

**KNOWLEDGE, ATTITUDE AND PRACTICE SURVEY OF HORSE KEEPERS  
TOWARDS TICK & TICK-BORNE DISEASES**

**BY**

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This is to certify that we have read this research paper entitle “**Knowledge, Attitude and Practice Survey of Horse Keeper Towards Tick & Tick-Borne Diseases**” by Liew Hong Khang, and in our opinion it is satisfactory in terms of scope, quality and presentation as partial fulfillment of the requirement for the course DVT 5436 - research project.



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## DEDICATIONS

I write my dissertation as a tribute to my numerous friends and family. My loving parents, Liew Ming Chong and Gun Suk Feng, whose words of support and encouragement keep ringing in my ears, deserve to be thanked.

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## TABLE OF CONTENTS

1.0	INTRODUCTION -----	7
2.0	PROBLEM STATEMENT -----	8
3.0	RESEARCH HYPOTHESIS -----	8
4.0	RESEARCH QUESTIONS -----	8
5.0	RESEARCH OBJECTIVES -----	8
6.0	LITERATURE REVIEW	
6.1	TICKS AND TICKS BORNE DISEASE IN HORSE -----	9
6.2	TRANSMISSION OF TICK-BORNE DISEASE IN HORSE -----	10
6.3	ECONOMIC IMPACTS OF TICK-BORNE DISEASES IN HORSES -----	10
6.4	KNOWLEDGE, ATTITUDE, AND BEHAVIOR OF HORSE KEEPER TOWARDS TICK AND TICK-BORNE DISEASE. -----	10
7.0	MATERIALS AND METHODS	
7.1	STUDY AREA AND TARGET POPULATION -----	11
7.2	RESEARCH DESIGN -----	12
7.3	SOURCE POPULATION -----	12
7.4	SELECTION CRITERIA -----	12
7.5	SAMPLING TECHNIQUES AND SAMPLING PROCEDURES -----	12
7.6	DATA COLLECTION METHODS -----	12
7.7	DATA COLLECTION TOOLS -----	13
7.8	DATA ANALYSIS -----	13
8.0	RESULTS -----	14 - 22
9.0	DISCUSSION -----	23 - 28
10.0	CONCLUSION -----	29
11.0	APPENDICES -----	30 - 33
12.0	REFERENCE -----	34 - 35

## ABSTRACT

An abstract of the research paper presented to the Faculty of Veterinary Medicine, Universiti Malaysia Kelantan, in partial requirement on the course DVT5436 – Research Project.

This study assessed the level of knowledge, attitudes, and practices (KAP) of horse keepers in regard to ticks and tick-borne disease in the east-coast of Malaysia, especially in Kelantan and Terengganu state. Horse owner, horse stable workers were subjected to an anonymous, voluntary, online questionnaire using Google form. Respondents were approached via farm/stable / barn visit, Cold call, and distribution of questionnaires on horse forum, messaging group. A total of 101 questionnaire responses were collected from the time period of Aug to Nov 2022, 101 respondents were included and analyzed through SSPS and presented in the form of univariate statistical analysis for descriptive statistics. The poor knowledge / awareness to tick and tick-borne diseases due to a shortage of manpower, resources and lack of government attention. The attitude of horse keepers is poor while the implementation of protective measures against ticks and tick-borne disease is not widely adopted. The Practice of horse keepers is moderate as they mainly practice biosecurity, husbandry and management that consist also preventive measure of parasite in general thus indirectly increase the level of practice against ticks and tick-borne disease. There is correlation between sociodemographic variables such as number of horses owned towards knowledge, purpose of horses towards attitude and relationship to horses towards practice. There is also a correlation between knowledge towards attitude and practice. In conclusion, horse keepers have poor knowledge, attitude and moderate practice in ticks and TBDs. Government bodies, veterinary facilities should pay more attention in increasing awareness of horse keepers to more effectively prevent tick and TBDs from spreading.

*Keywords: Knowledge-Attitude-Practice (KAP), Tick, Tick-borne-disease (TBD), Kelantan, Horse keeper*

## 1.0 INTRODUCTION

Ticks are obligate blood-sucking ectoparasites that belong to the class of Arachnida. Ticks are classified into two families which are Ixodidae (hard ticks) and Argasidae (soft ticks). In the Ixodidae, the tick possesses a capitulum that is positioned cranial to the body and a scutum. In the Argasidae, the tick possesses a capitulum that is positioned ventral to the body and lacks a scutum. Hard ticks contain most of the species of veterinary importance. (Wilson *et al.*, 2022)

Ticks are able to survive up to several years (Williams *et al.*, 2010). Tick bites can result in several devastating sequels, including blood loss, irritation, and inflammation which in turn results in anemia and reduced productivity of the host. On top of that, some species of ticks can result in toxicosis and paralysis from their salivary secretions.

Ticks play an important role as vectors in tick-borne diseases in horses such as anaplasmosis, borreliosis, and piroplasmosis. Tick-borne diseases (TBDs) in horses possess a zoonotic risk and can result in significant economic loss to horse keepers. Untreated tick-borne disease may lead to serious health problems, including death in rare cases.

According to Statista 2020, the number of horses in Malaysia has been fluctuating within a 10-year timeframe from 2011 to 2020. In 2020, Malaysia has 3,113 horse stocks which are slightly increase as compared to previous years (Hirschmann *et al.*, 2022). Hence, attention needs to be given to ticks and TBDs in Malaysia. Nevertheless, up to now, there is no scientific research on the knowledge (K), attitude (A), and practice (P) of horse keepers with regard to ticks and TBDs in Malaysia. The objective of this research is to investigate the KAP of horse keepers with regard to ticks and TBDs in Kelantan and Terengganu.

