UNIVERSITI PUTRA MALAYSIA

RETROSPECTIVE DATA ANALYSIS OF CASES OF PARASITIC DISEASES DIAGNOSED IN HORSES AT THE UNIVERSITY VETERINARY HOSPITAL (UVH), UNIVERSITI PUTRA MALAYSIA BETWEEN JANUARY 2018 AND SEPTEMBER 2022

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A project paper submitted to the Faculty of Veterinary Medicine, Universiti Putra Malaysia in partial fulfillment of the requirement of the DEGREE OF DOCTOR OF VETERINARY MEDICINE Universiti Putra Malaysia Serdang, Selangor Darul Ehsan.

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CERTIFICATION

It is hereby certified that we have read this project paper entitled "Retrospective data analysis of cases of parasitic diseases diagnosed in horses at University Veterinary Hospital, (UVH), Universiti Putra Malaysia between January 2018 and June 2022.", by Leyya Mohamed Hossen, and in our opinion, it is satisfactory in terms of scope, quality, and presentation as partial fulfilment of the requirement for the course VPD 4999 – Final Year Project.

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DEDICATION

This thesis is dedicated to:

My parents:

Khalil Hossen & Sadiya Hossen

&

My respected supervisors:

Assoc. Prof. Dr. Nurul Hayah Binti Khairuddin

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Abstrak

Parasit adalah ancaman biasa dan diketahui kepada kesejahteraan haiwan di seluruh dunia. Kuda boleh menjadi sasaran ektoparasit dan endoparasit, mewakili cabaran untuk pengurusan kesihatan mereka. Kawasan tropika dikenali sebagai endemik vektor, menambah kerumitan cabaran yang dihadapi. Kajian ini bertujuan untuk menyiasat kejadian dan faktor risiko yang berkaitan dengan kehadiran parasit dalam kuda yang didiagnosis di Hospital Veterinar Universiti, Universiti Putra Malaysia, Malaysia. Dari Januari 2018 hingga September 2022, sebanyak 1433 ekor kuda telah dibentangkan untuk rawatan di Hospital Veterinar Universiti, di mana hanya 27 (1.88%) secara rasmi didiagnosis dan dirawat kerana menyimpan sekurang-kurangnya satu spesies parasit. Diagnosis dibuat berdasarkan sejarah kes, pemeriksaan fizikal, tanda-tanda klinikal dan pengesahan makmal. Terdapat sedikit peningkatan dalam kejadian kes parasit setiap tahun dan kemuncak kes yang boleh dibezakan pada bulan Februari sepanjang

tahun 2018-2022 seperti yang diperhatikan oleh kajian ini. Status penyahcacingan secara statistik ($P<0.05$) dikaitkan dengan kejadian kes parasit kuda, kuda yang tidak diberi ubat cacing, lebih cenderung untuk dijangkiti. Kajian ini menunjukkan bahawa serangan parasit terdapat pada kuda di Malaysia, dengan helminthiasis menjadi punca kebimbangan. Terdapat keperluan untuk mengutamakan diagnosis yang betul kes parasit dalam kuda untuk tujuan bersama pembangunan langkah pencegahan yang sesuai untuk mengurangkan keadaan penyakit dan meningkatkan pengurusan keseluruhan, kesihatan, kesejahteraan dan prestasi kuda.

Kata kunci: Kuda; kejadian; faktor-faktor risiko; parasit; amalan berkuda

Retrospective data analysis of cases of parasitic diseases diagnosed in horses at University Veterinary Hospital, (UVH), Universiti Putra Malaysia between January 2018 and September 2022.

