Health and economic consequences: How COVID-19 affected households with pet and their pets. A systematic review

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Abstract: Households with pets had a unique experience with the COVID-19 since the lock-down protocols did not affect only the relationship they had with people but also with their pets. This paper analysed the evidence on the effect of COVID-19 on pets and pet owners. Employing the systematic review guidelines, the PubMed and the Google scholar database were utilised to select empirical studies published in English that focused on: (1) the COVID-19 effects on pets and (2) the COVID-19 effects on pet owners. We identified 24 articles conducted across 7 countries that met the eligibility criteria of the review. Few other studies used participants from multiple countries. Most of the studies utilised the cross-sectional survey and collected data from pet owners. Also, about 44.0% of the studies were published in only one journal (animal). COVID-19 affected the health status of both pets and pet owners. Despite the several negative health implications, there was some evidence of positive health implications. Surprisingly, several pet owners were not affected by the negative economic consequences of the pandemic. Recommendations for future studies were made in line with where attention is needed.

ABOUT THE AUTHORS

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PUBLIC INTEREST STATEMENT

The COVID-19 outbreak affected the lifestyle of all individuals. Due to the lockdown and stay at home policies, individuals spent several hours at home. The goal of the paper was to understand how the pandemic affected not only the health but also the economic impact of COVID-19 on pets owners and their pets. The study revealed that COVID-19 with its associated lockdown policies lead to increase in time spent with pets which lead to emotional and physical changes in both pets and pet owners. Pets also started showing new undesirable signs including attention-seeking and barking. There was also a shortage of pet feed and difficulty in accessing healthcare as a result of the lockdown. The study points out that there is no evidence in the literature for African pet owners. An empirical investigation on the experience of pet owners in Ghana is currently under study.
**Introduction**

The advent of the COVID-19 pandemic coupled with its associated policy measures including the social distancing and lockdown protocols had a significant impact on all households across the globe. Aside from the high mortality rate associated with the pandemic, there was also serious economic (Balde et al., 2020; Erokhin & Gao, 2020) and health (Abdel-Fattah et al., 2020; Arafa et al., 2021; Idrissi et al., 2020) consequences on various households. A recent systematic review confirmed the psychological effects of the COVID-19 pandemic on the general populations of many countries (Xiong et al., 2020). Households with pets were not left out of these implications. Conversations about these consequences pervaded all media spaces. A classic example was the argument between Niels Pedersen and Jane Sykes on the UC Davis LIVE: COVID-19 Livestream on 27 August 2020, about the effect of the pandemic on the anxiety levels of the population.

The consequences of COVID-19 lockdown on pet and pet owners were expected due to the lockdown measures and the initial uncertainty of whether the coronavirus could be transferred from animals to humans. However, the extent of these consequences was and is still not clear. As to whether the effect was going to be a positive or negative one, was one that was hard to predict. Lockdown measures mean pet owners get to spend more time home with pets. The lack of clarity on the possible transmission between humans and pets exacerbated the fear associated with the observation of irregular behavioural patterns in pets. There is existing evidence that behavioural problems, including aggression toward people, are the major reasons for pet relinquishment (Scarlett et al., 1999). This also adds up to the already complicated relationship between pets and pet owners. There is, therefore, the need to ask questions and explore all aspects of households that were affected by the pandemic for better policies now and in the future.

Studies have shown that there are several benefits of keeping pets including emotional support, reduced loneliness, reduced stress levels, and increased social activities (K. Allen et al., 2002). Some studies have even argued that individuals that own pets get more exercise, have a healthier heart (K. M. Allen et al., 1991; Da Silva Garcia & Martins, 2016), and visit doctors less. In the UK, it is estimated that nearly half of all households have pets with an estimated 50 million pets owned. In the United States, it is reported that about 90 million, representing 70% of U.S. households own a pet (American Pet Products Association's, 2021). In both regions, it was observed that ownership of more than one pet is a norm. These statistics show that households with pets constitute a significant proportion of our society. Currently, dogs and cats are the most popular pets worldwide. There are about 471 million and 373 million dogs and cats owned as pets worldwide (Bedford, 2018).

This review explored how COVID-19 affected pet and pet owners. This review identifies the current academic knowledge on how COVID-19 affected households having a pet, focusing on not just which aspects of the effects have attracted much attention but also how broad the current knowledge is, hence revealing research gaps that need to be addressed. The review also identifies the impact of the pandemic on pets. It is essential to explore the extent of the effects of COVID-19 on pets and their owners since they form a larger part of our society and the fact that petting is associated with several health benefits.

