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Changes in the health and behaviour of pet dogs during the COVID-19 pandemic as reported by the owners

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Abstract

The COVID-19 pandemic affects human health, movement and behaviour, and this may consequently influence the behaviour and health of their pets. The aim of this study was to assess the impact of the COVID-19 pandemic on pet dogs' behaviour, as reported by their owners, as well as the owners' experience in relation to their dogs. We hypothesized that dog owners who underwent lockdown or quarantine would indicate more behavioural changes in their dogs and experience support in having a dog during the pandemic. An international online survey asked dog owners questions regarding their household, the dog, and dog-related changes during the pandemic. A total of 688 surveys, collected May-June 2020, were analysed. Respondents were from across Europe (87%), the Americas (9%), and Asia and Australia (together 4%). Data were analysed in GLMM models with a binary distribution and country included as random variable. The main predictor variable was whether the respondent experienced lockdown (300 respondents, 44%); quarantine (76 respondents, 11%); or no restrictions (312 respondents, 45%). Respondents who underwent lockdown or quarantine were 1.8 times more likely to report behavioural changes in their dogs ($p = 0.02$), with more negative behavioural changes in the dogs reported by respondents in lockdown than expected by chance. However, overall behavioural changes were more often positive (30%) than negative (24%). Respondents in lockdown were 2.6 times more likely to report health changes in their dogs ($p = 0.02$). The dog was perceived as a source of support during the pandemic: 65% of the respondents indicated reduced tension due to their dog and 47% indicated that the ability to walk the dog outside was another benefit. Advantages were reported more by respondents in lockdown and quarantine as compared to respondents who did not face these restrictions ($p < 0.001$). Difficulties in dog care were increased for respondents who experienced lockdown or quarantine ($p < 0.01$) and those who had no garden as compared to those who did ($p < 0.001$). One-third of the respondents took dog-related measures to prevent the spread of the coronavirus, and this was associated with more behavioural changes and more difficulties. In conclusion, lockdown, and to a lesser extent quarantine, may influence the dogs' behaviour and health, or the owners' awareness of it, and can contribute to a perceived tension-reduction in the owners.

1. Introduction

The year 2020 will be remembered for the outbreak of the COVID-19 pandemic, caused by the coronavirus SARS-CoV-2. Besides the major impact that it has on human life, questions arise about the potential impacts of restrictions related to the pandemic on pet dogs, since they are a ubiquitous part of human societies. Human-animal interactions are an important source of social support for humans (reviewed by Gee et al., 2017), as well as for dogs (Bergamasco et al., 2010). Dogs and their caretakers may form a strong attachment (reviewed by Payne et al., 2016). Therefore, due to the inter-dependency between dogs and their human caretakers, it could be expected that changes to human life caused by COVID-19 and its subsequent social distancing measures will affect the life and welfare of pet dogs (e.g. McNamara et al., 2020;
Initial media reports suggested that the COVID-19 pandemic influenced the culling or abandoning of dogs, especially in Asia, but also increased adoption rates (Morgan et al., 2020; Parry, 2020). For example, during the US stay-at-home orders, an increase of 70 % in pet adoption was reported in New York and Los Angeles areas in March 2020 (Szydłowski and Gragg, 2020). The contrasting reaction by (future) pet owners partly depends on societal perspectives, which may differ by country. Recent evidence shows that dogs do not shed SARS-CoV-2 after infection but do develop an antibody response (Bosco-Lauth et al., 2020), with 12.8 % (6/47) of dogs from COVID-19 positive households showing SARS-CoV-2-neutralizing antibodies (Paterson et al., 2020). Although earlier research indeed suggested that the likelihood of COVID-19 transmission from dogs to humans is minimal (Goumenou et al., 2020; Vincent et al., 2020), public concerns and fear of infection have, according to the media, led to dog abandonment and euthanasia (Parry, 2020). As the possibility of transmission was not yet known in early 2020, the Italian Health Ministry recommended that contact with pets should be restricted from people who are infected with COVID-19 (Goumenou et al., 2020). This may have resulted in a change of humans’ attitudes towards dogs, for example altering dog care routines and reducing human-dog contact compared to pre-pandemic (Bowen et al., 2020). There is thus a need for more insight in how the pandemic has impacted dog welfare globally. To date, several survey-based studies have looked at the effects of the COVID-19 lockdown on people, their pets and the human-animal bond (Spain: Bowen et al., 2020; USA: Applebaum et al., 2020), but given the worldwide spread of the coronavirus these aspects need to be addressed globally.