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Abstract

Parasites are a common and known threat to the wellbeing of animals worldwide. Horses can be the target of ectoparasites and endoparasites alike, representing a challenge for the management of their health. Tropical regions are known to be vector endemic, adding to the complexity of the challenges faced. This study was aimed at investigating the occurrence and risk factors associated with the presence of parasites in horses diagnosed in University Veterinary Hospital, University Putra Malaysia, Malaysia. From January 2018 to September 2022, a total of 1433 horses were presented for treatment in the University Veterinary Hospital, of which only 27 (1.88%) were officially diagnosed and treated for harbouring at least one species of parasite. The diagnoses were made based on case history, physical examination, clinical signs and laboratory confirmation. There was a slight increase in the occurrence of parasitic cases yearly and a

distinguishable peak of cases in the month of February throughout the years 2018-2022 as observed by this study. Deworming status was statistically ($P<0.05$) associated with the occurrence of equine parasitic cases, horses that were not dewormed, were more likely to be infected. This study showed that parasitic infestation is present in horses in Malaysia, with helminthiasis being a cause for concern. There is a need to prioritize proper diagnosis of parasitic cases in horses for the common aim of the development of appropriate preventive measure in order to decrease disease conditions and improve the overall management, health, wellbeing and performance of horses.

Keywords: Horses; occurrence; risk factors; parasites; equine practice

1.0 INTRODUCTION

It is proven that equines host a large number of parasites, and although most of these parasites cause subclinical infections, they can also cause severe health problems in some horses, even under proper management, they can be infested with internal parasites, for example, helminth infections are ubiquitous in horses that have access to pasture (Tavassoli et al., 2010). Moreover, Love (1999) established that those parasites are frequently responsible not only for generally poor health and bad performances in horses, but also gastrointestinal dysfunctions including colic. As a result, it is important to identify animals that carry higher burdens of parasites and to combine this with appropriate control practices that ensure horses do not develop substantial levels of infection (Matthews, 2011).

In addition, since horses are susceptible to more than 60 species of parasites, and may even harbour several species of worms at any time as reported by Ehizibolo (2012), it is crucial to be able to identify the species that are prevalent to be able to control any infections. For instance, the most common parasites found in horses include small and large *Strongyle* spp., *Ascarids* (*Parascaris equorum*), pinworms (*Oxyuris equi*), and tapeworms (*Anocephala* spp.). Among blood parasites that commonly infest horses are the *Trypanosoma* sp., *Babesia* sp., and *Theileria* sp. (Peter et al., 2018).

1.1 OBJECTIVE

1. To determine the occurrence of parasitic infestation in horses diagnosed in the Equine Unit, UVH.

2. To determine the risk factors associated with the presence of parasites in horses diagnosed in at the Equine Unit, UVH.

1.2 HYPOTHESIS

- Null hypothesis (H0): No cases of parasitic infestation among horses attended at UVH.

- Alternative hypothesis (HA): There are parasitic infestation among horses attended at UVH.

- Null hypothesis (H0): There are no risk factors associated with the presence of parasites among horses diagnosed at UVH.

- Alternative hypothesis (HA): There are risk factors associated with the presence of parasites among horses diagnosed at UVH.

1.3 JUSTIFICATION

Currently, the prevalence of parasite infestations in horses in Malaysia and its associated risk factors are not clear. Therefore, difference in the occurrence of parasites

among horses of different sex, breed, age, location and other potential predisposing factors need to be studied.

2.0 LITERATURE REVIEW

2.1 Equus caballus

Horse (*Equus caballus*) is considered as livestock pet or companion animal. Horses and humans interact in many aspects and this includes working activities such as police service, agriculture, pleasure riding, polo games, ceremonies, crowd control, entertainment and research (Ola-Fadunsin *et al.,* 2018), making them valuable animals. However, they can harbor a great number of parasites without exhibiting any clinical signs (Claire & Masterson, 1987; Martin *et al.,* 2007; Khan *et al.,* 2015) and stress, such as after intensive training or transport, may lead to recrudescent parasitaemia in carrier animals, influencing the performance of sporting horses (Kerber *et al.,* 2009). Thus, a proper understanding of the epidemiology of a disease-causing agent is a prerequisite for the rational design of effective preventive and control programme against the diseases (Ola-Fadunsin *et al.,* 2019).

