UNIVERSITI PUTRA MALAYSIA

KNOWLEDGE, PRACTICES, AND RISK PERCEPTION AMONG PET OWNERS TOWARDS FOODBORNE ILLNESS FROM PET FOOD IN SELANGOR, MALAYSIA

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KNOWLEDGE, PRACTICES, AND RISK PERCEPTION AMONG PET OWNERS TOWARDS FOODBORNE ILLNESS FROM PET FOOD IN SELANGOR, MALAYSIA

LIEW CUI SING

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CERTIFICATION

It is hereby certified that we have read this project paper entitled "Knowledge, practices, and risk perception among pet owners towards foodborne illness from pet food in Selangor, Malaysia", by Liew Cui Sing and in our opinion, it is satisfactory in terms of scope, quality, and presentation as partial fulfilment of the requirement for the course of VPD 4999- Final Year Project.

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TABLE OF CONTENT

LIST OF TABLES

LIST OF ABBREVIATIONS

Foodborne disease	FBD
United Kingdom	UK
United States of America	US
Sijil Pelajaran Malaysia	SPM
Sijil Tinggi Persekolahan Malaysia	STPM
Center for Veterinary Medicine	CVM
Centers for Disease Control and Prevention	CDC
Universiti Putra Malaysia	UPM
Genetically modified organism	GMO

ABSTRAK

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

PENGETAHUAN, AMALAN DAN PERSEPSI RISIKO DALAM KALANGAN PEMILIK HAIWAN PELIHARAAN TERHADAP PENYAKIT BAWAAN MAKANAN DARIPADA MAKANAN HAIWAN PELIHARAAN DI SELANGOR, MALAYSIA

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2023

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Makanan haiwan peliharaan telah diiktiraf sebagai media berpotensi untuk bakteria patogen seperti *Salmonella* dan *Escherichia coli* untuk dikongsi dengan manusia, namun maklumat terkini tentang pengetahuan keselamatan makanan dan amalan pengendalian pemilik haiwan peliharaan masih kurang. Memahami pengetahuan, amalan dan tahap persepsi risiko adalah penting untuk mengurangkan risiko pendedahan. Kajian keratan rentas telah dijalankan untuk menilai pengetahuan, amalan dan persepsi risiko terhadap penyakit bawaan makanan daripada makanan haiwan di Selangor, Malaysia. Seramai 156 pemilik anjing dan kucing dari Selangor telah diambil menggunakan persampelan mudah. Soal selidik telah digunakan untuk mengumpul data daripada pemilik haiwan peliharaan mengenai butiran

sosiodemografi, pengurusan haiwan kesayangan terutamanya mengenai pemilihan makanan haiwan kesayangan, dan pengetahuan, amalan, dan persepsi risiko yang berkaitan dengan penyakit bawaan makanan yang berkaitan dengan haiwan peliharaan. Soal selidik yang telah diuji telah diedarkan kepada pemilik haiwan peliharaan sama ada dalam bentuk bercetak atau melalui tinjauan dalam talian. Skor min untuk pengetahuan, amalan dan persepsi risiko didapati masing-masing 52%, 61% dan 63%. Majoriti pemilik haiwan peliharaan (78%) tidak dimaklumkan tentang kejadian isu makanan haiwan kesayangan atau penarikan balik yang dikaitkan dengan patogen bawaan makanan. Hanya 38% daripada pemilik haiwan peliharaan menyedari bahawa penyakit bawaan makanan boleh berjangkit daripada haiwan peliharaan dan makanan haiwan kepada manusia. 34% daripada pemilik haiwan peliharaan tidak mencuci tangan selepas bermain atau memberi makan haiwan peliharaan mereka. Dua pertiga daripada pemilik haiwan peliharaan mengakui kebolehcegahan penyakit bawaan makanan pada manusia. Kebanyakan pemilik menyatakan kebimbangan mengenai manusia dan haiwan peliharaan yang jatuh sakit akibat makanan haiwan peliharaan. Kajian itu mengenal pasti perkaitan antara pengetahuan pemilik haiwan peliharaan dan amalan mereka, tetapi tiada perkaitan ditemui antara amalan dan persepsi risiko atau antara pengetahuan dan persepsi risiko. Bagi ciri sosiodemografi, terdapat perbezaan yang signifikan antara tahap pendidikan dan persepsi risiko. Kesimpulannya, walaupun amalan dan persepsi risiko dalam kalangan pemilik haiwan peliharaan didapati memuaskan, tahap pengetahuan mereka masih kurang. Kajian ini menggambarkan keperluan untuk mengukuhkan usaha yang bertujuan untuk mendidik pemilik haiwan peliharaan tentang penyakit bawaan makanan daripada makanan

haiwan peliharaan dan menggalakkan keselamatan makanan haiwan peliharaan untuk menjaga kesihatan dan kesejahteraan kedua-dua haiwan peliharaan dan pemiliknya.

KEYWORDS: penyakit bawaan makanan, pengetahuan, amalan, persepsi risiko, pemilik haiwan peliharaan, keselamatan makanan haiwan peliharaan

ABSTRACT

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

KNOWLEDGE, PRACTICES, AND RISK PERCEPTION AMONG PET OWNERS TOWARDS FOODBORNE ILLNESS FROM PET FOOD IN SELANGOR, MALAYSIA

By

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2023

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Pet food has been recognised as a potential vehicle for pathogenic bacteria such as *Salmonella* and *Escherichia coli* to be shared with humans, yet recent information on pet owners' food safety knowledge and handling practices is lacking. Understanding the knowledge, practices and risk perception levels is vital to mitigate the exposure risk. A cross-sectional study was conducted to evaluate the knowledge, practices and risk perception towards foodborne illness from pet food in Selangor, Malaysia. A total of 156 dog and cat owners from Selangor were recruited using convenience sampling. A questionnaire was used to collect data from pet owners on sociodemographic details, pet management particularly on pet food selection, and knowledge, practices, and risk perceptions relating to pet-associated foodborne illness. The pre-tested questionnaire was distributed to the pet owners either in printed form or through online surveys. Mean scores for knowledge, practices and risk perception

were found to be 52%, 61% and 63% respectively. The majority of pet owners (78%) were uninformed about occurrences of pet food issues or recalls linked to foodborne pathogens. Only 38% of the pet owners recognised that foodborne illness can be transmitted from pets and pet food to humans. 34% of the pet owners did not wash their hands after playing with or feeding their pets. Two-thirds of the pet owners acknowledged the preventability of foodborne illnesses in humans. Most of the owners expressed concern about humans and pets getting sick from pet food. The study identified an association between pet owners' knowledge and their practices, but no association was found between practices and risk perception or between knowledge and risk perception. For sociodemographic characteristics, there is significant difference between educational level and risk perception. In conclusion, while the practices and risk perception among pet owners were found to be satisfactory, their knowledge levels were lacking. This study illustrated the need to strengthen efforts aimed at educating pet owners about foodborne illnesses from pet food and promoting pet food safety to safeguard the health and well-being of both pets and their owners.

KEYWORDS: foodborne illness, knowledge, practice, risk perception, pet owners, pet food safety

1.0 INTRODUCTION

Increasing number of residents keep pets in their homes, either for social support, physical or mental well-being (Debbra *et al*., 2019). The primary pet food opted for by pet owners includes commercial pet food as it offers a simple method to provide varied nutrition for their dogs or cats while some choose home-prepared and raw food (Witaszak *et al*., 2020). Nonetheless, pet foods which might be harbouring *Salmonella*, *Escherichia coli*, *Listeria monocytogenes* and others can present significant health hazards to humans (Kępińska-Pacelik & Biel, 2021). The connection between dog treats and a salmonellosis outbreak in both Canada and the United States has heightened concerns even more. Foodborne disease (FBD), or illness from pet food can be acquired by humans through direct contact with contaminated pet food or interact closely with pets that have consumed contaminated food. The common agents responsible for foodborne illness include *Salmonella Typhi*, *Staphylococcus aureus*, *Escherichia coli*, and *Clostridium perfringens* (Pires *et al*., 2012). Consequences of foodborne illness in pets include lethargy, diarrhoea, vomiting and fever whereas in humans, encompasses nausea, vomiting, diarrhoea, headache, muscle aches, dizziness, weakness and fever. It also has the potential to result in fatalities and poses a greater risk to vulnerable populations such as the young, elderly, and immunocompromised individuals (Nyachuba, 2010).

Approximately 600 million people experience FBD on a yearly basis worldwide. In Malaysia, the Ministry of Health (MOH) documented an incidence rate of 19.59 per 100,000 population for food and water-borne diseases with 0.31 accounting for typhoid and paratyphoid (Ministry of Health Malaysia, 2022).

