

Acquiring a Dog and Walking It: A Preliminary Examination of the Possible Physical Activity and Health Benefits

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In light of the detrimental health consequences associated with insufficient physical activity, there is growing concern about the low percentage of adults who are sufficiently active. Given that some researchers have recommended that acquiring a dog should be promoted as a means of increasing physical activity, this longitudinal study examined whether acquiring a dog and walking it leads to an increase in physical activity. Results revealed that participants in the acquired-dog group ($n = 17$) increased their moderate- to vigorous-intensity physical activity in 10-minute bouts from baseline to 8 months, while there was no change in the control group ($n = 28$). The present study also examined whether, if dog owners become more physically active, this results in health benefits. Although individuals in the acquired-dog group increased their physical activity, they did not experience any improvements in their physical or psychological health over the course of the study relative to the control group. However, it is noteworthy that the majority of the acquired-dog group perceived that acquiring a dog had positively affected their health. Taken together, these findings suggest that acquiring a dog and walking it merits further attention as a way of increasing physical activity and there is a need for additional research on the possible physical activity-related health benefits from dog walking.

Keywords: dog, dog walking, longitudinal study, physical activity, physical health, psychological health

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An area of research that is receiving considerable attention is the relationship between physical activity and health. According to the World Health Organization (WHO) insufficient physical activity is the fourth leading risk factor for global mortality after high blood pressure, tobacco use, and high blood glucose (WHO, 2009). It is estimated that 3.2 million people die annually as a result of insufficient physical activity. The importance of physical activity is underscored by the fact that individuals who are insufficiently physically active have a 20% to 30% higher risk of all-cause mortality than those who engage in moderate physical activity for at least 30 minutes on most days of the week (WHO, 2011). The research on the link between physical activity and psychological health is less conclusive than for physical health. However, there is some evidence that physical activity is beneficial in terms of reducing stress (Rahl, 2010) and depression (U.S. Department of Health and Human Services, 2008), while increasing self-esteem (Warburton, Katzmarzyk, Rhodes, & Shephard, 2007) and life satisfaction (Sharpe, Ghangro, Johnson, & Kidwai, 2011).

The recognition that physical activity is important for health has resulted in the WHO and a number of countries developing guidelines for adults outlining the amount of physical activity needed for health benefits. According to the most recent Canadian physical activity guidelines, adults 18 to 64 years of age should accumulate at least 150 minutes of moderate- to vigorous-intensity aerobic physical activity weekly in bouts lasting at least 10 minutes (Canadian Society for Exercise Physiology, 2011). This guideline is similar to those developed by the

WHO (2010), the United States (U.S. Department of Health and Human Services, 2008) and the United Kingdom (Department of Health, Physical Activity, Health Improvement and Protection, 2011). Recent accelerometer studies found that only 22% of Canadians (Statistics Canada, 2015) and 8% of Americans (Tucker, Welk, & Beyler, 2011) achieved the 150-minute guideline.

Dog Walking

One popular way of obtaining physical activity is through dog walking. Dogs are a common household pet — approximately 1 in 3 American and Canadian households have a dog (American Veterinary Medical Association, 2015; Canadian Animal Health Institute, 2015) — and dogs are unique in that, unlike other household pets, they require exercise. Furthermore, dog walking is a *purposeful physical activity*, as it done in the process of achieving another goal (exercise for the dog) and, therefore, more likely to promote long-term adherence than physical activities engaged in for the sole purpose of improving fitness (Morgan, 2001). A number of researchers have gone as far as recommending that acquiring a dog should be promoted as a way to increase physical activity (Bauman, Russell, Furber, & Dobson, 2001; Brown & Rhodes, 2006; Knight & Edwards, 2008; Reeves, Rafferty, Miller, & Lyon-Callo, 2011).

To date, no longitudinal studies have compared the physical activity level of individuals who acquire a dog and walk it to a control group of non-dog owners.¹ However, a number of cross-sectional studies conducted by researchers in Canada, Japan, and the United States have examined whether individuals who own a dog and walk it

¹Although Cutt, Knuiman, and Giles-Corti (2008) conducted a longitudinal study in Australia comparing the total physical activity levels of individuals who acquired a dog and a control group of non-dog owners, they did not distinguish between

those individuals who acquired a dog and walked it versus those who did not walk their dog.

engage in more physical activity than non-dog owners. The one study conducted with accelerometers (Coleman et al., 2008) and the numerous self-report studies revealed that dog walkers are more physically active than non-dog owners (Duvall Antonacopoulos, 2009; Gretebeck et al., 2013; Lentino, Visek, McDonnell, & DiPietro, 2012; Reeves et al., 2011; Shibata et al., 2012). Furthermore, dog walkers are more likely than non-dog owners to meet recommended physical activity guidelines (Coleman et al., 2008; Reeves et al., 2011; Shibata et al., 2012). Indeed, researchers have found that some dog walkers come close to or achieve the recommended physical activity guidelines through dog walking alone (Hoerster et al., 2011; Reeves et al., 2011).

Health Benefits Associated with Dog Walking

Given that physical activity is beneficial for well-being (U.S. Department of Health and Human Services, 2008), researchers have examined whether dog walkers have better health than non-dog owners. When comparing the physical health of the two groups, two studies did not find that dog walkers had better physical health than non-dog owners (Duvall Antonacopoulos, 2009; Shibata et al., 2012), two studies had mixed results (Coleman et al., 2008; Gretebeck et al., 2013), and one cross-sectional study (Lentino et al., 2012) along with one longitudinal study (Thorpe et al., 2006) found that dog walkers had better physical health than non-dog owners. With respect to psychological health, only two studies have examined whether dog walkers have better psychological health than non-dog owners. While Duvall Antonacopoulos (2009) found that the two groups did not differ on a composite measure of psychological health, Lentino et al. (2012) found that non-dog owners had greater odds of self-reported depression than dog walkers,

but the two groups did not differ in their perceived level of stress. Given that the studies assessing physical and psychological health had mixed results, additional research is needed comparing the health of dog walkers versus non-dog owners.

Rationale for Present Study and Hypotheses

A number of researchers have recommended acquiring a dog as one way of addressing the problem of physical inactivity (e.g., Brown & Rhodes, 2006; Reeves et al., 2011). However, before promoting the acquisition of a dog as a way to increase physical activity, there is a need to assess whether acquiring a dog and walking it does have this result. To address this need, a preliminary investigation of the physical activity of individuals who acquired a dog and a control group of non-dog owners was conducted over an 8-month period using accelerometers to assess physical activity. We hypothesized that individuals who acquired a dog and walked it would increase their moderate- to vigorous-intensity physical activity in 10-minute bouts over the course of the 8-month study, while there would not be a change in the physical activity of the control group over time. Furthermore, we hypothesized that, in the case of the 150-minute guideline, although the groups would not differ at baseline, dog walkers would be more likely than non-dog owners to meet this guideline at 8 months.

Researchers have found that physical activity confers health benefits (U.S. Department of Health and Human Services, 2008; Warburton et al., 2007). Therefore, if acquiring a dog results in dog owners increasing the amount of time they engage in physical activity at a moderate- to vigorous-intensity level in 10-minute bouts, this should be beneficial for their well-being. We hypothesized that individuals who acquired a dog and walked it would experience

improvements in their physical and psychological health over the course of the 8-month study, while individuals in the control group would not experience changes in their health over time.

The present study also examined the contribution that dog walking made to the physical activity of participants who acquired a dog. This was achieved through an examination of the 8-month accelerometer data for time spent dog walking at a moderate- to vigorous-intensity level in 10-minute bouts. As well, participants were asked a number of closed- and open-ended questions to explore their perception of the effect of acquiring a dog on their physical activity and health.

