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INVITED REVIEW

Pet ownership and cardiovascular risk reduction: Supporting evidence, conflicting data and underlying mechanisms

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SUMMARY

1. It is widely believed that pet ownership is beneficial to humans and that some of this benefit is through favourable effects on cardiovascular risk. In the present review, we critically examine the evidence in support of this hypothesis and present the available data with respect to major cardiovascular risk factors.

2. There is evidence that dog owners are less sedentary and have lower blood pressure, plasma cholesterol and triglycerides, attenuated responses to laboratory-induced mental stress and improved survival following myocardial infarction compared with non-pet owners. However, conflicting data exist with regard to the association between pet ownership and each of these risk factors.

3. Numerous non-cardiovascular effects of pet ownership have been reported, largely in the psychosocial domain, but the relationship is complex and can vary with demographic and social factors.

4. A unifying hypothesis is presented, linking improved mood and emotional state to decreased central and regional autonomic activity, improved endothelial function and, thus, lower blood pressure and reduced cardiac arrhythmias.

5. Overall, ownership of domestic pets, particularly dogs, is associated with positive health benefits.

Key words: blood pressure, cardiovascular risk, pet ownership.

INTRODUCTION

''To sit with a dog on a hillside on a glorious afternoon is to be back in Eden, where doing nothing was not boring—it was peace.'' (Milan Kundera; http://www.1-famous-quotes.com/quote/8850)

Non-human companionship is believed to have beneficial effects on human health. From a cardiovascular perspective, pet ownership has been associated with higher levels of physical activity, lower blood pressure, diminished responses to stress, improved lipoproteins and a reduced incidence or severity of depression (Table 1). In addition, studies have shown that pet ownership may favourably modulate sympathetic nervous system activity. In patients with coronary artery disease, pet ownership reduces event rates and is associated with improved survival following a myocardial infarction. The underlying mechanisms of such benefits are complex and likely related to centrally mediated effects on a wide range of cardiovascular risk factors. Most of the evidence presented herein stems from studies of dog and cat owners, although some conflicting evidence exists with respect to the benefits of owning cats. Using a thorough review of data from PubMed, as well as additional published literature from books and online sources, the present review critically examines the evidence in support of the purported benefits of pet ownership and presents the available data with respect to effects on major cardiovascular risk factors.

EXERCISE IN PET OWNERS

''If your dog is fat, you're not getting enough exercise.'' (author unknown)

Pet owners report a reduction in minor health problems following pet acquisition and this effect is sustained over time in dog owners. Many dog owners adopt patterns of regular exercise, undertaking considerably more physical exercise while walking their dogs.[1] However, evidence for a clear benefit of pet ownership through increased activity is conflicting. In the Health ABC study,[2] after age, race, education level, number of assets, family income and site were adjusted for, dog owners were more likely than those without pets to have engaged in non-exercise-related walking, but did not differ in walking for exercise or any physical activity. In contrast, non-dog pet owners did not differ from individuals without pets in non-exercise-related walking in the preceding week and were less likely to have engaged in walking for exercise or any physical activity in the preceding week. The activity-related benefits of pet ownership in older adults were limited to dog owners, who engaged in greater overall physical activity, non-exercise-related walking, in particular. Of note, in a Canadian study of non-institutionalized subjects aged 65 years and older, the activities of daily living (ADL) of respondents who did not currently own pets deteriorated more than that of respondents who currently owned pets after adjusting for other variables during the 1-year period.[3]

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Table 1 Benefits effects of pet ownership on cardiovascular risk

Cardiovascular risk factor	Beneficial effect of pet ownership	Conflicting data	References
Sedentary lifestyle	Increases regular exercise, frequency of walking, especially for leisure	Yes	1–7
Hypertension	Lower SBP, pulse pressure, MAP	Yes	8–11
Stress	Lower BP response to mental stress	Yes	12–14
Hyperlipidaemia	Lower plasma TG and cholesterol	Yes	9,11
Diabetes	Early detection of hypoglycemia in Type 1 diabetes	Yes	11,15
Post-MI arrhythmias or re-infarction	Improved survival in the year following MI	Yes	16,17
Depression	Fewer physician visits, less depression	Yes	21–25

SBP, systolic blood pressure; MAP, mean arterial pressure; TG, triglycerides; MI, myocardial infarction.

Yabroff *et al.*[4] concluded from multivariate analyses that dog owners were slightly less likely to walk for transportation than were non-pet owners, but were more likely to walk for leisure than non-pet owners. Overall, dog owners walked an average of 19 min more per week than non-pet owners. Walking behaviours of cat owners were similar to non-pet owners. A study that examined the association between dog ownership and health-related physical activity among Japanese adults[5] also showed positive benefits. Dog owners had higher levels of physical activity than owners of other kinds of pets and those without any pets, suggesting that dogs may play a major role in promoting physical activity. However, only 30% of the dog owners met the recommended criteria for physical activity, as defined by the current national guidelines for exercise in Japan (23 metabolic equivalent of task (MET)-hours/week).[6] A Swedish survey-based study with approximately 40 000 respondents showed that people physically active at a level sufficient to have a positive effect on their health more often owned a pet than people who were less active.[7] Leisure activities of pet owners involved a greater interest in nature and/or gardening than those of non-pet-owners.

