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The Value of Pets to Public and Private Health and Well-Being

Prepared for the
American Veterinarian Medical Association

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Abstract

This analysis reviews empirical studies of the health benefits of pet ownership published between 1980 and 2016 and collected in the database of the Human-Animal Bond Research Initiative, or HABRI. The analysis began with 373 titles and eventually encompassed a dataset of 151 full-text documents. Along with analysis of substantive content, each study received a score for methodological rigor. The number of studies has steadily increased, particularly since 2000, and methodological rigor has improved. The literature encompasses four topics, including cardiovascular, general, and psychosocial health, and physical activity. Overall, the research finds that pets benefit human health, although the available evidence is inconsistent. The research on dog ownership and physical activity offers the clearest benefits. These studies also received the highest scores for methodological rigor. The exercise provided by dog walking provides cardiovascular and other health benefits. Moreover, dog walking offers opportunities to build social support through interactions with other dog walkers, and the combination of pet ownership and social support appears to mediate depression and stress. The dog walking research thus has substantial public health implications, indicating the importance of further research and suggesting opportunities for involvement by the veterinary profession.

The first published study of the benefits of pets for human health and well-being outside the clinical setting dates to 1975. The research focused on the potential for animals to improve well-being by increasing contact with other people.¹ The authors randomly gave retirees between the ages of 75 and 81 either a caged parakeet or a begonia. They also administered questionnaires that captured the recipients' interest in and attitudes toward other people and their own psychological health. Over a three-year period, those who received the birds reported favorable changes overall. They had more friends, more visitors, and were more involved in their communities, compared with those who received plants. In 1980, research by Friedmann, et al. examined the benefits of pets for cardiovascular health as part of a larger analysis of the effects of social isolation and support.² Among heart attack victims, twenty-eight percent of those who had pets survived for at least a year, compared to only six percent of non-pet owners.

In 1987, the National Institutes of Health held a workshop aimed at assessing the state of existing knowledge, developing recommendations for future research, and providing the public with accurate information about the health benefits of pets. Experts from various disciplines reviewed the research on the roles of pets in five topical areas, including cardiovascular health; child development; the health and functioning of the elderly; therapeutic effects; and safety and risks in relationships between people and pets. The research on pets and human health resulted in approximately two publications a year until 2000, when the publication rate tripled. Since 2010, nine studies per year, on average, have been published. The literature comes from various disciplines, but mostly from medicine, public health, and psychology.

This review of the literature on the benefits of pets locates the major topics of current research, summarizes findings, and suggests potential opportunities for the veterinary profession to promote human health through bonds with pets as well as engage in additional research. It focuses on studies of the benefits of “ordinary” pet keeping, rather than Animal Assisted Interventions, or the goal-directed use of animals as a specific part of a therapeutic treatment or other ameliorative process, such as pet visitation in hospitals and nursing homes. The analysis includes empirical articles published in peer-reviewed journals and dissertations from 1980 to 2016 and collected in the database of the Human-Animal Bond Research Initiative, or HABRI Central. Described as “an online platform for open research and collaboration into

the relationships between humans and animals, specifically companion animals,” HABRI Central is a collaborative effort of Purdue University's College of Veterinary Medicine and Purdue University Libraries. Its searchable library provides access to bibliographic references to tens of thousands of resources, including videos, web sites, audio recordings, articles from newspapers and magazines, along with scholarly articles. HABRI Central includes scholarship from veterinary medicine, human medicine, public health, nursing, psychology, politics, law, and other areas of study. In many cases, the library also provides full-text access.

Methods

We located articles using HABRI Central’s “tags,” or search terms, beginning with a wide range of tags and eventually narrowing to “pets and companion animals,” “human-animal bond,” human-animal relationship,” “animal roles,” “health,” and “zoonoses.” We excluded articles that focused solely on animal health, examined the impact of pet ownership on developmental disabilities such as autism, or focused on service animals. The analysis began with 373 titles and eventually encompassed a dataset of 151 full-text documents (see Appendix B).

----- Table 1 about here-----

We gave each study an identification code and recorded publication date, sample size, and effect size, if reported. We further coded each study for the following: discipline of lead author, type of benefits examined, pet species, (human) subject age, (human) subject gender, presence of lifelong disability, use of control or comparison group, location of study/treatment, use of self-reports, and benefit observed. Finally, we provided short descriptions of benefits, where found, and recorded any other notes of potential interest for the analysis.