To achieve the objectives of this study, we conducted a systematic literature search and review based on scientific databases. In truth, the scientific community is on the alert by researching the coronavirus and from a different perspective, the situation and population created and affected respectively, using several methods including systematic literature reviews (Cachón-Zagalaz et al., 2020). This systematic review is the first of its kind to examine how pet owners and their pets were
affected by the pandemic. This review is necessitated by the increasing attention to the perceived and actual distress brought upon pets and pet owners by the COVID-19 pandemic. The review contributes to knowledge on what has been done, where it has been done, the methodology that was employed as well as where more attention is needed in this field of study. Identifying these gaps is critical for future studies in this field of study.

2. Methodology
The systematic review was conducted based on suggested guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Page et al., 2021).

2.1. Eligibility criteria and information sources
The objective of this review was to analyse studies that have investigated how COVID-19 affected pets and pet owners. In line with this, all empirical studies that reported the effects of COVID-19 on either pet, pet owners, or both were utilised. Empirical studies that investigated the relationship between pets and pet owners during the COVID-19 period, but did not directly report the impact of COVID-19 were not included. Even though the COVID-19 period influenced the relationship between pets and pet owners, they were still excluded to avoid any biases due to subjectivity. That is to say, no assumption of indirect effects of COVID-19 was made. Both peer-reviewed and grey literature were considered eligible. Table 1 summarises the criteria for inclusion and exclusion.

Two E-databases, PubMed and Google scholar, were used for the electronic search. The PubMed and Google scholar search was employed to download articles. The PubMed search was used because of the available COVID-19 resource centre that contains all the COVID-19-related research published in Elsevier. Google scholar was then used to generate more related articles that were published on other platforms. We searched in just the first two weeks of February. Some links of studies from the google scholar platform were not available for download. To retrieve these studies, the “topic” and/or “Dio” of these studies are copied and searched through the Sci-hub search engine for the downloadable versions.

2.2. Search strategy and selection process
The search strategy was developed by two authors (EA & JE) however, the search itself was conducted by only one author (EA). The key search terms were COVID-19, coronavirus, lockdown, Pets, and Pets Owners. After these key search terms, specific pets such as dogs and cats were used as search terms. The dog and cat were included in the search terms because they are the two most popular pets in the world (Bedford, 2020). The search was done on the 28th and 29th of May, 2021, and no time limits were set. Table 2 below presents the search lines used, the total results related to the search lines that appeared, and the number of studies that were downloaded.

The articles retrieved were screened independently by two authors (EA & JE) to determine whether they should be included in the study. Two folders were created—the inclusion and exclusion folders. All the duplicates and documents that did not meet the eligibility criteria were moved to the exclusion folder while the eligible studies were moved to the inclusion folder. The

| Inclusion                                      | Exclusion                                      |
|-----------------------------------------------|-----------------------------------------------|
| Perceived effects of COVID-19 crisis on Pets | Effects of Pets activities on Pet owners      |
| Effects of COVID-19 on Pet owners             | Effects of Pet Ownership on Pet                |
| Papers in English                             | All papers in languages other than English     |
| Empirical papers                              | Reviews, Opinion, Commentary, Letters, Editorials |
|                                               | Unavailable full text and non-COVID related studies |
two authors then compared their selection. It was found that the second author (JE) had 7 more studies than the first author (EA), in its inclusion folder. All these 7 studies were related to the relationship between pets and pet owners during the COVID-19 era. After consultation with two investigators (VO & BE), it was agreed that since some of these studies were generally not looking at the implication of COVID-19 on pets (pet owners) but rather how the pets (pet owners) were influencing pet owners (pets) during the COVID-19 period, they should be excluded, even though the COVID-19 period may have influenced the activities of the pets which indirectly influenced the pet owner or vice versa. We however included the ones that went beyond just the relationship between pets and pet owners and explicitly examined how the COVID-19 affected pets and or pet owners.

3. Results and discussion
A total of 103 scientific articles published in international journals and indexed in PubMed and Google Scholar were generated after the search. Initial screening was conducted to remove a total of 15 duplicates. Of the 84 remaining articles, only 38 met the inclusion criteria after screening their titles and abstracts. The full texts of these 38 articles were then evaluated and this led to the exclusion of 6 non-empirical papers (1 review, 3 editorials, and 2 commentaries) and 5 articles that presents only evidence on the relationship between pet and their owners during the COVID-19 crisis without explicitly highlighting how the COVID-19 affected the pets and pet owners. As a result, a final list of 24 articles met the criteria. Figure 1 presents the details through the PRISMA flow diagram.

