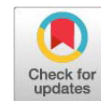


Research Article



Prevalence Study and Risk Factors Analysis for Feline Panleukopenia Viral Infection Among Pet Cats in Sylhet Sadar, Bangladesh

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Abstract | Feline Panleukopenia Virus (FPV) is a highly contagious and lethal disease that targets both unvaccinated and susceptible cats. The FPV is endemic in Bangladesh and might be a threat for pet lovers. The current study aimed to ascertain the incidence of FPV and related risk factors in cats in Sylhet Sadar. A total of 337 cats were examined as part of a cross-sectional survey conducted at selected private clinics. A structured questionnaire was given to the cat owners during in-person interviews depending on the possible risk factors of FPV. Rapid diagnostic test kits were used to validate the presumptive diagnosis. Multivariable logistic regression analysis was used to determine the associated variables for FPV in cat. The overall prevalence of FPV was 9.80% in our study area. The incidence of FPV was higher in kittens (10.20%) of ≤ 6 months of age, while in young adults it was 10.10% and 6.70%, respectively (p-value 0.833). Interestingly, tom cats were noticed almost 1.104 times more infected with FPV in comparison to queens. This investigation also portrayed that FPV infection was 25 times more in diarrhoeic cats than non-diarrhoeic cats. The study highlights the pressing need for pet owners and veterinary practitioners in Sylhet Sadar to adopt preventive measures against Feline Panleukopenia Virus (FPV), particularly affecting kittens and tom cats.

Keywords | Prevalence, Kitten and adult cat, Tom and queen, Diarrhoeic cat, Sylhet Sadar

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INTRODUCTION

With the increasing urbanization of modern civilization, the practice of adopting pets continues to grow everywhere, including Bangladesh. Great benefits cope up with pet ownership, such as companionship, psychological support, and also the improvement of health of the owners. Since pets promote children's physical,

social, and emotional development, they are displacing child care providers in several countries. In contrast to the people with pets and without pets, pet rearing people typically have tolerable blood pressure and cholesterol, less frequent movement to the doctors, and fewer medicine take (Robertson *et al.*, 2000; Headey and Grabka, 2000; Doho *et al.*, 1998). Since domestic cats (*Felis catus*) are the only members of the Felidae family that have undergone

domestication, the term “domestic cat” or “pet cat” is used to distinguish them from their wild relatives. Feral cats are wild cats that explore free and avoid human contact, whereas domestic cats are usually kept as house (Cove *et al.*, 2018; Driscoll *et al.*, 2009). While keeping a pet typically includes caring of it, as well as housing and feeding. Pet owners also need to pay closer attention to the health of their pets because of their susceptibility to diversified infections which comprises various bacterial, viral, protozoal, and non-infectious diseases. There is a possibility of the wide spreads of variety of diseases to not only the healthy animals but their owners too (William *et al.*, 2002; Hasan *et al.*, 2022; Parvez *et al.*, 2014). Among different viral diseases encountered in animals, feline panleukopenia was recognised as a highly transmissible and fatal viral disease, this is also known as cat plague, feline distemper, feline parvoviral enteritis, pseudomembranous enteritis, laryngoenteritis and feline agranulocytosis, feline infectious enteritis. This virus affects both domestic and wild felids, including cats, mink, raccoons, foxes, monkeys, tigers, leopards, jackals, badgers, and lions (Dishow *et al.*, 2024; Kolangath *et al.*, 2023; Tuzio, 2021; Sykes, 2014). Under the family of Parvoviridae, Protoparvo viruses are classified into two subfamilies: one is Parvovirinae, capable of infecting a broad variety of vertebrate animals, while the another one is Densovirinae, isolated from invertebrates (Dishow *et al.*, 2023; Péntzes *et al.*, 2020; Cotmore *et al.*, 2019). Canine parvovirus type 2 (CPV-2a, 2b, and 2c) can also infect cats, and co-infection may happen, resulting in symptoms that are similar to FPV (Pan *et al.*, 2023; Radhy *et al.*, 2021). When healthy cats come closure with diseased cats or their secretions represents the prompt cause of FPV transmission. Moreover, during the disease’s active stages, the virus is released from all bodily secretions. In addition, vertical transmission from infected queens to the embryo is also frequent through placenta. More frequently, the virus is found in the intestines and faeces. However, the virus may also escalate through flies and other insects (Raheena *et al.*, 2017; Stuetzer and Hartmann, 2014; Truyen *et al.*, 1994). FPV can remain contagious in a contaminated environment until weeks or even months for their great resistance to different means like physical and chemical substances. The virus can also viable in the surroundings for a long period, for instance, up to a year in unhealthy organic materials (Uttenthal *et al.*, 1999; Johnson, 1966). The disease could impact almost all individuals of a susceptible population. All age groups of cats are vulnerable to this disease but the kittens (under one year of age) are more prone to it. In routinely vaccinated populations, panleukopenia is rarely noticed (Bukar-Kolo *et al.*, 2018; Truyen *et al.*, 1994). Depending on a number of risk factors, including age, sex, breed, immunity, and concurrent infections, cats can develop FPLV disease in four different clinical forms: peracute, acute, subacute, and subclinical (Rehme *et al.*, 2022; Carrai

