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CABI Human–Animal Interactions

RESEARCH

The influence of animal ownership on mental health for people with severe mental illness: Findings from a UK population cohort study

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Abstract

Background and aims: There is increasing evidence to suggest companion animal ownership may positively impact mental health and wellbeing. However, there is limited research related to the role of companion animal ownership for mental health that focuses on people living with severe mental illness (SMI). We aimed to explore the connection among loneliness, mental health, wellbeing, animal ownership, and the perceived strength of the human-animal bond in this population.

Methods: We conducted a survey in an existing UK cohort of people living with SMI. The survey questionnaire included standardized measures to collect information related to mental health, loneliness, and the perceived strength of the human-animal bond.

Results: Of 286 participants who had previously consented to participate in the follow-up survey, 170 participants (59.4%) completed the survey. Of these, 81 (47.6%) owned at least one animal, and most perceived to have a strong human-animal bond with their companion animal as indicated by the Comfort from Companion Animals Scale (M = 39.80 of a maximum score of 44). However, regression analyses showed that owning an animal was not significantly associated with wellbeing, depression, anxiety, or loneliness scores. Likewise, the perceived strength of the human-animal bond was not significantly associated with animal species owned or wellbeing, depression, and anxiety scores.

Conclusion: The findings provide a counterpoint to the commonly held assumption that companion animals are beneficial for all owners' mental health. Further exploration of the role of human-animal relationships, including challenges and support needs related to animal ownership, in people living with SMI is required.

Keywords: companion animals, human-animal interaction, human-animal relationships, human-animal bond, mental health, severe mental illness

Introduction

The enduring relationship between humans and companion animals is well-established (Brooks *et al*., 2018), with nearly 70% of households in the UK owning an animal, and similar figures are shown worldwide (People's Dispensary for Sick Animals, 2019). The impact of companion animal ownership on human physical and mental health is an area of human-animal interaction research that has become increasingly popular (Brooks *et al*., 2018; Ratschen *et al*., 2020). Much of the existing evidence suggests that relationships with companion animals may positively impact mental health through hypothesized mechanisms involving attachment to or companionship provided by the animal (Antonacopoulos and Pychyl, 2010; Meehan *et al*., 2017; Brooks *et al*., 2018; Shoesmith *et al*., 2021a). Conversely, studies have also reported that a strong attachment to companion animals is associated with increased depression and loneliness (Antonacopoulos and Pychyl, 2010; Peacock *et al*., 2012). Studies investigating the link between animal ownership and human health tend to be conducted in the general population (Ratschen *et al*., 2020; Shoesmith *et al*., 2021a) or specific subpopulations such as children and adolescents (Bystrom and Persson, 2015; Mueller *et al*., 2021b) or older adults (Gee and Mueller, 2019; Hughes *et al*., 2020; Hui Gan *et al*., 2020), rather than those diagnosed with a severe mental illness (SMI). The evidence base for the potential benefit of companion animal ownership for those diagnosed with mental health conditions remains mixed and unclear (Brooks *et al*., 2018). While research indicates that animal ownership can improve the quality of life in those with mental illnesses (Brooks *et al*., 2016; Hayden-Evans *et al*., 2018), evidence also suggests that challenges related to animal ownership, combined with

housing and financial burdens, may be detrimental to owners' wellbeing (Zimolag and Krupa, 2010; Brooks *et al.*, 2016). There is limited understanding in the context of SMI of the potential value and contribution that companion animal ownership may have.

Findings from our previous UK population cohort survey study conducted during the COVID-19 pandemic reported that owning an animal was significantly associated with a self-reported deterioration in mental health in a cohort of individuals living with SMI (Shoesmith *et al.*, 2021b). This suggests that the commonly reported assumption that companion animals may have a positive impact on the health and wellbeing of most owners may not be transferable to specific subpopulations in certain contexts. However, the decline observed in the previous study may have been due to the restrictions associated with the COVID-19 pandemic and the associated difficulties of owning an animal that may be heightened during this context. The authors also acknowledged the study was limited by not collecting information regarding the perceived strength of the human-animal bond. Evidence within the general population has suggested that strong bonds with companion animals may predict mental health vulnerability in owners (Antonacopoulos and Pychyl, 2010; Peacock *et al.*, 2012). However, there has been a restricted amount of literature investigating this bond with companion animals for individuals living with SMI. Previous research often focuses on the development of the human-animal bond with a therapeutic animal within this population group, rather than a companion animal (Kovács *et al.*, 2004; Horowitz, 2010; Calvo *et al.*, 2016). Therefore, asking animal owners about the perceived closeness to their animals is an important factor to explore within this subpopulation and its links with mental health.