The 24 articles were assessed based on six characteristics: year of publication, geographic scope, methodology, aims of the study, key results, and journal of publication. Whereas only 37.5% of the studies that met the eligibility criteria were published in 2020, the majority (62.5%) were published in 2021. This indicates an increase in interest in studies that investigated how COVID-19 affected pet and pet owners. Also, most of the studies (70.8%) were conducted using participants from a single country whereas 29.2% of the studies utilised multiple countries (cross country analysis). Under this country-of-origin categorization, the studies were concentrated in Europe (UK, Italy, Spain), Asia (India), and the Americas. Not a single study was conducted in the African setting. Even for the studies that used multiple countries, it was only one that was found to have taken responses from one African country (Malaysia). Interestingly, most of these cross-country studies included Spain, the US, and the UK in their study. This is not surprising as they are among the countries that were severely impacted by the pandemic and therefore it took a while before the imposed lockdown regulation was lifted. Another plausible reason may be that less research and
attention is given to petting in Africa. The studies that used multiple countries all used social media platforms for data collection.

Apart from Morgan et al. (2020) who employed unique perspective and retrospective datasets, Parente et al. (2021) who employed retrospective study, and Holland et al. (2021) who used longitudinal cohort study of dogs, the rest of the studies all utilised cross-sectional survey. Moreover, except for one study (Madan et al., 2020) that collected data from veterinary doctors, the rest of the articles all used pet owners as either part of or all of the participants for the study. Moreover, the largest cross-sectional survey employed 347,000 participants whereas the least employed 30 participants. The least happens to be the article that used veterinary doctors as respondents of the study. The review also found that about 41.4% of the articles were published in only one journal (animal). None of the rest of the journals were found to have more than two articles in their journal that met the eligibility criteria of this review. Table 3 presents the summary characteristics of the study.

3.1. Impact of COVID-19 pandemic on pets and pet owners
This section presents the synthesis of the results of the studies that met the eligibility criteria. Table 4 presents the main results from the different articles based on the six characteristics identified in the previous section; year of publication, geographic scope, methodology, aims of the study, key results, and journal of publication. The synthesis of the results was organised into; change in time with pets, positive health impact, negative health impact, pet adoption and relinquishment, behavioural changes in pets, healthcare accessibility, and economic consequences of COVID-19 on pet and pet owners.

3.2. Change in time spent with pets
The COVID-19 lockdown measures affected the amount of time pet owners spend with their pets; however, it was found that not all pet owners’ activities were affected the same way. While some were spending a few of their time, others were spending all their time with pets (Holland et al.,
Some were reducing the amount of time they spend with their pets possibly due to fear of contracting coronavirus. Most of the studies conducted supported the hypothesis that the amount of time pet owners spent with their pets increased during the COVID-19 period (Applebaum et al., 2021; Hoffman, 2021; Madan et al., 2020; Oliva & Johnston, 2020). There are studies conducted at the cross-country level which also confirms the increase in time spent with pets (Bussolari et al., 2021). Bowen et al. (2020) on the other hand found that the amount of time Spanish pet owners spend with their dogs decreased. This study only measured the amount of time pet owners spend with their pets outside. In the study by Bowen et al. (2020), most of the participants were living in apartments with limited outdoor space, and the fact that there was a lockdown restriction, it is not surprising that the amount of time spent outside decreased. This highlights that the pandemic

| Characteristics                          | Number (%) |
|------------------------------------------|------------|
| **Year of Publication**                  |            |
| 2020                                     | 9 (37.5)   |
| 2021                                     | 15 (62.5)  |
| **Geographic Scope**                     |            |
| Single specific country                  | 17 (70.8)  |
| Multiple countries                       | 7 (29.2)   |
| **Single specific country**              |            |
| US                                       | 4 (16.7)   |
| UK                                       | 6 (25.0)   |
| India                                    | 3 (12.5)   |
| Spain                                    | 2 (8.3)    |
| **Methodology**                          |            |
| Cross-sectional survey                   | 22 (91.6)  |
| Prospective and/or Retrospective         | 2 (8.3)    |
| **Sample**                               |            |
| Maximum                                  | 6004       |
| Minimum                                  | 30         |
| **Journal**                              |            |
| Animals                                  | 10 (41.4)  |
| Journal of Veterinary Behaviour           | 2 (8.3)    |
| Frontiers in Veterinary Science           | 2 (8.3)    |
| Frontiers in Ecology and Evolution        | 1 (4.2)    |
| Frontiers in Public Health                | 1 (4.2)    |
| Frontiers in Psychiatry                  | 1 (4.2)    |
| One Health                               | 1 (4.2)    |
| A Multidisciplinary Journal              | 1 (4.2)    |
| Research Square (Pre-Print)              | 1 (4.2)    |
| Humanities and Social Sciences            | 1 (4.2)    |
| The Pharma Innovation Journal            | 1 (4.2)    |
| International Journal of Social Psychiatry| 1 (4.2)    |
| International Journal of Environmental Research and Public Health | 1 (4.2) |

