The Journal of Veterinary Medical Science

FULL PAPER

Epidemiology

The impact of coronavirus disease 2019 (COVID-19) in Japanese companion animal clinics

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ABSTRACT. The coronavirus disease 2019 (COVID-19) pandemic has had a tremendous impact on people's lives throughout the world. A cross-sectional study was conducted to clarify the influence of COVID-19 on Japanese companion animal clinics. A self-administered electronic questionnaire regarding the incidence of COVID-19, hygiene management, the influence on clinical service and employment, and mental stress of staff was conducted for workers in animal clinics between 1 May and 10 June 2021. Questions concerning the hygiene management before the occurrence of COVID-19, under the first state of emergency, and at the time of the survey were asked using the Likert scale. Kessler 6 (K6) was used as an indicator of mental distress. In total, 430 individuals responded. Of these, 4.9% experienced COVID-19 infection in staff. Hygiene management was strengthened, but no particular practice was statistically associated with the occurrence of COVID-19 cases in staff. In Nakaya's variation of Scheffe's paired comparison, the highest prioritized goal in the clinics was the prevention of nosocomial infection with COVID-19. The prevalence of serious mental illness (K6 >=13) was 11.1% (95% confidence interval: 6.3–18.6%). Multivariable negative binomial regression found four risk factors for psychological distress: veterinary nurse (P=0.016 with veterinarians and P<0.01 with other staff), female (P=0.004), fear of infection at work (P<0.001), and stress by refraining from going out (P<0.001). Directors of clinics are recommended to take care of female veterinary nurses for distress.

KEYWORDS: companion animal clinic, coronavirus disease 2019, hygiene management, mental health, veterinary nurse

J. Vet. Med. Sci.
84(8): 1041–1050, 2022
doi: 10.1292/jvms.22-0072

Received: 20 February 2022
Accepted: 11 June 2022
Advanced Epub:
22 June 2022

On December 31, 2019, the World Health Organization (WHO) was notified of an outbreak of pneumonia of unknown cause in Wuhan, Hubei province in China, by the Chinese Health Authorities, which was later named coronavirus disease 2019 (COVID-19) [10], caused by a novel coronavirus, Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) [5]. COVID-19 was announced as a pandemic by the WHO on 11 March 2020 [39]. In Japan, COVID-19 was included in the Act on Special Measures against Novel Influenza, etc., on 13 March 2020, and a state of emergency was announced for Chiba, Hyogo, Fukuoka, Kanagawa, Osaka, Saitama, and Tokyo Prefectures on 7 April 2020, followed by expansion to all of Japan on 16 April [23]. Since then, COVID-19 has heavily influenced the lives of citizens by repeated epidemic waves and countermeasure restrictions.

SARS-CoV-2 is a zoonotic agent that shares 96.2% sequence homology with a strain of coronavirus (RaTG13) previously identified by genetic sequencing from horseshoe bats (*Rhinolophus* spp.), which is the closest found so far to SARS-CoV-2 [40]. Companion animals can be infected with SARS-CoV-2. The first case was an asymptomatic dog from Hong Kong from which a low level of the virus was isolated, reported on 28 February 2020 [31]. Dogs are infected with SARS-CoV-2 by infected owners. However, when it comes to cats, infected cats can infect other susceptible cats [7]. In Japan, the risks of infection to humans by companion animals were communicated to the public by the Japan Veterinary Association [13]; the Ministry of Health, Labour, and Welfare [19]; and the Ministry of Agriculture, Forestry, and Fisheries [17] through their websites. As COVID-19 patients were isolated in hospitals

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immediately after the start of the COVID-19 response, taking care of animals owned by patients became an animal welfare issue. Local government authorities, as well as private companies such as Anicom Holdings, responded by looking after the animals while their owners were treated for COVID-19 [3].

COVID-19 affected the management of companion animal clinics. According to a global large-scale study on the influence of COVID-19 on companion animal clinics, conducted with 5,000 veterinarians from 91 countries, 10% of the respondents had lost their jobs or been furloughed [4]. In the UK, there is an epidemiological surveillance system for companion animals, the Small Animal Veterinary Surveillance Network (SAVSNET), and detailed data are available to analyze the effects of COVID-19 on companion animal clinics [35]. However, there is no such system for companion animal clinics in Japan. Healthcare providers are potentially vulnerable to emotional distress from the COVID-19 pandemic given their risk of exposure to the virus, concerns about infecting and caring for loved ones, shortages of personal protective equipment, longer work hours, and involvement in emotionally and ethically fraught resource-allocation decisions [26]. As companion animals as well as their pet owners can be infected with SARS-CoV-2, veterinarians in companion animal clinics are at risk of infection on a daily basis.

The present study was conducted to understand the effects of COVID-19 on Japanese companion animal clinics in an exploring manner, and to provide useful information for the management of those clinics.

MATERIALS AND METHODS

Online survey

Semi-structured interviews were conducted with four veterinarians working in Japanese companion animal clinics concerning COVID-19 incidence, hygiene management, provision of services, employment, clinic management and the mental stress of employees to design a questionnaire. After a draft questionnaire was developed, a pilot survey was conducted using Google Forms with 28 veterinarians from Rakuno Gakuen University Animal Medical Center between 14 April and 31 April 2021. Many of the veterinarians had previous experiences in working in private clinics, and the questions were amended based on their comments. The questionnaire was finalized, and a cross-sectional online study using Google Forms was conducted between 1 May and 10 June 2021. Veterinarians, nurses, and staff members currently working in veterinary clinics servicing for companion animals were included, and those working in university veterinary hospitals were excluded from the study. Prior to the survey, the objective and methods of this study was explained to all the 47 local prefectural veterinary associations, and sending the information of the survey to the member companion animal clinics was requested. Requests for participation were also sent through networks of universities, academic societies, and notifications on the websites of Rakuno Gakuen University.