We report findings from a follow-up survey conducted within the same cohort of people living with SMI (Shoesmith *et al.*, 2021b), conducted while no pandemic restrictions were in place. This study addresses the limitation identified in the previous follow-up survey (Shoesmith *et al.*, 2021b) by including an instrument to measure the perceived strength of the human-animal bond. The Comfort from Companion Animals Scale (CCA) (Zasloff, 1996) focuses specifically on the comfort or intimacy elements of the relationship between humans and animals, and is more appropriate for measuring the human-animal bond for a diverse range of species than the majority of other validated similar instruments (Zasloff, 1996). This study aimed to investigate the following research questions:

1. What proportion of participants own a companion animal? (RQ1)
2. For those who own a companion animal, what is the perceived strength of the human-animal bond, and what proportion of participants regularly interact with their animal? (RQ2)
3. Are participants' levels of wellbeing, depression, anxiety, or loneliness associated with animal ownership, after controlling for key sample characteristics? (RQ3)
4. For participants who own companion animals, is the strength of the human-animal bond associated with the species of the animal or participants' levels of wellbeing, depression, or anxiety? (RQ4)

Methods

STUDY DESIGN

The questionnaire survey could be completed via a range of methods: online, via telephone, or by postal copy. This follow-up survey was part of a four-part study that aimed to investigate the effects of COVID-19 restrictions on individuals living with SMI. This study reports the results from the fourth follow-up survey. Supplementary Material 1 presents a more detailed account of the methodology. The design and data analysis for this study were pre-specified and are available on the Open Science Framework (Available at: https://osf.io/jzp5x).

SETTING AND PARTICIPANTS

The survey was conducted within a subsample of 9914 adults (18+) in the UK living with SMI who had taken part in The Closing the Gap Health Study (CtG; 2016–2020). The CtG is described in detail elsewhere (Peckham *et al.*, 2023). The Optimising Wellbeing in Self-Isolation study (OWLS) explores the effects of pandemic restrictions in a subsection of the CtG clinical sample. To ensure the OWLS subsample reflected the diversity of the population, a sampling framework was created based on various demographics (e.g. gender, ethnicity, age) and recruitment via primary or secondary care. The full recruitment method for the OWLS study has been described in detail elsewhere (Peckham *et al.*, 2021) and can also be found in Supplementary Material 1.

Participants were eligible to participate in the OWLS study if they met the following inclusion criteria: (1) aged 18 years or above; (2) had a documented diagnosis of schizophrenia or other psychotic disorder (ICD-10 F20.X and F22.X (WHO, 2007) or DSM equivalent (Regier *et al.*, 2013)) or bipolar disorder (ICD-10 code F31.X or DSM equivalent), and (3) they had consented to be contacted again to participate in future research following participation in the CtG study.

RECRUITMENT AND PROCEDURES

In the first survey (OWLS 1; July–December 2020), 367 participants were recruited and 330 consented to follow-up. Over the course of the second (OWLS 2; January–March 2021) and third (OWLS 3; October 2021–January 2022) follow-up surveys, 44 participants withdrew their consent to further contact. Therefore, a total of 286 participants could be contacted for the current survey (OWLS 4). These participants were contacted and invited to participate in OWLS 4. Those who agreed to participate were able to complete the survey via their preferred method: (1) via telephone with a member of the research team; (2) by postal copy, or (3) via a link online sent by a member of the research team.

OWLS 4 commenced in May 2022 and data collection ended in August 2022. Ethical approval for the survey was granted by the Health Research Authority Northwest – Liverpool Central Research Ethics Committee (REC reference: 20/NW/0276) and Wales Research Ethics Committee 4 (REC reference: 21/WA/0239).

MEASURES

The bespoke questionnaire was developed by a multi-disciplinary team of academics. The survey was shared with members of the OWLS Lived Experience Advisory Group for feedback and the online survey was piloted with members of the study team, including the public co-applicant, to ensure the survey was displayed correctly. The measures included in this study are outlined below.

Demographic data: When the CtG Cohort was formed, demographic information including participants' gender, age, and ethnicity was collected. Further demographic questions about neighbourhood deprivation, professional activity, SMI diagnosis, and self-reported physical health condition comorbidity were included in the subsequent follow-up surveys.

Information obtained about ethnicity was used to derive a binary minority status variable for analyses (White, other than White). The binary grouping enabled statistical analysis of ethnicity due to limited numbers of ethnicities other than 'White'. Post-codes were obtained to assign participants to one of ten indices of deprivation, with higher scores indicating less socio-economic deprivation. Indices were organized into five groups ranging from very high deprivation to very low deprivation for analyses. Information obtained about the professional activity was used to derive a binary minority status variable for analyses. Where participants were employed (full-time, part-time, self-employed), volunteering, or studying, they were classed as professionally active. Those who were not employed, retired, or not engaging in studying or volunteering were grouped as not professionally active.

Animal ownership: Participants were asked, 'Do you have any animals that live with you or near you, and that you or anyone in your household are the main caretaker of? Please do not include animals kept as livestock (e.g. farm sheep, cattle).' If answering 'yes', participants were required to indicate how many and which species (dog, cat, small mammal, bird, fish, reptile or amphibian, horse or pony, farm animal, other).

