First Report of Feline Immunodeficiency Virus in Stray and Pet Cats in Baghdad Governorate, Iraq

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Abstract

Feline immunodeficiency virus (FIV) is a retrovirus known to cause various forms of diseases in pet and wild cats. FIV prevalence and its associated risk factors in Iraqi cats have heretofore been unknown. From January 2021 to January 2022, a cross–sectional study was conducted in Baghdad governorate to estimate the seropositivity for FIV antibody and the potential risk factors associated with positive serological results among stray and pet cats. Across 60 Baghdad governorate regions (32 regions from Al–Rusafa, 28 regions from Al–Karkh), a total of 250 cat blood samples were randomly collected from 78 pet and 172 stray cats. All cats were clinically examined, and data regarding age, sex, breed, lifestyle, health status, and clinical history were obtained from cat owners, whereas stray cats' data were estimated based on their body condition and dental age. Recorded data were evaluated as risk factors potentially associated with the status of FIV. The presence of FIV antibodies in blood samples was determined using an immunochromatographic assay. The overall FIV seroprevalence was estimated at 13.20% (33/250). Out of 172 stray and 78 pet cats, there were 13.95% (24/172), and 11.54% (9/78) positive cats for FIV antibody, respectively. In addition, the highest rate of cats tested positive for FIV antibodies was recorded in Shirazi breed (16.13%, 5/31) followed by local breed (14.43%, 28/194). However, these two variables (lifestyle and breed), in addition to the sampling area variable were not significantly associated with the FIV seropositive status. The risk factors significantly associated with FIV seroprevalence were determined as age, sex, and health status. Adult cats (22.4%, 32/143) were more than 30 times likely to be FIV seropositive compared to young cats. The estimated odd ratio of cats' exposure to FIV infection increased 1.81 times (95% CI=1.46–2.25, P<0.001) for each year of life. Risk of FIV seropositive status was significantly higher in male cats than females. Male cats were 4.79 times more likely (95% CI=1.76–12.9, P<0.0019) to test positive for FIV antibody than females (5/105, 4.76%). Compared to apparent healthy cats, cats clinically appeared non–healthy had 12.51 times (95% CI=1.67–93.6, P<0.0139) higher odds of being seropositive for FIV antibody. This is the first report on the prevalence rate of FIV infection in cats in Iraq, Baghdad. Our results indicated the presence of FIV among cats in Baghdad governorate at a relatively high rate with a higher risk of infection may be associated with adult males experiencing health issues.

Keywords: feline immunodeficiency virus, retrovirus, serology, prevalence, cat, Baghdad

1. Introduction

Retroviral infections in cats are still a ubiquitous and significant conditions all over the world (1). Feline retroviruses belong to *Retroviridae* family (retroviruses) (Latin retro=backward) which is a diverse and large group of RNA genome enveloped viruses that rely on a double–stranded DNA (dsDNA) intermediate for replication (2). Among feline retroviruses, the most common and clinically important is feline immunodeficiency virus (FIV) which has been identified as threat etiology of domestic cats worldwide (3). FIV is a retrovirus classified in the genus *Lentivirus* (Latin lenti=slow), within the subfamily *Orthoretrovirinae* (4).

In 1986, FIV, (formerly known as Feline T–lymphotropic Virus) was first isolated by Pedersen et al. (5) the UC Davis School of Veterinary Medicine from a colony of cats with a high prevalence of opportunistic infections and degenerative conditions. FIV is a collection of closely related viruses endemic to domestic cats and wild felids such as lions, leopards, and spotted hyenas (6). FIV shares many characteristic properties such as viral genome structures, genetic variation, epidemiology, and immunopathogenesis of its human homologous human immunodeficiency virus (HIV) (7–10). Although FIV infection exhibit evolution, virulence, and pathogenicity patterns that are remarkably similar to those caused by homologous viruses in humans (11), they are not zoonotic (1).