Method

Participants

Individuals were recruited from across Canada to participate in an 8-month longitudinal study.² The sample was comprised of two groups: individuals who were planning to acquire a dog within 3 months and a control group of individuals who were not planning to acquire a dog.³

Individuals were eligible to participate in the study if they lived in a city or town in Canada, were at least 18 years of age, did not currently own a dog, and were not a professional dog walker. The control group was recruited through advertisements placed in the volunteer section for different cities across Canada on Kijiji and Craigslist, websites for classified advertisements. It was

necessary to utilize a variety of methods to recruit participants for the group who were planning to acquire a dog, given the challenge of finding individuals who were planning to do so within 3 months. First, advertisements for this group were placed in the pet-related sections of Kijiji and Craigslist. Second, Find Participants and Research Now, companies with on-line panels, were used to recruit this group. Third, a description of the study was made available to dog breeders.

The recruitment notices for both the control group and the group that was planning to acquire a dog stated that this was a physical activity and health study and that participation would involve completing online surveys and wearing a small physical activity monitoring device for one week at two time periods. Participants were not informed that the two groups were being compared. Individuals who were interested in participating in the study were instructed to email the first author.

Procedure

Participants in both the control and acquired-dog groups completed an online survey on Survey Monkey and wore a physical activity monitoring device for 7 days at the beginning of the study and again at 8 months. In addition, participants in both groups completed a very brief online survey on Survey Monkey at 4 months. Ethics approval for this study was obtained from Carleton University's Psychology Research Ethics Board. In order to participate in the

²An 8-month time period was deemed adequate, given that two studies of dog walking programs detected physical health benefits within 4- (Johnson & McKenney, 2011) and 12-week periods (Johnson, McKenney, & McCune, 2010). Furthermore, a case study of an individual who acquired a dog and walked it found physical and psychological health benefits within a 4-month period (Tatschl, Finsterer, & Stöllberger, 2006). Our study effectively doubled

the length of data collection from these studies, while avoiding the potential attrition in longer studies.

³Using G*Power 3 (Faul, Erdfelder, Lang, & Buchner, 2007), an ANOVA repeated measures, within-between interaction a priori power analysis was conducted. It was determined that in order to achieve a power of .80 with an alpha of .05, a sample size of at least 22 was necessary in order to detect medium effects.

study, participants had to provide informed consent.

Baseline component (online survey and accelerometer). When interested participants in both groups contacted the researcher, they were e-mailed the link to the baseline online survey. The online survey was comprised of the following: five questions to determine whether participants met the inclusion criteria for the study, six demographic questions, and eight measures of participants' physical and psychological health. As well, those participants who indicated that they were planning to acquire a dog were asked to indicate how soon they planned to do so and their reasons for doing so. On the last page of the online survey, participants were instructed to e-mail the researcher their contact information to obtain the physical activity materials. Participants were then either mailed or hand delivered a package containing a physical activity monitoring device, waist band, a paper time log to record when they wore the device, and a postage paid return envelope (when the package was mailed to participants).

Participants wore an Actical accelerometer (*Bio-Lynx Scientific Equipment, Montreal, Canada*) over their right hip during all of their waking hours (except for bathing and swimming) for 7 consecutive days. Using the paper time log, participants were also asked to indicate when they put on the accelerometer in the morning and removed it in the evening. In addition, they were asked to record any times during the day when they did not wear the accelerometer and their reasons for not wearing it. The accelerometers were set to record data in 1-minute intervals (epochs), resulting in a count value per minute. In the present study, a *valid day* was defined as wearing the accelerometer for at least 8 hours. Only participants with *at least 3 days*

of valid data were retained in the study. The cut-points that were applied to interpret the raw accelerometer data were those utilized by Statistics Canada when assessing Canadians' physical activity levels using the Actical accelerometer (Colley et al., 2011).

Verifying whether dog was acquired. Participants who indicated at baseline that they were planning to acquire a dog within 3 months (acquired-dog group) were re-contacted to ascertain whether they had acquired a dog and asked to provide the date they brought their dog home.

4-month component (brief online survey). Participants in the acquired-dog group completed the brief online survey 4 months after the date they brought their dog home. The control group completed the brief online survey 4 months after they completed the baseline survey. The online survey that was completed by both groups included three of the eight measures of physical and psychological health included in the baseline and 8-month online surveys and a question about dog ownership status. The latter question was included in order to verify that participants in the acquired-dog group still owned a dog and that none of the control group had acquired a dog.

8-month component (online survey and accelerometer). Four months after participants in the control and acquired-dog groups completed the 4-month online survey, they completed the 8-month online survey, wore an accelerometer for 7 days, and completed a paper time log. The 8-month online survey included a question to assess participants' dog ownership status as well as the eight measures assessing participants' physical and psychological health. In the 8-month online survey, participants in the acquired-dog group were also asked a number of questions regarding their dog, the

exercise obtained dog walking, and possible changes in health after acquiring a dog. The 8-month paper time log was identical to the one that was completed at baseline by both groups with one exception: individuals in the acquired-dog group were also asked to indicate the start and end time for their dog walks. To thank participants for their time, they were able to select a \$10 gift card at baseline and a \$12 gift card at 8 months from a selection of stores.

Demographic Measures

In the online survey completed at baseline, participants were asked to provide information about their age, sex, marital status, whether they lived alone, level of education, and family household income before tax.

Information About Participants' Dogs

Participants who acquired a dog were asked to complete a number of dog-related questions in the 8-month online survey. First, they were asked to indicate the size of their dog (small, medium, or large). Second, they were asked to provide the age of their dog in order to determine whether the dog was ≤ 1 year or > 1 year. Third, in order to understand when new dog owners began walking their dog, participants were asked how soon after acquiring their dog they began walking it. Participants who acquired more than one dog were asked to respond to the preceding three questions for each dog. For the three participants who acquired more than one dog, information was only included for their oldest dog, which for these participants was also their largest dog. Finally, at the end of the 8-month online survey, in order to ascertain whether participants had a dog with

behavioural problems that could affect the length and quality of their dog walks, they were asked whether they had experienced any difficulties with their dog and, if so, to describe the difficulties.

Independent Variables

Three independent variables were created. The first independent variable, *dog ownership status*, consisted of two groups: participants who owned a dog for 8 months and typically walked it for periods lasting at least 10 minutes⁴ (*acquired-dog group*) and participants who did not own a dog throughout the study (*control group*). The second independent variable, *time 2*, consisted of two time periods: baseline and 8 months. The third independent variable, *time 3*, consisted of three time periods: baseline, 4 months, and 8 months.

Dependent Variables: Physical Activity

For the first physical activity dependent variable, *moderate- to vigorous-intensity physical activity (MVPA)*, participants' average daily moderate- to vigorous-intensity physical activity in 10-minute bouts was multiplied by 7 to obtain weekly physical activity scores in bouts. To be classified as a bout, the physical activity had to last at least 10 minutes and 8 of the 10 minutes had to be at a moderate- or vigorous-intensity level (Colley et al., 2011; Tucker et al., 2011). For the second physical activity dependent variable, *150-minute guideline*, participants were classified according to whether they achieved the recommended physical activity guideline of at least 150 minutes of MVPA weekly in bouts.

⁴In order to ensure that participants who acquired a dog walked it and did so for sufficient time to achieve health benefits, they were asked at 8 months whether they walked their dog and, if so, whether their dog walks typically lasted less than 10 minutes or 10 or

more minutes. Participants who indicated that they usually walked their dog for less than 10 minutes were excluded.

Dog Walking Physical Activity

The following section describes the additional physical activity information that was collected from individuals in the acquired-dog group.

MVPA obtained dog walking. As part of the paper time log completed at 8 months, participants in the acquired-dog group were asked to provide the start and end time for their dog walks on the 7 days they wore the accelerometer. This self-report information was used to identify time spent dog walking in participants' raw accelerometer data. Cut-points (Colley et al., 2011) were then applied to determine the intensity level of each minute dog walking. Weekly figures were calculated by multiplying participants' average daily moderate- to vigorous-intensity physical activity dog walking in 10-minute bouts by 7.