## **2.0 PROBLEM STATEMENT**

Ticks are widely distributed around the world, especially in warm and humid countries such as Malaysia. This environment is favorable to ticks, thus facilitates the transmission of tick-borne diseases. There is a knowledge gap in ticks and tick-borne diseases in Malaysia, up to now, there is no scientific research on the knowledge, attitude, and practice of horse keepers with regard to ticks and tick-borne diseases in Kelantan and Terengganu.

## **3.0 RESEARCH QUESTION**

What are the level of knowledge, attitude, and practice of horse keepers with regard to ticks and tick-borne diseases in Kelantan and Terengganu?

## **4.0 RESEARCH HYPOTHESIS**

Horse keepers in Kelantan have a moderate level of knowledge, moderate attitude, and moderate practice with regard to ticks and tick-borne diseases.

## **5.0 RESEARCH OBJECTIVE**

To determine the knowledge, attitude, and practice of horse keepers with regard to ticks and tick-borne diseases in Kelantan and Terengganu.



## 6.0 LITERATURE REVIEW

### 6.1 TICKS AND TICKS BORNE DISEASE IN HORSE

In Malaysia, there are at least 34 tick species that belong to the genera of *Rhipicephalus*, *Ixodes*, *Amblyomma*, *Dermacentor*, and *Haemaphysalis* have been documented (Hoogstraal *et al.*, 1969; Mariana *et al.*, 2007; Petney *et al.*, 2007; Kolonin 2009). There is little data in regards to prevalence and study of ticks that infest horses in Malaysia. However, majority of the reported documented tick-borne disease in horses can be carried by *Rhipicephalus sanguineus*. Tick-borne disease in Malaysia in general is still under investigated and under-appreciated. (Bolongon *et al.*, 2017). In equine health, Ixodidae ticks of the genera *R. sanguineus* was present in Peninsular Malaysia (Koh *et al.*, 2016) and carries pathogen such as *Anaplasma phagocytophilum* that able to invade blood cells of mammalian host in horse result in equine granulocytic ehrlichiosis. (Alicja *et al.*, 2022) *Rhipicephalus spp* also carries *Theileria equi* and *Babesia caballi* causing acute equine piroplasmosis (McFarland *et al.*, 2014). Ixodidae ticks are also able to transmit *Borrelia burgdorferi* also known as Lyme disease, a zoonotic disease. Seroprevalence of Lyme disease was tested among indigenous people of peninsular Malaysia and was tested positive for anti-*B. burgdorferi* IgG antibodies (Sieng Khor *et al.*, 2019)

### 6.2 TRANSMISSION OF TICK-BORNE DISEASE IN HORSE

Ticks transmitted pathogen through feeding process, when an uninfected tick feeds, it inserts its feeding tube and secrete saliva with anesthetic properties and also cement-like substance to keep in place firmly for several days. The longer the tick feeds infected host blood, the higher chances tick will be infected with pathogens and transmit acquired disease to new host during its next life stage. (CDC *et al.*, 2020)

### 6.3 ECONOMIC IMPACTS OF TICK-BORNE DISEASES IN HORSES

Tick are important ectoparasite that cause great economical and health losses in production and companion animal. (Cristian *et al.*, 2018). The health of productive animal can be altered by direct or indirect effect of ticks, which result in health and economical losses. Direct losses are caused by damage produced by ticks while feeds on horse that cause tissue irritation that result in self-induced trauma affecting appearance. (Cristian *et al.*, 2018) While indirect losses are due to infectious agent transmitted by ticks and cost associated to treat and control pathogen. (Perera *et al.*, 2018) Health impact such as self-induced trauma will result in hair loss result in economic losses horse as appearance was affected diminish the trading cost. Other health impact includes anime due to blood loss and disease such as Equine piroplasmosis, lyme disease, Anaplasmosis. (Lenz *et al.*, 2022)

### 6.4 KNOWLEDGE, ATTITUDE, AND BEHAVIOR OF HORSE KEEPER TOWARDS TICK AND TICK-BORNE DISEASE.

KAP studies also known as knowledge, attitude, behavior and practice survey. This survey is mainly for health-related behavior / health seeking practices investigation. KAP is an important study to simplify complicated data and to enable data that able to represent the target population. Unfortunately, there are no studies on horse keeper knowledge, attitude and practices (KAP) regarding ticks and tick-borne disease have been conducted in Malaysia.

Ticks are an ectoparasite of sanitary importance in equine. (Hurtado *et al.*, 2018) Among horse keeper there will be existence of knowledge gaps which result in different attitude and practices in handling ticks and tick-borne disease (TBD). The accuracy and correctness of knowledge of horse keeper towards tick and tick-borne disease is important as mis-information and misbeliefs of certain information can lead to mal-practices or passive attitude in protecting against ticks.

## 7.0 METHODOLOGY

### 7.1 STUDY AREA AND TARGET POPULATION

This study will be conducted in Kota Bharu, Bachok, Pasir Puteh, Machang, Tanah Merah, Pasir Mas, and Tumpat in Kelantan, Malaysia. These seven districts are located in the vicinity of the Kelantan state capital, Kota Bharu and Kuala Terengganu, Terengganu. Hence, it is believed that equine farm density within these districts can achieve a target population of 100 horse keepers within a two months period of time. On top of that, the selected study areas are reachable.