FIV infection can impact quality of life and longevity of domestic cats, with various ability to cause disease associated with a variety of clinical signs (12). Immunodeficiency is the most common complication of FIV infections resulting in predisposing to opportunistic and secondary infections, which account for the majority of clinical manifestations, altering tumor–control mechanisms thus increasing the chance of tumor formation, and causing central nervous system and haematological abnormalities (13). FIV is spread through wound bites during fights (14), thus, cats aggressively behave play a considerable influence in the FIV transmission. FIV is present globally, with age, sex, health status, lifestyle, breed, neuter status, outdoor access, and aggressive activity have all been reported with some

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degree of controversiality of being associated or not to higher rates of viral positivity (1). The geographic distribution of cats infected with FIV differs widely depending on the population of cats investigated, risk factors, and the diagnostic procedure used (13,15). Courchamp and Pontier (1994) (16) conducted a comprehensive review of the infection rate results from 59 epidemiological studies, mostly serological surveys, involving 85,529 cats, and estimated an 11.04% overall FIV infection rate. However, disparities in infection rates were shown on both regional and continental scales, with Asia (23.12%, n=4,762) and Oceania (23.30%, n=1,332) having higher rates than Europe (12.71%, n=44,270) and North America (8.06%, n=35,165). Another global observational study assessed the frequency trends over a of 9–year period, from 2008 to 2016, in more than 2.9 million test findings of FIV in domestic cats from 68 countries grouped geographically into 7 global regions (17). All test results were from cats tested by rapid in–clinic tests for detection of FIV antibody in blood. Results of seroprevalence status reported that the highest prevalence of FIV infection was in Middle East–Africa (14.2%, n=4,787, 6 countries), followed by Asia–Pacific (13%, n=81,201, 10 countries), Caribbean (12.6%, n=6,882, 8 countries), Southern Europe (12.4%, n=206,157, 12 countries), Northern Europe (7.5%, n=95,800, 20 countries), Latin America (7.4%, n=9,984, 9 countries), and North America (5%, n=2,538,792, 3 countries).

The widespread spread of FIV among domestic cats is well–documented and recognized around the world. However, there has been no reported data on the FIV prevalence in Iraq. Data on the prevalence of stray, feral, and owned cats are needed to develop preventative, control, and therapeutic approaches (18). Given the importance of feline retroviral infections in clinical practice and the growing popularity of cats as pets in Iraq, there is currently insufficient evidence to allow veterinarians and pet owners to make informed decisions about FIV infections. This could be due to a lack of FIV diagnostic techniques in veterinary clinics. Furthermore, regular vaccination against FIV among cats in Iraq is not available, for both stray and pets, particularly those with outdoor access, thus high cases, or prevalence would be expected. Therefore, the aims of this study were to determine the prevalence of FIV in stray and pet cats in Baghdad governorate, Iraq and to assess the potential factors associated with positive serological outcomes.

2. Materials and Methods

2.1. Study area

The study was conducted in Baghdad governate, Iraq's capital, which is located in the center of the country within the Mesopotamian Plain (geographic coordinates 33°20′N, 44°23′E). Despite being the smallest governorate in Iraq (area 4555 km^2, 1759 sq mile), Baghdad has the highest population of any Iraqi governorates, with a population of 8,780,422, making it the largest city in Iraq, the second-largest city in the Arab world after Cairo, and the second-largest city in West Asia after Tehran, the capital of Iran. It is also considered Iraq's administrative and commercial center. Baghdad is divided into two halves by the Tigris River: Al-Karkh (Karkh, the western half) and Al-Rusafa (Rusafa, the eastern half). Each half is divided into administrative districts, which are further subdivided into neighborhoods. Al-Karkh includes the districts of Kadhimiya, Mansour, Al Rashid, and Karkh, while Al-Rusafa includes Adhamiyah, Karadah, Sadr City, Rusafa, and 9Nissan. In total there are nine administrative districts making up 89 neighborhoods.

2.2. Study design and cat population

In a cross–sectional study conducted from January 2021 to January 2022, a total of 250 cat blood samples from 60 neighborhoods of five districts in Al-Rusafa half (Adhamiyah 11 neighborhoods, Karadah 3 neighborhoods, Rusafa 5 neighborhoods, 9Nissan 10 neighborhoods, and Sadr City 3 neighborhoods) and four districts of Al-Karkh half (Kadhimiya 8 neighborhoods, Mansour 10 neighborhoods, Karkh 2 neighborhoods, Al Rashid 8 neighborhoods) were included in this study. These cats consisted of two groups: 78 pet (client–owned) and 172 stray cats.