However, the report did not provide precise causes linked to the FBD outbreak. The actual number of cases is expected to be higher than the reported cases for individuals who perceive diarrhoea as a transient inconvenience that does not need the attention of medical professionals and a sequence of complex actions must be taken before reporting to the authorities (Soon *et al*., 2011).

Generally, poor handling of contaminated pet food can elevate the likelihood of contracting FBD. However, there is still a wide gap of knowledge among pet owners regarding the presence of microorganisms in Malaysia's dog or cat food (Bilung *et al*., 2018). As this can lead to severe illness in pets and might contribute to foodborne disease in humans, it is critical for pet owners to have knowledge about pet food safety and proper pet food handling to mitigate the exposure risk. Hence, studies can be conducted to evaluate the current status of knowledge, practices and risk perceptions regarding foodborne illness from pet food in Malaysia.

Thus, to determine the level of knowledge, practices and risk perceptions towards foodborne illness from pet food among pet owners in Selangor, Malaysia.

2.0 LITERATURE REVIEW

2.1 Foodborne illness and zoonotic diseases

Zoonotic diseases transmitted through food are a significant public health concern and can result in substantial economic impact. Foodborne illness, or foodborne disease (FBD) is defined as any health condition resulting from the ingestion of food or drinks contaminated with specific infectious or non-infectious agents (Boslaugh & S. E, 2023). Foodborne zoonoses refer to infections and illnesses that can be transmitted from animals to humans through food (Shao *et al*., 2011). FBD can be caused by bacteria, viruses, and parasites, often involving agents such as *Salmonella Typhi*, *Staphylococcus aureus*, *Escherichia coli*, and *Clostridium perfringens* (Pires *et al*., 2012). Every year, an estimated 600 million individuals globally endure FBD, and in Malaysia, an incidence rate of 19.59 cases per 100,000 population for food and water-borne diseases was documented (Ministry of Health Malaysia, 2022).

Pet food such as dry pet food, canned food, treats made from meat or vegetables, home-prepared food, and raw meat can harbour *Salmonella*, *Escherichia coli*, *Listeria monocytogenes* and others, making them a potential source of human diseases (Kępińska-Pacelik & Biel, 2021). Cereals and vegetables are the subsequent main components in dry pet food after animal derivatives. Cereals have the potential to be significant origins of harmful contaminants in pet food, stemming from mycotoxin-producing fungi especially the *Fusarium* (Witaszak *et al*., 2020).

Concern has arisen due to the identification of several human outbreaks and pet food recalls associated with commercial pet food and treats. From 2014 to 2019, a total of 203 cases of human diseases reported in the UK and US have been linked to raw meat-based diets (Centers for Disease Control and Prevention, 2019). These diets included pig ear treats, raw turkey, raw chicken, frozen feeder rodents and tripe. In 2013, a human outbreak of *Salmonella Typhimurium* in the US was associated with pet treats (Cavallo *et al*., 2015). Research conducted by Yukawa *et al*. (2019) showed that dog treats contaminated with *Salmonella* also included the antimicrobial strains. Between 2009 and 2018, there were 173 recalls involving pet food in which 85% of pet treats and all raw pet food were recalled due to contamination with *Salmonella*, *Listeria* and *E. coli*. In 2021, two American dog foods were recalled due to high levels of aflatoxin (Kępińska-Pacelik & Biel, 2021). Recently, a random sample of dry dog food that tested positive for *Salmonella* by the state agency in the US was immediately recalled (Affairs, 2023). In Malaysia, there is no FBD linked with pet food being reported and no routine surveillance of dog treats for *Salmonella* contamination.

The heightened levels of international travel and the expansion of food trade have elevated the potential for rapid worldwide dissemination of these foodborne zoonoses. The impact of pet food contamination includes severe physical consequences for pets and brings about foodborne illness and emotional distress as well as financial burdens for their caregivers (Bischoff & Rumbeiha, 2018). However, no stringent regulations regarding the upper thresholds of bacterial and fungal presence in pet food are made (Kępińska-Pacelik & Biel, 2021). The Commission Regulation (EU) has microbiological limit values for *Salmonella* and

Enterobacteriaceae, but not for other bacteria such as *Clostridium* or *Listeria*. To date, there are no established thresholds for mycotoxins in pet food. Moreover, an increasing number of pet owners are adopting raw meat as it is believed that the raw meat diet is a more natural and species-appropriate choice and will improve their pets' health and well-being (Bulochova & Evans, 2021). In addition to this, antimicrobial resistant-bacteria have been detected in raw meat-based diets, which may be a concern to the health of both pets and their owners (van Bree *et al*., 2018).

2.2 Risk factors for transmission of foodborne illness

According to a survey conducted in Putrajaya, Malaysia, close to half of the households (47%) in the area have pets, serving as a source of companionship and contributing to their physical and mental health (Debbra *et al*., 2019). This close connection extends beyond mere companionship to include the shared environment and close contact (Finley *et al*., 2006). There can be potential food safety hazards related to direct contact with pets and their excrements. Numerous research studies have shown that pets can carry pathogenic bacteria without showing symptoms after consuming contaminated raw pet food, resulting in the contamination of the household surroundings through their paws, fur, and saliva, potentially transmitting these pathogens to pet owners through direct contact (Lambertini, Buchanan, Narrod, Ford, *et al*., 2016). Direct contact with pet food can happen when handling the food during pet feeding; indirect contact is through contact with items that have been in contact with the food, like containers, scoops, or bowls. If hands are not properly cleaned or sanitized, it can serve as a potential pathway for pathogens to be shared with humans.

Pet food can get contaminated during production or in the finished product. In raw diets, the meat remains untreated, without any heating or other processes to reduce the pathogen loads. The US Food and Drug Administration (FDA) has recognized pets diets primarily consisting of raw meat as an emerging concern. tThe research discovered that 64% (N=25) of raw meat diet samples were positive for *E. coli*, while 20% (N=25) were positive for *Salmonella* (Weese *et al*., 2005). While a raw meat diet is assumed to pose the highest risk, a case-control study noted that the risk of diarrhoea in dogs was elevated when provided with home-prepared food (Stavisky *et al*., 2011).

According to Codex Alimentarius, the primary critical control point for managing microbial risk is the extrusion process. American Feed Industry Association (AFIA) suggested that subjecting to moist heat at 22% moisture and a temperature of 77°C should ensure complete elimination of *Salmonella*. However, processed pet food has been found to contain pathogens and microbial-origin toxins whereas finished pet food and treats were found to have a considerably high prevalence of *Salmonella* (Li *et al*., 2012). The product could be contaminated again between the treatment phase and consumption, either within the facility or during household handling. In low-moisture food processing, stressors like dehydration in the process can increase *Salmonella* resistance to high temperatures (Gruzdev *et al*., 2011). Dry pet foods that undergo extrusion under high pressure of 34-37 bars and temperatures of 100 to 200 °C do not effectively address the concern of mycotoxins, as they are heat-resistant and remain a health hazard (Witaszak *et al*., 2020).

Handling pet food and inadequate hygiene practices pose a risk for the spread of foodborne diseases. The pet owner's hands come into contact with the pet food bag or container while dispensing the food for their pet, either by pouring it out or using their bare hands or a scoop. However, the extent of contact between hands and the food to assess potential pathogen exposure from pet food has not been studied (Lambertini, Buchanan, Narrod, & Pradhan, 2016). Wet pet food stored at room temperature is a risk for the proliferation of foodborne pathogens. *Salmonella* and *E. coli* can endure in minimal quantities on dry food for months or even years even in a non-replicating state (Podolak et al., 2010). Any moisture introduction to the finished pet food at room temperature can provide an environment conducive to bacterial

proliferation. Thus, maintaining dry storage is vital. When preparing raw meat or a home-prepared diet, cross-contamination occurs in the kitchen when proper food safety and hygiene protocols are not followed (Waters, 2017). Therefore, proper hand hygiene is crucial when engaging in raw pet feeding (Bulochova & Evans, 2021).

2.3 Recommended strategies to enhance pet food safety

Ensuring that pet food is safe and of high quality is not only crucial for the health and well-being of pets but also for the health of pet owners and their families. Recommended strategies to enhance pet food safety encompass implementing and enforcing strict regulations and standards for pet food production. In Malaysia, pet food is regulated under the Feed Act 2009 and the Feed Regulations 2012 to regulate feed quality by controlling the importation, manufacture, sale and use of feed and feed additives. Under the Feed Act law enacted by the Parliament of Malaysia, pet food should satisfy the nutritional requirements of animals, is not harmful to animals and is not contaminated.

