



Anthrozoös

A multidisciplinary journal of the interactions of people and animals

ISSN: 0892-7936 (Print) 1753-0377 (Online) Journal homepage: <https://www.tandfonline.com/loi/rfan20>

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To cite this article: Shengxin Liu, Lauren Powell, Debbie Chia, Tom C. Russ, Paul D. McGreevy, Adrian E. Bauman, Kate M. Edwards & Emmanuel Stamatakis (2019) Is Dog Ownership Associated with Mental Health? A Population Study of 68,362 Adults Living in England, *Anthrozoös*, 32:6, 729-739, DOI: [10.1080/08927936.2019.1673033](https://doi.org/10.1080/08927936.2019.1673033)

To link to this article: <https://doi.org/10.1080/08927936.2019.1673033>



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Is Dog Ownership Associated with Mental Health? A Population Study of 68,362 Adults Living in England

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Supplemental files for this paper are available online.

ABSTRACT The association between dog ownership and mental health remains unclear. The primary aim of this study was to investigate this association, while the secondary aim was to examine possible interactions between dog ownership and marital status in relation to mental health. A population sample of 68,362 adults living in England were included in this study. Self-reported information on short-term psychological distress and long-standing mental illness was collected. Multilevel logistical models were used to allow for interdependence of participants within the same household. In total, 15,856 (23.2%) participants reported the presence of dog in the household. Dog owners were less likely to report long-standing mental illness than non-owners. An interaction was found between dog ownership and marital status in relation to mental health. In subsequent stratified analyses solitary owners displayed increased odds of short-term psychological distress, whilst companioned owners displayed lower odds of reporting long-standing mental illness. Our findings indicate a complex relationship between dog ownership and mental health, and suggest that psychological health attributes of dog ownership may vary based on marital status. Further investigation is warranted, especially longitudinal studies which consider variation in dog-ownership behaviors.

Keywords: dog ownership, human–animal interaction, mental health

Dog ownership is very common: in high income countries, such as Sweden and Australia, between 25% and 60% of households own one or more dogs (Bauman et al., 2011). Despite the popular belief that dog ownership is beneficial for mental health, existing evidence is scant and often contradictory. Some studies have found an association between dog ownership and improved mental health outcomes, such as reduced depression, anxiety (Garrity, Stallones, Marx, & Johnson, 1989; Siegel, 1990), and loneliness (Krause-Parella, 2012; McConnell, Brown, Shoda, Stayton, & Martin, 2011) and greater life satisfaction (Bao & Schreer, 2016; McConnell et al., 2011). Other studies suggest that dogs can cause additional stress for the owner (Enmarker, Hellzén, Ekker, & Berg, 2015; Miltiades, & Shearer, 2011). Additionally, some studies have found no association between dog ownership and mental health outcomes (Clark, 2010; Raina, Waltner-Toews, Bonnett, Woodward, & Abernathy, 1999).

Several factors may complicate our understanding of the association between dog ownership and mental health. Firstly, dog ownership may influence an owners' short-term psychological distress and long-standing mental illness differently. Fundamental differences exist between short-term distress and long-standing illness in relation to mental health (Horiwitz, 2007; Payton, 2009). Therefore it is important to distinguish between and incorporate both constructs when investigating mental health. Yet, to our knowledge, no study has examined the influence of dog ownership on each outcome separately. Moreover, the associations between dog ownership and mental health seem to vary with an owner's personal circumstance, such as marital status (Clark, 2010; Enmarker et al., 2015). Although several studies have investigated the interaction between marital status and dog ownership, the literature remains inconclusive. For example, a small cross-sectional study of 201 adults in United States found that dog ownership is associated with greater benefit in single adults compared with married adults (Bauman et al., 2011). However, a Norwegian cross-sectional population study of 12,093 older people found no interaction between marital status and dog ownership in relation to the presence of symptoms of depression (Enmarker et al., 2015). Furthermore, methodological limitations, such as small sample sizes and limited variation in exposure or outcomes, may also have compromised previous studies in their ability to detect associations (Herzog, 2011; Saunders, Parast, Babey, & Miles, 2017).

The aim of the current study was to investigate associations between dog ownership and both short-term psychological distress and long-standing mental illness in a large sample of adults living in England. Interactions between dog ownership and marital status in relation to mental health were also examined.