The aim of this study was to assess the impact of the COVID-19 pandemic on the behaviour and health of pet dogs, as reported by their owners, as well as the experience of the owners in relation to their dog(s). Based on the fact that the lives of people are substantially changed during lockdown or quarantine, including dog care routines, we hypothesized that dogs will show behavioural changes when the owners are in lockdown or quarantine, as compared to owners who did not face such restrictions during the pandemic. As it is known that humans may perceive their dog as a source of support during challenging situations, we further hypothesized that owners in lockdown or quarantine will perceive their dogs as a source of support more than owners who did not face these restrictions during the pandemic. This was investigated through an international online survey in which dog owners were asked to report on the behaviour and health of their dog(s), on the household and on the human-animal interactions.

2. Material and methods

2.1. Survey design

A survey was designed to include questions on potential changes in the health and behaviour of dogs during the COVID-19 pandemic. The responses were anonymous and confidential, meaning that no identifiable information such as names and email addresses were collected. IP addresses of respondents were deleted after initial inspection for double entries. Participation was voluntary. The survey did not require ethical approval from the human ethical review committee but adhered to international standards for consent and GDPR (General Data Protection Regulation).

The survey started with a brief introduction that explained the aim of the project and provided information on anonymity, data protection, and participant consent. To start the survey, participants had to confirm that they had read the aim of the survey, that they were at least eighteen years old, and provided their consent to participate. The survey was designed to take no more than 10 min to fill in. Twenty-two questions were asked, divided over four parts: A) Country of residence and information about the dog(s); B) Changes in dog care, behaviour and health during pandemic; C) Difficulties and/or advantages of having a dog during pandemic; and D) The household characteristics. The full list of questions is provided in Table 1.

The survey was checked by a native English speaker and then translated by native speakers into Mandarin (Simplified Chinese), Italian, French, Spanish, German, Portuguese, Dutch and Polish. This covered four of the main World languages (estimated 1.9 billion native speakers of English, Chinese, Spanish and Portuguese jointly) and covered the languages spoken in the five countries that were at the time of the survey most affected by COVID-19.

2.2. Survey distribution

The survey was placed online using the EUSurvey platform, version v1.5; a free online survey-management system supported by the European Commission that allows multiple languages. The EUSurvey ISA2 programme was used as template. The survey targeted dog owners internationally and was advertised globally using the snowball technique, starting with sending e-mails to approximately 20 known contacts in canine science and canine training in various countries. The contacts were asked to forward the e-mail to recruit further participants among dog owners, e.g. using Facebook. In addition, short announcements were placed on social media (on websites and newsletters of animal science societies and networks, Twitter, and on the YouTube channel Animal Welfare Science). The survey was available online from 1 May to 30 June 2020.

2.3. Data preparation

Initially 691 surveys were received. Survey responses were first checked for completeness and potential false or faulty answers by checking for double IP addresses and whether the respondent was at least 18 years of age. Data were inspected for incorrect entries in the open text boxes, such as breed (e.g. no existing breed entered) and year of birth (e.g. random numbers or age instead of birth year), in which case the answer was left open. The average completion rate for the respondents, when considering all questions in the survey, was 98.6 ± 3.38 % (mean ± std.dev.; range: 77.2–100%), with most missing entries for the last two questions on participant age and gender. Therefore no participants were discarded due to incompleteness. Three entries were deleted due to respondents being <18 years of age. A total of 688 surveys were analysed.