The required sample size was calculated based on estimating the proportions of binary responses as questionnaire items (Equation 1) [33], as the main objective was to explore the influence of COVID-19.

$$n = \frac{1.96^2 \times P_{exp}(1 - P_{exp})}{d^2} \quad \text{Equation 1}$$

where n is the required sample size, and P_{exp} is the expected proportion. We set P_{exp} as 0.5 to maximize the sample size. The desired absolute precision d was set as 0.05. The sample size was calculated as 384.

Table 1 shows the contents of the questionnaire. The first part of the questionnaire was asked to all participants, and the second part was only for directors/representatives of the clinics. To monitor changes in preventive measures against infectious diseases and clinic operations, questions were asked about situations before the COVID-19 pandemic, during the first state of emergency, and at the time of the survey using a 5-point Likert scale (0–4). Kessler 6 (K6) [15], as it is already validated in Japanese translation [6], was used as an indicator of mental distress at the time of the survey. A cutoff of K6 12/13 was used to suggest serious mental illness (SMI) according to the original documents on both English and Japanese versions of the tool [6, 15]. A 23-item questionnaire for occupational stress is readily available [11], but our study employed K6 to keep questions of the management for and the specific stress from COVID-19. To understand the policies of the clinics, the relative importance for the director/representative was asked between each of two policies with regard to three goals: the prevention of infection of pet owners and staff with COVID-19, the maintenance of veterinary service for the needs of animals in view of animal welfare, and the maintenance of outpatient visits in view of financial management, on a 5-point scale (1: choice A is much more important than choice B; 2: choice A is slightly more important than choice B; 3: choices A and B are equally important; 4: choice B is slightly more important than choice A; and 5: choice B is much more important than choice A).

The survey was approved by the Research Ethical Committee of Rakuno Gakuen University (approval number: 20-6). An ethical statement was provided with the electronic questionnaire form, and informed consent was opt-out by participation in the survey.

Statistical analysis

The online survey was conducted at an individual level. Due to anonymity, clinic identification was not possible, and the number of clinics that responded within each prefecture was not known. However, to ensure the representativeness of respondents within Japan, Spearman's correlation test was performed to assess the correlation between the number of respondents and the number of clinics by prefecture reported to the government in 2020 [18]. In addition, a generalized linear model (GLM) with binomial errors was performed by selecting cumulative incidences of COVID-19 as of 30 April 2021 as an outcome variable, and the response rates (proxy: the number of responses out of the number of clinics reported by prefecture) as an explanatory variable, to test whether the local situation of COVID-19 influenced the response rate. For the question items, descriptive statistics were performed.

Table 1. Contents of the questionnaire

Sections	Questions
1. Questions to all staff	
Attributes of the clinic and respondents	Clinic: city, primary/secondary clinic, type of animals, numbers of veterinary/nurse/other employees, opening/closing hours, and night shift. Respondent: age, sex, and clinical experience.
Infection with COVID-19	Infection with COVID-19 and designation as a contacted person in veterinarians, nurses, other staff, and pet owners. Measures taken at occurrences: closure of clinic, quarantine of contacted persons at home, and stoppage of employment.
Preventive measures against infectious diseases	Wearing a mask or faceguard; disinfection of hands and fingers, examination tables, reception areas, waiting rooms, and floors; changing the air; restricting the number of owners in the examination room or waiting room; asking owners questions about infection with COVID-19 and contact with cases; and preparation of manuals for the prevention of infection. Experience receiving requests to look after the animals of owners infected with COVID-19.
Change of clinic operations	Mode of reception (visit and queue, reservation priority, reservation only, and setting of reservation hours), average daily number of outpatient visits in the clinic, average daily number of treatments by the respondent. Changes in the numbers of first visit cases, revisit cases, and vaccination from before the COVID-19 pandemic to the first state of emergency, and at the time of the survey. Reasons for changes in the number of cases or introduction of remote diagnosis.
Change of working style	Change in the number of working days, hours of working, and income from before the COVID-19 pandemic to first state of emergency, and at the time of survey. Introduction of shifts to reduce the number of staff in the clinic and/or separation of working days/hours to reduce the chance of contact between staff.
Influence on management of the clinic	Changes in the availability of masks, gloves, gowns for surgical operations, hand disinfectant, drugs, and pet foods; and measures taken to overcome shortages (substitution, change of treatment, and giving up).
Stress associated with COVID-19	Current level of mental stress from COVID-19 on a 5-point Likert scale. Level of stress from COVID-19 due to restrictions on eating/going out, risk of infection at work, low awareness of infection risk among pet owners, increased working burden, worry about income, and reduction of spare time on a 5-point Likert scale. K6 score (1 to 5, for not at all to always): felt nervous, hopeless, restless or fidgety, so depressed that nothing could cheer you up, that everything was an effort, and feeling worthless, during past one month.
Change in society	Increase in pet demand and abandonment of pets on a 5-point Likert scale.
2. Questions to director/representative of the clinic	
Policies of the clinic	Relative importance between each of two policies on a 5-point scale with regard to three goals: prevention of infection of pet owners and staff with COVID-19, maintenance of veterinary services for the needs of animals in view of animal welfare, and maintenance of outpatient visits in view of financial management. Policies (i) at the occurrence of COVID-19 cases in staff, (ii) announcements for pet owners when staff is infected with COVID-19, (iii) for when a pet owner who visited the clinic was found infected with COVID-19, and (iv) for when a pet owner infected with COVID-19 requested to look after his/her animal.
Financial management	Changes in expenditures and the reason; assistance from local government.
Human resource management	Stoppage of employment of veterinarians, nurses, and other staff due to financial difficulty caused by COVID-19. Changes in the numbers of veterinarians, nurses, and other staff. Changes in acceptance of internship.

