Increasing physical activity by four legs rather than two: Systematic review of dog-facilitated physical activity interventions

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Increasing physical activity – by 4 legs rather than 2: A systematic review of dog facilitated physical activity interventions

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ABSTRACT

Objective: Regular walking is a critical target of physical activity promotion, and dog walking is a feasible physical activity intervention for a large segment of the population. The purpose of this paper was to review physical activity interventions that have involved canine interactions, and evaluate their effectiveness. A secondary aim of this review was to highlight the populations, settings, designs, and intervention components that have been applied so as to inform future research. **Design:** Systematic review. **Data Sources:** We carried out literature searches to August 2019 using six common databases. **Eligibility Criteria:** Studies included published papers in peer-reviewed journals and grey literature (theses, dissertations) in the English language that included any physical activity behavior change design (i.e., RCT, quasi experimental) that focused on canine-related intervention. We grouped findings grouped by population, setting, medium, research design and quality, theory, and behavior change techniques applied. **Results:** The initial search yielded 25,010 publications which was reduced to 13 independent studies of medium and high risk of bias after screening for eligibility criteria. The approaches to intervene on physical activity were varied and included loaner dogs, new dog owners, and the promotion of walking among established dog owners. Findings were consistent in showing that canine-assisted interventions do increase physical activity (82% of the studies had changes favoring the canine-facilitated intervention). Exploratory sub-analyses showed that specific study characteristics and methods may have moderated the effects. Compared to studies with longer follow-up periods, studies with shorter follow-up favored behaviour changes of the canine intervention over the control condition. **Conclusions:** Canine-based physical activity interventions appear effective, but future research should move beyond feasibility and proof of concept studies to increase rigor, quality, and generalisability of findings.

SUMMARY

- Dog ownership is estimated at over 30% of households in developed countries yet approximately half of owners do not walk their dogs regularly
- This is the first systematic review of physical activity interventions focused on dog walking
- The 13 interventions identified in the literature review showed evidence of increases in dog walking over time
- Whether dog walking-specific content results in increased physical activity over generic content is inconclusive at present
- Most studies were proof of concept or feasibility in nature. Future research needs to explore dog walking interventions using larger sample sizes in diverse community settings

INTRODUCTION

Regular physical activity among adults has a significant number of health benefits, evidenced by considerably reduced risks of key chronic diseases such as heart disease, type 2 diabetes, several cancers and even all-cause mortality [1, 2]. Physical activity is also a critical health behavior among children and adolescents as it protects against high blood pressure, high blood cholesterol, metabolic syndrome, low bone density, depression, and obesity [3-5] and forms the behavioral patterns that track into adulthood [6, 7]. Despite the irrefutable benefits of regular physical activity, participation rates are low, particularly among industrialized and wealthy nations [8]. Consequently, sustainable physical activity promotion initiatives are of high importance to public health.

Regular walking is one of the most common physical activities and thus a key target for intervention [9]. Walking is one of the safest and most affordable forms of physical activity [10]. It is easily achievable by a large majority of people with little skill or equipment involved, and is an activity that can be performed individually or with others in groups. People walking their dogs is a common sight in most urban communities in many countries. Thus, perhaps unsurprisingly, dog ownership is an established correlate of regular walking [11-13]. It is now well-established that dog owners report more recreational walking than non-owners [14-17].

While there is ample cross-sectional evidence of higher walking levels associated with dog ownership, such evidence has limited application to physical activity promotion. Dog ownership is a considerable responsibility with cost implications and so recommending that people adopt dogs merely for the health benefits of walking is not practical, nor ethical [18]. Approximately 30% of the households in high income countries own dogs [12], yet it is estimated that up to half of these dog owners do not walk with their dogs regularly [14]. Promoting more

walking as a low-cost sustainable behavior among existing dog owners seems like a logical way to engender both human and canine health benefits simultaneously in a large target population [19, 12, 20]. Dogs are also often used in various rehabilitation contexts and social programs for marginalised or clinical populations [13, 11]. Leveraging these programs to increase physical activity may be an additional benefit.