Methods

Study Population

Participants in this study were drawn from a pooled cohort of the Health Survey for England (HSE) (1995, 1996, 1997, 2001, 2002, and 2004). The methods used in the HSE are described in detail elsewhere (Mindell et al., 2012). Briefly, the HSE is a repeated cross-sectional survey running in annual thematic cycles to monitor health trends of the population. A representative sample of the population residing in England was recruited on an annual cycle by using multistage, stratified probability. All participants provided informed written consent (Mindell et al., 2012). The HSE was approved by the relevant Local Research Ethics

Committees (see Online Supplemental Material—Ethics Statement for more details on the ethical approval processes of HSE).

Dog Ownership

Dog ownership was defined as residing in a household with one or more dogs. Questions on dog ownership were presented at the household level. For example, the household representative was asked, “Do you keep any household pets inside your house/flat?” For those who answered yes, a further question on the type of pet, including dogs, was asked (Ding et al., 2018).

Mental Health Assessments

Mental health was assessed by two outcomes: short-term psychological distress and long-standing mental illness. The presence of short-term psychological distress was assessed using the 12-item version of the General Health Questionnaire (GHQ-12), a tool widely used in population-based studies (Russ et al., 2012). The GHQ-12 is a well validated instrument that has been strongly associated with various types of psychological distress (Garcia, & McCarthy, 2000; Goldberg, 1978; Goldberg et al., 1997; Hankins, 2008), particularly short-term distress (Garcia et al., 2000). Participants indicated whether they had experienced each symptom in the preceding four weeks by using a 4-point bimodal method (“not at all” = 0, “same as usual” = 0, “more than usual” = 1 and “much more than usual” = 1). Participants with a total GHQ-12 score of 4 or more were categorized as being psychologically distressed, while those with 0 to 3 were categorized as not distressed (Russ et al., 2012). The presence of long-standing mental illness was assessed by a single question: “Do you have any long-standing illness, disability or infirmity? By ‘long-standing’ I mean anything that has troubled you over a period of time or that is likely to affect you over a period of time.” Participants who reported having any of the illnesses listed in Online Supplemental Table 1 were categorized as having long-standing mental illness. Examples of illnesses are alcoholism, anxiety, drug addiction, depression, and stress.

Co-variates

Our selection of covariates was based on previous literature on the health effects of dog ownership (including but not limited to Ding et al., 2018, Parslow et al., 2005; Torske, Krookstad, Stamatakis, & Bauman, 2017). We considered a number of demographic and lifestyle characteristics as potential confounders, including owners' age, gender, marital status, socio-economic status, household size, smoking status, alcohol consumption, and physical activity. As with many epidemiological studies, we were restricted by the availability of information on potential confounders in this particular dataset. All co-variates were measured with the interview-administered questionnaire during a face-to-face interview or nurse screening visit. Marital status was categorized into groups: solitary (single/separated/divorced/widowed) and companioned (married/partnered/cohabited). Socio-economic status was based on participants' occupations using the 4-group version of Registrar General's classification: professional and managerial occupations, skilled non-manual occupations, skilled manual occupations, or routine and semi-skilled manual occupations. Smoking status was categorized as current, previous, or never smoked. Alcohol consumption was categorized as high (5 times or more per week), regular (1 to 4 times per week), low (1 or 2 times a month or less than once every couple of months), previous (used to drink but not anymore), or never drank. Information on household size, that is, number of persons in each household, was acquired for HSE1997,

2001, 2002, and 2004. Physical activity was measured using a validated questionnaire in HSE1997 and 2004, from which metabolic equivalents (METs) hours were calculated (Stamatakis, Ekelund, & Wareham, 2007). As described by the previous study, physically inactive was defined as 0 MET-hours per week, moderately active was > 0 to < 7.5 MET-hours per week, and active was \geq 7.5 MET-hours per week (Perreault et al., 2017).

Statistics Analysis

Data were analyzed in 2017, and all statistical analyses were executed in SAS 9.4 (SAS Institute). Descriptive characteristics of the study population were calculated between dog owners and non-owners and presented as means (standard deviation) and medians (interquartile range) for continuous variables and percentages for categorical variables.