To examine the effect of hygiene management on the prevention of COVID-19 nosocomial infection, a logistic regression was performed by selecting the occurrence of COVID-19 among veterinarians, nurses, and staff as an outcome variable, and the level of each hygiene measurement on a 5-point Likert scale as an explanatory variable, during the first state of emergency and at the time of the survey. To examine whether a policy of the clinic determined the change in the number of outpatient visits, the responses for the questions asked only to clinic directors were used. First, the relative importance of three different goals (prevention of infection of pet owners and staff with COVID-19, maintenance of veterinary services for the needs of animals in view of animal welfare, and maintenance of outpatient visits in view of financial management) was measured as a psychological score using Nakaya's variation of the Scheffe's paired comparison [21, 29] from 5-point Likert scale responses. Second, Spearman's rank correlation tests were performed between the psychological scores and the 5-point Likert scale responses on the change in the number of outpatient visits during the first state of emergency.

The prevalence of SMI (K6 >=13) was compared between groups where necessary by chi-squared test or Fisher's exact test. This survey was over-represented by directors of veterinary clinics (see Results), and the overall prevalence of SMI was adjusted using Bayesian simulation. According to a report of questionnaire survey for veterinary nurses [14], the approximate ratio of veterinarians and veterinary nurses was 1.5, and approximate number of other staff member per clinic was 1. Based on the numbers of director veterinarians and employed veterinarians registered in 2020 (8,424 and 7,779, respectively) [18], and the estimated numbers of veterinary nurses and other staff members, the numbers of individuals with SMI were simulated using beta-binomial distribution for each position category, and adjusted prevalence of SMI was simulated for 1,000 iterations. To analyze factors associated with mental distress, negative binomial regressions were performed by selecting K6 as an outcome variable, and sex, age group, roles in a

clinic (veterinarian, veterinary nurse or other staff), and the levels of stress from refraining from going out, and fear of infection with COVID-19 at the time of the survey, respectively, as explanatory variables. The K6 is used as a screening scale for SMI using a cutoff [6]; however, it is also used as a level of psychological distress for the analysis of risk factors using negative binomial regression elsewhere [36]. After univariable analyses were performed, multivariable analysis was conducted to find the final model by stepwise model simplification. All statistical analyses were performed using statistical software R version 4.1.2 [28].

RESULTS

Respondents

In total, there were 430 responses, of which 70.5% (n=303) were male, and the number of responses exceeded the required sample size. Average age and range were 49.1 and 20–76 years old. The most frequent age groups were 50s (n=116, 27.0%), 40s (n=112, 26.0%), 60s (n=88, 20.5%), and 30s (n=71, 16.5%). Directors/representatives were predominant (73.5%, 316 veterinarians), and full-time employed veterinarians, part-time veterinarians, full-time veterinary nurses, part-time veterinary nurses, and other staff accounted for 10.7% (n=46), 2.3% (n=10), 9.3% (n=40), 1.4% (n=6), and 2.8% (n=12) of respondents, respectively. There was a significant correlation between the number of responses and registered clinics by prefectures (ρ=0.67, P<0.001), which suggested that the data were representative of Japan.

Out of 430 clinics (there can be several responses from the same clinic), 424 (98.6%) and 20 clinics (4.7%) provided primary and secondary clinical services, respectively, and 14 of these provided both services. The majority of the clinics treated cats and dogs (416/430 clinics, 96.7%), and 40.9% (n=176), 23.7% (n=102), 10.0% (n=43), and 2.8% (n=12) of the clinics treated small mammals, birds, reptiles/amphibians, and farm animals, respectively (multiple selections allowed). The mean and median numbers of veterinarians, veterinary nurses, and other staff were 3.0, 2 (25th and 75th percentiles: 1 and 3; range 0–33), 4.8, 4 (25th and 75th percentiles: 2 and 6; range 0–50), and 2.5, 1 (25th and 75th percentiles: 0 and 3; range 0–29), respectively.

Occurrence of COVID-19 in clinics

Out of the 430 respondents, 2.6% (n=11), 1.9% (n=8), 1.4% (n=6), and 14.9% (n=64) reported the occurrence of COVID-19 in veterinarians, veterinary nurses, other staff, and pet owners, respectively. The proportion of respondents reporting the occurrence of COVID-19 in any staff in the clinic (excluding pet owners) was 4.9% (21/430). The experience of being consulted for looking after the pets of COVID-19 patients was more common (104/430, 24.2%). When COVID-19 cases occurred among staff, 36.8% (7/19) closed the clinic for a few days, and the rest (63.2%) maintained clinical services while those infected who had close contact with patients stayed home.

Shortages of supplies and the response

Table 2 shows items for which shortages occurred due to the COVID-19 pandemic. All listed items were difficult to procure, particularly masks (70.0%), pet food (66.5%), and hand disinfectant (65.3%). The most common response to the shortages was using a substitute (84.7%, 342/404), followed by giving up (30.2%, 122/404) and changing the treatment strategy (21.5%, 87/404). A shortage of at least one item was reported from 96.7% (416/430) of the respondents.

Changes in service operations

Even after the COVID-19 pandemic started, the majority of clinics did not change the starting time of service (95.6%, 411/430), the ending time of telephone reception (84.0%, 361), and the service (87.7%, 377). Ending telephone reception early (15.3%, 66/430) and clinical service early (11.6%, 50) were the most common changes. The proportion of operating night clinic service did not change between before (23.7%, 102/430) and after the start of the pandemic (19.3%, 83/430, χ^2=2.23, df=1, P=0.135).

