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Psychosocial and Environmental Factors Associated with Dog

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Abstract:

Dog walking is associated with higher levels of physical activity (PA). However, not all dog owners walk their dog(s) at a level sufficient for health benefits. Therefore, identifying correlates of dog walking may help to inform the design of more effective interventions to promote this specific form of PA. The purpose of this study was to examine psychosocial and environmental correlates of dog walking and relationships of dog walking with overall PA. In 2010, 391 dog owners (M_{age}= 43.6±12.3 years) completed a survey. Multiple logistic regression and structural equation modeling were used to examine psychosocial and environmental correlates of dog walking status, weekly minutes of dog walking and relationships of dog walking with overall PA. Self-efficacy for dog walking, dog-related outcome expectancies, family social support, dog social support, and neighborhood walking environment were associated with a 1.3 to 5.6 greater odds of being a dog walker. Self-efficacy mediated relationships between family support, dog support, and presence of a yard and dog walking. Neighborhood environment, including the presence of greenery and trails, was also positively associated with duration of dog walking (β=0.17; p<0.05). Every 30 minute increase in dog walking was associated with a 23% greater odds of meeting PA guidelines by walking. Individual, social, and environmental factors consistent with a social ecological framework were positively associated with dog walking. Individuals were more likely to meet PA guidelines if they walked their dog(s) and engaged in dog walking for longer duration.

Introduction

Strong evidence for the health benefits of physical activity (PA) and relatively low prevalence of PA in the U.S. has resulted in an increased focus on promoting moderate intensity PA such as walking (Physical Activity Guidelines Committee (PAGC), 2008). Effective physical activity interventions that are accessible, sustainable, purposeful, and can reach a large proportion of the population are needed (Epping, 2011). Promotion of dog walking may be such a strategy since it is estimated that 40% of U.S. households own a dog (American Pet Products Association, 2011). Results from recent cross-sectional studies indicate that dog owners are more physically active than non-dog owners and that dog walking is positively associated with meeting PA recommendations (Moudon *et* al., 2007; Hoerster *et al*., 2011; Lentino *et al*., 2012; Reeves *et al,*. 2011). Although dog walking appears to play an important role in higher levels of PA among dog owners, dog ownership does not necessarily lead to increased PA. Previous studies have shown that many dog owners do not walk their dogs at a level sufficient to achieve health benefits (Bauman *et al.,* 2001; Cutt *et al*., 2008; Reeves *et al,*. 2011). Given the high rates of dog ownership in the U.S. and other industrialized counties, it is important to understand factors which contribute to dog walking among dog owners in order to develop effective interventions. Only a small number of studies have examined correlates of dog walking behavior. While it appears that perceived motivation, obligation and social support for walking provided by the dog are important correlates of dog walking, findings for other potential correlates such as dog size and the built environment have been more equivocal (Brown and Rhodes, 2006; Christian *et al,*. 2010; Hoerster *et al.,* 2011; Johnson and Meadows, 2010; Schofield *et al,*. 2005). To inform physical activity interventions which target dog walking, researchers need to identify theory-based influences on dog walking behaviors.

Social cognitive theory and social ecological models were used as the theoretical framework for this study (Bandura, 1997; McLeroy, 1988). Social ecological models for health promotion focus on multiple levels of influence on health behaviors (McLeroy, 1988). Consistent with a social ecological approach, study measures were included that assessed individual, interpersonal, and environmental factors potentially associated with dog walking. For example, neighborhood environment characteristics have been shown to be relevant to dog walking (Christian *et al.,* 2010; Hoerster, *et al*., 2011). An analysis of 483 dog walkers in Australia showed that access to parks with green space was positively associated with dog

walking (Christian *et al.* 2010). In addition, a study of dog owners in San Diego County, California, found that walking features and neighborhood aesthetics were associated with being a dog walker (Hoerster *et al.,* 2011). However, a limited range of environmental variables have been examined in relation to dog walking, such as crime and aesthetics.

Social cognitive theory (SCT) indicates that behavior is influenced through relationships between personal factors, environmental influences, and behavioral attributes (Bandura, 1997). SCT recognizes the complexity of behavior change through several channels including that behaviors are directed by goals and purpose. Self-efficacy has a direct influence on physical activity and also acts as a mediator of the association between all other SCT constructs and behavior (Maddux, 1995). For example, Bandura (1997) has stated that social support influences physical activity indirectly via the effects it has on self-efficacy. Outcome expectations and outcome expectancies are also thought to affect behavior. Outcome expectations are the effects an individual anticipates from making a behavioral change. Outcome expectancies are the value an individual places on the outcome expectations (Baranowski, 2002). Reinforcements and barriers can increase or reduce, respectively, the likelihood of health behavior change (Baranowski, 2002).It is theorized that when an individual perceives positive outcome expectations, places a high value on these outcomes, has high self-efficacy, and perceives that physical activity is reinforced and barriers are relatively few, that physical activity will increase (Williams, 2005).