2.2 Occurrence of parasitic infestation

Generally, parasitism in horses causes a lot of negative impact on the animal including chronic weight loss, retarded growth anemia, icterus, occasional abortions, neurological signs, and reduce work out put and performance, unthriftness and even death (Osman *et al.,* 2006; Berhanu *et al.,* 2014; Enigidaw *et al.,* 2015). As a result, it is the single most important impediment to successful horse rearing and horses can be infected with many species of parasites (Periyasamy *et al.,* 2017), this includes ectoparasites and endoparasites.

2.2.1 Ectoparasites of significance

Ectoparasites of horses include ticks, mites, flies and lice (Bob 2006; Kaufman *et al.*, 2008), all of which can act as vectors between domestic animals and humans, causing a number of diseases, some of which are zoonotic.

For instance, a study conducted by Payne (2017) in the western highlands of Cameroon established that three species of hard ticks (*Boophilus decoloratus, Amblyomma hebraeum and Hyalomma rufipes*) and one species of biting lice (*Bovicola equi*) were identified, however, other ectoparasites may have been present. It was concluded that the prevalence of the species *B. decoloratus* was highest in all the localities followed by *A. habraeum*, *H. rufipes* and *B. equi*. This may be due to the fact that *B. decoloratus* is a one host tick which parasitizes large mammals especially horses and cattle in the Neotropical, Afrotropical and Australian regions of the world (Abebaw 2004).

2.2.2 Endoparasites of significance

Horses are susceptible to intestinal and blood parasite infestations. For instance, the most common parasite found in horses include small and large *Strongyle spp*., *Ascarids* (*Parascaris equorum*), pin worms (*Oxyuris equi*), and tape worms (*Anocephala spp*.) (Peter *et al.*, 2018). Similarly, a study conducted by Peter (2018) in various establishments in Selangor, Malaysia showed that 26% of horses were positive for gastrointestinal parasites and the species of larva with the highest identification rate was Trichonema sp. at 94%. Moreover, a similar study was carried out to determine the prevalence and identify the types of gastrointestinal nematode in horses from various establishment in Malaysia, and the species identified included *Trichonema*

spp (53%)., *Ascaris sp* (5%)., *Tricostrongylus sp* (21%), *Strongyloides sp* (12%)., *Strongylus sp* (2%)., and *Poteriostomum sp.* (2%) (Periyasamy *et al.,* 2017).

On the other hand, blood parasites that commonly infest horses are the *Trypanosoma sp.*, *Babesia sp*., and *Theileria sp.* Horse infested with *Trypanosoma evansi* show clinical signs including intermittent fever, anaemia, weight loss, and death (Peter *et al.,* 2018). In Malaysia, the first clinical report of acute piroplasmosis in horses was in Kelantan (Al-Obaidi et al., 2016), which was due to to *Theileria equi* and *Babesia caballi*. It is interesting to note that the detection rate of haemoparasites in horses reflects the management practices and climatic conditions of the region (Peter *et al.,* 2018), thus some studies may not reflect the actual prevalence of those parasites.

2.3 Risk associated factors

The presence of parasites can be associated with various factors related to the animal and environmental or geographical factors (Romero *et al.,* 2020).

2.3.1 Host related factors

Despite millions of years of evolution, horses are highly susceptible to endoparasites and ectoparasites at any stage of their life (Romero *et al.,* 2020), some factors may or may not make horses more susceptible to infection. For instance, a study conducted by Romero (2020) and according to the occurrence of gastrointestinal parasites based on sex, females were significantly ($p < 0.01$) more affected than males by *Strongylus sp*. infections, too were significantly ($p < 0.01$) more susceptible to infections by *Anoplocephala sp*. than females. Similarly, Khan *et al.,* (2017) also observed a significant difference between infection in females, which could be

associated with pregnancy and lactation as causes of a decreased immunity. By contrast, no significant differences were found between genders in other studies. In addition, it has been reported that horse breed is a factor significantly associated with helminth infection, horses of some breeds showed significantly greater infection ($p < 0.02$) than in cross breeds. Lastly, immunity develops following exposure to parasites, this is indicated to be the reason as to why young horses are more susceptible to helminth infections, as they have had less opportunities for exposure (Romero *et al.*, 2020). Age is a reoccurring vital index in the epidemiology of parasitic diseases in horses (Ola-Fadunsin *et al.*, 2018).