For the style of reception, the proportion of clinics serving outpatients by visiting order was significantly reduced from before the pandemic (81.4%, 350/430) to during the first state of emergency (67.0%, 288/430, χ^2=22.59, df=1, P<0.001), and was even lower at the time of survey (66.0%, 284/430, χ^2=25.36, df=1, P<0.001). Conversely, the proportion of clinics adopting an appointment style significantly increased from before the pandemic (20.4%, 88/430) to during the first state of emergency (33.4%, 144/430, χ^2=17.86, df=1, P<0.001), and was even higher at the time of survey (34.0%, 146/430, χ^2=19.08, df=1, P<0.001). Many clinics stopped allowing pet owners to stay in waiting rooms (change from 88.8%, 382/430 to 53.3%, 229/430, χ^2=130.60, df=1, P<0.001), but this had reverted at the time of the survey (85.8%, 369/430). However, the proportion of clinics having visitors wait outside of a clinic, such as in a vehicle, significantly increased from before the pandemic (29.3%, 126/430) to during the first state of emergency (71.4%, 307/430, χ^2=150.71, df=1, P<0.001), and was even higher at the time of the survey (72.6%, 312/430, χ^2=159.24, df=1, P<0.001), suggesting efforts to reduce the number of pet owners in a waiting room. Triage based on outside history taking used to be very rare before the pandemic (3.0%, 13/430) but significantly increased during the state of emergency (10.5%, 45/430, χ^2=17.77, df=1, P<0.001) and was still maintained at the time of the survey (7.4%, 32/430). Some clinics announced the waiting order by smartphone

Table 2. Items for which shortages occurred in clinics after the COVID-19 pandemic began, and the numbers and proportions of clinics that experienced them (n=430)

Item	Respondents experiencing a shortage	Percentage (%)
Masks	301	70.0
Pet food	286	66.5
Hand disinfectant	281	65.3
Drugs	254	59.1
Surgical gloves	224	52.1
Surgery gowns	166	38.6

application, but the proportions of adopting clinics remained low over time (3.7%, 16; 5.6%, 24; and 7.4%, 32 clinics).

At the time of the survey, some clinics were conducting remote clinical services by telephone (69/430, 16.0%) and by video communication (16/430, 3.7%). Only 20.0% (17/85) consulted first-visit cases by remote clinical service, and the service was mostly targeted at repeated cases. Out of 72 clinics conducting remote diagnosis that provided the response, 22.2% (n=16) started before the pandemic, and 33.3% (n=24) and 41.7% (n=30) introduced it before and after the first state of emergency, respectively.

In the questions targeted to directors/representatives, 39.3% (125/318) had not decided the policy for the received requests from pet owners infected with COVID-19 to look after their animals. But there were several active responses: consulting with a public service (38.7%, 123/318) or a private service (19.5%, 62/318), and looking after them in their own clinic (10.7%, 34/318, multiple choice allowed).

Changes in hygiene management

Figure 1 shows changes in the strength of hygiene practice provided as 5-point scores (1: never; 2: rarely; 3: sometimes; 4: usually; 5: always) for 11 items, from before the COVID-19 pandemic, during the first state of emergency, and at the time of the survey. The proportions of high scores increased over time for all 11 items. Dramatic change was observed in wearing masks, disinfection of hands, disinfection at cleaning, changing the air, and restrictions on the number of people in waiting rooms. At the time of the survey, body temperature check was not practiced in 60.4% of the clinics, and 27.9% did not have a manual for the prevention of infections.

For all 11 items, there was no significant association between the occurrence of COVID-19 among the staff and the strength of hygiene score during the first state of emergency (Table 3).

Relationship between clinic policies and changes in outpatient visits

For the 5-point-score of changes in outpatient visits (1: great decline; 2: slight decline; 3: no change; 4: slight increase; 5: great increase), the mean scores for the change of first visit outpatients were 3.0 and 3.3 during the first state of emergency and at the time of the survey, compared to before the pandemic, respectively (n=430). The mean scores for the change of repeated outpatient visits were 2.9 and 3.1 during the emergency and at the time of the survey, respectively. The mean scores for the change of visits for vaccination were 2.8 and 3.1 during the emergency and at the time of survey, respectively, suggesting that there was no obvious trend in changes in the visits to clinics.