Other questions relating to exercise from dog walking. In the online survey completed at baseline, participants who indicated that they were planning to acquire a dog were asked to list their top three reasons for doing so in order to understand whether one of the main reasons for acquiring a dog was to obtain physical activity through dog walking. In the 8-month online survey, participants in the acquired-dog group completed two questions relating to the physical activity they obtained dog walking. First, dog owners were asked to describe the two main benefits of owning a dog to determine whether they perceived that one of the main benefits of dog ownership was the

physical activity obtained through dog walking. Second, in order to assess possible changes in physical activity after acquiring a dog, dog owners were asked how the amount of time they engaged in physical activities at 8 months compared to the time they spent before they acquired a dog on a 5-point scale ranging from 1 (*considerably less*) to 5 (*considerably more*).

Dependent Variables: Health Assessed at Two Time Periods

For both groups, the online health questions completed at two time periods (baseline and 8 months) assessed participants' physical health (a checklist of physical symptoms and sensations and a self-report rating of health) and psychological health (depression, self-esteem, and life satisfaction).⁵ Each of these measures is described below.

Physical symptoms and sensations. Using a 5-point scale ranging from 1 (*never or almost never*) to 5 (*more than once every week*), participants rated how often they experienced each of the 54 physical symptoms and sensations (e.g., chest pains) listed in Pennebaker's (1982) Inventory of Limbic Languidness (PILL). The PILL was scored by calculating mean item scores, with higher scores indicating a greater number of health symptoms. Item analyses revealed that Cronbach's alpha was .96 at baseline and .95 at 8 months.

Self-report rating of health. Using an item from the Canadian Community Health

⁵Although there is strong evidence that regular physical activity lowers the risk of noncommunicable diseases such as coronary heart disease and adverse blood lipid profile (U.S. Department of Health and Human Services, 2008), given the challenge of accurately assessing noncommunicable diseases through online surveys, a checklist of physical symptoms and sensations and a self-report rating of health were selected as physical health measures as

they have been used in other dog-related physical activity and health studies (e.g., Serpell, 1991; Shibata et al., 2012). In the case of psychological health, depression, self-esteem, and life satisfaction measures were selected as they have been linked to physical activity (Sharpe et al., 2011; U.S. Department of Health and Human Services, 2008; Warburton et al., 2007).

Survey (Gilmour, 2007), participants rated their health on a scale ranging from 1 (*poor*) to 5 (*excellent*). This item was reverse coded, so that higher scores reflected poorer self-rated health.

Depression. Using a scale ranging from 0 (*rarely or none of the time [less than 1 day a week]*) to 3 (*most or all of the time [5-7 days a week]*) participants completed Radloff's (1977) 20-item Center for Epidemiologic Studies Depression Scale (CES-D). This scale assesses how frequently participants experienced symptoms of depression during the past week (e.g., "I felt sad"). The CES-D was scored by calculating mean item scores, with higher scores indicating more depressive symptoms. Item analyses revealed that Cronbach's alpha was .93 at both baseline and 8 months.

Self-esteem. Using a scale ranging from 1 (*strongly agree*) to 4 (*strongly disagree*) participants completed the Rosenberg Self-Esteem Scale (SES; Rosenberg, 1965), which assesses global self-esteem through 10-items (e.g., "I am able to do things as well as most other people"). The SES was scored by calculating mean item scores, with higher scores indicating lower self-esteem. Item analyses revealed that Cronbach's alpha was .89 at baseline and .92 at 8 months.

Life satisfaction. Using a scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) participants completed Diener, Emmons, Larsen, and Griffin's (1985) 5-item Satisfaction with Life Scale

(SWLS), which assesses global life satisfaction (e.g., "I am satisfied with my life"). Prior to calculating mean item scores the SWLS was reverse coded, so that higher scores indicated more dissatisfaction with life. Item analyses revealed that Cronbach's alpha was .87 at baseline and .85 at 8 months.

Dependent Variables: Health Assessed at Three Time Periods

For both groups, the online health questions completed at three time periods (baseline, 4 months, and 8 months) assessed participants' Body Mass Index (BMI), trouble falling asleep, and stress.⁶

BMI. Participants were asked to provide their height and weight in order to calculate their BMI using the following formula: $BMI = \text{weight (kg)}/\text{height (m)}^2$ (Health Canada, 2003). A BMI correction factor (Connor Gorber, Shields, Tremblay, & McDowell, 2008) was applied to adjust for the bias created by people's tendency to underestimate their weight and overestimate their height (Shields, Connor Gorber, & Tremblay, 2008).

Trouble falling asleep. Using an item from the National Health and Nutrition Examination Survey (Centers for Disease Control and Prevention, 2009), participants were asked how often they had trouble falling asleep in the past month on a scale ranging from 0 (*never*) to 4 (*almost always [16 - 30 times a month]*).

Stress. Using an item from the Canadian Health Measures Survey (CHMS;

baseline and 8 months, in order to provide additional insight into the changes in health that may occur within a short period after acquiring a dog and walking it.

⁶In order to keep participants engaged during the course of the 8-month study, participants in both groups were asked to complete a brief online survey at 4 months. The 4-month online survey was restricted in length in order to provide a way to maintain contact with participants without overburdening them. BMI, trouble sleeping, and stress were assessed at 4 months, as well as at

Statistics Canada, 2012), participants were asked when they think about the amount of stress in their life whether most days are 1 (*not at all stressful*) to 5 (*extremely stressful*).

Other Health Questions Completed by Dog Owners

In order to assess possible health changes following the acquisition of a dog, in the 8-month online survey, dog owners were asked whether they perceived that acquiring a dog had made a difference to their health (yes, no). Those dog owners who responded "yes" were then asked through an open-ended question to describe how acquiring a dog had affected their health. As well, using an item from the CHMS (Statistics Canada, 2012), dog owners were asked to rate their current health compared to their health 8 months ago on a scale ranging from 1 (*much better now*) to 5 (*much worse now*).

Results

Preliminary Analyses

Attrition. Ninety-eight individuals completed the baseline component of the study (online survey and accelerometer), 71 participants completed the 4-month component (brief online survey) and 62 the 8-month component (online survey and accelerometer). Therefore, the attrition rate over the course of the study was 36.73% (36 of 98). The 62 participants who completed all components of the study consisted of 36 participants from the control group and 26 from the acquired-dog group.

Attrition analyses were conducted to determine whether the 62 individuals who completed all components of the study

(*completers*) differed from the 36 individuals who dropped out after baseline (*non-completers*) with respect to the following: dog ownership status, demographic characteristics, and the physical activity and health dependent variables. Chi-square and independent samples *t*-tests revealed that completers and non-completers differed on two variables: one demographic variable (education) and one dependent variable (self-reported health). First, a higher percentage of the completers (58.06%) than non-completers (36.11%) had at least one university degree, $\chi^2(1, N = 98) = 4.39, p = .036$. Second, completers ($M = 2.69, SD = 0.85$) had better self-rated health than non-completers ($M = 3.09, SD = 0.98; t[96] = 2.09, p = .040$).⁷

Sample size. Although 62 participants completed all three components of the study, 17 of these participants were deleted for one of three reasons. First, Tabachnik and Fidell (2013) state that one approach when only a few participants have missing data is to delete those participants who have missing data on *any* of the variables (i.e., listwise deletion). Using this method, seven participants (4 control and 3 acquired-dog) were deleted. Second, five participants (4 control and 1 acquired-dog) were eliminated as they did not wear the accelerometer for 8 hours on at least 3 days. Third, five participants from the acquired-dog group were eliminated as their dog walks typically lasted less than 10 minutes. The final sample was comprised of 45 participants (28 control and 17 acquired-dog).