et al., 2021). The peracute form of disease is encountered by an unexpected death within 12 hours without showing almost no observable symptoms (Barrs, 2019; Awad *et al.*, 2018). Many systemic signs and symptoms, such as vomiting, diarrhoea, neurological problems, young animals’ impaired vision, and reproductive failure due to vertical transmission, including abortion, stillbirth, and early neonatal mortality, are clinically present in the acute and subacute stages of the disease (Riya *et al.*, 2020; Allison *et al.*, 2013). Except from virus shedding, the subclinical type is more widespread and has no clinical symptoms (Dishow *et al.*, 2024; Rehme *et al.*, 2022). Infected FPV cats exhibit leukopenia, thrombocytopenia, and anaemia as the main haematological and biochemical changes. Due to the increased protein leakage into the infected GI tract, serum AST and creatinine levels rise significantly while total protein level fell markedly (Al-Autaish *et al.*, 2024; Kruse *et al.*, 2010). When a young, susceptible un-vaccinated cat exhibits acute gastroenteritis with systemic involvement and significant panleukopenia (total leukocyte count < 500/ μ L), a tentative diagnosis is typically made (Kim *et al.*, 2013) on the basis of that signs. As FPV infection may conflict with other diseases like feline immunodeficiency virus, feline leukemia virus, feline calicivirus, feline bocavirus, or feline astrovirus infections, the clinical signs and pathological changes of FPLV in cats are not conclusive for confirmatory diagnosis (Hofmann-Lehmann *et al.*, 2022; Zhang *et al.*, 2019; Gleich and Hartmann, 2009). Therefore, virus isolation, immunofluorescent antibody testing, Polymerase chain reaction (PCR) assay, real time PCR technique, Multiplex PCR technique, serological testing (paired neutralizing antibody titres), ELISA (direct and indirect) and FPV antigen detection can be used to confirm the disease (Rehme *et al.*, 2022; Jacobson *et al.*, 2021; Zenad and Radhy, 2020). Undoubtedly, the considering fact is that these very sensitive and specific tests are only be able to perform in the specialized labs. The immunochromatographic experiment is also a relatively quick on spot diagnostic test that may be carried out using a commercially available test kit. Both the veterinarian and the pet owner can use the immunochromatographic assay in clinical practice, according to evaluations that showed overall relative sensitivity and specificity of FPV (Mosallanejad *et al.*, 2009; Addie *et al.*, 1998).

The purpose of this study is to determine the prevalence of Feline Panleukopenia Viral infection in cats in Sylhet Sadar and to pinpoint risk variables in order to develop therapeutic interventions and preventative measures for this deadly disease in feline companions.

MATERIALS AND METHODS

Using a previously designed questionnaire with clinical

case records, a cross-sectional study was carried out. Pet owners were interviewed in order to gather information about breed, age, sex, and clinical symptoms.

STUDY AREA AND STUDY PERIOD

The study was carried out from January to June 2024 in two of the most renowned pet hospitals in Sylhet, one was Sylhet Pet Care and another was Vet Care Center.

STUDY POPULATION

A cross-sectional survey was conducted on 337 cats at selected private veterinary clinics. The animals were categorized according to age, sex and breed to assess the association of these risk factors on the occurrence of Feline Panleukopenia viral infection in cats of the study area.

