ 31 - 40
- ◯ 41 - 50
- ◯ 51 - 60
- ◯ > 60

3. Highest level of education / Tahap pendidikan tertinggi / 最高学历 *

Mark only one oval.

- ◯ Primary / Sekolah Rendah / 小学
- ◯ Secondary / Sekolah Menengah / 中学
- ◯ Pre-University or Diploma / Pra-Universiti atau Diploma / 大学预科或文凭
- ◯ Bachelor's Degree / Ijazah Sarjana Muda / 学士学位
- ◯ Masters / Sarjana / 硕士
- ◯ PhD / Doktor Falsafah / 博士

4. Monthly income / Pendapatan bulanan / 月收入 *

Mark only one oval.

- ◯ < RM 2000
- ◯ RM 2000 - RM 4999
- ◯ RM 5000 - RM 7999
- ◯ > RM 8000
- ◯ None

5. District of Residence / Daerah Kediaman / 居住地区 *

Mark only one oval.

- ◯ North Seberang Perai / Seberang Perai Utara / 威北县
- ◯ Central Seberang Perai / Seberang Perai Tengah / 威中县
- ◯ South Seberang Perai / Seberang Perai Selatan / 威南县
- ◯ Northeast Penang Island / Daerah Timur Laut / 东北县
- ◯ Southwest Penang Island / Daerah Barat Daya / 西南县

6. Number of dog owned / Bilangan anjing yang dimiliki / 养狗的数量 *

Mark only one oval.

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ ≥ 5

7. Management of dog / Cara peliharaan anjing / 狗的饲养方法 *

Mark only one oval.

- Indoor / Dalaman / 室内
- Outdoor / Luar / 室外
- Semi-indoor / Separuh dalaman / 半室内

8. What ectoparasite preventative did you practice on your dog? / * Apakah pencegahan ektoparasit yang anda amalkan pada anjing anda? / 您对您的狗采取了什么体外寄生虫预防措施?

Mark only one oval.

- Ectoparasite collar / Kolar ektoparasit / 体外驱虫项圈
- Oral tablets / Tablet secara oral / 口服
- Spot-on / Cecair titis / 点滴
- Spray / Semburan / 喷雾
- None / Tiada / 没有

9. What factors influenced your choice of ectoparasite prevention methods for * your dog? /
Apakah faktor yang mempengaruhi pilihan kaedah pencegahan ektoparasit untuk anjing anda? /
哪些因素影响您为您的狗选择体外寄生虫的预防方法呢?

Mark only one oval.

- Convenience / Mudah diguna / 方便使用
- Cost / Harga / 价格
- Effectiveness & Safety / Keberkesanan & Keselamatan / 有效性和安全性
- Duration of protection / Tempoh perlindungan / 保护期限
- Veterinarian recommendation / Cadangan veterinar / 兽医推荐

Section B: Knowledge Towards Dog's Ectoparasite Prevention

Bahagian B: Pengetahuan Terhadap Pencegahan Ektoparasit Anjing
B 部分：关于狗体外寄生虫预防的知识

1. Is ticks an ectoparasite in dogs? / *
Adakah sengkenit merupakan ektoparasit anjing? /
蜱虫是狗的体外寄生虫吗?

Mark only one oval.

- Yes / Ya / 是
- No / Tidak / 否
- I don't know / Tidak tahu / 不知道

2. Is mite an ectoparasite in dogs? / *
Adakah hama merupakan ektoparasit anjing? /
螨虫是狗的体外寄生虫吗?

Mark only one oval.

- Yes / Ya / 是
- No / Tidak / 否
- I don't know / Tidak tahu / 不知道

3. Is flea an ectoparasite in dogs? / *
Adakah pinjal merupakan ektoparasit dalam anjing? /
跳蚤是狗的体外寄生虫吗?

Mark only one oval.

- Yes / Ya / 是
- No / Tidak / 否
- I don't know / Tidak tahu / 不知道

4. Is lice an ectoparasite in dogs? / *
Adakah kutu merupakan ektoparasit anjing? /
虱子是狗的体外寄生虫吗?

Mark only one oval.

