

RETROSPECTIVE STUDY OF *Mycoplasma haemofelis* INFECTION IN CATS IN KELANTAN  
FROM THE YEAR 2017 TO 2021

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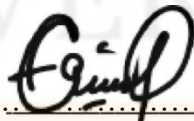
## CERTIFICATION

This is to certify that we have read this research paper entitled '**Retrospective Study of *Mycoplasma haemofelis* Infection in Cats in Kelantan**' by **Aravin Kumaran A/L S Thiruvarasu** and in our opinion it is satisfactory in terms of scope, quality, and presentation as a partial fulfillment of the requirement for the course **DVT 55204 – Research Project**



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**Thank You**

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## DEDICATIONS

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## ABSTRACT

An abstract of the research paper presented to the Faculty of Veterinary Medicine, Universiti Malaysia Kelantan, in partial requirement on the course DVT 55204 - Research Project.

*Mycoplasma haemofelis* is a bacterial parasite that affects many cats in Malaysia. This retrospective study was done to determine the prevalence of *Mycoplasma haemofelis* infection in cats in Kelantan, the diagnostic approach used and the risk factors associated with *Mycoplasma haemofelis* infection in cats in veterinary clinics in Kelantan. Data was collected from Hospital Pengajar Perubatan Veterinar Universiti Malaysia Kelantan and Kitty Cat Klinik from the year 2017 to 2021. Case files and computerized data were analyzed for this retrospective study. Chi-square test was used to analyze the risk factors associated with the occurrence of *Mycoplasma haemofelis* infection in cats from the year 2017 to 2021. The overall prevalence of *Mycoplasma haemofelis* infection in cats throughout the 5 years is 64.75%. The most common way to diagnose *Mycoplasma haemofelis* in this study is via polymerase chain reaction (PCR) where 68.03% of the cases were subjected to the test. Seasonality, roaming status and household condition are all considered as associated risk factors with *Mycoplasma haemofelis* infection in cats.

Keywords : *Mycoplasma haemofelis* infection, Prevalence, Diagnostic methods, Risk factors

## ABSTRAK

Abstrak daripada kertas penyelidikan dikemukakan kepada Fakulti Perubatan Veterinar, Universiti Malaysia Kelantan untuk memenuhi sebahagian daripada keperluan kursus DVT 55204 - Projek Penyelidikan.

*Mycoplasma haemofelis* adalah sejenis bakteria yang memberi kesan kepada banyak kucing di Malaysia. Kajian retrospektif ini dilakukan untuk menentukan kelaziman jangkitan *Mycoplasma haemofelis* pada kucing di Kelantan, kaedah diagnosis yang digunakan dan juga risiko yang dikaitkan dengan jangkitan *Mycoplasma haemofelis* pada kucing. Data telah dikumpul daripada Hospital Pengajar Perubatan Veterinar Universiti Malaysia Kelantan dan Kitty Cat Klinik dari tahun 2017 hingga 2021. Fail kes dan data berkomputer telah dianalisis untuk kajian retrospektif ini. Faktor risiko berkaitan dengan jangkitan *Mycoplasma haemofelis* dalam kucing dari tahun 2017 hingga 2021 telah dianalisis. Kelaziman keseluruhan jangkitan *Mycoplasma haemofelis* dalam kucing sepanjang 5 tahun ialah 64.75%. Kaedah yang paling biasa untuk mendiagnosis *Mycoplasma haemofelis* adalah melalui polymerase chain reaction di mana 68.03% daripada kes yang direkodkan telah menjalani ujian tersebut. Untuk risiko, musim, status perayauan dan keadaan isi rumah semuanya dikaitkan dengan jangkitan *Mycoplasma haemofelis* pada kucing.

Kata Kunci : *Mycoplasma haemofelis* infection, Prevalence, Diagnostic methods, Risk factors

## 1.0 INTRODUCTION

*Mycoplasma haemofelis*, formerly known as *Haemobartonella felis* is a pleomorphic bacterial parasite found on the surface of red blood cells of cats (Kewish et al., 2004). It belongs to the phylum *Tenericutes*, class *Mollicutes*, order *Mycoplasmoidales*, family *Mycoplasmoidaceae*, genus *Mycoplasma*. This bacterium is gram-negative, but is not normally stained because the cells will then be fragmented. It also lacks a cell wall (VetBact, 2021).

