Pet Ownership and Cardiovascular Risk : A Scientific Statement From the American Heart Association

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AHA Scientific Statement

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A Scientific Statement From the American Heart Association

Endorsed by the American Association of Cardiovascular and Pulmonary Rehabilitation, American Society of Hypertension, American Society for Preventive Cardiology, National Heart Foundation of Australia, Preventive Cardiovascular Nurses Association, and World Heart Federation

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Cardiovascular disease (CVD) is the leading cause of death in the United States.[1] Despite efforts promoting primary and secondary CVD prevention,[2–8] obesity and physical inactivity remain at epidemic proportions, with >60% of Americans adults overweight or obese and >50% not performing recommended levels of physical activity.[9] Similarly, hypertension, hypercholesterolemia, and other CVD risk factors remain poorly controlled in many Americans. Despite numerous pharmacological and device-based advances in the management of patients with established CVD, morbidity and mortality associated with this condition remain substantial. Hence, a critical need exists for novel strategies and interventions that can potentially reduce the risk of CVD and its attendant morbidity and mortality.

Numerous studies have explored the relationship between pet (primarily dog or cat) ownership and CVD, with many reporting beneficial effects, including increased physical activity, favorable lipid profiles, lower systemic blood pressure, improved autonomic tone, diminished sympathetic responses to stress, and improved survival after an acute coronary syndrome. Accordingly, the potential cardiovascular benefits of pet ownership have received considerable lay press and medical media coverage and attention from the Centers for Disease Control and Prevention[10] and have been the focus of a meeting sponsored by the National Institutes of Health.[11] The purpose of this American Heart Association Scientific Statement is to critically assess the data regarding the influence of pet ownership on the presence and reduction of CVD risk factors and CVD risk.

Pet Ownership and Systemic Hypertension

Some, but not all, studies of pet ownership and systemic blood pressure have found an association between pet ownership and lower blood pressure. An Australian study of 5741 participants attending a free screening clinic found that pet owners had significantly (P=0.03) lower systolic blood pressures than pet nonowners despite similar body mass index (BMI) and socioeconomic profiles.[12] In a study of 240 married couples with or without pets, both systolic and diastolic blood pressures were significantly (P<0.01) lower in participants with a pet (dog or cat) than in those without a pet (Allen et al[13] and personal communication from Karen Allen on P values, August 12, 2012). An online electronic survey of dog owners (n=536) and nonowners (n=380) found a greater adjusted odds ratio (OR) of self-reported hypertension in nonowners (OR, 1.71; 95% confidence interval [CI], 1.03–2.83).[14] A study of 1179 subjects found that pet owners had lower systolic blood pressure (132.8 versus 139.5 mm Hg), pulse pressure (55.5 versus 63.9 mm Hg), and mean arterial pressure (105.0 versus 107.6 mm Hg) than nonowners and a lower incidence of hypertension (OR, 0.62; 95% CI, 0.49–0.80); however, after adjustment for age and other confounders, pet ownership was no longer associated with a lower blood pressure or incidence of hypertension.[15] A community survey of 5079 middle-aged adults found pet

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owners and nonowners had similar systolic blood pressures, and those with pets had slightly higher diastolic blood pressures.[16]

The only randomized data on pet ownership and blood pressure come from a presented[17] but unpublished study of 30 participants with borderline hypertension who were randomized either to adopt a dog from a shelter or to defer adoption of a dog. Ambulatory resting systolic blood pressure was similar in both groups at baseline (before dog adoption or deferred adoption). Ambulatory blood pressure monitoring 2 and 5 months after dog adoption demonstrated significantly (P<0.001) lower systolic blood pressures in the dog-adoption group than in the deferred-adoption group. Interestingly, at later follow-up, after all study participants had adopted dogs, systolic blood pressure was found to be similarly lowered in the deferred-adoption group as well.

Pet Ownership and Hyperlipidemia

There are minimal data on the association of pet ownership and lipid levels. In a study of 5741 participants attending a free screening clinic, male (but not female) dog owners had significantly but clinically modestly lower total cholesterol (201 versus 206 mg/dL; P=0.02) and triglyceride (108 versus 125 mg/dL; P=0.01) levels than nonowners of dogs.[12] In a small (n=32) cross-sectional study of adults ≥60 years of age, pet owners had significantly lower triglyceride levels than pet nonowners (109 versus 192 mg/dL; P<0.01).[18]

In a cross-sectional online survey (n=916), dog nonowners were more likely to report elevated serum cholesterol levels and diabetes mellitus than dog owners who regularly walked their dogs.[14] These findings persisted after controlling for owner's age and intensity of physical activity but not after also controlling for BMI. In addition, tobacco use was more common among dog nonowners than dog owners.[14]

