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OPINION
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To a Future Where Everyone Can Walk a Dog Even if They Don't Own One

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Despite desperately wanting a dog, like many children, because of restricted financial circumstances, I did not have the good fortune of owning a dog as a child. However, research may overcome this barrier so that lack of dog ownership need not be a barrier to spending time with and walking dogs.

The US Department of Health and Human Services recommends walking 5 days a week for at least 45 minutes at a time, with 30 minutes at a moderate to brisk pace of 3–4 miles per hour and 15 minutes at a very brisk walking of 5–6 miles per hour (1). This level of physical activity is associated with a decreased risk of mortality, cardiorespiratory disease, and increased likelihood for weight-loss, and improvements in musculoskeletal health (2). Only about half of Americans engage in this recommended amount of physical activity (3). But if every American had a healthy dog and walked it regularly, they would be more likely to achieve these recommended levels of activity (4).

Multiple studies show that dog ownership improves human health. Becoming a dog owner increases physical activity (4–7) and walking (8–10), reduces your weight (11), and decreases your odds of diabetes, hypertension, hypercholesterolemia, and depression (12–15). Dog ownership reduces predictors of negative cardiovascular outcomes like blood pressure (15–19), triglycerides (20, 21), and stress (22–25). Indeed, owning a dog increases the likelihood of you surviving a heart attack (26–28) such that even the American Heart Association advocates dog ownership as a way to reduce the risk of cardiovascular disease (29). Australian, German, and Chinese studies show that pet ownership decreases doctor visits, and reduces the likelihood of cardiac problems and sleeping difficulties (30–33). Interventions with dogs improve the outcome of children, adolescents, and adults with a range of medical and psychological problems including post-traumatic stress disorder, developmental disabilities, schizophrenia, autism-spectrum disorders, and cancer (34–38). In a short period of time, human-animal studies have progressed from small experimental studies to studies assessing the public health impact of dogs on human lives, including increasing human physical activity, please see these reviews (6, 34–43).

Despite the double challenge of conducting clinical trials with humans and animals (44) randomized controlled trials are needed in this field. For instance in considering the needs of both dogs and humans, human-animal trials require approval from both human and animal institutional review boards. However, the randomized controlled trial is the gold standard for the assessment of intervention efficacy because it most effectively and efficiently evaluates an intervention's effect, eliminating systematic, and random bias (45).

A search using the terms "randomized controlled trial" AND "dogs" and "walking" resulted in 40 hits in PubMed up to 4/15/2018. When studies with groups with psychological or medical problems were excluded, this yielded five randomized controlled trials (46–51), that examine the effects of dog-walking on human walking, see **Table 1**. An effect size could not be calculated for one of the five randomized controlled trials, and of the remaining 4 randomized controlled trials, two had moderate to large effects (Hedges g) for the dog-walking intervention arm, and two of the four had small effects.

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TABLE 1 | Randomized controlled trials examining the effect of dog-walking interventions on human walking.

Study	Intervention	Physical activity	Assesed at # months	*n/N*	*g*
Richards et al. (46)	3 month intervention: (1) Dog owners + intervention (weekly emails addressing self-efficacy, social support, goal setting, and benefits/barriers to walking). Other arms were (2) Non-dog owners + intervention, (3) Non-dog owners with control intervention (emailed Physical activity guidelines) intervention and (4) Dog owners with control intervention.	Min/wk	6	20/65	1.00
Schneider et al. (47)	6 month intervention: (1) Dog owners + social online network meetup and newsletters. Other arm was (2) Dog owners + control intervention (emailed physical activity guidelines)	Steps/day	6	45/102	0.21
Rhodes et al. (48)	3 month intervention: (1) Dog owners+ Persuasive information about dog health and walking, and walking calendar. Other arm was (2) Dog owners walking-as-usual	Min/wk	3	30/58	0.72
Morrison et al. (49)	2.5 month intervention: (1) Dog owners and their families + behavioral intervention. Other arm was (2) Dog owners and families with no intervention.	Parent Actigraph counts/min/wk	2.5	15/27	0.15
Byers et al. (50, 51)	1 week intervention: (1) Dog owners and their overweight dogs + vets physical activity prescription. Other arm was (2) Dog owners and their overweight dogs + standard care	Human steps unreported.	3	32/72	NA