Constructs from SCT have been shown to explain a significant amount of variance in PA behavior (Bandura, 1997; Dzewaltowski, 1994; Sallis and Owen, 2006). However, to the authors' knowledge no investigations of dog walking correlates have used SCT constructs within a social ecological framework to examine influences on dog walking. This is true despite evidence that key constructs from these theoretical perspectives such as self-efficacy, social support, and environmental perceptions are linked to walking in general (Dzewaltowski, 1994; Sallis and Owen, 2006). Therefore, the purpose of this study was two-fold: 1) to assess relationships between individual, interpersonal, and neighborhood environment factors and dog walking behaviors and 2) to examine the association between dog walking and overall PA.

Methods

Participants

In spring 2010, a snowballing technique was used to recruit a convenience sample of dog owners 18 years of age and older. A recruitment e-mail was sent to faculty and staff at Purdue University in West Lafayette, Indiana which included a statement to forward the e-mail to friends and family outside of the university to diversify the sample. In addition, two local animal shelters were enlisted for recruitment using their social networking websites and contact lists. Flyers were also distributed to local pet stores, groomers, and veterinarians. A one dollar donation was made to local animal shelters for each survey completed as an incentive for participation. Study procedures were approved by the Purdue University Committee on the Use of Human Research Subjects. Informed consent was obtained at the time of survey completion.

DAWGS measures

The Dogs and WalkinG Survey (DAWGS) is a self-report instrument of individual and interpersonal correlates of dog walking based on SCT constructs. Reliability and validity testing of DAWGS have previously been reported (Richards *et al*., In Press). The DAWGS includes items to assess self-efficacy for dog walking, outcome expectations and outcome expectancies of dog walking, barriers and reinforcements of dog walking, and social support for dog walking from friends, family, and the dog(s). Survey subscales demonstrated adequate internal consistency (Cronbach's alpha= 0.65-0.92) and items demonstrated adequate test-retest reliability (Kappa coefficients=0.41-0.96 and Spearman correlations= 0.39-0.93) (Richards *et al.,* In Press). Confirmatory factor analysis results support the factorial validity of the scale, and factorial invariance across age and walking level provided evidence for the validity of the scale for both younger and older adults and more and less physically active individuals (Richards *et al.,* In Press).

Self-efficacy for dog walking items measured a person's confidence to walk their dog under various circumstances. This measure consisted of two factors of Likert-scale items: making time (5 items) (e.g., get up early to walk the dog; walk the dog after a long work day) and resisting relapse (4 items) (e.g., walk the dog when you have house work to do; walk the dog when you have excessive demands at work). Outcome expectation items were used to assess the benefits participants believe they derive from walking their dog(s). Outcome expectancy items were used to assess the value placed on each specific outcome. The outcome expectation and expectancy measures each consisted of two factors: owner-specific outcomes (5 Likert-scale

items) and dog-specific outcomes (2 Likert-scale items). Owner specific outcomes included: improve health, improve mood, companionship, enjoyment, and accomplishment. Dog specific outcomes included: improve dog behavior and have a happy dog. Based on prior research (Cutt, 2008) and input from an expert panel, ten dichotomous (yes/no) reinforcement items and 15 dichotomous barriers to dog walking items were also included in the DAWGS. Examples of reinforcements included enjoyable weather and enhancement of personal health or dog health. Examples of barriers included more than one dog to walk, lack of time or having an untrained dog. The social support for dog walking items measured social interactions and activities aimed at supporting dog walking behavior that the individual perceived to be receiving from their dog(s), family, and friends. This measure consisted of Likert-scale items and comprised three factors: dog social support (3 items) (e.g., having my dog makes me walk more; my dog provides support for me to go on walks), family social support (4 items) (e.g., family walk the dog with me; family encourage me to walk), and friend social support (4 items) (e.g., friends change their schedule to walk the dog with me; friends plan activities with me that include dog walking).