*Figure 1: Location of Kelantan, Malaysia is marked as yellow.*



*Figure 2: Location of Kota Bharu, Bachok, Pasir Puteh, Machang, Tanah Merah, Pasir Mas, and Tumpat in Kelantan, Malaysia*

## 7.2 RESEARCH DESIGN

This study will be conducted as a cross-sectional study in which data collection is achieved from different horse keepers within the two months period of time.

## 7.3 SOURCE POPULATION

Source population are horse owner and care taker around the seven districts that are located in the vicinity of the Kelantan state capital, Kota Bharu

## 7.4 SELECTION CRITERIA

The respondents must fulfill the selection criteria of having at least six months horse ownership or care-taking and involve in the management of horse husbandry.

## 7.5 SAMPLING TECHNIQUES AND SAMPLING PROCEDURES

This study were conducted via Consecutive sampling, the sample were selected until 100 respondents' size is achieved. The respondents that fulfill the selection criteria were selected randomly by chance.

## 7.6 DATA COLLECTION METHODS

A well-designed questionnaire that is related to the research objective were produced. To achieve this, different sources of questionnaires and journals from the internet were referred to construct a questionnaire that best fits the research objective. Next, a pilot test were conducted on three respondents that fulfill the selection criteria to pre-test the questionnaire. If the questionnaire has been successfully subjected to a thorough pilot test, a final questionnaire are produced. The questionnaire then distributed to respondents through either hard or soft copies. The soft copies were then delivered throughout Google form.

## 7.7 DATA COLLECTION TOOLS

Google form and hard copy questionnaires (appendix) was used for the collection of data from horse keepers.

Google form link: <https://docs.google.com/forms/d/e/1FAIpQLSc-pSlktwG6bIJ9Bx9OhwrtrMqHUZPIQ8ubn7DEHp2V18MSoQ/viewform>

**KNOWLEDGE (K), ATTITUDE (A), PRACTICE (P) SURVEY OF HORSE OWNERS TOWARDS TICKS AND TICK-BORNE DISEASES**

Nama saya Liew Hong Khang, seorang pelajar dari fakulti perubatan veterinar (FPV), University Malaysia Kelantan (UMK).  
Terima kasih kerana meluangkan masa berharga anda untuk mengambil bahagian dalam penyelidikan ini! 😊  
Soal selidik ini direka bentuk untuk mengkaji KAP pemilik kuda terhadap kutu dan penyakit bawaan kutu.

hongkhang1021@gmail.com (not shared) [Switch account](#)

**Borang Persetujuan Soal Selidik**  
Saya memberi kebenaran kepada penyelidik, Liew Hong Khang untuk mengumpul jawapan saya dalam soal selidik bertajuk **Knowledge, Attitude, Practice survey of horse owner towards ticks and tick-borne disease**  
Saya faham bahawa penyelidikan ini adalah untuk tujuan akademik. Saya juga faham

Figure 3: Google form questionnaires

## 7.5 DATA ANALYSIS

The collected data will be summarized by using Microsoft Excel from google form and analyzed using SPSS. The method used by *Tack et al.* was adapted to categorize the respondents as either having “good knowledge, moderate knowledge, poor knowledge”. The numerical data will be presented in the form of univariate statistical analysis for descriptive statistics. A score was then assigned to each question in survey. Based on the answer chosen by the respondent, the total score for each category (KAP) was used in calculating the percentage. Through application of original Bloom’s cut-off grade, level of KAP score was given 80-100% response as good, 60-79% as moderate and score < 60%. Cross tabulation of

sociodemographic variable to level of knowledge, attitude and practice was also performed to determine any correlation between each sociodemographic variable to knowledge.

## 8.0 RESULTS

### Sociodemographic characteristics

One hundred and one respondents were interviewed, and the response rate was 100 percent.

The detail of the sociodemographic and farm characteristics is presented in Table 8.1.

Table 8.1 CHARACTERISTIC OF STUDY GROUP

*Table 1: sociodemographic characteristic of the respondents*

Variable	Categories	Total (n=101)	Percent
Gender	Male	70	69.3
	Female	31	30.7
Age	18 – 35	46	45.5
	36 – 45	20	19.8
	> 45	35	34.7
Years of horse ownership	1 to 5 years	51	50.5
	6 to 10 years	34	33.7
	11 to 15 years	12	11.9
	> 16	4	4.0
Level of education	High school education	63	62.4
	Diploma / University education	38	37.6
Number of horses owned	< 2	46	45.5
	< 5	30	29.7
	< 10	10	9.9
	> 11	15	14.9
Purpose of horses	Breeding	36	35.6
	Endurance	28	27.7
	Hobi	20	19.8
	Racing	15	14.9
	Tourism	2	2.0
Type of housing management	Free roaming with access to shelter	39	38.6
	Guided exercise and kept in barn or stable	62	61.4
Relationship of horse	Worker	55	54.5
	Owner	46	45.5

### Knowledge about ticks and TBDs in horse keeper

According to table 2, out of 101 respondents 54.5 % of respondents had seen ticks on its horse and 67.3% of respondents were able to recognize and differentiate ticks from another insect. Approximately 63% of respondents did not experience tick bites while raising horses. About 77.2% of respondents had reported seeing ticks on horses, 23% of respondents had seen them in horse barn. While 43% of respondents had seen ticks in grazing lands and vegetation. Majority of respondents (55.4%) saw ticks generally distributed on head / neck, chest / axilla and rump and inguinal region of horse.