The names of the dog breeds were translated to English where needed. As dog breeds differ in their behaviour and their requirements for care, we categorized breeds into 10 groups based on the FCI (Federation Cynologique International; Supplementary Table S1). An eleventh group of ‘mixed breeds’ was added.

Due to low responses for some countries, those with at least 20 responses (9 countries) were included with their country name as categories. All other countries were categorized as ‘Other’. The variable ‘Measures’ (Table 1, question B5) was the sum of the number of measures related to the dog that were taken to reduce the chance of infection. The number of measures taken ranged from 1 to 6, whereby the responses for 5 and 6 measures were summed to have at least 5 respondents per option. The answers to questions B6 (Table 1; dogs’ behavioural changes) and B7 (Table 1; dogs’ health changes) were used as binary response variables, with yes/no for behavioural and health changes of the dog(s) in the household. The variables Difficulties (Table 1, question C1) and Advantages (Table 1, question C2) were, because of a skewed distribution, also transformed to binary variables (yes/no). It was indicated whether each respondent had experienced restrictions to movement or not (Lockdown / Quarantine / ‘Control’), irrespective of the duration of lockdown or quarantine due to low variation herein (see Supplementary Table S2). Persons who experienced both lockdown and quarantine were classified as ‘Quarantine’. ‘Control’ refers here to the use as a control group for statistical
Table 1
Questions and types of answers in the survey. A-D indicate the sections A) Country of residence and information about dogs; B) Changes in dogs’ handling, care, behaviour and health during pandemic; C) Difficulties and/or advantages of having a dog during pandemic; and D) The household characteristic. * The list of multiple-choice options is provided in the results.

| No. | Question | Type of answer |
|-----|----------|----------------|
| A1  | In which country were you living during the pandemic? | Drop-down box |
| A2  | How many dogs do you have? Give the number of dogs per age category [Puppy < 2 years old, Adult 2–7 years old, Old >7 years old] | Table |
| A3  | What is the breed? If you have more than one dog then list the breeds of all dogs | Open text box |
| A4  | If the dog is of a mixed breed, which size is it approximately? Give the number of dogs per size category [Small <10 kg, Medium 10–30 kg, Big >30 kg] | Table |
| A5  | When did the most recent dog arrive at your household? [<1 month, 1–6 months, 7–12 months, >1 year before the pandemic] | Single choice |
| A6  | What is your gender? [Man, Women, Prefer not to disclose] | Single choice |
| A7  | What is your year of birth? | Single choice |
| B1  | During the pandemic, where did the dog(s) mostly stay? [Outdoor, Indoor, but not on places usually occupied by humans (bed, armchair etc.), Indoor, including on places usually occupied by humans] | Single choice |
| B2  | How frequent was the physical contact with the dog(s) during the pandemic? [Only minimal touching, stroking or petting; 1–2 times a day briefly touching, stroking or petting; Multiple times a day touching, stroking or petting] | Multiple choice |
| B3  | Did the care of the dog(s) change during the pandemic? [No, care remained as usual; Yes, friends, relatives or neighbours took care of one or more of the dog(s); Yes, the dog(s) went to a shelter / animal hotel] | Multiple choice |
| B4  | If yes, what was the reason for changing care? [Fear of being infected with COVID-19; Difficulties with life organization due to restrictions during the pandemic; Financial difficulties due to the pandemic; Other] | Multiple choice |
| B5  | Did you take any special measures or actions with respect to your dog(s) in order to prevent spreading of COVID-19? (18 choice options, see Results section*) | Multiple choice |
| B6  | Did you observe any changes in the behaviour of your dog(s) during the pandemic as compared to before the pandemic? (18 choice options, see Results section*) | Multiple choice |
| B7  | Did you observe any changes in the health of your dog(s) during the pandemic as compared to before the pandemic? (18 choice options, see Results section*) | Multiple choice |
| B8  | Does your dog suffer from any chronic disease? [Yes, skin/parasitic diseases; Yes, internal diseases; Yes, other chronic disease; No] | Multiple choice |
| C1  | Which difficulties did you experience of keeping a dog during the pandemic? (10 choice options, see Results section*) | Multiple choice |
| C2  | Did you see any advantages of the presence of a dog during the pandemic? (5 choice options, see Results section*) | Multiple choice |
| D1  | What best describes where you lived most of the time during the pandemic? [Densely populated city / capital city; Regular city; Suburb/small town; Country side; Flat without yard/garden; House/apartment with small yard/garden] | Open text box |
| D2  | How many adult persons were staying at the house during the pandemic? | Multiple choice |
| D3  | Did you have to take care of children during the pandemic? [Yes, one or more infants of < 1 years old; Yes, one or more children of 1–5 years old; Yes, one or more children of 5–15 years old; No] | Multiple choice |
| D4  | For how long have you been restricted in going outside (lockdown)? [Not at all; 2 weeks; 1 month; 2 months; 3 months >3 months] | Single choice |
| D5  | Have you or anyone in your household been under quarantine? [Yes, for 2 weeks; Yes, for >2 weeks; No; Prefer not to disclose] | Single choice |