The prevalence of *Mycoplasma haemofelis* in cats has been shown to be related to the cat's lifestyle. Some preliminary studies were done on stray cats in Kota Bharu, Kelantan and revealed the prevalence rate of 11.7 %, detected using polymerase chain reaction and thin blood smear (Aklilu et al., 2016). Similarly, another study conducted in Kelantan involving data from March 2016 to December 2019 among a total of 77 owned cats revealed 46 cats were infected by *Mycoplasma haemofelis* confirmed by polymerase chain reaction (Peng, 2022). It is often discussed that *Mycoplasma haemofelis* infections are more likely to occur in male, non-pedigree cats that would have access to outdoor surroundings, however, data regarding the associated risk factors are still less in Malaysia.

The most common clinical signs of *Mycoplasma haemofelis* infection in cats, include anorexia, lethargy, tachypnea, pale mucous membrane, and jaundice. For the diagnostic workup, peripheral blood film examinations can be done together with polymerase chain reaction, a diagnostic modality with a higher sensitivity. To treat *Mycoplasma haemofelis* infection, doxycycline is the antibiotic of choice and is administered for 3 to 4 weeks. Enrofloxacin, which is an antibiotic of the fluoroquinolones group has also been deemed effective, however it can lead to blindness in the cats that were treated. *Mycoplasma haemofelis* infection can cause the cats to develop immune-mediated hemolytic anemia, so glucocorticosteroid administration might be indicated. Studies have indicated that treatment will not always be effective, and cats can remain as carriers throughout their lifetime (Harrus, 2014). The purpose of the research is to identify the prevalence, risk factors and diagnostic workup among cats infected with *Mycoplasma haemofelis* in Kelantan.

## 1.1 RESEARCH PROBLEM

It is a known fact that *Mycoplasma haemofelis* infection is distributed worldwide. However, the prevalence, risk factors and diagnostic workups of *Mycoplasma haemofelis* infection are not reported among the cats that visited veterinary hospitals in Kelantan. There is a lack of published analysis about the infection involving the risk factors and its transmission in Kelantan.



## 1.2 RESEARCH QUESTIONS

- What is the prevalence of *Mycoplasma haemofelis* infection in cats in Kelantan?
- What are the risk factors associated with *Mycoplasma haemofelis* infection in cats in Kelantan?
- What is the diagnostic workup used to diagnose *Mycoplasma haemofelis* infection in cats in Kelantan?

## 1.3 RESEARCH HYPOTHESIS

- There is high prevalence of *Mycoplasma haemofelis* infection in cats in Kelantan.
- There is association between sex, breed, season, life stage, roaming status and household condition with *Mycoplasma haemofelis* infection in cats in Kelantan.
- The diagnostic workup used to diagnose *Mycoplasma haemofelis* infection in cats in Kelantan include polymerase chain reaction and peripheral blood film.

## 1.4 RESEARCH OBJECTIVES

- To determine the prevalence of *Mycoplasma haemofelis* infection in cats in Kelantan.
- To determine the risk factors associated with *Mycoplasma haemofelis* infection in cats in Kelantan.
- To identify the diagnostic workup used to diagnose *Mycoplasma haemofelis* infection in cats in Kelantan.

## 2.0 LITERATURE REVIEW

### 2.1 ETIOLOGY

*Mycoplasma haemofelis* previously known as *Haemobartonella felis* is a pleomorphic bacterium that is found on the surface of erythrocytes of cats. In polychrome stain, they are seen as small blue cocci shaped bacteria on the edges of red blood cells (Kewish et al., 2004).

### 2.2 TRANSMISSION

The transmission of *Mycoplasma haemofelis* is reported to involve cat flea which are blood sucking parasites. The cat flea is known as *Ctenocephalides felis*. Blood transfusions has also been noted to be a source of transmission of *Mycoplasma haemofelis*. Healthy cats can also be infected if contaminated needles are used. The bacteria can also be transmitted vertically where the kitten can get infected within the uterus, via parturition or even nursing (Lehmann, 2010).

### 2.3 CLINICAL SIGNS

One of the major clinical signs in cats that have *Mycoplasma haemofelis* infection is anemia. This occurs because when the bacterial parasite attaches itself to the surface of the erythrocytes and this triggers the immune system to recognize the red blood cells as 'foreign'. This causes the destruction of the red blood cells leading to decreased amount of red blood cells within the body. The decrease in red blood cells can lead to pale mucous membrane and if there is jaundice, the membrane would be appeared yellow. Jaundice occurs due to the excessive level of bilirubin in the blood due to excessive red blood cell hemolysis. When the red blood cells are reduced, they cat will fatigue easily and become lethargic. Pyrexia, tachypnea, and tachycardia are some of the common clinical signs seen in a cat that is infected (Llera & Ward, 2019).

