Dog Ownership May Promote Cardiac Health in U.S. Military Veterans: Results from the National Health and Resilience in Veterans Study

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Abstract

Dog ownership has been associated with reduced cardiovascular and all-cause mortality in epidemiological samples. U.S. miliary Veterans exhibit elevated rates of cardiovascular disease. Associations between dog ownership and cardiovascular disease were examined in the National Health and Resilience in Veterans Study (NHRVS) which surveys nationally representative samples of U.S. military Veterans. Dog ownership data were obtained from 3078 Veterans and cross-tabulated with self-reported cardiovascular disease and risk factors. Adjustments were made for age, gender, trauma load, posttraumatic stress disorder (PTSD), major depressive disorder (MDD), alcohol/substance use, and exercise. Relative to non-owners, dog owners (39.2% of sample) were younger, more likely to meet criteria for PTSD and/or MDD, and to report more exercise. Dog ownership was associated with lower adjusted odds of hypertension and dyslipidemia. Dog ownership interacted with exercise to lower odds of self-reported heart disease by 33% and mitigated an effect of trauma load on hypertension. Conversely, the lowering of odds for diabetes and stroke in young and middle-aged Veterans reversed sign in older Veterans. Finally, dog ownership doubled the risk for stroke in Veterans who smoked. Increased physical activity remains the most likely factor accounting for these results, though potentially adverse interactions with aging and concurrent medical conditions call for additional investigation.

Introduction

There is mounting evidence that individuals diagnosed with posttraumatic stress disorder (PTSD), major depressive disorder (MDD), and/or who are exposed to trauma have an elevated prevalence of cardiovascular disease CVD; [1,2–10], as well as associated risk factors for CVD [11–19]. Twin studies have suggested that shared consequences of early childhood adversity may underlie this association [20,21], and studies using animal models have begun to examine candidate mechanisms [22–26]. Studies have also begun to address the possibility that dog ownership may provide an adjunctive, non-pharmacologic avenue of primary and secondary prevention of CVD by promoting physical activity [27–31] and mitigating loneliness [32,33]. Using Sweden's Register of the Total Population, Mubanga and colleagues [34] crossed the records of all persons aged between 40 and 80 in 2001 with a registry of all dogs owned at that time. After adjusting for multiple covariates in a sample of 3,432,153, and assuming a dog lifespan of 10 years, they found strong support for the possibility that dog ownership was associated with reduced CVD-related mortality (acute myocardial infarction + heart failure + ischemic stroke + hemorrhagic stroke; hazard ratio = 0.77) over a 12-year follow-up period. Risk reductions were larger in persons registered as living alone. In a follow-up study, Mubanga et al [35] found a similar pattern of risk reduction of a large sample of persons (n = 181,696) followed for 12 years after a first myocardial infarction. Kramer et al [36] have reviewed additional smaller studies yielding similar results. The current study examined whether benefits of dog ownership on CVD morbidity and risk extend to U.S. military Veterans, a population that is substantially older than their civilian counterparts [37] with elevated rates of PTSD, MDD, and CVD [38].

Methods

These secondary analyses of de-identified data were conducted as "not human subjects research" in accordance with the "Common Rule" as stipulated by the Institutional Review Board of the VA Connecticut Health Care System. Data were drawn from the 2019–2020 National Health and Resilience in Veterans Study (NHRVS) which surveyed a nationally representative sample of U.S. military Veterans. Inaugurated in 2011, the NHVRS has recruited three independent cohorts of U.S. Veterans from the KnowledgePanel survey research panel of more than 50,000 U.S. households. KnowledgePanel sampling implements multiple strategies to minimize bias, including the use of unlisted telephone numbers and conventional mail, inclusion of households without internet access (who are then provided with the necessary devices), and exclusion of uninvited participants. Post-stratification weights were computed in accordance with the distribution of Veterans in the 2019 Veterans Supplement of the U.S. Census Current Population Survey. The data gathered to date have assessed Veterans' physical, psychological, and social health, with foci on suicidality, aging, resilience/posttraumatic growth, genetics/epigenetics, and topics of special interest to Veterans such as that of the present paper [39].

In the third and most recent NHRVS cohort, a total of 4,069 Veterans completed Wave 1 (median completion date: 11/21/2019) and 3,078 (75.6%) completed Wave 2 (median completion date: 11/14/2020). A total 9.7% percent of the Wave 2 sample was female and the mean age was 62.6 years (SD = 15.4, range = 23–100). The following brief pet ownership-related questionnaire were added in Wave 2 and embedded among questions regarding mental health outcomes cf. [40].