Furthermore, body condition score is a reliable sign of parasitic burden and can serve as a useful indicator to identify horses that require an immediate attention against gastrointestinal parasitic infections (Ehizibolo *et al.*, 2012; Worku & Afera, 2012; Tesfu *et al.*, 2014; Samuel *et al.*, 2015). In line with this, a study conducted by Ola-Fadunsin (2019) pointed out that horses with poor body condition score were more prone to coccidiosis than horses with better body condition score.

2.3.2 Agent related factors

An effective way to tackle and decrease the occurrence of parasitic infestation is gather essential knowledge on the agents responsible for the infestations, such as morphology, epidemiology and life cycle. For instance, nematodes were the most numerous and prevalent gastrointestinal parasites detected in a study conducted by Ola-Fadunsin *et al.*, (2019), with *Strongylus spp*. being the most prevalent among all. The researchers also established that the high prevalence of nematodes *(Strongylus spp*.) recorded may be due to the direct life cycle of this group of

helminths where an intermediate host is not required, thereby making infection easier and completion of lifecycle faster. *Strongylus edentatus, Strongylus vulgaris* and *Strongylus equinus* are the *Strongylus* species known to infect horses and they are worldwide in distribution.

Next, Habronematidosis is a parasitic disease distributed all over the world. It is caused by *Habronema microstoma*, *Habronema muscae*, and *Draschia megastoma* (*Spirurida, Habronematidae*), and it is maintained in the environment by muscid flies which act as intermediate hosts. At larval and adult stages these species live in the stomach of domestic and wild equids. However, the larvae can also be found on the skin, causing lesions known as "summer sores", and occasionally on other body areas, such as ocular and genital mucosa (muco-cutaneous habronematidosis) and lung, liver, brain parenchyma as demonstrated by Barlaam *et al.,* (2020).

Lastly, prevalence of gastrointestinal parasites in horses is associated with modification of their biological cycle, and resistance to deworming drugs. The degree of damage caused to the horse by parasites will directly depend on the species and quantities of helminths (Romero *et al.,* 2020).

2.3.3 Environment and management related factors

Nowadays, emphasis is placed on climate change, as some parasites have modified their biological cycle as a result of temperature, precipitation and humidity changes (Romero *et al.,* 2020). Environmental factors play the biggest role in the occurrence of parasitic infestation, hence, access to grass, routinely deworming, season, geographic area and emergence of drug-resistant strains are some of the risk factors that have been associated with parasite infection

(Romero *et al.,* 2020). Coincidentally, a study conducted in Malaysia by Periyasamy *et al.,* (2017) established that irregular deworming causes horses to be more prone to be infected than horses dewormed regularly every 3 and 6 months. The irregularity in dewormed results in large parasite residing in the intestines (Loving, 2014).

In addition, following the same study by Periyasamy *et al.,* (2017), some establishment had 100% prevalence of gastrointestinal parasites, probably due to poor sanitation in some stables where the contaminated manure remained even after 3 days. Although all horses in this study were stabled, they are allowed graze a few hours on the same pasture each day. Therefore, they were at risk of acquiring infection from contaminated pasture and horse manure.

2.4 Effective control and prevention

Firstly, public awareness creation to equine owners on proper deworming, sufficient feed supply and minimizing extensive open grazing of donkeys and horses is important. Balancing of the work load and duration should be managed (Tesfu *et al.,* 2014).

Moreover, removal of faeces from pickets and stalls prevents infection of treated animals and autoinfection. These are simple measures that help, in a considerable way, in the success of helminth control. Several studies have shown that pasture management is one of the tools to maximize the control of helminths in the property, thereby reducing the frequency of anthelmintic treatments in animals. Regarding the time of higher occurrence of helminths, most creators claimed it to be during the rainy season, which is correct because heat and humidity provide ideal conditions for proliferation and survival of these parasites (Rosa *et al.,* 2018).