* Possible answers were listed randomly to avoid bias in responses of a positive or negative nature, e.g. negative behavioural changes such as ‘less play’ were interspersed with positive changes such as ‘more play’.
specific to humans (15.2%, n = 106 households) or stayed (most of the time) outdoors (8.8%, n = 61 households).

3.2. Dogs’ health and behavioural changes as reported by the owners

The majority of the respondents (74.1%, n = 512) indicated that they did not perceive a behavioural change in their dog. However, respondents who were in lockdown or in quarantine were 1.8 times more likely to indicate a behavioural change in their dog(s) as compared to those who did not undergo these restrictions (here classified as ‘control’; $F_{2,676} = 4.07, p = 0.02$; Table 3). Respondents who took more dog-related measures to prevent the spread of the coronavirus were 1.3 times (CI 1.10–1.66) more likely to indicate a behavioural change ($b = 0.30 \pm 0.107, F_{1,676} = 7.91, p = 0.005$). None of the other variables were associated with behavioural changes (all $p > 0.05$).

Table 2

| Respondent demographics | %  | n   |
|-------------------------|----|-----|
| Gender                  |    |     |
| Male                    | 11.8 | 80 |
| Female                  | 88.2 | 599 |
| Locality                |    |     |
| Countryside             | 26.3 | 182 |
| Town or suburbs         | 24.3 | 168 |
| City                    | 17.7 | 122 |
| Capital city            | 17.2 | 119 |
| Accommodation type      |    |     |
| Apartment or house with a small garden | 25.5 | 176 |
| House with large garden or farm | 22.6 | 156 |
| Flat or apartment without garden | 10.9 | 75 |
| Household composition   |    |     |
| 1-person                | 19.3 | 130 |
| 2-person                | 52.0 | 351 |
| 3-person                | 15.6 | 105 |
| 4-person                | 7.8  | 54  |
| 5-person                | 5.3  | 36  |
| Children under care     |    |     |
| No                      | 83.3 | 569 |
| Infants of < 1 years old| 1.3  | 9   |
| Children of 1–5 years old| 3.9  | 27  |
| Children of 5–15 years old | 9.7  | 66  |
| Combination of children from 1–15 years old | 1.6  | 11  |
| Lockdown                |    |     |
| No                      | 49.7 | 342 |
| Yes                     | 50.3 | 346 |
| Quarantine              |    |     |
| No                      | 88.9 | 611 |
| Yes                     | 11.1 | 76  |

Fig. 1. Distribution of respondents by country, with the percentage of respondents per country indicated from white (<1%) to dark red (>25%). Countries without respondents are depicted in grey (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