We also gave each study a score for methodological rigor. Previous assessments of claims about the health benefits of pets acknowledge that methodological pitfalls preclude determining that the presence of pets, rather than any other factor, accounts for the outcome.^{3,4} In reviews of the literature on

Animal Assisted Therapy, for example, many peer-reviewed, published studies did not meet minimal standards of research design that would allow for inclusion in a quantitative meta-analysis, such as adequate sample size and enough data to calculate effect sizes.^{5,6} To assess rigor, we scored each quantitative study on a six-point scale. Each study received one point for including: a control group; randomization; blind coding of observational data; at least three descriptions of the sample (e.g., participant age, gender, socioeconomic status); well-known measures of dependent variables (e.g., walking distance measured by pedometer or pace by accelerometer, rather than self-reports); and provision of sufficient information to calculate an effect size, if it not reported directly. For descriptive, qualitative, and pilot studies that did not meet these criteria, we coded these using recognized verification strategies that ensure both reliability and validity, such as evidence of methodological coherence, sampling sufficiency, a dynamic relationship between sampling, data collection and analysis, and theory development.⁷

The mean rigor score for the dataset was 4.66. Sixty-five percent of the studies (N=99) had a rigor score of five or above. We found that the research methods have become slightly more rigorous over time, with the mean score increasing from 4.36, for studies conducted through 1999 (N=44), to 4.9 for studies conducted after 2000 (N=107). The majority of studies (73%; N=110) reported a benefit.

The topics in the literature include the following:¹

- General physical health (N=46; rigor 4.56)
- Cardiovascular Health (N=33; rigor 4.39)
- Psychosocial health (N=38; rigor 4.58)
- Physical Activity (N=34; rigor 5.14)

The topics in many studies overlap. For example, much of the literature that examines how dog ownership increases physical activity also incorporates potential cardiovascular benefits and the psychosocial benefits of supportive canine and human walking companions. Although we agreed on a primary focus of each study and categorized it accordingly, our decisions should be seen as indicative rather than definitive.

¹ Appendix A lists studies under each category.

General physical health

Studies in this category examined a variety of health behaviors and health status indicators, as well as the use of health services and prescription medications. The number of studies finding no benefit (N=21) nearly equals those finding benefits (N=24). One of the few studies to use a truly experimental and longitudinal design compared people who adopted dogs or cats from a shelter after being without pets for at least a year with non-pet-owners.⁸ Participants' health, psychological well-being, and number of walks taken were measured before acquiring a pet and at six and ten months later. Both dog- and cat-owners reported a significant reduction in minor health problems during the month following pet acquisition, and this effect continued among dog owners through ten months. For cat owners, the effect was statistically significant only during the first six months. Dog owners also reported an increased number and duration of walks taken throughout the ten months. Non-owners showed no improvement on these measures.

Nationally representative surveys from Germany and Australia revealed that pet owners were in better physical health and made 15 percent fewer annual doctor visits, compared to non-owners.⁹ Because these surveys are longitudinal, the data allow consideration of whether pets improve people's health or people in better health tend to have pets. Their analysis indicates that people who continuously own a pet enjoy better health, measured by fewer doctor visits, compared with non-pet-owners or people who cease to have a pet. If pet owners make fewer visits to the doctor and take less time off from work than non-owners do, then pet ownership may reduce national health expenditures. By linking Australian sample survey results to data on health expenditures, the national health cost savings associated with pet ownership was estimated at \$988 million for 1994–95.¹⁰

China offers an opportunity for a “natural experiment” in the relationship between pet ownership and health. Prohibitions against dog ownership, particularly in cities, were relaxed starting in the 1990s, resulting in a population of first-time pet owning adults. One study found that Chinese women who owned dogs exercised more, slept better, felt more physically fit, made fewer annual doctor visits, and missed fewer days from work than women without dogs.¹¹ Other studies of women point out that demographic factors, such as age, socioeconomic status, and type of housing, influence the relationship

between pet ownership and health.¹² Additional research emphasizes the role of attachment to a pet for health benefits.¹³

Not all the results are positive, however. Nearly every study that finds an association between pet ownership and better health¹⁴⁻¹⁶ can be matched with one finding no differences in the health of pet owners compared to non-owners.^{17,18} Whereas one study found an association between dog ownership and perceived physical quality of life,¹⁹ another found that dog owners did not differ from non-owners in perceived health.²⁰ One study of older adults of both sexes found that neither pet ownership did not contribute significantly to explained variance in health and well-being,²¹ but another found more positive health-related characteristics among dog owners, in particular.²²