Dog-specific measures

In addition to DAWGS items, other potential correlates of dog walking were measured. Dog specific items assessed the age, size, and body condition of up to four dogs (Laflamme, 1997).

Environmental measures

Yard specific items included the presence and size of a yard, the presence of a fence, and the ability of the dog(s) to run freely in the yard. Items from the Dogs and Physical Activity (DAPA) tool were used to assess the neighborhood environment for dog walking (Cutt *et al,*. 2008). These items were previously tested with a four factor solution, but the current study found a two factor model containing four neighborhood walking feature items (α=0.70) (e.g., interesting walking paths, grassy, open areas) and six environment items specific to dogs (e.g., presence of leash signs; presence of dog waste bins) (α=0.91) (χ^2=111.3; *df*= 34; CFI=0.96; RMSEA=0.07). In addition, four separate Likert-scale items were used to assess neighborhood

walking safety (day and night crime, heavy traffic, and presence of sidewalks) (Cerin *et al.,* 2006).

Physical activity

Dog walking, defined as an activity in which both the dog and the owner are walking together with the dog on or off leash, was assessed with three items: number of days of dog walking in a typical week, average number of dog walks per day, and the typical duration per dog walk. Participants were classified as being a dog walker if they reported any dog walking in a typical week (n=312). Seventy-nine survey respondents reported that they did not walk their dog(s); henceforth referred to as non-dog walkers. Weekly minutes of dog walking was calculated based on the self-reported frequency and duration of dog walks. In addition, self-reported PA during the past seven days was assessed with six items from the International Physical Activity Questionnaire (IPAQ) (Craig *et al.,* 2003). Questions assessed the number of days and minutes per day of moderate and vigorous PA and walking performed for at least 10 minutes at a time. A participant was classified as meeting PA recommendations if they reported walking 150 minutes or more per week (PAGC, 2008).

Socio-demographic variables

Demographic variables included age, gender, race, ethnicity, highest level of education, marital status, and annual household income. Body mass index (BMI) was calculated based on self-reported height and weight. Participants were classified as overweight if BMI was 25.0-29.9 and obese if BMI was ≥30.0.

Statistical analysis

Descriptive analyses and multiple logistic regression were performed using SAS® 9.2. (SAS Institute, 2009). Logistic regression was used to estimate associations between individual, interpersonal, and environmental variables and dog walking status. Logistic regression also was used to examine the associations between dog walking and meeting PA recommendations. Unadjusted, age-adjusted and fully-adjusted models were estimated. Fully-adjusted models controlled for age, gender, household income, education, employment status, marital status, and weight status.

It was hypothesized that social support and perceived environment would predict dog walking behaviors, and that these associations would be mediated by self-efficacy. It was also hypothesized that outcome expectations and expectancies would mediate the relationship between self-efficacy and dog walking. Hypotheses about relationships between individual, interpersonal, and environmental factors and weekly minutes of dog walking (including mediation) were examined using structural equation modeling with AMOS™ 18.0 software (Arbuckle, 2008). Full information maximum likelihood (FIML) estimation (Kline, 2005). was used due to missing responses (ranging from <1% for the measure of dog age to 7% for household income). Patterns in missing data were examined and it was determined that data were missing at random. A measurement model which consisted of nine latent variables (two self-efficacy factors, owner outcome expectations, owner outcome expectancies, three social support factors, and two environment factors) was examined. A structural model was then tested using the SCT constructs within a social ecological framework (Bandura, 1997; McLeroy *et al.,* 1988). The model controlled for age, gender, household income, education, employment status, marital status, and weight status.

Comparative fit index (CFI $\geq$ 0.90) and root mean square error of approximation (RMSEA $\leq$ 0.08) were used as the primary criteria to determine adequate model fit (Kline, 2005). Squared multiple correlation (R^2) was used to examine the effectiveness of the model in explaining the observed variance in dog walking. Mediation was examined using the process detailed by Holmbeck (Holmbeck, 1997).

Results

Participant characteristics

Four-hundred and twenty-nine adults completed the survey. Thirty-eight respondents were excluded from the analysis due to incomplete walking or dog walking data (n=12), implausible dog walking values (n=7), and out of range (> 4 hours per day) self-reports for moderate and vigorous PA (n=19). Models were tested with and without these outliers. The outliers significantly attenuated associations with dog walking status and associations between dog walking and PA and therefore were excluded from the final analysis. The final analytic sample consisted of 391 adults (mean age = 43.6 ±12.3 years).