For the main analyses, multilevel logistic models were used to allow for interdependence of participants within one household (Cummins, Stafford, Macintyre, Marmot, & Ellaway, 2005). In a 2-level model, the overall prevalence of each outcome category in each household was estimated as the fixed effect. Outcomes for each participant were allowed to vary from this overall value, that is, random intercepts. Second-order penalized quasi-likelihood (PQL) estimates were obtained as they are the least biased estimation (Moerbeek, van Breukelen, & Berger, 2003). Model 1 was a basic model including dog ownership. Model 2 was also adjusted for age and gender. Model 3 was additionally adjusted for demographic and life-style factors: marital status, socio-economic status, smoking status, and alcohol consumption level. Interactions between marital status and dog ownership, in relation to the outcomes, were estimated by including interaction terms in the final adjustment model. Where a significant interaction was observed ($p < 0.05$), we performed stratification analysis. In a smaller subsample, we performed sensitivity analyses by additionally adjusting the models for household size and physical activity level, where data were available.

Results

As shown in Figure 1, we excluded participants with missing information on dog ownership ($n = 9,909$) and other co-variates, such as marital status ($n = 1,545$). A total of 68,362 adults (mean age: 45.9 y, 55.2% women) were included in the final analyses. There was no significant difference in demographic characteristics between the study sample and participants who were excluded due to missing information on dog ownership (Online Supplemental Table 2). In the main analysis sample, dog owners were on average younger and of a lower socio-economic status. Dog owners were also more likely to be companioned, smokers, and have higher alcohol consumption (Table 1).

Table 2 shows the associations between household-level dog ownership and mental health. No association was observed between dog ownership and short-term psychological distress, with an odds ratio (OR) of 1.07 (95% CI: 0.99–1.15). After multivariate adjustment, an inverse association was found between dog ownership and the presence of long-standing mental illness (OR: 0.85, 95% CI: 0.76–0.95).

Statistically significant interactions were observed between marital status and dog ownership regarding short-term psychological distress (p -value for interaction: 0.03) and long-standing mental illness (p -value for interaction: 0.02). As Table 3 shows, solitary dog owners displayed significantly higher odds of experiencing short-term psychological distress compared with non-owners (OR: 1.15, 95%CI: 1.05–1.27). In contrast, there was no evidence of an association between dog ownership and short-term psychological distress among