Table 3. Summary characteristics of articles (n = 24)
### Table 4. Basis of the study

| Author (Year)                | Geographic Scope | Methodology                        | Sample                                                                 | Objectives                                                                                                                                  | Results                                                                                                                                                                                                 | Journal                                                                                       |
|------------------------------|------------------|------------------------------------|------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Madan et al. (2020)          | India            | Cross-sectional survey             | 30 pet animal practitioners                                            | To analyse the changes, trends, and impact of lockdown on veterinary pet animal practice                                                   | Animal owners started to spend more time with the pets and consequently care more for the pets during the lockdown. There is a considerably short supply of vaccines, animal food, consumables, and medicines during this period. Reduced veterinary services. | The Pharma Innovation Journal                                                                |
| Hoffman (2021)               | US               | Cross-sectional survey             | 90 dog owners, 90 pet owners, 50 dog and pet owners, and 150 without a pet | To examine whether having a dog or cat at home was associated with individuals’ perceptions of the teleworking experience                  | Participants spend more quality time with their companion animals and family members when they work from home during the crisis. Dog owners engaged in physical activity, such as walking, more frequently than those without dogs. Pets created a distraction when working from home | Animals                                                                                       |
| Bussolari et al., (2021)     | Multiple countries | Cross-sectional survey             | dog owners (n = 4105)                                                  | To examine how Covid-19 restrictions influenced dog owners’ relationships and sense of connection with their canine companions.            | The amount of time they spent with their dogs naturally increased. Humans had more time to exercise, play, and engage in fun activities with their dogs which improved mental and physical health. | Animals                                                                                       |
| Shoesmith et al. (2021)      | The U.K.          | Cross-sectional survey             | General population (n = 5926)                                          | To explore the impact of the first COVID-19 lockdown phase in the U.K. on animal owners, their animals, and the relationships between them. | COVID-19 increased stress in taking care of pets. Restrictions to veterinary care such as delay in appointment. Financial uncertainty to buy pet food as well as provide healthcare if needed | International Journal of Environmental Research and Public Health                                 |

(Continued)
| Author (Year)         | Geographic Scope       | Methodology                | Sample                          | Objectives                                                                                                                                  | Results                                                                                           | Journal                          |
|----------------------|------------------------|----------------------------|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|-----------------------------------|
| Esam et al. (2021)   | New Zealand’s          | Cross-sectional survey     | Pet owners (n = 686)            | To explore the impact of the COVID-19 lockdown and following alert levels on pets in New Zealand                                                                                       | Pets got more company, more or better-quality attention (exercise, play, training, physical affection,), and environmental benefits. Pet's wellbeing was better than usual during the lockdown. Pet feeding practices were largely unchanged. Some pets-animals gained weight | Animals                           |
| Parente et al. (2021) | Italy                  | Retrospective study        | Patients with dog bites         | Consequences of COVID-19 Lockdown on Children and Their Pets                                                                                                                                   | The number of bites coming from family dogs is drastically growing due to the negative effect that confinement has on the animals. | Research Square (Pre-Print)      |
| Williams et al. (2020) | U.K.                   | Cross-sectional survey     | Horse owners (n = 374,000)      | Rapid analysis of the initial impact of the COVID-19 outbreak on the management of UK leisure and competition horses                                                                 | COVID-19 affected horses health and welfare through reduced (owner) access and variation in exercise levels leading to weight gain and health issues in older horses. Horse owners felt they were personally experiencing a negative impact of the pandemic on their mental health and wellbeing through stress and worry related to COVID-19 | Animals                           |
| Ho et al. (2021)     | Multiple countries.    | Cross-sectional survey     | General public is interested in adopting pets | To determine if there has been an increase in global interest in pet adoption                                                                                                                   | We observed a global interest in pet adoption, in particular for dogs, following the COVID-19 pandemic. | Frontiers in Veterinary Science |
| Author (Year)          | Geographic Scope | Methodology                  | Sample                        | Objectives                                                                 | Results                                                                 | Journal                                |
|------------------------|------------------|------------------------------|-------------------------------|----------------------------------------------------------------------------|--------------------------------------------------------------------------|----------------------------------------|
| Applebaum et al. (2021) | US               | Cross-sectional survey       | U.S. pet owners (n = 2,068)   | To assess the impact of relationships with pets during COVID-19 on human health and well-being | COVID-19 leads to more time together; life purpose or meaning; love; support; stress relief; routine; distraction; exercise. Increase in general worry; potential for illness; limited participation; veterinary care access; obtaining supplies; difficulty meeting pet needs and financial concerns | Frontiers in Public Health            |
| Applebaum et al. (2020) | The U.S.         | Cross-sectional survey       | U.S. pet owners (n = 2254)    | To assess the ways that relationships with pets impacted life during COVID-19 |                                                                          | Animals                                |
| Applebaum et al. (2020b) | US               | Cross-sectional survey       | Adult pet owners in the U.S (n = 1356) | To understand pet owners’ consideration of their pets’ welfare when making personal healthcare decisions specific to COVID-19. | Pet owners experienced unique hardships related to changes in everyday life from the COVID-19 pandemic. Pet owners became resistant to leaving their pets alone. Pet owners became concerned about finances related to pet care. | One Health                            |
| Oliva & Johnston, 2020 | Australia        | Cross-sectional survey       | Pet owners (n = 384)          | To capture the experience of such a lockdown in Australians living alone, with and without a dog or a cat. | Pet has been getting more companionship or attention than pre-COVID-19 Pet demonstrated an emotion or behaviour reflective of a change in the emotional state. Expresses that the pet is getting more exercise during the lockdown than previously. Expresses that the pet’s regular activities have changed as a result of the lockdown. | International Journal of Social Psychiatry |