Do you own a dog or cat? Yes No

If Yes, then administer the following questions:

Dog: Yes No
Cat: Yes No

1. Do you spend time each day playing with or exercising your pet?
Never Sometimes Often Almost Always

2. When you feel bad, do you seek your pet for comfort?
Never Sometimes Often Almost Always

3. How often do you consider your pet to be a member of your family?
Never Sometimes Often Almost Always

Endorsements of dog ownership were cross-tabulated with endorsements of health outcomes related to CVD and/or CVD risk factors. CVD measures were assessed as part of a Medical Conditions Checklist adapted from a previous population-based epidemiologic study [41] and included heart disease, heart attack, high cholesterol, hypertension, stroke, and diabetes. We adjusted for the presence/absence of PTSD using the PTSD Checklist for DSM-5 [42], for MDD, alcohol use disorder (AUD), and drug use disorder (DUD) using a modified self-report versions of the MINI Neuropsychiatric Interview [43], and for nicotine use disorder (NUD) using the Fagerström Test for Nicotine Dependence [44]. Psychiatric disorder variables were grouped and dichotomized as follows: PTSD and/or MDD vs. neither, and AUD and/or DUD vs. neither.

Cumulative lifetime trauma load was estimated by summing the number of potentially traumatic direct and indirect exposures endorsed on the Life Events Checklist for DSM-5 [45]. Physical exercise engagement was assessed using the Godin Leisure-Time Exercise Questionnaire [46] which assesses typical weekly frequency of engagement in strenuous, moderate, and mild/light exercise. Higher scores indicate greater engagement in physical exercise. Complete data for all study variables were available for 3,061 Veterans.

Data analyses were conducted using SPSS v27 and proceeded in three steps. First, we computed chi-square analyses to compare the prevalence of CVD and CVD risk factors by dog ownership status. Second, we conducted a series of binary logistic regressions to examine the effect of dog ownership status on odds of CVD and CVD risk factors. Age, gender, traumas, lifetime PTSD/MDD, AUD/DUD, and NUD, and exercise level were adjusted for in these analyses. Third, to test for the possible role of dog ownership in moderating the effects of these variables in relation to CVD and CVD risk factors, we incorporated interaction terms of dog ownership status and all of the control variables into the regression models.

Results

Dog ownership was endorsed by 1,106 Veterans (39.2%) and denied by 1,955 Veterans (60.8%). Relative to non-dog owners, dog owners were younger (57.7 vs. 65.8 years, respectively, $t(3053) = 14.6$, $p < 0.001$), more likely to be female (51.5% vs. 37.9%, $\chi^2(1) = 20.88$, $p < 0.001$), and reported a greater number of potentially traumatic events (10.3 vs. 8.2, $t(3053) = 6.82$, $p < 0.001$). They were also more likely to screen positive for lifetime PTSD/MDD (30.0% vs. 18.9%, $\chi^2(1) = 45.76$, $p < 0.001$); AUD/DUD (45.8% vs. 41.7%, $\chi^2(1) = 4.99$, $p = 0.025$); and NUD (18.4% vs. 15.4%, $\chi^2(1) = 4.52$, $p = 0.033$), and reported more physical exercise (36.0 vs. 29.9, $t(3053) = 4.98$, $p < 0.001$). They did not differ with respect to BMI (29.4 vs. 29.1, $t(3053) = 1.71$, $p = 0.087$).

Insert Tables 1 and 2 **and** Figs. 1 and 2 **about here.**

Table 1
Prevalence of cardiovascular disease-relevant measures by dog ownership status

	No Dog Ownership N = 1,955 (60.8%)	**Dog Ownership N = 1,106 (39.2%)**	**Test of Difference**
	N (weighted %)	N (weighted %)	
Heart disease***	338 (14.4%)	138 (9.5%)	15.95, < 0.001
Heart attack	155 (6.8%)	83 (6.0%)	0.87, = 0.35
Stroke	94 (4.2%)	46 (3.6%)	0.58, = 0.44
Hypertension***	1,114 (54.4%)	531 (41.5%)	48.18, < 0.001
Diabetes**	458 (20.8%)	216 (16.0%)	10.59, = 0.001
High cholesterol***	1,043 (49.1%)	488 (38.6%)	32.24, < 0.001
Note. Significant association: **p < 0.01; ***p < 0.001.			