Demographic characteristics of control and acquired-dog groups.

In order the text. The results for the non-significant attrition analyses are available upon request.

⁷Results from the attrition analyses comparing completers and non-completers in terms of their dog ownership status, the demographic variables and the physical activity and health dependent variables revealed only two differences, which are presented in

to determine whether participants in the control and acquired-dog groups had similar demographic characteristics at baseline, chi-square and independent samples *t*-tests were

conducted. As shown in Table 1, the two groups did not differ in their demographic characteristics at baseline.

Table 1
Demographic Characteristics of Participants at Baseline by Dog Ownership Status

Demographic variable	Dog ownership status		<i>p</i>
	Control group (<i>n</i> = 28)	Acquired-dog group (<i>n</i> = 17)	
Age			
Mean (<i>SD</i>)	39.64 (13.92)	34.18 (11.87)	.185
Range	21-65	21-66	
Sex (%)			
Male	35.71	35.29	.997
Female	64.29	64.71	
Marital status (%)			
Single/separated/divorced/widowed	64.29	35.29	.059
Married/cohabitating/common-law	35.71	64.71	
Live alone (%) ^a			
Yes	21.43	23.53	1.00
No	78.57	76.47	
At least one university degree (%)			
Yes	53.57	70.59	.259
No	46.43	29.41	
Household income (%) ^b			
< \$80,000	75.00	52.94	.128
≥ 80,000	25.00	47.06	

^aGiven that for the crosstab between live alone and dog ownership status the expected count was below five in one of the cells, Fisher's exact test (two-sided) was used. ^bParticipants' annual family household income was divided at \$80,000 before tax, given that the average 2011 income before tax in Canada was \$75,000 (Statistics Canada, 2013).

Information about participants' dogs. Participants' dogs were the following sizes: 23.53% small, 11.76% medium, and 64.71% large. At 8 months, more than half, 58.82%, of the individuals in the acquired-dog group had a dog who was one year of age or less. All dog owners began walking their dog within the first (94.12%) or second month (5.88%) of acquiring it. Finally, in response to a question at 8 months inquiring about possible difficulties as a result of

acquiring a dog, 70.59% of dog owners indicated that they had experienced at least one problem with their dog, with the most common difficulty being dog behavioural problems (75%).

Main Analyses: Physical Activity

MVPA. In order to determine whether participants in the control and acquired-dog groups differed in their weekly

moderate- to vigorous-intensity physical activity in 10-minute bouts over time, a two-way mixed analysis of variance (ANOVA) was conducted using *MVPA* as the dependent variable. The between-subjects independent variable was dog ownership status (control group, acquired-dog group), and the within-

subjects independent variable was time 2 (baseline, 8 months). As may be seen in Table 2, results revealed that both the main effect for time 2 and the main effect for dog ownership status were not significant; however, there was a significant time 2 by dog ownership status interaction.

Table 2
ANOVA Results and Means and Standard Deviations for MVPA at Baseline and 8 Months by Dog Ownership Status

	Control group		Acquired-dog group		<i>F</i> (1,43)	Partial η^2
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Baseline	172.13	209.51	91.87	110.03		
8 Months	165.90	204.59	170.07	180.39		
Time 2					4.00	.085
Dog ownership					0.48	.011
Time 2 x dog ownership					5.50*	.113

Note. Dog ownership refers to whether participants were in the control or acquired-dog group.
 * $p < .05$.

In order to interpret the significant interaction between time 2 and dog ownership status for *MVPA*, simple effects were conducted. To begin, they were conducted for the within-subjects independent variable, time 2, to test for mean differences in *MVPA* between baseline and 8 months at each level of the between-subjects independent variable, dog ownership status. To control the Type 1 error rate, a Bonferonni corrected alpha of .025 was adopted ($\alpha/2$). Among participants in the control group, time spent at a *MVPA level* did not differ between baseline and 8 months (172.13 minutes vs.

165.90 minutes; $F [1, 27] = 0.84, p = .774$, partial $\eta^2 = .003$). On the other hand, among participants in the acquired-dog group, there was a significant increase in time spent at a *MVPA level* from baseline to 8 months (91.87 minutes vs. 170.07 minutes; $F[1, 16] = 6.88, p = .018$, partial $\eta^2 = .301$).

Simple effects were then conducted for the between-subjects independent variable, dog ownership status, to test for mean differences in *MVPA* between the control and acquired-dog groups at each level of the within-subjects independent variable, time 2, using a Bonferonni correlated alpha

of .025 ($\alpha/2$). At baseline, participants in the control and acquired-dog groups (172.13 minutes vs. 91.87 minutes) did not differ in their MVPA, $F(1, 43) = 2.13, p = .152$, partial $\eta^2 = .047$. Similarly, at 8 months, participants

in the control and acquired-dog groups (165.90 minutes vs. 170.07 minutes) did not differ in their MVPA, $F(1, 43) = 0.05, p = .945$, partial $\eta^2 = .000$. These results are displayed in Figure 1.

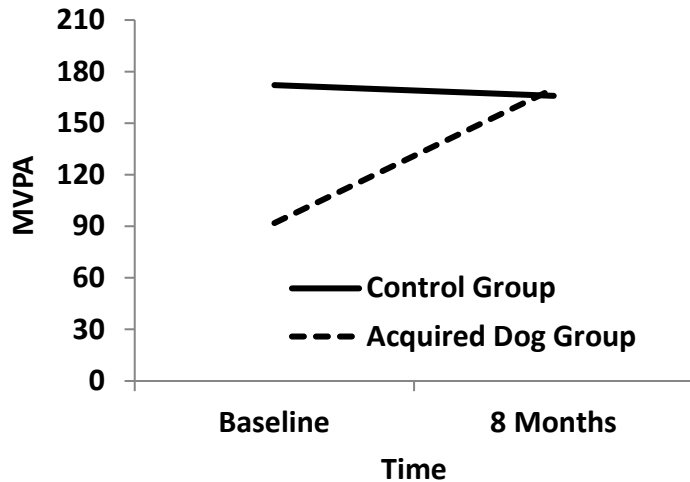


Figure 1. Mean MVPA in 10-minute bouts at baseline and 8 months by dog ownership status.

Meeting guidelines. As may be seen in Table 3, at baseline a higher percentage of the participants in the control than the acquired-dog group achieved the 150-minute guideline. The acquired-dog group increased

their MVPA in 10-minute bouts from baseline to 8 months with the result that a relatively similar percentage of the acquired-dog group and control group achieved the 150-minute guideline at 8 months.

Table 3
 Percentage of Participants Attaining Weekly Physical Activity Criteria at Baseline and 8 Months by Dog Ownership Status

	Control group (%)		Acquired-dog group (%)	
	Baseline	8 Months	Baseline	8 Months
≥ 150 minutes of MVPA in bouts	42.86	46.43	23.53	41.18

Binary logistic regression analyses were conducted to examine the odds of participants in the acquired-dog group

achieving the recommended 150-minute guideline (0 = yes, 1 = no) relative to the control group (the reference group) at

baseline and 8 months. Consistent with expectations, at baseline the odds of achieving the 150-minute guideline through *MVPA* did not differ for those in the control versus acquired-dog group (*OR*, 0.41; 95% *CI* [0.11, 1.58], $p = .195$). Contrary to expectations, at 8 months the odds of achieving the 150-minute guideline through *MVPA* also did not differ by dog ownership status (*OR*, 0.81; 95% *CI* [0.24, 2.73], $p = .731$).

MVPA obtained dog walking. On average, at 8 months dog owners achieved more than 100 minutes of *MVPA* in 10-minute bouts weekly through dog walking alone ($M = 109.94$ minutes, $SD = 127.31$). Dog walking accounted for 64.59% of dog owners' total weekly moderate- to vigorous-intensity physical activity in 10-minute bouts.