Pet cats consisted of cats presented to AL–Sadeem Veterinary Private Clinic (located in Adhamiya, Almashtal Street, Baghdad, Iraq) for varied reasons such as routine checking, treatment, or vaccination. The agreement of cat owners to participate in the study, after explaining the goals of the study, was a criterion for inclusion in the study. Additionally, a prior to the sampling, cat owners gave their approval verbally. The information collected consisted of age, sex, breed, lifestyle, clinical history, previous vaccinations, and clinical signs. These cats had not been vaccinated against FIV. Age was estimated by the dental formulary and owner information's. All cats in this group were intact. In terms of multi-cat household, in this study only one client-owned had 6 cats living together in the same house.

A volunteer group had been asked with offering incentive to help trapping stray cats cross the neighborhoods of Baghdad governorate. Cat collection was authorized by the Iraqi Veterinary Medical Syndicate. The group was provided with several locally manufactured live traps and some instructions for trapping. The traps, containing live baits and water, were positioned in shady areas, and were periodically checked. Trapped animals were transferred to two locally manufactured collecting cages then transported to AL–Sadeem Veterinary Private Clinic and housed there temporarily in separated large cages up to testing (blood collection) which did not exceed more than 2 days. During trapping, all cats were supplied standard diet and water and were checked regularly. All cats were clinically examined, and the age was estimated based on size, dentition, and other physical

characteristics. After sampling, cats were returned to the area of capture and released.

2.3. Sample size

The sampling size was calculated using the StatCal of Epi Info™ software version 7.2.5.0 (Centers of Disease Control and Prevention, Atlanta, Georgia, USA) with 50% expected frequency (as no previous study was conducted), 5% acceptable margin of error, and 90% confidence level. Two hundred and seventy-one was the minimum number of samples. Given the limitations of available resources, a smaller and more realistic sample was studied. Therefore, a total of 250 cats were included in the study.

2.4. Sampling and Serological test

The cats were sedated with ketamine (15 mg/kg; Alfasan Woerden, Holland) and xylazine (0.15 mg/kg; VMD Livestock Pharma, Belgium) administered intramuscularly, based on estimated body weight. Blood sample (1–3 mL) was drawn aseptically from the cephalic or femoral veins of each cat using a 3–mL disposable syringes with 23–gauge and placed in EDTA collecting tubes.

FIV antibody detection was performed using a commercially available kit Anigen Rapid™ FIV Ab/FeLV Ag Test Kit (BioNote, Inc., Gyeonggi–do, Korea) according to the manufacturer's instructions. Anigen Rapid™ is an in–clinic immunochromatographic test that detects antibodies to gp40 (96% sensitivity, 98% specificity) in feline serum, plasma, or whole blood. Estimation of sensitivity and specificity values were previously reported in comparison to the Western blot as the gold standard for FIV verification method (**19,20**). The letters "T" and "C" on the device's surface represent the test and control lines, respectively. Before loading samples, neither the T nor the C lines in the result window are visible. One drop (about 10 µL) of EDTA–anticoagulated whole blood sample was added by a capillary tube (disposable) to the sample hole. Then after, two drops (roughly 60 µL) of the assay diluents were added by assay diluent bottle to the sample hole. The control band, which indicates that the test is properly running, is when appearing the color band in the left side of the results window. The test result(s) is displayed on the right side of the results window. A negative result is indicated by one band on the FIV strip; a positive result is indicated by two bands (T and C) on the FIV strip. Finally, test results were interpreted at 10 minutes. The tests were carried out within one hour of collecting the blood samples, if not immediately tested, samples were refrigerated at 4°C and used within 24 hours. Digital photographs of test device results were taken for each cat at the testing time.

2.5. Statistical Analysis

The data were arranged in Microsoft Excel 365 spreadsheet (Microsoft Corporation) and imported into JMP Pro 14.0 software (SAS, Institute Inc., Cary NC, USA). Chi–square (χ^2) and binomial logistic regression analyses were used to determine prevalence rate, association between the factors and seropositive response to FIV, and to calculate odd ratios (ORs) and their 95% confidence intervals (CIs). Positive/negative FIV test was set as a nominal outcome variable and the independent variables were age (young ≤ 1 year, adult >1 year), sex, health status (signs of illness or fight wounds: healthy, non–healthy), area (Al–Karkh, Al–Rusafa), lifestyle (pet (client–owned), stray), and breed. The neuter status was not categorized as all cats tested were intact. Pearson's χ^2 test was used to assess the significance at $P \leq 0.05$ of each group of predictor variables.