DIAGNOSIS OF THE DISEASE

In the hospitals or pet clinics, tentative diagnosis of cat diseases was performed on the basis of owner's complaints, clinical examination, physical examination, and confirmatory diagnosis with commercially available antigen kits as a rapid diagnostic tool.

OWNER'S COMPLAINTS

During the assessment of the animals, the owner's objections along with previous treatment records, vaccination, de-worming, and diarrhoeal records were taken into consideration.

CLINICAL EXAMINATION

The posture and gait of the pets were evaluated, and the overall condition of the patient was evaluated from a distance. Abnormalities were discovered through direct observation, palpation, and hair separation during a visual inspection (Figure 1).

PHYSICAL EXAMINATION

Temperature, heart rate and respiratory rate of animals were recorded for assessment of animal health condition.

Rapid test was performed according to the guidelines of manufacture protocol for the confirmatory diagnosis of the disease (Figure 1).

STATISTICAL ANALYSIS

The prevalence among different variables such as age, sex, health condition and breeds were determined by using chi square test for proportions. First, univariable logistic regression models were used to assess the relationship between the FPV infection and associated risk factors. A p-value of ≤ 0.2 was used to select explanatory variables, using a threshold of ≤ 5 , the variation inflation factor (VIF) was utilised to test for multicollinearity among the explanatory variables before doing the multivariable

logistic regression analysis. For the last model selection, a backward model selection technique was used. The overall model fit was assessed using the Hosmer-Lemeshow test.

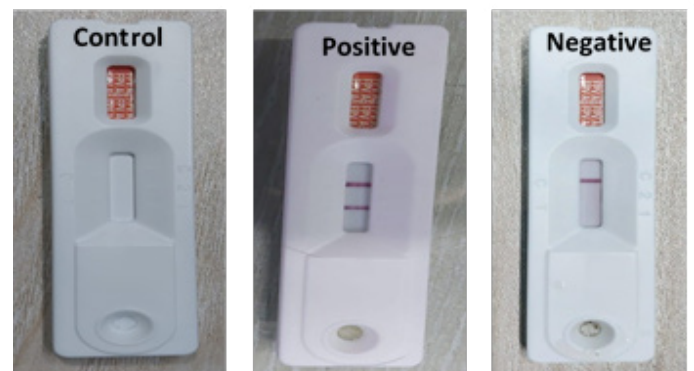


Figure 1: At the top, the picture depicts the distant examination of suspected cat followed by the middle picture shows vomits, one of the important clinical signs of FPV and finally at the bottom, the picture illustrates the Rapid Diagnosis process of FPV by using FPV antigen kit.

RESULTS

OVERALL PREVALENCE OF FPV

Out of 337 examined cat population 33cats were positive, thus prevalence of FPV was 9.80 % in Sylhet (Table 1).

AGE-WISE PREVALENCE OF FPV

FPV was highest (10.20%) in kitten and lowest (6.70%) in adult as only 2 adult cats were positive with FPV (Table 1).

SEX-WISE PREVALENCE OF FPV

Prevalence of FPV was higher in tom (10.20%) than queen (9.30%) (Table 1). Toms had 1.104 times higher odds of FPV compared to queens with a 95% CI (Confidence Interval) of 0.505 - 2.634 (Table 2).

Table 1: Overall prevalence (chi square test) of FPV infection in cat of Sylhet.

Variable	Category Level	No. of sample tested	Positive	Prevalence	p value
Age	Kitten (< = 6 Months)	118	12	10.20%	0.833
	Young (> 6 to 24 months)	189	19	10.10%	
	Adult (> 24 Months)	30	2	6.70%	
	Subtotal	337	33	9.80%	
Sex	Tom	197	20	10.20%	0.854
	Queen	140	13	9.30%	
	Subtotal	337	33	9.80%	
Health condition	Diarrheic Cat	54	24	44.40%	<0.01
	Non-diarrheic Cat	283	9	3.20%	
	Subtotal	337	33	9.80%	
Breed	Local	153	14	9.20%	0.239
	Persian	101	10	9.90%	
	Domestic short hair	21	4	19.00%	
	Domestic long hair	15	3	20.00%	
	Others	47	2	4.30%	
	Subtotal	337	33	9.80%	

Table 2: Univariable correlation between explanatory variables and FPV infection.