### 2.4 DIAGNOSTIC WORKUP

Diagnosis of *Mycoplasma haemofelis* infection can be done by can be done via peripheral blood film or polymerase chain reaction. When the blood smears are done, the organisms are seen as basophilic, ring- or rod-shaped structures found on the surface of the erythrocytes. The sensitivity of a blood smear may be poor, because in chronic infections, parasitaemia is cyclic. Organisms may disappear from circulation in as less as 2 hours. Polymerase chain reaction, on the other hand has higher sensitivity and can more accurately detect *Mycoplasma haemofelis* infection. Polymerase chain reaction can be carried out using whole blood and aspirates taken from the affected animal's spleen (Foley, 2022).



## 2.5 TREATMENT AND PREVENTION

Antibiotics such as doxycycline (5–10 mg/kg q 12–24 h, respectively, PO), are recommended to be administered for 3 to 4 weeks to eliminate the infection. Other antibiotics such as enrofloxacin (5 mg/kg q 24 h, PO) that is administered for 10 to 14 days have been proven to be effective. However, the antibiotic has the potential to cause blindness in cats. Antibiotic treatment should be accompanied by prednisone administration as cats may develop immune mediated hemolytic anemia secondary to *Mycoplasma haemofelis* infection (Harrus, 2014). Some of the preventive measures include flea control and managing cats indoors. Other than that, blood donors must be screened *Mycoplasma haemofelis* infection by polymerase chain reaction before blood transfusion can be done. There are no vaccines against *Mycoplasma haemofelis* till date (Tasker, 2022).

### **3.0 MATERIALS AND METHODS**

#### **3.1 STUDY AREA**

The study area is Kelantan which is a northeastern state in Peninsular Malaysia. There are 10 districts in Kelantan and Kota Bharu is the state capital. Kelantan is an area with warm temperatures and high humidity year-round. Two veterinary clinics are included in this study, which are Hospital Pengajar Perubatan Veterinar Universiti Malaysia Kelantan and Kitty Cat Klinik.

#### **3.2 STUDY DESIGN**

This study is a retrospective cohort study where the members of the cohort who have been exposed to a certain risk factor are traced back to whether they have confirmed *Mycoplasma haemofelis* infection.

#### **3.3 STUDY POPULATION**

Cats that are infected by *Mycoplasma haemofelis* that are recorded in veterinary clinics and veterinary hospitals in Kelantan.

#### **3.4 SELECTION CRITERIA**

##### **3.4.1 INCLUSION CRITERIA**

The inclusion criteria for this study are cats that have been suspected to have *Mycoplasma haemofelis* infection that have been recorded in veterinary clinics in Kelantan. Suspected cases include cats that have clinical signs of *Mycoplasma haemofelis* infection such as jaundice and flu. Incidental findings are also under the suspected cases category.

### **3.4.2 EXCLUSION CRITERIA**

The exclusion criteria for this study are cats that are stray.

### **3.5 SAMPLING TECHNIQUE**

The sampling technique used is convenience sampling where there are collections of sampling units which are easily accessible.

### **3.6 SAMPLING PROCEDURE**

The data is collected from veterinary clinics in Kelantan from the year 2017 to 2021.

### **3.7 DATA COLLECTION**

The tool used is data collection form to obtain patient details. Data was retrospectively collected from patient case files and digital database of the sampled clinics from 1/1/2017 to 31/12/2021 . Data on patient details and diagnostic workup are collected from veterinary clinics in Kelantan. Patient details like sex, age, breed, management, and the diagnostic workup used to diagnose the infection are collected. The 122 cases were divided by their age according to the American Animal Hospital Association (AAHA) guideline. The cats were classified as Kitten (up to 1 year old), young adult (1 to 6 years old), mature adult (7 to 10 years old), or senior (more than 10 years old). A cat is considered a roamer cat if the cat gains access to the outdoor environment while it is considered non-roamer if it does not gain access to the outdoor environment. According to the official website of Malaysian Meteorological Department, the

northeast monsoon starts in November and ends in March and Kelantan is affected by this monsoon. Rainy season is defined as the period where the northeast monsoon occurs while sunny season is the period where the monsoon does not occur.