Table 3

| Variable                              | Reference class | OR   | CI                |
|---------------------------------------|-----------------|------|-------------------|
| Behavioural change in dog             |                 |      |                   |
| Lockdown                              | Control         | 1.834| 1.182 – 2.845     |
| Quarantine                            | Control         | 1.795| 0.988 – 3.259     |
| Health change in dog                  |                 |      |                   |
| Lockdown                              | Control         | 2.687| 1.190 – 6.067     |
| Quarantine                            | Control         | 0.789| 0.195 – 3.194     |
| Advantages of having a dog            |                 |      |                   |
| Lockdown                              | Control         | 2.605| 1.602 – 4.257     |
| Quarantine                            | Control         | 1.609| 0.827 – 3.131     |
| Difficulties of having a dog          |                 |      |                   |
| Lockdown                              | Control         | 2.336| 1.346 – 4.052     |
| Quarantine                            | Control         | 1.282| 0.573 – 2.867     |
| House type – apartment with small     |                 |      |                   |
| outdoor access                        | No outdoor access| 0.438| 0.237 – 0.809     |
| House type – farm/house with large    |                 |      |                   |
| garden                                | No outdoor access| 0.293| 0.155 – 0.556     |
| Arrival – less than 1 month before the |                 |      |                   |
| pandemic                              | More than 1 year| 2.355| 0.885 – 6.264     |
The perceived behavioural changes were mostly positive (Table 4), with 144 respondents indicating positive changes and 93 respondents indicating negative changes. The response differed in relation to the restrictions ($\chi^2 (1, N = 321) = 10.838, p = 0.004$), with respondents in lockdown reporting more negative behavioural changes and fewer positive behavioural changes than expected by chance.

The majority of the respondents (92.4 %, n = 636) indicated that they perceived no health changes in their dog(s). Health changes during the pandemic included increased appetite (n = 6), decreased appetite (n = 12), diarrhoea (n = 8), decreased mobility (n = 6), skin problems (n = 10), constipation (n = 6) and other changes (n = 15). Respondents who were in lockdown, but not in quarantine, had a higher likelihood of reporting health changes ($F_{1,672} = 4.01, p = 0.02; \text{Table 3}$). Respondents who took more dog-related measures to prevent the spread of the coronavirus were 1.3 times (CI 1.00–1.79) more likely to report health changes ($b = 0.30 \pm 0.148, F_{1,672} = 3.88, p = 0.05$). Health changes were 3.7 times (CI 1.50–9.29) more likely to be reported by respondents who had only old dogs as compared to those who had dogs of multiple age categories (regardless of number of dogs) ($F_{3,672} = 2.71, p = 0.04$). None of the other variables were associated with health changes (all $p > 0.05$).

### 3.3. Advantages of having a dog during the pandemic

Human-dog interactions occurred in most households multiple times during the day (97.4 %, n = 670 households). There were only some households in which the dogs received contact 1–2 times a day (n = 17) or minimal contact (n = 4). The majority of respondents indicated that their psychological tension was reduced due to the presence of the dog, and that the ability to walk the dog during the pandemic was an advantage (Table 5). Respondents who were, or had been, in lockdown or quarantine were more likely to report advantages of having a dog during the pandemic than those who did not face these restrictions ($F_{2,673} = 7.58, p < 0.001; \text{Table 3}$). None of the other variables were significantly associated with the experience of advantages, including whether respondents were living on their own or not ($p > 0.05$).

### 3.4. Difficulties of having a dog during the pandemic

Most respondents (63.2 %, n = 435) did not take special measures or actions regarding their dog to prevent the spread of COVID-19 (Table 6). Respondents in lockdown took measures more than expected by chance, whereas fewer ‘control’ respondents took measures than expected by chance ($\chi^2 (1, N = 688) = 19.421, p < 0.001$). Only eight respondents had to temporarily relocate their dog from its household due to the pandemic.