Human-animal bond: Animal owners were asked to select which of their animals they felt closest to and indicate the species of this animal. Participants were then asked to respond to a number of statements on the validated 11-item Comfort from Companion Animals Scale (CCA) (Zasloff, 1996), with this animal in mind. The CCA uses a four-point Likert scale (1 = strongly disagree; 4 = strongly agree). As reported elsewhere (Ratschen *et al*., 2020), we use this instrument as a measure that assesses the comfort or intimacy element of the human-animal bond. Scores for individual CCA items were calculated into one overall score (11–44) and included as a continuous variable in our analyses.

Engagement with companion animals: Participants were also asked to indicate their agreement to statements on the 3-item measure derived from the 29-item CENSHARE Pet Attachment Survey (Bures *et al*., 2019), using a four-point Likert scale (1 = never; 4 = almost always). Statements included: 'do you spend time each day playing with or exercising your pet?'; 'when you feel bad, do you seek your pet for comfort?', and 'how often do you consider your pet to be a member of your family?' Scores for each question were calculated into one overall score (3–12) and included as a continuous variable in our analyses.

Wellbeing: Four questions were taken from the ONS Health and Lifestyle Survey (HLS) (Office for National Statistics, 2021). Participants were asked to respond to four statements using an 11-point Likert scale (0 = not at all; 10 = completely) to indicate how they had been feeling, as follows: 'overall, how satisfied are you with your life nowadays?'; 'overall, to what extent do you feel that the things you do in your life are worthwhile?'; 'overall, how happy did you feel yesterday?', and 'overall, how anxious did you feel yesterday?'. The response for the last item was reversed, and the scores for individual questions were calculated into one overall score and used as a continuous variable in our analyses, with greater total scores representing better wellbeing.

Depression: The PHQ-2 (Thombs *et al*., 2014) was included, asking participants to respond to two items on a four-point Likert scale, based on their experiences in the last 2 weeks (0 = not at all; 3 = nearly every day). Scores for individual questions were calculated into one overall score (0–6) and used as a continuous variable in our analyses, with higher scores representing greater levels of depression. The PHQ-2 was not included in our previous study reporting the findings from OWLS 2 (Shoesmith *et al*., 2021b).

Anxiety: The GAD-2 (Sapra *et al*., 2020) was included, asking participants to respond to two items on a four-point Likert scale, based on experiences in the last 2 weeks (0 = not at all; 3 = nearly every day). Scores for individual questions were calculated into one overall score (0–6) and used as a continuous variable in our analyses, with higher scores representing greater levels of anxiety. The GAD-2 was not included in our previous study reporting the findings from OWLS 2 (Shoesmith *et al*., 2021b).

Loneliness: The 3-item short version of the UCLA loneliness scale (Hughes *et al*., 2004) was included and asked participants to indicate agreement to three items on a three-point Likert scale, based on the last 2 weeks (1 = hardly ever; 3 = often). Scores for individual questions were calculated into one overall score (3–9) and used as a continuous variable in the analyses, with higher scores representing greater loneliness.

DATA ANALYSIS

Descriptive statistics are provided for demographic information and data relating to animal ownership (RQ1 and 2). To address RQ3, separate linear regression analyses were conducted. These assessed the associations between the predictor animal ownership (yes/no) and total scores for wellbeing, depression, anxiety, or loneliness (outcome variables), adjusting for key sample characteristics (gender, age, ethnicity, socio-economic deprivation, professional activity, SMI diagnosis, and self-reported physical health condition comorbidity). For those participants who owned an animal, to understand whether the strength of the human-animal bond (predictor) is associated with animal species or participant's levels of wellbeing, depression, or anxiety (outcome variables) (RQ4), one linear regression analysis was conducted, controlling for relevant covariates (gender, age, ethnicity, loneliness).

Before applying the above regression models, nonparametric missing value imputation was conducted using the R Statistical Software package missForest (Stekhoven and Stekhoven, 2013). MissForest is an algorithm based on the machine learning approach of Random Forest and imputes missing values by using observed values to develop a Random Forest predictive model for each variable, and then using these models to predict missing values in said variables. Evidence suggests that it is effective in imputing missing values for variables that have missing information of up to 30% (Stekhoven and Bühlmann, 2012). All other statistical analyses were conducted using SPSS version 28.0 (IBM®). As sensitivity analyses, the regression models were conducted using only those participants with complete information.

CHANGES FROM PRE-REGISTRATION

It was not initially intended to provide descriptive statistics for wellbeing, loneliness, depression, and anxiety scores. However, our previous findings reported animal ownership appeared to be linked to self-reported mental health decline in people living with SMI (Shoesmith *et al*., 2021b), and this may be attributable to COVID-19 as the data were collected during the second wave of the pandemic in the UK. As the current sample was from the same cohort as the previous study, it was deemed important to explore the differences in scores based on the removal of COVID-19 restrictions. Therefore, descriptive statistics for the current survey have been reported, and change scores for wellbeing and loneliness across time points have been calculated.