3. Results

3.1. Sample Characterization

The total number of cats included in this study was 250, from 60 regions of Baghdad, Iraq, of which 107 (42.8%) were young (≤ 1 year), 143 (57.2%) adults (>1 year); 145 (58%) males, 105 (42%) females; 62 (24.8%) healthy, 188 (75.2%) non–healthy; 102 (40.8%) from Al–Karkh, 148 (59.2%) from Al–Rusafa; 78 (31.20%) pets, 172 (68.80%) strays; 194 (77.6%) local breed, 56 (22.4%) non–local breeds, of which 31 Shirazi, 7 Himalayan, 4 Scottish, 4 Chinchilla, 4 Persian, 3 Siberian, 2 British, and 1 Ragdoll. The mean age of cats was 2.2 years (minimum = 0.5 year, maximum = 16 years).

The estimated prevalence of FIV was 13.20% (33/250) (95% CI = 9.56–17.96). The mean age of FIV–infected cats was 4.46 years (minimum = 7 months, maximum = 10 years). Out of 143 adult cats (>1 year) examined, 32 (22.4%) were positive for FIV antibodies. However, only 1 (0.93%) out of 107 young cats (≤1 year, 7 months stray female) tested positive. The Pearson's χ^2 test indicated that there was a significant relationship between the age of cats and seropositive with FIV ($\chi^2 = 24.56$, $P < 0.001$). Adult cats (>1 year) were 30.56× more likely to have FIV antibody–positive than young cats (≤1 year). The estimated odd ratio of cats' exposure to FIV infection increased by 1.81 times (95% CI=1.46–2.25) for each year of life.

FIV seropositive was found in 19.3% (28/145) of male and 4.76% (5/105) of female cats tested. There was a significant association between feline sex and FIV seropositive (χ^2=11.3; $P < 0.001$). The risk of FIV seropositive status was significantly ($P < 0.001$) higher in male cats than in females. Male cats were 4.79 times more likely (OR=4.79, 95% CI=1.76–12.9, P<0.0019) to test positive for FIV antibody than females.

The rate of FIV seropositive among cats with healthy status was 1.61% (1/62), while 17.0% (32/188) FIV seropositive was found among cats with obvious clinical manifestations. Animal health status was significantly associated with FIV seropositive (χ^2=9.66, P=0.002). Compared to apparent healthy cats, clinically appeared non–healthy cats had 12.51 times (95% CI=1.67–93.6) higher odds of being seropositive for FIV. The major clinical manifestations observed in FIV antibody–positive cats were rough

hair coat (33.33%); dehydration and skin lesion (24.24%); hair loss, weight loss, and cracked decayed teeth (21.21%); cracked teeth (18.18%); gingivitis, poor skin condition, signs of fighting, stomatitis (15.15%); cachexia, diarrhea, and severe dehydration (9.09%); vomiting (3.03%); respiratory infection, severe hypothermia, and severe pneumonia (3.03%) (Table 2, Figure 1 a-g, Figure 2).

Out of 102 cats tested from Al–Karkh area, there were 11 (10.78%) positive cats for FIV antibody, while FIV seropositive cats tested from Al–Rusafa were 22 (14.86%). Although higher infection rate was recorded from cats sampled from Al–Rusafa than that from Al–Karkh, the association between FIV seropositive status and the factor sampling area was not statistically significant (χ^2=0.88, *P*=0.349). FIV seropositive status was unaffected by factor area when analyzed individually.

Out of 78 pet cats tested, there were 9 (11.54%) positive cats for FIV antibodies. Among the 172 strays tested, 24 (13.95%) were FIV antibody positive. FIV seropositive status was unaffected by factor lifestyle, though (χ^2=0.273, *P*=0.601).

Seropositive results for FIV in relation to breeds when grouped as local and non-local revealed that the highest rate was recorded among the Shirazi breed (5/31, 16.13%) followed by the local breed (28/194, 14.43%). All other breeds tested had a 0.0% seropositive. The association between the breed and infection rate of FIV was not significant (χ^2=1.149; *P*=0.284). FIV seropositive status was unaffected by factor breed when analyzed individually (χ^2=4.29; *P*=0.829).