Research focused on the correlates of dog walking has been building in order to inform interventions. A review of 31 studies on the correlates of walking among dog owners found that the relationship with a dog, often in the form of feelings of responsibility/obligation/support, is the foremost factor associated with dog walking that may distinguish it uniquely from other forms of physical activity[21]. The review also highlighted environmental access to suitable walking areas with dog supportive features (e.g., off-leash exercise) as consistently associated with increased dog walking. Individual-level theories of behavior change have also been applied to understand dog walking behavior such as social cognitive theory [22], self-determination theory [23], theory of planned behavior [24, e.g., 25, 26], and multi-process action control [27]. These approaches have highlighted the importance of canine-related outcome expectations, social support, intention to walk, autonomous motivation, habit, and identity.

Taken together, there are a number of correlates of dog walking behavior that could be targeted as mediators to change behavior across multiple levels of agency, from policy and environment, to social support groups and individual motivation. At present, however, there is no systematic review of interventions where dogs were used as the means to increase human physical activity. Thus, the purpose of this paper was to review physical activity interventions that have involved canine interactions, and evaluate their effectiveness. As a secondary objective, we sought to explore the reasons behind successful interventions, the breadth of the intervention

approaches, and highlight the populations, settings, designs, and intervention components that have been explored in order to inform future intervention research.

METHODS

This systematic review was conducted and reported in accordance with the Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) guidelines [28].

Eligibility criteria

Four eligibility criteria were implemented for papers to be included: 1) published in an English, peer-reviewed journal or the grey literature; 2) used a design that can infer changes in physical activity (RCT, quasi experimental, pre-post design) and not cross-sectional or qualitative designs; 3) measured dog-facilitated physical activity; and 4) included an intervention component to impart physical activity change (i.e., not passive observational).

Information sources, search strategy and study selection

From August to September 2019, the second author searched 6 electronic databases (Psych Info, Web of Science, ERIC, PsychARTICLES and HealthSource: Nursing/Academic Edition, PubMed) to identify eligible articles. Search terms were the following: ("dog" OR "pet" OR "canine" AND "physical activity" OR "walking" AND "intervention" OR "trial" OR "experiment"). Boolean searching was used to ensure all articles included at least one term from each of the three groups as follows: the phrase 'OR' was used within groups and 'AND' was used between groups. To streamline the search, the author applied a filter to the search strategy – English-language (see Appendix 1). Theses and Dissertations were also included with this search strategy to assist in retrieving the gray literature. Finally, a manual search of all reference lists from the retrieved eligible papers was performed to cross-reference eligible studies that may have been missed in the formal search. Articles were screened for eligibility by title and abstract. At

this point exclusion was mainly due to study design or absence of human physical activity. See Figure 1 for a detailed depiction of the literature search screening process.

Data collection process and data items

Data were extracted independently among two authors (first and second authors) for intervention, measurement, and participant characteristics, as well as statistical significance of the findings. Intervention characteristics included: use of theory, intervention duration and quality, setting, medium of dissemination, and behavior change techniques. Measurement characteristics included: physical activity measures (objective, self-reported or both). In all cases where possible, we sought the most robust measure of physical activity in our analyses (e.g., total walking, compared to dog walking specifically; objective assessments, compared to self-report). Participant characteristics included: sample size, mean age, sex, baseline activity status, population type (general community or clinical), and geographical location.

These two coders also coded behavior change techniques according to Michie et al.'s [29] 93-item taxonomy. Independently, the two coders completed a binary checklist (0 = no, 1 = yes) for each included study. Any discrepancies were resolved by discussion until 100% consensus was reached. A total number of behavior change techniques per study was also coded.

Risk of bias assessment

We conducted a risk of bias assessment using the ROB-2 for randomized controlled trials [30] and the ROBINS-I for nonrandomized interventions [31]. Three independent coders (first, third and fourth authors) assessed study quality and any disagreements were resolved via discussion to reach a final decision. The studies were then classified into overall low risk, some concerns (medium quality), and high risk categories based on the scoring protocol of the instruments. A detailed quality assessment for each item by study is included in Appendices 2 and 3.

