

***Corresponding author:**

SungShik Shin

Laboratory of Veterinary Parasitology,
College of Veterinary Medicine, Chonnam
National University, 77 Yongbong-ro, Buk-
gu, Gwangju 61186, Korea
Tel: +82-62-530-2860
E-mail: sungshik@jnu.ac.kr
<https://orcid.org/0000-0003-1072-6473>

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Status of selected feline infectious diseases in Gwangju, Korea

Juyeon Choi¹, Kyu-Sung Ahn^{2,4}, Ah-Jin Ahn³, SungShik Shin^{2,4,*}

¹Bon Pet Animal Clinic, Gwangju 61927, Korea

²BIOREEDS Research Institute, College of Veterinary Medicine, Chonnam National University, Gwangju 61186, Korea

³Health & Environment Research Institute of Gwangju, Gwangju 61027, Korea

⁴Laboratory of Veterinary Parasitology, College of Veterinary Medicine, Chonnam National University, Gwangju 61186, Korea

Abstract

From 2008 to 2017, blood samples from 280 and fecal samples from 149 stray cats in Gwangju, South Korea, were examined for feline immunodeficiency virus (FIV), feline leukemia virus (FeLV), *Dirofilaria immitis*, and *Giardia* infections using commercial diagnostic tests. Overall, the combined prevalence of FeLV, FIV, *D. immitis*, and *Giardia* was 8.6%, 1.4%, 0.4%, and 2.0%, respectively. FeLV exhibited the highest prevalence rate among the 4 pathogens surveyed, both in the 2008–2009 (9.6%) and 2015–2017 (6.3%) surveys. The results of the feline *Giardia* study represent the first prevalence report of *Giardia* infection among stray cats in Korea.

Keywords: feline immunodeficiency virus; feline leukemia virus; *Dirofilaria immitis*; *Giardia*; Korea

According to the Animal and Plant Quarantine Agency of the Korean government, the number of pet cats in Korea has increased significantly, from 477,510 in 2006 [1] to 2,254,321 in 2021 [2], indicating a rising interest in cats among Koreans. However, as the cat population has grown, so has the issue of abandoned cats, with a total of 33,572 cats being housed in animal shelters across Korea in 2020 [3]. The surge in stray cats not only impacts the welfare of these animals but also poses public nuisances and health risks due to the zoonotic pathogens they may carry. Despite the increase in stray cats, the number of animal shelters in Korea has decreased from 339 in 2011 to 280 in 2020 [3].

Among the various feline infectious diseases, feline leukemia virus (FeLV), feline immunodeficiency virus (FIV), *Dirofilaria immitis*, and *Giardia* spp. have significant implications for disease control in animal shelters. FeLV and FIV are viruses associated with immune suppression, increasing susceptibility to opportunistic infections in cats [4]. Heartworm infections in cats, caused by *D. immitis*, can lead to extensive pulmonary injuries, even in cats with natural resistance [5]. *Giardia* spp. can cause diarrhea and is a typical zoonotic disease [6].

These 4 pathogens are representative of diseases that can be easily transmitted among cats in the shelter environment. FeLV is mainly transmitted horizontally among cats through saliva and feces, while FIV is primarily transmitted through bite wounds [7]. *Giardia* is transmitted through water or food contaminated by feces, while *D. immitis* is transmitted via mosquitoes. Therefore, the infection status of these pathogens in a shelter serves as a good indicator of shelter hygiene con-

trol. However, only one study has been published on FeLV and FIV in stray cats [8], and the prevalence of giardiasis in Korea remains uninvestigated.

In this study, we investigated the prevalence rate of these 4 infectious diseases in stray cats during 2008–2009 and 2015–2017. Our aims were to raise awareness regarding the status of major feline pathogens in shelter environments.