- Yes / Ya / 是
- No / Tidak / 否
- I don't know / Tidak tahu / 不知道

5. Is cockroach an ectoparasite in dogs? / *
Adakah lipas merupakan ektoparasit pada anjing? /
蟑螂是狗的体外寄生虫吗?

Mark only one oval.

- Yes / Ya / 是
- No / Tidak / 否
- I don't know / Tidak tahu / 不知道

6. Are there ectoparasite preventatives available for dogs? / *
Adakah terdapat pencegah ektoparasit yang tersedia untuk anjing? /
市场上是否有适用于预防狗体外寄生虫的产品呢?

Mark only one oval.

- Yes / Ya / 是
- No / Tidak / 否
- I don't know / Tidak tahu / 不知道

7. Ectoparasite prevention can start as early as 6 weeks old in puppies. / * Pencegahan ektoparasit boleh bermula seawal berusia 6 minggu pada anjing. / 幼犬可以于6周大时开始使用预防体外寄生虫的产品。

Mark only one oval.

- ◯ Yes / Ya / 是
- ◯ No / Tidak / 否
- ◯ I don't know / Tidak tahu / 不知道

8. Ectoparasite prevention can be applied via various methods including collar, * oral tablets, spot-on and spray. /
Pelbagai kaedah pencegahan ektoparasit boleh dilakukan termasuk kolar, tablet oral, cecair titis dan semburan. /
预防体外寄生虫可通过颈圈、口服、点滴和喷雾等多种方法进行。

Mark only one oval.

- ◯ Yes / Ya / 是
- ◯ No / Tidak / 否
- ◯ I don't know / Tidak tahu / 不知道

9. Different ectoparasite prevention products have different duration of * protection for ectoparasites. /
Produk pencegahan ektoparasit yang berbeza mempunyai tempoh perlindungan yang berbeza untuk ektoparasit. /
不同的体外寄生虫预防产品有不同的体外寄生虫的保护期。

Mark only one oval.

- ◯ Yes / Ya / 是
- ◯ No / Tidak / 否
- ◯ I don't know / Tidak tahu / 不知道

10. Dogs with ectoparasite can transmit several ectoparasitic diseases. / * Anjing dengan ektoparasit boleh menyebarkan beberapa penyakit ektoparasit. /
拥有体外寄生虫的狗可以传播多种体外寄生虫疾病。

Mark only one oval.

- ◯ Yes / Ya / 是
- ◯ No / Tidak / 否
- ◯ I don't know / Tidak tahu / 不知道

Section C: Attitude Towards Dog's Ectoparasite Prevention

Bahagian C: Sikap Terhadap Pencegahan Ektoparasit Anjing
C 部分：对于狗体外寄生虫预防的态度

1. I believe that the use of ectoparasite prevention is important for my dog's overall-health. / Saya percaya bahawa penggunaan pencegahan ektoparasit adalah penting untuk kesihatan keseluruhan anjing saya. / 我相信预防外寄生虫对于我的狗的整体健康很重要。 *

	1	2	3	4	5	
Strongly Disagree / Sangat Tidak Setuju / 非常不同意	○	○	○	○	○	Strongly Agree / Sangat Setuju / 非常同意

2. I believe that applying ectoparasite prevention is an essential responsibility as a dog owner. / Saya percaya bahawa penggunaan pencegahan ektoparasit adalah tanggungjawab penting sebagai seorang pemilik anjing. / 我相信使用预防体外寄生虫措施是作为狗主人的重要责任。 *

	1	2	3	4	5	
Strongly Disagree / Sangat Tidak Setuju / 非常不同意	○	○	○	○	○	Strongly Agree / Sangat Setuju / 非常同意

3. I believe that the use of ectoparasite prevention can prevent the transmission of many vector-borne diseases. / Saya percaya bahawa penggunaan pencegahan ektoparasit dapat mencegah penyebaran pelbagai penyakit yang merebak kepada anjing melalui pelbagai vektor parasit. / 我相信使用体外寄生虫预防措施可以预防许多媒介传播的疾病。 *

	1	2	3	4	5	
Strongly Disagree / Sangat Tidak Setuju / 非常不同意	○	○	○	○	○	Strongly Agree / Sangat Setuju / 非常同意