Finally, it is confirmed that breed, sex and geographic location are risk factors associated with susceptibility to infection. Adequate detection and implementation of new strategies for parasite control in equines is advisable (Romero *et al.,* 2020).

Large animals such as horses are commonly managed and housed in open stables especially in Malaysia. Therefore, their constant exposure to the surrounding environment could be detrimental to their welfare and to their overall performances. An important component of the environment is the presence of parasites, as they can be particularly harmful to equines if appropriate preventive and control measures are not applied. Thus, this study aims at forging a better understanding of the risk factors associated with parasitic infections in horses to limit health problems associated with this condition.

3.0 MATERIALS AND METHODS

3.1 Data collection

The case files from January 2018 to September 2022 were studied and those that decrypted parasitaemia cases were selected. In the case files, diagnosis of each parasitic disease was carried out based on case history, physical examination, clinical signs and in some cases via laboratory testing by blood (thin and thick smears) and faecal (floatation and sedimentation techniques). Parameters such as date of presentation, age, sex, breed, deworming status, presence of co-morbidities and stable location were recorded.

3.2 Statistical analysis

Firstly, descriptive statistics was conducted to estimate the frequency of parasitic cases yearly, and monthly using percentages in tables and graphs. Then, the univariate analysis (chi-square) test was used to determine the association between each risk factor and the incidences of parasitic cases with 59 cases. All statistical tests were conducted using Microsoft Excel and IBM SPSS Statistics for Windows, Version 26. Significant level was set at $P < 0.05$.

4.0 RESULTS

The yearly and monthly prevalence of parasitic cases of horses is presented in figures 1 and 2 respectively. Parasitic cases were most prevalent in 2022 recording 3.39% until the month of September. The pattern of the curve shows a linear increase of parasitic cases over the years. Moreover, parasitic cases seem to peek in the month of February, constituting 0.49% of the overall cases presented in the hospital in 5 years as shown by figure 2. In contrast, the months of January, August and October show no parasitic case presentation in 5 years.

	2018	2019	2020	2021	2022 (Until September)	Total
Infected	4	4	6	5	8	27
Non-infected	375	412	195	196	228	1406
Total	379	416	201	201	236	1433

Table 1. Total number of parasitic cases presented to University Veterinary Hospital (UVH), University Putra Malaysia. ** Overall proportion: 1.88%*

	January	February	March	April	May	June	July	August	September	Total
Infected	0	6	1	0	0	0	1	0	0	8
Non-infected	42	5	8	35	59	33	6	25	15	228
Total	42	11	9	35	59	33	7	25	15	236

Table 2. Total number of parasitic cases presented monthly to University Veterinary Hospital (UVH), University Putra Malaysia.

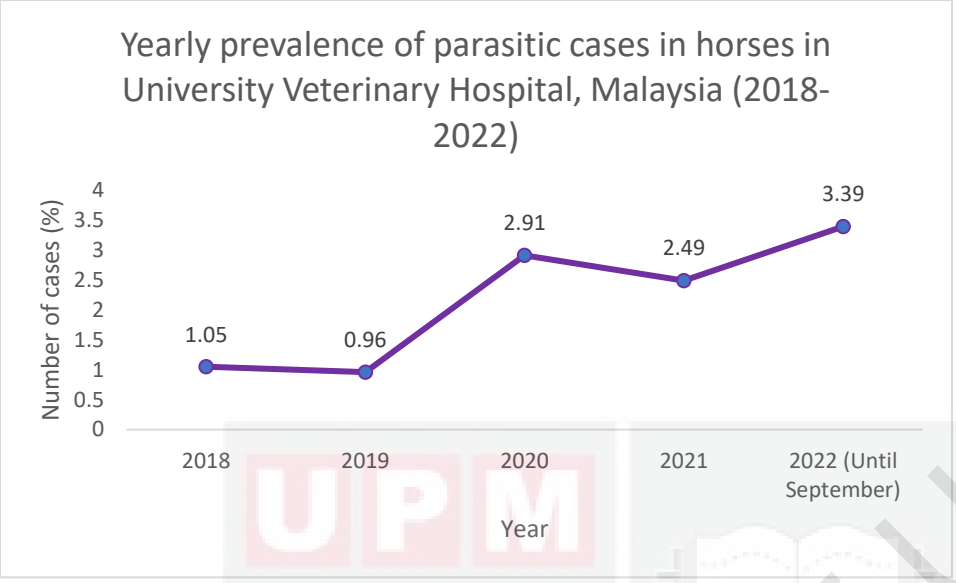

Fig 1.