From 2008 to 2009, blood samples from 184 cats (97 males, 87 females) at the Gwangju Animal Shelter were examined for FIV, FeLV, and *D. immitis* infections. Fecal samples from 35 of the 184 cats were also examined for *Giardia* infection. The SNAP FIV/FeLV Combo (IDEXX, USA) was utilized to identify FIV and FeLV infections, while the SNAP Heartworm RT (IDEXX) was employed to detect *D. immitis* infections. Blood samples were collected from each cat in a BD Vacutainer blood collection tube (Becton Dickinson, USA) for the examination of FeLV, FIV, and *D. immitis* infections.

To identify *Giardia* infection, rectal swab samples of feces were collected from each animal and subjected to examination using the SNAP *Giardia* kit (IDEXX). This test identifies *Giardia lamblia*, also known as *Giardia intestinalis* or *Giardia duodenalis*, the primary species affecting mammals, by detecting cyst wall antigen GSA-65 [9]. The presence of this antigen in fecal samples indicates that the animal has ingested *Giardia* cysts, may be actively infected, and may be shedding cysts in its feces.

From 2015 to 2017, 96 cats at the Gwangju Animal Shelter

were examined for FeLV, FIV, and *D. immitis* infections. In addition, rectal swab samples of feces were collected from a total of 114 cats for *Giardia* testing. Out of these, fecal samples were obtained from 96 cats, which included the same cats from which blood samples were collected. The remaining 18 fecal samples were collected from additional cats that provided fecal samples exclusively. For the 2008–2009 survey, only the sex of each animal was recorded. In contrast, during the 2015–2017 survey, we recorded the sex, breed, and estimated age of each animal. In total, we examined 280 cats for FeLV, FIV, and *D. immitis* infections, and 149 cats for giardiasis.

The combined prevalence of FeLV, FIV, *D. immitis*, and *G. lamblia* in 2008–2009 and 2015–2017 was 8.6%, 1.4%, 0.4%, and 2.0%, respectively. More cats were exposed to infectious diseases in the 2008–2009 survey than in 2015–2017 (Table 1).

In the 2008–2009 survey, 22 out of 188 cats (11.7%) were infected with one or more pathogens. Among these 22 cats, 19 were positive for a single pathogen, while 3 male cats were superinfected with both FIV and FeLV. FeLV exhibited the highest prevalence rate among the 4 pathogens surveyed in 2008–2009. Out of the 188 blood samples, 18 (9.6%) tested positive for FeLV, with 9 of 99 male cats (9.1%) and 9 of 89 female cats (10.1%) showing FeLV positivity (Table 1). FIV infection in cats had a prevalence rate of 2.1%, with 4 male cats out of 188 infected, while only one female cat tested positive for *D. immitis* (0.5%). Of the 37 cats tested for *Giardia*, one male and one fe-

Table 1. Infection status of FeLV, FIV, *Dirofilaria immitis*, and *Giardia* among stray cats in Korea

Sex/age/breed	No. of positive cats/no. of total cats (%)			
	FeLV	FIV	<i>D. immitis</i>	<i>Giardia</i>
2008–2009				
Sex				
Male	9/99 (9.1)	4/99 (4.0)	0/99 (0)	1/16 (6.3)
Female	9/89 (10.1)	0/89 (0)	1/89 (1.1)	1/21 (4.8)
Subtotal	18/188 (9.6)	4/188 (2.1)	1/188 (0.5)	2/37 (5.7)
2015–2017				
Age (y)				
> 1	3/66 (4.5)	0/66 (0)	0/66 (0)	0/27 (0)
< 1	3/30 (10.0)	0/30 (0)	0/30 (0)	1/87 (1.1)
Sex				
Male	4/51 (7.8)	0/51 (0)	0/51 (0)	1/59 (1.7)
Female	2/45 (4.4)	0/45 (0)	0/51 (0)	0/55 (0)
Breed				
Korean shorthair	3/80 (3.7)	0/80 (0)	0/80 (0)	0/113 (0)
Persian	3/7 (42.9)	0/7 (0)	0/7 (0)	0
Mixed	0/9 (0)	0/9 (0)	0/9 (0)	1/1 (100)
Subtotal	6/96 (6.3)	0/96 (0)	0/96 (0)	1/114 (0.9)
Total	24/280 (8.6)	4/280 (1.4)	1/280 (0.4)	3/149 (2.0)

FeLV, feline leukemia virus; FIV, feline immunodeficiency virus.

male cat tested positive (5.7%).