Calculation for Hedges $g = (m_1 - m_2)/s^*$ *where* m_1 *=baseline mean,* m_2 *=mean at 2nd timepoint,* $s^* = \sqrt{[(n_1-1)s_1{}^2 + (n_2-1)\, s_2{}^2 / (n_1 + n_2-2)]}$ *where* n_1 *=baseline sample size,* n_2 *is sample size at 2nd timepoint calculated on the intervention arm of interest. In* ***Table 1****, n=number of participants in intervention arm of interest, N=number of participants in the whole study. NA = not available.*

These randomized controlled trials focus on dog owners walking their dogs. However, randomized controlled trials that focus on dog owners walking their own dogs may limit whether dog-walking interventions can be "scaled-up" or implemented on a more widespread basis (52).

Certain correlates may distinguish dog owners from non-dog owners. For instance, a large US study showed that dog ownership is associated with being white, with home ownership, and with living in a house (53). A review of the literature also suggests that living close to places wheredogs can be walked (41) also increases the likelihood of owning a dog. The implication of this is that racial diversity, renting rather than owning a home, living in an apartment, and possibly socioeconomic disadvantage may decrease the likelihood of dog ownership. So although 44% of households in the US (2015–2016) are estimated to own a dog, the majority of households do not (54).

But does lack of dog ownership have to be a barrier to dog-walking interventions? One of the foreseeable challenges for dog-walking interventions targeting human physical activity is working out how to scale this intervention to individuals who do not own a dog. There are numerous online media reports of shelter dog-walking programs, even phone applications for walking shelter dogs. However, trials published in peer-reviewed journals are scant (55, 56). One small open trial with public housing residents showed that overweight individuals who borrowed and walked dogs from a dog-shelter had small (hedges g = 0.17), but significant weight loss (57). This suggests that pairing individuals who do not own a dog with dogs in rescues or shelters may be a feasible weight loss solution.

Designing behavioral interventions that can "scale-up" is increasingly becoming an important criteria for the success of an intervention (58, 59). One of the ways that this critical barrier can be addressed is by considering mutually beneficial partnerships between dog shelters/rescues and other institutions, some of which may seem improbable at first.

An important start is to take into account both the socio-ecological structure and function of institutions. Drawing on Bronferonner's work (60), Westgarth et al. (41) describes the structure of a socio-ecological model of dog-walking that highlights the individual sphere of influence and its dog-related factors, as well as more distal social-environmental, and physical-environmental factors that are associated with dog-walking (6). This can add to a consideration of the functions of different institutions and how these can promote healthy behaviors in both individuals and institutions.

Human-dog relationships have been described as a form of social capital which is defined as an "investment in social relations with expected returns" (61–63). On a system-level mutually reinforcing, sustainable partnerships can be formed between institutions to improve the health of both humans and animals (62, 63). Social capital requires the utilization of resources embedded in a social structure, accessibility to this, and the mobilization of these resources for purposive action, e.g., improved health for both humans and animals (62, 63). Increasing physical activityis a serious public health challenge; as is ensuring that homeless dogs are cared for. Considering a model of human-dog interventions that considers function as well as the structure of institutions and individuals is empowering and self-sustaining, and has the potential to build scalable, sustainable interventions.

Everyone who does not own a dog could probably benefit from walking a dog daily. However, there may be certain institutions that could provide the other half of a mutually beneficial partnership. For instance, with appropriate supervision, various institutions could offer dog-walking opportunities: health care

institutions like rehabilitation centers, half-way houses, group homes or elder care facilities; educational institutions, such as colleges or schools; even insurance companies.