Pet Ownership and Physical Activity

Of all pets, dogs appear most likely to positively influence the level of human physical activity. Cross-sectional studies show that dog owners engage in more physical activity and walking and are more likely to achieve the recommended level of physical activity than nonowners of dogs.[18–38] For example, data from an online survey of 5253 Japanese adults revealed that after controlling for age, sex, and socioeconomic status, dog owners engaged in significantly more walking and physical activity than nonowners and were 54% more likely to obtain the recommended level of physical activity.[25] Similarly, an Australian study that controlled for sociodemographic, neighborhood, social environmental, and intrapersonal factors reported that dog owners engaged in significantly more minutes per week of physical activity (322.4 versus. 267.1, P<0.001) and walking (150.3 versus 110.9, P<0.001) and were 57% more likely to meet the recommended level of physical activity than nonowners.[27] A Canadian study (n=351) found that dog owners walked an average of 300 minutes per week compared with 168 minutes per week for nonowners (P<0.01), with the obligation to care for one's dog being the key mediator of this association.[28] After controlling for sociodemographic, health, and housing characteristics, the California Health Interview Survey found that dog owners walked 18.9 minutes more per week than pet nonowners.[30] Some,[23,32,33] but not all,[39] studies of adolescents and children found a relationship between the presence of a family dog and physical activity. A meta-analysis of 11 studies found that dog owners walked significantly more and were more physically active than nonowners, with the differences between the 2 groups being small to moderate.[40]

Not surprisingly, dog owners who walk their dogs are more likely to achieve the recommended level of physical activity than dog owners who do not walk their dogs.[25,26,41–44] Unfortunately, a significant proportion of dog owners do not regularly walk their dogs.[25,27,31,36,43,45] No significant associations have been reported between physical activity and cat or other types of pet ownership.[18,25,26,30,38,39,46]

Several studies have assessed changes in physical activity after acquisition of a pet. A prospective cohort study of people who adopted either a dog or a cat from an animal shelter found a marked and sustained increase in the number and duration of recreational walks among those who adopted a dog but no or little change among those who adopted a cat or no pet (Figure 1).[46] Similarly, a longitudinal study of Western Australians taking part in the Residential Environments (RESIDE) project found that self-reported recreational walking increased 22 to 31 minutes per week among those who acquired a dog.[47] The primary mechanism through which acquisition of a dog leads to an increase in physical activity is believed to be behavioral intention (via the dog's positive effect on the owner's cognitive beliefs about walking), as well as motivation and social support for walking.[47,48]

Pet Ownership and Obesity

Participation in physical activity jointly by pets and humans is one mechanism whereby pet ownership may reduce obesity. The other important role that pets play in human health is social support, which is one of the most powerful predictors of adoption and maintenance of behavior change,[49] including weight loss.[50,51] Companion animals may strengthen engagement in a weight loss program by providing encouragement and motivation and reducing perceived barriers (ie, concerns about neighborhood safety) that hinder exercise.[52,53] Accordingly, numerous studies have examined whether pet ownership is associated with a lower incidence of obesity and whether pet ownership enhances weight loss programs among obese people.

Observational studies that have examined how weight status varies among households with and without pets have yielded conflicting results, in part because of differing patient populations, types of pet studied, and human-pet interactions (ie, animal walking versus ownership). "Low-quality" observational studies (ie, nonrandom subject sampling, no adjustment for confounding factors) comparing pet owners and nonowners have found similar[12,15] or higher[54] BMI for pet owners. Similarly, an analysis of National Health and Nutrition Examination Study (NHANES) III data showed no difference in the incidence of being overweight (BMI >25 kg/m^2) between pet nonowners (56%), dog owners (53%), and other pet owners (58%; P=0.09).[34]

In contrast, dog walking, as opposed to pet or dog ownership, does appear to be associated with a lower incidence

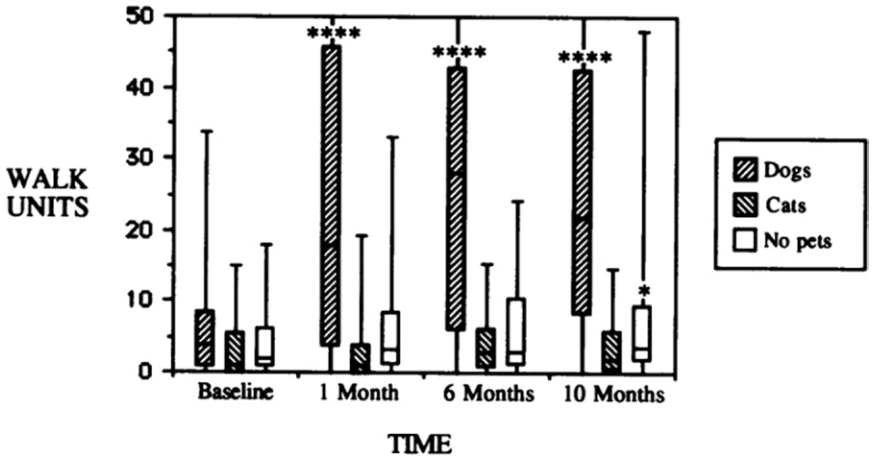

Figure 1. Changes over time in the units of recreational walks in people adopting a dog or cat from an animal shelter or not adopting a pet. Walk "units" represent a combination of the number and length of recreational walks taken during the prior fortnight. Results are displayed for baseline and at 1-, 6-, and 10-month follow-up. Median, upper and lower quartiles, and maximum and minimum scores are shown. *P<0.05; ****P<0.0001. Reproduced from Serpell et al[46] with permission of SAGE Publications Ltd; all rights reserved. Copyright © 1991, J. Serpell.