PET OWNERSHIP AND HYPERTENSION

It has been suggested that pet ownership has beneficial effects on blood pressure.[8] An analysis of data by Anderson *et al.*[9] of 5741 participants attending a free screening clinic showed that pet owners (n = 784) had significantly lower systolic blood pressure (SBP) and plasma triglycerides than non-owners. In men, pet owners had significantly lower SBP, but not diastolic blood pressure (DBP), than non-owners. In women over 40 years of age, SBP but not DBP was significantly lower in pet owners. However, conflicting data exist, as shown by Parslow *et al.*;[10] in their study, pet owners and non-pet owners had similar levels of SBP and those with pets had significantly higher DBP. In that study, pet owners also had a higher body mass index (BMI) and were more likely to smoke. These conflicting observations may be reconciled by a study of 1179 community-dwelling men (n = 498) and women (n = 681) aged 50–95 years, in which unadjusted analyses showed that pet owners had lower SBP, pulse pressure and mean arterial pressure, as well as a reduced risk of hypertension (odds ratio 0.62; 95% confidence interval 0.49–0.80).[11] However, in that study, after adjustment for age and other confounders, pet ownership was not associated with SBP or DBP, pulse pressure, mean arterial pressure or the risk of hypertension. Thus, although there is some evidence that pet ownership may reduce the risk of hypertension, confounding variables, such as age and bodyweight, are likely to influence the relationship with blood pressure.

PETS AND CARDIOVASCULAR RESPONSES TO STRESS

A study in college students[12] examining the effect of a pet on psychological consequences of stress indicated that, for some individuals, interacting with a pet favourably affects both physiological and psychological responses; the beneficial effect was similar to that seen by reading quietly. Allen *et al.*[13] evaluated the effect of a non-evaluative social support intervention through pet ownership on blood pressure response to mental stress before and during angiotensin-converting enzyme (ACE) inhibitor therapy: ACE inhibitor therapy lowered resting blood pressure, whereas increased social support through pet ownership lowered the blood pressure response to mental stress. However, varying results were obtained in another study by Kingwell *et al.*,[14] where the effect of a friendly but unfamiliar dog on cardiovascular and autonomic responses to acute, mild mental stress was investigated. In that study, it was found that the dog's presence did not influence blood pressure or heart rate either at rest or during mild mental stress. However, the cardiac autonomic profile (derived from heart period variability data assessed using spectral analysis of heart period) was most favourable in the presence of the dog for dog owners and in the absence of the dog for non-owners.[14] Thus, the data overall show a beneficial effect of an interaction with pets on laboratory responses to mental stress, but the response depends on whether the subject is a dog owner or not.

PET OWNERSHIP, HYPERLIPIDAEMIA AND DIABETES

There are limited data available on the subject of pet ownership and hyperlipidaemia. Anderson *et al.*[9] showed that pet owners have significantly lower plasma cholesterol and triglyceride levels compared with non-owners. However, it is possible that the lower lipid levels observed are related to other factors in these subjects, such as more exercise and lower bodyweight in pet owners. More clinical data are required for definitive conclusions in this area.

With respect to diabetes, it has been reported that domestic dogs exhibit behavioural reactions to hypoglycaemic episodes in their owners with Type 1 diabetes, providing 'early warning of an impending hypoglycaemic episode'.[15] Possible benefits of pet ownership in

adult onset and older diabetic subjects are unclear. Wright *et al.*[11] observed that, in older community dwellers, there was a higher likelihood of diabetes in pet owners compared with non-owners, but in that study pet owners were also slightly more overweight and exercised less than non-owners, again suggesting that such confounders play an important role in determining the impact of pet ownership on cardiovascular risk.

SURVIVAL AFTER MYOCARDIAL INFARCTION IN PET OWNERS

In the Cardiac Arrhythmia Suppression Trial, which studied post-myocardial infarction patients with asymptomatic ventricular arrhythmias, an ancillary study analysed psychosocial data, including pet ownership and social support in these patients.[16] Subjects (n = 424) were randomly selected from patients attending participating Cardiac Arrhythmia Suppression Trial sites who completed baseline psychosocial questionnaires. One year survival data were obtained for 369 patients, of whom 112 owned pets and 20 died. High social support and owning a pet tended to predict survival, independent of physiological severity and demographic and other psychosocial factors. Dog owners were significantly less likely to die within 1 year than those who did not own dogs. These data confirm and extend previous findings relating pet ownership and social support to survival among patients with coronary artery disease. However, a recent Australian study showed conflicting results.[17] Pet owners were more likely to experience a death or readmission following their hospitalization, after controlling for key psychosocial and medical covariates. When dog and cat owners were considered separately, cat ownership was significantly associated with increased risk of death or readmission. These data strongly suggest that the beneficial effects of pet ownership may be restricted to dog owners and may not apply to those who own cats.