Efforts are being made to educate consumers including the pet owners. However, a brief review of the Food Safety Information website in Malaysia reveals information technology is outdated, lacks user-friendliness, and is not particularly effective as an educational tool (Salleh *et al*., 2017). More efforts such as the Malaysia Foodborne Disease Network (MyFoodNet) aimed to address the requirement for efficient foodborne disease surveillance systems were established then. An incident associated with pet treats contaminated with *Salmonella* resulted in an infection of 150 individuals in the US. Thus, routine surveillance of pet food such as dog treats should be done for *Salmonella* contamination. For example, the Centre for Veterinary Medicine (CVM) in the US has instituted a surveillance initiative, known as the Feed Contaminants Program to focus on patterns of *Salmonella* contamination in animal feeds including pet foods, pet treats, and supplements for pets within the domestic market and at entry points into the US.

A study conducted by Thomas and Feng found that an overwhelming 78 per cent of individuals lacked knowledge about recent recalls or instances of foodborne pathogen outbreaks linked to pet food (Thomas & Feng, 2020). Inadequate food handling and poor hygiene practices can heighten the risk of diseases being passed from animals to humans. Implementing safety measures when dealing with pet food and overseeing pet feeding routines can serve as a tangible defence, lowering the chances of pathogens being transferred or contaminating hands. Implementing safer storage procedures may involve keeping pet food in a dry location that is separate from the kitchen. Implementing safer methods for handling pet food could involve utilizing a designated scooping utensil, which remains separate from dishes and eating utensils and is washed independently.

Additionally, it's important to wash hands after handling pet food and avoid leaving pet food exposed in the bowl for extended periods. CDC guidelines advise against permitting children under the age of five to enter areas where pets are fed, touch pet food, or engage with pets without supervision. Following contact with animals, their food, or items associated with pets (such as bowls, cages, and toys), it is advised to wash your hands. This practice helps minimize the presence of harmful microorganisms on the hands, consequently lowering the risk of unintentional ingestion and the transmission of pathogens to other surfaces. A comprehensive study examining the efficacy of hand washing found that in high-income nations, there was a 39% decrease in the occurrence of diarrhoea among children, while in low-income countries, the reduction was 32% (Ejemot *et al*., 2008).

2.4 Knowledge, practices and risk perceptions towards foodborne illness

The rise in pet ownership is accompanied by increasing concern regarding possible health implications of foodborne illness for pet owners through the handling of pet food. Inadequate personal hygiene practices demonstrated by certain pet owners following interactions with their pets or within pet environments like food, toys, or bedding can result in illness, especially if hands are not properly washed before handling human food. Studies showed that the management of pet food is influenced by various factors, including previous knowledge, information sources, and level of awareness (Laflamme *et al*., 2008). For instance, online sources for credible health information such as CDC stated that providing a separate feeding area for pets, distinct from human food, can minimize the potential for cross-contamination between pet food or pets and human food (CDC, 2017).

The way pet owners choose to feed their pets can be shaped by how they perceive the associated risks (Thomas & Feng, 2020). For example, people who showed a significantly reduced risk perception of getting sick from pets or their food neglected hand hygiene after pet interaction (Thomas & Feng, 2020). Thus, assessing the existing knowledge of food safety and risk perception among pet owners is crucial for effectively educating them on methods to minimize potential hazards.

3.0 METHODOLOGY

3.1 Study design

A cross-sectional, questionnaire-based study was conducted over a period of 3 weeks to assess the knowledge, practices and risk perception among pet owners towards foodborne illness from pet food in Selangor, Malaysia. Sampling of respondents was conducted based on selective criteria: must be either a cat and/or a dog owner, acts as the primary caregivers of the cat and/or dog, aged 18 or above, resides in Selangor and can understand English or Bahasa Malaysia well. Convenience sampling was used in which the respondents were selected based on their availability to voluntarily participate in this study.

3.2 Questionnaire administration and data collection

Data were collected after obtaining consent from the respondents. A convenience sample of 156 respondents were reached by distributing physically at three veterinary premises in Selangor. The purpose of the study and confidentiality of all information provided were made known. Those willing to participate answered the questionnaire either via a printed survey or online Google Forms or they will scan a QR code that will link them to the Google Forms. Respondents were informed to fill out the questionnaire themselves with all the instructions and guidelines well indicated.

3.3 Questionnaire design

The questionnaire was pre-tested by randomly selected 10 students of UPM to test the reliability and validity of the questionnaire before distributing it to the target population. The questionnaire consisted of closed-ended questions, and multiple-

answers questions and chose either one question in both Malay and English languages. The respondents answered a set of questionnaires developed and modified based on previous studies (Thomas & Feng, 2020). There were 5 sections in the questionnaire comprising Section A: sociodemographic and pet ownership, the questions were on the respondents' sociodemographic characteristics such as gender, age, race, highest education level and type of pet ownership, Section B: pet food and pet treat selection questions such as kind of pet food, the place to purchase pet food, Section C: knowledge to assess pet owner's knowledge towards foodborne illness from pet food. Section D: interaction and practices to assess the interaction along with the feeding and pet food handling practices of pet owners, Section E: risk perception to assess pet owner's risk perception towards foodborne illness from pet food. All the questions are listed in appendix section.

3.4 Pilot study

A pre-test of the survey instrument was conducted on 10 participants who fulfilled the criteria. Comprehension of instructions and questions from the survey, time taken to complete the questionnaire and problems raised during the pre-test were assessed and addressed based on the respondent's feedback. The calculated Cronbach alpha value of more than 0.7 was achieved and all the items in the questionnaire were validated, hence the survey was deemed reliable and valid.

Guideline for the total scoring of pet owners' knowledge, practices, and risk perception towards foodborne illness from pet food (Modified from Mohd Yusof *et al*., 2018).

Table 3.1 Blooms's cutoff categories for the total knowledge, practices, and risk perception scores.

	Category	Scores
Knowledge	High level	80%-100%
	Moderate level	60%-79%
	Low level	<60%
Practices	Positive practices	80%-100%
	Neutral practices	60%-79%
	Negative practices	<60%
Risk perception	High level	80%-100%
	Moderate level	60%-79%
	Low level	<60%

The response to the questions were in the form of either "yes-or-no" options, single or multiple-choice answers. For Section C, there were 8 questions. Two points were given for "yes" and correct answer and 0 point for "no", "not sure" and incorrect answer. A maximum score of 16 points can be obtained. There were 14 questions in Section D where 5 of them were assigned 1 point for "no" and 0 point for "yes" and other 5 questions were assigned with 1 point for "yes" and 0 point for "no". Two of them were assigned 2 points for "always", 1 point for "sometimes", and 0 point for "never". Two questions were not counted for point. A maximum of 14 points can be obtained by each respondent for this section.

For Section E, there were a total of 5 questions. Two points were given for "very much", 1 point for "somewhat" and 0 point for "not at all". The maximum score is 10 points. The total points for knowledge, practices and risk perception were calculated.

3.5 Statistical analysis

Data were entered into Microsoft Excel Version 2209 and analysed using IBM SPSS Statistics Version 26. The data were not normally distributed based on the Kolmogorov-Smirnov test (p-value = .000). Descriptive statistics, Mann-Whitney U test, and Kruskal-Wallis test were used to analyse the results. The Spearman Correlation test was used to assess the relationship between the total knowledge, practices, and risk perception towards foodborne illness from pet food. The interpretation of correlation coefficients was as following: 0-0.25 = weak correlation, 0.25-0.5 = fair correlation, 0.5-0.75 = good correlation and >0.75 = excellent correlation (Mohd Yusof *et al*., 2018). A P-value <0.05 was considered statistically significant for the Mann-Whitney U test and Kruskal-Wallis test., whereas a P-value <0.01 was taken as significant for correlation analysis.

4.0 RESULTS

4.1 Sociodemographic background and pet ownership details

A total of 156 pet owners participated in this study. As shown in Table 4.1, most of the respondents were cat owners and only a minority had both cat and dog as pets. In the surveyed population, most of the pet owners were female and many were between 27-42 years old. Half of the respondents had a total household income between RM 3000 and RM 9000. The education level for the majority of the respondents was undergraduate, followed by STPM/Diploma, postgraduate and SPM. Most of the respondents involved were from the Petaling district.

Table 4.1 Descriptive statistics of pet owners' sociodemographic characteristics

Characteristic (N=156)	Frequency (n)	Percentage (%)
Type of pets		
• **Dog**	68	44
• **Cat**	84	54
• **Both**	4	3
Gender		
• **Male**	66	42
• **Female**	90	58
Age		
• **18-26**	56	36
• **27-42**	79	51
• **43-58**	16	10
• **59 and above**	5	3
District		
• **Klang**	28	18
• **Petaling**	40	26
• **Kuala Selangor**	16	10
• **Kuala Langat**	9	6
• **Hulu Selangor**	7	4
• **Hulu Langat**	12	8
• **Gombak**	11	7
• **Sepang**	28	18
• **Sabak Bernam**	5	3

Characteristic (N=156)	Frequency (n)	Percentage (%)
Total household income		
• **Less than RM3000**	42	27
• **3001-9000**	78	50
• **Equal or more than 9000**	36	23
Educational qualification		
• **SPM**	11	7
• **STPM/diploma**	29	18
• **Undergraduate**	105	68
• **Postgraduate**	11	7

Out of the 72 dog owners, most of them were found to keep 1 dog only at home. Among the 88 cat owners, majority of them kept 1 or 2 cats at home. Higher percentage of both cat and dog owners kept their pets inside the house.