Among adult²³ and adolescent pet owners²⁴ neither owning nor caring for a pet had an effect on measures of physical and mental health, and adults who owned or cared for pets used pain relief medications more frequently, compared to non-owners. Living with pets was not associated with reduced risk of death, after controlling for confounding variables.²⁵ A study of adults suffering from Chronic Fatigue Syndrome found that pet ownership conferred no physical or psychological advantages, although all participants believed that their pets provided psychological benefits, in particular.²⁶ In a study of adolescents, those with pets were more likely to report ill health, including more frequent stomach aches, headaches, and sleeping difficulties.²⁷ Similarly, children aged 8-12 whose families acquired new pet dogs showed a significant increase in the total number of reported illness symptoms they suffered from, between acquisition and the one-year follow-up.²⁸

A number of studies examine pet ownership and health among the elderly. In comparing older female dog and cat owners, women with dogs reported higher levels of general health than those with cats.²⁹ However, analysis of data from a 70-year longitudinal study revealed no association between the frequency of playing with pets and longevity or self-rated health among the elderly.³⁰ A mixed-methods study found no health benefits of pet ownership among the elderly, with the exception of reduced use of sleeping pills.³¹ Similarly, analysis of Australian Medicare data showed that elderly pet owners did not differ from non-owners on any physical or mental health measures or in the use of health services.³²

Another Australian study found that elderly pet owners reported poorer physical health, and higher rates of use of pain relief medication, and found no relationship between pet ownership and use of physician services.³³

Finally, pets are strongly associated with emergency room visits for injuries from falls, the leading cause of non-fatal injuries in the United States. Although pets present a fall hazard for people of all ages, those over age 75 have higher injury rates, and more injuries occur among women than men.³⁴ Seven times more fall injuries are associated with dogs, compared with cats.³⁵

Cardiovascular health

Broadly speaking, the literature on pets and cardiovascular health addresses two topics, addressed here in turn: (1) risk factors for heart disease and (2) survival of patients with established heart disease. The majority of studies find benefits associated with pet ownership.

Because stress, in the form of increased blood pressure or heart rate, can increase the risk for heart disease, reducing it has implications for cardiovascular health. Some research has established an association between pet ownership and lower risk factors for cardiovascular disease. However, owning or caring for a pet may not be required. Decreases in diastolic blood pressure have been found among elderly people when simply watching fish in an aquarium.³⁶ Several studies suggest that tactile interaction with pets reduces cardiovascular activity. An early study found that dog owners' blood pressures were lower while petting their dogs, compared to reading aloud.³⁷ Another found that participants' blood pressures remained at resting levels while petting a dog, but rose when talking to the dog, and rose higher still when talking to the experimenter.³⁸ In contrast, participants' heart rates were lower when the researcher's pet was visually present than while they were permitted to touch the animal.³⁹

The research literature has long documented that the presence of human friends, and even friendly strangers, can buffer response to psychological stressors by providing non-judgmental support.⁴⁰ To examine whether the "friends" category included the non-human, researchers asked women to perform mental arithmetic while alone, in the presence of a female friend, and in the presence of their dogs.⁴¹

Participants perceived their human friends as judgmental, but their dogs as friendly and supportive. Although the presence of human friends increased blood pressure, the presence of dogs did not do so. Repeating the experiment with married couples and using the presence of either their spouses, cats, or dogs revealed that the blood pressure increases under stress were less when participants' pets were present than when in the presence of their spouses.⁴²

To test whether people who have pets are healthier to begin with, another study used participants who did not have pets but were willing to acquire them.⁴³ Participants all worked as stockbrokers and described their jobs as highly stressful. They all lived alone. Moreover, they all had diagnosed stage-II hypertension, and would soon begin treatment with an ACE-inhibiting drug to reduce it. The researchers randomly assigned participants into those who would adopt pets and those who would not. Although the ACE inhibitor lowered the blood pressure of all participants, those in the pet group had lower blood pressure increases under stress, compared to those without pets. Other studies have found less optimistic results. To examine responses to stress-inducing cognitive tasks, half of male dog-owners in one study were tested in the presence of their dogs. Blood pressure and heart rate increased during the tasks in both groups, but there was no difference between the dog-present and dog-absent groups.⁴⁴ And because the familiarity of a pet might influence results through the beneficial effects of attachment, researchers used a friendly dog but one unknown to research participants.⁴⁵ Whether at rest or during stress, the dog had no effect on measures of blood pressure or heart rate.

