

Risk factors for FCoV infection in client-owned cats in Croatia

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ABSTRACT – *Feline coronavirus (FCoV) infection is prevalent in cats in multi-cat households and catteries. This retrospective study aimed to determine risk factors for FCoV infection in client-owned cats in Croatia. Investigated epidemiological parameters included: age, breed and behavior characteristics (whether cats shared same food and water dishes, and litter trays or cats did not share same food and water dishes, and litter trays). FCoV infection was registered the most frequently in non-pedigree cats. FCoV infection was more frequently registered in adult cats and cats which shared same food and water dishes, and litter trays with other cats. Age, breed and sharing same food and water dishes, and litter trays were not statistically significantly associated with the seropositivity to FCoV. Further research using a larger population of owned FCoV+ cats is required because this study is underpowered for statistical analyses.*

Keywords—Risk factors, feline coronavirus, cat

1. INTRODUCTION

Feline coronavirus (FCoV) infection is prevalent in cats living in multi-cat households and catteries where many cats share the same food and water dishes and litter trays (Baneth *et al.*, 1999; Holst *et al.*, 2006). Previous studies have reported that different behavior characteristics such as sharing food and water dishes, and use common litter areas (Baneth *et al.*, 1999; Holst *et al.*, 2006), age (Almeida *et al.*, 2019; Klein-Richers *et al.*, 2020) and breed (Bell *et al.*, 2006; Holst *et al.*, 2006) may increase the risk of FCoV infection. Data on risk factors for FCoV infection in Croatia are limited. For this reason, the aim of this study was to determine risk factors for FCoV infection in client-owned cats in Zagreb and Varaždin in Croatia.

2. MATERIALS AND METHODS

2.1. Animals

This study enrolled 79 client-owned cats that were included in a previous study (Raukar, 2021), in which those cats were tested for anti-FCoV antibodies. Blood sampling and virological laboratory method for the detection of FCoV infection have been described in this study (Raukar, 2021). Epidemiological parameters of FCoV infection were not presented in that previous study (Raukar, 2021). Therefore, epidemiological parameters of FCoV infection in client-owned cats are presented in this study.

2.2. Ethical consideration

Ethical approval (Ministry of Agriculture of the Republic of Croatia, area codes: 525-6-08-3 BBŠ; 525-6-08-5 BBŠ) was not required for this research.

2.3. Data collection of potential risk factors

Data on age range, behavior characteristics (whether cats shared same food and water dishes, and litter trays or cats did not share same food and water dishes, and litter trays) and breeds (non-pedigree cats, pedigree cats) were recorded by the veterinarian in a questionnaire at the time of blood sample collection in veterinary clinics in Zagreb and Varaždin, Croatia.

2.4. Statistical analysis

Statistical evaluation of different categories of age range, behavior characteristics and breed in two groups; uninfected cats (FCoV- cats) and infected cats (FCoV+ cats) was conducted with the program IBM SPSS Statistics Version 23.0. Results were presented in tabular form.

For determining whether there was statistically significant difference ($p < 0.05$) between two groups; non-infected (FCoV- cats) and infected cats (FCoV+ cats) by different categories of age range (younger than 4 years of age < 4 years, 4 years old, older than 4 years of age > 4 years) was used a non-parametric test for several independent samples - Kruskal-Wallis test.

For determining whether there was statistically significant difference ($p < 0.05$) between two groups; non-infected (FCoV- cats) and infected cats (FCoV+ cats) by behavior characteristics (cats shared same food and water dishes, and litter trays, cats did not share same food and water dishes, and litter trays), different breeds (non-pedigree cats, pedigree cats) was used a non-parametric test for two independent samples – Mann - Whitney U test.

For Kruskal-Wallis test and Mann- Whitney U test values $p < 0.05$ were considered to indicate a statistically significant difference.