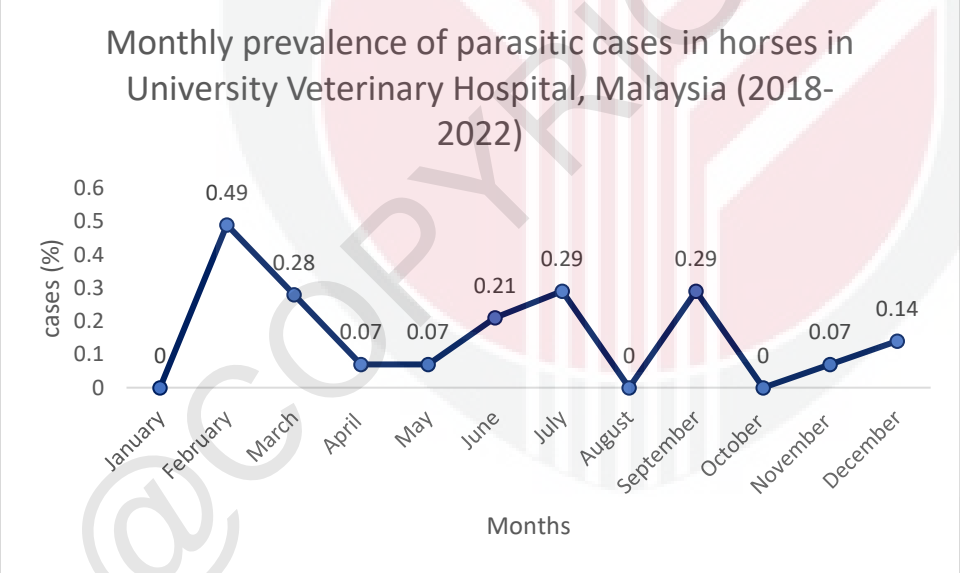

Fig 2.

The relationship between different risk factors with the diagnosis of parasitic cases of horses is presented in Table 1. There was a statistically significant relationship between the diagnoses of parasitic cases with deworming status ($P<0.05$). However, sex, age, breed, co-morbidity and location were not statistically ($P>0.05$) associated with the diagnoses of parasites in horses in this study.

Risk factors	**Total cases**	**Parasitic cases**	**Odd ratio**	***P* value**
Sex				
Stallion	1	1		
Gelding	39	12		.34
Mare	19	6		
Age (years)				
4-8	12	7		
9-13	23	6		.24
14-18	15	3		
19-23	7	2		
24-28	2	1		
Breed				
Arabian	8	6		
Criollo	2	0		.06
Polo Pony	20	4		
Thoroughbred	15	5		
Warmblood	14	4		
Co-morbidity				
At least one	24	6		
None	35	13		.33
Deworming status				
Up to date	35	5		
Not up to date	24	14	8.45	<0.05*
			Ref	

Premises type			
Government	18	5	
City council	15	6	.74
Private	26	8	

Table 3: Risk factors associated with parasitic cases of horses in University Veterinary Hospital, University Putra Malaysia (2018 – September 2022).