Analysis

Meta-analysis was precluded for two main reasons. First, there was extensive heterogeneity in the study designs, statistical tests employed, and populations, all of which impact the ability to accurately pool the studies for quantitative synthesis [32]. Second, a descriptive synthesis is most appropriate when there are caveats or other idiosyncrasies specific to some studies that could change the outcome in a meta-analysis. Thus, we employed two methods of synthesis suggested by McKenzie and Brennan [33]. Following initial read-throughs of the studies, our analysis collated the median effect size and quartile range, as well as a count of the direction of the findings in support of the dog-related intervention compared to its comparison condition, independent of whether the finding was reported as statistically significant. Sub-analyses of these results were also conducted to explore group differences according to the design employed, the follow-up length of the studies, the population of the sample, the quality of the studies, setting and medium of intervention, and the theoretical frame and behavior change techniques (BCTs) employed using the same analysis approach.

RESULTS

Study Selection

As shown in Figure 1, the electronic database search yielded 25010 articles, out of which 116 were determined to be potentially relevant through title screening. Of those, 42 records were screened out by titles and abstracts including duplicates that were removed. In the remaining 74 records, 62 studies were excluded because they a) covered topics other than physical activity in a form of dog-walking (n = 27), b) did not use the appropriate design (n = 25), or c) were review articles (n = 10). Three additional articles were identified by manual cross-referencing and searching theses and dissertations. If there was any doubt regarding the relevance

of a paper, the full text was discussed among authors. A total of 13 independent studies passed the inclusion criteria and were included for analysis (see Supplementary Table 1).

Study Characteristics and Measures

Table 1 provides study characteristics for the final 13 studies and 844 participants in the analysis. Sample sizes across studies ranged from n = 16 to n = 236. Participant samples also varied in age from 10 to 95 years of age. Three studies included children, eight studies included middle-aged adults, one study included older adult samples (primarily over 65+ years), and one study did not specify the age of the participants. In terms of gender distribution: all studies included both male and female participants. The PA levels of participants also varied across studies. Six studies included only participants below recommended PA guidelines (as in inclusion criterion) and seven studies had no criterion of baseline PA for inclusion in the study.

Our risk of bias assessment revealed that five studies were classified as high risk/low quality, and eight were classified as medium quality/risk. Most of the studies (n=10) were conducted in USA, while two studies were conducted in Canada and one in the United Kingdom. Seven studies did not explicitly mention a theoretical framework and six studies employed either one or more theories, such as Multi-Process Action Control (n = 1), Social Cognitive Theory (n = 4), or the Health Promotion Model (n = 1). Behavior change technique (BCT) application ranged from 0 to 15 across studies with six studies employing more than four. Eight studies were randomized designs; three were quasi experimental, and two studies had a single pre-post group design. A number of different tools were employed to measure physical activity: nine studies used objective measures such as accelerometers (n=5), pedometers (n=3), and counts of attendance checks; and four studies used self-report. Three studies conducted interventions in a group setting, four studies used weekly or biweekly emails, four studies used face-to-face

intervention, and two studies used alternative means (mail, internet). In terms of the intervention setting: three studies took place in a clinical setting (hospital, vet clinics, assisted-living facilities) with observation, and the remaining 10 studies were conducted within a community or home setting.

Table 1. Characteristics of the Studies in the Review

Characteristics	Sample: *k*=13 independent data sets	Percentage of total *k*
Age		
0-11	-	-
12-35	3	22%
36-50	8	62%
51-65	-	-
65+	1	8%
Not specified	1	8%
Gender		
Male only	-	-
Female only	-	-
Mixed	13	100%
PA Levels at Baseline		
Meeting Guidelines	-	-
Not Meeting Guidelines	6	46%
Mixed	-	-
Unreported	7	54%
Population		
Community	10	77%
Clinical	2	15%
Assisted-living residents	1	8%
Geographical Location		
USA	10	77%
UK	1	8%
Canada	2	15%
Study Design		
Randomized Trial	8	62%
Quasi Experimental	3	23%
Single group	2	15%
Quality Rating		
Moderate	8	62%
Low	5	38%
Theory		

No framework explicitly mentioned	7	54%
Multi-Process Action Control	1	8%
Social Cognitive Theory	4	31%
Health promotion model	1	8%
Physical Activity Measurement		
Objective	9	69%
Validated self-report	3	23%
Study created self-report	1	8%
Setting of the intervention		
Supervised clinical setting (hospital, AL facilities)	3	23%
Community/Home	10	77%
Medium		
Group face-to-face	3	23%
Emails	4	31%
Individual face-to-face	4	31%
Internet/Mail	2	15%