4. Discussion

4.1. Prevalence

This investigation reported the status of FIV infection in Baghdad governorate for the first time. Evidence of FIV infection was found in both stray and pet cats, with a total prevalence of 13.20%. Our results were consistent with some studies reported worldwide, and sometimes not. Prevalence statistics of FIV for countries neighboring to Iraq are scarce. In Iran, for example, the first report of FIV was published by (31) where the authors found 1.2% (2/123) of household and sick cats referred to Small Animals Teaching Hospital of Tehran University infected with FIV as screened by ELISA and confirmed by Western blot. Akhtardanesh et al. (32) reported an overall seroprevalence 19.2% (27/140) in 70 stray and 70 client–owned cats in Kerman (southeastern Iran) tested against FIV antibodies using an immunochromatography assay. Higher FIV prevalence rate was reported by (33) in healthy (42%) and sick (87%) household cats from small animal hospital of University of Tehran using PCR. Furthermore, (21) reported in Ahvaz area (the capital of Khouzestan province) Southwestern Iran 10.5% FIV prevalence among 238 client-owned cats using a chromatographic immunoassay. In Turkey, (34) investigated FIV infection prevalence among 1008 stray cats in Western Turkey by serologic and molecular–based tests. The authors reported that the FIV seroprevalence based on antibody and proviral DNA detection was 25.5% and 25.2%, respectively. The authors described their results as higher than the results previously reported in different area of Turkey which ranged between 3% to 22.3% (35-37). In Egypt, Cairo, (38) found 59 feral cats of 174 (33.9%) tested against anti–FIV antibodies to be seropositive. Globally, positive cases of FIV in this study were greater than that reported in Spain 7.4% (22), United States and Canada 3.6% (23), Brazil 6% in owned and 6.66% in stray cats (24), China 9.12% (stray 10.38% 27/260, pet 5.88% 6/1052) (25) in stray and pet cats, and Madrid 8.3% (26). Szilasi et al. (2019) (29) sampled blood from 335 domestic cats (only client–owned cats) in Hungary and found 9.9% prevalence of FIV with ELISA, and the apparent prevalence calculated from the PCR results were 13.1% for FIV. In Ireland, 183 client–owned domestic cats were tested from 10 veterinary clinics for FIV antibodies, and the results showed a prevalence of 10.4% and 9.3% with ELISA and PCR, respectively (30). Little (2005) (39) examined 246 cats in Ottawa, Canada, tested for antibodies to FIV by using an in–hospital ELISA kit, and found that overall, 27 cats (11%) were FIV–antibody positive, however, FIV seroprevalence was highest 23% (17/74) in urban stray cats compared to 5.9% (9/152) in client–owned cats, and 5%; (1/20) in feral cats. The same author (2009) (40) determined 4.3% seroprevalence of FIV antibodies among cats' population across 10 Canadian provinces. In an exceedingly early study in Canada, (41) evaluated the epidemiologic features of FIV infection and categorized cats as high–risk (n = 2254) or healthy with low or unknown risk (n = 511). In the high–risk group, 14% were FIV seropositive compared to 1.2% in the healthy group. Further, in the high–risk group, FIV seropositivity was more likely in males than females, in cats over 6 years of age than younger cats, and free–roaming cats than confined cats. Chi et el. (2021) (42) reported that FIV–positive status was detected in 18 of 105 (17.1%) feral cats sampled using a commercial ELISA kit. The observed differences might be attributed to variation among geographic regions, cat population densities, lifestyles, techniques used, and control policies and practices among different countries. The comparatively high frequency of FIV antibodies found in our study could be attributed to the absence of FIV regular vaccination in Baghdad province.

4.2. Risk Factors

Many factors have been shown to be associated with the severity of FIV infection such as age, sex, behavior, lifestyle, type of habitant and health status (39). Our results demonstrated that FIV infection was significantly associated with age, sex, and health status. All kittens less than six months old were seronegative.

Regarding the age variable, results of the current study showed that out of 143 adult cats, 32 (22.4%) were positive for FIV antibody and only 1 (0.93%) out of 107 young cats tested was positive. Additionally, the results demonstrated that FIV seroprevalence was significantly associated with age. Adults (> 1 year) were 30.56 times more likely to have FIV than young cats and the infection increased 1.81 times for each year of life. These findings consisted with results reported in previous studies that adult cats are more susceptible to FIV (40–43, 15, 31, 34). Recently, (28) examined 260 healthy cats originating from thirteen places in North, Northeast, and Central Thailand and reported a significantly higher risk for FIV infection when cats were two years or older.