Table 2. Results of logistic regression models examining association between dog ownership and cardiovascular disease-relevant measures

	Heart Disease	Heart Attack	Stroke	Hypertension	Diabetes	High Cholesterol
Dog ownership	0.96 (0.74-1.24)	1.28 (0.92-1.79)	1.37 (0.90-2.07)	0.84* (0.71-0.99)	0.93 (0.75-1.16)	0.79** (0.67-0.93)
Age	1.06*** (1.05-1.07)	1.06*** (1.04-1.08)	1.04*** (1.02-1.06)	1.04*** (1.04-1.05)	1.04*** (1.03-1.05)	1.03*** (1.02-1.04)
Male gender	2.41* (1.13-5.15)	5.80* (1.30-25.83)	1.97 (0.64-6.02)	1.48* (1.09-2.00)	0.94 (0.62-1.43)	1.26 (0.93-1.70)
Traumas	1.02** (1.01-1.04)	1.03*** (1.02-1.05)	0.99 (0.97-1.02)	1.02** (1.01-1.03)	1.02*** (1.01-1.04)	1.02** (1.01-1.03)
Lifetime PTSD or MDD	1.04 (0.74-1.45)	1.32 (0.87-2.000	1.12 (0.66-1.91)	0.94 (0.76-1.16)	0.98 (0.75-1.29)	1.03 (0.84-1.27)
Lifetime AUD or DUD	0.86 (0.67-1.11)	0.85 (0.61-1.18)	1.29 0.85-1.95)	1.10 (0.93-1.31)	1.03 (0.84-1.27)	0.87 (0.73-1.03)
Lifetime NUD	1.90*** (1.43-2.53)	1.88** (1.31-2.70)	1.55 (0.98-2.46)	1.42** (1.14-1.77)	1.46** (1.14-1.88)	1.33* (1.07-1.64)
Exercise level	0.83* (0.70-0.99)	0.84 (0.67-1.05)	0.68* (0.49-0.96)	0.98 (0.90-1.06)	0.60*** (0.51-0.71)	0.87** (0.79-0.95)

Note. Significant association: *p<0.05; **p<0.01; ***p<0.001.

As shown in Table 1, the unadjusted prevalence of CVD-related conditions differed by dog ownership. Relative to non-dog owners, dog owners had a lower prevalence of heart disease, hypertension, diabetes, and high cholesterol. As shown in Table 2, after adjustment for all covariates, dog ownership was associated with significantly lower odds of hypertension (16% lower odds) and high cholesterol (21% lower odds). Several significant interactions were observed, with some suggesting that dog ownership was associated with risk reduction and others suggesting risk increases. Specifically, dog ownership and exercise level interacted constructively such that among Veterans with greater engagement in exercise, dog owners had lower probability of heart disease relative to non-dog owners (OR = 0.67, 95%CI = 0.45–0.98; Fig. 1). Among Veterans with high trauma load, dog owners had a significantly lower probability of hypertension than non-dog owners (OR = 0.97, 95%CI = 0.96–0.99; Fig. 2).

Significant age by dog ownership interactions were observed for diabetes (OR = 1.03, 95%CI = 1.01–1.04; Fig. 3) and for stroke (OR = 1.05, 1.01–1.08; Fig. 4), with dog ownership associated with lower probability of these diagnoses in young and middle-aged Veterans but greater probability in older Veterans. Finally,

while dog ownership appeared protective against the endorsement of stroke in those without NUD, the opposite was observed in those with NUD (OR = 2.57, 95%CI = 1.02–6.23; See Fig. 5).

Insert Figs. 3–5 **about here.**

Discussion

The results of this nationally representative study of U.S. military Veterans suggest that dog ownership may is associated with lower odds of hypertension and high cholesterol in this population. Dog ownership also interacted with elevated habitual exercise to yield a nearly 30% reduction in the likelihood of self-reported heart disease. The source of the constructive interaction is difficult to further resolve without more precise estimates of exercise levels. For example, Zhou et al [47] recently observed a curvilinear relationship between an estimate of total daily activity, including commuting- and work-related activity, and CVD incidence in a large sample of hypertensive adults. Mixed exercise has been promoted by the American Heart Association as reducing CVD risk [48], but without a comprehensive tally of exercise types from participants, we can only speculate that the addition of dog walking may have yielded a mixed exercise program in this sample. It is interesting in this regard that Mubanga et al (2017) found that ownership of "hounds" conferred the CVD greatest risk reduction in their sample, while Pickup et al [49] found that "gundogs" were the breed group most frequently walked in their sample of more than 12,000 pet dogs. The extension of the interaction observed here into the most active category suggests that the benefits associated with dog ownership were not limited to increased walking. A testable hypothesis is that the increased walking associated with dog ownership may function as a gateway to more strenuous exercise conferring additional protection against CVD.