Results

PARTICIPANT CHARACTERISTICS

A total of 170 participants completed OWLS 4 (via online link or telephone, n = 133; via postal copy, n = 37). Table 1 presents a summary of participant characteristics using the raw dataset.

MENTAL HEALTH, WELLBEING, AND LONELINESS SCORES

Mean scores and standard deviation (SD) for wellbeing, loneliness, depression, and anxiety were also calculated using the raw dataset (Table 2). Mean scores for participants diagnosed with psychosis and bipolar were similar, but those diagnosed with another SMI had lower mean wellbeing scores (indicating lower wellbeing), and higher mean loneliness, depression, and anxiety scores (indicating greater loneliness, depression, and anxiety). Mean total scores for wellbeing, loneliness, depression, and anxiety were similar for participants who owned one or more than one companion animals.

For participants who completed both OWLS 2 and OWLS 4, the mean wellbeing and loneliness scores were compared across time points (Table 3). As PHQ-2 and GAD-2 were not included in OWLS 2, it was not possible to compare the depression and anxiety scores. Mean wellbeing scores were marginally higher at the OWLS 4 time point (+1.3), indicating better wellbeing, whereas mean loneliness scores remained similar (−0.1).

Table 1. Participant characteristics (n = 170).

Characteristics		% (N)	Missing data % (N)
Gender	Female	46.5 (79)	0 (0)
	Male	52.4 (89)	
	Transgender	1.2 (2)	
Age (years)	M = 52.19, SD = 14.83		0 (0)
Ethnicity	White	88.2 (150)	0 (0)
	Other ethnic	11.8 (20)	
Socio-economic deprivation	Very low deprivation	15.9 (27)	2.4 (4)
	Low deprivation	17.6 (30)	
	Medium deprivation	18.8 (32)	
	High deprivation	24.7 (42)	
	Very high deprivation	20.6 (35)	
Professional activity	Professionally active	106 (62.4)	0 (0)
	Not professionally active	64 (37.6)	
SMI diagnosis	Psychosis	48.8 (83)	9.4 (16)
	Bipolar	34.7 (59)	
	Other	7.1 (12)	
Self-reported physical health condition comorbidity	Yes	55.9 (95)	18.2 (31)
	No	25.9 (44)	
Companion animal ownership	Yes	47.6 (81)	1.2 (2)
	No	51.2 (87)	
Companion animal species	Dogs	56.8 (46)	0 (0)
	Cats	47.0 (38)	
	Small mammals	7.4 (6)	
	Birds	3.7 (3)	
	Fish	6.2 (5)	
	Reptiles	4.9 (4)	
	Horses	0 (0)	
	Farm animals	1.2 (1)	
	Other	2.5 (2)	

Table 2. Mean scores and standard deviation (SD) for wellbeing, loneliness, depression and anxiety by all participants, SMI diagnosis, and a number of companion animals owned.

Diagnosis	Mean wellbeing score (SD)	Mean loneliness score (SD)	Mean depression score (SD)	Mean anxiety score (SD)
All (n = 153)	23.1 (8.7)	5.6 (1.9)	2.4 (1.9)	2.8 (1.9)
Psychosis (n = 83)	23.1 (9.7)	5.5 (2.0)	2.3 (1.9)	2.7 (1.9)
Bipolar (n = 59)	23.6 (7.4)	5.6 (1.9)	2.3 (1.8)	2.7 (1.9)
Other (n = 12)	19.5 (10.4)	6.1 (2.2)	3.7 (2.4)	4.7 (2.3)
Number of companion animals owned				
One animal (n = 48)	21.7 (8.8)	5.7 (1.9)	2.4 (2.0)	2.9 (2.0)
More than one animal (n = 33)	21.8 (.8.2)	5.7 (1.7)	2.8 (2.0)	3.1 (1.9)

WHAT PROPORTION OF PARTICIPANTS OWN A COMPANION ANIMAL? (RQ1)

Just under half of the participants (47.6%; n = 81) owned a companion animal (Table 1). Of these, 59.3% (n = 48) owned one, with the most common animal being a dog (56.2%, n = 27), followed by a cat (39.6%, n = 19), and two (4.2%) reported owning one small mammal. Of the remaining animal owners, 14.8% (n = 12) owned two, 12.3% (n = 10) owned three, 1.2% (n = 1) owned four, and 2.5% (n = 2) owned five, six, and eight animals, respectively. Four participants (4.9%) owned more than 10 animals. Of these, participants reported owning 10 animals (1 dog, 1 cat, 8 fish); 26 animals (2 dogs, 24 birds); 32 animals (32 birds); and 41 animals (1 cat and 40 fish).