Table 4.2 Characteristics of owned pets as reported by respondents in this study

Questions (n=88)	**Frequency (n)**	**Percentage (%)**
Number of cats		
• **1**	33	38
• **2**	26	30
• **3**	11	13
• **More than 3**	18	20
Where do the cat(s) live?		
• **Inside the house**	46	52
• **Outside the house**	10	11
• **Both inside and outside, depending on the cat(s)**	32	36
Questions (n=72)	Frequency (n)	Percentage (%)
Number of dogs		
• **1**	50	69
• **2**	13	18
• **3**	5	7
• **More than 3**	4	6
Where do the dog(s) live?		
• **Inside the house**	40	56
• **Outside the house**	25	35
• **Both inside and outside, depending on the dog(s)**	7	10

4.2 Pet food / treats selection

Based on Table 4.3, almost all (98%, n=153) fed their pets with dry pet food, followed by canned pet food (79%, n=124), and dry (animal part or meat-based) pet treats (67%, n=104). Only a minority of pet owners fed their pets with table scraps (24%, n=38) and raw meat (13%, n=21). A predominant proportion reported purchasing pet food or treats from pet stores (80%, n=125) and their pets took 2 weeks to 1 month to finish one package of pet food (47%, n=73). Majority of the pet owners were affected by pets' preferences (81%, n=127), price (67%, n=104), and vet recommendations (67%, n=104) when choosing a pet food or treats.

Table 4.3 Choice of pet food/treats

Questions	Frequency (n)	Percentage (%)
What kind of pet foods/treats do you feed your pet(s)? (Check all that apply)		
• **Dry pet food**	153	98
• **Dry (vegetable-based) pet treats like biscuits**	58	37
• **Dry (animal part or meat-based) pet treats like hard or soft jerky**	104	67
• **Canned pet food**	124	79
• **Table scraps (Home-prepared food that is intended for human consumption)**	38	24
• **Home-prepared foods that are only for pet's consumption**	82	53
• **Raw meat**	21	13
Where do you get pet food? (Check all that apply)		
• **Pet stores**	125	80
• **Supermarkets**	73	47
• **Online stores, like Shopee, Lazada**	90	58
• **I make them myself**	4	3

Questions	Frequency (n)	Percentage (%)
How long does it take your pet(s) to finish one package of pet food that you often buy?		
• **Less than 2 weeks**	16	10
• **2 weeks to 1 month**	73	47
• **1 to 3 months**	56	36
• **3 to 6 months**	9	6
• **6 months to a year**	2	1
• **More than a year**	0	0
When choosing a pet food/treat, what are the labels and/or information affecting your choice? (Check all that apply)		
• **Price**	104	67
• **My pet(s) like it**	127	81
• **It is Organic**	61	39
• **It is non-GMO**	35	22
• **It is Natural**	70	45
• **It is Raw**	19	12
• **Vet recommendations**	104	67
• **Pet employee recommendations**	54	35
• **Other pet owners' recommendations**	58	37
• **Use-by-date**	74	47

Among the 21 pet owners who incorporated raw meat into their pets' diets, more than half (57%, n=12) reported they first learnt about it from book, magazine, or other printed sources. Majority of these owners (52%, n=11) fed raw meat due to concern about safety / quality control / nutritional value of commercial foods.

Table 4.4 Questions about raw-meat diet

Questions (n=21)	Frequency (n)	Percentage (%)
Where did you first learn about feeding raw meat or raw animal parts for pets? (Check all that apply)		
• **Social media like Facebook and Twitter**	10	48
• **Bloggers**	1	5
• **YouTube influencers**	5	24
• **Pet store employee**	3	14
• **Family or friends**	9	43
• **Veterinarian**	4	19
• **Book, magazine, or other printed sources**	12	57
• **Breeder instructions or advice**	1	5
• **None of the above**	5	24
Why do you feed pet raw meat or raw animal parts? (Check all that apply)		
• **Concern about safety/quality control/nutritional value of commercial foods.**	11	52
• **I try not to eat processed foods and do not want my pet to eat them either.**	4	19
• **To prevent food allergies.**	1	5
• **To improve my pet's immune system.**	3	14
• **Feeding a raw animal product diet is more natural.**	9	43

4.3 Knowledge, practices, and risk perception towards foodborne illness from pet food

The mean score and standard deviation for knowledge, practices and risk perception level were 52% (SD=22), 61% (SD=21), and 63% (SD=21) respectively. Table showed the results of the pet owners towards knowledge, practices, and risk perception.

4.3.1 Knowledge towards foodborne illness from pet food

58% of pet owners had low level of knowledge towards foodborne illness from pet food. Based on Table 4.4, 38% (n=59) of the respondents recognised that foodborne illness can be transmitted from pets and pet food to human. A large portion of them 65% (n=101) acknowledged that foodborne illness in human is preventable. The majority of pet owners 78% (n=121) were uninformed about the occurrence of any pet food or treat issues or recalls linked to foodborne pathogens.

Majority of the pet owners 87% (n=136) indicated that raw meat can pose microbial food safety risk. For raw vegetables and raw fruit respectively, only 38% (n=59) and 37% (n=58) of them believed that they could harbour foodborne pathogens. For raw milk, more than half 58% (n=90) of them mentioned that it posed microbial risk.

When the pet food or treat they bought was in a recall or outbreak related to microbial contamination, a large portion of respondents 69% (n=107) would throw them away and sanitise all contacting surfaces, 28% (n=43) were not sure what to do and 4% (n=6) would continue to use the recalled product. In addition, the majority of them 59% (n=92) will never buy any related products from the brand anymore after the recall or outbreak is over, followed by 18% (n=28) who will buy the same product from a different brand for a few months before they go back to the recalled brand, 17% (n=27) of respondents will never buy the same product from the brand anymore, but they will buy different products from the brand.

Furthermore, government agencies 72% (n=112) and veterinarians 73% (n=114) are the sources which respondents believed concerning microbial food safety information delivery about pet food.

Table 4.5 Pet owners' knowledge towards foodborne illness from pet food

Questions	Frequency (n)	Percentage (%)
Do you think pets and pet food can be a source of foodborne illness to human?		
• **Yes**	59	38
• **No**	51	33
• **Not sure**	46	29
Do you think foodborne illness in human can be prevented?		
• **Yes**	101	65
• **No**	37	24
• **Not sure**	18	12
Have you heard of any pet food/treat that was involved in foodborne outbreaks or recalls, due to microbial contamination, like *Salmonella* and *E. coli*?		
• **Yes**	35	22
• **No**	58	37
• **Not sure**	63	40
Do you think raw meat can pose microbial food safety risk, like *Salmonella* and *E. coli*?		
• **Yes**	136	87
• **No**	12	8
• **Not sure**	8	5
Do you think raw vegetables can pose microbial food safety risk, like *Salmonella* and *E. coli*?		
• **Yes**	59	38
• **No**	61	39
• **Not sure**	36	23
Do you think raw fruits can pose microbial food safety risk, like *Salmonella* and *E. coli*?		
• **Yes**	58	37
• **No**	55	35
• **Not sure**	43	28

Questions	Frequency (n)	Percentage (%)
Do you think raw milk can pose microbial food safety risk, like *Salmonella* and *E. coli*?		
• **Yes**	90	58
• **No**	39	25
• **Not sure**	27	17
If the pet food/treat you bought is in a recall/outbreak related to microbial contamination, what should you do?		
• **I throw them away and sanitize all contacting surfaces.**	107	69
• **Continue to use the recalled product.**	6	4
• **Not sure**	43	28
If the pet food/treat you bought is in a recall/outbreak related to microbial contamination, what will you do after the recall/outbreak is over?		
• **I will buy the same product from this brand immediately after the recall is over.**	5	3
• **I will buy the same product from a different brand for a few months before I go back to the recalled brand.**	28	18
• **I will never buy the same product from this brand anymore, but I will buy different products from this brand.**	27	17
• **I will never buy any related products from this brand anymore.**	92	59
• **None of above.**	4	3

Questions	Frequency (n)	Percentage (%)
With respect to microbial food safety information about pet food/treat, who, do you think, is responsible to communicate the food safety risk to you? (Check all that apply)		
• **Government agencies**	112	72
• **Veterinarian**	114	73
• **Pet store employees**	96	62
• **The stores that I buy pet foods/treats from**	92	59
• **The pet food/treat companies**	108	69
• **Health professionals (doctors, nurse, physician assistant, nutritionists, dietitians)**	85	54
• **University extension**	39	25
• **No one's responsibility**	2	1
• **Myself**	56	36

4.3.2 Practices towards foodborne illness from pet food

All the pet owners interacted with their pets, with most of them petting their pets 94% (n=147), cuddling with their pets 84% (n=131) and allowing their pets to lick them 69% (n=107). A considerable 54% (n=85) expressed their affection by kissing their pets and 33% (n=51) shared their sleeping space with their pets. A small proportion, 15% (n=23), let their pets lick the dishes before dish-cleaning. A third 33% (n=52), allowed their pets on the kitchen countertop and 38% (n=60) permitted their pets in the kitchen or dining room during mealtime. A majority of 60% (n=94) fed their pets directly from their palms. Interestingly, 8% (n=12) of the owners admitted to consuming their pet's food or treats.