(Continued)
### Table 4. (Continued)

| Author (Year)          | Geographic Scope | Methodology       | Sample                                      | Objectives                                                                 | Results                                                                 | Journal                  |
|------------------------|------------------|-------------------|---------------------------------------------|----------------------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------|
| Hackenhull et al.      | UK               | Cross-sectional survey | UK Horse, Pony, and Donkey Owners (n = 452) | To understand the decisions made by UK horse, pony, and donkey owners during this time. | The restrictions lead to opting to stop riding, as well as reducing the time spent at the yard. Horse owners changed the activities they did with their horse, including riding, with common examples including avoiding “high risk” activities such as riding on busy roads, jumping, riding young or nervous horses. | Animals                  |
| Bowen et al.           | Spain            | Cross-sectional Survey | Spanish dog-owners (501)                  | To show how social support from dogs can increase during a crisis            | The lockdown period lead to an increase in shared activities with their dogs including hugging and turned to them more as a source of companionship and comfort. | Frontiers in Psychiatry |
| Bowen et al., 2020     | Spanish          | Cross-sectional Survey | Spanish dog-owners (n = 1297)              | The effects of the Spanish COVID-19 lockdown on people, their pets, and the human-animal bond | The quality of life of owners was strongly influenced by the lifestyle and emotional effects of the confinement, and that pets provided them with substantial support to mitigate those effects. However, pets showed signs of behavioural change that were consistent with stress, with dogs that had pre-existing behavioural problems being the most affected. | Journal of Veterinary Behaviour |
| Author (Year)          | Geographic Scope | Methodology                          | Sample                                      | Objectives                                                                 | Results                                                                 | Journal                      |
|-----------------------|------------------|--------------------------------------|---------------------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------|------------------------------|
| Holland et al. (2021) | UK               | Longitudinal Survey                  | a longitudinal cohort study of dogs         | To explore how the experience of dog ownership in the UK was impacted during this lockdown | The confinement increased more time at home sharing quality time with pets. The period provided an opportunity for walking with dogs as a daily exercise, however, the restrictions protocols made this exercise not sufficient, which reduced the level of socialisation with other dogs. The confinement also led to new undesirable behaviours in dogs including barking and dogs being “clingy” or vocalising when briefly left alone | Animals                     |
| Kogan et al (2021)    | Multiple countries (UK, US, Spain, Australia, Canada, Brazil) | Cross-sectional Survey               | cat guardians (n = 956)                     | To understand the impact of COVID-19 on cat guardians                        | The results revealed an increase in the number of time guardians spent with their cat. Cat guardians feared the ability to afford the emergency veterinary care and obtain cat food and supplies. | Animals                     |
| Morgan et al. (2020)  | Israel            | Unique Prospective and Retrospective datasets |                              | To investigate how people perceived and acted during the COVID-19 pandemic social isolation, in regards to dog adoption and abandonment; | During the pandemic, the interest in dog adoption and the adoption rate increased significantly, while abandonment did not change. | Humanities and Social Sciences |
| Kogan et al (2021)    | Multiple countries (UK, US, Spain, Australia, Canada, Brazil) | Cross-sectional Survey               | Dog owners (n = 4,105)                      | To understand dog owners’ fears and concerns about veterinary care and obtainment of pet care products and food during the lockdown | Dog owners became concerned about the availability and cost of veterinary care (emergency and non-emergency) and dog supplies | Frontiers in Veterinary Science |
| Author (Year)                  | Geographic Scope | Methodology         | Sample            | Objectives                                                                 | Results                                                                 | Journal                      |
|-------------------------------|------------------|---------------------|-------------------|-----------------------------------------------------------------------------|--------------------------------------------------------------------------|-------------------------------|
| Pawar, Tawde & Mane (2021)    | India            | Cross-sectional Survey | 100 pet owners   | To study the impact of this unprecedented situation on pets and strays     | Initially, during the lockdown, the pets experienced a lack of outdoor activities and space. Few pet owners were facing trouble to bear the expenses of their pets due to an increase in economic strain created by lockdown conditions. Shops being closed initially, an account of the COVID-19 outbreak resulted in a shortage of pet food, supplies, medicines, vaccines, etc. | A Multidisciplinary Journal  |
| Piotti et al. (2021)          | Italy            | Cross-sectional Survey | 235 pet owners   | To study the role of personality, the human-animal relationship, COVID-19-related factors, and demographics on feline and canine quality of life. | COVID-19 lockdown had negatively impacted the quality of life of pets. COVID-19 lockdown-related factors influenced to some degree the psychological and social quality of life of pets. | Animals                      |
| Christley et al. (2021)       | UK               | Cross-sectional Survey | 6004 dog owners  | To explore the impact of this lockdown on pet dog welfare                  | Many dogs were spending more time with household adults and children. During the lockdown, dogs were typically walked less often and for less time daily. Dogs had fewer opportunities to interact with other dogs during the lockdown. Many dogs had more play/training sessions with their owners and were given toys more frequently during the lockdown. | Animals                      |
affected the amount of time pet owners spend with their pets, however, whether the time increased or decreased depended on other factors. Possible reasons for this observation could be categorised as factors about pets, owners, household, and location of the home (Christley et al., 2021).