WHAT IS THE PERCEIVED STRENGTH OF THE HUMAN-ANIMAL BOND, AND WHAT PROPORTION OF COMPANION ANIMAL OWNERS REGULARLY INTERACT WITH THEIR ANIMAL? (RQ2)

Total CCA scores were high (M = 39.8, SD = 6.2), indicating most participants perceived there to be a strong human-animal bond with their closest companion animal. Likewise, total scores related to engagement frequency were high (M = 10.1, SD = 2.0), indicating most participants frequently interacted with their animals and perceived their companion animal to be a member of the family. Table 4 presents the descriptive statistics for the total

Table 3. Comparison of mean wellbeing and loneliness scores across OWLS 2 and OWLS 4.

	Mean wellbeing score (SD)	Mean loneliness score (SD)
OWLS 2	21.8 (8.3)	5.7 (2.1)
OWLS 4	23.1 (8.7)	5.6 (1.9)

CCA scores and frequency of engagement with the participants' closest companion animal. Companion animal owner responses to individual CCA statements and statements related to engagement frequency are presented in Supplementary Material 2.

ARE PARTICIPANTS' LEVELS OF WELLBEING, DEPRESSION, ANXIETY, OR LONELINESS ASSOCIATED WITH ANIMAL OWNERSHIP? (RQ3)

Adjusting for key sample characteristics, companion animal ownership was not significantly associated with total wellbeing, depression, anxiety, or loneliness scores (Table 5). Similar findings were observed when repeating the regression models using the 132 participants with complete information in the non-imputed dataset (see Supplementary Material 3).

IN COMPANION ANIMAL OWNERS, IS THE STRENGTH OF THE HUMAN-ANIMAL BOND ASSOCIATED WITH ANIMAL SPECIES OR PARTICIPANTS' LEVELS OF WELLBEING, DEPRESSION, OR ANXIETY? (RQ4)

The majority of companion animal owners identified their closest species as dogs (53.1%; n = 43) or cats (38.3%; n = 31). Only four participants identified other species as their closest companion animal (small mammals; n = 3; birds; n = 1). These were categorized as 'other' and excluded from the analysis due to the small number within the category not likely to allow for meaningful analysis. Three participants (3.7%) entered 'both dogs and cats' as their closest species so were also excluded from the current analysis. Therefore, 74 companion animal owners were included in this analysis.

Adjusting for relevant covariates, animal species (dogs, cats), and total wellbeing, depression and anxiety scores were not significantly associated with the perceived strength of the human-animal bond (Table 6). Similar findings were observed when repeating the

Table 4. Descriptive statistics for total CCA scores and frequency of engagement.

	% (N)	Missing % (N)	Minimum	Maximum	Mode	Median	Mean	Standard deviation
Total CCA score	90.1 (73)	9.9 (8)	11	44	44	43	39.8	6.2
Engagement frequency	100 (81)	0 (0)	4	12	12	11	10.1	2.0

Table 5. Linear regression models of association of animal ownership and wellbeing, depression, anxiety, and loneliness, adjusting for key sample characteristics.

Predictor	Total wellbeing score			
	^{b}adj	95% CI	*p*-value	R^2
Animal ownership[1]	−1.898	−4.730 to 0.935	0.188	0.082
	Total depression score			
	^{b}adj	95% CI	*p*-value	R^2
Animal ownership[2]	0.101	−0.501 to 0.703	0.741	0.154
	Total anxiety score			
	^{b}adj	95% CI	*p*-value	R^2
Animal ownership[3]	0.120	−0.517 to 0.757	0.710	0.125
	Total loneliness score			
	^{b}adj	95% CI	*p*-value	R^2
Animal ownership[1]	0.019	−0.644 to 0.683	0.954	0.037

[1]No covariate (gender, age, ethnicity, professional activity, socio-economic deprivation, SMI diagnosis, physical condition comorbidity) indicated significance.
[2]Gender, age, ethnicity, professional activity, socio-economic deprivation*, SMI diagnosis, physical condition comorbidity*; * indicates significance ($p < 0.05$).
[3]Gender*, age, ethnicity, professional activity, socio-economic deprivation, SMI diagnosis, physical condition comorbidity; * indicates significance ($p < 0.05$).

Table 6. Linear regression model of association of animal species, wellbeing, depression and anxiety, and the perceived strength of the human-animal bond, adjusting for relevant covariates.

Predictor	Human-animal bond (CCA scores)			
	^{b}adj	95% CI	*p*-value	R^2
Animal species	−0.413	−2.352 to 1.526	0.672	0.089
Total wellbeing scores	−0.075	−0.328 to 0.178	0.555	
Total depression scores	−0.832	−1.843 to 0.180	0.106	
Total anxiety scores	0.769	−0.173 to 1.710	0.108	

No covariate (gender, age, ethnicity, loneliness) indicated significance.

regression model using 56 participants with complete information in the non-imputed dataset (see Supplementary Material 3).