Moreover, a significant 66% (n=103) consistently washed their hands with soap after playing with their pets and 67% (n=104) ensured hand hygiene after feeding

their pets. A substantial 68% (n=106) reported promptly disposing of pet food spills and wiping the spill area. For pet food storage, only 13% (n=21) stored them separately from human foods. Besides, about half of the respondents 53% (n=83) used extra containers to prevent runoff when storing pet food leftovers.

All the pet owners bought utensils or toys for their pets, with most of them having feeding bowls 80% (n=125), followed by containers that used to store pet food 72% (n=112), scoops used for pet food 69% (n=108) and chewing toys 39% (n=61). 46% (n=71) "sometimes" washed them with soap, while another 46% (n=71) "always" washed these items with soap. 37% (n=57) "sometimes" sanitized, while 35% (n=54) "always" sanitized these items after washing.

Table 4.6 Pet owners' practices towards foodborne illness from pet food

Questions	Frequency (n)	Percentage (%)
Interactions and Practices		
• **Kiss pets**	85	54
• **pets lick them**	107	69
• **cuddle with pets**	131	84
• **pet their pets**	147	94
• **sleep with pets**	51	33
My pet(s) clean my dishes by licking before the dishes go into the dishwasher.		
• **Yes**	23	15
• **No**	133	85
My pet(s) get on the kitchen countertop.		
• **Yes**	52	33
• **No**	104	67
My pet(s) can access the kitchen or dining room while I eat or cook.		
• **Yes**	60	38
• **No**	96	62
I feed my pet(s) food from my palm.		
• **Yes**	94	60
• **No**	62	40

Questions	Frequency (n)	Percentage (%)
I eat my pet's food/treats.		
• **Yes**	12	8
• **No**	144	92
Wash hands with soap after play with my pet(s).		
• **Yes**	103	66
• **No**	53	34
Wash hands with soap after feeding my pet(s).		
• **Yes**	104	67
• **No**	52	33
When there is a pet foods spill, do you throw them away and wipe the spill area?		
• **Yes**	106	68
• **No**	50	32
Do you store the leftovers separately from human foods (in different refrigerator or freezer)?		
• **Yes**	21	13
• **No**	135	87
When you store the pet food leftovers in the refrigerator or freezer, do you provide with extra containers or bags to prevent juice runoff?		
• **Yes**	83	53
• **No**	73	47
As pet owners, you may buy utensils or toys for your pet(s). What are the utensils or toys that you have for them? (Check all that apply)		
• **Scoops that I use for pet foods/treats**	108	69
• **Containers that I use to store pet foods/treats**	112	72
• **Feeding bowls**	125	80
• **Chewing toys**	61	39
I wash them with soap		
• **Never**	14	9
• **Sometimes**	71	46
• **Always**	71	46
I sanitize them after wash		
• **Never**	47	30
• **Sometimes**	57	37
• **Always**	54	35

4.3.3 Risk perception towards foodborne illness from pet food

In terms of perceived risks, a significant 54% (n=85) of respondents expressed a "somewhat" concern about the risk of their pets transmitting foodborne pathogens to them, while 28% (n=44) reported a "very much" concern. Similarly, 54% (n=84) expressed a "somewhat" concern about the risk of getting sick from pet foods or treats, while 17% (n=27) reported a "very much" concern. Concerns about the risk of pets getting sick from pet foods or treats were evenly distributed, with 54% (n=84) expressing a "somewhat" concern and 24% (n=37) expressing a "very much" concern.

Regarding a hypothetical scenario involving a specific pet treat brand, a significant majority (73%, n=114) expressed a "very much" concern about 100 people getting sick from bacteria tied to the ABC brand dry pet treats. Similarly, 76% (n=118) expressed a "very much" concern about 100 pets getting sick from the same brand, indicating a heightened sensitivity and vigilance among pet owners regarding potential health risks associated with specific pet food products.

Table 4.7 Pet owners' risk perception towards foodborne illness from pet food

Questions	Frequency (n)	Percentage (%)
"The risk of my pet(s) transmitting foodborne pathogens to me is…"		
• **Not at all**	27	17
• **Somewhat**	85	54
• **Very much**	44	28
"The risk to me getting sick from pet foods/treats is…"		
• **Not at all**	49	31
• **Somewhat**	84	54
• **Very much**	27	17

Questions	Frequency (n)	Percentage (%)
"The risk of my pet getting sick from pet foods/treats is…"		
• **Not at all**	39	25
• **Somewhat**	84	54
• **Very much**	37	24
"100 PEOPLE got sick from bacteria tied to ABC brand dry pet treats."		
• **Not at all**	7	4
• **Somewhat**	41	26
• **Very much**	114	73
"100 PETS got sick from bacteria tied to ABC brand dry pet treats."		
• **Not at all**	6	4
• **Somewhat**	34	22
• **Very much**	118	76

4.4 Pet food choice between cat and dog owners

Based on Table 4.8, there was a statistically significant difference in choice of dry vegetable-based pet treats and table scraps between cat and dog owners. Dog owners were significantly more inclined to feed their pets with dry vegetable-based pet treats and table scraps compared to cat owners.

Table 4.8 Choice of pet food based on type of pet

Variable	Gender	N	Mean Rank	Sum of Ranks	U	p
Dry (vegetable-based) pet treats like biscuits	Cat	84	73.33	6160.00	2100.0	.001*
	Dog	68	80.41	5468.00		
Dry (animal part or meat-based) pet treats like hard or soft jerky	Cat	84	77.48	6508.00	2456.0	.071
	Dog	68	75.29	5120.00		

Variable	Gender	N	Mean Rank	Sum of Ranks	U	p
Canned pet food	Cat	84	74.81	6284.00	2268.0	.062
	Dog	68	78.59	5344.00		
Table scraps (Home-prepared food)	Cat	84	68.18	6992.00	2290.0	.005*
	Dog	68	83.24	4636.00		
Home-prepared foods that are only for pet's consumption	Cat	84	82.02	6890.00	2392.0	.057
	Dog	68	69.68	4738.00		
Raw meat	Cat	84	76.95	6464.00	2818.0	.806
	Dog	68	75.94	5164.00		

Note. * indicates p <.05

4.5 Associations between demographic variables and knowledge, practices and risk perception levels

Table 4.9 showed the associations between educational qualification and knowledge, practices and risk perception accordingly. The association was observed as significant with $p=0.032$ ($p<0.05$) between educational qualification and risk perception level. In this study, there were no association found between other demographic variables with knowledge, practices and risk perception levels.

Table 4.9 Educational level vs Knowledge / Practice / Risk Perception (Kruskal-Wallis Test)

Variable	Educational qualification	*N*	Mean Rank	df	χ^2	*p*
Practice	SPM or lower	11	87.82	3	5.121	.163
	STPM/diploma	29	63.55			
	Undergraduate	105	80.04			
	Postgraduate	11	93.86			
Knowledge	SPM or lower	11	77.36	3	3.020	.389
	STPM/diploma	29	65.79			
	Undergraduate	105	82.00			
	Postgraduate	11	79.68			
Risk Perception	SPM or lower	11	62.27	3	8.799	.032*
	STPM/diploma	29	65.55			
	Undergraduate	105	85.80			
	Postgraduate	11	59.14			

Note. * indicates p <.05

4.6 Associations between knowledge, practices and risk perception levels

Knowledge, practices and risk perception were tested for association with the Spearman correlation test. The positive correlation was observed at significant level ($p<0.05$) between knowledge and practices.