of obesity. An observational epidemiological study[44] of 2199 subjects noted significantly fewer obese (BMI >30 kg/m^2) dog walkers (17%) compared with both owners who did not walk their dogs (28%) and nonowners (22%). In this study, dog walking was associated with a higher proportion of participants who met national recommendations for moderate to vigorous physical activity (53%) compared with those who had owned but did not walk their dog (33%) and dog nonowners (46%).[44] Similar results were noted in a recent study showing that individuals who did not own a dog had nearly a 2-fold greater odds (OR, 1.92; 95% CI, 1.45–2.56) of being overweight (BMI >25 kg/m^2), whereas those who did not walk their dog had a 60% higher odds (OR, 1.58; 95% CI, 1.07–2.33) of being overweight compared with dog walkers.[14] In one study of younger children, the odds of being overweight or obese were lower among those whose family owned a dog than among families without a dog (OR, 0.5; 95% CI, 0.3–0.8).[55]

Whether people walking with their dogs would lose more weight after 1 year than people walking alone was assessed in the People and Pets Exercising Together (PPET) Study.[56] Thirty-six pairs of overweight or obese people with an obese pet and 56 overweight or obese people without pets participated in a 1-year prospective, controlled weight loss study in which people received dietary and physical activity counseling and dogs were fed a calorie-controlled prescription diet. Both people and their pets successfully lost weight; however, obese pet owners had similar weight loss as those without pets (4.7% versus 5.2%, respectively; *P*=NS).

Pet Ownership and Autonomic Function and Cardiovascular Reactivity

A positive or beneficial relationship between pet ownership and autonomic function or cardiovascular reactivity to stress has been reported in most[13,57–69] but not all[69–72] published studies. For example, cardiovascular reactivity to stress (ie, mental arithmetic and cold pressor) was assessed in 240 couples, half of whom owned a cat or dog. People with pets had significantly lower resting baseline heart rates and blood pressure, significantly smaller increases in heart rate and blood pressure in response to stress, and faster recovery of these parameters to baseline after cessation of stress. Reactivity to stress was lowest and recovery fastest in couples tested when their pet was present.[13]

One published randomized study on pet ownership and cardiovascular reactivity was identified. As part of a study of blood pressure response to mental stress, 48 hypertensive patients with a high-stress occupation who were interested in stress reduction and had agreed to acquire a pet if chosen to do so were randomized to acquire or not acquire a pet.[59] Physiological responses to mental stress were assessed before pet adoption and 6 months later, with pets present for those who had adopted them. Compared with pet nonowners, those who adopted a pet had similar physiological responses to mental stress at baseline but significantly diminished increases in systolic and diastolic blood pressure, heart rate, and plasma renin activity when exposed to mental stress at 6 months (Figure 2).

Two studies measured heart rate variability with 24-hour Holter monitors to assess autonomic function.[57,58] In people with ≥1 cardiac risk factor, pet (primarily dog or cat) owners (n=82) had greater elevated parasympathetic and diminished sympathetic nervous activities than nonowners (n=109), which indicates that pet ownership (1) attenuated the imbalance in autonomic nervous activity among patients with lifestyle-related diseases and (2) was associated with greater adaptability to perturbations in the cardiovascular system.[57] Among 102 post–myocardial infarction patients, owners of pets (dogs or cats) had significantly higher heart rate variability than nonowners,[58] which has been associated with decreased cardiac mortality among such patients.[73]

Although most studies of autonomic and cardiovascular reactivity involved dogs or cats, several studies demonstrated beneficial effects on these parameters associated with goat,[60] fish,[74] chimpanzee,[61] and snake[75] ownership. One experiment even demonstrated a benefit on cardiovascular stress responses with "virtual" animals, which were presented in the form of video recordings.[76]

Pet Ownership and Survival in People Without Established CVD

There are scant data on pet ownership and survival in people without established CVD. Analysis of data from a