In exploring other potential mechanisms for the protective effects of pets, some evidence of higher heart rate variability appeared among pet owners, albeit in a sample too small to draw definitive conclusions.⁴⁶ One study found that the lower level of risk found among pet owners could not be explained by differences in cigarette smoking habits, diet, body mass index, or socioeconomic profile.⁴⁷

Other studies found no evidence that pets are associated with cardiovascular benefits. Similar systolic blood pressures were found among both pet owners and non-pet owners, but pet owners had higher diastolic blood pressure, as well as higher body mass index measures and more cigarette smoking.⁴⁸ After adjusting for age and other confounding variables, pet ownership was not independently

associated with systolic or diastolic blood pressure, pulse pressure, mean arterial pressure or risk of hypertension.⁴⁹ Although pet owners were younger, compared to non-owners, they were also slightly more overweight and engaged in less exercise. They were more likely to have diabetes and to use beta-blockers, frequently prescribed for cardiac issues.

By studying people with established cardiovascular disease, researchers aim to shed light on the factors that contribute to recovery following heart attack. In the seminal 1980 study of heart attack survivors, Friedmann and co-authors found that 28 percent of pet owners had survived to the one-year follow up, compared to only six percent of non-owners.² This finding, widely cited by the popular press at the time, continues to inform the public's impression of the benefits of pets. Yet, when the researchers analyzed pet ownership along with seven other social and physiological variables, it was the least important, with a discriminant coefficient function of only 0.12. Critics have pointed out that "pet ownership makes a relatively trivial contribution" compared to other factors included in the study, such as age, severity of disease, and place of residence.⁵⁰ Subsequent research found that pet owners were more likely than non-owners were to die or be readmitted to a hospital within a year of a heart attack.⁵¹ Nevertheless, the study by Friedmann et al. fueled subsequent research on the effect of pets on cardiovascular health.

In survival beyond the first year following a heart attack, pet ownership remained a significant predictor, but species-specific differences were not discussed.⁵² Other research on survival after heart attack studied patients enrolled in a cardiac rehabilitation program.⁵³ Questionnaires recorded demographic data and subjects underwent personality assessments at the start of the program. After 12 weeks, pet owners were more likely to have adhered to the program. Adherence could not be attributed to alternative explanations.

Research has also examined the protective effects of dog ownership compared to cat ownership. When Friedmann et al.'s 1980 study was replicated with a larger sample of 369 heart attack patients, dog ownership, but not cat ownership, along with social support, predicted one-year survival after discharge.⁵⁴ A later study also found that cat ownership predicted increased risk of death or readmission.⁵¹ However,

using a large, nationally representative sample, one study found a significantly lower risk for death due to myocardial infarction among previous or present owners of *cats*, rather than dogs.⁵⁵ Similarly, a study using a representative sample of people free of major illness also attributes the association between pet ownership and low rates of death from cardiovascular disease to having a cat rather than a dog.⁵⁶

Psychosocial health

This literature examines whether and how pets contribute to general psychological well-being. Research designs vary widely, including analysis of correlational, cross-sectional data^{30,47,57-59} semi-structured^{13,60} and in-depth interviews,^{61,62} focus groups,⁶³ and participatory photo analysis.⁶⁴ Conceptual frameworks also vary, framing the data from the perspective of the life course^{19,65} or attachment theory,^{17,21,57,66} just to give two examples. In this literature, as in other categories, results are inconclusive. For example, a study of people who acquired a dog or cat after not recently owning one showed improvements over the subsequent ten months in their psychological well-being and self-esteem.⁸ Yet, a study comparing pet owners to non-owners showed that owners suffered more from psychological problems such as anxiety and depression.⁶⁷ Another found no difference between owners and non-owners on scores for life satisfaction and happiness.⁶⁸ Along with examining general well-being, the research focused on determinants of psychosocial health, such as social support, loneliness, and bereavement, and outcomes, such as depression.

Social support and other determinants

The literature on human-animal interaction has long documented how dogs, in particular, serve as “social facilitators,” increasing interactions between people.⁶⁹⁻⁷² Strangers will initiate conversations with people accompanied by dogs where they would not do so with a person alone. Consistent with this, studies found that dog walkers often conversed with the people they encountered while on walks.^{73,74,63} Those who engaged in conversation reported feeling less lonely than those who did not converse with the people they encountered.⁷³ The majority of people who conversed with other people developed new friendships, but

the move from conversation to friendship did not reduce either loneliness or stress. However, one study found that having a pet did not significantly increase the frequency of social contacts for the elderly.⁷⁵ At least three studies found an association between pet ownership and lower levels of loneliness.^{58,63,74} Other studies, however, found no evidence that pets reduce loneliness.⁷⁵⁻⁷⁸ One even found that dog ownership significantly increased the likelihood of using mental healthcare services among the elderly.⁷⁵ Nevertheless, owners commonly listed companionship as the most important benefit of pet ownership and claimed that their pets had a positive impact on their lives.^{62,64,79,80}