Other questions relating to exercise from dog walking. At baseline, slightly more than half, 52.94%, of the individuals in the acquired-dog group indicated that one of their top three reasons for wanting to acquire a dog was to obtain exercise. At 8 months, when asked to describe the two main benefits of owning a dog, half of the 16 dog owners who responded to this question indicated that one of the top two benefits of owning a dog was the exercise they obtained.⁸ It is noteworthy that of the dog owners who indicated that one of their main reasons for acquiring a dog was to obtain exercise, 66.67% reported that exercise was one of the main benefits that they received from acquiring a dog. Two dog owners who did *not* identify exercise as a reason for acquiring a dog did, however, report that exercise was

a benefit of acquiring a dog. At 8 months, in response to a question asking how acquiring a dog had affected the amount of time they spend engaging in physical activities, the overwhelming majority indicated that their physical activity level had increased after acquiring a dog; 70.59% exercised somewhat more and 23.53% considerably more. Only 5.88% exercised considerably less.

Main Analyses: Health

Analyses were conducted to determine whether participants in the acquired-dog and control groups differed when health was assessed at two and three time periods.

Two time periods. A two-way mixed multivariate analysis of variance (MANOVA) was performed on two physical health dependent variables: the *PILL* and self-rated health. The between-subjects independent variable was dog ownership status (control group, acquired-dog group), and the within-subjects independent variable was time 2 (baseline, 8 months). Results revealed that neither the main effect for time 2 nor the main effect for dog ownership status were significant. These findings indicate that: 1) participants did not experience a significant change over time on the combined physical health dependent variable (Wilks' $\lambda = .998$, $F[2, 42] = 0.05$, $p = .954$, partial $\eta^2 = .002$), and 2) participants in the control and acquired-dog groups did not differ significantly on the combined physical health dependent variable (Wilks' $\lambda = .986$, $F[2, 42] = 0.31$, $p = .736$, partial $\eta^2 = .014$). Finally, the interaction between time 2 and dog ownership status was not significant

⁸The most frequently cited benefit of owning a dog was companionship (68.75%) followed by exercise (50%).

(Wilks' $\lambda = .881$, $F[2, 42] = 2.83$, $p = .070$, partial $\eta^2 = .119$).

A two-way mixed MANOVA was performed on three psychological health dependent variables: depression, self-esteem, and life satisfaction. The between-subjects independent variable was dog ownership status (control group, acquired-dog group), and the within-subjects independent variable was time 2 (baseline, 8 months). The main effect for time 2 was not significant (Wilks' $\lambda = .913$, $F[3, 41] = 1.30$, $p = .288$, partial $\eta^2 = .087$); participants did not experience a significant change over time on the combined psychological health dependent variable. In addition, the main effect for dog ownership status was not significant (Wilks' $\lambda = .863$, $F[3, 41] = 2.16$, $p = .107$, partial $\eta^2 = .137$); the control and acquired-dog groups did not differ significantly on the combined psychological health dependent variable. However, the time 2 by dog ownership status interaction was significant (Wilks' $\lambda = .786$, $F[3, 41] = 3.73$, $p = .018$, partial $\eta^2 = .214$).

To investigate the significant multivariate time 2 by dog ownership status interaction, follow-up two-way mixed ANOVAs were conducted separately for each of the psychological health dependent variables. As may be seen in Table 4, although none of the main effects were significant, the time 2 by dog ownership status interaction was significant for life satisfaction.

In order to interpret the significant interaction between time 2 and dog

ownership status for life satisfaction, simple effects were conducted. To begin, simple effects were conducted for the within-subjects independent variable, time 2, to test for mean differences in life satisfaction between baseline and 8 months at each level of the between-subjects independent variable, dog ownership status, using a Bonferroni corrected alpha of .025. Among participants in the control group, life satisfaction did not differ between baseline and 8 months (4.40 vs. 4.17; $F[1, 27] = 2.59$, $p = .119$, partial $\eta^2 = .088$). Similarly, among individuals in the acquired-dog group, life satisfaction did not differ between baseline and 8 months (3.36 vs. 3.85; $F[1, 16] = 5.00$, $p = .040$, partial $\eta^2 = .238$).

Simple effects were subsequently conducted for the between-subjects independent variable, dog ownership status, to test for mean differences in life satisfaction between the control and acquired-dog groups at each level of the within-subjects independent variable, time 2, using a Bonferroni corrected alpha of .025. At baseline, participants in the control group were significantly less satisfied with life compared to those in the acquired-dog group (4.40 vs. 3.36; $F[1, 43] = 6.03$, $p = .018$, partial $\eta^2 = .123$). On the other hand, at 8 months, participants in the control and acquired-dog groups (4.17 vs. 3.85) did not differ in their life satisfaction, $F(1, 43) = 0.62$, $p = .436$, partial $\eta^2 = .014$. These findings are displayed in Figure 2.

Table 4
ANOVA Results and Means and Standard Deviations for Three Psychological Health Measures at Baseline and 8 Months by Dog Ownership Status

	Control group		Acquired-dog group		<i>F</i> (1,43)	Partial η^2
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Depression						
Baseline	0.82	0.56	0.79	0.63		
8 Months	0.88	0.59	0.69	0.54		
Time 2					0.10	.002
Dog ownership					0.46	.011
Time 2 x dog ownership					1.31	.030
Self-esteem						
Baseline	2.07	0.53	1.96	0.59		
8 Months	2.10	0.60	2.14	0.60		
Time 2					2.55	.056
Dog ownership					0.50	.001
Time 2 x dog ownership					1.27	.029
Life satisfaction						
Baseline	4.40	1.40	3.36	1.32		
8 Months	4.17	1.34	3.85	1.34		
Time 2					1.12	.025
Dog ownership					2.91	.063
Time 2 x dog ownership					8.32**	.162

Note. Dog ownership refers to whether participants were in the control or acquired-dog group.
 ** $p < .01$.

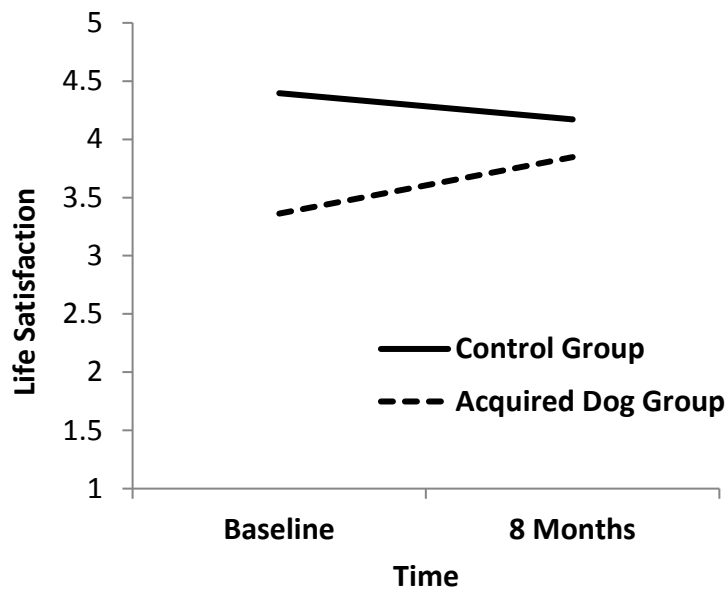


Figure 2. Mean life satisfaction scores at baseline and 8 months by dog ownership status.

Three time periods. Three separate 2 x 3 mixed ANOVAs were performed on BMI, trouble sleeping, and stress. The between-subjects independent variable was dog ownership status (control group, acquired-dog group), and the within-subjects independent variable was time 3 (baseline, 4 months, 8 months). As shown in Table 5, results revealed that none of the main effects or interactions were significant.