### **3.8 DATA ANALYSIS**

The collected data is keyed into Microsoft Excel and analyzed using Statistical Package for Social Sciences 26.0. Categorical data is then summarized as frequency and percentage while numerical data is summarized as mean and standard deviation. Pearson's chi-squared test is used to determine the association between categorical variables. Data is considered significant at  $p < 0.05$ .

## 4.0 RESULTS

### 4.1 DESCRIPTIVE CHARACTERISTICS OF THE STUDY SUBJECTS AND THE PREVALENCE OF *Mycoplasma haemofelis* INFECTION IN CATS FROM THE YEAR 2017 TO 2021

Of the 122 cases included in this study, 62.30% (n=76) of the cases were male cats while 37.70% (n=46) of the cases were female cats. 23.77% (n=29) were kittens, 70.49% (n=86) were young adults, 4.10% (n=5) were mature adults and 1.64% (n=2) were senior cats. For the breed of the cats, 80.33% (n=98) of the cats were domestic shorthair cats, 5.74% (n=7) were persian, 2.46% (n=3) were british shorthair, 8.19% (n=10) were domestic longhair, 0.82% (n=1) were bengal cross, 0.82% (n=1) were siamese, 0.82% (n=1) were mix maine coon and 0.82% (n=1) were british longhair cats. For the roaming status, 43.44% (n=53) were roamer cats, 36.07% (n=44) were non-roamer cats and 20.49% (n=25) were unknown. 58.20% (n=71) of the cats are single cats in a household while 21.31% (n=26) of the cats live with other cats. The household condition for 25 other cats were unknown which amounts to 20.49%. For the seasonality that the cats were subjected to either polymerase chain reaction or peripheral blood film, 47.54% (n=58) of the cats were subjected to the tests during the rainy season while 52.46% (n=64) were subjected to tests during the sunny season.

The overall total number of cats that were presented to both clinics were over the 5 years was 11817. Out of 11817 cases, only 122 cases were subjected to polymerase chain reaction or peripheral blood film for the confirmation of the infection in the span of 5 years in Hospital Pengajar Perubatan Veterinar Universiti Malaysia Kelantan and Kitty Cat Klinik. The prevalence of *Mycoplasma haemofelis* infection was highest in 2021 (100%) while the lowest was in 2020 (39.13%) as shown in Figure 2. The overall prevalence of *Mycoplasma haemofelis* infection over the 5 years is 64.75%.

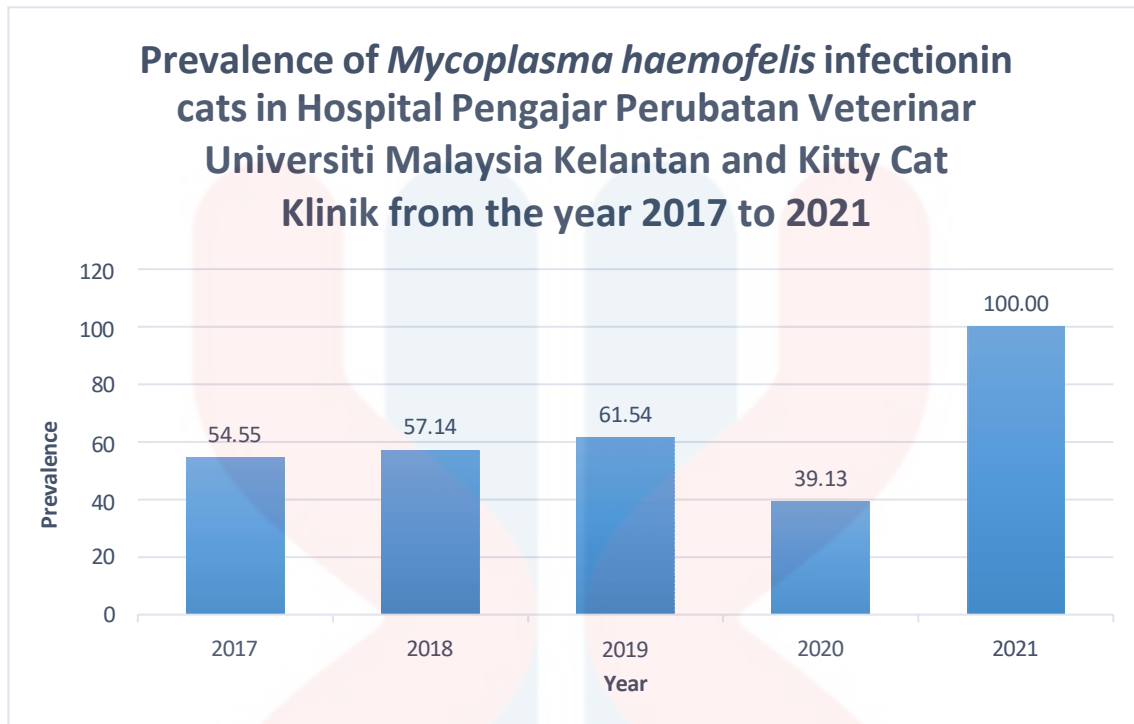


Figure 1 : Bar graph representing prevalence of *Mycoplasma haemofelis* infection from 2017 to 2021.