Changes in physical activity behavior

Of the 13 studies included in the review, we used nine [35, 38-41, 44, 42, 45, 47] for effect size-based analyses, and 11 [35, 38-41, 44, 42, 45, 47, 34, 46] for vote counting of the direction of effects in the interventions (see Table 2). Overall, there was positive evidence that canine-related interventions increased physical activity across time with a median effect size *d* of .28 (quartile range = 0.02) and 82% of the studies showed a direction in favor of the dog walking intervention.

Results of the effectiveness of these interventions were mixed, however, when exploratory sub-analyses were conducted by study methods, and characteristics (see Table 2). For example, studies with passive control groups that did not involve a physical activity promotion component [35, 39-41, 44, 42] resulted in larger and more consistent effect (*d* = 30; 86% of studies in the direction favoring the dog intervention) than the small number of studies that

included active physical activity comparison interventions [38, 45, 34] (d = .06; 67 % of studies in the direction favoring the dog intervention). Studies were not heterogeneous enough to evaluate risk of bias in sub-group analyses (all but one study with extracted effect sizes was medium risk). Studies [47, 34, 35, 39-41] with a shorter (< 5 months) follow-up appeared to have larger (d = .50) and more consistent effects favoring the dog walking intervention (100% of studies) than studies [38, 44, 42, 45, 46] with longer (>5 months) follow-up periods (d = .02; 60 % of studies in the direction favoring the dog intervention). Similarly, studies with supervised settings [35, 47], and some component of face-to-face intervention [47, 34, 35, 38, 39, 41] appeared to have greater consistency in findings (100% studies favored supervised dog intervention; 86% of face-to-face studies favored dog intervention). These face-to-face studies also had larger effects (supervised *d* = .68; face-to-face *d* = .42) than community [38-41, 44, 42, 45, 34, 46] physical activity with e-health or distance-based [45, 44, 42, 46] forms of intervention (community *d* = .10; 77% of studies in the direction favoring the dog intervention; e-health d = .05; 75 % of studies in the direction favoring the dog intervention).

To explore the potential effect of sample size on the findings, we used an N = 70 cut-off based upon a rudimentary power analysis using G-Power for a small effect size (f = .17) typically observed in physical activity interventions [2], with alpha = .05, power = .80, and a pre-post, two group experimental design [48]. Studies with larger samples [38, 45, 46] had a lower median effect size (d = .06) and less consistent results (67 % of studies in the direction favoring the dog intervention) than samples within the smaller size [35, 39-41, 44, 42, 47, 34] grouping (*d* = .34; 88 % of studies in the direction favoring the dog intervention). Finally, studies with an explicitly stated theoretical basis for the intervention [34, 35, 40, 44, 42, 45, 47] had some indication of a larger effect (*d* = .31) and more consistency (86% of studies in the direction favoring the dog intervention) than interventions [38, 39, 41, 46] based on no stated theory (*d* = .10; 75% of

studies in the direction favoring the dog intervention), but the volume of BCTs was not clearly linked to behavior change outcomes.