Other health questions completed by dog owners. In the 8-month online survey, in response to a closed-ended question, the overwhelming majority, 88.24%, indicated that their dog had made a difference to their health. When these dog owners were asked to explain through an

open-ended question how acquiring a dog had affected their health, 60% indicated that the dog resulted in them increasing their physical activity. Other health-related benefits mentioned by dog owners included losing weight, a healthier lifestyle, feeling less stressed, and sleeping better. Through a closed-ended question, dog owners were also asked to rate their current health at 8 months compared to their health at baseline. Almost half of the dog owners, 47.06%, indicated that their health was somewhat better at 8 months compared to at baseline. The same percentage, 47.06%, reported that their health had not changed, while 5.88% reported somewhat worse health.

Table 5
ANOVA Results and Means and Standard Deviations for Three Health Measures at Three Time Periods by Dog Ownership Status

	Control group		Acquired-dog group		<i>df</i>	<i>F</i>	Partial η^2
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
BMI							
Baseline	27.46	5.84	26.15	4.03			
4 Months	27.26	5.71	25.87	4.35			
8 Months	27.21	5.62	26.21	4.41			
Time 3					2, 86	1.37	.031
Dog ownership					1, 43	0.60	.014
Time 3 x dog ownership					2, 86	0.97	.022
Trouble sleeping							
Baseline	2.61	1.10	2.76	1.15			
4 Months	2.57	1.00	2.29	0.92			
8 Months	2.64	1.16	2.59	0.87			
Time 3					2, 86	1.94	.043
Dog ownership					1, 43	0.04	.001
Time 3 x dog ownership					2, 86	1.34	.030
Stress							
Baseline	2.89	0.83	3.12	0.93			
4 Months	2.82	0.86	2.76	0.56			
8 Months	2.93	0.90	3.06	0.83			
Time 3					2, 86	1.95	.043
Dog ownership					1, 43	0.21	.005
Time 3 x dog ownership					2, 86	0.70	.016

Note. Dog ownership refers to whether participants were in the control or acquired-dog group.

Discussion

The present study examined whether acquiring a dog and walking it leads to an

increase in adults' physical activity. Consistent with expectations, the accelerometer data revealed that participants in the acquired-dog and control groups

differed in their *MVPA* in 10-minute bouts from baseline to 8 months. Specifically, the acquired-dog group became more physically active over time, while the control group did not differ in their physical activity level over the course of the study. Based on Cohen's (1988) conventions for interpreting the magnitude of effect sizes, large effects were detected when the acquired-dog group was compared at baseline and 8 months on their *MVPA* (partial $\eta^2 = .301$). Individuals who acquired a dog and walked it experienced a sizeable increase in their weekly *MVPA* (1 hour and 18 minutes from baseline to 8 months). It is noteworthy that the findings from the self-report physical activity measure were similar to the preceding accelerometer results, as participants in the acquired-dog group perceived that they were more active at 8 months relative to baseline (71% perceived that they exercised somewhat more at 8 months and 24% that they exercised considerably more at 8 months).

The finding that at 8 months participants in the acquired-dog group did not differ from the control group in either their minutes of *MVPA* in 10-minute bouts or their likelihood of achieving the 150-minute guideline is not consistent with previous research (e.g., Coleman et al., 2008; Reeves et al., 2011). In order to explore possible reasons for the non-significant difference between the groups at 8 months, the physical activity levels of the participants in the present study were compared to those of Canadian adults. According to the latest figures from Statistics Canada (2015), adults in the general population achieved an average of 12 minutes of *MVPA* in 10-minute bouts daily and 22% achieved the 150-minute weekly guideline in 10-minute bouts. In the present study, we anticipated that individuals in the acquired-dog group would be more active relative to the Canadian population 8 months after acquiring a dog. On the other hand, we anticipated that at baseline (before

they acquired a dog) they would be similar. When physical activity figures were examined at baseline, the acquired-dog group had virtually identical figures to those from Statistics Canada (13 minutes daily of *MVPA* in bouts and 24% met 150-minute guideline), while at 8 months they were more active than the Canadian population (24 minutes daily of *MVPA* in bouts and 41% met 150-minute guideline).

In the case of the control group, we anticipated that over the course of the study they would have similar physical activity figures to those of the Canadian population (Statistics Canada, 2015). However, at baseline and 8 months the control group's figures were higher relative to those from Statistics Canada. On average daily, individuals in the control group engaged in 25 minutes of *MVPA* in bouts at baseline and 24 minutes at 8 months. With respect to the percentage meeting the 150-minute guideline, 43% did so at baseline and 46% at 8 months. From these figures, it appears that the control group was more physically active relative to the population as a whole and therefore not representative of the population as a "control" group.

An important component of the longitudinal study was the determination of the role that dog walking played in the physical activity obtained by the participants who acquired a dog. This was achieved by examining the accelerometer data for the time that individuals who acquired a dog spent dog walking at 8 months. Over the course of a week, dog owners accumulated a considerable amount of *MVPA* in 10-minute bouts through dog walking, 110 minutes. Furthermore, when the contribution that dog walking made to participants' overall weekly moderate- to vigorous-intensity physical activity was examined, dog walking accounted for nearly two-thirds (65%) of dog owners' *MVPA* in bouts. From dog owners' responses to the open-ended questions in the

longitudinal study, it appears that they were aware of the potential exercise-related benefits that dogs may confer. At baseline, 53% of the individuals in the acquired-dog group indicated that one of their main reasons for acquiring a dog was to obtain physical activity. Furthermore, when these individuals were asked at 8 months about the main benefits of dog ownership, 67% cited exercise. Thus, dog walking not only makes a major contribution to participants' physical activity at the recommended *MVPA* intensity level, but a sizeable percentage of dog owners consider the physical activity benefits when acquiring a dog.

We expected that individuals who acquired a dog and walked it would become more physically active and, as a result, would experience improvements in their health over the 8-month study, given the link between physical activity and health (U.S. Department of Health and Human Services, 2008; Warburton et al., 2007). Therefore, we hypothesized that participants in the acquired-dog group would experience improvements in their health over the course of the study, while participants in the control group would not experience changes in their health over time. Contrary to expectations, although participants in the acquired-dog group became more physically active over the course of the study, they did not experience improvements in either their physical or psychological health over time compared to the control group based on the measures utilized in the present study. However, from the responses of the acquired-dog group to closed- and open-ended questions, it is apparent that many of them perceived that their health improved as a result of acquiring a dog. The overwhelming majority (88%) of those in the acquired-dog group indicated that acquiring a dog had made a difference to their health and cited the following health benefits: more active, lost weight, healthier lifestyle, less stressed, and

better sleep. Furthermore, nearly half (47%) perceived that their health had improved at 8 months compared to baseline.

A possible explanation for the difference in the quantitative versus qualitative findings is provided by Herzog's (2011) suggestion that, as a result of extensive media coverage on the benefits of pet ownership, it has become widely accepted by the general public that pet ownership is beneficial for health, even though there are mixed findings. Therefore, participants in the present study may have believed that they should have experienced health benefits as a result of acquiring a dog. However, given that dog owners reported a number of different health benefits at 8 months, a more likely explanation is that the small sample size of the present study made it difficult to detect health effects.

Another possible reason for the finding that there were no differences in physical health may be the type of physical health measures used in this study, as they did not assess the chronic health diseases that have been strongly linked to physical inactivity (U.S. Department of Health and Human Services, 2008). To date, only one study conducted in the general population examined whether dog walkers and non-dog owners differed in their likelihood of having a physical inactivity-related chronic disease (Lentino et al., 2012). They found that dog walkers were less likely than non-dog owners to report having been diagnosed by a doctor in the past year with diabetes or hypertension. This suggests that some of the physical health benefits from acquiring a dog may not have been captured in the current study.