Studies also discuss the importance of attachment to pets^{13,14,21} and its interaction with levels of social support. Among clients at a tertiary-care veterinary hospital, for example, owners who reported the highest measures of attachment to their dogs also had lower levels of social support from other people.⁶⁵ Strong attachment to pets was associated with less reported illness only among those with low support from other people; it was associated with greater reported illness among those with high support.¹⁷ Close bonds with pets also moderated the grief experienced after the death of a spouse.⁸¹ One study examined the influence of anthropomorphism.⁸² Regardless of the amount of human social support available, dog owners who engaged in high levels of anthropomorphism experienced more stress and depression, reported more visits to doctors, and took more medications.

The research on social support also highlights the potential benefits of pets for community well-being. By facilitating social contact and interaction, pets may contribute to the formation of social capital. Understood as the features of social life, such as the networks, norms, and sense of goodwill and trust that enable members to act together to pursue shared objectives, social capital has also been associated with psychosocial health.^{63,74} By encouraging interaction with other people, dog ownership, in particular, can contribute to a general sense of community and a feeling of safety.

Depression

According to the World Health Organization, depression is the leading cause of disability worldwide.⁸³ Finding that pets provide a buffer against depression would enhance public health significantly.

Conclusions about the role of pets in reducing depression remain elusive, however, with multiple studies reporting conflicting results. Although some studies find an association between pet ownership and reduced prevalence of depression,⁸⁴ the difference between pet owners and non-owners may not reach statistical significance.⁸⁵ Other studies find that pet owners do not differ from non-owners on either depression scores or measures of anxiety, life happiness, and satisfaction.^{59,86} Evidence suggests that the benefits of pet ownership for depression may depend on the social support one has from other people. In a study of men diagnosed with AIDS, pet owners who reported having fewer human confidants reported less depression, compared with non-owners.⁸⁴ Some evidence suggests that degree of attachment to pets might influence the benefits derived from the relationship, but results shed no light on the direction of the association. Whereas two studies found that owners who are more attached to their pets (measured by the Lexington Attachment to Pets Scale) have higher levels of depression than those who are less attached,^{87,66} another found that strong attachment to a pet was significantly associated with less depression.¹⁷

One large study of older adults found *more* symptoms of depression among pet owners.³³ Moreover, a data-mining study of electronic health records found that women presenting to health services with cat bites had a 47% lifetime risk of developing depression, compared to 23% for men.⁸⁸ As of yet, no causal links are offered for this association.

Physical Activity

The relationship between pet ownership and physical activity has received increasing attention with the growing awareness that large proportions of the populations of developed countries lead sedentary lives, which could contribute to obesity and related chronic disease. Moreover, in 2003, a report by the U.S. National Academy of Sciences announced, “one out of every four dogs and cats in the western world is now obese.”⁸⁹ In 2008, only 21% of American adults meet the guidelines for physical activity established by the Centers for Disease Control and Prevention.⁹⁰ Because brisk walking for 150 minutes per week

meets the requirement for physical activity, regular walks could contribute to the overall health of people and their dogs.

All but two of the studies found an association between pet ownership, particularly dog ownership, and physical activity. Most studies use cross-sectional methodologies, and the majority were conducted in the United States or Australia. Methods used for reporting activity vary, including pedometers, accelerometers, and self-reports. Although some of the studies we categorized under other topics also examined physical activity,^{8,48} we include here only those studies that *directly* examine the association between exercise and pet ownership.

Overall, the majority of the research indicates that dog owners engage in more physical activity, particularly walking, compared to non-owners. Exceptions include the earliest study, which found no statistically significant differences in amount of overall physical activity engaged in by dog owners, despite taking longer walks than the non-owners in the research.⁹¹ A study of owners and dogs in a veterinary-directed walking program found no significant differences between owners instructed to walk 30 minutes each day and those in a control group who did not increase their activity.⁹² Measures of serum triglycerides increased significantly among those walking their dogs. One study of adolescents found only a small, albeit positive, association between physical activity and family dog ownership.⁹³