Risk factors	Category level	OR	95% CI lower upper	P value	Significant
Age	Kitten (< = 6 Months)	Ref			
	Young (> 6 to 24 Months)	0.987	0.461- 2.116	0.974	No
	Adult (> 24 Months)	0.631	0.133- 2.984	0.561	No
Sex	Tom	1.104	0.505- 2.634	0.792	
	Queen	Ref			No
Diarrheic	Yes	24.356	10.371- 57.200	0.0005	Yes
	No	Ref			
Breed	Local	Ref			
	Persian	1.091	0.465 - 2.562	0.841	No
	Domestic short hair	2.336	0.690 - 7.913	0.173	Yes
	Domestic long hair	2.482	0.625 - 9.860	0.196	Yes
	Others	0.441	0.097 - 2.016	0.291	No

*OR (Odd ratio) *CI (Confidence Interval).

HEALTH CONDITION

Among different health conditions of diseased cat, diarrhoea showed strongly significant association with the p-value < 0.05. Considering this noticeable symptom, cat with diarrhoea showed high rate of FPV with 44.40% than non-diarrheic cat confirmed FPV in only 3.20% cases. Diarrheic cat had 24.356 times higher odds in relation to cat without showing the signs of diarrhoea (OR-24.356; 95% CI-10.371 -57.200) (Tables 2 and 3).

Table 3: Multivariable logistic regression model for identification of potential risk factors for FPV infection in cat.

Risk factors	Category level	OR	95% CI lower-upper	P value
Diarrheic	Yes	24.356	10.371 - 57.200	0.000
	No	Ref		

PREVALENCE ON THE BASIS OF BREED

A good number of local cats 153 were subjected during the study period. Among that indigenous breed, FPV prevalence rate was at great height in the Domestic long hair cats with the percentage of 20.00. On the other hand, in the other nonregistered breeds, the prevalence rate was in the down position and that was 4.30%. Prevalence of FPV in Domestic short hair, Persian and Local breed were also observed 19.00%, 9.90% and 9.20% respectively (Table 1).

Three variables were found to be associated with FPV at p-values ≤ 0.2 in the univariable screening and were included in the multivariable model (Table 2). However, in the final multivariable logistic regression model, only one variable showed significant associations with FPV among the suspected cats (Table 3). Diarrhoea in cat was significantly associated with FPV.

DISCUSSION

Raising pets, especially cats, is becoming more common in Bangladesh because of their simple management system. Sylhet is a rising pet-rearing city in this context with special emphasis on caring for friends at home. However, a serious concern to the cat population is the emerging incidence of feline panleukopenia viral infection, a fatal and extremely contagious disease. Regretfully, many Bangladeshi cat owners are ignorant of this disease and do not follow the right precautions to minimize the infection. The epidemiology and risk factors for FPV infection in Sylhet, Bangladesh, have been thoroughly investigated under this study. The investigation into the prevalence of FPV in cats was constructed by hospital-based diagnostic tools or ways during the study period. Therefore, a few cases might have been overlooked in this analysis as the author was unable

to visit the hospitals at all moments throughout the study period for unavoidable reasons.

A total of 337 cats were examined during the study period, among them 33 cats were infected with FPV indicates prevalence was 9.80 % which was almost similar with the findings of [Ostrowski et al. \(2003\)](#), who reported the prevalence of FPV was 8% in central west Saudi Arabia. Although the current findings were slightly larger than the findings of [Leutenegger et al. \(1999\)](#) and [Hasan et al. \(2024\)](#), as their study showed the prevalence was 2% and 4.12% in Europe (France, Switzerland, and Germany) and Bangladesh, respectively, many of the previously published reports showed that the prevalence of FPV in cats was much higher than the current findings by [Bukar-Kolo et al. \(2018\)](#), [Kabir et al. \(2023\)](#), and [Dishow et al. \(2024\)](#), where they represented the prevalence of FPV was 13.5%, 23%, and 70% in selected regions of Nigeria, Bangladesh, and Iraq, respectively.