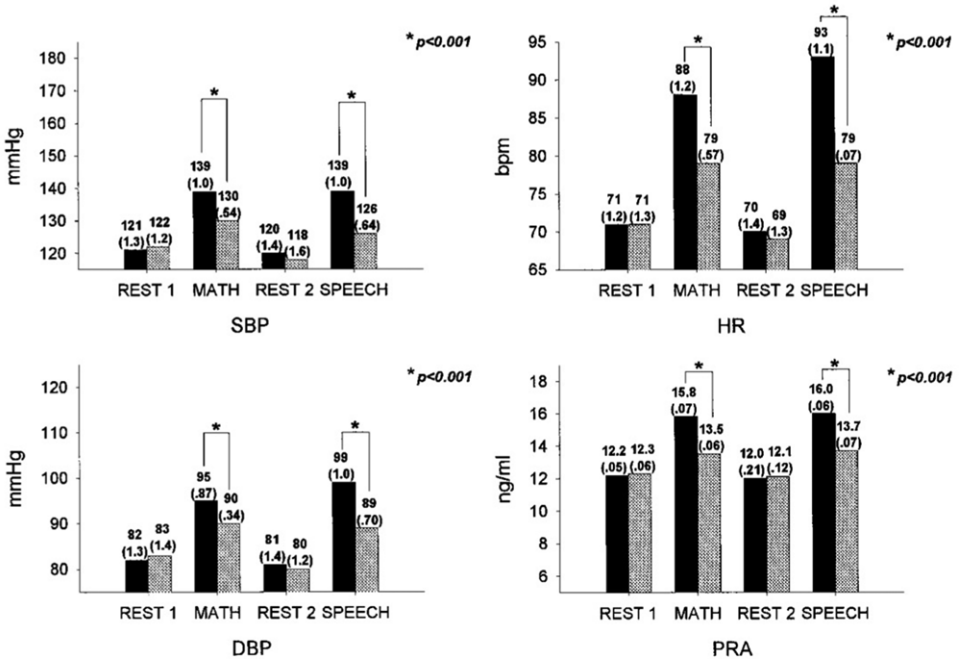

Figure 2. Physiological responses to mental stress at 6-month follow-up among those who acquired pets (gray bars) and those who did not (black bars). DBP indicates diastolic blood pressure; HR, heart rate; MATH, mental arithmetic tasks; PRA, plasma renin activity; and SBP, systolic blood pressure. Figures modified from Allen et al.[59] Copyright © 2001, American Heart Association, Inc.

large national health survey (published in an open-access journal) did not find a survival advantage associated with pet ownership.[34] Likewise, analysis of data from the NHANES II, a longitudinal cohort study, did not find pet ownership was associated with reduced overall mortality.[77]

Pet Ownership and Survival in Patients With Established CVD

Pet ownership is an important nonhuman form of social support and may provide cardioprotective benefits in patients with established CVD. In a substudy of the Cardiac Arrhythmia Suppression Trial (CAST), 1-year survival data were assessed in 369 study participants on the basis of whether or not the participant owned a pet. Overall, pet ownership of any kind tended to be independently associated with survival (P=0.085). Dog ownership was strongly associated with decreased mortality, with the likelihood of mortality being 4.05 times greater for dog nonowners than for dog owners (P<0.05); the benefit of dog ownership on survival was independent of physiological measures or the severity of CVD. Cat ownership was not found to be associated with decreased mortality or cardiac-related rehospitalization.[78]

One-year survival was prospectively assessed in 96 patients admitted to a cardiac care unit or intensive care unit with myocardial infarction or angina pectoris.[79] At 1-year follow-up, 11 (28%) of 39 pet nonowners had died compared with only 3 (6%) of 53 pet (primarily dog) owners (P=0.002); the beneficial effect of pet ownership on survival appeared to be independent of age and the physiological severity of CVD. A post hoc analysis of survivors of myocardial infarction who were followed up in the Psychosocial Responses in the Home Automated External Defibrillator Trial (PR-HAT) found that lack of pet ownership was a significant (P=0.036) predictor of mortality.[80]

In contrast to the findings in the above studies, a study of 412 patients with acute coronary syndrome found that the 1-year risk of readmission or cardiac death was not statistically different between dog owners and nonowners (OR, 1.59; 95% CI, 0.759–3.321; P=0.22) and was greater in cat owners than in nonowners (OR, 3.22; 95% CI, 1.44–7.19; P=0.004).[81]

Summary, Conclusions, and Recommendations

A summary of the most relevant studies of pet ownership and cardiovascular risk is given in Table 1. Table 2 displays the American College of Cardiology Foundation and American Heart Association scheme for the classification of recommendations and level of evidence. The writing group's conclusions and recommendations using this classification scheme are listed below.

Conclusions

- Pet ownership, particularly dog ownership, is probably associated with decreased CVD risk (*Level of Evidence: B*).
- Pet ownership, particularly dog ownership, may have some causal role in reducing CVD risk (*Level of Evidence: B*).

Recommendations

1. **Pet ownership, particularly dog ownership, may be reasonable for reduction in CVD risk *(Class IIb; Level of Evidence B)*.**
2. **Pet adoption, rescue, or purchase should not be done for the primary purpose of reducing CVD risk *(Class III; Level of Evidence C)*.**

Methodological issues in many studies of pet ownership and CVD include modest numbers of subjects, confounding factors (eg, sociodemographics, comorbid medical conditions,

Table 1. Summary of the Most Relevant Studies of Pet Ownership and Cardiovascular Risk