Dog-ownership also moderated the association between trauma load and self-reported hypertension, rendering it slightly negative. Associations between both trauma and PTSD and hypertension have been observed in both cross-sectional and longitudinal studies [17,18,41,50–52]; however, the largest study to date, a trans-ethnic meta-analysis of more than 70,000 participants that included genetic markers of risk found only small associations between PTSD symptomology and blood pressure. Moreover, these associations differed directionally over different cohorts and for systolic versus diastolic pressures [53]. Further research is necessary to disentangle mechanisms underlying the association between cumulative trauma load, dog ownership, and hypertension risk.

In additional to the apparent benefits noted above, conditional risk increases were observed in association with dog ownership. As expected, the probability of self-reported diagnoses of both diabetes and stroke increased with age, but while dog ownership was associated with lower likelihood of both disorders through mid-life, these effects reversed in the eighth and ninth decades, respectively. Laine et al [54] also observed higher odds of diabetes in a sample of older males (but not females) who owned dogs compared to those who did not. Alarmingly, dog ownership interacted with NUD to increase the risk of stroke independent of age. It is possible that both advanced age and nicotine use operate to nullify the relationship between dog ownership and physical activity. Mobility declines in advanced age due to the

normal accumulation of musculoskeletal injuries and diseases [55]. As well, smokers are less active than non-smokers [56,57]. However, if the activity-related benefits of dog ownership are gated by advanced age and smoking, they should disappear under those conditions but not augment risk. Intensive investigation of the lifestyles and family circumstances of the respondents in their eighth and ninth decades could reveal factors interacting with dog ownership to influence risk for diabetes and stroke. As regards the alarming doubling of self-reported stroke incidence in dog owners who smoked, we may need to consider whether increased activity could interact with smoking to adversely impact cardiac health in an older sample. While such an interaction appears unlikely, the large literature addressing lifestyle factors and stroke is generally silent on interactions between exercise and smoking, though their respective main effects are well established [58,59]. Such an interaction could involve a third mediating condition, such as atrial fibrillation, which can be triggered by both exercise and smoking, and is a potent risk factor for stroke [60]. Assessment of conditions possibly potentiated by adverse interactions of exercise and smoking should be included in future surveys addressing the cardiovascular benefits of dog ownership. Researchers should also remain alert to the possibility that non-obvious consequences or covariates of dog ownership could interact with smoking to increase the incidence of stroke.

The cross-sectional study design of this study cannot rule out the possibility that an advantageous cardiac risk profile characterizes those who elect to obtain dogs, rather than resulting from dog ownership itself. Analyses of cardiac risk profiles among those who acquired dogs since the last wave of the NHVRS, a period during which many people acquired dogs to mitigate the social impacts of the COVID-19 pandemic, may shed more light on the possibility that dog ownership could play a causative role in CVD risk reduction.

Declarations

Author Contributions

S. H. W. contributed to the design of the study, to the analysis and interpretation of the results, and to the writing of the manuscript.

S. R. B. contributed to the analysis and interpretation of the results and to the writing of the manuscript.

R. H. P. contributed to the design of the study, to the analysis and interpretation of the results, and to the writing of the manuscript.

Data Availability

The data that support the findings of this study are available on request from R. H. P. The data are not publicly available due to privacy or ethical restrictions.

Competing Interests Statement

The authors have no competing interests to declare.

Ethics Statement

These secondary analyses of de-identified data were conducted as "not human subjects research" in accordance with the "Common Rule" as stipulated by the Institutional Review Board of the VA Connecticut Health Care System.