3. RESULTS

In total, 79 client-owned cats were included in this study. The sampled cats were characterized by age, breed and behavior characteristics. Cats were between 2 months and 19 years. The descriptive statistics of all variables are shown in Tables 1 and 2. Out of the 79 cats were tested in previous study (Raukar, 2021), 55.7% (44/79) were positive for anti-FCoV antibodies and 44.3% (35/79) were negative for anti-FCoV antibodies. Sixty-nine cats were non-pedigree cats (87.3%) and 10 cats were pedigree cats (12.7%). Fifty-seven cats shared food and water dishes, and litter trays (72.2%) and 22 cats did not share food and water dishes, and litter trays (27.8%) (Table 1). Twenty-seven cats were younger than 4 years of age (34.2%), 7 cats were 4 years old (8.9%) and 45 cats were older than 4 years of age (56.9%) (Table 2).

There were no statistically significant differences ($p > 0.05$) related to different categories of age range, behavior characteristics and breed between FCoV+ cats and non-infected cats (Tables 3 and 4).

Sharing food and water dishes, and litter trays was not statistically significantly different ($p > 0.05$) between FCoV+ cats and non-infected cats (Table 3).

The breed was not statistically significantly different ($p > 0.05$) between FCoV+ cats and non-infected cats (Table 3).

Different categories of age range were not statistically significantly different ($p > 0.05$) between FCoV+ cats and non-infected cats (Table 4).

Table 5 shows frequencies of FCoV seroprevalence classifications for sharing food and water dishes, and litter trays for each group (infected cats, FCoV+ cats and non-infected cats, FCoV- cats).

Table 6 shows frequencies of FCoV seroprevalence classifications for age range for each group (infected cats, FCoV+ cats and non-infected cats, FCoV- cats).

Table 7 shows frequencies of FCoV seroprevalence classifications for breed for each group (infected cats, FCoV+ cats and non-infected cats, FCoV- cats).

4. DISCUSSION

In this study the age was not significantly associated with the FCoV infection (Table 4). This result is consistent with (Baneth *et al.*, 1999; Moestl *et al.*, 2002; Bell *et al.*, 2006; Holst *et al.*, 2006; Sharif *et al.*, 2009; Oğuzoğlu *et al.*, 2010; Rypula *et al.*, 2014), who observed no significant association between age and FCoV seropositive status. FCoV infection was more frequently registered in adult cats in presented study (Table 6), which is in agreement with (Rodgers & Baldwin, 1990; Sharif *et al.*, 2009), but inconsistent with (Baneth *et al.*, 1999; Bell *et al.*, 2006; Oğuzoğlu *et al.*, 2010), who found that FCoV is more frequent in younger cats. In contrast with my results, Almeida *et al.*, (2019) and Klein-Richers *et al.*, (2020) observed significant association between age and FCoV infection. Klein-Richers *et al.*, (2020) reported that young age was significantly associated with FCoV. Klein-Richers *et al.*, (2020) reported that FCoV infection was registered significantly more frequently in cats

under one year of age. On the other hand, Almeida *et al.*, (2019) observed that seroprevalence of FCoV infection of adult and elderly cats was significantly higher than cats less than 3 years.

FCoV infection was registered in fourteen senior/geriatric cats between 10 and 19 years in presented study. In this study, thirteen of fourteen senior/geriatric cats shared their food and water dishes, and litter trays with other cats. FCoV infection in those senior/geriatric cats was probably a reflection of the re-infection in multi-cat households where cats share litter trays (Bell *et al.*, 2006; Holst *et al.*, 2006). Elderly cats have high risk of developing feline infectious peritonitis (FIP) due to decline of their immune system (Bell *et al.*, 2006; Almeida *et al.*, 2019). Immunosuppression could be related to a decrease of cell-immunity in some older cats, because immunosuppression could be caused by concurrent disease in older cats (Bell *et al.*, 2006). Study in Brazil (Almeida *et al.*, 2019) confirmed FCoV infection in senior/geriatric cats.