Reference	Study Type, Design, and Population	Primary Findings
Blood pressure and hypertension		
Anderson et al[12]	Cohort analysis of cardiac risk factors in 5741 participants (784 pet owners; 4957 nonowners) attending a free screening clinic	• Pet owners had lower SBPs than nonowners (P=0.03) despite similar BMI and socioeconomic profiles
Allen et al[13]	Prospective study of heart rate, BP, and cardioreactivity in 240 married couples, half of whom owned a pet (dog or cat)	• Pet owners had lower resting heart rates and BPs (P=0.001)
Wright et al[15]	Cohort analysis of 1179 community-dwelling men and women, aged 50 to 95 years, who owned or did not own a pet, assessing BP	• Pet owners had lower SBP, pulse pressure, and mean arterial pressure and a reduced risk of hypertension (OR, 0.62; 95% CI, 0.49–0.80) • No significant association remained after adjustment for age and other confounders
Parslow and Jorm[16]	Community survey of 5079 middle-aged pet owners and nonowners	• Pet owners and nonowners had similar SBP • Pet owners had slightly higher DBP
Allen (unpublished data and reference [17])	Randomized study assessing BP changes in 30 participants with borderline hypertension randomized either to adopt or defer adoption of a dog	• Ambulatory BP monitoring 2 and 5 months after adoption demonstrated significantly lower SBP in the dog-adoption group (P<0.001)
Physical activity		
Serpell[46]	Observational study of 97 adults comparing PA between 28 pet nonowners and 71 pet owners who recently acquired a pet (dog or cat) from an animal shelter	• Compared with nonowners and new cat owners, new dog owners increased their recreational walking significantly more over a 10-mo period (from 1 h to 5 h/wk; P<0.05)
Bauman et al[36]	Cross-sectional analysis of PA in 894 adult dog owners (45.6%) and nonowners (54.4%)	• On average, dog owners engaged in 210 min/wk of PA (95% CI, 186–228) compared with 198 min/wk (95% CI, 174–216) among nonowners • On average, dog owners walked for 120 min/wk (95% CI, 108–132) compared with 102 min/wk (95% CI, 84–108) among nonowners • No significant difference was seen in the proportion of dog owners vs nonowners achieving the recommended level of PA • Forty percent of dog owners were physically active with their dog and walked with a median frequency of 3 times/wk and median duration of 57 min/wk
Brown and Rhodes[28]	Cross-sectional study of PA in 351 randomly sampled adult dog owners (19.9%) and nonowners (80.1%)	• On average, dog owners engaged in significantly more PA than nonowners (410.3 vs 287.5 min/wk; P<0.01) • On average, dog owners walked significantly more than nonowners (300.2 vs 168.4 min/wk; P<0.01)
Thorpe et al (Health ABC Study)[26]	Cross-sectional study of PA in 2533 older (aged 70–79 years) pet owners (12.9% dog owners; 6.6% cat owners; 2.2% dog and cat owners) and pet nonowners	• Compared with nonowners, dog owners were 32% (OR, 1.32; 95% CI, 1–1.76) more likely to engage in any weekly PA • 67.9% of dog owners and 32.1% of nonowners did some nonexercise walking weekly (P<0.05) • 75.4% of dog owners and 57.8% of nonowners did some exercise walking weekly (P>0.05)
Cutt et al[27]	Cross-sectional study of PA in 1813 adult dog owners (44%) and nonowners (56%)	• On average, dog owners engaged in significantly more PA (322.4 vs 267.1 min/wk; P<0.001) and walking (150.3 vs 110.9 min/wk; P<0.001) than nonowners • After adjustment, dog owners were 57% more likely than nonowners to achieve the recommended level of PA (95% CI, 1.14–2.16) • After adjustment, dog owners were 59% more likely than nonowners to walk ≥150 min/wk (95% CI, 1.08–2.36) • 23% of dog owners walked with their dog ≥5 times/wk; 22% did no walking with their dog
Cutt et al[43]	Cross-sectional study of PA in 629 adult dog walkers (77%) and nonwalkers	• Significantly more dog walkers than nonwalkers achieved the recommended level of PA (72% vs 44%; P<0.001) • Dog walkers engaged in significantly more PA (356 vs 211 min/wk; P<0.001), walking (180 vs 72 min/wk; P<0.001), and walking for recreation (134 vs 41 min/wk; P<0.001) than nonwalkers
Cutt et al[47]	Longitudinal 12-month study of PA of 92 dog nonowners acquiring a dog	• After adjustment for baseline variables, dog acquisition was associated with an additional 31 min/wk (95% CI, 7.39–54.22) of neighborhood recreational walking. The increase was only 22 min/wk (95% CI, –1.53 to 45.42) after further adjustment for change in baseline to follow-up variables

(*Continued*)