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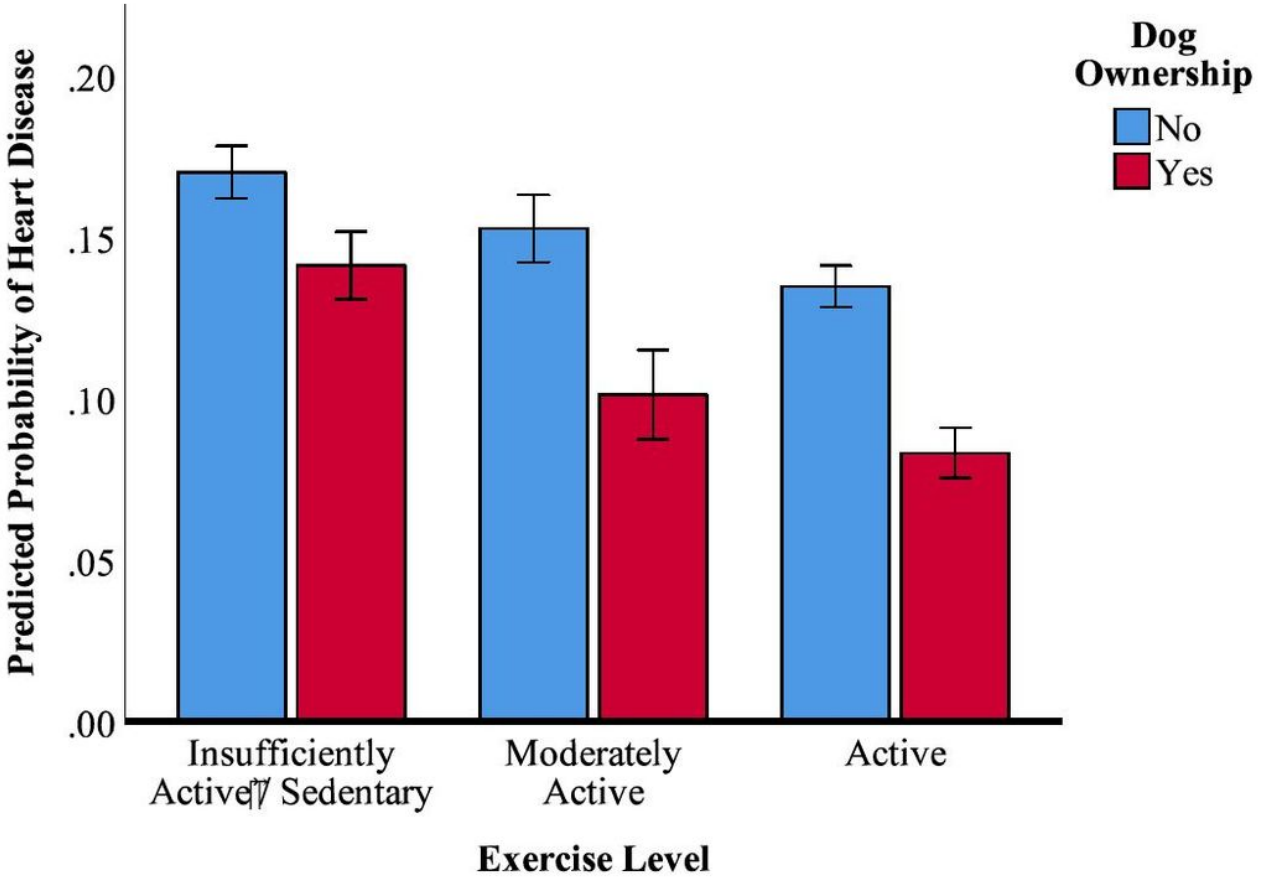
Figures



Note. Error bars represent 95% confidence intervals.

Figure 1

Plot of the interaction of dog ownership and exercise level on the odds of endorsement of heart disease.