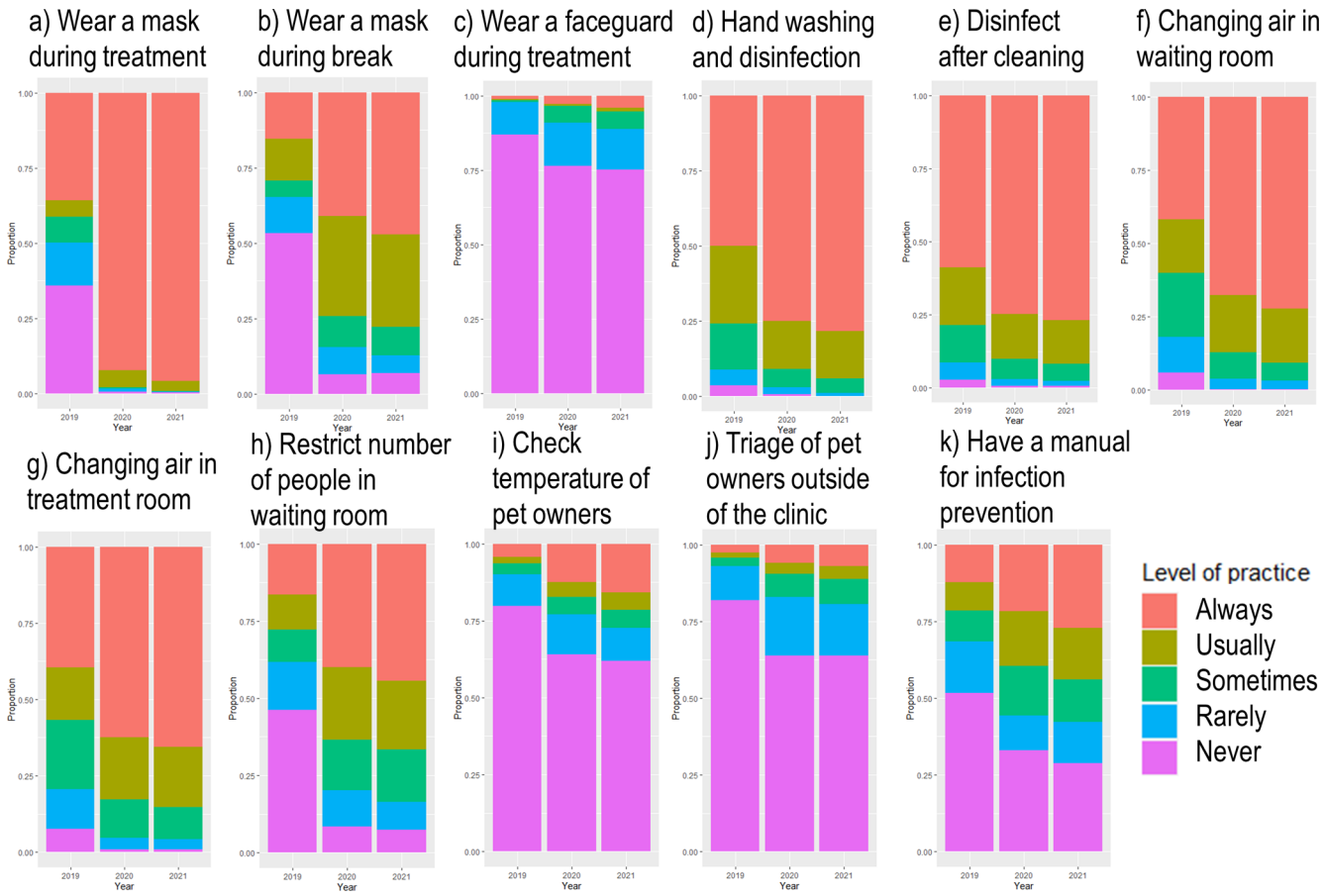

Fig. 1. Changes in the strength of hygiene practice answered as 5-point scores (1: never; 2: rarely; 3: sometimes; 4: usually; 5: always) for 11 items, from before the COVID-19 pandemic (2019), during the first state of emergency (2020), and at the time of the survey (2021) (n=430).

Some respondents felt that pet owners refrained from visiting the veterinary clinic for mild cases (22.9%, 96/420) or for vaccinating their animals (25.5%, 107/420) to prevent infection with COVID-19. In contrast, other respondents answered that outpatient visits increased due to the increase of individuals who started raising animals (21.7%, 91/420) or increased awareness among pet owners concerning changes of the health status of their animals by being at home more often (15.2%, 64/420).

From the responses regarding the relative importance between each two of three goals asked of directors/representatives (n=316), the goal with the highest priority was the prevention of infection with COVID-19 in the clinic (psychological score by Nakaya's variation in Scheffe's paired comparison [21, 29]: 0.210), followed by the maintenance of veterinary clinical service (0.118). The goal of maintaining the number of cases for financial reasons (−0.328) was the least prioritized by the directors.

Table 4 shows the results of correlation tests between the psychological scores of prioritized goals and perceived changes in outpatient visits during the first state of emergency. The prioritized goal of preventing infection with COVID-19 was significantly associated with a reduction in repeated visits (ρ= −0.132, P=0.019) and visits for vaccination (ρ= −0.158, P=0.005). In contrast, the prioritized goal of maintaining clinical service in view of animal welfare was significantly associated with an increase of repeated visits (ρ=0.129, P=0.022), and the prioritized goal of maintaining finances was significantly associated with an increase of visits for vaccination (ρ=0.125, P=0.027).

Employment and financial management of a veterinary clinic

The majority of respondents answered that there was no change in employment (89.3%, 384/430). According to the directors/representatives that responded, new employments of veterinarians (2.5%, 8/319), veterinary nurses (5.0%, 16/319), and other staff (2.5%, 8/319) were limited, but dismissals of veterinarians (0.6%, 2/319), veterinary nurses (0.9%, 3/319), and other staff (1.3%, 4/319) due to financial constraints caused by COVID-19 were very few. One clinic stopped employment of veterinarians, nurses, and other staff, while six others dismissed one in each of the three work categories.

Half of the clinics answered that expenditures increased (45.7%, 146/319), and the main reasons were increased costs of preventing infection (47.0%, 150/319) and difficulty in procuring supplies (24.5%, 78/319, multiple answers allowed).

Mental distress

The proportion of respondents with a score above or equal to 13, which suggested SMI was 5.8% (25/430) of the total respondents. The position-category-specific prevalences of SMI were 4.8%, 14.9%, and 0% for veterinarians, veterinary nurses, and other staff members (Table 5), and the prevalence in nurses was significantly higher than that in veterinarians (χ^2=5.90, df=1, P=0.015). The prevalences of SMI in director veterinarians (5.1%) and employed veterinarians (3.6%) were not significantly different (P=1 in Fisher's

Table 3. Logistic regression for the association of COVID-19 occurrence in clinics and hygiene management during the first state of emergency and at the time of survey (n=430)