Table 1. Continued

Reference	Study Type, Design, and Population	Primary Findings
Yabroff et al[30]	Cross-sectional study of PA in a population-based sample of 41 514 pet (dog or cat) owners (17.7% dogs; 13% cats; 8.5% dog and cat) and nonowners	• After adjustment, dog owners were 64% more likely than nonowners to do any walking for leisure (95% CI, 1.52–1.77) • After adjustment, cat owners were 9% less likely to do any walking for leisure than nonowners (95% CI, 0.84–0.99)
Oka and Shibata[25]	Cross-sectional study of PA among 5177 adult pet owners (18% dog owners) and non–pet owners	• Dog owners engaged in significantly more moderate- to vigorous-intensity PA than dog nonowners and pet nonowners (17.0 vs 10.9 vs 11.7 h/wk, respectively; $P<0.001$) and significantly more hours of walking per week (12.4 vs 10.5 vs 9.8, respectively; $P<0.05$) • Dog owners were 54% more likely to achieve the recommended level of PA than nonowners (95% CI, 1.30–1.82)
Hoerster et al[41]	Cross-sectional study of PA among 984 adult dog owners and nonowners	• A greater proportion of dog walkers than nonwalkers achieved the recommended level of PA (64.3% vs 55.0%; $P=0.006$) • After adjustment, dog walking was independently associated with meeting PA guidelines (OR, 1.59; $P=0.004$)
Obesity		
Anderson et al[12]	Observational study of dog owners (n=784) and non–dog owners (n=4957) attending a free screening clinic	• No difference in BMI between dog owners and nonowners
Coleman et al; NQLS[44]	Observational study of dog owners and nonowners enrolled in NQLS (n=2199)	• Significantly fewer obese (BMI >30 kg/m^2) dog walkers (17%) than either owners who did not walk their dogs (28%) or nonowners (22%) • No difference in overweight (BMI >25 kg/m^2) status among dog walkers, (60%) dog owners who did not walk their dogs (62%), and nonowners (56%)
Gillum et al; NHANES III[34]	National health survey (n=11 394) of pet owners and nonowners (NHANES III)	• No difference in incidence of being overweight (BMI <25 kg/m^2) between non–pet owners (56%), dog owners (53%), and other pet owners (58%; $P=0.09$)
Kushner et al; PPET[56]	Prospective, controlled study (n=92) of weight loss in dog owners and nonowners	• Obese patients with dogs and those without dogs enrolled in comparable weight loss programs had similar weight loss at 12 months (4.7% vs 5.2%, respectively; P=NS)
Timperio et al[55]	Observational study of dog owners and nonowners including children (n=1145) and their parents (n=1108)	• The odds of being overweight or obese were lower among younger children who owned a dog (OR, 0.5; 95% CI, 0.3–0.8) and higher among mothers whose families walked the dog together (OR, 1.3; 95% CI, 1.0–1.7)
Lentino et al[14]	Observational online study (n=916) of dog owners and nonowners	• Compared with dog walkers, those who did not own or walk their dog reported less PA (MET-min per week) and a higher BMI ($P<0.01$)
Parslow et al[16]	Observational study of randomly selected Australian electorate (n=5079) pet owners (dogs, cats, birds, or fish) and nonowners	• Pet owners had higher BMI than nonowners (26.85 vs 26.36 kg/m^2, respectively; $P=0.002$)
Wright et al[15]	Observational community survey (n=1179) of pet owners (dogs, cats, birds, hamsters, gerbils, others) and nonowners	• Pet owners were more likely to be overweight (defined as BMI >25.0 kg/m^2) than those who did not own pets (58% vs 46%), although mean BMI was similar between groups (mean=25.4 and 25.7 kg/m^2, respectively)
Westgarth et al[38]	Observational study of pregnant women with or without pets (n=14 273)	• No association between dog ownership and weight status • Bird ownership was associated with maternal overweight or obesity (OR, 1.55; 95% CI, 1.25–1.93; $P=0.001$) after adjustment for confounding factors • Cat ownership was associated with maternal overweight or obesity (OR, 1.27; 95% CI, 1.00–1.62; $P=0.05$) after adjustment for confounding factors
Cardiovascular reactivity and autonomic function		
Allen et al[59]	Randomized, controlled 6-mo clinical trial of 48 stockbrokers with BP >160/100 mm Hg treated with ACE inhibitor and randomized to pet (dog or cat) adoption or no adoption	• ACE inhibitor therapy alone lowered resting BP, but not BP reactivity to mental stress ($P<0.001$) • Combination of ACE inhibitor therapy and pet ownership lowered BP responses to mental stress ($P<0.001$) • Cats and dogs were associated equally with lower BP responses to mental stress
Allen et al[13]	Prospective study of heart rate, BP, and cardioreactivity in 240 married couples, half of whom owned a pet (dog or cat)	• Relative to people without pets, people with pets had: – lower resting BP and heart rate ($P<0.001$) – smaller increases in heart rate and BP from baseline level during mental and physical stress ($P<0.001$) – faster recovery (back toward baseline) of heart rate and BP from mental and physical stress ($P<0.001$) • Cats and dogs were associated equally with lower responses to and recovery from stress • Pets elicited the lowest reactivity to stress, whereas spouses caused highest

(*Continued*)