#### 4.2 PREVALENCE OF *Mycoplasma haemofelis* INFECTION IN CATS AMONG TOTAL NUMBER OF CATS PRESENTED FROM THE YEAR 2017 TO 2021

Out of the 122 cases included in this study, the prevalence of *Mycoplasma haemofelis* infection among total number of cats presented in the span of 5 years in Hospital Pengajar Perubatan Veterinar Universiti Malaysia Kelantan and Kitty Cat Klinik was highest in 2021 (1.06%) while the lowest was in 2017 (0.24%) as shown in Figure 1.

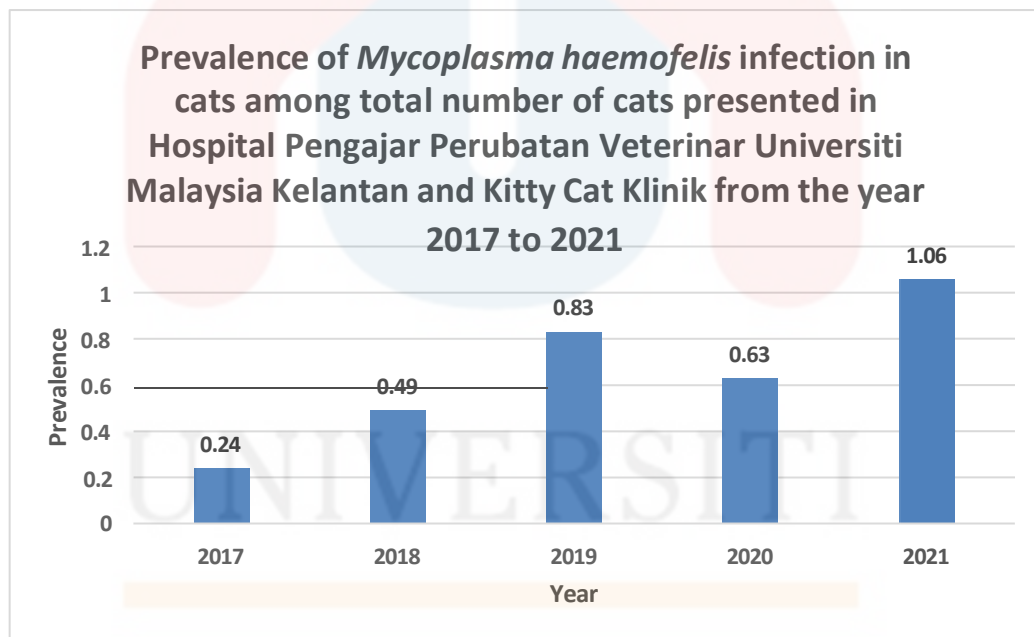


Figure 2 : Bar graph representing the prevalence of *Mycoplasma haemofelis* infection in among total number of cats presented from 2017 to 2021

#### 4.3 DIAGNOSTIC METHODS USED TO DIAGNOSE *Mycoplasma haemofelis* INFECTION IN CATS FROM THE YEAR 2017 TO 2021

There were 122 total cases that were subjected to polymerase chain reaction or peripheral blood film in the span of 5 years in Hospital Pengajar Perubatan Veterinar Universiti Malaysia Kelantan and Kitty Cat Klinik. The percentage of cases that were subjected to peripheral blood film is 31.97% which is a total of 39 cases while the percentage of cases that were subjected to polymerase chain reaction is 68.03% which is a total of 83 cases. Out of the 39 cases that were subjected to peripheral blood film, 87.18% of the cases were positive for *Mycoplasma haemofelis* which is a total of 34 cases. Out of the 83 cases that were subjected to polymerase chain reaction, 54.22% of the cases were positive for *Mycoplasma haemofelis* which is a total of 45 cases.