The present findings also revealed that prevalence of FPV was higher in kitten compared to young and adult which was validated by the findings of ([Cave et al., 2002](#); [Mosallanejad et al., 2009](#); [Islam et al., 2010](#); [Kim et al., 2013](#)). They reported that FPV prevalence and mortality were significantly higher in kittens than in young and adult cats, and this might be due to the less immunity and adult acts as a reservoir to spread diseases ([Oğuzoğlu et al., 2013](#)). But the findings are in conflict with the results of [Bayati \(2013\)](#), as he showed there was no significant difference in the prevalence of FPV in kittens and adults. Underdeveloped immune status, weak management, less maintained vaccination schedule, and more exposure to the environment make more prone to the FPV infection in kittens.

The current study showed that there is no significant relationship between the prevalence of FPV in toms and queens due to the ignorable higher prevalence rate in toms than queens. The findings were coherent with the findings of [Dishow et al. \(2024\)](#), [Jenkins et al. \(2020\)](#), and [Awad et al. \(2018\)](#). On the other hand, [Bayati \(2016\)](#) reported that queens were more prone to FPV than toms. Pregnancy stress, lactation stress, and a less maintained vaccination schedule influence more the queens to the FPV infection.

The current study revealed that there is a strongly significant relationship between diarrheic and non-diarrheic cats in the occurrence of FPV infection. The infection rate was almost 25 times higher in cats with diarrhea than in cats without diarrhea. [Islam et al. \(2010\)](#) also reported that the prevalence of FPV was much higher in cats with diarrhea (29.73%) compared to cats without the signs of diarrhea (9.52%). FPV has a more preferable site of infection, which is the GI tract; for that reason, diarrhea will be the prompt

symptom for affecting this digestive system. Due to the genetic variation and other stressors in FPV, diarrhea is sometimes exposed, or in some cases this symptom is hidden in cats.

The present study reflected that the prevalence of FPV was higher in domestic long-haired and short-haired breeds than in other breeds (local, Persian, and others), which was aligned with the findings of [Dishow et al. \(2024\)](#), who showed that the prevalence of FPV in domestic short-haired cats was higher than in other breeds studied during their study. Due to the genotypic variation, the susceptibility status might be varied in different breeds.

The variation in overall prevalence of FPV in the current study with previous different studies may be due to the difference in geographical distribution, study period, number of animals studied, immunity level, vaccination status, stress during pregnancy and lactation, overall management, etc.

CONCLUSION

The study found a 9.80% prevalence rate of FPV in cats in the Sylhet Sadar. From this investigation work, we assessed that age and breed had limited impact on FPV in cats, but interestingly sex and the cat's health condition had a significant effect on the occurrence of FPV infection in cats. Due to the enormous expense in treatment and management of FPV-infected cats, as well as the fact that FPV is the primary cause of cat morbidity and mortality, in those points of view adopting pets is discouraged. This affects the pet care industry and necessitates a stronger focus on disease prevention, early detection, and effective control. Improvements must be made to hygienic measures, public awareness campaigns, and vaccination programs in order to prevent the spread of virus. The findings suggest further investigation into the epidemiological and molecular aspects of this highly fatal and contagious cat disease, highlighting the need for further research and investigation.

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NOVELTY STATEMENT

Pet ownership is a popular custom, and many people cherish pets as devoted companions. Various viral diseases pose a threat to pet animals, with FPV being a common

and fatal one in the cat population. Antibiotics are not suitable for minimizing infection, so proper management and preventive care can be a better alternative for curing this viral disease. So, our research works focused to control this FPV infection in cat by determining its presence percentage in our targeted area along with evaluating its risk factors. This data-based work on FPV is new in the Sylhet Sadar and being helpful for proper guidelines to the cat rearing people.

AUTHOR'S CONTRIBUTION

Moushumi Purkayastha and Rakibul Hasan conceptualized and designed the study, collected the data, carried out the whole research work and made the initial draft of the manuscript.

Kazi Asma Akther, Chhanda Rani Das, Shofiqul Islam, Shahriar Rahman Sagar, Saiful Islam, Sohag Talukder assisted in collecting, preparing and analyzing data and revised the manuscript.

Bashudeb Paul, SultanAhmed, A.T.M. Mahbub-E-Elahi helped during revision and prepreparation of final manuscript.

All authors discussed and approved the final version of the manuscript.

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ETHICAL STATEMENT

Written and verbal informed consent was given by the owner of the animals involved in this study for each procedure. As neither humans nor animals can be identified, no additional informed consent was required for this work to be published.

CONFLICT OF INTEREST

The authors have declared no conflict of interest.

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