5.0 DISCUSSION

This appears to be the first retrospective study on the occurrence and risk factors associated with parasitic infestation in horses in the University Veterinary Hospital, Universiti Putra Malaysia. The findings showed that parasitic infestations are not frequent compared to other conditions with an overall proportion of 1.88% between 2018 and September 2022. This may translate in the fact that there are not enough initiatives in the diagnosis of parasitic conditions as unhealthy animals are brought to the hospital for other medical conditions, and the numbers found in this study do not reflect the reality of the situation. The yearly distribution of parasitic cases showed no defined pattern, apart from a steady increase between 2018 and 2022. This may be due to the constant effort of the Equine veterinarians in sensitizing the public on the need to report and present their animals and pets to the clinics whenever a disease condition is seen, as depicted by Tesfu *et al.,* (2017) stating that public awareness creation to equine owners on proper deworming, sufficient feed supply and minimizing extensive open grazing of donkeys and horses is important and balancing of the work load and duration should be managed. On the other hand, the monthly distribution of parasitic cases showed a peek in the month of February, constituting 0.49% of the overall cases presented in the hospital in 5 years. This may be due to the weather at this time of the year, which is hot, humid and sunny as the region experiences one of its driest months of the year with average temperatures of 30 °C, constituting optimum environmental conditions for the proliferation of parasites, as highlighted by Ola Fadunsin *et al.,* (2019), for instance, the differences in the prevalence could be attributed to the season of sampling, climatic and environmental differences.

From the diagnoses recorded, ocular habronemiasis, helminthiasis, and flea infestation were the conditions present, which can be attributed to a few things. Firstly, habronemiasis is caused by

Habronema microstoma, Habronema muscae, and Draschia megastoma, and it is maintained in the environment by muscid flies which act as intermediate hosts. Thus, climate is an important factor as the parasites and flies alike prevail in subtropical and tropical regions as reported by Barlaam *et al.,* (2020). Moreover, horses are allowed to intermittently graze on grass paddocks in groups, increasing the chances of helminth infection. In addition, cleanliness of the premises (in stable and in paddocks) may not be maintained at all times as described by Periyasamy *et al.,* (2017), thus manure serves on one hand as common source of infection between infected and uninfected individuals and on the other hand as a means to attract flies.

In terms of risk factors, age was repeatedly shown as a vital parameter in the epidemiology of parasitic diseases in horses as stated by Ola-Fadunsin *et al.,* (2018). However, the results were shown to be inconclusive in this study possibly due to a small sample size paired with an inappropriate categorization of the age groups. Similarly, this study found no significant correlation between gender and parasitic infestation contrary to other studies which discovered that there was a higher prevalence recorded in female horses that could be attributed to stress associated with gestation, parturition and lactation (Ola-Fadunsin *et al.,* 2018). This may be because male and female horses are subjected to the same type of management and work. Furthermore, breed and type of premises were proven to be unsignificant factors in parasitic infestations in contradiction with Romero *et al.,* (2020) who confirmed that breed, sex and geographic location are risk factors associated with susceptibility to infection, which may also be attributed to the small sample size in this study. Lastly, deworming status was statistically significant and correlates with parasitic infection. For instance, horses that had an up-to-date deworming status were 8.45 times less likely to develop a parasitic infection as shown by Table 3, which sheds a light on the importance of establishing an appropriate deworming protocol

especially for horses, as they are verily exposed and prone to parasitic infections and possible related complications. This finding is similar to other studies, as seen by the following statement: Many factors influence a horse's susceptibility to pick up worms. These include the type of pasture and the worming protocol (Paterson., 2009).

6.0 CONCLUSION

To conclude, there are parasitic infestation cases seen at the University Veterinary Hospital (UVH), Universiti Putra Malaysia as demonstrated by this study, although their occurrences may be low and parasites such as helminths were the most common. This further demonstrates the necessity for the development of an appropriate deworming regime, and other measures to limit the parasitic burden on horses within stables.

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APPENDICES

APPENDIX A: CHI-SQUARE TESTS

SPSS generated table depicting age groups

			STATUS		
			infected	not infected	Total
AGE	4-8yrs	Count	7	5	12
		Expected Count	3.9	8.1	12.0
		% within AGE	58.3%	41.7%	100.0%
	9-13yrs	Count	6	17	23
		Expected Count	7.4	15.6	23.0
		% within AGE	26.1%	73.9%	100.0%
	14-18yrs	Count	3	12	15
		Expected Count	4.8	10.2	15.0
		% within AGE	20.0%	80.0%	100.0%
	19-23yrs	Count	2	5	7
		Expected Count	2.3	4.7	7.0
		% within AGE	28.6%	71.4%	100.0%
	24-28yrs	Count	1	1	2
		Expected Count	.6	1.4	2.0
		% within AGE	50.0%	50.0%	100.0%
Total		Count	19	40	59
		Expected Count	19.0	40.0	59.0
		% within AGE	32.2%	67.8%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5.502[a]	4	.240
Likelihood Ratio	5.287	4	.259
Linear-by-Linear Association	1.366	1	.243
N of Valid Cases	59		