Table 2. *Group differences by study characteristics, and methods*

Grouping variable	Median effect size *d* (*k*)	Quartile	% of effects favoring dog walking intervention
Total	0.28 (*k* = 9)	.02	9 of 11 studies (82%)
Design			
Experimental design	0.28 (*k* = 7)	.05	6 of 7 studies (86%)
Quasi-experimental	0.43 (*k* = 2)	.16	3 of 4 studies (75%)
Control group			
Active	0.06 (*k* = 2)	.16	2 of 3 studies (67%)
Passive	0.30 (*k* = 7)	.03	6 of 7 studies (86%)
Theoretical frame			
Stated theory	0.31 (*k* = 6)	.03	6 of 7 studies (86%)
No theory	0.10 (*k* = 3)	.16	3 of 4 studies (75%)
BCTs			
>4 BCTs	0.28 (*k* = 7)	.05	6 of 7 studies (86%)
<5 BCTs	0.43 (*k* = 2)	.16	3 of 4 studies (75%)
Follow-up			
>5 months	0.02 (*k* = 4)	.13	3 of 5 studies (60%)
<5 months	0.50 (*k* = 5)	.22	6 of 6 studies (100%)
Sample			
Clinical population	0.34 (*k* = 3)	.16	2 of 3 studies (67%)
General population	0.19 (*k* = 6)	.03	7 of 8 studies (88%)
Sample size			
< 70	0.06 (*k* = 2)	.16	2 of 3 studies (67%)
>69	0.34 (*k* = 7)	.05	7 of 8 studies (88%)
Setting			
Supervised	0.68 (*k* = 2)	.34	2 of 2 studies (100%)
Community	0.10 (*k* = 7)	.02	7 of 9 studies (77%)
Dissemination			
Face-to-face	0.42 (*k* = 6)	.04	6 of 7 studies (86%)
Distance	0.05 (*k* = 3)	.02	3 of 4 studies (75%)

BCTs = behavior change techniques.

DISCUSSION

Regular walking is a critical target of physical activity promotion, given its ease of performance, relative affordability and high preference among other PA alternatives [9]. Promoting dog walking is a viable physical activity intervention for a large segment of the population [12]. While a considerable amount of observational evidence on the correlates of dog walking has been published [21], this review provides the first systematic assessment of interventions that aimed at increasing walking. Overall, the findings of this review show that interventions targeting dog walking do result in behavior change, with a quartile range of the median effect size *d* from .26 to .30, commensurate with traditional forms of physical activity intervention [2]. Regular dog walking is a type of physical activity that is sustainable because of its routine nature, and its resilience to changes in season/weather [49]. Additionally dog walking serves multiple collateral goals such as canine wellbeing and human health improvements, and can be a catalyst for more socializing in the community [12].

Overall, 13 mostly randomized or non-randomized studies met inclusion criteria and were included in our review of a total of 844 participants from three countries. There was and a mix of medium and high risk of bias and studies were heterogeneous in terms of age, ranging from children to older adults with a balanced mix of male and female participants. The approaches to intervene on dog walking were also varied and included loaner dogs, new dog owners, and promotion of walking among established dog owners. The theoretical approaches to the dog walking intervention were also varied, with six studies stating a theoretical basis for its proposed mediators, employing a total of 26 different types of BCTs that ranged from zero to 15 different techniques used within the studies. By contrast, the measurement of the criterion variable of physical activity was consistently sound, with 10 of the studies utilizing objective assessments. Finally, implementation of these interventions included a wide variety of dissemination such as face-to-face consultations, email, telephone, physical mail, group presentations, internet delivery

in settings from home or group living facilities, and walking groups at parks, classrooms, and medical facilities. Intervention effectiveness follow-up also varied considerably and ranged from four weeks to one year. Thus, the available sample of studies represents a rich data-set to appraise the state of current evidence in an attempt to synthesise findings and identify areas for future research.

From this review we recommend that dog walking interventions with extended follow-ups are needed to understand the sustainability of this intervention approach and advance this literature beyond the feasibility and proof of concept stage. Specifically, there was evidence that shorter-duration intervention follow-ups (e.g., 12 weeks or less) may have been more effective than longer durations (e.g., 6 months+) so this needs further exploration. Long-term behavior fits with the longer-term nature of dog ownership, yet future research may also need to consider the life stage of human and dogs within different households as interventions begin to scale up.

The results of our review also showed differences in the effectiveness of these interventions, depending on the comparison groups included within the designs. Specifically, walking in the dog intervention condition increased over the comparison condition within the studies where these groups were given no/minimal physical activity promotion content, but dog-based interventions seemed less effective when comparison conditions also included physical activity promotion content. There are a couple of possible reasons for this finding. First, it may be that generic physical activity/walking promotion interventions are used by dog owners as a means to increase walking with their dog anyway. Thus, the participants adapt the information themselves and apply it to increase their own dog walking [34]. Alternatively, the tailored approach to targeting dog walking specifically is no more or less sensitive than standard physical activity interventions. This was supported in the one study we reviewed that compared walking interventions for dog owners and non-dog owners [44]; both intervention conditions increased

walking over time, albeit the small sample size prevented definitive conclusions. Future research using three-armed randomized trials (e.g., no contact control, generic physical activity intervention, and tailored dog walking intervention) are needed to answer these possible scenarios more definitively. The results would help identify whether the added cost of dog-related intervention content and tailoring is necessary/beneficial in physical activity campaigns.