The breed was not significantly associated with the FCoV infection in presented study (Table 3). This result is in agreement with (Moestl *et al.*, 2002; Holst *et al.*, 2006), who observed no significant association between breed and FCoV infection. FCoV infection was registered the most frequently in non-pedigree cats in presented study (Table 7). This result is consistent with the study in Austria (Moestl *et al.*, 2002), but inconsistent with studies in Czech Republic (Moestl *et al.*, 2002), Malaysia (Sharif *et al.*, 2009) and Poland (Rypula *et al.*, 2014) in which FCoV infection was more frequently registered in pure breed cats. A Swedish study (Holst *et al.*, 2006) reported that the seroprevalence of FCoV infection was significantly higher among pure breed cats than among non-pedigree cats.

Behavior such as sharingsame food and water dishes, and litter areas may increase the risk of FCoV infection in multi-cat households and catteries (Baneth *et al.*, 1999), because FCoV is mainly spread through fecal-oral route, in urine (Sharif *et al.*, 2009) and by the oro-nasal secretions (Sharif *et al.*, 2009).

Sharing same food and water dishes, and litter trays was not significantly associated with the seropositivity to FCoV (Table 3). The seroprevalence of FCoV infection was registered more frequently in cats which shared same food and water dishes, and litter trays with other cats than in cats which did not share same food and water dishes, and litter trays in presented study. From the results shown in Table 5, it can be seen that there is a trend of a higher seroprevalence among cats which shared same food and water dishes, and litter trays with other cats. This trend suggests that the statistically significant association between sharing same food and water dishes, and litter trays, and FCoV infection could have been recorded if the number of FCoV+ cats in this study was larger.

5. CONCLUSION

Age, breed and sharing same food and water dishes, and litter trays were not statistically significantly associated with the seropositivity to FCoV. Further research using a larger population of owned FCoV+ cats is required because this study is underpowered for statistical analyses.

Conflict of Interest Statement

The author declares that there is no conflict of interest.

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Table 1: Descriptive data on the prevalence of FCoV, breed and behavior characteristics of the client-owned cats in Croatia

Variables	N		%	
	Yes	No	Yes	No
Cats positive for anti-FCoV antibodies	44	35	55.7%	44.3%
Breed	Non-pedigree cats	Pedigree cats	Non-pedigree cats	Pedigree cats
	69	10	87.3%	12.7%
Sharing food and water dishes, and litter trays	Yes	No	Yes	No
	57	22	72.2%	27.8%

N – total number of cats; % - percentage

Table 2: Descriptive data on different categories of age range

Age range	N
Younger than 4 years of age (< 4 years)	27/79 (34.2%)
4 years old	7/79 (8.9%)
Older than 4 years of age (> 4 years)	45/79 (56.9%)

N – total number of cats; % - percentage

Table 3: Results of Mann - Whitney U test of risk factors for infection with FCoV

Variables	Cats positive for anti-FCoV antibodies	Mean Rank	Mann-Whitney U test	p
Sharing food and water dishes, and litter trays	Yes	37.98	681	.26
	No	42.54		
	Yes	38.59	708	.29

Breed	No	41.77
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p- value of significance

Table 4: Results of Kruskal-Wallis test of different categories of age range

χ^2	3.97
Degrees of freedom	2
p	.14

χ^2 – chi-square; p- value of significance

Table 5: Frequencies of FCoV seroprevalence classifications for sharing food and water dishes, and litter trays

Cats positive for anti-FCoV antibodies	Sharing food and water dishes, and litter trays	N
Yes	Yes	34
	No	10
No	Yes	23
	No	12

N – total number of cats

Table 6: Frequencies of FCoV seroprevalence classifications for age range

Age range	Cats positive for anti-FCoV antibodies	N
Younger than 4 years of age (< 4 years)	Yes	12
	No	15
4 years old	Yes	6
	No	1
Older than 4 years of age (> 4 years)	Yes	26
	No	19

N – total number of cats

Table 7: Frequencies of FCoV seroprevalence classifications for breed

Cats positive for anti-FCoV antibodies	Breed	N
Yes	non-pedigree cats	40
	pedigree cats	4
No	non-pedigree cats	29
	pedigree cats	6

N – total number of cats

LIST OF ABBREVIATIONS

FCoV: feline coronavirus

FIP: feline infectious peritonitis

N: total number of cats

% - percentage

p: value level of significance

χ^2 – chi-square