Majority of respondents believe horses infested with ticks due to transmission from other infested horses, surrounding infested farm animals. Majority of respondents 46.5% report horses more susceptible to tick infestation all year round. Approximately, 45% of respondent does not aware does tick stay on body of horse unless removed, while 35% believe tick will stay on body of horse unless removed which were incorrect. In the knowledge categories of greatest health / production impact of horse with tick infestation, majority of respondents 36% report skin irritation on horses, while anemia due to blood sucking 27.5%, disease transmission 26%. The majority 68% of respondents were aware that ticks are potential vectors of tick-borne disease (TBDs) in horses. Majority 58% of respondents believe tick bites can cause disease transmission from horse to human.

$$\begin{aligned}
 \text{Percentage of Knowledge} &= \frac{\text{Mean} \times \text{total respondent}}{\text{total knowledge score} \times \text{total respondent}} \times 100\% \\
 &= \frac{2164}{3838} \times 100\% \\
 &= 56.38\% \text{ (poor knowledge)}
 \end{aligned}$$

The analysis of the knowledge total score of 101 respondents was 56.38% which classified under poor knowledge about ticks and tick-borne disease in horse keepers.

Table 2: Knowledge's variable and response of respondent

Variable	Categories	score	percentage (%)
Have you seen ticks on horses?	Yes	2	45
	No	2	34
	I don't know	0	21
Is this a Ticks?	Yes	2	67
	No	0	7
	I don't know	0	26
On horses	Yes	2	77.2
	No	0	2
	I don't know	0	20.8
In horse barn	Yes	2	21.8
	No	0	19.8
	I don't know	0	58.4
In grazing lands	Yes	2	40.6
	No	0	9.9
	I don't know	0	49.5
Which season do you think horses more susceptible to tick infestation?	Dry/ Hot season	1	14
	Rainy/ Cold season	1	13
	All year round	2	46
	Not aware	0	27
Do you think ticks always stay on body of horses unless removed?	Yes. Ticks always stay on body of horses unless removed.	0	35
	No. Ticks drop off from body of horses after blood meal.	2	20
	Not aware	0	45
Do you think ticks are potential vectors of tick-borne diseases (TBDs) in horses?	Yes	2	68
	No	0	3
	Not aware	0	29
Have you experienced tick bites at one point of your lives?	Yes	1	16
	No	1	62
	Not aware	0	22

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Table 3: Knowledge variable which have more than one option

Variable	categories	Score	Total Score	Percentage (%)
<b>Which is the greatest health and production impact of horses with tick infestation (more than one option)</b>	skin irritation due to bite wound	2	0	21.8
	Anemia due to blood sucking	2	2	11.9
	Disease transmission	2	4	17.8
	Not aware	0	6	48.5
<b>Which body part of horses do you commonly seen ticks? (more than one option)</b>	Rump & Inguinal	2	1	22.8
	Chest & Axilla	2	2	5
	Head & Neck	1	3	11.9
			4	5
			5	55.4
<b>Where do you think horses get tick infestation? (more than one option)</b>	From surrounding infested farm animal	2	0	18.8
	From contaminated grazing lands	2	2	18.8
	From contaminated stables / bedding materials	2	4	27.7
	From other infested horses	2	6	19.8
	Not aware	0	8	14.9

Table 4 showed the cross-tabulation results of socio-demographic variables to knowledge was as performed. Number of horses owned across different categories most of the keepers that have less than two horses had moderate knowledge 45.7%, 34.8% of respondent have poor knowledge and 19.6% have good knowledge. Horse keepers under categories of < 5, < 10, and > 11 horses are mostly having poor knowledge. Chi square tests show's p-value is 0.07 which is close to 0.05 indicate close correlation between variable and knowledge. Horse keepers that raise many horses seems to have lower knowledge. It may due to those data often collected from well manage, establish equatorial facilities that groom the horse often with good biosecurity. Thus, keepers has lesser chance of encounter infested horses.

Another variable is relationship to horse. Categories worker – horse relationship, majority have poor knowledge 60.0%, followed with moderate knowledge 27.3% and lastly good knowledge 12.7%. Owner – horse relationship, majority have poor knowledge 37%, follow with moderate knowledge 34.8% and lastly good knowledge 28.3%. Chi square tests showed that relationship to horse was the only variable significant and play a role in influencing the knowledge with p-value of 0.045 which less than 0.05. Although both owner and worker majority have poor knowledge, the owner have better knowledge when compare to worker. This may due to owner are more proactive in increasing performance and productivity of horses compare to worker. Other socio demographic variable was not significant in this analysis.