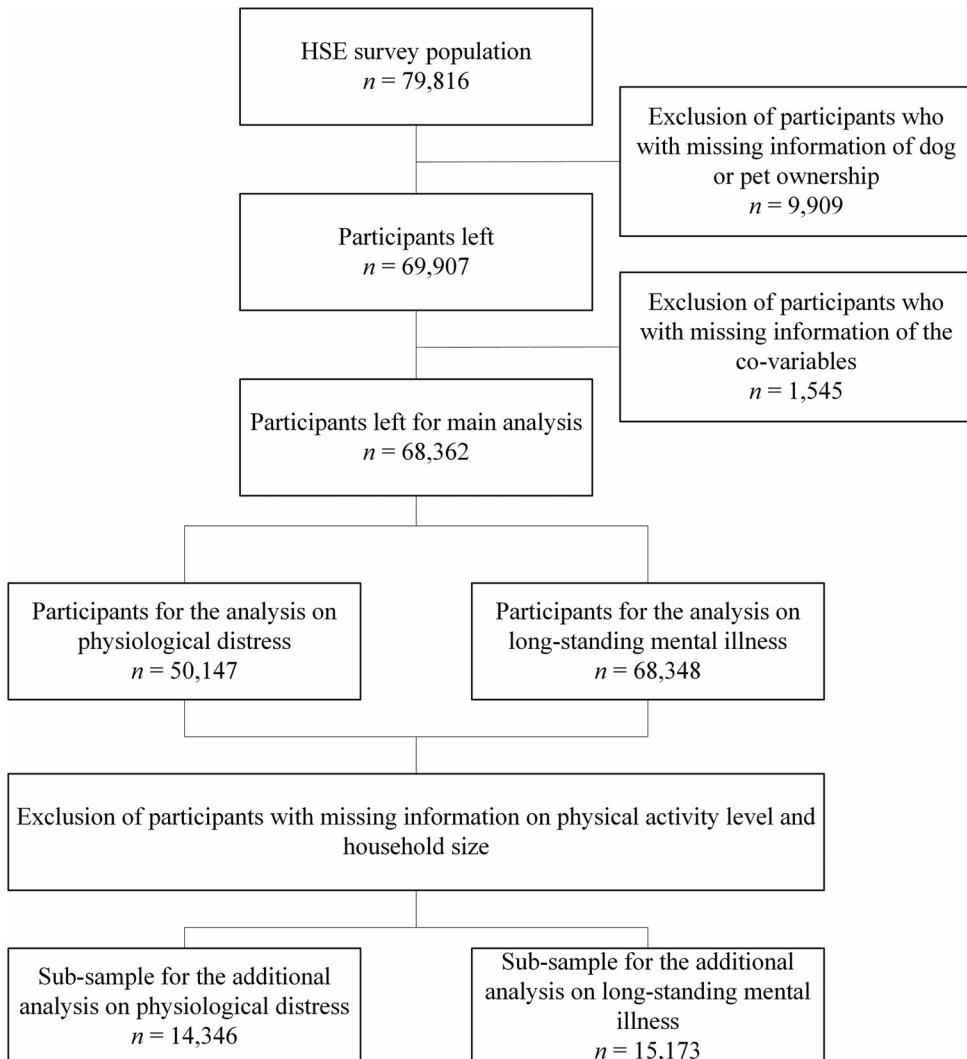


Figure 1. Participants' flowchart.

companioned owners (OR: 0.99, 95% CI: 0.92–1.07). When examining associations with long-standing mental illness, companioned dog owners displayed significantly lower odds (OR: 0.75, 95% CI: 0.65–0.87) than non-owners, while no difference was observed in solitary dog owners (OR: 1.00, 95% CI: 0.84–1.21) (Table 3).

In agreement with the main results presented in Table 2, Online Supplemental Table 3 showed lower odds of having long-standing mental illness (OR: 0.72, 95%CI: 0.59–0.91) after adjustment for physical activity and household size in a sub-sample ($n = 15,173$).

Table 1. Descriptive characteristic of the study population by dog ownership status (*n* = 68,342).

	All	Dog Owners	Non-owners
<i>n</i>	68,362	15,856 (23.2%)	52,506 (77.8%)
Age, y	45.9 ± 18.5	44.0 ± 16.6	46.5 ± 19.0
Female %	37,740 (55.2%)	8,752 (55.2%)	23,518 (44.8%)
<i>Marital Status</i> ^a			
Solitary	24,216 (35.4%)	4,805 (30.3%)	19,411 (37.0%)
Companioned	44,146 (64.6%)	11,051 (69.7%)	33,095 (63.0%)
<i>Socio-economic Status</i> ^b			
Professional and managerial	20,825 (30.5%)	4,441 (28.0%)	16,384 (31.2%)
Skilled non-manual	16,656 (24.4%)	3,624 (22.9%)	13,032 (24.8%)
Skilled manual	13,075 (19.1%)	3,384 (21.3%)	9,691 (18.5%)
Routine and unskilled manual	16,162 (26.6%)	4,211 (26.6%)	11,951 (22.8%)
Other	1,644 (2.4%)	196 (1.2%)	1,448 (2.8%)
<i>Smoker</i>			
Current	18,593 (27.2%)	5,171 (32.6%)	13,422 (25.6%)
Previous	17,100 (25.0%)	3,964 (25.0%)	13,136 (25.0%)
Never	32,669 (47.8%)	6,721 (42.4%)	25,948 (49.4%)
<i>Alcohol Consumption</i> ^c			
High	12,833 (18.8%)	3,161 (19.9%)	9,672 (18.4%)
Regular	30,645 (44.8%)	7,196 (45.4%)	23,449 (44.7%)
Low	18,007 (26.3%)	4,367 (27.5%)	13,640 (26.0%)
Previous drinker	2,693 (3.9%)	608 (3.8%)	2,085 (4.0%)
Never drank	4,184 (6.1%)	524 (3.3%)	3,660 (7.0%)

^aSolitary: single, separated, divorced, or widowed. Companioned: married, partnered, or cohabited.^bSocio-economic status was categorized according to the occupation of the head of the household.^cAlcohol consumption was categorized according to the usual frequency of the drinking in the past 12 months. High: 5 times or more a week; regular: 1 to 4 times a week; low: < 2 times a month.**Table 2.** Associations between dog ownership and mental health.