The change in time spent had both positive and negative impacts on both pet and pet owners (Applebaum et al., 2021; Bussolari et al., 2021). However, the positive impact outweighed the negatives. Bussolari et al., (2021) reported that the established bonds between pets and their owners were either strengthened or strained with the increased time at home. They observed that the relationship between pets and owners was positively impacted within the majority of the respondents (76.3 %) increasing time they spend in the house. This had a concomitant positive impact on the general well-being of the pet owners.

### 3.3. Positive health impacts

Some of the positive health impacts of COVID 19 includes more play, comfort, and more care and attention for pets. The period also saw an increase in exercise for both pets and pet owners. Like Bussolari et al., (2021), Holland et al. (2021) also observed an increase in time spent with pets, especially during the lockdown period. A greater fraction of the respondents described the time spent with pets as “quality time” and agreed their relationship with their pets was a great source of emotional and social support, especially during the lockdown periods. Dog owners were more likely than non-dog owners to report getting a sufficient quantity of exercise, socialisation with other individuals, and taking at least a quarter an hour walk during the workday (Hoffman, 2021). Christley et al. (2021) intimated that dogs had increased playtimes and/or training sessions with their owners and were given toys regularly. Veterinarians also confirmed that the animal owners they dealt with started to spend more time with the pets and consequently care more for the pets during the lockdown (Madan et al., 2020).

According to Oliva and Johnston (2020), it is a very common perception that both dogs and cats received a lot of attention as an unintended effect of the pandemic. They further explained that, while dogs generally became excited/more relaxed, cats were exposed to a greater variety of changes ranging from being “put-out” through to being playful. Bussolari et al., (2021) found that the increased time with pet dogs encouraged more physical activities and served as a buffer from work, relationships, and other pandemic-associated stressors. Bowen et al. (2021) listed petting and hugging of dogs by owners as some shared activities which later became a source of companionship and comfort. Several studies found that pets were engaged with more exercise than pre-lockdown (Esam et al., 2021; Oliva & Johnston, 2020). These increases in physical
(exercise, play) and emotional activities (attention, hugging, etc.) improved both the physical and mental wellbeing of pets and their owners (Bowen et al., 2020; Kogan et al., 2021).

### 3.4. Negative health impacts

The change in time spent with pets also was found to have some negative implications on pets and pet owners. On the contrary to other studies (see, Esam et al., 2021; Oliva & Johnston, 2020), Christley et al. (2021) revealed that exercise for pets decreased. Christley et al. (2021) found that dogs walked less often and for a lesser time and therefore had fewer opportunities to play with other dogs. Dogs were also unable to attend doggy daycare, dog parks, or participate in service dog activities as a result of the lockdown. (Bussolari et al., 2021). This was in line with Christley et al. (2021) who reported that exercise in the form of walking decreased. Holland et al. (2021) also stated that the ability to walk their dog(s) due to the lockdown was not always sufficient in terms of providing enough exercise and opportunities for socialising with other dogs. Authors who happen to investigate horse owners found that horse welfare was harmed as a result of modifications made to their horses' training and management regimes (Hockenhull et al., 2021; Williams et al., 2020) leading to weight gain and health issues in older horses.