*Table 4: Cross Tabulation of sociodemographic variables to Knowledge*

Variable	Categories	Knowledge (%) = 100%			P value
		poor	Moderate	good	
Number of horses owned	< 2	34.8%	45.7%	19.6%	0.070
	< 5	60.0%	16.7%	23.3%	
	< 10	50.0%	30.0%	20.0%	
	> 11	73.3%	13.3%	13.3%	
Relationship to horse	Worker	60.0%	27.3%	12.7%	0.045
	Owner	37.0%	34.8%	28.3%	

**Attitude about horse keeper in ticks and TBDs.**

Out of 101 respondents 86.1 % of respondents agreed the usage of commercial insect repellent can effectively prevent and control tick infestation in horses. Approximately, 35.6% of respondent agreed that keeping and feeding the horse in stall can prevent and control tick infestation in horse while most respondent 48.5% have a neutral attitude in this category. About 90% of respondents agreed that good hygiene can effectively prevent and control tick infestation in horses.

$$\begin{aligned}
 \text{Percentage of Attitude} &= \frac{\text{Mean} \times \text{total respondent}}{\text{total attitude score} \times \text{total respondent}} \times 100\% \\
 &= \frac{474}{909} \times 100\% \\
 &= 52.14\% \text{ (poor attitude)}
 \end{aligned}$$

The analysis of the attitude total score of 101 respondents was 52.14% which classified under poor attitude about ticks and tick-borne disease in horse keeper

*Table 5: Attitude's variable and response of respondent*

Variable	Categories	scoring	percentage (100%)
<b>The proper use of commercial insect repellent can prevent and control tick infestation in horses.</b>	Strongly disagree	0	-
	Disagree	0	1
	Neutral	0	12.9
	Agree	2	69.3
	Strongly agree	3	16.8
<b>Keeping and feeding horse in a stall can prevent and control tick infestation in horse</b>	Strongly disagree	0	2
	Disagree	0	13.9
	Neutral	0	48.5
	Agree	2	27.7
	Strongly agree	3	7.9
<b>Good hygiene can prevent and control tick infestation in horses</b>	Strongly disagree	0	-
	Disagree	0	-
	Neutral	0	9.9
	Agree	2	69.3
	Strongly agree	3	20.8

Table 6 show the cross tabulation of sociodemographic variable to attitude. Across different categories in purpose of horse, breeding, hobbies, racing purpose horse keeper majority have moderate attitude, followed with good attitude and lastly poor attitude. Endurance purpose horse majority have poor attitude 53.6%, followed with moderate attitude 32.1%, and lastly good attitude 14.3%. Chi square tests showed that purpose of horse was the only variable significant and play a role in influencing the attitude with p-value of 0.031 which less than 0.05. Other sociodemographic variable was not significant in this analysis.

Table 6: Cross Tabulation of purpose of horses to attitude

Variable	Categories	Attitude % = (100%)			P-value
		poor	moderate	good	
Purpose of Horses	Breeding	13.9%	55.6%	30.6%	0.031
	Endurance	53.6%	32.1%	14.3%	
	Hobby	20.0%	50.0%	30.0%	
	Racing	13.3%	46.7%	40.0%	
	Tourism	50.0%	50.0%	0.0%	

**Practice about horse keeper in ticks and TBDs.**

Out of 101 respondents 89.1 % of respondents have effective practice in terminating ticks if founded on horses. Upon handling of horses, respondents only spray insect repellent occasionally 52.5%, while approximately 17.8% practice application of insect repellent when handling horses. 53.5% of respondents will only check its body occasionally after handling horses with a history of infestation of ticks. While 19.8% of respondents practice checking the body for ticks after handling the horse. Respondent’s tick prevention and control program majority have scored that higher than 6 (81.3%). Among the categories, most respondent response includes usage of commercial insect repellent (30%) and maintaining good hygiene (27%).

$$\begin{aligned}
 \text{Percentage of Practice} &= \frac{\text{Mean} \times \text{total respondent}}{\text{total practice score} \times \text{total respondent}} \times 100\% \\
 &= \frac{1145}{1717} \times 100\% \\
 &= 66.7\% \text{ (moderate practice)}
 \end{aligned}$$

The analysis of the practice total score of 101 respondents was 66.7% which classified under moderate practice in regards to ticks and tick-borne disease in horse keepers.

Table 7: Practice's variable and response of respondent

Variable	Categories	Scoring	Percentage (%)
<b>What do you do with the ticks if founded on horses?</b>	Collect and burn	2	47
	Collect and throw it in the field	0	10.9
	Collect and drown it in water	2	37.1
	Others method	2	5
<b>Do you spray your clothes with insect repellent before handling horses</b>	Yes	2	17.8
	No	0	29.7
	Sometimes	1	52.5
<b>Do you check your body for ticks after handling horses?</b>	Yes	2	19.8
	No	0	26.7
	Sometimes	1	53.5

Table 8: Responses of type of prevention / practice method for tick control program

Variable	Categories	Scoring	Total Score	Percentage (%)	
<b>What tick prevention and control programs do you practice (more than one option)</b>	Maintain good hygiene	3	3	11.9	
	Practice stall feeding	2	5	6.9	
	Use commercial insect repellent	3	6	11.9	
	Use homemade insect repellent	1	7	3	
	Manually remove ticks from horses	2	8	32.7	
				9	7.9
				10	4
				11	21.8

From Table 9 the data shows cross tabulation of sociodemographic variables to practice. Across different categories in relationship to horse, worker – horse relationship, majority respondents 69.1% have poor practice, followed with moderate practice 16.4% and lastly good practice 14.5%. Owner – horse relationship, majority respondents 54.3% have moderate

practice, followed with poor practice 37% and lastly good practice 8.7%. Chi square tests showed that relationship to horse was the only variable significant and play a role in influencing the practice with p-value of 0.000 which less than 0.05. Other sociodemographic variable was not significant in this analysis.