SPSS generated table depicting breed groups

			STATUS		
			infected	not infected	Total
BREED	A	Count	6	2	8
		Expected Count	2.6	5.4	8.0
		% within BREED	75.0%	25.0%	100.0%
	Cr	Count	0	2	2
		Expected Count	.6	1.4	2.0
		% within BREED	0.0%	100.0%	100.0%
	PP	Count	4	16	20
		Expected Count	6.4	13.6	20.0
		% within BREED	20.0%	80.0%	100.0%
	TB	Count	5	10	15
		Expected Count	4.8	10.2	15.0
		% within BREED	33.3%	66.7%	100.0%
	WB	Count	4	10	14
		Expected Count	4.5	9.5	14.0
		% within BREED	28.6%	71.4%	100.0%
Total		Count	19	40	59
		Expected Count	19.0	40.0	59.0
		% within BREED	32.2%	67.8%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	9.119[a]	4	.058
Likelihood Ratio	9.290	4	.054
N of Valid Cases	59		

SPSS generated table depicting the presence of comorbidities

	STATUS	Total

			infected	not infected	
COMORBIDITY	yes comorbidity	Count	6	18	24
		Expected Count	7.7	16.3	24.0
		% within COMORBIDITY	25.0%	75.0%	100.0%
	no comorbidity	Count	13	22	35
		Expected Count	11.3	23.7	35.0
		% within COMORBIDITY	37.1%	62.9%	100.0%
Total		Count	19	40	59
		Expected Count	19.0	40.0	59.0
		% within COMORBIDITY	32.2%	67.8%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.962[a]	1	.327		
Continuity Correction[b]	.486	1	.486		
Likelihood Ratio	.978	1	.323		
Fisher's Exact Test				.402	.244
Linear-by-Linear Association	.945	1	.331		
N of Valid Cases	59				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 7.73.

b. Computed only for a 2x2 table

SPSS generated table depicting the deworming status

			STATUS		
			infected	not infected	Total
DEWORMING	up to date	Count	5	30	35
		Expected Count	11.3	23.7	35.0
		% within DEWORMING	14.3%	85.7%	100.0%
	not up to date	Count	14	10	24
		Expected Count	7.7	16.3	24.0
		% within DEWORMING	58.3%	41.7%	100.0%
Total		Count	19	40	59
		Expected Count	19.0	40.0	59.0
		% within DEWORMING	32.2%	67.8%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	12.652[a]	1	.000		
Continuity Correction[b]	10.715	1	.001		
Likelihood Ratio	12.841	1	.000		
Fisher's Exact Test				.001	.001
Linear-by-Linear Association	12.438	1	.000		
N of Valid Cases	59				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 7.73.

b. Computed only for a 2x2 table

SPSS generated table depicting gender groups

			STATUS		
			infected	not infected	Total
SEX	stallion	Count	1	0	1
		Expected Count	.3	.7	1.0
		% within SEX	100.0%	0.0%	100.0%
	Gelding	Count	12	27	39
		Expected Count	12.6	26.4	39.0
		% within SEX	30.8%	69.2%	100.0%
	Mare	Count	6	13	19
		Expected Count	6.1	12.9	19.0
		% within SEX	31.6%	68.4%	100.0%
Total		Count	19	40	59
		Expected Count	19.0	40.0	59.0
		% within SEX	32.2%	67.8%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.145[a]	2	.342
Likelihood Ratio	2.307	2	.316
Linear-by-Linear Association	.197	1	.657
N of Valid Cases	59		