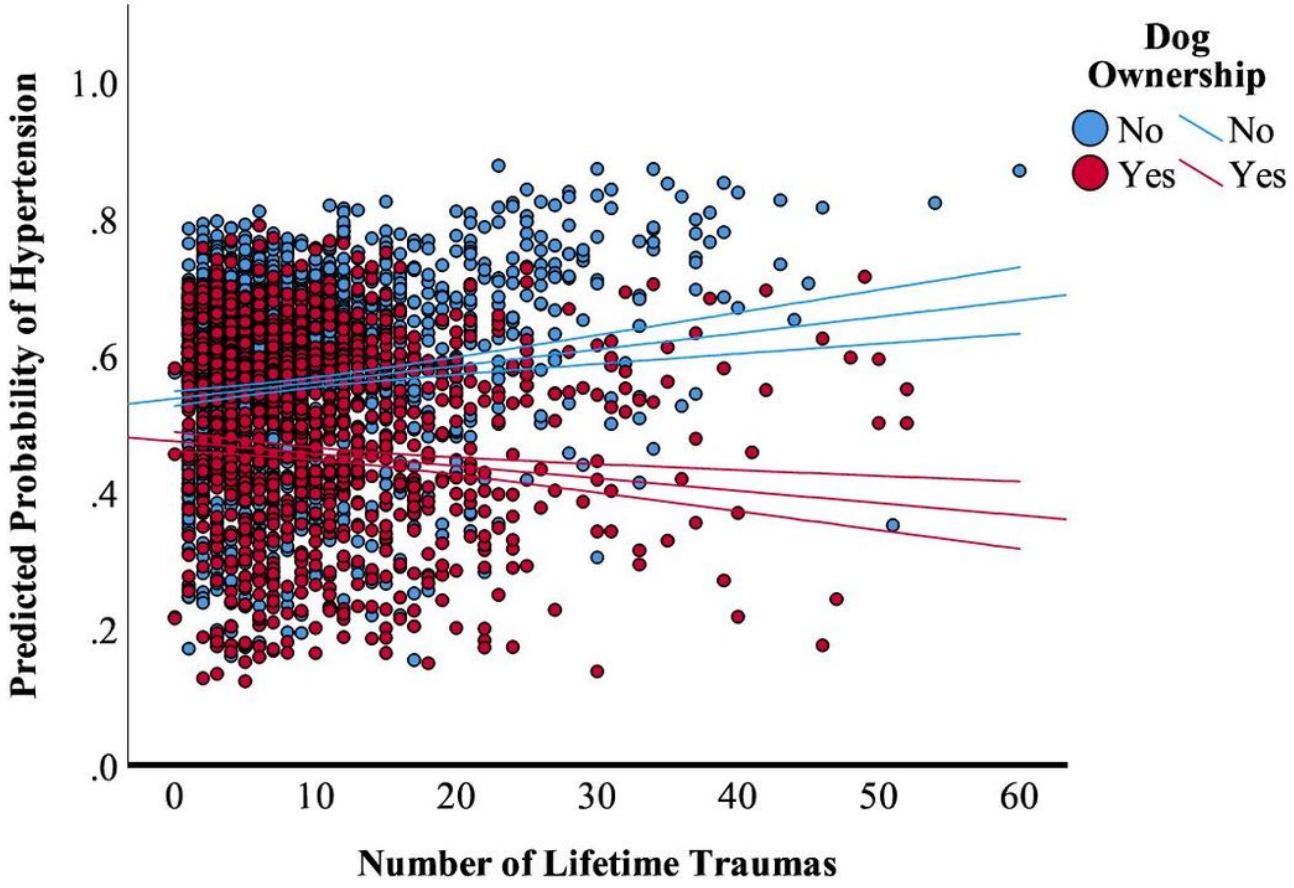
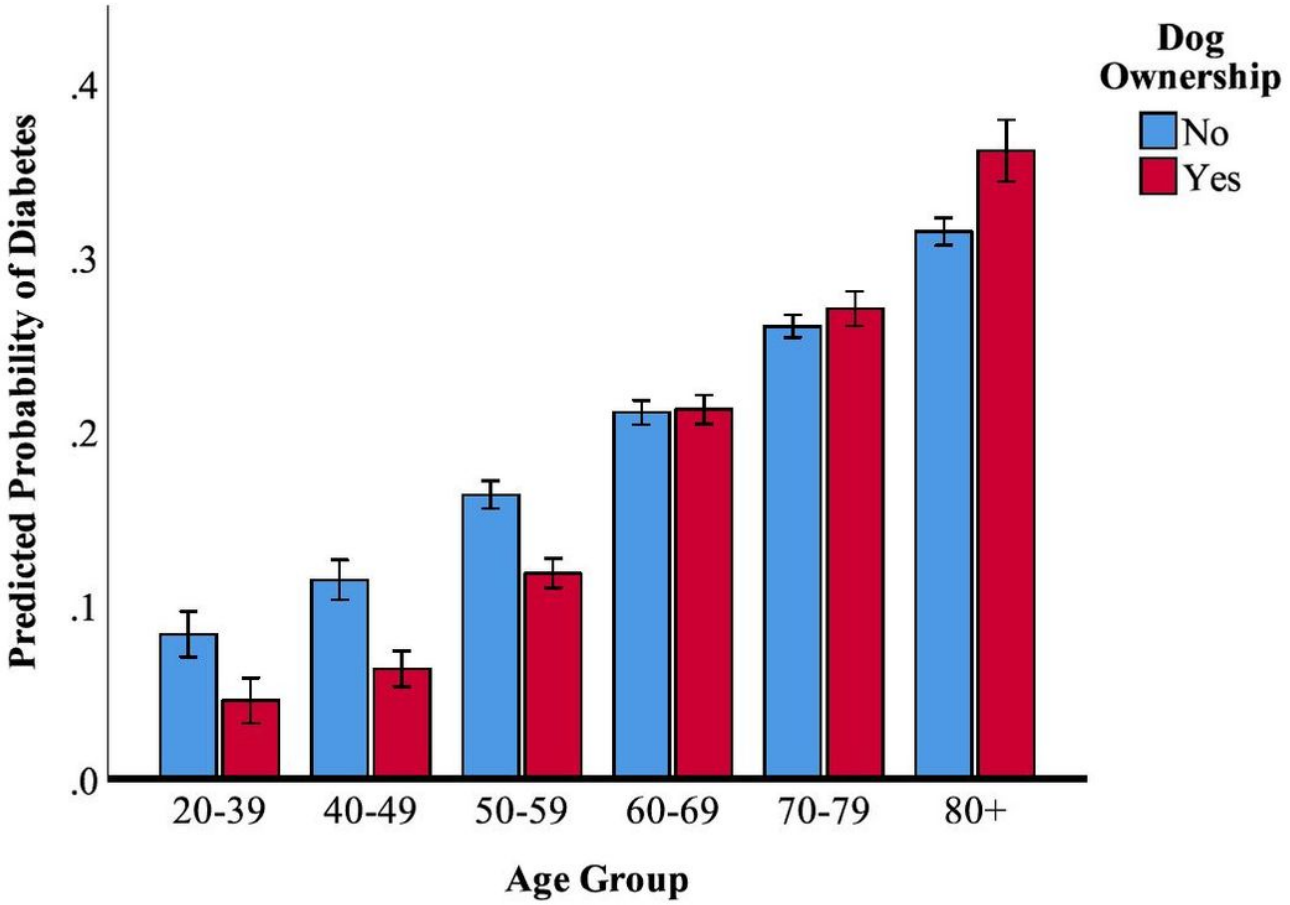