Across the literature, only about 60% of owners walk their dogs regularly.⁹⁴ For example, a study of children (age 9-10) found that only about a third of those who have dogs report walking them at least once a day.⁹⁵ Another found that dog owners who walked their dogs engaged in 18 minutes more exercise per week more than non-dog owners did.⁹⁶ However, more than half of dog owners did not walk their dogs at all. Estimates based on Australian data suggest that, if all owners walked their dogs, it might result in a national annual healthcare cost savings of \$175 million per year.⁹⁶ Consequently, several studies examine correlates of and motivators for dog walking.⁹⁷ These include dogs' requirement for exercise,⁹⁸⁻¹⁰⁰ people's level of attachment to dogs,¹⁰¹ environmental factors,¹⁰² and the support and companionship provided by dogs.^{97,103,104}

Discussion

This analysis summarizes empirical studies of the health benefits of pet ownership published between 1980 and 2016. The literature encompasses four topics, including cardiovascular, general, and psychosocial health, and physical activity. The number of studies has steadily increased, particularly since 2000, and the methodological rigor has improved. Overall, the literature finds that pets benefit human health, although the available evidence is far from consistent. Results do not always reach statistical significance and effect sizes, where reported, are often small to moderate. Moreover, numerous studies raise questions about validity. Many use cross-sectional designs, which may establish associations but cannot establish causality. Statistical studies are often underpowered, having sample sizes too small to detect even a moderate effect. Small sample sizes, biased samples, anecdotal evidence, homogeneous populations, and varying research designs compromise the methodological rigor required to understand the direct benefits of pets. Some reveal few details about samples and provide no measure of the size of the effect they claim to find. Only two studies manipulate pet ownership using a quasi-experimental design. Although it would be impossible to “blind” a person to the presence of a pet, increased rigor is nevertheless essential for building on established findings. It could come from randomization, longitudinal designs, and numerous other methodological strategies.

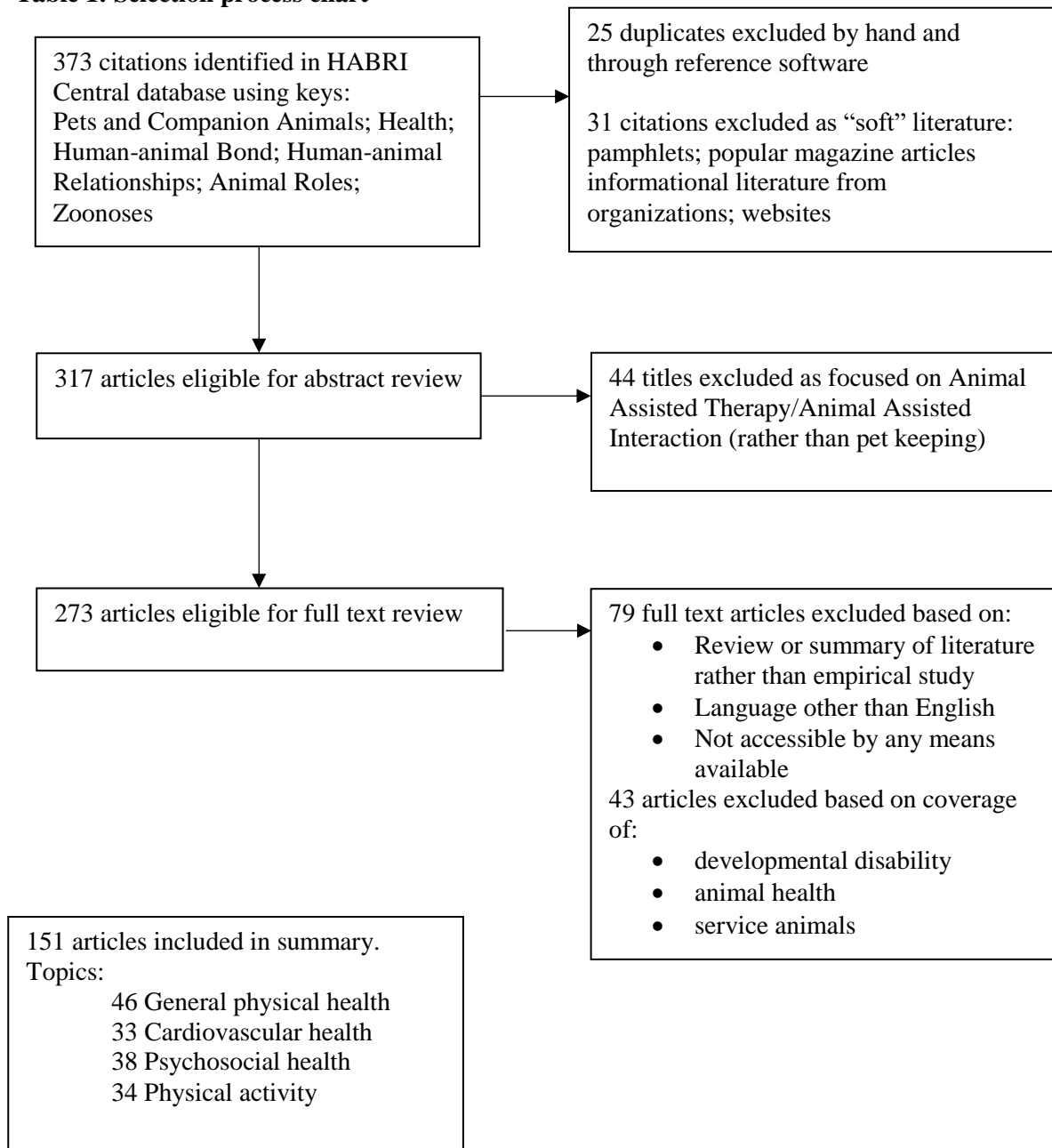
Many studies rely on self-reports by self-selected pet owners, raising questions of confirmation bias. Moreover, it may be difficult to disguise the goal of a study involving animals, making them susceptible to demand characteristics, whereby participants change their behavior to fit their perception of the intended outcome. Researchers, too, can bring threats to validity by having a stake in the outcome of their studies. As pet lovers, some might come to the research already confident of the positive influence of pets on health. Finally, funding for some studies comes from pet-related sources, which have an investment in finding the benefits of pet ownership.