Sex as a risk factor associated with FIV seropositive status has been reported in the majority of the literature controversially. Sivagurunathan et al. (47) and Danner et al. (48) reported that there was a significant association between sex and FIV seropositivity in feral cats. However, in owned cats, no significant association between sex and seropositivity to FIV was reported by (37) and (41). Cats in our study, on the other hand, were both owned and stray, as such they displayed a range of physical and behavioral traits (46). The risk of FIV seropositive status was significantly higher in male cats (19.31%) than in females (4.76%). FIV was 4.79 times higher in males than in females. The same results have been found in previously reported studies (40,47,48). Levy et al. (44) reported that male cats were 4 times more likely to carry FIV than female cats, as biting is the primary mode of transmission. (49) reported that males were three times more likely to be FIV positive than females with an OR of 3.93. However, (50) did not observe the same result in a study performed in Rio de Janeiro city, but in that case, most male cats were neutered, which decreases the fights for breeding and, consequently, the risk of FIV transmission. Increased risk of transmitting the virus has been linked to the greater propensity of males to engage in territorial behavior, such as fighting, which has been mainly accountable for the correlation between male sex and FIV infection. A relationship between aggressive behaviors and seropositivity to FIV has been reported by several authors (15, 42, 51).

In terms of multi-cat household, two of the household Shirazi breed cats (one 3-year male and one 5-year female) that were living together in a group of 6 cats (two Shirazi breed at 1 year age, one 2-years Persian breed, and an 8 months Himalayan) were positive for FIV, although the owner did not identify aggressive behavior in relation to other cats, suggesting that the infection occurred either from a sexual transmission or from sharing food and water bowls. Our finding was in accordance with a study on one household of 26 cats that were not observed to fight, FIV infection was originally diagnosed in nine cats, but spread to six other cats during a 10–year observation period (52), proposed that FIV transmission is possible even without the presence of aggression among cats, such that mutual contact between FIV–positive cats and susceptible cats, or sharing of feeding bowls, could be sufficient for transmission of viruses. However, in a sanctuary in which eight FIV–infected cats were housed with 130 uninfected cats, no transmission was documented over several years (53).

Seroprevalence of FIV ranges from less than 1% in healthy cats in North America to 30% in sick cats in Japan and Italy (10). Our results demonstrated that animal health status was significantly associated with a positive response to FIV testing. This result was in agreement with other studies (34,40,50,54) as the positive FIV infections were higher in sick cats than healthy cats in the present study. Lara et al. (2008) (27) investigated the frequency of FIV infection in 454 blood samples from healthy and sick domestic cats from 13 cities of São Paulo State, Brazil using the nested PCR technique. The results showed that 14.7% (67/454) of the cats were positive for FIV. FIV prevalence of 5.8% (15/260) was detected in healthy cats in North, Northeast, and Central Thailand using ELISA (28).

Higher prevalences are found in feral and free–ranging cats and sick cats. In the North American study, the prevalence of FIV infection in sick, feral cats was 18.2%, whereas that in healthy indoor cats was only 0.7%. Rough hair coat and dehydration and skin lesion were the most common clinical findings in FIV–positive cats in our survey, which is compatible with other reports (55). Other manifestations involved hair loss, weight loss, and cracked decayed teeth (21.21%); cracked teeth (18.18%); gingivitis, poor skin condition, signs of fighting, stomatitis (15.15%); cachexia, diarrhea, and severe dehydration (9.09%); vomiting (3.03%), respiratory infection, severe hypothermia, and severe pneumonia (3.03%). Animal health status was significantly associated with FIV (34,55).

In conclusion, our results show for the first time the presence of FIV among stray and pet cats in high rate in Baghdad province. Higher risk of FIV infection, based on the sample of the study, may be associated with adult male experiencing health issues. To ensure that FIV is controlled in Baghdad's cat population, certain control, and prevention measures such as screening and routine immunization are required.

Author Contributions

1. Study concept and design: Saleem Hasso
2. Acquisition of data: Sadeem Abdulkareem
3. Analysis and interpretation of data: Saleem Hasso and Sadeem Abdulkareem
4. Drafting of the manuscript: Sadeem Abdulkareem
5. Critical revision of the manuscript for important intellectual content: Saleem Hasso and Sadeem Abdulkareem
6. Statistical analysis: Saleem Hasso and Sadeem Abdulkareem
7. Administrative, technical, and material

support: Saleem Hasso and Sadeem Abdulkareem
8. Study supervision: Saleem Hasso
9. Both authors have read and agreed to the published version of the manuscript

Ethics

Experimental procedures in this study were reviewed and approved by the Scientific Research Committee of the Internal and Preventive Veterinary Medicine Department, College of Veterinary Medicine, University of Baghdad, in its session held on December 5, 2020, and Ethics Committee of the College of Veterinary Medicine, University of Baghdad, Baghdad, Iraq.