Table 4.10 Knowledge vs Practice vs Risk Perception (Spearman Correlation)

		Practice	Knowledge	Risk Perception
Knowledge	Correlation Coefficient	1.000	.330**	.066
	Sig. (2-tailed)	-	.000	.417
	N	156	156	156
Practices	Correlation Coefficient	.330**	1.000	.058
	Sig. (2-tailed)	.000	-	.474
	N	156	156	156
Risk Perception	Correlation Coefficient	.058	.066	1.000
	Sig. (2-tailed)	.474	.417	-
	N	156	156	156

****. Correlation is significant at the 0.01 level (2-tailed).**

5.0 DISCUSSION

This study showed that the majority of participants provided their animals with dry pet food, with canned pet food and dry pet treats being the next most common choices. In low-moisture food processing, stressors like dehydration in the process can increase *Salmonella* resistance to high temperatures (Gruzdev *et al*., 2011). In the drying process of dry pet food, microorganisms can survive the drying process and potentially serve as carriers for pathogens like *Salmonella* and *E. coli* which require only a minimal cell to cause disease (Beuchat *et al*., 2013). Only a minority of pet owners fed their pets with raw meat. Research conducted by Weese *et al* (2005) discovered that 64% of raw meat diet samples obtained positive for *E. coli*, while 20% were positive for *Salmonella*. This study revealed that dog owners were more inclined to feed their pets with dry vegetable-based treats and table scraps compared to cat owners. This is inconsistent with the previous study (Thomas & Feng, 2020). According to Linder & Mueller (2014), giving treats such as biscuits is seen as a fundamental element of the bond between a dog and its owner. Besides, in relation to less likely table scrap feeding in cat owners, a study suggested that cats may have faced less pressure to adapt to human food scraps compared to dogs (Knight & Leitsberger, 2016).

Knowledge of food handling is crucial as it shapes appropriate food-handling practices, and there is a notable positive correlation between knowledge and practices in this context (Wang *et al*., 2021). Although a total of 154 cases of human salmonellosis outbreak in the US were linked to dry animal-based pet treats in October 2019. However, only 38% of the respondents recognised that foodborne illness can be

transmitted from pets and pet food to humans. CDC (2017) stated that keeping pet food distant from human food and areas where food is prepared can minimize the risk of cross-contamination. A large portion of respondents in this study acknowledged that foodborne illness in human is preventable. The present study also revealed that the majority of the pet owners were uninformed about the occurrence of any pet food or treat issues or recalls linked to foodborne pathogens.

Most of the pet owners knew that raw meat could pose microbial food safety. This is consistent with a study by Carbas *et al*. (2013) in which the majority of consumers were aware of the risk associated with raw or undercooked meat. Another study pointed out that a potential risk of toxoplasmosis when feeding a cat with a raw meat-based diet, as it may harbour *Toxoplasma gondii* (Cornell University, 2018).

For the practice level, it was determined that all respondents in the present study interacted with their pets. Animals are integrated into human life through intense interactions that result in enhancements to the human-animal biopsychosocial system (Aragunde-Kohl *et al*., 2020). Most of them pet their pets, cuddle with their pets and allow their pets to lick them. The intimate contact may expose pet owners to potential health hazards. Cases of human illness associated with pet food have been reported and these illnesses can be spread through direct contact with pets that have been exposed to contaminated pet food (Adley *et al*., 2011). A number of them also fed their pets directly from their palms. The health risks for pet owners who contact with a pet's saliva are linked to the uncertainty and the potential presence of high pathogens levels (Lambertini, Buchanan, Narrod, & Pradhan, 2016).

Proper hand washing following the handling of pet food can mitigate the potential risk of *Salmonella* exposure (Lambertini, Buchanan, Narrod, & Pradhan, 2016). In the present study, more than half of the pet owners consistently washed their hands with soap after playing with their pets and feeding their pets. This is inconsistent with the previous study where only 31% washed their hands after playing with their pets and 58% washed their hands after feeding their pets (Thomas & Feng, 2020). A small portion of pet owners permitted their pets in the kitchen or dining room during mealtime. Pets' access to the kitchen causes cross-contamination between human and pet food, especially when the pet owners do not wash their hands after handling pet food or before handling human food. Keeping pet food distant from human food and areas where food is prepared can minimize the risk of cross-contamination. However, in this study, only a minority of pet owners stored pet food separately from human food. More than half of them stored leftovers in the refrigerator with extra containers which is in accordance with another study regarding foodborne illness in humans (Wang *et al*., 2021).

Regarding pet owners' risk perception level towards foodborne illness from pet food, a predominant part perceived risk of their pets getting sick from pet food is higher than humans. This is in line with findings from Thomas and Feng (2020) where owners of pets presume that those who fell ill consumed pet food and hold the belief that they won't become ill as they do not consume pet food. A food safety education programme can heighten an individual's risk perception level (Barrett & Feng, 2021). This study indicated that pet owners tend to place greater trust in government agencies and veterinarians as reliable sources for the dissemination of information concerning

microbial food safety in pet food. Hence, collaborative efforts such as educational campaigns and community outreach programs with government agencies and veterinarians should be implemented.

The current study represents the initial efforts to report on the knowledge, practices and risk perception towards foodborne illness from pet food among pet owners in Selangor, Malaysia. Overall, the results showed an average score of 52%, 61%, and 63% for knowledge, practices and risk perception respectively. This indicates that the pet owners in Selangor had low levels of knowledge, neutral practices and moderate risk perception levels. Other studies reported low levels of knowledge on foodborne illness (Wang *et al*., 2021). In contrast, other studies revealed good knowledge towards food safety among food handlers (Wan Nawawi *et al*., 2022; Mohd Yusof *et al*., 2018). However, it must be noted that the current study focused on foodborne illness from pet food and the studies mentioned above targeted foodborne illness in general.

For the association between demographic variables with knowledge, practices and risk perception levels, other studies found that gender and income significantly influence knowledge and practices on food safety (Gong *et al*., 2016; Moreb *et al*., 2017). In this study, only the educational level had a significant difference between educational level and risk perception level. A study on KAP levels related to food safety revealed that the educational level of respondents is statistically significant influence on the risk perception of respondents about food safety (Wang *et al*., 2021). Besides, a fair correlation was found between knowledge and practices towards foodborne illness from pet food. A previous study revealed a positive correlation

between knowledge and practices among food handlers towards foodborne illness (Mohd Yusof *et al*., 2018). This is in accordance with researchers who claimed that a good understanding should serve as a catalyst for adopting proper practices in the handling of food (Byrd-Bredbenner *et al*., 2013). In the present study, no correlation is found between knowledge and risk perception or practices and risk perception. According to Parra *et al*. (2014), individuals with a heightened awareness of food safety risks demonstrated superior food-handling practices. Young *et al* (2017) also stated that risk perception in food handling consistently demonstrates strong predictive capabilities for food-handling practices. The findings might be due to the limited number of pet owners in this study which influence the data analysis.

6.0 CONCLUSION

In general, pet owners in Selangor showed low knowledge, acceptable practices and moderate risk perception towards foodborne illness from pet food. There is an association between pet owners' knowledge and their practices, but no association was found between knowledge and risk perception or between practices and risk perception. The sociodemographic factors such as educational level influence the pet owners' risk perception. Therefore, both the veterinary and medical counterparts should strengthen efforts to educate pet owners in Selangor by promoting awareness of pet food safety via food safety programs focusing on safe pet food handling and developing effective communication strategies on pet food outbreak and recall.

7.0 RECOMMENDATIONS

In future studies, it is recommended to increase the sample size to 485 respondents and above to avoid uncertainty and for a more statistically robust analysis. Besides, incorporating other pet types beyond cats and dogs as people in Malaysia own a diversified range of pets. This will provide a more comprehensive insight into knowledge, practices and risk perception associated with different types of pets. Lastly, it is recommended to widen the study area to include the whole of Malaysia to understand the influence of geographical and cultural variations on knowledge, practices and risk perception towards foodborne illness from pet food.

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APPENDICES

Questionnaire

Knowledge, practices, and risk perception among pet owners towards foodborne illness from pet food in Selangor, Malaysia

Pengetahuan, amalan dan persepsi risiko dalam kalangan pemilik haiwan peliharaan terhadap penyakit bawaan makanan daripada makanan haiwan peliharaan di Selangor, Malaysia.

This 10–15-minute survey is part of the Final Year Project to evaluate Knowledge, practices, and risk perception among pet owners towards foodborne illness from pet food in Selangor, Malaysia. The results of the survey will be reported only in the form of a summary and your individual responses will be kept confidential. Thank you in advance for filling in this form.
Soal selidik ini adalah sebahagian daripada Projek Akhir Tahun mengenai pengetahuan, amalan, dan persepsi risiko anda terhadap penyakit bawaan makanan daripada makanan haiwan kesayangan. Ia akan mengambil masa lebih kurang 10-15 minit. Keputusan soal selidik ini hanya akan dilaporkan dalam bentuk ringkasan dan maklum balas individu anda akan dikekal sulit. Terima kasih terlebih dahulu kerana menjawab soal selidik ini.