4. I believe that it is important to follow the proper application of ectoparasite prevention for my dog. / *
Saya percaya bahawa adalah penting untuk mengikuti kaedah aplikasi yang betul bagi pencegahan ektoparasit untuk anjing saya. /
我认为正确使用体外寄生虫预防措施对我的狗来说非常重要。

	1	2	3	4	5	
Strongly Disagree / Sangat Tidak Setuju / 非常不同意	○	○	○	○	○	Strongly Agree / Sangat Setuju / 非常同意

5. I believe that ectoparasite preventatives are important even if the dog is managed indoors. / *
Saya percaya bahawa pencegahan ektoparasit adalah penting walaupun anjing itu dipelihara dalam rumah. /
我相信采取预防体外寄生虫措施至关重要即使是饲养在室内的狗。

	1	2	3	4	5	
Strongly Disagree / Sangat Tidak Setuju / 非常不同意	○	○	○	○	○	Strongly Agree / Sangat Setuju / 非常同意

6. I believe that ectoparasite preventative cannot be replaced by good hygiene and environmental control solely to against common vector-borne diseases. / *
Saya percaya bahawa pencegahan ektoparasit tidak boleh digantikan hanya dengan kebersihan yang baik dan kawalan persekitaran untuk melawan penyakit yang disebarkan oleh vektor yang biasa. /
我认为仅良好的卫生和环境控制不能取代体外寄生虫预防措施来消灭常见的媒介传播疾病。

	1	2	3	4	5	
Strongly Disagree / Sangat Tidak Setuju / 非常不同意	○	○	○	○	○	Strongly Agree / Sangat Setuju / 非常同意

Section D: Practice Towards Dog's Ectoparasite Prevention

Bahagian D: Amalan Ke Arah Pencegahan Ektoparasit Anjing
D 部分：对于狗体外寄生虫预防的实践

1. I always see other dogs in my area when I bring my dog out for a walk. / *
Saya sering melihat anjing-anjing lain di kawasan saya apabila saya membawa anjing saya keluar untuk berjalan-jalan. /
当我带我的狗出门散步时，我总是看到我所在地区有其他的狗。

Mark only one oval.

- ◯ Always / Selalu / 经常
- ◯ Sometimes / Kadang kala / 有时
- ◯ Rarely / Jarang / 很少
- ◯ Never / Tidak pernah / 不曾

2. I regularly check for the presence of ectoparasites in my dogs. / *
Saya kerap memeriksa kehadiran ektoparasit dalam anjing saya. /
我定期检查我的狗是否存在体外寄生虫。

Mark only one oval.

- ◯ Always / Selalu / 经常
- ◯ Sometimes / Kadang kala / 有时
- ◯ Rarely / Jarang / 很少
- ◯ Never / Tidak pernah / 不曾

3. I always enquire with veterinarian on the type of ectoparasite prevention used on my dogs. / *
Saya sentiasa bertanya dengan veterinar tentang jenis pencegahan ektoparasit yang patut digunakan pada anjing saya. /
我总是向兽医询问我的狗适合使用的体外寄生虫预防类型。

Mark only one oval.

- ◯ Always / Selalu / 经常
- ◯ Sometimes / Kadang kala / 有时
- ◯ Rarely / Jarang / 很少
- ◯ Never / Tidak pernah / 不曾

4. I always administer ectoparasite prevention on my dog, even though there is no ectoparasite seen. / *
Saya sentiasa memberikan pencegahan ektoparasit pada anjing saya, walaupun tiada ektoparasit dilihat. /
我总是对我的狗进行体外寄生虫预防，即使没有发现体外寄生虫。

Mark only one oval.

- Always / Selalu / 经常
- Sometimes / Kadang kala / 有时
- Rarely / Jarang / 很少
- Never / Tidak pernah / 不曾

5. Do you follow the proper duration to apply ectoparasite prevention for your dog? / *
Adakah anda mengikut tempoh yang sepatutnya untuk menggunakan pencegahan ektoparasit untuk anjing anda? /
您是否按照规定的时间为您的狗应用体外寄生虫预防措施呢?

Mark only one oval.

- Always / Selalu / 经常
- Sometimes / Kadang kala / 有时
- Rarely / Jarang / 很少
- Never / Tidak pernah / 不曾

Thank you for participating in this study.

Terima kasih kerana mengambil bahagian dalam kajian ini.

感谢您参与这项研究。

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