In 2015–2017, 6 out of 96 tested cats (6.3%) were positive for FeLV, including 3 Korean shorthair and 3 Persian cats. The prevalence of FeLV was higher in males (7.8%) than in females (4.4%), and it was also higher in cats under 1 year of age (10.0%) compared to cats over 1 year of age (4.5%). Only 1 cat (0.9%) tested positive for *Giardia*. FIV and heartworm infections were not identified in the 2015–2017 survey.

We investigated the infection statuses of FeLV, FIV, *D. immitis*, and *Giardia* infections in stray cats in 2008–2009 and 2015–2017. In our study, the prevalence of the 4 infectious diseases all decreased in 2015–2017. FeLV had the highest prevalence among the 4 diseases in both 2008–2009 and 2015–2017.

FeLV and FIV are 2 common retroviruses that cause disease in cats. FeLV is transmitted horizontally among cats through saliva and feces, while FIV is transmitted primarily through bite wounds [7]. These viruses still persist in advanced countries with better shelter hygiene. In our study, the prevalence rates of 9.7% in 2008–2009 and 6.3% in 2015–2017 for FeLV were much higher compared to previous reports in domestic cats (1.1%) and stray cats (0%) in Korea [8,10]. The prevalence of FIV in this study was 2.2% in 2008–2009, while no cats were positive in 2015–2017. Previous reports of the prevalence of Korean stray cats (1%) and domestic cats (0%) were similar [8,10]. Those cats that showed positive to FIV were all male in this study. Male cats exhibit territorial disputes, so they are prone to becoming infected by FIV due to fighting and biting wounds [11].

D. immitis, transmitted by mosquitoes, causes heartworm disease in dogs and cats. In previous studies in Korea, 2.6% of 155 cats in Gyunggi province and 6.0% of 235 cats in 2 cities and 1 province in South Korea showed positive reactions [12,13]. Therefore, the relatively lower prevalence of only 1 cat out of 280 (0.4%) testing positive for *D. immitis* in this study may be partly attributed to the inclusion of some cats under one year old.

Giardia spp. is a parasite frequently detected in humans and animals, with transmission occurring through fecal-oral contact with cysts, direct contact with infected individuals or contaminated objects, or ingestion of cysts from contaminated water or food. In our study, the prevalence of *Giardia* infection was 5.7% (2/35) in 2008–2009 and 0.9% (1/115) in 2015–2017 (2.0% combined). This rate was lower than that found in dogs (11.2%) in Korea [14] and in the United States. (10.3%) [15]. This study represents the first prevalence report of *Giardia* infection among Korean cats.

In summary, our study investigated the prevalence of FeLV,

FIV, *D. immitis*, and *Giardia* in stray cats in Korea from 2008–2009 and 2015–2017. Over approximately 8 years, the prevalence of these diseases has diminished but still exists. Because many cats entering shelters lack immunity due to the various stresses they experience during their time wandering, they become susceptible to various infectious agents, thereby making shelters potential hubs for disease transmission. In Korea, there is less research on feline diseases in animal shelters compared to dogs. This study highlights the need for government-initiated shelter guidelines to control shelter-associated transmissible feline diseases and improve public health in Korea.

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ORCID

Juyeon Choi, <https://orcid.org/0009-0000-6047-3756>

Kyu-Sung Ahn, <https://orcid.org/0000-0002-0878-9419>

Ah-Jin Ahn, <https://orcid.org/0000-0002-4251-2851>

Sung Shik Shin, <https://orcid.org/0000-0003-1072-6473>

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