Discussion

The current survey investigated the connection between owning an animal and mental health in individuals living with SMI, and whether the perceived strength of the bond between owner and animal was associated with mental health and animal species owned. As far as we are aware, this is the first study to explore the perceived strength of the human-animal bond with companion animals in individuals with an existing SMI diagnosis and the connections with mental health. It also addresses the limitations outlined in our previous survey conducted within the same cohort (Shoesmith *et al.*, 2021b). Findings from this survey indicate that while most participants reported a strong human-animal bond with their animal, owning an animal was not significantly associated with wellbeing, depression, anxiety, or loneliness scores. Likewise, for those participants who owned an animal, the strength of the human-animal bond was not associated with animal species or wellbeing, depression, and anxiety scores.

ASSOCIATION BETWEEN ANIMAL OWNERSHIP AND MENTAL HEALTH

The evidence base for the impact of animal ownership on mental health is mixed. It is commonly assumed that companion animals are beneficial for the health and welfare of most owners in both the general population (Ratschen *et al.*, 2020; Shoesmith *et al.*, 2021a) and those with a mental health diagnosis (Stern *et al.*, 2013; Brooks *et al.*, 2018; Hayden-Evans *et al.*, 2018). For example, research conducted within the general population suggests that animal ownership can ameliorate feelings of stress, insecurity, loneliness, and depression (Crawford *et al.*, 2006; Staats *et al.*, 2008; McConnell *et al.*, 2011). In fact, evidence suggests that animal ownership was associated with less deterioration in mental health within the general population during COVID-19 restrictions in the UK, suggesting animal ownership may have mitigated some of the detrimental psychological effects of the pandemic (Ratschen *et al.*, 2020). Likewise, companion animals are considered important sources of psychological support for those with mental health illnesses (Brooks *et al.*, 2018, 2019). Studies have suggested that animal ownership may help to reduce feelings of loneliness and depression (Stern *et al.*, 2013), and provides community engagement and meaningful participation, which assists the development of coping skills for people who have been diagnosed with a mental health illness (Brooks *et al.*, 2016; Hayden-Evans *et al.*, 2018).

Conversely, some studies have found no association, or a negative association, between companion animal ownership and mental health within both the general population (Gilbey *et al.*, 2007; Rijken and van Beek, 2011; Ding *et al.*, 2018) and for those with a mental health diagnosis (Shoesmith *et al.*, 2021b). These findings align with our current results, as we did not identify a significant association between animal ownership and wellbeing, depression,

anxiety, and loneliness scores in people living with SMI. Our previous findings from OWLS 2 reported animal ownership was associated with a self-reported decline in mental health, and it was possible due to the pandemic restrictions and subsequent challenges of animal ownership being amplified during this context (Shoesmith *et al.*, 2021b). The current data were collected following the removal of COVID-19 restrictions, and there was a marginal increase in wellbeing scores (+1.3), suggesting the pandemic context may have influenced the findings in OWLS 2. However, it was not possible to compare depression and anxiety scores, a limitation that would have allowed us to explore this further.

In the absence of COVID-19 restrictions, a possible explanation for our current findings could be that the added responsibility of animal ownership may still exacerbate other potential stressors experienced by people living with SMI (e.g. financial and housing uncertainty/instability), thus possibly counteracting the benefits of ownership to mental health (Wells, 2009; Zimolag and Krupa, 2010; Brooks *et al.*, 2016; Hayden-Evans *et al.*, 2018; Shoesmith *et al.*, 2021b). This is plausible to suggest, considering socio-economic deprivation was a significant covariate in the regression model investigating the association between ownership and total depression scores. This also aligns with evidence in the general population as research has indicated that animal owners reported lower psychological wellbeing if they were unemployed, suggesting the experience of ownership amplifies financial burden and responsibility (Amiot *et al.*, 2022). A primary responsibility of animal ownership is the financial investment to pay for veterinary care, food, and supplies (Anderson *et al.*, 2015), and this burden may result in increased stress levels (Anderson *et al.*, 2015; Needell and Mehta-Naik, 2016; Shoesmith *et al.*, 2021a). It may be possible this burden is amplified further by owning more than one companion animal. However, the influence of owning multiple animals is seldom reported, as previous evidence frequently requests participants to report on their relationships with their favourite animal, which restricts the opportunity to assess if there are any cumulative effects of having multiple animals (Mueller *et al.*, 2021b). Additionally, our findings only indicate marginal differences in mean wellbeing, loneliness, depression, and anxiety scores for those who own one or more than one companion animal, with the largest difference being 0.4 for the mean depression score (Table 2). However, it is important for future research to explore the impact of these potential stressors on animal ownership for those living with SMI, as further work is required in the context of social inequalities and disadvantages (LaVallee *et al.*, 2017; McCabe *et al.*, 2021).