Study Screening Questions / Soalan Saringan Kajian:

1. Do you have a pet dog or cat living with you?
   Adakah anda mempunyai anjing atau kucing peliharaan yang tinggal bersama anda?
   - Yes / Ya
   - No / Tidak
2. Are you the primary caregiver of the pet(s) that live with you?
   Adakah anda penjaga utama haiwan peliharaan yang tinggal bersama anda?
   - Yes / Ya
   - No / Tidak

Section A: Socio-Demographic and Pet Ownership Details / Socio-Demografi Dan Butiran Pemilikan Haiwan Peliharaan

1. What kind of pet(s) that live with you currently?
   Apakah jenis haiwan peliharaan yang tinggal bersama anda pada masa ini?
   - Dog / Anjing
   - Cat / Kucing
   - Both / Kedua-duanya

2. What is your gender?
   Apakah jantina anda?
   - Male / Lelaki
   - Female / Perempuan
3. What is your age?
   Berapakah umur anda?
   - 18-26
   - 27-42
   - 43-58
   - 59 and above / 59 dan ke atas
4. District:
   Daerah:
   _____
5. Could you estimate your total household's income (previous year) before taxes?
   Bolehkah anda memberi kami tekaan jumlah pendapatan isi rumah anda (tahun sebelumnya) sebelum cukai?
   - Less than RM3,000 / Kurang daripada RM3,000
   - RM3,001-RM9,000
   - ≥ RM9,001
6. What is your highest level of education?
   Apakah tahap pendidikan tertinggi anda?
   - SPM
   - STPM/Diploma
   - Undergraduate / Sarjana Muda
   - Postgraduate / Pascasiswazah
   - Other / Lain-lain: _____

Cats Questions

7. How many cats do you have now?
   Berapa ekor kucing yang anda ada sekarang?
   - 1
   - 2
   - 3
   - More than 3 / Lebih daripada 3
8. Where do the cat(s) live?
   Di manakah kucing tinggal?
   - Inside the house. / Di dalam rumah.
   - Outside the house. / Di luar rumah.
   - Both inside and outside, depending on the cat(s). / Di dalam dan di luar, bergantung pada kucing.
   - None of above / Tiada satu pun di atas.

Dog Questions

9. How many dogs do you have now?
   Berapa ekor anjing yang anda ada sekarang?
   - 1
   - 2
   - 3
   - More than 3 / Lebih daripada 3
10. Where do the dog(s) live?
    Di manakah anjing tinggal?
    - Inside the house. / Di dalam rumah.
    - Outside the house. / Di luar rumah.
    - Both inside and outside, depending on the dog(s). / Di dalam dan di luar, bergantung pada anjing.
    - None of above / Tiada satu pun di atas.

Section B: Pet Food and Pet Treat Selection / Makanan Haiwan Kesayangan:

1. What kind of pet foods/treats do you feed your pet(s)?
   Apakah jenis makanan/snek haiwan kesayangan yang anda berikan kepada haiwan kesayangan anda?
   - Dry pet foods / Makanan haiwan peliharaan kering
   - Dry (vegetable-based) pet treats, like biscuits / Hidangan haiwan peliharaan kering (berasaskan sayur-sayuran), seperti biskut
   - Dry (animal parts or meat-based) pet treats, like hard or soft jerky / Hidangan haiwan peliharaan kering (bahagian haiwan atau berasaskan daging), seperti dendeng keras atau lembut
   - Canned pet foods / Makanan haiwan peliharaan dalam tin
   - Table scrap (Home-prepared foods that are intended for human) / Makanan yang disediakan di rumah untuk dimakan manusia
   - Home-prepared foods that are only for pet's consumption / Makanan yang disediakan di rumah yang hanya untuk dimakan haiwan peliharaan
   - Raw pet foods (including raw meat and/or raw animal parts) / Makanan haiwan peliharaan mentah (termasuk daging mentah dan/atau bahagian haiwan mentah)
2. Where do you get pet food? (Check all that apply)
   Di manakah anda mendapatkan makanan haiwan peliharaan? (Semak semua yang berkenaan)
   - Pet stores / Kedai haiwan peliharaan
   - Supermarkets / Pasaraya
   - Online, like Shopee, Lazada / Dalam talian, seperti Shopee, Lazada
   - I make them myself. / Saya membuatnya sendiri.
   - None of above / Tiada satu pun di atas

3. How long does it take your pet(s) to finish one package of pet food that you often buy?
   Berapa lamakah masa haiwan peliharaan anda untuk menghabiskan satu bungkusan makanan haiwan peliharaan yang sering anda beli?
   - Less than 2 weeks / Kurang daripada 2 minggu
   - 2 weeks to 1 month / 2 minggu hingga 1 bulan
   - 1 to 3 months / 1 hingga 3 bulan
   - 3 to 6 months / 3 hingga 6 bulan
   - 6 months to a year / 6 bulan hingga setahun
   - More than a year / Lebih daripada setahun

4. When choosing a pet food/treat, what are the labels and/or information affecting your choice? (Check all that apply)
   Apabila memilih makanan/snek haiwan kesayangan, apakah label dan/atau maklumat yang mempengaruhi pilihan anda? (Semak semua yang berkenaan)
   - Price / Harga
   - My pet(s) like it / Haiwan peliharaan saya menyukainya
   - It is Organic / Ia adalah Organik
   - It is Non-GMO / Ia bukan GMO
   - It is Natural / Ia Semulajadi
   - It is Raw / Ia Mentah
   - Vet recommendations / Cadangan doktor haiwan
   - Pet employee recommendations / Cadangan pekerja haiwan peliharaan
   - Other pet owners' recommendations / Cadangan pemilik haiwan peliharaan lain
   - Use-by-date / Penggunaan mengikut tarikh

Raw Pet Foods Questions / Soalan Makanan Haiwan Mentah:

5. Where did you first learn about feeding raw meat or raw animal parts for pets? (Check all that apply)
   Di manakah anda mula-mula belajar tentang memberi makan daging mentah atau bahagian haiwan mentah untuk haiwan peliharaan? (Semak semua yang berkenaan)
   - Social media, like Facebook and Twitter / Media sosial, seperti Facebook dan Twitter
   - Bloggers / Blogger
   - YouTube Influencers / Pengaruh YouTube
   - Pet store employees / Pekerja kedai haiwan peliharaan
   - Family or friends / Keluarga atau rakan
   - Veterinarian / Doktor haiwan
   - Book, magazine, or other printed sources / Buku, majalah, atau sumber bercetak lain
   - Breeder instructions or advice / Arahan atau nasihat penternak
   - None of above / Tiada satu pun di atas

6. Why do you feed pet raw meat or raw animal parts? (Check all that apply)
   Mengapakah anda memberi makan daging mentah haiwan kesayangan atau bahagian haiwan mentah? (Semak semua yang berkenaan)
   - Concern about safety/quality control/nutritional value of commercial foods. / Kebimbangan tentang keselamatan/kawalan kualiti/nilai pemakanan makanan komersial.
   - I try not to eat processed foods and do not want my pet to eat them either. / Saya cuba untuk tidak makan makanan yang diproses dan tidak mahu haiwan kesayangan saya memakannya sama ada.
   - To prevent food allergies. / Untuk mengelakkan alahan makanan.
   - To improve my pet's immune system. / Untuk meningkatkan sistem imun haiwan kesayangan saya.
   - Feeding a raw animal product diet is more natural. / Memberi makanan diet produk haiwan mentah adalah lebih semula jadi.
   - None of above / Tiada satu pun di atas

Section C: Knowledge / Pengetahuan

1. Do you think pets and pet food can be a source of foodborne illness to human?
   Adakah anda rasa haiwan peliharaan dan makanan haiwan peliharaan boleh menjadi sumber penyakit bawaan makanan kepada manusia?
   - Yes / Ya
   - No / Tidak
   - Not sure / Tidak pasti
2. Do you think foodborne illness in human can be prevented?
   Adakah anda rasa penyakit bawaan makanan pada manusia boleh dicegah?
   - Yes / Ya
   - No / Tidak
   - Not sure / Tidak pasti
3. Have you heard of any pet food/treat that was involved in foodborne outbreaks or recalls, due to microbial contamination, like Salmonella and E. coli?
   Pernahkah anda mendengar sebarang makanan/snek haiwan peliharaan yang terlibat dalam wabak bawaan makanan atau penarikan balik, disebabkan oleh pencemaran kuman bakteria, seperti Salmonella dan E. coli?
   - Yes / Ya
   - No / Tidak
   - Not sure / Tidak pasti

Which of the following products can pose microbial food safety risk, like *Salmonella* and *E. coli*?
Antara produk berikut, yang manakah boleh menimbulkan risiko keselamatan makanan kuman bakteria, seperti Salmonella dan E. coli?