Measures	During state of emergency		At the time of the survey	
	Odds ratio (95% CI)	*P*-value	Odds ratio (95% CI)	*P*-value
Wear a mask during treatment	1.72 (0.34–8.58)	0.512	2.3×10^6 (0-∞)	0.989
Wear a mask during break	1.14 (0.77–1.69)	0.520	1.17 (0.77–1.76)	0.460
Wear a faceguard during treatment	1.12 (0.70–1.77)	0.641	1.17 (0.79–1.73)	0.425
Hand washing and disinfection	0.86 (0.51–1.43)	0.549	1.00 (0.49–2.06)	0.998
Disinfecting reception, waiting room, and floor after cleaning	0.72 (0.46–1.14)	0.167	0.75 (0.46–1.22)	0.246
Changing air in a waiting room	0.89 (0.54–1.46)	0.644	0.77 (0.47–1.26)	0.304
Changing air in a treatment room	0.84 (0.54–1.29)	0.420	0.81 (0.52–1.26)	0.357
Restricting the number of people in a waiting room	1.26 (0.88–1.82)	0.213	1.26 (0.88–1.82)	0.213
Checking the temperature of outpatient pet owners	1.11 (0.83–1.47)	0.491	1.09 (0.83–1.43)	0.514
Triage of pet owners according to the status of infection with COVID-19 or close contact	1.14 (0.80–1.61)	0.475	1.12 (0.8–1.56)	0.519
Having a manual for the prevention of infection	1.09 (0.83–1.45)	0.534	1.13 (0.85–1.49)	0.402

95% CI: 95% confidence interval.

Table 4. Correlations between the psychological scores of prioritized goals as measured by Nakaya's variation in Scheffe's paired comparison and perceived changes in outpatient visits during the first state of emergency (n=316)

Category of outpatient visits	Prevention of infection with COVID-19		Maintenance of clinical service		Maintenance of finance	
	Correlation coefficient	*P*-value	Correlation coefficient	*P*-value	Correlation coefficient	*P*-value
First visit	−0.106	0.061	0.076	0.179	0.044	0.439
Repeated visits	−0.132	0.019	0.129	0.022	0.028	0.618
Vaccination	−0.158	0.005	0.035	0.532	0.125	0.027

exact test). The adjusted overall prevalence of SMI in veterinary clinics using Bayesian estimation was 11.1% (95%CI: 6.3–18.6%).

In a univariable negative binomial regression for staff, veterinary nurses had significantly higher K6 scores (6.5) than veterinarians (3.5, $P<0.001$) and other staff (1.2, $P=0.001$). The mean K6 score was significantly higher in female respondents (5.0) than males (3.2, difference in estimate=0.433, se=0.132, $P=0.001$). Compared to respondents aged in their 70s (mean K6=2.0), those in their 20s (4.4, $P<0.001$), 30s (4.3, $P<0.001$), and 40s (4.2, $P<0.001$) had significantly higher K6 scores.

Figure 2 shows the proportions of the 5-point scores answered, which indicate the strengths of various causes of mental distress. The strongest cause of mental distress was refraining from going outdoors (mean score 4.0), and the second highest was fear of infection at work (3.6) on a 5-point scale (1: very low; 2: low; 3: neutral; 4: moderate; and 4: high). Both the strengths of distress from remaining indoors (estimate=0.184, se=0.054, $P<0.001$) and fear of infection risk at work (estimate=0.267, se=0.054, $P<0.001$), on a 5-point Likert scale, had significant relationships with K6. Table 6 shows the multivariable negative binomial regression result. Being a veterinary nurse, female, experiencing distress by not going outdoors and a fear of infection risk at work were significant risk factors for higher K6. Age category was removed from the final model, as it became non-significant in the multivariable analysis. In an additional analysis selecting only veterinarians, the K6 score was not significantly different between male and female veterinarians (estimate for males= −0.251, se=0.159, $P=0.114$).

Table 7 shows situations where respondents may fear infection with COVID-19 or experience relevant anxiety. The top four situations were associated with the risk of infection from pet owners. Fewer respondents feared risk of zoonotic infection from animals than from humans.

Change in pet ownership

Over half of the respondents felt that demand for purchasing pets increased after the start of the COVID-19 pandemic (51.6%, 222/430). On a 5-point Likert scale (1: strongly disagree; 2: disagree; 3: neutral; 4: agree; 5: strongly agree), the mean score for perceiving that pet demand in society increased due to COVID-19 was 3.4, which suggested neutral to slight agreement. Increased number of abandoning and sheltering animals was perceived by 21.4% (92/430) of the respondents. The score for perceiving that cases of abandoned pets increased was 2.5, showing disagreement with this trend.

Table 5. Prevalence of serious mental illness (K6 >=13) by position category

Position category	K6 >=13	Respondents	Prevalence (%)
Veterinarians	18	374	4.8
(Directors)	16	316	5.1
(Employed veterinarians)	2	56	3.6
Veterinary nurse	7	47	14.9
Others	0	9	0
Overall	25	430	5.8

DISCUSSION

This study describes the effects of the COVID-19 pandemic on the operation, hygiene management, and mental health of staff in Japanese companion animal clinics. After the COVID-19 epidemic began in Wuhan, Hubei Province, China, the Chinese government decided to implement containment measures, including the discontinuation of ordinary flights to and from Wuhan. The first COVID-19 case in Japan was announced on 16 January 2020 [20], the evacuation of Japanese citizens from Wuhan took place from 29 to 31 January 2020, and scientific