*Table 9: Cross Tabulation of horse relationship to practice*

variable	categories	Practice % = (100%)			P-value
		poor	moderate	good	
<b>Relationship to horse</b>	worker	69.1%	16.4%	14.5%	0.000
	owner	37.0%	54.3%	8.7%	

**The correlations between knowledge, attitude and practice**

There is a significant, positive relationship / correlation between knowledge of horse keeper in tick and tick-borne disease scores to attitude of horse keeper in tick and tick-borne disease scores as p- value is 0.021 which is less than 0.05. There is a significant, positive relationship / correlation between knowledge of horse keeper in tick and tick-borne disease scores to practice of horse keeper in tick and tick-borne disease scores as p- value is 0.000 which is less than 0.05.

*Table 10: The p-value between knowledge, attitude and practice*

Total score	p-value		
	Knowledge	Attitude	Practice
Knowledge	-	0.021	0.000
Attitude	0.021	-	0.106
Practice	0.000	0.106	-

## 9.0 DISCUSSION

This is the first KAP study conducted to determine horse keeper's knowledge, attitudes and practices about ticks and TBDs in Kelantan, Malaysia. In this study, Majority of the respondent reported for having seen and recognized ticks. This is not surprising given that the respondent's majority were workers / caretaker who's live are intimately linked with animals, pastures and forests, where ticks are commonly found. Most of the horse keeper's in Kelantan raise their horse through backyard barn where exposure to ticks is higher compare to well establish equine housing facilities for example equine club house with better husbandry and management. Despite majority of respondents having seen ticks, more than half of the respondents did not know horse can become infested and where ticks are commonly found in the grazing lands and pastures. Majority of respondent does not consider horse barn as potential source of area of infestation, as ticks after feeds on host, it will detach itself and undergo incomplete metamorphosis (*Verlag et al., 2001*). The reason may due to the color and texture of bedding usually compose of sawdust, or dirt / sand which increase the difficulties of horse keeper's noticing ticks from within. Most of the keepers notice ticks on horses especially after feeding as it becomes more enlarged and visible after blood meal. Majority of the respondents recognized that horses are susceptible to tick infestation all year round especially in temperate countries like Malaysia where it is moist / humid and warm all year round. (*Khoo et al., 2016*) Some respondent though that ticks are more common in rainy / cold season. Normally, lower temperature will reduce the development process of ticks such as molting which are highly dependent on temperature. (*Deirdre et al., 2021*) Most horse will reduce in immune capacity when long term exposure to extreme temperature which predispose many to tick infestation. This may explain why some respondents believe ticks are more common in the rainy / cold season. Dry / Hot seasons have a strong impact on reducing ticks' density especially during nymphs' phase of ticks. (*James et al., 2016*) Thus, ticks usually thrive only in the appropriate

temperature range from 15°C to 21°C. (*Deirdre et al., 2021*) Despite the majority of respondents having seen ticks, most of the respondent believe ticks will always stay on host unless being removed, the reason for such belief may be due the duration of ticks remains on horse until it detaches itself. If left undisturbed, larvae remain attached for feeding for about a week. (*Dania et al., 2013*) The long duration of tick on horse may contribute to the horse keeper's understanding in this category.

Majority of respondents have knowledge and awareness that ticks are potential vectors of tick-borne disease (TBDs) in horses but do not recognize the name of disease, clinical sign. This may be due to a lack of awareness program of ticks and TBDs from the veterinary department. Most respondents recognized the common side effects of tick infestation such as skin irritation, anemia and disease transmission. (*Kathryn et al., 2022*) They are aware of those side effects highly possibly through the media, equine social group / club or through the personal experience / observation or knowledge of affected horse keepers. However, the participants have limited knowledge about for example disease carried by ticks and do not understand the mechanism of disease transmission for example the principle of hosts / vector and not all ticks carry TBDs. Body parts of horses which are commonly infested with ticks, majority of respondents believe ticks will be attach all around the horse body from head / neck, chest / axilla to rump / inguinal. But large amount of respondents believed ticks mostly attach to the head / neck. This is likely due to spreading of incorrect knowledge as ticks usually move around the horse's body searching for areas where skin will be thinner and less visible. Those areas are chest / axilla, rump / inguinal. (*Thomas et al., 2020*). Factors such as horses surrounded by infested farm animals, allowing horse graze in contaminated grass fields, and living in contaminated stables can increase risk factor of tick infestation. Most of the respondent agreed, all of the category's mention can increase risk of tick infestation in horses which is accurate as



ticks have higher prevalence in high livestock density, rural area, forest / grassland. (*Mathisson et al., 2021*)

The analysis of the knowledge total score of respondents was 56.38% which classified under poor knowledge about ticks and tick-borne disease in horse keepers. There have been few efforts made from veterinary laboratories to diagnose and record cases in a systematic manner due to a shortage of manpower and resources to the subject. Equine veterinarians usually treat the horse based on clinical signs without tentatively diagnosing. Also there was no major outbreak resulting in mortality of animals due to TBDs, worker / caretaker, horse owner and veterinary officer thus less attention was placed. Further, immunity acquired through previous exposure to ticks make horses “endemically stable”. (*Minjauw et al., 2003*) It was noted that a large proportion of respondents do believe ticks are able to carry tick-borne disease but never heard of names of TBDs in horses. This could have been due to a lack of awareness program on ticks and TBDs in the veterinary department which is highly likely due to limited resources and absence of major outbreak.