Figure 2

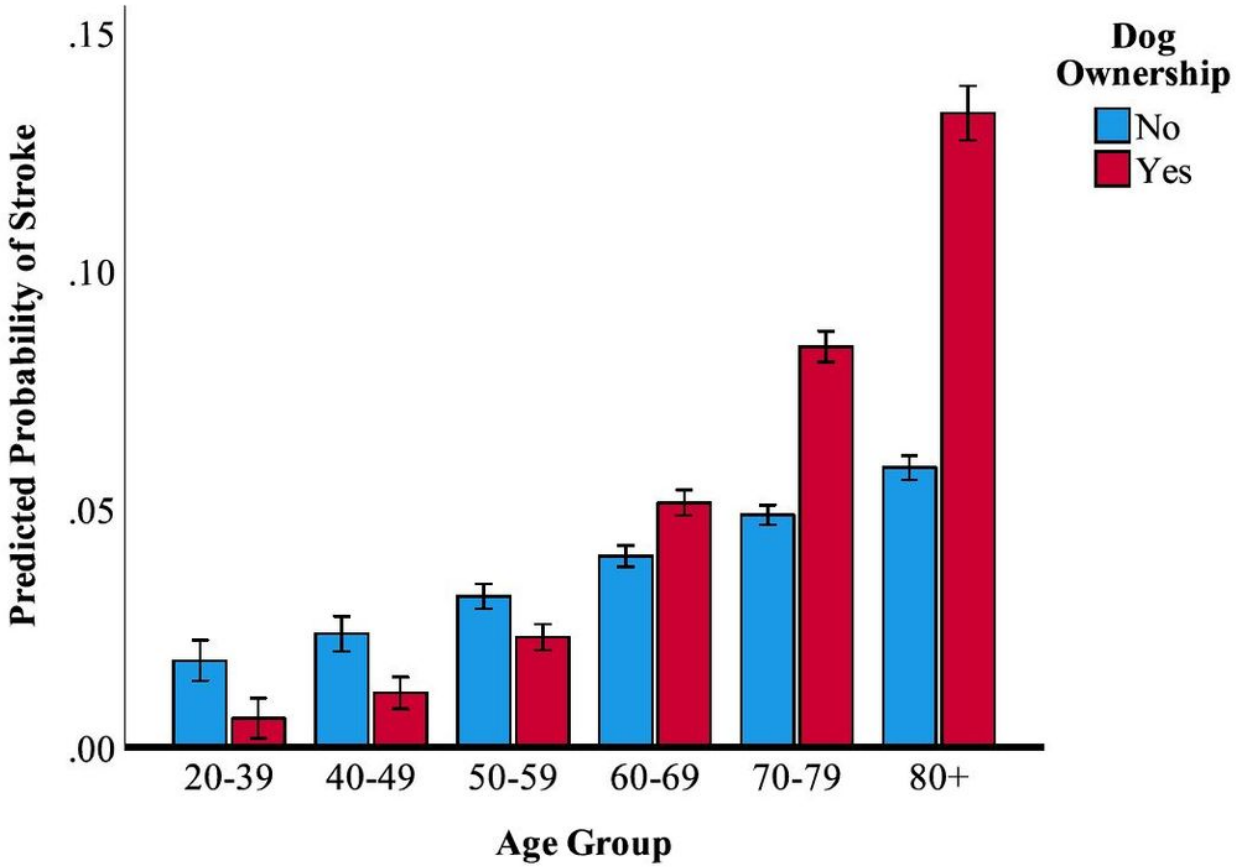
Plot of the interaction of dog ownership and trauma load on the odds of endorsement of hypertension.