4. Raw meat / Daging mentah
    - Yes / Ya
    - No / Tidak
    - Not sure / Tidak pasti
5. Raw vegetables / Sayuran mentah
    - Yes / Ya
    - No / Tidak
    - Not sure / Tidak pasti
6. Raw fruits / Buah-buahan mentah
    - Yes / Ya
    - No / Tidak
    - Not sure / Tidak pasti
7. Raw milk / Susu mentah
    - Yes / Ya
    - No / Tidak
    - Not sure / Tidak pasti

8. If the pet food/treat you bought is in a recall/outbreak related to microbial contamination, what should you do?
   Jika makanan/snek haiwan peliharaan yang anda beli adalah dalam panggilan balik/wabak yang berkaitan dengan pencemaran kuman bakteria, apakah yang harus anda lakukan?
    - I throw them away and sanitize all contacting surfaces. / Saya membuangnya dan sanitasi semua permukaan.
    - Continue to use the recalled product. / Meneruskan penggunaan produk dalam panggilan balik.
    - Not sure / Tidak pasti
9. If the pet food/treat you bought is in a recall/outbreak related to microbial contamination, what will you do after the recall/outbreak is over?
   Jika makanan/snek haiwan peliharaan yang anda beli adalah dalam panggilan balik/wabak yang berkaitan dengan pencemaran kuman bakteria, apakah yang akan anda lakukan selepas panggilan balik/wabak itu tamat?
    - I will buy the same product from this brand immediately after the recall is over. / Saya akan membeli produk yang sama daripada jenama ini sejurus selepas panggilan balik tamat.
    - I will buy the same product from a different brand for a few months before I go back to the recalled brand. / Saya akan membeli produk yang sama daripada jenama yang berbeza selama beberapa bulan sebelum saya kembali kepada jenama yang ditarik balik.
    - I will never buy the same product from this brand anymore, but I will buy different products from this brand. / Saya tidak akan membeli produk yang

sama daripada jenama ini lagi, tetapi saya akan membeli produk yang berbeza daripada jenama ini.
- I will never buy any related products from this brand anymore. / Saya tidak akan membeli sebarang produk berkaitan daripada jenama ini lagi.
- None of above. / Tiada satu pun di atas.

10. With respect to microbial food safety information about pet food/treat, who, do you think, is responsible to communicate the food safety risk to you? (Check all that apply)
Berkenaan dengan maklumat keselamatan makanan kuman bakteria tentang makanan/snek haiwan peliharaan, pada pendapat anda, siapakah yang bertanggungjawab untuk menyampaikan risiko keselamatan makanan kepada anda? (Semak semua yang berkenaan)
    - Government agencies / Agensi kerajaan
    - Veterinarian / Doktor haiwan
    - Pet store employees / Pekerja kedai haiwan peliharaan
    - The pet food/treat companies / Syarikat makanan/snek haiwan peliharaan
    - Health professionals (doctors, nurse, physician assistant, nutritionists, dietitians) / Pakar kesihatan (doktor, jururawat, pembantu doktor, pakar pemakanan, pakar diet)
    - University extension / Sambungan universiti
    - No one's responsibility / Bukan tanggungjawab sesiapa
    - Myself / Saya sendiri
    - None of above / Tiada satu pun di atas

Section D: Interactions and Practices / Interaksi dan Amalan:

7. Read the following statements and select the option if you interact with the pet(s) as stated. (Check all that apply)
Baca kenyataan berikut dan pilih pilihan jika anda berinteraksi dengan haiwan peliharaan seperti yang dinyatakan. (Semak semua yang berkenaan)
    - I kiss my pet(s). / Saya mencium haiwan peliharaan saya.
    - My pet(s) lick me. / Haiwan peliharaan saya menjilat saya.
    - I cuddle with my pet(s). / Saya berpelukan dengan haiwan peliharaan saya.
    - I pet my pet(s). / Saya membelai haiwan peliharaan saya.
    - My pet(s) sleep with me. / Haiwan peliharaan saya tidur dengan saya.
    - None of above / Tiada satu pun di atas

Read the following statements and select the option if your pet(s) practice as stated.
Baca kenyataan berikut dan pilih pilihan jika haiwan peliharaan anda berlatih seperti yang dinyatakan.

8. My pet(s) clean my dishes by licking before the dishes go into the dishwasher. / Haiwan *peliharaan saya membersihkan pinggan saya dengan menjilat sebelum pinggan masuk ke dalam mesin basuh pinggan mangkuk.*

- Yes / Ya
- No / Tidak

9. My pet(s) get on the kitchen countertop.
   Haiwan peliharaan saya naik ke atas meja dapur.
   - Yes / Ya
   - No / Tidak
10. My pet(s) can access the kitchen or dining room while I eat or cook.
    Haiwan peliharaan saya boleh mengakses dapur atau ruang makan semasa saya makan atau memasak.
    - Yes / Ya
    - No / Tidak
11. I feed my pet(s) food from my palm.
    Saya memberi makan haiwan peliharaan saya dari tapak tangan saya.
    - Yes / Ya
    - No / Tidak
12. I eat my pet's food/treats.
    Saya makan makanan/snek haiwan kesayangan saya.
    - Yes / Ya
    - No / Tidak

Read the following statements and select the option if you practice as stated.
Baca pernyataan berikut dan pilih pilihan jika anda berlatih seperti yang dinyatakan.

13. Wash hands with soap after play with my pet(s).
    Mencuci tangan dengan sabun selepas bermain dengan haiwan peliharaan saya.
    - Yes / Ya
    - No / Tidak
14. Wash hands with soap after feeding my pet(s).
    Basuh tangan dengan sabun selepas memberi makan kepada haiwan peliharaan saya.
    - Yes / Ya
    - No / Tidak
15. When there is a pet foods spill, do you throw them away and wipe the spill area?
    Apabila terdapat tumpahan makanan haiwan peliharaan, adakah anda membuangkannya dan menyapu kawasan tumpahan tersebut?
    - Yes / Ya
    - No / Tidak
16. Do you store the leftovers separately from human foods (in different refrigerator or freezer)?
    Adakah anda asingkan penyimpanan sisa makanan daripada makanan manusia (dalam peti sejuk yang berbeza)?
    - Yes / Ya
    - No / Tidak
17. When you store the pet food leftovers in the refrigerator or freezer, do you provide with extra containers or bags to prevent juice runoff?

Apabila anda menyimpan sisa makanan haiwan di dalam peti sejuk atau peti ais, adakah anda sedia dengan bekas atau beg tambahan untuk mengelakkan larian jus?

- Yes / Ya
- No / Tidak

How do you clean the SCOOPS / CONTAINERS / FEEDING BOWLS / CHEWING TOYS that you use for pet foods/treats?
Bagaimanakah anda membersihkan SENDUK / BEKAS / MANGKUK MAKAN / MAINAN UNTUK MENGUNYAH yang anda gunakan untuk makanan/snek haiwan peliharaan?

18. I wash them with soap
    Saya membasuhnya dengan sabun
    - Never / Tidak pernah
    - Sometimes / Kadang-kadang
    - Always / Sentiasa
19. I sanitize them after wash
    Saya mensanitasinya selepas mencuci
    - Never / Tidak pernah
    - Sometimes / Kadang-kadang
    - Always / Sentiasa

Section E: Risk Perception / Persepsi Risiko

Read the following statements and answer how much risk associates with each statement.
Baca pernyataan berikut dan jawab berapa banyak risiko yang dikaitkan dengan setiap pernyataan.

1. "The risk of my pet(s) transmitting foodborne pathogens to me is…" / "Risiko haiwan peliharaan saya menghantar patogen bawaan makanan kepada saya adalah…"
    - Not at all / Tidak sama sekali
    - Somewhat / Agak-agak
    - Very much / Sangat
2. "The risk to me getting sick from pet foods/treats is…" / "Risiko untuk saya jatuh sakit akibat makanan/snek haiwan peliharaan adalah…"
    - Not at all / Tidak sama sekali
    - Somewhat / Agak-agak
    - Very much / Sangat
3. "The risk of my pet getting sick from pet foods/treats is…" / "Risiko haiwan kesayangan saya jatuh sakit akibat makanan/snek haiwan adalah…"
    - Not at all / Tidak sama sekali
    - Somewhat / Agak-agak
    - Very much / Sangat

Read the following story headlines and answer how concerned you are about pet food safety after reading each story headline?

Baca tajuk cerita berikut dan jawab sejauh manakah anda prihatin terhadap keselamatan makanan haiwan peliharaan selepas membaca setiap tajuk cerita?

4. “100 PEOPLE got sick from bacteria tied to ABC brand dry pet treats." / "100 ORANG jatuh sakit akibat bakteria yang terikat dengan makanan haiwan peliharaan kering jenama ABC."
    - Not at all / Tidak sama sekali
    - Somewhat / Agak-agak
    - Very much / Sangat
5. “100 PETS got sick from bacteria tied to ABC brand dry pet treats." / "100 PETS jatuh sakit akibat bakteria yang diikat dengan makanan kering jenama ABC."
    - Not at all / Tidak sama sekali
    - Somewhat / Agak-agak
    - Very much / Sangat