Upon cross tabulation of the number of horse keepers to knowledge, most of the respondents have less than 5 horses which account for more than 70% of respondents. This may be due to lesser horses being easier and cheaper in terms of maintenance and cost of facility. Most of the farm animals in Kelantan as well as horses are raised by backyard farmers. Categories that have less than 5 horses have moderate to good knowledge, while categories <10, > 11 have poor knowledge. This may due to backyard farmer have higher chances of encounter with ticks by allowing horse to graze on field for long period of time which increase the chances of encounter with ticks (*Robert et al., 2022*) compare to more establish equine facilities for example clubhouse, which have better management, husbandry and grooming regiment thus result in reduce encounter with ticks. (*Heather et al., 2016*) There is correlation between horses’ relationship to knowledge. Under worker categories, worker / caretaker has poor knowledge

while horse owner although 37% have poor knowledge, but have higher moderate and good knowledge compared to workers. This may be due to the worker not learning proactively and only performing daily tasks as instructed by the owner while the horse owner is more eager to acquire new knowledge for betterment of horse productivity.

Overall, respondents have a poor attitude (52.14%) towards tick prevention and control programs. There are many factors that can influence a person's attitude towards tick prevention programs as individual knowledge, beliefs, emotions, values will closely influence a person's attitude, which can either be positive or negative. (*Launiala et al., 2009*) In usage of commercial insect repellent when controlling tick infestation in horses, majority agreed application of pesticide is useful in preventing and controlling tick infestation. There are several methods, the first method is application of pesticide such as pyrethrin, cypermethrin, commercial grade pyrethroids on pastures and paddocks to eliminate ticks that live in the environment as grazing horses can easily obtain ticks when brushed by vegetation. (*Thomas et al., 2020*) Application of acaricidal on horse is most widely used method for controlling ticks in horse, chemicals such as pyrethrin, fipronil (frontline) are commonly practiced, usually only applied on site such as chest and inguinal which is not necessary on the entire horse. (*Thomas et al., 2020*). Most of the respondents remain neutral in keeping and feeding horses in barn or stall to prevent and control tick infestation. Keeping, feeding horse in barn with guided exercise on a clean, non-contaminated area can prevent tick infestation as environmental risk is removed. However, horse keepers thought that frequent grooming, and inspection of hair coats in horses after returning to the barn can prevent chances of tick infestation which does not limit the freedom of horse as well as less labor in this approach. All respondents agreed that good hygiene can effectively prevent and control tick infestation in horses. For example, good husbandry such as frequent grooming and inspecting horses daily at susceptible areas and maintaining hygiene of the barn by changing the bedding on time to prevent ticks from

contaminating the barn. (*Gabby et al., 2020*) The sociodemographic variable of horse purpose has correlation with the attitude of the horse keepers. This may due to the infestation of the tick and low immune system can decrease the productivity and performance of horses which may hinder its purpose. Thus, better attitude when dealing with ticks and TBDs. There is a correlation between the purpose of horses and the attitude of horse keepers. Majority of the respondents raise their horses for breeding purposes, this is because Kelantan is one of the popular breeding sites for horses. Across different categories in purpose of horse, in breeding, endurance horse, majority of the respondents have poor knowledge. This may be due to establishing breeding farms, equine facilities such as club houses have good biosecurity and usually have good management, husbandry, grooming regimens which reduce the chances of tick encounter by worker and owner thus resulting in poorer attitudes.

Overall, respondents have moderate practice (66.7%) towards tick prevention and control programs. This may due to the employment of biosecurity in horse keepers to prevent disease have also helped in preventing ticks and TBDs. (*Emily et al., 2011*) Majority of the respondent chooses an effective method of terminating the ticks when founded on horse. Majority of respondents will only occasionally spray its clothes with insect repellent before handling horses as well as check the body for ticks after handling horses. There are many factors that can influence a person's practice towards tick prevention programs as it may be due to inconvenience and lack of knowledge that result in horse keepers only practicing tick prevention occasionally. Tick prevention and control programs that respondents practice mostly the usage of commercial insect repellent, maintain good hygiene and manually remove ticks from horses. Those are good practices to effectively prevent ticks' infestation in horses. (*Thomas et al., 2020*) There is correlation between relationship to horse and practice of horse keeper. Workers generally have poor practice while horse owners have moderate practice. This may be due to multiple factors. For example, workers have lesser knowledge compared to

owners which results in less awareness and understanding of the importance of tick prevention. Workers might be unable to practice tick prevention due to following orders from the owner or other external factors such as laziness, or dissatisfaction resulting in poorer worker performance in horse care.

There is a significant correlation between knowledge of horse keepers in tick and tick-borne disease scores to attitude and practice of horse keepers in tick and tick-borne disease. This indicates the level of knowledge in horse keepers does affect and play a role in influencing the attitude and practice when dealing with tick and tick-borne disease (TBD). There was no correlation between attitude and practice of horse keepers in tick and tick-borne disease. The reason can be multifactorial, such as individual knowledge, beliefs, emotions, values can influence a person's attitude. Circumstances such as employment benefits, personalities, relationship of owner and worker, financial abilities can influence the practice either good or bad. Thus, this survey might have insufficient variables in determine the correlation.

## 10.0 CONCLUSION

In conclusion, the assessment of knowledge, attitude and practice in tick and tick-borne disease in Kelantan, Terengganu Malaysia was carried out in this study, it revealed horse keepers have poor knowledge, poor attitude and moderate practice in regards to tick and tick-borne disease. The poor knowledge / awareness may due to lack of exposure, negligent of the horse keepers towards TBD. The attitude of horse keepers is poor while the implementation of protective measures against ticks and tick-borne disease is not widely adopted. The practice of horse keepers is moderate as it practices biosecurity, good husbandry and management will be able to protect against ticks and tick-borne disease.