	Dog Owners	Non-owners
Short-Term Psychological Distress (GHQ-12 > 3)		
<i>n</i> (cases) ^a	11,690 (1,761)	38,457 (5,985)
Model 1 ^b	1.05 (0.99, 1.11)	1.0 (ref)
Model 2 ^c	1.06 (1.00, 1.12)	1.0 (ref)
Model 3 ^d	1.07 (0.99, 1.15)	1.0 (ref)
Long-Standing Mental Illness^e		
<i>n</i> (cases)	15,849 (440)	52,499 (1,257)
Model 1 ^b	0.85 (0.76, 0.95)	1.0 (ref)
Model 2 ^c	0.85 (0.76, 0.95)	1.0 (ref)
Model 3 ^d	0.86 (0.77, 0.96)	1.0 (ref)

^aInformation on short-term psychological distress (GHG-12) was available for 50,147 participants in the study population. Participants with a score of 4 or higher were defined as being psychologically distressed, whereas those who scored 3 or lower were defined as not distressed. *n* indicates the number of participants who were psychologically distressed.^bModel 1 was the basic model which included dog ownership as the independent variable.^cModel 2 was additionally adjusted for age and gender.^dModel 3 was additionally adjusted for socio-economic status, marital status, smoking status, and level of alcohol consumption.^eInformation on long-standing mental illness was available for 68,348 participants in the study population.

Table 3. Association between living with dog(s) and mental health stratified by the marital status of the participants.

	Dog Owners	Non-owners	<i>p</i> -value for Interaction
Short-Term Psychological Distress (GHQ-12 > 3)^a			0.03
<i>Solitary</i>			
<i>n</i> (cases)	3,667 (637)	14,432 (2,721)	
Model 1 ^b	1.11 (1.01,1.22)	1 (ref)	
Model 2 ^c	1.14 (1.03,1.25)	1 (ref)	
Model 3 ^d	1.15 (1.05,1.27)	1 (ref)	
<i>Companioned</i>			
<i>n</i> (cases)	8,023 (1,124)	24,025 (3,264)	
Model 1	0.97 (0.90,1.05)	1 (ref)	
Model 2	0.98 (0.91,1.05)	1 (ref)	
Model 3	0.99 (0.92,1.07)	1 (ref)	
Long-Standing Mental Illness^e			0.02
<i>Solitary</i>			
<i>n</i> (cases)	4,802 (167)	19,405 (669)	
Model 1	0.99 (0.83,1.18)	1 (ref)	
Model 2	0.97 (0.82,1.16)	1 (ref)	
Model 3	1.00 (0.84,1.21)	1 (ref)	
<i>Companioned</i>			
<i>n</i> (cases)	11,047 (273)	33,094 (588)	
Model 1	0.71 (0.61,0.82)	1 (ref)	
Model 2	0.71 (0.61,0.82)	1 (ref)	
Model 3	0.75 (0.65, 0.87)	1 (ref)	

^aInformation on short-term psychological distress (GHG-12) was available for 50,147 participants in the study population. Participants with a score of 4 or higher were defined as being psychologically distressed, whereas those who scored 3 or lower were defined as not distressed. *n* indicates the number of participants who were psychologically distressed.

^bModel 1 was the basic model which included dog ownership as the independent variable.

^cModel 2 was additionally adjusted for age and gender.

^dModel 3 was additionally adjusted for socio-economic status, marital status, smoking status, and level of alcohol consumption.

^eInformation on long-standing mental illness was available for 68,348 participants in the study population.

Discussion

In this cross-sectional analysis of a population-based sample comprising six nationally representative pooled datasets totaling 68,362 participants, we found diverse associations between dog ownership and human mental health. Dog ownership was associated with a lower risk of long-standing mental illness; however, the associations with short-term psychological distress were unclear and tended to be in the opposite direction. We found that marital status modified the relationship between dog ownership and both short-term psychological distress and long-standing mental illness.

Dog Ownership and Short-Term Psychological Distress

To our knowledge, only one previous study investigating dog ownership has used the GHQ-12 to examine psychological distress: a study of 193 chronic fatigue syndrome patients (Wells, 2009) which documented no association between dog ownership and psychological distress. In accordance, our study also found no evidence of an association between dog ownership and GHQ-12 scores. Another cross-sectional study, of 201 adults, further confirmed our

results, finding that dog ownership was not associated with the owners' recent experience of depression, which is a subtype of psychological distress (Clark, 2010). That same study indicated differential associations between dog ownership and depression by marital status (Clark, 2010).

The interaction between marital status and dog ownership regarding short-term psychological distress merits attention. We found that dog ownership was associated with an increased risk of reporting short-term psychological distress among solitary participants only. There are various possible explanations for this finding. It is plausible that companioned participants receive positive psychological benefits from their relationship with their partner. For instance, social support provided by their partner may buffer the acute effects of stress and therefore help to minimize short-term psychological distress regardless of dog ownership status (Gove, Hughes, & Style, 1983). On the other hand, it is also plausible that solitary dog owners had limited social support and increased acute distress before acquiring a dog.