Note. Error bars represent 95% confidence intervals.

Figure 3

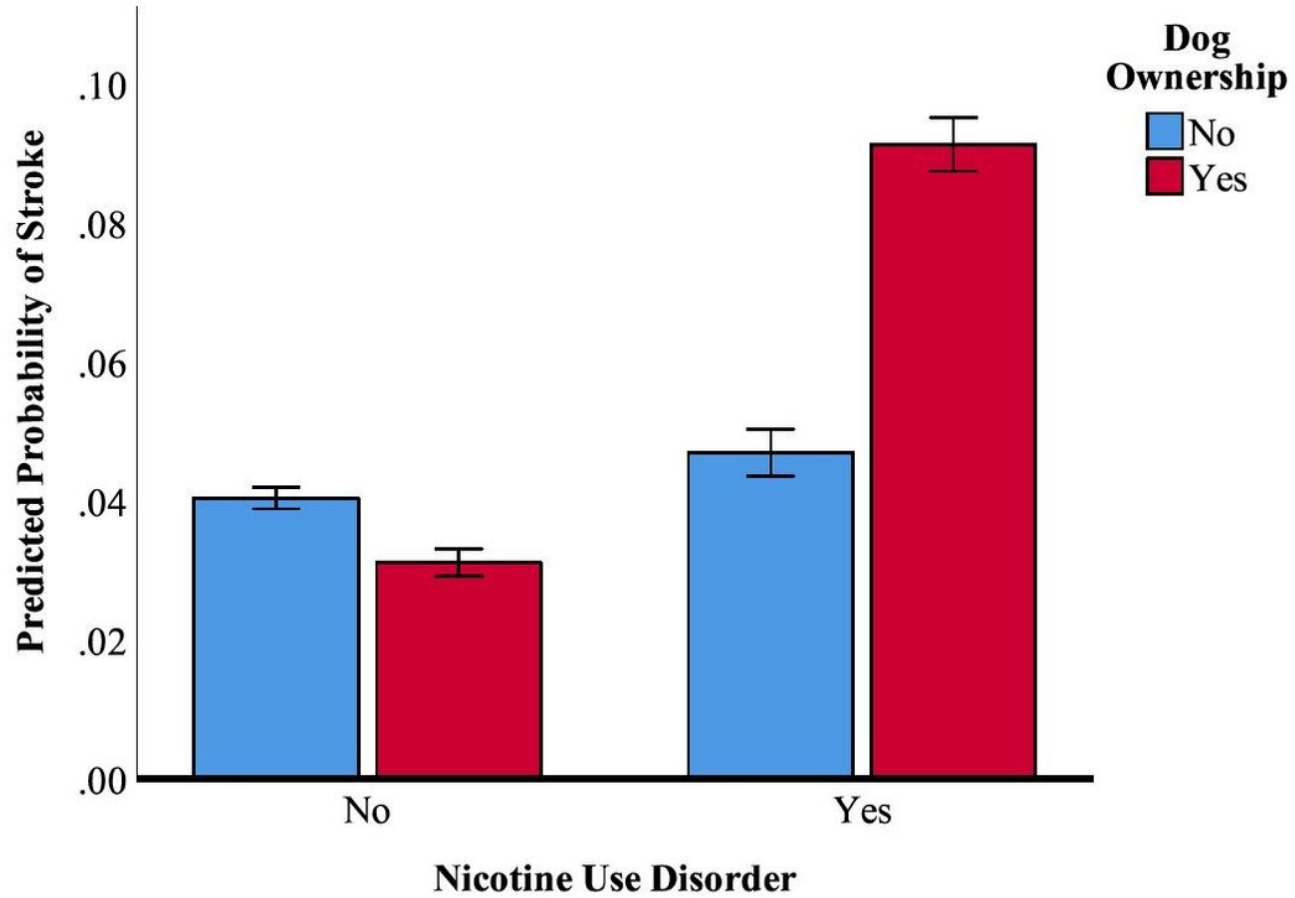
Plot of the interaction of dog ownership and age on the odds of endorsement of diabetes.



Note. Error bars represent 95% confidence intervals.

Figure 4

Plot of the interaction of dog ownership and age on the odds of endorsement of stroke.



Note. Error bars represent 95% confidence intervals.

Figure 5

Plot of the interaction of dog ownership and nicotine use disorder on the odds of endorsement of stroke.