Table 1 : Diagnostic methods used to diagnose *Mycoplasma haemofelis* infection in cats in Hospital Pengajar Perubatan Veterinar Universiti Malaysia Kelantan and Kitty Cat Klinik from The Year 2017 To 2021

	Positive cases	Negative cases	Total cases
Cases subjected to Peripheral Blood Film	34	5	39
Cases subjected to Polymerase Chain Reaction	45	38	83



Diagnostic methods used to diagnose *Mycoplasma haemofelis* infection in cats in Hospital Pengajar Perubatan Veterinar Universiti Malaysia Kelantan and Kitty Cat Klinik from The Year 2017 To 2021

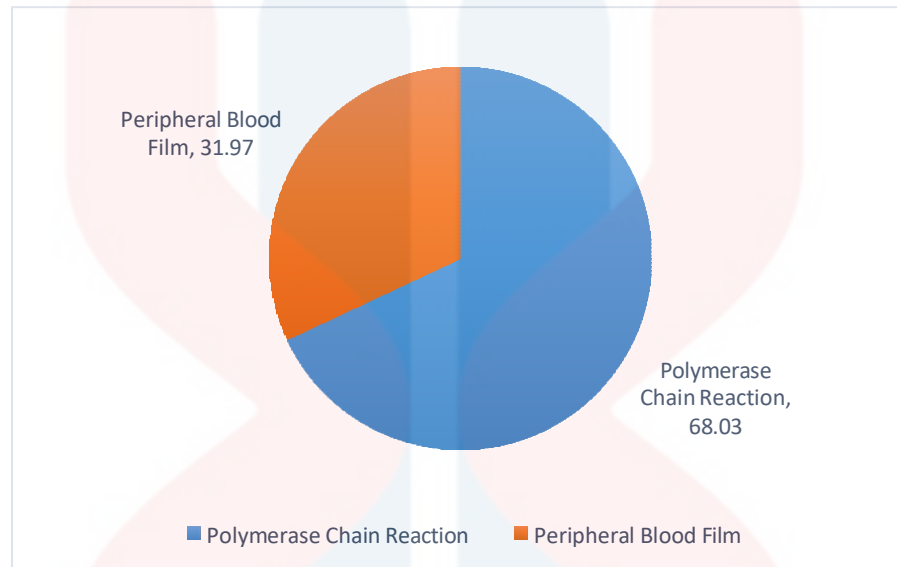


Figure 3: Pie Chart representing the diagnostic methods used to diagnose *Mycoplasma haemofelis* infection.

#### **4.4 RISK FACTORS ASSOCIATED WITH THE OCCURRENCE OF *Mycoplasma haemofelis* INFECTION IN CATS FROM THE YEAR 2017 TO 2021**

The association between risk factors such as sex, breed, season, life stage, roaming status and household condition were calculated using Chi-square test. As tabulated below in Table 1, the results show that the independent variables such as season, roaming status and household condition are all significant ( $P < 0.05$ ) except the sex, life stage and breed ( $P > 0.05$ )

Table 2 : Risk factors associated with the occurrence of *Mycoplasma haemofelis* infection in cats in Hospital Pengajar Perubatan Veterinar Universiti Malaysia Kelantan and Kitty Cat Klinik from the year 2017 to 2021

Risk Factors		Prevalence (%)	p-Value	Significant
Sex	Male	68.35%	0.061	No
	Female	31.65%		
Season	Rainy	37.97%	0.004	Yes
	Sunny	62.03%		
Life Stage	Kitten	26.58%	0.166	No
	Young Adult	68.35%		
	Mature Adult	5.06%		
	Senior	0.00%		
Breed	Domestic	84.81%	0.316	No
	Shorthair			
	Persian	5.06%		
	British	1.27%		
	Shorthair			
	Domestic	7.59%		
	Longhair			
	Bengal Cross	0.00%		
	Siamese	0.00%		
	Mix Maine	1.27%		
	Coon			
British longhair	0.00%			
Roaming	Roamer	45.57%	0.000	Yes
Status	Non-roamer	22.78%		
	Unknown	31.65%		
Household	Single cat	50.63%	0.000	Yes
Condition	Multicat	17.72%		
	Unknown	31.65%		