This study reveals an urgent need to raise the awareness of horse keepers regarding the importance of diagnosis, treatment, control, and prevention of tick and tick-borne disease in horses. The outcome of this study serves as a baseline data about the knowledge, attitude, and practice of horse keepers with regard to ticks and tick-borne diseases in Kelantan and Terengganu.

## 11.0 APPENDIX

Table 11: Questionnaires used to collect data

No	Question	Response
<b>Respondent's Personal Information</b>		
1	Gender	<input type="checkbox"/> Male <input type="checkbox"/> Female
2	Age?	<input type="checkbox"/> 18 - 35 <input type="checkbox"/> 36 - 45 <input type="checkbox"/> > 46
3	Years of horse ownership?	<input type="checkbox"/> 1 - 5 <input type="checkbox"/> 6 - 10 <input type="checkbox"/> 11 - 15 <input type="checkbox"/> > 16
4	Level of education	<input type="checkbox"/> High school education <input type="checkbox"/> Diploma / University education
5	Number of horses owned	<input type="checkbox"/> < 2 <input type="checkbox"/> < 5 <input type="checkbox"/> < 10 <input type="checkbox"/> > 11
6	Purpose of horses	<input type="checkbox"/> Breeding <input type="checkbox"/> Endurance <input type="checkbox"/> Hobbies <input type="checkbox"/> Racing <input type="checkbox"/> Tourism
7	Type of housing management	<input type="checkbox"/> Free roaming with access to shelter <input type="checkbox"/> Guided exercise and kept in barn or stable
8	Relationship of horses	<input type="checkbox"/> Worker / Caretaker <input type="checkbox"/> Owner
<b>Knowledge Towards Ticks and Tick-borne Diseases in Horse</b>		
1	Have you seen ticks on horses?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know
2	Is this a Ticks?	<input type="checkbox"/> Yes

		<input type="checkbox"/> No <input type="checkbox"/> I don't know
3	On horses	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know
4	In horse barn	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know
5	In grazing lands	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know
6	Which season do you think horses are more susceptible to tick infestation?	<input type="checkbox"/> Dry season/ Hot weather <input type="checkbox"/> Rainy season/ Cold weather <input type="checkbox"/> All year round <input type="checkbox"/> Not aware
7	Do you think ticks always stay on body of horses unless removed?	<input type="checkbox"/> Yes. Ticks always stay on body of horses unless removed <input type="checkbox"/> No. Ticks drop off from body of horses unless removed. <input type="checkbox"/> Not aware
8	Do you think ticks are potential vectors for diseases in horses?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not aware
9	Have you experienced tick bites at one point of your lives?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not aware
10	Which is the greatest health and production impact of horses with tick infestation? (more than one option)	<input type="checkbox"/> Skin irritation due to bite wound <input type="checkbox"/> Anemia due to blood-sucking <input type="checkbox"/> Disease transmission <input type="checkbox"/> Not aware
11	Which body part of horses did you commonly seen ticks? (more than one option)	<input type="checkbox"/> Head & Neck <input type="checkbox"/> Chest & Axilla <input type="checkbox"/> Rump & Inguinal
12	Where do you think horses get tick infestation?	<input type="checkbox"/> From other infested horses <input type="checkbox"/> From tick-contaminated horse stable <input type="checkbox"/> From tick-contaminated grazing lands <input type="checkbox"/> Not aware
Attitude Towards Tick Prevention and Control Programs in Horses		

1	The proper use of synthetic acaricides can prevent and control tick infestation in horses?	<input type="checkbox"/> Strongly disagree <input type="checkbox"/> Disagree <input type="checkbox"/> Neutral <input type="checkbox"/> Agree <input type="checkbox"/> Strongly agree
2	Keeping and feeding horse in a stall can prevent and control tick infestation in horses?	<input type="checkbox"/> Strongly disagree <input type="checkbox"/> Disagree <input type="checkbox"/> Neutral <input type="checkbox"/> Agree <input type="checkbox"/> Strongly agree
3	Good hygiene can prevent and control tick infestation in horses?	<input type="checkbox"/> Strongly disagree <input type="checkbox"/> Disagree <input type="checkbox"/> Neutral <input type="checkbox"/> Agree <input type="checkbox"/> Strongly agree
<b>Practice Towards Tick Prevention and Control Programs in Horses?</b>		
1	What tick prevention and control programs did you practice? (Can have more than 1 answer)	<input type="checkbox"/> Manually remove ticks from horses <input type="checkbox"/> Use homemade remedies <input type="checkbox"/> Use synthetic acaricides <input type="checkbox"/> Keep and feed horses in stall <input type="checkbox"/> Maintain good hygiene <input type="checkbox"/> Not aware
2	What did you do with the ticks if you found them?	<input type="checkbox"/> Collect and burn them promptly <input type="checkbox"/> Collect and sock them in water promptly <input type="checkbox"/> Collect and throw them in the grazing lands <input type="checkbox"/> Other
3	Do you spray your clothes with insect repellent before handling horses?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Sometimes
4	Do you check your body for ticks after handling horses?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Sometimes





*Figure 4: data collection of horse owner / worker / caretaker*



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