A second explanation to our findings may be related to the complexity of the human-animal relationship, and the range of factors that mediate the relationship between companion animals and their owners. Commonly cited mediating factors often include animal species and the strength of attachment (Siegel *et al.*, 1999; Barcelos *et al.*, 2021; Hawkins *et al.*, 2022). However, characteristics of the companion animal may also mediate the relationship between animal ownership and owner wellbeing (Cavanaugh

et al., 2008). For example, research has suggested participants who own more disobedient animals reported greater stress than those who owned more obedient animals (Bradley and Bennett, 2015), and companion animal characteristics and individual preferences of owners may impact the ability of an animal to benefit human mental health (Cavanaugh *et al.*, 2008; Walsh, 2009). Therefore, our findings may imply that animal ownership and the perceived strength of the human-animal bond are not sufficient to benefit participants' wellbeing, but we also need to consider the animal's temperament and characteristics (Bradley and Bennett, 2015). This may explain why trained therapy animals, unlike companion animals, often enhance wellbeing of individuals diagnosed with mental health illnesses, as they are typically selected and trained due to friendly, obedient, and relaxed personality traits (D'Arcy, 2011). It is vital for future research to further explore the mediating factors influencing the complex relationship between humans and animals to further our knowledge of the more specific requirements of those living with SMI who own animals. Importantly, our current results and findings from our previous study (Shoesmith *et al.*, 2021b) highlight that the common assumption that owning an animal has a positive impact on mental health may not be the case for this subpopulation.

ASSOCIATION AMONG THE PERCEIVED STRENGTH OF THE HUMAN-ANIMAL BOND, ANIMAL SPECIES, AND MENTAL HEALTH

It is often reported that the perceived strength of the human-animal bond influences the connection between owning an animal and human health (Islam and Towell, 2013). Existing evidence suggests that owners often report strong bonds with their animals (Smolkovic *et al.*, 2012; Brooks *et al.*, 2018), sometimes indicate a closer bond to their animals than their relatives (Beck and Madresh, 2008). Therefore, research has progressively focused on the links between mental health and the perceived attachment to companion animals (Lass-Hennemann *et al.*, 2022). While some studies have reported a positive relationship between the human-animal bond and mental health (Mahalski *et al.*, 1988; Barker, 1999; Cohen, 2002), most research has reported a negative relationship (Antonacopoulos and Pychyl, 2010; Miltiades and Shearer, 2011; Peacock *et al.*, 2012; Smolkovic *et al.*, 2012; Lass-Hennemann *et al.*, 2020). Specifically, stronger bonds to companion animals were associated with worse mental health and can predict mental health vulnerability in some research (Antonacopoulos and Pychyl, 2010; Peacock *et al.*, 2012; Lass-Hennemann *et al.*, 2022; Wells *et al.*, 2022). Given the strong association between attachment to companion animals and mental health, it is important to further explore this within our subpopulation.

Due to the complex and dynamic interaction between the human-animal bond and human-related factors (Payne *et al.*, 2015), there is currently a lack of consensus on the terminology used to evaluate human-animal relationships (Anderson, 2007). The instruments available are limited and often focus on the human-animal bond between adult participants and dogs (Anderson, 2007). The Lexington Attachment to Pets Scale (Johnson *et al.*, 1992) is a widely used measure in human-animal interaction studies (Wilson and Netting, 2012), but its items may fail to address some aspects of the human-animal bond that may be unique to the relationship with specific animal species other than dogs and cats (Riggio *et al.*, 2021). Therefore, the CCA was selected as it focuses specifically on the intimacy or comfort domain of the human-animal relationship (Zasloff, 1996) and is more appropriate for measuring the human-animal bond for a variety of species than other standardized measures, as 'physical' domain items such as dog walking would not be relevant for all other species (Zasloff, 1996).

Our findings show that a significant association between the perceived strength of the human-animal bond and mental health scores was not identified. Despite this, companion animal owners in the sample reported near-ceiling levels of attachment to their animals. Over 95% reported their animal provided them with companionship, provided a source of constancy in their life, and made them feel loved (see Supplementary Material 2). While we did not find a significant association, responses to the individual CCA statements indicate that companion animals do provide emotional support to their owners, a finding that echoes results from existing studies within the general population (Hoy-Gerlach *et al.*, 2020; Ratschen *et al.*, 2020; Kogan *et al.*, 2021; Shoesmith *et al.*, 2021a) and also in those diagnosed with mental health conditions (Wisdom *et al.*, 2009; Zimolag and Krupa, 2010; Brooks *et al.*, 2016; Shoesmith *et al.*, 2021b). Therefore, these results suggest that animal ownership may offer similar benefits to those living with SMI as those in the general population, and companion animals may be a vital part of the social network of people who have received an SMI diagnosis (Brooks *et al.*, 2016).

Lastly, we did not identify a significant association between the human-animal bond and animal species. This aligns with a previous study on the general population that reported the strength of the human-animal bond did not vary by species (Ratschen *et al.*, 2020). This finding may support the social buffering hypothesis (Cohen and Wills, 1985), in that the presence of any animal within an individual's social network may be more important for shaping the relationship than species-specific aspects. However, it is important to acknowledge the lack of variation of species identified by participants as their closest animal, so species were categorized as dogs and cats for the purpose of our analysis. Future research would benefit from recruiting a larger sample size and comparing a wider variety of species identified as the animal the participant felt closest to. However, it is not surprising that dogs and cats were the most frequently reported animals owned by this sample, and this is consistent with the numbers reported in previous mental health populations (Brooks *et al.*, 2016; Shoesmith *et al.*, 2021b), and the general population (Ratschen *et al.*, 2020).