### 3.5. Pet adoption and relinquishment

There were mixed findings regarding the interest in acquiring pets. Ho et al. (2021) reported that global pet adoption increased during the first phase of COVID-19. The authors found that even though some pets were abandoned, the number of pets adopted exceeded the number that left their pets. Morgan et al. (2020) also confirmed that as the stringency on social isolation increased during the pandemic, the willingness to adopt dogs and the adoption rate increased significantly, while abandonment was not affected significantly. However, Moorhouse et al. (2021) show that the pandemic decreased the stated likelihood of pet-owners from Brazil, China, or the USA buying a given exotic pet. These contradictory results may be attributable to the participants used by the various studies. There was also mixed findings on studies done on behavioural changes in pets and availability of healthcare services.
3.6. Behavioural changes in pets

Regarding the behavioural changes in pet dogs, Bowen et al. (2020) revealed that while the lockdown might not result in dramatic changes in pet behaviour including the acquisition of new traits, it might contribute to the worsening of pre-existing problem behaviours. This was evidenced in the observation of pets being a major source of distraction during workdays by some pet owners (Hoffman, 2021) or being more clingy/needy (Olivia & Johnston, 2020); a behaviour potentially stemming from increased boredom (Holland et al., 2021) and associated desire of pets for more attention especially with owners staying longer at home (Hoffman, 2021).

Parente et al. (2021) found that in Italy, there was a palpable increase in the number of dog bite cases related to family members especially children due to the negative effect of confinement on the animals. Saleem et al. (2021) on the other hand found that the lockdown indirectly reduced the number of dog bites in India. The differences in the studies may be attributable to the country of origin. This was confirmed by Piotti et al. (2021). Piotti et al. (2021) found differences in the social and environmental quality of life of pets across countries. According to their study, management of the pets such as usage of kennels, access to outdoors, and free-roaming varied with countries and therefore this may affect the patterns exhibited by pets.

3.7. Healthcare accessibility

Whereas access to health services became a challenge for most pet owners (Kogan et al., 2021; Applebaum et al., 2020b), there were other areas where services were operating smoothly (Pawar et al., 2020). Pawar et al. (2020) found the systematic functioning of veterinary clinics in some areas. However, most of the studies reported that accessibility was a critical challenge during the pandemic which caused serious emotional problems for the owners. Kogan et al. (2021) reported that participants’ veterinary-related concerns centred on the availability of their veterinarian for both emergency and non-emergency care. Shoesmith et al. (2021) reported that the required routine appointments (e.g., vaccinations, flea treatment) were often delayed. Moreover, Applebaum et al. (2020b) found that owners of pets experienced unique obstacles to accessing quality healthcare related to COVID-19. These changes in routine services in the form of reduced healthcare accessibility and delayed appointments all contributed to additional stress for the pet owners. The decrease in healthcare accessibility does not only have negative implications for the pet owner’s health status but also the pets. Owners felt that the decreased access to veterinary professionals could be detrimental to equine health (Williams et al., 2020).

3.8. Economic consequences

There were only a few studies that were found to have investigated the economic effects of COVID-19 on pet owners. A couple of them found that the COVID-19 pandemic had detrimental economic implications on pet and pet owners. Globally, the income of various households was reduced drastically due to lay off and a reduction in work hours. Pet owners became concerned over purchasing pet food and other pet essentials, access to provide healthcare if required, and sustaining their animal’s insurance due to the financial uncertainty (Shoesmith et al., 2021). Coupled with the reduction in income was inflation due to limited supply. Access to medicines, vaccines, supplies, and pet food became a challenge due to the lockdown restrictions. Shops being closed initially, on account of the COVID-19 outbreak resulted in a shortage of pet food, supplies, medicines, vaccines (Pawar, Tawde & Mane 2021; Madan et al., 2020). This shortage in supply increased the cost burden on pet owners.

The economic hardship during the pandemic had serious emotional implications on pet owners. Studies found that pet owners were worried about the ability to afford emergency veterinary care and obtain dog and cat food and supplies (Applebaum et al., 2021; Kogan et al., 2021). According to Williams et al. (2020), the negative financial impact of COVID-19 was a major source of concern, with owners fearing that they would have to think critically about horse management based on prices, which could contribute to greater relinquishments and additional
burdens on equine charities, as well as negative equine well-being. The older people were more worried than their younger counterparts in terms of caring for their pets (Applebaum et al., 2021).