### Table 4

Behavioural changes of the dogs during the pandemic as perceived by the respondents. Values are the percentage of respondents per group (lockdown, quarantine or control), with the number of respondents between brackets. Respondents could click multiple choices of the predetermined options listed in this table. Green shading indicates the positive behavioural changes and red shading the negative behavioural changes.

| Did you observe any changes in the behaviour of your dog(s) during the pandemic as compared to before the pandemic? (Multiple answers possible) | Lockdown % (n=300) | Quarantine % (n=76) | Control % (n=312) |
|---|---|---|---|
| No change | 66 (199) | 70 (53) | 83 (258) |
| More frequent seeking close contacts (approaching, sniffing, etc.) | 12 (37) | 16 (12) | 7 (22) |
| Calmer | 6 (19) | 14 (11) | 10 (30) |
| More playful | 10 (30) | 16 (12) | 6 (18) |
| Less frequent barking/vocalizations | 1 (4) | 4 (3) | 3 (9) |
| Restlessness | 5 (15) | 4 (3) | 1 (4) |
| More frequent barking/vocalizations | 5 (15) | 5 (4) | 1 (3) |
| Anxious | 4 (12) | 5 (4) | 1 (4) |
| Less playful | 2 (7) | 0 (0) | 1 (4) |
| Incontinence/urinating or defecating indoors | 1 (4) | 3 (2) | 0 (1) |
| Development or increase of repetitive (stereotypic) behaviour | 2 (6) | 0 (0) | 0 (0) |
| Apathetic (unresponsive) | 1 (4) | 0 (0) | 0 (0) |
| Increased aggression towards humans | 0 (1) | 4 (3) | 0 (0) |
| Avoiding close contact to caretaker (e.g. frequent withdrawal to lying place, hiding) | 1 (2) | 0 (0) | 0 (0) |
| Increased damaging behaviour (e.g. scratching door) | 0 (0) | 0 (0) | 0 (0) |
| More frequent requests for being walked outdoors | 7 (21) | 3 (2) | 2 (6) |
| Reluctance of being frequently walked outdoors | 1 (3) | 0 (0) | 0 (1) |
| Other | 2 (7) | 1 (1) | 3 (8) |
The majority of respondents (67.7 %, n = 468) indicated that they did not experience difficulties in caring for a dog during the pandemic, but 16 % did experience difficulty with accessing veterinary care (Table 6). Respondents in lockdown and quarantine indicated more difficulties with keeping a dog during the pandemic than control respondents (F2,379 = 4.72, p = 0.01; Table 3). More difficulties were reported by respondents who lived in a flat without a garden, as compared to those who lived in houses with a small or large garden (F2,379 = 7.14, p < 0.001; Table 3). Difficulties were 1.5 times (CI 1.12–1.85) more likely to occur when the most recent dog had arrived to the household (F2,379 = 2.09, p = 0.10), with a post-hoc difference (p = 0.02) for dogs that arrived less than 1 month before the pandemic as compared to dogs that were kept for more than a year. However, the lower bound of the CI of this post-hoc comparison was below 1 (Table 3).

4. Discussion

Given the impact of the COVID-19 pandemic on people’s lives, we expected that this would also be reflected in their pet dogs. With lockdown and quarantine restricting human movement, daily activities and social interactions of people, we hypothesized that lockdown and quarantine would result in more behavioural changes in the dogs as reported by the owner, and that owners would perceive the dog more often as a source of social support than people who were not in lockdown or quarantine. The responses of dog owners, of which 44 % underwent lockdown, 11 % underwent quarantine, and 45 % did not face lockdown or quarantine, showed that lockdown and quarantine significantly influenced respondents’ answers about dog behaviour, dog health, and the disadvantages and difficulties of having a dog during the COVID-19 pandemic. In line with our hypotheses, dog owners in lockdown and quarantine reported more behavioural changes that they perceived in their dogs and were more likely to indicate advantages related to the dog such as a reduction in their psychological tension.