LIMITATIONS

We acknowledge the limitations of our current study. First, the generalizability of our findings is limited by the sample size. Future research would benefit from recruiting a larger sample size and comparing larger groups of animal owners to non-owners. The limited sample size may also have prevented any effect between the perceived strength of the human-animal bond and mental health scores from being identified, considering the lack of variability in responses observed in relation to the perceived strength of the bond (near ceiling levels reported across the sample). In future investigations of this research question, a larger sample is likely required to ensure there is sufficient variability in responses. Additionally, ethnicity was used to derive a binary variable ('white'/'other ethnic'), restricting the possibility to explore cultural influences on mental health and companion animal ownership. This would be important to further explore as research has reported animal ownership does vary across ethnic identities, but is not consistently controlled for in studies on animal ownership (Mueller *et al.*, 2021a; Rodriguez *et al.*, 2021).

We also acknowledge that we explored animal ownership cross-sectionally. Although there were no differences reported in wellbeing, depression, anxiety, and loneliness between animal owners and non-owners, it may be that for this specific group of animal owners, ownership was providing benefits above and beyond what would have been the case without a companion animal at the point of data collection or at another time point. It would be useful for future research to explore how animal ownership impacts an individual living with SMI dynamically over time.

Furthermore, while most studies that investigate the connection between mental health and human-animal relationships primarily focus on specific species (particularly dogs and cats), we did endeavour to include all animal species in our analysis. However, the data presented here predominantly involved dogs and cats,

and therefore, the species were categorized into dogs and cats for the purpose of our analysis. Although this was expected that given cats and dogs are the most commonly owned animal species, and research reports that the participants tend to discuss these animals more than other species (Hui Gan *et al*., 2020), this study was unable to explore the potential impact of a more diverse range of animal species. Future research should exclusively focus on other animal species within this population group to explore the impact of a wider variety of species. Last, we did not collect data relating to animal characteristics or the amount of time the participant had owned their animal(s), factors which may be imperative in the development of the bond between the owner and their animal and may influence the extent to which an animal impacts their owner's health.

CONCLUSIONS

Our current survey provided further insight into the impact of human-animal relationships for participants living with SMI. While the majority of participants perceived a strong human-animal bond with their companion animal, animal ownership and the strength of the human-animal bond were not associated with mental health scores. Our findings highlight the need for further exploration about animal ownership in people living with SMI and in the context of social inequalities and disadvantages. In order to reap the benefits of animal ownership, the development of targeted support strategies needs to be considered as a lack of personal and financial resources may turn animal ownership into a burden. Critically, the current findings build on previous work by bringing additional nuance to our understanding of the role of companion animals within this subpopulation, providing insights across a range of mental health measures and the inclusion of the CCA to measure the perceived strength of the human-animal bond. Our findings, together with prior research, suggest that the commonly held belief that animals are beneficial for wellbeing may not be entirely true for all members of all subpopulations in all contexts.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

ETHICS STATEMENT

Ethical approval for the survey was granted by the Health Research Authority Northwest – Liverpool Central Research Ethics Committee (REC reference: 20/NW/0276) and Wales Research Ethics Committee 4 (REC reference: 21/WA/0239). All participants provided informed consent to take part. All participants received a Participant Information Sheet at the beginning of the wider study and were given the opportunity to ask any questions about participation. Participants consented to follow-up in the first survey. Voluntary completion of this follow-up survey was indicative of participant consent.

AUTHOR CONTRIBUTIONS

E.P., B.L., and L.W. conceptualized the study; E.P., B.L., and L.W. carried out the methodology; B.L. and E.S. used software for this study; E.S., B.L., E.P., L.W., and E.R. validated the data; E.S. and B.L. carried out formal analysis; E.P., B.L., and L.W. carried out investigation; E.S., B.L., E.P., L.W., and E.R. gathered resources for this study; E.S. and B.L. curated the data; E.S. carried out writing—original draft preparation; E.S., B.L., E.P., L.W., and E.R. carried out writing—review and editing; E.S., B.L., E.P., L.W., and E.R. visualized the study; E.R. supervised the study; E.P., B.L., and L.W. administrated the project; E.P. carried out funding acquisition. All authors have read and agreed to the published version of the manuscript.

DATA AVAILABILITY STATEMENT

We are not able to share a de-identified dataset as we do not have consent from the research participants to do this. We have checked with the GDPR team at the University of York, and they have advised us that we cannot upload this data to a public repository without explicit consent from the study participants. Data requests for the full dataset may be sent to the Closing the Gap Network email: ctg-network@york.ac.uk whose Steering Committee manages our data access requests.

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