Interestingly not all pet owners were economically affected by the COVID-19 (Esam et al., 2021; Pawar, Tawde & Mane 2021). Among all the concerns of pet owners, the financial concerns seem to be the least (Applebaum et al., 2021). In the study by Pawar, Tawde & Mane (2021) only a few pet owners were facing trouble to bear the expenses of their pets. This means that the pets of these owners were also not affected economically. One report revealed that the impact of lockdown was trivial on the behaviour of the majority of the pets due to good care taken by the owners and the availability of food (Pawar, Tawde & Mane 2021). Esam et al. (2021) also found that some pet owners did not change the way they feed their pets during the lockdown. Applebaum et al. (2021) found that only 3% of pet owners were concerned about the finances of pet care concerning hospitalisation. Various factors may account for these results. One possible reason for this may be attributed to the economic standards of participants included in their study. Probably, these studies selected participants from well-to-do homes hence they did not feel the economic impact.

3.9. Health and economic focus of studies on impact of COVID-19 on pet and pet owners

This section presents a summary analysis of the aspects of the impact that the various studies have concentrated on. Thus, this section categorised the various studies on the impact of COVID-19 into either health, economic or general implication of COVID-19. Only countries that were found to have more than one article were included in this analysis. The sub-themes that have been ticked (√) implies such evidence is available in that country. Table 5 presents the summary of the evidence.

Most of the studies on the impact of COVID-19 on pet and pet owners were concentrated in some parts of the world. About 64.0% of the studies on COVID-19 impact on pet and pet owners that met the eligibility criteria of this review were conducted in the UK, US, India, and Spain. In general, most of the articles were found to assess how COVID-19 affected the health of pet and pet owners, with only a few studies interested in the economic implications. None of the six (6) studies conducted in the UK, four (4) studies from the US, and two (2) studies from Spain assessed how COVID-19 affected the supply of pet feeds as well as the effect of COVID-19 on pet adoption or relinquishment. Thus, studies conducted in these countries have largely been on the health implications.

Also, none of the three (3) from India investigated the emotional challenges, physical activities, new behaviours of pets, and the state of pet adoption in India. Studies conducted in India were more focused on the economic implications more than the health concerns of COVID-19. Interestingly, all the studies in the various countries have one way or the other presented evidence of monetary concerns by pet owners. Also, the least area investigated among all the aspects of impact is how COVID-19 affected pet adoption or relinquishment. The studies that utilised multiple countries have however presented enough evidence on the economic implications of COVID-19 on pet owners and pets. Interestingly, none of these studies have assessed the emotional impact.

4. Conclusion

This review highlighted the key impact of COVID-19 on pet and pet owners. Much of the evidence shows that the COVID-19 lockdown affected the health status of both pets and pet owners. The change in the number of hours that pet and pet owners spend together was associated with emotional and physical changes in both pet and pet owners. Pets were found to have received more care and attention during the pandemic. Pet and pet owners were found to engage in more physical activities which have good implications on the health of both of them. Most studies found improvement in exercise which affects both physical and mental health status. Pet owners also used pets as a source of comfort and stress-relieving strategy during the pandemic. Despite all these health benefits, there were some negative impacts on the health status of pet owners. Pets started showing new undesirable signs including attention-seeking and barking. There was also a shortage of pet feed and difficulty in accessing healthcare as a result of the lockdown. This
negative effect has serious implications on the mental health of pet owners and in worst instances, pet relinquishment. However, several pet owners were found to have not changed how they were feeding their pets.

There were not enough studies on whether this crisis contributed to pet relinquishment but that does not also mean nothing should be done about this to prevent any possibility of such in the future. Besides, the empirical evidence on the effect of COVID-19 on pet and pet owners focused largely on the health implications and in only a few countries. Even though there were several corroborations between the few studies, the impact of COVID-19 on pet and pet owners is inconclusive. Only a few of the studies assessed the economic implication on pet and pet owners. More than half of the studies utilised participants from only 4 countries (US, UK, Spain, and India). Moreover, there was not a single study from the perspective of especially African pet owners and only one study used veterinary doctors as a sample. This unbalanced coverage is not only understandable due to the novelty of the literature but also points to many research opportunities.

Future studies can therefore use different populations for their study. Such a population could either utilise pet owners from different regions or veterinary doctors to explore how COVID-19 affected pets and pet owners. This is very vital due to the differences in socio-demographic characteristics of countries as well as the varying impact of the COVID-19 crisis. This article also recommends a new study to estimate the opportunity costs of the COVID-19 lockdown to provide an economic insight on how much pet owners should be compensated should there be any such crisis in the future.

5. Limitations
Findings from this current review should be interpreted with caution as whereas some studies assessed the impact of the lockdown, some were interested in the general implications associated with the COVID-19 pandemic either during or after the pandemic. Another key drawback of this study is that it just highlights the evidence available for the various aspects (health and economic) in each country instead of presenting the volume of evidence that was available.

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