Largely because the methodologies used in the research reviewed here differ substantially, conflicting results preclude definitive claims about the health benefits of pets. Criticisms aside, however, the findings about dog ownership and physical activity are promising. These studies received the highest

scores for methodological rigor. Overall, the research indicates that the exercise provided by dog walking provides cardiovascular and other health benefits. Moreover, dog walking offers opportunities to build social support through connections with other dog walkers, and the combination of pet ownership and social support appears to mediate depression and stress. The research on dog walking thus has substantial public health implications, indicating the importance of further research. Moreover, because canine obesity represents a growing veterinary health concern, the topic merits involvement by the veterinary profession. This analysis suggests two potential opportunities for such involvement. The first has to do with the development and implementation of means to measure walking. The research revealed considerable variation in the frequency and duration of walks engaged in by dog owners. Some of this variation stems from the different methods used to measure walking, with range from self-reports to pedometers and accelerometers. The variation can be resolved with consistent, objective measures. Veterinarians have assisted in developing ways of measuring canine physical activity, and continued efforts can improve accuracy.

Since some of the variation in walking activity occurs because many owners simply do not walk their dogs, a second opportunity for involvement by veterinarians arises through the need to understand the obstacles that prevent owners from walking. In this analysis, only one study examined why dog owners do *not* walk their dogs.⁹⁹ The obstacles can be associated with characteristics of dogs, the human-dog relationship, their owners themselves, or the physical environment. Existing research suggests that dog owners respond positively to veterinary-directed counseling about physical activity.¹⁰⁵ Although outcomes for canine health are an obvious research possibility, research could also suggest how veterinarians might collaborate with physicians to enhance the health of the human-canine pair. Quantitative and qualitative research could assess the best ways to offer counseling about physical activity. The results would contribute to the existing research on veterinary-client communication and make recommendations to companion animal practitioners. In short, the goal of increasing canine and human activity, and therefore, health, depends on greater involvement by veterinarians.

Table 1: Selection process chart



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Appendix A: Studies by Category