NON-CARDIOVASCULAR EFFECTS OF PET OWNERSHIP

Psychosocial benefits

''Happiness is a warm puppy.'' (Lucy, in *Charlie Brown*, created by Charles M Schulz; http://en.wikipedia.org/wiki/Lucy_van_Pelt Charles M Schulz).

McNicholas *et al.*[18] have pointed out that people do not own pets specifically to enhance their health, but rather for companionship, which provides intrinsic satisfactions, such as shared pleasure in recreation, relaxation and spontaneity, all of which add to quality of life. Support from pets may mirror elements of human relationships known to have positive benefits to health;[19] conversely, the loss of a pet may be distressing for owners, particularly when the pet was linked with a deceased spouse or when it offered companionship or social contact with people.[20] Not surprisingly, numerous non-cardiovascular effects of pet ownership have been reported, largely in the psychosocial domain.

In a study of 938 Medicare enrolees in a health maintenance organization, followed prospectively for 1 year, respondents who owned pets reported fewer doctor contacts than those who did not, after adjusting for demographic characteristics and health status at baseline.[21] Prior stressful life events were associated with increased physician contact during the study year for respondents without pets, but not for pet owners. Owners of dogs, in particular, were buffered from the impact of stressful life events on physician utilization. Pet ownership has also been associated with less depression in HIV-infected men.[22] Other data are conflicting: an Australian study reported that, compared with non-owners, those with pets reported more depressive symptoms, whereas female pet owners who were married also had poorer physical health.[23] In that study, caring for a pet was associated with negative health outcomes, including more symptoms of depression, poorer physical health and higher rates of use of pain relief medication. Furthermore, in studies in adolescents, despite high rates of pet ownership, there was little interaction with pets and owning a pet was not clearly associated with adolescents' health or well-being.[24] A more recent study has shown that gender and marital status influence the relationship between dog ownership and well-being, with women and single adults more likely to benefit from dog ownership.[25] These data suggest that the relationship between pet ownership and well-being is complex and can vary with demographics and social factors.

Pet ownership and allergic disorders

There are conflicting data on exposure to pets and allergic diseases. Almquist *et al.* have shown that early exposure to cats increases the risk of sensitization, but not of asthma. Conversely, dog ownership appears to be associated with a lowered risk of sensitization to airborne allergens and asthma.[26] Others have confirmed a negative association between dog ownership and the development of atopic diseases in early childhood, although the effect was only observed in families without a history of atopic disorders.[27] Fujimura *et al.*[28] have suggested that specific house dust microbial communities are associated with pet keeping and that potentially microbe-based mechanisms could explain why pet exposure appears to reduce the prevalence of allergic disease development.

MECHANISMS OF CARDIOVASCULAR BENEFIT: A UNIFYING HYPOTHESIS

Esler *et al.*[29] have shown that sympathetic neural outflow to the heart is selectively activated in response to cognitive challenge. Mental stress can also induce prolonged endothelial dysfunction,[30] whereas depressive illness is associated with sympathetic activation.[31,32] Among its many psychosocial benefits,[12,18–22] pet ownership, through satisfying companionship, can reduce stress and improve mood and emotional state. A decrease in central autonomic activity consequent to positive mood induction[33] is likely to account for decreased responsiveness to stressors. Lower efferent autonomic outflow to the kidneys, vasculature and the heart may, in turn, be the underlying mechanisms for lower blood pressure[34] and reduced propensity to cardiac arrhythmias and sudden death.[35] In addition, an increase in physical activity and weight loss in dog owners possibly lowers blood pressure and exerts cardiovascular benefits, potentially through decreases in total body noradrenaline spillover[36] and renal sympathetic activity,[37] increased endothelial nitric oxide-dependent vasodilation[38] and, hence, reduced total peripheral resistance.[39] Thus, an overall reduction in central and regional autonomic activity and an improvement in endothelial function likely underlies the favourable benefits of pet ownership (Fig. 1). Future research examining the effects of pet exposure and ownership on total and regional (cardiac and renal) sympathetic activity and endothelial function in humans