Note: \* significant at p-value < 0.05

## 5.0 DISCUSSION

The result showed that the overall prevalence of *Mycoplasma haemofelis* infection in this retrospective study was 64.75%. This value is slightly lower than the overall prevalence of another retrospective study that was done in Kelantan which had a value of 68.8%. This previous study was done from 2016 to 2019 (Peng, 2022). This study recorded a higher prevalence than a study done in the same region where stray cats that randomly sampled were subject to polymerase chain reaction. That study revealed a prevalence rate of only 11.7% (Aklilu et al., 2016). The extended period of research together with the number of clinics where the data was taken from may have contributed to the high prevalence of this study. Different clinics cover different parts of Kelantan which would give the different prevalence of the infection rate. The yearly breakdown of the cases revealed that in 2021, there was a 100% prevalence rate which was the highest among the 5 years. This was because only confirmed cases was able to be obtained during that year. 2020 saw the lowest prevalence of cases with a percentage of 39.13%. This could be due to 2 causes. The first being due to the global pandemic. In 2020, Malaysia's Movement Restriction Order was in full swing which lead to lesser owners bringing their pets to be diagnosed for *Mycoplasma haemofelis* infection. The next cause would be due to the change in location of Hospital Pengajar Perubatan Veterinar Universiti Malaysia Kelantan which was then known as Klinik Veterinar Univeristi Malaysia Kelantan. This hospital which had a major bulk of the cases that were recorded changed location from Kota Bharu to Bachok in 2020. This would have lead to the existing clients being able to bring their cats to clinics only within Kota Bharu due to the Movement Restriction Order. Excluding 2020, the increased prevalence of *Mycoplasma haemofelis* infection in 2019 and 2021 may be due an increased awareness of cat owners in taking care of the health condition of their cats (McConnell et al., 2019).

Out of the 122 total cases in the span of 5 years that was recorded in Hospital Pengajar Perubatan Veterinar Universiti Malaysia Kelantan and Kitty Cat Klinik, 83 cases, which is 68.03% of the total number of cases were subject to polymerase chain reaction while 39 of the cases, which is 31.97% of the cases were subject to peripheral blood film. Most of the cases that were subject to peripheral blood film were cases from Kitty Cat Klinik. 25 out of 39 cases which amounts to 64.10%, are cases from that clinic. This is due to the clinic only offering peripheral blood film as a way of detection of *Mycoplasma haemofelis* infection. This may be due to polymerase chain reaction being expensive for clients to pay. Even though, peripheral blood film might be a cheaper way to diagnose *Mycoplasma haemofelis* infection, it is reported that the test can be false negative around half the time whenever the test is conducted (Stokes, 2011). Furthermore, organisms may disappear from circulation in as less as 2 hours making diagnosis via peripheral blood film more difficult (Foley, 2022). The most common way to diagnose *Mycoplasma haemofelis* infection is via polymerase chain reaction based on the data collected over the 5 years. The reason may be due to the accuracy of the test. Polymerase chain reaction has a high sensitivity rate and this has lead to the increase in detection of *Mycoplasma haemofelis* (Martínez-Díaz et al., 2013). If data from other veterinary clinics in the region were collected for analysis, then the percentage of the diagnostic modality used would have changed. However, due to improper data keeping and some clinics refusing to allow students to collect data, those data were not able to use for this retrospective study.

Various risk factors were associated with *Mycoplasma haemofelis* infection in this retrospective study. They include sex, season, life stage, breed, roaming status and household condition. From the analysis that was done, the results show that season, roaming status and household condition have significant association ( $P < 0.05$ ) while sex, life stage and breed has no significant association ( $P > 0.05$ ).

Based on the analysed data, season has a significant association with *Mycoplasma haemofelis* infection. The northeast monsoon affects Kelantan heavily as it is situated at the northeast region of Malaysia. There were an increased number of cases between April to October where it was not the rainy season. An increase in the occurrence of haemoplasmosis has been reported in the summer in Pakistan (Salim et al., 2020). The rainy weather might cause the cats to take shelter, and this may lead to a reduced exposure to cats that have flea infestation. This will ultimately reduce the number of cats getting infected.

Roaming status has a significant association with the occurrence of *Mycoplasma haemofelis* infection. Cats that have outdoor access have been reported to have higher rates of infection. Cats that have outdoor access are exposed more to bloodsucking arthropods like fleas leading to an increased infection rate (Spada et al., 2014). In this study, 36 out of the 79 confirmed cases which amounts to 45.57%, are roamer cats. Another risk factor that has a significant association with *Mycoplasma haemofelis* infection is household condition. Cats found near each other is said to contribute to the transmission of *Mycoplasma haemofelis* (Spada et al., 2014). This study revealed that a household that has a single cat

has more confirmed cases compared to a multicat household. For both the household condition and the roaming status, 25 of the cases were listed as unknown. This could have led to an improper interpretation of both the risk factors.