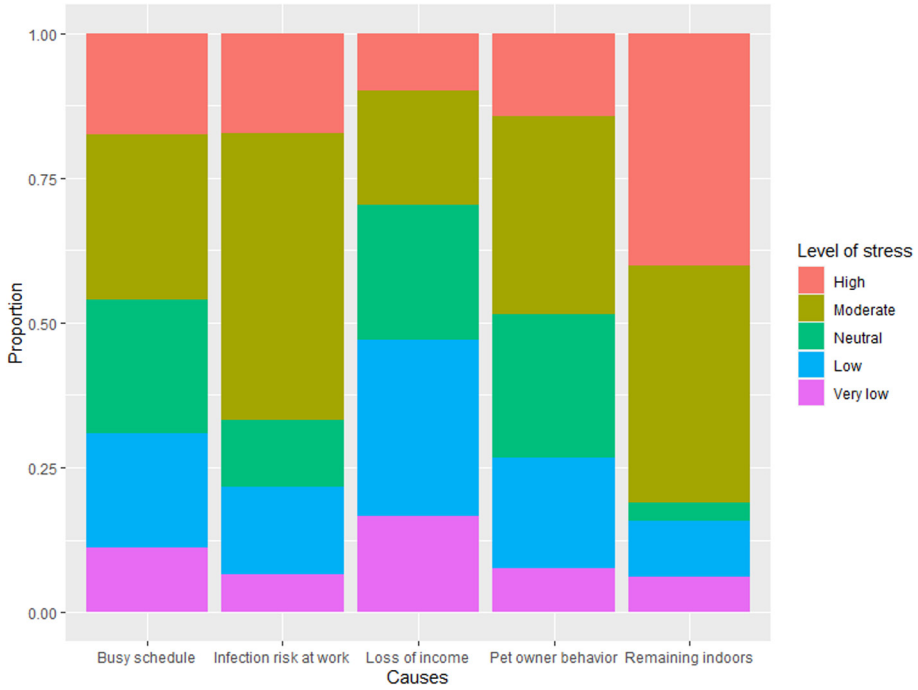

Fig. 2. Levels of mental stress by various causes: busy schedule, anxiety over loss of income, pet owners not caring about infection risk, remaining indoors, and fear of infection at work, at the time of survey, answered as 5-point scores (1: very low; 2: low; 3: neutral; 4: moderate; 5: high) (n=430).

Table 6. Multivariable negative binomial regression results for the factors associated with mental distress

Variables	Estimate	Standard error	*P*-value
Veterinary nurse	Reference	-	-
Veterinarians	−0.477	0.198	0.016
Other staff	−1.930	0.497	<0.001
Sex: male	−0.407	0.142	0.004
Refraining from going out	0.191	0.054	<0.001
Fear of infection risk	0.297	0.055	<0.001

Table 7. Situations in which respondents fear infection with COVID-19 or experience relevant anxiety (*n*=430)

Situation	Responses	Percentage (%)
Contact with a large number of people per day	257	59.8
Prolonged and close conversation during consultation	229	53.3
Crowded waiting room due to outpatient visits	175	40.7
Pet owners not taking adequate preventative measures against infection	155	36.0
Necessary equipment/supplies are unavailable	145	33.7
Inevitable close proximity among staff	99	23.0
Possibility of becoming a carrier	98	22.8
Risk of zoonotic infection	46	10.7

communications [25] began to raise awareness about the risk of infection with SARS-CoV-2 among the Japanese public. A shortage of masks occurred immediately all over Japan, and wearing hand-made masks by citizens was observed and reported in February 2020 by the media [32]. Almost all companion animal clinics experienced a shortage of various items including masks, and in this study, we report the situation and subsequent response. According to a previous report, the global trade in goods returned to a normal level by the end of 2020 [2], so this study describes the situation of shortages in that year particularly.

The companion animal clinics did not change their operating hours, but notable changes were observed in reception style. By adapting the appointment system and requiring waiting outside, the majority of clinics tried to reduce the number of pet owners in waiting rooms. In March 2020, it was reported that closed environments facilitate secondary transmission of COVID-19, and avoidance of the 'Three Cs': closed spaces, crowded places, and close-contact settings, was soon communicated to citizens [30]. Changing the air frequently in waiting and treatment rooms was also a response facilitated by the Three Cs. Wearing a mask, which is a common preventive measure for respiratory infectious diseases in Japan, and disinfection of hands and the environment, were additional practices clearly strengthened to prevent infection with SARS-CoV-2. While several guidelines for the prevention of infectious diseases in dogs and cats have been published worldwide [16, 37], manuals for preventing infection had not been prepared in many clinics. Setting standard operation procedures for preventing infectious diseases should be facilitated in veterinary clinics. Appointment and call management applications are gradually being applied, and digital technologies should be of great support during the COVID-19 pandemic. Although hygiene measures were clearly strengthened in the clinics, no hygiene practice item was statistically associated with the occurrence of COVID-19 among the staff. This can be interpreted as infections with SARS-CoV-2 among clinical staff mainly occurring at home or through private activities outside of the clinics. However, hygiene management remains important in preventing nosocomial COVID-19 transmission in companion animal clinics.

As mentioned in the Introduction, 10% of respondents in a global survey of veterinarians have lost their jobs or have been furloughed after the COVID-19 pandemic began [4]. In this study, there was no trend of unemployment in Japanese companion animal clinics due to COVID-19. Economically, the travel, transport, and construction services sectors have been the most affected [2]. Although expenditures increased in half of the studied clinics, their finances were resilient. To prevent infection with SARS-CoV-2, the time spent at home increased among citizens, and the demand for companion animals might also have increased. According to the Japan Pet Food Association, the proportion of households rearing dogs and cats increased from 5.0% and 5.9%, respectively, in 2019 then to 5.8% and 6.9%, respectively, in 2020 [12]. The perception of the respondents about the increase was mild, probably because outpatient visits did not change according to the respondents, but the data from the Japan Pet Food Association indicates a change.