One of the most noteworthy potential moderators, through our exploratory analyses of the findings, was the tendency for larger sample studies to report lower effectiveness estimates. While this finding was also linked to the above content differences in the comparison arms, it suggests the presence of publication biases. It is therefore crucial for the field's development to move away from feasibility/pilot trials towards adequately powered larger trials examining the effects of dog walking interventions on human physical activity behavior change [2]. Such studies will provide the evidence required to pragmatically assess the scalability of dog walking interventions as a means for population health improvements [12].

We found that interventions with supervision and a face-to-face component of delivery may produced larger behavior change effects than distance-based and community interventions. This finding is commensurate with past reviews of physical activity interventions [50, 51], but poses a challenge to scalability and reach. It may be worth exploring hybrids of these approaches as that had success in some of the studies reviewed [40, 39].

Finally, we noted that half of these reviewed studies were not based on an explicitly stated theoretical framework. Among better designed studies, there was a tendency for theory-based interventions to elicit more significant increases in dog walking compared to those that did not state a theoretical framework. While the role of explicit theory in improving behavioral interventions is debatable [52-54], it was clear that almost all of the theoretical approaches in this literature at present are couched in the social cognitive tradition [see 55 for a review of

approaches]. This was explicitly stated in six of the 13 interventions and obvious by the types of behavior change techniques employed among the studies. For example, behavioral instructions on dog walking and social support were included in over half of the studies (e.g., information on dog walking for canine health, places to walk dogs, and walking groups), and problem solving (listing barriers and forming solutions), behavioral demonstration (practice walks with instructors), and information about health consequences (information about how physical activity affects health outcomes) were used in almost half of the interventions. These approaches attempt to address rational expectations about outcomes, perceptions of capability, social connections, and self-regulation tactics as the cornerstones of behavior change [56]. There was evidence for the effectiveness of these approaches in these studies and within the larger physical activity intervention literature [2, 57]. Still, future research may improve upon these strategies by also targeting automatic/reflexive factors (e.g., habit, affective response, identity) or broader socioecological environment and policy factors (dog parks, walking areas for dog owners, off leash sites). The former suggestion had some apparent success in one of the studies within this review [40, 27], while the latter approach is backed by considerable observational research evidence [12, 21].

Strengths and limitations of reviewed studies

The majority of reviewed studies had considerable strengths, including randomized trial methodology, with direct assessments of physical activity, and applications to diverse populations. Still, the current literature also has several weaknesses. The available literature at present is comprised of primarily small sample, short-assessment proof of concept/feasibility interventions.

Strengths and limitations of the current review

Our paper used systematic review reporting standards. Still, there were some limitations of the review methods. Because of the limited number of studies, we mixed a variety of populations and settings into the same analysis. It will be important to separate these interesting aspects with formal testing (once this literature matures) in order to provide evidence that is more conclusive. This literature review is limited by the search terms and search engines employed as well as the English language restrictions. Our analysis methods were also limited to a median effect size estimate and vote counting of the direction of effects at present, given the heterogeneity of the methods employed. This means that the effect size estimates are not corrected for sampling bias and thus do not represent a weighted estimate. While this is an appropriate first assessment a more refined analysis in the future involving formal meta-analysis with subsequent formal moderator analyses will give more concrete answers to the questions or review addressed.

Conclusion

To our knowledge, this is the first systematic review on the effectiveness of canine-based interventions to increase human physical activity. The 13 studies we synthesised showed that these interventions do increase regular walking, but it is not clear whether the dog-related tailoring of the intervention is more effective than more generic walking intervention content. We recommend that future research move beyond feasibility and proof of concept studies to increase rigor and quality, and longer follow-up. We also recommend that researchers expand on the range of theoretical approaches and behavior change techniques used in these interventions.

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Figure Caption:

Figure 1: PRISMA Flow Diagram. Caption: Source inclusion process. Adapted from PRISMA Statement, Moher et al., 2009

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