With respect to psychological health, it is possible that the challenges associated with being a new dog owner contributed to individuals who acquired a dog not experiencing improvements in their psychological health over time relative to the control group. Support for this possibility is

provided by the fact that when dog owners were asked at 8 months whether they had experienced any difficulties as a result of acquiring a dog, 71% responded positively. Furthermore, the most commonly experienced problem was dog behavioural problems (75%). If dogs misbehaved on their walks, it is unlikely that the owners would have experienced improvements in their psychological health as these may have been offset by the stress experienced as both the dog and owner adapted to dog walking. This is supported by Campbell, Smith, Tumilty, Cameron, and Treharne's (2016) finding that problematic dog behaviour on dog walks creates anxiety for some dog walkers.

Limitations and Future Research

A limitation of the present study was that it was not possible to randomly assign participants to a group that either did or did not acquire a dog. As a result, it was necessary to utilize a quasi-experimental longitudinal design in which individuals who were actively seeking to acquire a dog and those who were not planning to do so were recruited. Given the challenge of finding individuals who were planning to acquire a dog and then actually adopted a dog, the sample was comprised of only 17 dog owners, which limits the generalizability of the findings.

Two limitations that may have contributed to the non-significant health findings are the small sample size, which reduced our power to detect true effects, and the time frame of the study. Although the majority of dog owners (94%) indicated that they began walking their dog within the first month of acquiring it, at 8 months 59% of the sample had a dog who was one year of age or less. This indicates that a sizeable percentage of the sample acquired puppies, which according to the UK Kennel Club (2015) need to be taken on shorter walks initially as they tire easily. As well, the fact that a

considerable percentage of the dog owners had a dog with behavioural problems may have resulted in dog owners being unable to take their dog on long walks for a considerable period after acquiring it. As a result, although the individuals who acquired a dog were obtaining considerable physical activity at a *MVPA level* in 10-minute bouts at 8 months through dog walking, it is not known how much time they spent dog walking over the first 7 months of the study. When examining the effect of dog walking on health, future longitudinal studies should be conducted over a longer time period and should also assess how much time is spent dog walking at a *MVPA level* in 10-minute bouts at different time periods after acquiring a dog.

A different type of limitation stems from the possibility that wearing an accelerometer may have influenced participants' behaviour. Participants in both the control and acquired-dog groups may have been tempted to engage in additional physical activity when wearing the device in order to appear more active, given that it is generally accepted that exercise is beneficial for well-being (Parliamentary Office of Science and Technology, 2001). Although this is a possibility, the fact that participants were unable to view their physical activity data on the accelerometer likely helped to discourage participants from trying to appear more physically active while participating in the study. We also attempted to minimize this risk by having participants wear the accelerometer for 7 days and utilizing weekly physical activity scores in the analyses. Finally, national Canadian and American physical activity studies have found that a lower percentage of individuals achieved the recommended 150-minute guideline when accelerometers were worn compared to when self-report measures were used (Statistics Canada, 2015; Tucker et al., 2011).

There is a need for a longitudinal study with a larger sample to examine possible changes in physical activity and health following the acquisition of a dog according to whether the dog is acquired primarily for exercise versus for other reasons (e.g., companionship, security, love of dogs). In the current study, slightly more than half (53%) of the participants in the acquired-dog group indicated that one of their primary reasons for acquiring a dog was for exercise. While a cross-sectional study found that individuals who acquired their dog for exercise were *not* more likely to walk it at least once daily compared to those who did not acquire their dog for exercise (Westgarth, Christian, & Christley, 2015), research is needed to explore whether compared to those who acquire a dog for non-exercise reasons, individuals who acquire a dog for exercise are less active at baseline, but experience a greater increase in their physical activity after acquiring a dog.

Conclusions

To our knowledge, this preliminary longitudinal study is the first to examine the effect of acquiring a dog and walking it on

physical activity using an objective measure of *MVPA* in 10-minute bouts. The finding that adults who acquired a dog and walked it increased their physical activity at the recommended intensity level for health benefits suggests that encouraging adults to acquire a dog merits further attention as a possible strategy to increase physical activity levels. That said, researchers need to be aware that dogs are complex, sentient beings rather than objects to facilitate physical activity. In the case of health, the quantitative component of this study did not provide evidence that becoming more physically active after acquiring a dog was beneficial for health, however a number of possible explanations were provided, such as the reduced power from the small sample, the time frame, and the types of measures used to assess health. The fact that a sizeable percentage of the participants who acquired a dog and walked it perceived that their health had improved 8 months after becoming a dog owner highlights the need for additional research to explore further the possible physical activity-related health benefits from dog walking.

References

- American Veterinary Medical Association. (2015). U.S. *pet ownership statistics*. Retrieved from <https://www.avma.org/KB/Resources/Statistics/Pages/Market-research-statistics-US-pet-ownership.aspx>
- Bauman, A. E., Russell, S. J., Furber, S. E., & Dobson, A. J. (2001). The epidemiology of dog walking: An unmet need for human and canine health. *Medical Journal of Australia*, *175*, 632-634.
- Brown, S. G., & Rhodes, R. E. (2006). Relationships among dog ownership and leisure-time walking in Western Canadian adults. *American Journal of Preventive Medicine*, *30*, 131-136. doi:10.1016/j.amepre.2005.10.007
- Campbell, K., Smith, C. M., Tumilty, S., Cameron, C., & Treharne, G. J. (2016). How does dog-walking influence perceptions of health and well-being in healthy adults? A qualitative dog-walk-along study. *Anthrozoös*, *29*, 181-192. doi:10.1080/08927936.2015.1082770
- Canadian Animal Health Institute. (2015). Latest *Canadian pet population figures released*. Retrieved from <http://www.canadianveterinarians.net/documents/canadian-pet-population-figures-cahi-2014>
- Canadian Society for Exercise Physiology. (2011). *Canadian physical activity guidelines for adults 18 – 64 years*. Retrieved from http://www.csep.ca/CMFiles/Guidelines/CSEP_PAGuidelines_adults_en.pdf
- Centers for Disease Control and Prevention. (2009). *NHANES 2007 - 2008 data documentation, codebook, and frequencies*. Retrieved from http://wwwn.cdc.gov/nchs/nhanes/2007-2008/SLQ_E.htm
- Cohen, J. (1988). *Statistics power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Coleman, K. J., Rosenberg, D. E., Conway, T. L., Sallis, J. F., Saelens, B. E., Frank, L. D., & Cain, K. (2008). Physical activity, weight status, and neighbourhood characteristics of dog walkers. *Preventive Medicine*, *47*, 309-312. doi:10.1016/j.ypmed.2008.05.007
- Colley, R. C., Garriguet, D., Janssen, I., Craig, C. L., Clarke, J., & Tremblay, M. S. (2011). Physical activity of Canadian adults: Accelerometer results from the 2007 to 2009 Canadian Community Health Measures Survey. *Health Reports* (Statistics Canada, Cat. No. 82-003-XPE), *22*(1), 7-14.
- Connor Gorber, S., Shields, M., Tremblay, M. S., & McDowell, I. (2008). The feasibility of establishing correction factors to adjust self-reported estimates of obesity. *Health Reports* (Statistics Canada, Cat. No. 82-003-XPE), *19*(3), 71-82.
- Cutt, H., Knuiiman, M. W., & Giles-Corti, B. (2008). Does getting a dog increase recreational walking? *International Journal of Behavioral Nutrition and Physical Activity*, *5*, 17. doi:10.1186/1479-5868-5-17
- Department of Health, Physical Activity, Health Improvement and Protection. (2011). *Start active, stay active: A report on physical activity from the four home countries' Chief Medical Officers*. Retrieved from <https://www.gov.uk/government/publications/start-active-stay-active-a-report-on-physical-activity-from-the-four-home-countries-chief-medical-officers>

- Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The Satisfaction with Life Scale. *Journal of Personality Assessment*, 49, 71-75. doi:10.1207/s15327752jpa4901_13
- Duvall Antonacopoulos, N. M. (2009). *The effects of dog walking on well-being* (Master's thesis). Retrieved from ProQuest Dissertations and Theses database. (Order No.MR68658).
- Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioural, and biomedical sciences. *Behavior Research Methods*, 39, 175-191. doi:10.1684/pnv.2009.0175
- Gilmour, H. (2007). Physically active Canadians. *Health Reports* (Statistics Canada, Cat. No. 82-003), 18(3), 45-65.
- Gretebeck, K. A., Radius, K., Black, D. R., Gretebeck, R. J., Ziemba, R., & Glickman, L. T. (2013). Dog ownership, functional ability, and walking in community-dwelling older adults. *Journal of Physical Activity and Health*, 10, 646-655. doi:10.1123/jpah.10.5.646
- Health Canada. (2003). *Canadian guidelines for body weight classification in adults* (Cat. No. H49-179/2003E). Ottawa, Canada: Health Canada.
- Herzog, H. (2011). The impact of pets on human health and psychological well-being: Fact, fiction, or hypothesis? *Current Directions in Psychological Science*, 20, 236-239. doi:10.1177/0963721411415220
- Hoerster, K. D., Mayer, J. A., Sallis, J. F., Pizzi, N., Talley, S., Pichon, L. C., & Butler, D. A. (2011). Dog walking: Its association with physical activity guideline adherence and its correlates. *Preventive Medicine*, 52, 33-38. doi:10.1016/j.ypmed.2010.10.011
- Johnson, R. A., & McKenney, C. A. (2011). "Walk a hound, lose a pound": A community dog walking program for families. In R. A. Johnson, A. M. Beck, & S. McCune (Eds.), *The health benefits of dog walking for pets & people: Evidence & case studies* (pp. 89-104). West Lafayette, IN: Purdue University Press.
- Johnson, R. A., McKenney, C. A., & McCune, S. (2010). Walk a hound, lose a pound, and stay fit for seniors [Abstract]. *Nursing Outlook*, 58, 14. doi:10.1016/j.outlook.2010.02.105
- Knight, S., & Edwards, V. (2008). In the company of wolves: The physical, social, and psychological benefits of dog ownership. *Journal of Aging and Health*, 20, 437-455. doi:10.1177/0898264308315875
- Lentino, C., Visek, A. J., McDonnell, K., & DiPietro, L. (2012). Dog-walking is associated with a favourable risk profile independent of a moderate to high volume of physical activity. *Journal of Physical Activity and Health*, 9, 414-420. doi:10.1123/jpah.9.3.414
- Morgan, W. P. (2001). Prescription of physical activity: A paradigm shift. *Quest*, 53, 366-382. doi:10.1080/00336297.2001.10491754
- Parliamentary Office of Science and Technology. (2001). *Health benefits of physical activity*. Retrieved from <http://www.parliament.uk/documents/post/pn162.pdf>
- Pennebaker, J. W. (1982). *The psychology of physical symptoms*. New York, NY: Springer-Verlag.
- Radloff, L. S. (1977). The CES-D Scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*,

- I, 385-401. doi:10.1177/014662167700100306
- Rahl, R. L. (2010). *Physical activity and health guidelines: Recommendations for various ages, fitness levels, and conditions from 57 authoritative sources*. Windsor, Canada: Human Kinetics.
- Reeves, M. J., Rafferty, A. P., Miller, C. E., & Lyon-Callo, S. K. (2011). The impact of dog walking on leisure-time physical activity: Results from a population-based survey of Michigan Adults. *Journal of Physical Activity and Health, 8*, 436-444. doi:10.1123/jpah.8.3.436
- Rosenberg, M. (1965). *Society and the adolescent self-image*. Princeton, NJ: University Press.
- Serpell, J. (1991). Beneficial effects of pet ownership on some aspects of human health and behaviour. *Journal of the Royal Society of Medicine, 84*, 717-720. doi:10.1177/014107689108401209
- Sharpe, A., Ghangro, A., Johnson, E., & Kidwai, A. (2011). *Does money matter? Determining the happiness of Canadians* (CSLS Research Report No. 2010-09). Ottawa, Canada: Centre for the Study of Living Standards.
- Shibata, A., Oka, K., Inoue, S., Christian, H., Kitabatake, Y., & Shimomitsu, T. (2012). Physical activity of Japanese older adults who own and walk dogs. *American Journal of Preventive Medicine, 43*, 429-433. doi:10.1016/j.amepre.2012.06.019
- Shields, M., Connor Gorber, S., & Tremblay, M. S. (2008). Estimates of obesity based on self-report versus direct measures. *Health Reports* (Statistics Canada, Cat. No. 82-003-X), *19*(2), 61-76.
- Statistics Canada. (2012). *Canadian Health Measures Survey - Cycle 2*. Retrieved from http://www23.statcan.gc.ca/imdb-bmdi/instrument/5071_Q1_V2-eng.htm
- Statistics Canada. (2013). *Table 202-0401 - Distribution of total income, by economic family type, 2011 constant dollars, annual*. Retrieved from <http://www5.statcan.gc.ca/cansim/a05?lang=eng&id=2020401&pattern=2020401&searchTypeByValue=1&p2=35>
- Statistics Canada. (2015). *Directly measured physical activity of adults, 2012 and 2013* (Cat. No. 82-625-X). Retrieved from <http://www.statcan.gc.ca/pub/82-625-x/2015001/article/14135-eng.htm>
- Tabachnik, B. G., & Fidell, L. S. (2013). *Using multivariate statistics* (6th ed.). Toronto, Canada: Pearson.
- Tatschl, C., Finsterer, J., & Stöllberger, C. (2006). Back to the dogs. *American Journal of Preventive Medicine, 30*, 362. doi:10.1016/j.amepre.2005.12.003
- Thorpe, R. J., Simonsick, E. M., Brach, J. S., Ayonayon, H., Satterfield, S., Harris, T. B., . . . Kritchevsky, S. B. (2006). Dog ownership, walking behaviour, and maintained mobility in late life. *Journal of the American Geriatrics Society, 54*, 1419-1424. doi:10.1111/j.1532-5415.2006.00856.x
- Tucker, J. M., Welk, G. J., & Beyler, N. K. (2011). Physical activity in U.S. adults: Compliance with the physical activity guidelines for Americans. *American Journal of Preventive Medicine, 40*, 454-461. doi:10.1016/j.amepre.2010.12.016
- UK Kennel Club. (2015). *Kennel Club assured breeder scheme new puppy owner advice sheet: Keep your dog healthy and happy*. Retrieved from www.thekennelclub.org.uk/media/106019/puppyexerciseas

- U.S. Department of Health and Human Services. (2008). *2008 physical activity guidelines for Americans*. Retrieved from <https://health.gov/paguidelines/guidelines/>
- Warburton, D. E. R., Katzmarzyk, P. T., Rhodes, R. E., & Shephard, R. J. (2007). Evidence-informed physical activity guidelines for Canadian adults. *Applied Physiology, Nutrition, and Metabolism*, *32*, S16-S68. doi:10.1139/H07-123
- Westgarth, C., Christian, H. E., & Christley, R. M. (2015). Factors associated with daily walking of dogs. *BMC Veterinary Research*, *11*, 116. doi:10.1186/s12917-015-0434-5
- World Health Organization. (2009). *Global health risks: Mortality and burden of disease attributable to selected major risks*. Geneva, Switzerland: World Health Organization.
- World Health Organization. (2010). *Global recommendations on physical activity for health*. Geneva, Switzerland: World Health Organization.
- World Health Organization. (2011). *Global health observatory: Prevalence of insufficient physical activity*. Retrieved from http://www.who.int/gho/ncd/risk_factors/physical_activity_text/en/index.html