Based on the analysis that was done, there was no significant association between the life stage of the cat and occurrence of *Mycoplasma haemofelis* infection . This finding is in line with a study that was done in cats in Spain (Roura et al., 2010). However, there are studies that suggest younger cats have a higher prevalence of *Mycoplasma haemofelis* infection (Salim et al., 2020 ; Sykes et al., 2008). Normally, the immune system of a healthy young cat is not as good as a healthy older cat because the older animal has increased exposure to the pathogen. In this study, 94.94% of the cats are confirmed cases are from the kitten and young adult life stage which might indicate younger animals are more prone to *Mycoplasma haemofelis* infection, however more studies should be done using better defined age groups to determine whether age really is an important risk factor.

The sex of the cat has no significant association according to this study. A study done in this same region using stray cats that were subject to polymerase chain reaction revealed that stray male cats are more susceptible to *Mycoplasma haemofelis* infection compared to stray female cats due to the male cat's roaming behaviour (Aklilu et al., 2016). There is still dispute among authors on whether sex of the cat can be considered as a risk factor, so more studies conducted in the future would produce a more conclusive answer.

The breed of the cat showed no significant association in this study. This is in line with the study that was done in Spain (*Roura et al., 2010*). Domestic breeds in Kelantan like Domestic Short Hair and Domestic Long hair are normally allowed to go outdoor unlike the pure-bred breeds, so it may affect the interpretation of breed as a risk factor of *Mycoplasma haemofelis* infection.





## 6.0 CONCLUSION AND RECOMMENDATION

In a nutshell, the overall prevalence of *Mycoplasma haemofelis* infection over the 5 years in veterinary clinics in Kelantan is 64.75%. The most common method that was used to diagnose *Mycoplasma haemofelis* infection is polymerase chain reaction, where the percentage of cases that were subject to polymerase chain reaction is 68.03%. The risk factors that are associated with *Mycoplasma haemofelis* infection are season, roaming status and household condition. This study will hopefully provide information for future researchers who are studying the prevalence of *Mycoplasma haemofelis* infection and also risk factors that are associated to it.

For the recommendation, data from more veterinary clinics should be taken. The period of research should also be extended to obtain a clearer picture of the distribution of cases throughout the years and to observe the fluctuations of the cases throughout the years. The reason why not much data was able to be obtained is due to the lack of access to the data of the clinics and missing data in the databases of the clinic.

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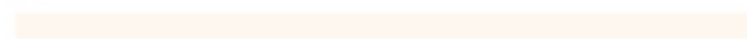
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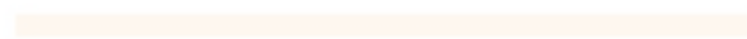
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## APPENDIX A



Appendix A.1 : Collecting data at Hospital Pengajar Perubatan Veterinar Universiti Malaysia

Kelantan

### Crosstab

Count		Confirmed		Total
		yes	no	
Season	Rainy	30	28	58
	Sunny	49	15	64
Total		79	43	122

Appendix A.2 : Cross tabulation of season against confirmed cases

**Crosstab**

Count		Confirmed		Total
		yes	no	
LS	Kitten	21	8	29
	Young Adult	54	32	86
	Mature Adult	4	1	5
	Senior	0	2	2
Total		79	43	122

Appendix A.3 : Cross tabulation of life stage against confirmed cases

**Crosstab**

Count		Confirmed		Total
		yes	no	
Sex	Male	54	22	76
	Female	25	21	46
Total		79	43	122

Appendix A.4 : Cross tabulation of sex against confirmed cases

**Crosstab**

Count		Confirmed		Total
		yes	no	
Breed	dsh	67	31	98
	persian	4	3	7
	bsh	1	2	3
	dlh	6	4	10
	bengal cross	0	1	1
	siamese	0	1	1
	mix maine coon	1	0	1
	blh	0	1	1
	Total	79	43	122

Appendix A.5 : Cross tabulation of breed against confirmed cases

**Crosstab**

Count		Confirmed		Total
		yes	no	
RS	Roamer	36	17	53
	Non-roamer	18	26	44
	Unknown	25	0	25
Total		79	43	122

Appendix A.6 : Cross tabulation of roaming status against confirmed cases

**Crosstab**

Count		Confirmed		Total
		yes	no	
HC	Single cat	40	31	71
	Multicat	14	12	26
	Unknown	25	0	25
Total		79	43	122

Appendix A.7 : Cross tabulation of household condition against confirmed cases