Behavioural changes in dogs during the COVID-19 pandemic are a serious and global concern (Gray, 2020). In our survey the majority of respondents did not ascertain any differences in dogs’ behaviour during the pandemic as compared to the period before, however, for those who did, 67 % of the behavioural changes could be considered as positive. Respondents in lockdown indicated more negative behavioural changes in their dogs than expected by chance, including restlessness, increased barking and anxiousness. In the U.K., 26 % of the 6004 surveyed dog owners reported behavioural changes in their dogs during lockdown, of which most respondents indicated increased vocalizations such as barking (Christley et al., 2021). Bowen et al. (2020) also reported changes in dogs’ behaviour during the pandemic, in particular negative behavioural changes such as increased vocalization, fear of loud or sudden noises, problems with being left alone at home, and aggression towards unfamiliar humans and dogs. We found no problems increased dog aggression in our survey, but Dixon and Mistry (2020) show based on emergency department data a clear spike in dog bites during lockdown in April 2020. Bowen et al. (2020) found a relatively high increase in dogs’ attention-seeking behaviour (41.6 % respondents), which corresponds with the responses on ‘seeking close contact’ in our study, albeit in a lower percentage of respondents (10.2 %). In the study of Morgan et al. (2020), in Israel, 11.6 % of the dog owners reported behavioural problems, and lockdown was a significant risk factor for the dogs’ quality of life.

Respondents in lockdown (but not quarantine) reported more health changes in their dog, but the number of health changes was overall very low (7.3 % of respondents reported a change). Changes were mostly gastro-intestinal such as appetite and excretion, which may be caused by changes in exercise (shorter walks and less frequent walks were reported) and a potential change in nutrition as globally various grocery supplies became unavailable due to hoarding. Dog feed supply was indeed in this study (40 respondents) and in other studies (Applebaum et al., 2020; Bowen et al., 2020) mentioned as a difficulty or concern during the pandemic.

The health and behavioural changes as reported by the owners can be true changes. However, the reports are based on the owner’s perception and given the likely increased contact with the dogs due to the general stay-at-home orders, owners may have been more attentive to their dog and may have been more likely to notice behaviour that they did not notice previously.

Another main predictor of the respondents’ answers about their dogs was the number of measures that they took to prevent potential spread of COVID-19 through the dog. Dog petting and walking may theoretically contribute to the transmission of COVID-19 (Goumenou et al., 2020; Kirov et al., 2020; Leroy et al., 2020), through touching of the same animal and through gathering at public places suitable for dog walking. Only one-third of the respondents took dog-related preventive measures against COVID-19. The most common measure was to prevent the dogs from contacting other people and other animals, which may have influenced the social life of the dog and may have especially been detrimental to puppy socialization (Howell et al., 2015; a concern also voiced in Applebaum et al., 2020). Another common measure was to have shorter walks during the pandemic than usual, which may have affected the dogs’ health and behaviour. During the pandemic, dog owners in Spain (Bowen et al., 2020) and the U.K. (Christley et al., 2021) made more short walks and fewer long walks. Respondents in lockdown

Table 6
Dog-related measures taken to prevent the spread of COVID-19 and perceived difficulties. Values are the percentage of respondents per group (lockdown, quarantine or control), with the number of respondents between brackets. Respondents could click multiple choices of the predetermined options listed in this table.

| Did you take any special measures or actions with respect to your dog (s) in order to prevent spreading of COVID-19? (Multiple answers possible) | Lockdown % (n = 300) | Quarantine % (n = 76) | Control % (n = 312) |
|---|---|---|---|
| None | 56 (167) | 57 (43) | 72 (225) |
| Avoiding that the dog(s) made contact with other people | 30 (90) | 33 (25) | 23 (72) |
| Avoiding of close contact with other animals | 20 (60) | 13 (10) | 9 (28) |
| Shorter walks outdoors | 19 (56) | 9 (7) | 5 (16) |
| Disinfection of paws/coat | 10 (30) | 5 (4) | 4 (12) |
| Decreasing physical contact with the dog(s) compared to before | 7 (20) | 7 (5) | 2 (5) |
| Letting the dog(s) less frequently outdoors | 7 (21) | 5 (4) | 1 (4) |
| No more outdoor access beyond the house / garden | 6 (19) | 1 (1) | 1 (2) |
| Leaving dog(s) temporarily under custody of other people | 1 (4) | 1 (1) | 1 (3) |
| Other | 1 (3) | 1 (1) | 4 (12) |