Is it possible to do something like this? Recently undergraduates at Temple University undertook this endeavor. Temple University is a large urban college in Center City Philadelphia consisting of a socioeconomically and racially diverse group of more than 30,000 undergraduates. After a review of the literature (64) over the summer of 2017, one of my lab undergraduates sent an informational Facebook message on July 18th, 2017 to the incoming freshmen class and in one day 22 incoming freshmen posted their interest (and photos of their dogs) in joining a volunteer dog-walking association, with another 56 freshmen signing up. In 10 days, 172 incoming freshmen posted their interest in joining the volunteer dog-walking association. On December 6th, 2017, the "Diamond Dogs" undergraduate dog-walking association was formally ratified by the university, with support from the Dean's office and since then there have been 3 townhall meetings of ∼70 students a time. "Diamond Dogs" is partnered with two inner-city dog rescues approximately a mile from Temple University's campus. My last communication with the rescues was that students are participating in their orientations and training and are walking their dogs. From the perspective of dog rescues, this is a "win-win." Inner city rescues in Philadelphia find it difficult to recuit regular dog-walkers but a schedule of regular volunteer walkers has eased their need to play and to walk their healthy dogs daily.

Humans form strong attachments to pets, particularly dogs (65–68) and pets increase social capital through creating more social connections and networks (61, 69, 70). But will people who don't own a dog develop an attachment for a dog at a shelter or rescue who may leave in a couple of weeks because they have been adopted? Are the positive cardiovascular effects in response to stressful situations also found in non-dog owners who interact with shelter or rescue dogs (71)? Can shelter/rescue dog-walking interventions increase the likelihood of walkers to eventually adopt a dog? Can cortisol or immunological measures be used to check that shelter/rescue dogs are experiencing less stress with regular walkers (72)? While these are important research questions there are also important ethical and practical issues to consider in research of this nature.

Rescue and shelter dogs often have greater psychological and medical needs than dogs not in a shelter or rescue. Volunteers at shelters are likely to be pet-owners (73) and shelters and rescues are likely to prefer experienced dog owners rather than non-dog owners to walk their dogs. Guidelines from the Association of Shelter Veterinarians (74), and from the American Veterinary Medical Association (75) and the Humane Society (76) highlight the importance of training and supervising shelter and rescue volunteers, including basic training in animal handling and bite prevention. However, research addressing the training of non-dog owner volunteers is in its infancy (77, 78). Some questions that will need to be answered include: how much training do non-dog owner volunteer walkers need to achieve the skill level of experienced dog owners? How are these skills best assessed? And what are the effects of volunteers with varied experience on shelter dogs?

Assessing the efficacy of shelter dog-walking intervention for non- owners, deserves the best designs and methods. This means that non-peer reviewed reports by the media are not sufficient as evidence for the efficacy of interventions like this and the use of phone applications to encourage the walking of shelter dogs warrant thoughtful and rigorous testing prior to widespread use or claims about their effect. Clinical trials with shelter dogs and humans need to meet both Human Institutional Review Board and Institutional Animal Care and Use Committee requirements. The design and oversight of these trials require the partnership of human clinical trial experts, human-animal intervention research experts, veternarians, and shelters/rescues. There are not only ethical issues that must be considered but also legal issues in clinical trials of this nature. For instance animal rescues in the United States are governed by state, county and city ordinances that may differ between rescues. Careful attention to these ordinances are needed in rescue dog-walking intervention trials.

It is important to conduct clinical trials to test if it is possible to engage educational and social institutions in mutually reinforcing partnerships to improve the health of people and animals. The Shelter dog-walking intervention proposed can potentially make dog-walking a scalable intervention and has broad applicability to a wide variety of institutions and partnerships.

Despite the challenges, I'm looking forward to a future where everyone can walk a dog even if they don't own one.

AUTHOR CONTRIBUTIONS

EC conceived of this idea and opinion and wrote this paper.

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