Conflict of Interest

The authors declare that there is no conflict of interest.

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Table 1. Frequency distributions, chi–square (χ^2) and biverate logistic regression results of cats tested positive for antibodies to feline immunodeficiency virus (FIV) from 60 regions of Baghdad governorate, Iraq as determined by an in-clinic immunochromatographic test between January 1, 2020, and January 1, 2021

Variable	No. tested	+ve No.	+ve %	95% CI	χ^2	P value	OR (95% CI)	P value
Total	250	33	13.2	9.56–17.9	–	–	–	–
Age								
Young ≤1y	107	1	0.93	0.17–5.10	24.6	<0.001	Reference	0.0008
Adult >1	143	32	22.4	16.3–29.9			30.6 (4.10–228)	
Sex								
Female	105	5	4.76	2.05–10.7	11.3	<0.001	Reference	0.0019
Male	145	28	19.3	13.7–29.9			4.79 (1.76–12.9)	
Health status								
Healthy	62	1	1.61	0.17–5.10	9.66	0.002	Reference	0.0139
Non–Healthy	188	32	17.0	16.3–29.9			12.51 (1.67–93.6)	
District								
9Nissan	46	7	15.2	7.57-28.2	6.80	0.558	Reference	
Adhamiyah	74	12	16.2	9.53-26.2			1.08 (0.39-2.97)	0.884
Al Rashid	21	2	9.52	2.65-28.9			0.59 (0.11-3.10)	0.530
Kadhimiya	27	2	7.41	2.06-23.4			0.45 (0.09-2.32)	0.337
Karadah	14	2	14.3	4.01-39.9			0.93 (0.17-5.08)	0.932
Karkh	5	2	40.0	11.8-76.9			3.71 (0.52-26.4)	0.189
Mansour	50	5	10.0	4.35-21.4			0.62 (0.18-2.11)	0.443
Rusafa	5	1	20.0	3.62-62.5			1.39 (0.13-14.4)	0.781
Sadr	8	0	0.00	0.00-32.4			NA	NA
Lifestyle								
Pet	78	9	11.54	6.19–20.5	0.273	0.601	Reference	0.602
Stray	172	24	13.95	6.19–20.5			1.24 (0.55–2.82)	
Breed								
Local	194	28	14.43	10.2–20.0	0.061	0.804	Reference	
Shirazi	31	5	16.13	7.09-32.6			0.88 (0.31-2.48)	0.8044
Other*	25	0	0	NA	NA	NA	NA	NA

*7 Himalayan, 4 Scottish, 4 Chinchilla, 4 Persian, 3 Siberian, 2 British, and 1 Ragdoll

Table 2. Clinical signs frequency of seropositive cats for antibodies to feline immunodeficiency virus (FIV) in Baghdad governorate		
Clinical signs	Count/total	%
Rough hair coat	11/33	33.33
Dehydration	8/33	24.24
Skin lesions	8/33	24.24
Cracked decayed teeth	7/33	21.21
Hair loss	7/33	21.21
Weight loss	7/33	21.21
Cracked teeth	6/33	18.18
Gingivitis	5/33	15.15
Poor skin condition	5/33	15.15
Signs of fighting	5/33	15.15
Stomatitis	5/33	15.15
Cachexia	3/33	9.09
Diarrhea	3/33	9.09
Severe dehydration	3/33	9.09
Died on second day after diagnosis	2/33	6.06
Vomiting	2/33	6.06
All teeth falling out except for canines	1/33	3.03
Anorexia	1/33	3.03
Incontinence	1/33	3.03
Infectious peritonitis	1/33	3.03
Jaundice	1/33	3.03
Ophthalmitis	1/33	3.03
Otitis	1/33	3.03
Pyoderma	1/33	3.03
Respiratory infection	1/33	3.03
Severe hypothermia	1/33	3.03
Severe pneumonia	1/33	3.03
Unhealed wounds from 6 months ago	1/33	3.03

Figure 1. Photographs of cats with clinical signs of rough hair coat, hair loss (a, b, c), skin lesions (d, e), signs of fighting (f), signs of severe dehydration and rough hair coat (g)

Figure 2. Photographs showing signs of gingivitis, stomatitis, and cracked decayed teeth