Dog Ownership and Long-Standing Mental Illness

In contrast to the above findings, dog owners displayed significantly lower odds of experiencing long-standing mental illness compared with non-owners. Established, long-standing mental illness differs from acute psychological distress not only in time-scale (Horwitz, 2007; Payton, 2009) but also in terms of protecting factors (World Health Organization, 2012). For instance, good physical health and fitness reduce risk for mental illness, especially in adults (Gove, Hughes, & Style, 1983). A possible explanation for the above finding is that dogs offer pivotal social support to their owners and therefore have beneficial effect on owners' mental health (McNicholas & Collis, 2000; Netting et al., 2013). For instance, McNicholas and Collis (2000) concluded that dogs can be catalysts for social interaction. A number of studies indicate that the strength of social support is associated with better mental health (Harter, 1998; McConnell et al., 2011; Netting et al., 2013). Also, attachment to a companion dog may act as a buffer to ameliorate owners' response to stressful life-events (Allen, Blascovich, & Mendes, 2002; Allen, Blascovich, Tomaka, & Kelsey, 1991).

When considering marital status, we found companioned owners displayed markedly lower odds of having long-standing mental illness whilst there was no association in solitary owners. However, given the cross-sectional nature of our study, these findings need to be interpreted with caution. As such, it is difficult to conclude whether the observed associations reflect a truly beneficial effect of dog ownership or whether they are the result of reverse causation. Perhaps the reasons for acquiring a dog systematically differ between solitary and companioned owners, subsequently influencing the mental health of each group. For example, solitary dog owners with poor mental health may acquire dogs for affection and companionship to reduce pre-existent feelings of loneliness (Collis & McNicholas, 1998; Tower & Nokota, 2006). Alternatively, companioned dog owners, who tend to report higher levels of social support from their families (Antonacopoulos & Puchyl, 2008), may already have positive mental health at the time of acquiring a dog.

Study Strengths and Limitations

To our knowledge, our analysis is the largest study to date to investigate dog ownership and mental health in a series of pooled population samples. In addition, we examined dog ownership in relation to both short-term and long-standing psychological status. The GHQ-12, which demonstrates high validity and reliability, was used as the measurement tool of recent

psychological distress (Goldberg, 1978; Goldberg et al., 1997). The long-standing mental illness outcome included a wide array of conditions. Nevertheless, there are several limitations that need to be considered. Firstly, as aforementioned, the cross-sectional study design precludes us from making causal inferences about the relationship between dog ownership and mental health. Secondly, a lack of information regarding the temporality of an individual's marital status prevented us from discriminating possible differences between the two groups. Moreover, although we adjusted for all available confounders, we cannot exclude the possibility of residual confounding due to factors such as variation in an individual's role in dog ownership or the strength of the bond owners had with their dogs. However, to check the robustness of the observed associations and eliminate possible confounding from physical activity level and household size of the owners, we performed additional sensitivity analyses in which the observed associations remained (Online Supplemental Table 3). Furthermore, the questionnaire inquired only about the presence of a dog within the household, without collecting any information regarding additional aspects of dog ownership, dog walking, or canine characteristics. Factors such as dog-walking patterns and strength of human–dog attachment have previously been found to influence the effect of dog ownership on human health outcomes (Payne, Bennett, & McGreevy, 2015; Westgarth, Knuiman, & Christian, 2016). Finally, we used self-reported questions to assess mental health. It is possible that some participants suffered from undiagnosed mental illness or did not consider conditions such as stress or panic attacks as "an illness, disability or infirmity." As a result, the long-standing mental illness outcome may underestimate the true number of participants suffering from psychological distress, thereby partially explaining the inverse association between dog ownership and long-standing mental illness compared to the weak, positive association with psychological distress.

In conclusion, our findings indicate the relationship between dog ownership and mental health is complex when examining short-term psychological distress and long-standing mental illness. Assuming the associations we observed reflect causal relationships, to some degree our study also suggests the health effects of owning a dog may vary, dependent on owners' marital status. Further investigation is warranted, especially longitudinal studies that measure multiple aspects of dog ownership.

Conflicts of Interest

ES (the lead), LP, PMcG, AB, and KE are members of the Dog Ownership and Human Health Node at Charles Perkins Centre (University of Sydney) that has received in-kind support by Animal Medicines Australia for relevant work outside the submitted work. None of the remaining authors report a conflict of interest.

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