Table 1. Continued

Reference	Study Type, Design, and Population	Primary Findings
Baun et al[63]	Prospective study of BP, heart rate, and respiratory rate in 24 adults assessed during 3 conditions: petting an unknown dog; petting a well-known dog; or reading quietly	• Significant (P<0.05) decrease in both SBP and DBP while petting a well-known dog paralleled the relaxation effect of quiet reading
Jenkins et al[66]	Prospective study of BP and heart rate in 20 participants (aged 9–58 years) while petting a familiar dog and reading aloud	• Lower BP (P<0.001) while petting the dog than while reading aloud
Aiba et al[57]	Prospective 24-hour Holter monitor study of 191 patients with 1 or more cardiac risk factor who either owned a pet (primarily dog or cat) or did not own a pet	• Pet owners had elevated parasympathetic and diminished sympathetic nervous activities compared with nonowners
Friedmann et al; CAST substudy[58]	CAST substudy post hoc analysis of 102 post-MI patients with or without pets (dog or cat) who underwent Holter monitoring	• Greater heart rate variability among pet owners than nonowners (P<0.05)
Survival in people without established CVD		
Gillum and Obisesan[34]	National health survey (n=11 394) of pet owners and nonowners (NHANES III)	• After adjustment for numerous factors, no significant differences in mortality between individuals living or not living with a dog
Qureshi et al[77]	Post hoc subgroup analysis of NHANES II database of people (n=4435) queried about whether or not they owned pets (dog or cat)	• In general, no significant relationships found between past or current pet ownership and mortality
Survival in patients with established CVD		
Friedmann et al[79]	Cohort analysis of patients hospitalized for coronary artery disease (n=92) who either owned or did not own a pet	• Pet owners were more likely to survive for 1 year than nonowners (94.3% vs 71.8%, respectively; P<0.002) • Owners of pets other than dogs were more likely to survive for 1 year than pet nonowners (100% vs 71.8%, respectively; P<0.05) • Pet ownership added significantly to the prediction of 1-year survival beyond the contribution of physiological severity of disease (P<0.004)
Friedmann et al[78]	Cohort analysis of pet (dog or cat) ownership and all-cause 1-year mortality in patients with ventricular arrhythmias after MI (n=369)	• In univariate analysis, dog ownership predicted survival (P<0.05). Neither pet ownership (dog or cat) nor cat ownership predicted survival. • After adjustment for numerous factors, not owning a dog made a significant independent contribution to mortality (OR, 0.11; P=0.05); not owning a cat did not make a contribution to mortality.
Friedmann et al[80]	Cohort analysis of pet ownership, depression, and all-cause mortality with a median follow-up of 2.8 years among patients who had an MI ≥6 months previously (n=460)	• Not owning a pet predicted mortality in multivariate Cox regression (HR=0.072, P=0.045), after controlling for depression score (HR=1.228, P=0.782) and the interaction between pet ownership and depression • There was a tendency for an interaction between pet ownership and depressive symptoms for predicting time to death; depressed patients who did not own pets were 75% more likely to die than depressed patients without pets (HR=1.757; P=0.092)
Parker et al[81]	Cohort analysis of pet (dog or cat) ownership and combined outcome of cardiac rehospitalization or cardiac mortality within 1 year among patients hospitalized for coronary artery disease (n=412)	• People with a pet in their household were more likely to experience a cardiac readmission or cardiac death than people who did not have a pet in their household (22% vs 13.6%, respectively; P=0.03) • People who owned a pet tended to be more likely to experience a cardiac readmission or cardiac death than people who did not own a pet (22.3% vs 14.5%; P=0.061) • People who owned a dog did not differ in likelihood of experiencing a cardiac readmission or cardiac death from nonowners • People who owned a cat tended to be more likely to experience a cardiac readmission or cardiac death than people who did not own a cat (27.3% vs 16.2%, respectively; P=0.071)

ACE indicates angiotensin-converting enzyme; BMI indicates body mass index; BP, blood pressure; CAST, Cardiac Arrhythmia Suppression Trial; CI, confidence interval; CVD, cardiovascular disease; DBP, diastolic blood pressure; HR, hazard ratio; MET-min, metabolic equivalent minutes; MI, myocardial infarction; NHANES, National Health and Nutrition Examination Survey; NQLS, Neighborhood Quality of Life Study; OR, odds ratio; PA, physical activity; PPET, People and Pets Exercising Together; and SBP, systolic blood pressure.

and unidentified differences between those who choose to own or not own pets), differing pet populations, post hoc (ie, not prospective) analyses, and (understandably) lack of randomized data. Nevertheless, there are a number of methodologically sound studies, and there is a substantial body of data that suggests that pet ownership is associated with a reduction in CVD risk factors and increased survival in individuals with established CVD. The data are most robust for a relationship between dog ownership and CVD risk reduction, particularly dog ownership and increased physical activity. Whether this is attributable to dogs being the pets most commonly owned and studied, dogs being the pet most likely

