

# Sustained SARS-CoV-2 antibody response in domestic pets: Insights from a longitudinal study

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The COVID-19 pandemic, triggered by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has not only impacted human health on a global scale but also raised concerns about the vulnerability of a wide array of animals that are in close contact with humans. Particularly, the potential for infection and the subsequent immune response in domestic pets such as dogs and cats remain largely unexplored under natural living conditions. In this study, we have undertaken the task of detecting and tracking the presence of antibodies against SARS-CoV-2 in a small cohort of household pets—specifically, two dogs and two cats. Employing techniques such as the indirect ELISA and plaque reduction neutralization tests, we observed that the neutralizing antibodies against SARS-CoV-2 in these animals were maintained for a duration of up to six months following their initial positive test result. This duration mirrors the antibody response documented in human cases of COVID-19, suggesting a comparable post-infection immune response timeline between humans and these domestic animals.

**Key Words:** Cat, Dog, Long-term persistence, Plaque reduction neutralization test, SARS-CoV-2 antibodies

The COVID-19 pandemic, triggered by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has been widely understood as a human crisis, but its impact extends beyond our species. Evidence suggests that the virus, believed to have originated in animals before transferring to humans, has now come full circle, infecting a variety of animal species across the globe (Decaro et al, 2021). To date, 775 cases have been documented in 29 different animal species across 36 countries, with the first known instance reported in Hong Kong (WOAH, 2023). Transmission, in most cases, appears to have occurred from humans back to animals, a phenomenon known as reverse zoonosis.

Amidst this backdrop, there have been scattered reports of active SARS-CoV-2 infections and the presence of specific antibodies in domestic animals like dogs and

cats (Patterson et al, 2020; Hamer et al, 2021; Murphy and Ly, 2022; Bae et al, 2022). Such findings raise questions about the immune response in these animals and how it compares to humans, in whom neutralizing antibodies have been shown to persist for 6 to 12 months post-infection (Chia et al, 2021; Dispinseri et al, 2021; Knies et al, 2022; Sonnleitner et al, 2022). However, there is a notable scarcity of data regarding the longevity of these responses in our pets (Decaro et al, 2022).

All animal work was conducted with approvals from the Jeonbuk National University Institutional Animal Care and Use Committee (JBNU IACUC; Permit no. JBNU 2021-039). Our research presents a longitudinal study on SARS-CoV-2 seropositive pets, providing evidence that neutralizing antibodies can persist for at least 6 months in dogs and cats from Korea, which indi-

cates a notable duration of immunity in these animals. The study initially identified antibodies in two dogs and cats, aged between 2 to 4 years, all from households with confirmed COVID-19 cases (Table 1). Interestingly, these animals showed no clinical signs of COVID-19 themselves. Serum samples were collected within a month of the virus being detected in their owners and were subsequently tested using a commercial indirect ELISA kit (ID Screen SARS-CoV-2 Double Antigen Multi-species ELISA, IDvet, Grabels, France) (Laidoudi et al, 2021) and a plaque reduction neutralization test (PRNT) (Patterson et al, 2020). These tests confirmed the presence of SARS-CoV-2 neutralizing antibodies 6 months or beyond the initial positive test result (Table 1). The fact that all four animals tested positive at the outset suggests that the detected humoral immunity may represent a response to a recent infection, correlating with the timeline of the pandemic's initial surge.

Despite a growing number of SARS-CoV-2 cases in pets, understanding of antibody longevity under natural conditions, particularly in at-risk pets, is scant. Our findings, indicating a persistence of antibodies for up to 10 months in dogs and cats, echo the patterns seen in human COVID-19 patients.

Previous monitoring of the pet antibody response has

typically spanned only 2 to 3 months post-infection, displaying relatively stable or increasing titers and no evidence of seroreversion (Hamer et al, 2021). However, a study by Zhang et al in 2020 tracked the antibody levels in two cats over approximately 4 months, observing a peak in antibodies 10 days post first sample, followed by a decline to the detection limit within 110 days. In contrast, one of other studies have noted that the presence of neutralizing antibodies at 8 months or more after the first positive testing (Decaro et al, 2021). Our findings contribute to the growing body of evidence of SARS-CoV-2 infections in pets. In Spain, for instance, neutralizing antibodies were detectable in cats for over 16 months post-infection, with a gradual decline over time, suggesting a lasting immunity after natural infection. The cat even appeared appear healthy. Additionally, it appears that, akin to human cases, reinfection in these animals can lead to an uptick in neutralizing antibodies, a phenomenon observed in both cats and dogs (Villanueva-Saz et al, 2023).

The observed persistence of neutralizing antibodies in dogs and cats, which in some instances exceeded 6 months, was coupled with no clinical pathology, suggesting a state of healthy infection. Furthermore, upon re-exposure to the virus, both dogs and cats exhibited

**Table 1.** Serological follow-up for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) antibodies in positive dogs and cats

No.	Species	Age (yr)	Sex	COVID-19 patient owner	Sampling number	Date of collection	ELISA <sup>a</sup>	PRNT <sub>50</sub> <sup>b</sup>	Antibody persistence (months)
1	Dog	2	F	Yes	1	10 May 2022	Pos (132.14%)	1:20	≤2
					2	04 Jul 2022	Pos (98.52%)	1:10	
					3	20 Sep 2022	Neg	<1:10	
2	Dog	3	M	Yes	1	14 Jun 2022	Pos (185.35%)	1:40	≥6
					2	12 Sep 2022	Pos (103.43%)	1:20	
					3	12 Dec 2022	Pos (80.41%)	1:10	
3	Cat	4	M	Yes	1	04 Apr 2022	Pos (163.15%)	1:40	≥3
					2	05 Jul 2022	Pos (82.72%)	1:20	
					3	03 Oct 2022	Pos (64.93%)	<1:10	
4	Cat	3	F	Yes	1	12 Jan 2023	Pos (189.19%)	1:80	≥6
					2	13 Apr 2023	Pos (158.92%)	1:40	
					3	17 Jul 2023	Pos (106.87%)	1:20	

<sup>a</sup>Values in brackets represent the ratio between the optical densities of the tested serum and the positive control (cut-off value=50%).

<sup>b</sup>Antibody tier is expressed as the highest serum dilution with 50% reduction in plaques in inoculated VERO-E6 cells compare to the control, with a titer of ≥1:10 was considered to be positive.

a significant rise in neutralizing antibody titers without any noticeable illness or deviations from normal blood work and biochemistry values.

The question of how well these antibodies can protect dogs and cats from future SARS-CoV-2 infections remains unanswered. It is clear that these pets can develop a long-term antibody response, but the extent of the protection conferred by this response necessitates further research.

Our observations mirror the immune response seen in human COVID-19 patients, revealing intriguing similarities between the species. These insights into the immune responses of our pets are not just of scientific interest but hold practical implications for public health and veterinary care, potentially informing how we manage the health of companion animals amid ongoing and future outbreaks.

The advancing our understanding of SARS-CoV-2's behavior in animals, we can better prepare for the needs of all members of our households - human and animal alike - during pandemics. Further investigation into the protective effects of these antibodies and the possibility of vaccination for pets could lead to a more comprehensive approach to managing and preventing the spread of such viruses. The interconnection of human and animal health, underscored by this pandemic, has never been clearer, reinforcing the One Health approach that advocates for the integrated health of people, animals, and the environment.

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## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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