Which difficulties did you experience of keeping a dog during the pandemic?

| No difficulties | 58 (173) | 74 (56) | 76 (237) |
| More difficult access to veterinary care | 18 (53) | 13 (10) | 16 (49) |
| No place for safe walking without encountering too many people | 16 (49) | 12 (9) | 6 (18) |
| Shortage of time for walking the dog | 11 (34) | 5 (4) | 0 (1) |
| Food supply | 7 (20) | 0 (0) | 6 (20) |
| Not being able to use dog care facilities | 6 (17) | 4 (3) | 2 (5) |
| Other difficulties | 3 (10) | 7 (5) | 3 (9) |
| Negative comments / hostility of neighbours / pedestrians | 5 (15) | 0 (0) | 1 (3) |
| Unfavourable changes in dog’s behaviour | 3 (9) | 1 (1) | 1 (2) |
| Fear of being infected with COVID-19 related to the dog | 2 (7) | 1 (1) | 2 (5) |
the prohibition of outdoor access was found as the main difficulty for the dog, and the need to go out of the home to let the dog out. In Spain dog owners during the pandemic (Bowen et al., 2020). Lockdown pol

horses with outdoor access or a garden. This can be for various reasons, pet during the veterinary visit (Applebaum et al., 2020). More difficulties in dog care were experienced by respondents who were in lock

down as compared to those who did not have lockdown, which may be due to difficulties directly related to the restriction in movement. More difficulties also tended to be present in households where the most recent dog had arrived less than a month before the pandemic; a concern which was also raised by U.S. dog owners (Applebaum et al., 2020). Newly acquired dogs require more attention, acclimatization and training as compared to familiarised dogs, however, during the pandemic the access to veterinary care and professional advice may be limited (Hurn et al., 2020). Respondents living in houses without a garden indicated more difficulties in keeping a dog as compared to houses with outdoor access or a garden. This can be for various reasons, such as generally smaller living spaces, less opportunity for exercising the dog, and the need to go out of the home to let the dog out. In Spain the prohibition of outdoor access was found as the main difficulty for dog owners during the pandemic (Bowen et al., 2020). Lockdown pol

The approach of international data collection led to the possibility of comparing levels of pandemic restrictions, e.g. lockdown versus no lockdown between countries. The geographical distribution of respondents was broad, spreading all continents, which reduces the representation of the sample population. To account for dependence between respondents of the same country, the country of residence was included in all models as a random factor. However, due to the low number of respondents for most countries, countries with fewer than 20 respondents were grouped together in one category. This resulted in a high variation within this category (data not shown) but prevented a reduced statistical power. The majority of respondents in this study were women, which was similar to comparable surveys (Applebaum et al., 2020; Bowen et al., 2020) and in line with the literature showing that women are more engaged with issues related to pets (Shaw et al., 2012) and animal welfare (Helgeski et al., 2004; Phillips and McCullough, 2005; Serpell, 2005).

The COVID-19 pandemic will have a long-lasting impact on many households, and thus potentially on pet dogs as well. It is therefore important to continue monitoring the welfare of animals under human care using a holistic approach of considering both human well-being and animal welfare, for example by using the One Welfare framework (Morgan et al., 2020; García Pinillos, 2021, this issue). This survey focused only on the effects of the pandemic in May–June 2020, when most countries had their first restrictions in place. Problems may, however, also arise at the ease of restrictions, when dog owners return to work and leave the (new) dog alone at home, or when dog owners may change their mind regarding a newly acquired dog. The return to a “normal” life for humans could be disruptive for dogs and cause behavioural issues. It is therefore important to increase the monitoring of dog welfare and shelter statistics during the pandemic, as well as when restrictions ease.

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Data availability

None of the data were deposited in an official repository. Data sets are available upon request to the authors.

Declaration of Competing Interest

The authors report no declarations of interest.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.applanim.2021.10.5395.

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