By the increased number of pets, it is anticipated that cases of pet abandonment may increase. The respondents did not perceive this trend, but pet abandonment should be carefully monitored over several years for the sake of animal welfare. Another animal welfare issue identified in this study is that policies for pet owners infected with SARS-CoV-2 have not been clarified. There are private companies that look after the animals of infected owners with SARS-CoV-2 [3]. Health authorities should strengthen the animal shelter system for such cases, probably with public-private collaborations, including companion animal clinics, veterinary associations, and universities.

Efforts to maintain finances were associated with increased numbers of vaccinations according to our analysis using the psychological score by Nakaya's variation in Scheffe's paired comparison [21, 29]. However, the highest prioritized goal among the respondents was to prevent nosocomial infection with SARS-CoV-2. The second prioritized goal was to continue helping sick animals, which was associated with increased repeat visits. Overall, the professionalism of veterinarians was fundamental to the changes in the number of outpatient visits.

According to the K6 scores, the adjusted prevalence of SMI among workers in veterinary clinics, 11.1%, and that of veterinary nurses, 14.9%, were high compared with the global prevalence of depression before COVID-19, 4.4% [38]. The prevalence of SMI K6 cutoff 12/13 among Japanese citizens in 2016 was reported to be 3.9% [34]. The respondents in the present study are only from a working population, while the global and Japanese prevalences of SMI [34, 38] included those not working due to SMI; the results suggested that workers in companion animal clinics are distressed at higher levels than in the general population before COVID-19 pandemic. A high proportion (9%) of 30–39-year-old veterinarians with serious psychological distress was reported in 2015 from the United States of America [22]. The prevalence of SMI (K6 >=13) among general population in the United States in 2018 by the

National Health Interview Survey was 4.0% [34], and the prevalence among veterinarians may be higher than general population. However, a risk factor in the present study, distress by not going out to avoid infection with SARS-CoV-2, should have been common among general population under the pandemic. Another risk factor, fear of infection risk at work, can be perceived by many business offices which require face-to-face consultation with customers. Animals can be infected with SARS-CoV-2 [7], but in this study it was not a major cause of the stress associated with perceived risk of infection. Moreover, individuals with stronger negative emotion by the pandemic might be more willing to participate [9], and this study may be over-estimating the mental health situation. As general populations other than workers in veterinary clinics are not involved in this study, relative severity of distress cannot be determined. However, this study showed that COVID-19 apparently affects the mental health of workers in companion animal clinics through these risk factors. Moreover, the risk factor analysis identified high-risk populations in companion animal clinics: veterinary nurses and females. The K6 score was not different between male and female veterinarians, so in practice, clinic directors should consider the needs of female veterinary nurses in particular. It is common for females to be more vulnerable to mental stress from traumatic events, including in the field of veterinary medicine [1, 27]. In Japan, females had a higher Impact of Event Scale-Revised score, which is an indicator of post-traumatic stress disorder (PTSD), among volunteers who participated in foot-and-mouth disease control in Miyazaki Prefecture [8]. Although age was removed from the final model for mental stress, the first and second COVID-19 vaccinations were available for the elderly population at the time of the survey, which may explain the low K6 of those aged over 70. The Omicron variant was reported to be 3.3- or 4.2-times more transmissible than the first SARS-CoV-2 strain [24]. Currently, vaccine boosters are being provided, but the COVID-19 pandemic may persist with the emergence of such new variants, and immunity waning. Therefore, the mental stress situation in veterinary clinics may better be monitored.

This study was conducted in the absence of supports from national authorities or organizations, but the number of responses exceeded the calculated sample size and representativeness of the clinics in terms of geographical distribution was confirmed. On the other hand, this study employed electronic questionnaire survey and may have a selection bias to the respondents who are familiar with internet. Actually, a clinic requested the research team to send a questionnaire by facsimile, and hard copies of filled forms were received. Directors/representatives dominated (74.2%) the responses, and the results, particularly on mental distress, may be biased to the sub-population. The median number of veterinarians in a clinic was two, and the majority of the directors/representatives are likely to face pet owners on a daily basis. Moreover, the prevalence of SMI was not significantly different between director and employed veterinarians. Therefore, the results should represent the views of practitioners.

The questions in this study included practices both prior to and during the COVID-19 pandemic, which rely on the recall of participants. Memory can be altered by heightened emotional status [9], and stress experienced at the time of completing the survey could affect recall of prior experience.

In conclusion, it is advisable to introduce digital applications for smart management of outpatient visits to reduce direct contact, which would reduce stress from the fear of infection. Care should be taken to mitigate mental stress, particularly for female veterinary nurses.

CONFLICT OF INTEREST. The authors declare no conflict interest.

ACKNOWLEDGMENTS. We thank Dr. Yosuke Shinno at Kariki Animal Clinic, Dr. Yoko Watanabe at Ishiyama-dori Animal Hospital, Dr. Ryo Okamoto at Maetani Animal Hospital, and Dr. Natsuki Yanagimoto at Sapporo Sogo Animal Hospital for the semi-structured interviews to help design the questionnaire. We thank Dr. Yasukazu Muramatsu at Rakuno Gakuen University for asking these veterinarians to participate in the interviews. The veterinarians and nurses in Rakuno Gakuen University Animal Medical Center helped revise the draft questionnaire. Many thanks go to the local veterinary associations, the Animal Clinical Research Foundation, Professor Masato Yamazaki and Dr. Akiko Yamazaki at Iwate University, the Farm Animal Health Consortium, Professor Tetsuya Mizutani at Tokyo University of Agriculture and Technology, Professor Makoto Nagai at Azabu University, and Professor Tamaki Okabayashi at University of Miyazaki, the Japanese Society of Veterinary Nursing, and Dr. Takuya Kimura and Dr. Yoko Kimura at Mu Animal Hospital for their assistance with the questionnaire survey facilitation. Finally, we thank all of the participants of this survey for their valuable information.

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