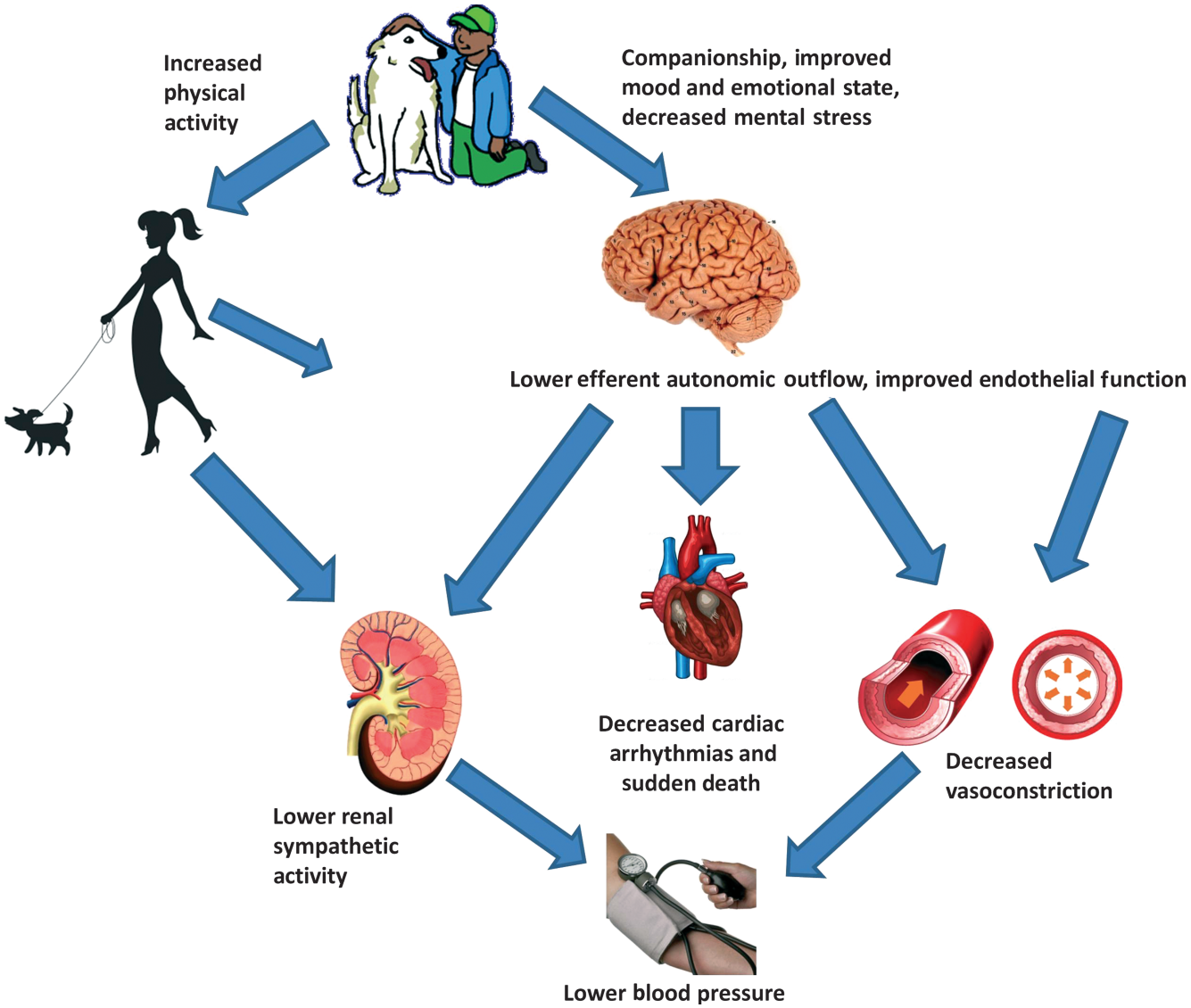

Fig. 1 Schematic illustrating a unifying hypothesis for pet ownership, linking companionship, improved mood, decreased stress and increased exercise to lower autonomic outflow and improved endothelial function, and thus reduced arrhythmias and lower blood pressure.

will help elucidate the potential mechanisms of cardiovascular benefit.

CONCLUSIONS

Ownership of pets, particularly dogs, appears to be beneficial to humans and some of this benefit is through favourable effects on cardiovascular risk factors. Although there is some evidence that dog owners engage in more physical activity than those who do not have pets, levels of physical activity achieved may often be lower than recommended criteria. A lower blood pressure associated with pet ownership has been found in some, but not all, studies. There is evidence for attenuated blood pressure responses to mental stress induced in a laboratory environment and generally favourable effects on autonomic activity with pet interaction. The CAST trial showed that pet ownership was a predictor of survival following myocardial infarction, but other data suggest this may be restricted to dog owners. Although generally beneficial from a psychosocial perspective, the relationship between pet ownership and well-being is complex and can vary with demographics and social factors. Pet ownership may decrease allergic disorders, perhaps via microbe-based mechanisms. Overall, ownership of domestic pets, particularly dogs, is associated with positive health benefits.

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