REPORT BENEFITS	NO BENEFITS
<i>General physical health</i>	
<p>Akiyama, et al. 1987 Almqvist, et al., 2003 Bolin, 1987 Budge, et al., 1998 Chur-Hansen, et al., 2009 Enmarker, et al., 2012 Fossey, 2013 Friedmann, et al., 1984 (with demographic variables) Gonzalez Ramirez & Hernandez, 2013 Headey, 1999 Headey & Grabka, 2007 Headey, et al, 2008 Lewis, et al., 2009 Maranda & Gupta, 2016 McConnell, et al., 2011 Ming, et al., 2007 Norris, et al., 1999 Ownby & Johnson, 2003 Pachana, et al., 2005 (with demographic and other variables) Pohlabein, et al., 2007 Riddick, 1985 Serpell, 1991 Siegel, 1990 Terra, et al., 2012</p>	<p>Gillum & Obisesan, 2010 Gulick & Krause-Parello, 2012 Jorm, et al., 1997 Kovusilta & Ojanlatva, 2006 Kurrle, 2004 Lodrup Carlsen, et al., 2012 Mathers, et al., 2010 Müllersdorf, et al., 2012 Mullersdorf, et al., 2010 Parslow, et al., 2005 Parslow, et al., 2003a Paul & Serpell, 1996 Robb & Stegman, 1983 Rijken & Beek, 2011 Simons, et al., 2000 Stallones, et al., 1990 Stevens, et al, 2010 Tucker, et al., 1995 Wells, 2009 Wells & Rodi, 2000 Winefield, et al., 2008</p>
<i>Cardiovascular health</i>	
<p>Allen, et al., 1991 Allen, et al., 2001 Allen, et al., 2002 Anderson, et al., 1992 Charnetski, et al., 2004 Demello 1999 DeSchrive & Riddick, 1996 Friedmann & Thomas, 1995 (dogs only, with social support) Friedmann, et al., 1979 Friedmann, et al., 1980 (with other social variables) Friedmann, et al., 1983 Friedmann, et al., 1993 Friedmann, et al., 2003 Friedmann, et al., 2007 Friedmann, et al., 2011 Gadowski, et al., 2015 Grossberg, 1988 (but not for autonomic functions)</p>	<p>Kingwell, 2001 McNicholas, et al., 1998 Parker, et al., 2010 Parslow, et al., 2003b Wright, et al., 2007</p>

<p>Handlin, et al., 2015 Herrald, et al., 1999 Jenkins, 1986 Miller, et al., 2009 Motooka, et al., 2006 Ogechi, et al., 2016 (cats only) Qureshi, et al., 2009 (cats only) Schofield, 2003 Suguwara, et al., 2012 Vormbrock & Grossberg, 1988 Wilson, 1991</p>	
<i>Psychosocial health</i>	
<p>Albert & Anderson, 1997 Antonacopoulos & Pychyl, 2010a, 2014 Connell & Lago, 1984 El-Alayli, et al., 2006 Enders-Slegers, 2000 Fu, et al., 2009 Hutton, 2014 Kabel, et al., 2015 Kidd & Kidd, 1998, 1999 Mahalski, et al., 1988 Miltiades & Shearer, 2011 Netting, et al., 2012 Putney, 2014 Raina, et al., 1999 Siegel, et al., 1999 Stoekel, et al., 2014 Straede & Gates, 1993 Watt & Pachana, 2007 Westgarth, et al., 2009 Wood, et al., 2005 Wood, et al., 2007 Zasloff & Kidd, 1994</p>	<p>Antonacopoulos & Pychyl, 2010b Christiansen, et al., 2013 Cline, 2010 Crowley-Robinson & Blackshaw, 1998 Fritz, et al., 1996 Garrity, et al., 1989 Gilbey, et al., 2007 Girardi & Pozzulo, 2015 Hanauer et al., 2013 Himsworth & Rock, 2013 Kimura, et al., 2011, 2014 Ory & Goldberg, 1983 Watson & Weinstein, 1993</p>
<i>Physical Activity</i>	
<p>Bauman, et al., 2001 Brown & Rhodes, 2006 Christian, et al., 2010 Coleman Physical Activity 2008 Cutt, et al., 2008a Cutt, et al., 2008b Cutt, et al., 2008c Cutt, et al., 2008d Cutt, et al., 2008e Feng, et al., 2014 Garcia, et al., 2015 Gretebeck, et al, 2013 Ham & Epping, 2006</p>	<p>Dembicki & Anderson, 1996</p>

Higgins, et al., 2013 Lacey, 2004 Lentino, et al., 2012 Oka & Shibata, 2009 Owen, et al., 2010 Reeves, et al., 2011 Richards, et al., 2013 Salmon, et al., 2010 Schofield, et al., 2005 Sirard, et al., 2011 Stephens, et al., 2012 Straub, et al., 2013 Thorpe, 2004 (but only “non-exercise” walking) Thorpe, et al., 2006b Thorpe, et al., 2006a Utz, 2014 Westgarth, et al., 2012 Westgarth, et al., 2013 Westgarth, et al., 2015 Yabroff, et al., 2008	
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Appendix B: Full list of studies reviewed

- Akiyama H, Holtzman JM, Britz WE. Pet ownership and health status during bereavement. *Omega J Death Dying*. 1987;17(2):187-193.
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