Table 2. Applying Classification of Recommendations and Level of Evidence

ESTIMATE OF CERTAINTY (PRECISION) OF TREATMENT EFFECT	SIZE OF TREATMENT EFFECT: CLASS I *Benefit >>> Risk* Procedure/Treatment **SHOULD** be performed/ administered	CLASS IIa *Benefit >> Risk* *Additional studies with focused objectives needed* **IT IS REASONABLE** to perform procedure/administer treatment	CLASS IIb *Benefit ≥ Risk* *Additional studies with broad objectives needed; additional registry data would be helpful* Procedure/Treatment **MAY BE CONSIDERED**	CLASS III *No Benefit* or CLASS III *Harm* Procedure/Test / Treatment COR III: No benefit — Not Helpful / No Proven Benefit COR III: Harm — Excess Cost w/o Benefit or Harmful / Harmful to Patients
LEVEL A Multiple populations evaluated* Data derived from multiple randomized clinical trials or meta-analyses	■ Recommendation that procedure or treatment is useful/effective ■ Sufficient evidence from multiple randomized trials or meta-analyses	■ Recommendation in favor of treatment or procedure being useful/effective ■ Some conflicting evidence from multiple randomized trials or meta-analyses	■ Recommendation's usefulness/efficacy less well established ■ Greater conflicting evidence from multiple randomized trials or meta-analyses	■ Recommendation that procedure or treatment is not useful/effective and may be harmful ■ Sufficient evidence from multiple randomized trials or meta-analyses
LEVEL B Limited populations evaluated* Data derived from a single randomized trial or nonrandomized studies	■ Recommendation that procedure or treatment is useful/effective ■ Evidence from single randomized trial or nonrandomized studies	■ Recommendation in favor of treatment or procedure being useful/effective ■ Some conflicting evidence from single randomized trial or nonrandomized studies	■ Recommendation's usefulness/efficacy less well established ■ Greater conflicting evidence from single randomized trial or nonrandomized studies	■ Recommendation that procedure or treatment is not useful/effective and may be harmful ■ Evidence from single randomized trial or nonrandomized studies
LEVEL C Very limited populations evaluated* Only consensus opinion of experts, case studies, or standard of care	■ Recommendation that procedure or treatment is useful/effective ■ Only expert opinion, case studies, or standard of care	■ Recommendation in favor of treatment or procedure being useful/effective ■ Only diverging expert opinion, case studies, or standard of care	■ Recommendation's usefulness/efficacy less well established ■ Only diverging expert opinion, case studies, or standard of care	■ Recommendation that procedure or treatment is not useful/effective and may be harmful ■ Only expert opinion, case studies, or standard of care
Suggested phrases for writing recommendations	should is recommended is indicated is useful/effective/beneficial	is reasonable can be useful/effective/beneficial is probably recommended or indicated	may/might be considered may/might be reasonable usefulness/effectiveness is unknown/unclear/uncertain or not well established	COR III: No Benefit: is not recommended; is not indicated; should not be performed/ administered/ other; is not useful/ beneficial/ effective COR III: Harm: potentially harmful; causes harm; associated with excess morbidity/mortality; should not be performed/ administered/ other
Comparative effectiveness phrases†	treatment/strategy A is recommended/indicated in preference to treatment B treatment A should be chosen over treatment B	treatment/strategy A is probably recommended/indicated in preference to treatment B it is reasonable to choose treatment A over treatment B		

A recommendation with Level of Evidence B or C does not imply that the recommendation is weak. Many important clinical questions addressed in the guidelines do not lend themselves to clinical trials. Although randomized trials are unavailable, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.

*Data available from clinical trials or registries about the usefulness/efficacy in different subpopulations, such as sex, age, history of diabetes, history of prior MI, history of heart failure, and prior aspirin use.

†For comparative effectiveness recommendations (Class I and IIa; Level of Evidence A and B only), studies that support the use of comparator verbs should involve direct comparisons of the treatments or strategies being evaluated.

to increase their owner's physical activity, or additional other beneficial effects of dog ownership is uncertain. Given that most studies are nonrandomized, it cannot be determined with confidence whether the reduction of CVD risk factors with pet ownership is merely associative or causative, although there are plausible psychological, sociological, and physiological mechanisms for causation for many of the associations, particularly dog ownership and increased physical activity.

The writing group emphasizes that although pet adoption, rescue, or purchase may be associated with some future reduction in CVD, the primary purpose of adopting, rescuing, or purchasing a pet should not be to achieve a reduction in CVD risk. Furthermore, the mere adoption, rescue, or purchase of a pet, without a plan of regular aerobic activity (such as walking a dog) and implementation of other primary and secondary cardiovascular preventive measures, is not a sound or advisable strategy for reduction in CVD risk.

Further research is clearly needed on this important topic, including studies of risk factor modification, primary prevention, and pet acquisition as part of a strategy of secondary risk reduction. Future studies of pet ownership and CVD risk, when possible, should be prospective, include and account for socioeconomic factors and comorbid medical conditions, use well-defined and quantifiable end points, and use robust statistical analytical methodologies. Randomization, to the extent that it is ethically and feasibly possible, is strongly encouraged.

Disclosures

Writing Group Disclosures

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This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all members of the writing group are required to complete and submit. A relationship is considered to be "significant" if (1) the person receives $10 000 or more during any 12-month period, or 5% or more of the person's gross income; or (2) the person owns 5% or more of the voting stock or share of the entity, or owns $10 000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

†Significant.

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†Significant.

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KEY WORDS: AHA Scientific Statements ■ high blood pressure ■ obesity ■ physical activity