Participants were primarily Caucasian (96%). On average, dog walkers (*n*=312) were 6 years younger than non-dog walkers and were also less likely to be overweight or obese (see Table 1). Sixty-one percent of dog walkers, compared to 37% of non-dog walkers, met physical activity guidelines based on walking. Among dog walkers, the average duration of each walk was approximately 30 minutes and mean weekly duration was 185.7±164.1 minutes (median= 137.5 minutes). Correlations, means, standard deviations, skewness, and kurtosis of survey scales are reported in Table 2.

Associations with dog walking status

In unadjusted models, both self-efficacy factors; outcome expectations and expectancies; dog, family, and friend support; walking environment; dog specific environment; and sidewalks were significantly associated with an increased odds of being a dog walker (see Table 3). The presence of heavy traffic and a yard were associated with a decreased odds of being a dog walker. In fully-adjusted models, the effects of dog-specific environment, sidewalks, and presence of a yard were attenuated. When a fully-adjusted model with all significant independent variables was examined (see Model 3 in Table 3), the self-efficacy factor of making time for dog walking, dog-specific outcome expectancies, social support from family and the dog(s), and neighborhood walking environment were associated with a 1.3 to 5.7 greater odds of being a dog walker.

In fully-adjusted models, six out of 10 reinforcements that included personal health, maintenance of owner weight, dog health, dog enjoyment, maintenance of dog weight, and having an energetic dog had statistically significant positive associations with dog walking status. Four out of 15 barriers, having an old dog, poor dog health, more than one dog to walk, and having a difficult dog to control, were associated with a lower odds of being a dog walker (Table 4).

Associations with weekly minutes of dog walking

An initial direct effects model included all variables with significant individual correlations with weekly minutes of dog walking: owner and dog-related outcome expectations and outcome expectancies; family, friend, and dog social support; neighborhood walking features; dog-specific environment; presence of a yard; presence of sidewalks; perceptions of

daytime crime; and weight status. The overall fit of this model was good (χ^2=1257.3; *df*=734; CFI=0.92; RMSEA =0.05). When all variables were included together in the direct effects model, owner and dog-related outcome expectations, owner-related outcome expectancies, family support, and environment variables of neighborhood walking features, dog-specific environment, sidewalks, and daytime crime were not associated with dog walking minutes. Two of these variables, sidewalks and daytime crime, were removed from the model to examine potential suppression effects on the latent neighborhood environment variables. Removal of these two variables resulted in a statistically significant positive relationship of neighborhood walking features with dog walking minutes. A final direct effects model including only variables that significantly predicted dog walking behavior fit the data well (χ^2=544.4; *df*=292; CFI=0.94; RMSEA =0.05). A mediation model including predictor variables that had significant direct effects with dog walking, and self-efficacy as a mediator, was tested. The model fit well (χ^2=446.3; *df*=261; CFI=0.95; RMSEA =0.05) and self-efficacy was significantly associated with dog walking. All predictor variables were significantly associated with self-efficacy, with the exception of neighborhood walking features. Therefore a mediation effect of neighborhood walking features was not tested.

A final model was tested which included both direct effects and mediation by self-efficacy (see Figure 1). Self-efficacy fully mediated the relationships between friend support and presence of a yard with weekly minutes of dog walking. Self-efficacy partially mediated the relationship of dog support with dog walking minutes. This model yielded good fit and explained 37% of the variance in dog walking minutes. Self-efficacy had the strongest relationship with dog walking.

Associations between dog walking and physical activity

In unadjusted, age-, and fully-adjusted models, dog walkers were significantly more likely to meet PA guidelines via walking than non-dog walkers, with no attenuation of effects seen across models. In a fully-adjusted model, dog walkers had a 2.7 (CI=1.54, 4.77) greater odds of meeting PA recommendations than non-dog walkers. Also, every 30 minute increase in weekly minutes of dog walking was associated with a 23% greater odds of meeting PA recommendations (OR=1.23; CI=1.15, 1.31).

Discussion

In line with a recent call to advance dog walking research methods (Christian *et al*., In Press), the present study sought to identify correlates and mediators of dog walking by examining relevant individual, interpersonal, and environmental-level factors based on SCT and a social-ecological framework. Several SCT measures developed specifically for dog walking, including self-efficacy, outcome expectations and expectancies, and social support were shown to be significant correlates of dog walking. Also, consistent with previous studies, dog walkers were significantly more likely to meet PA guidelines than non-dog walkers, even after adjusting for covariates (Brown and Rhodes, 2006; Christian *et al.,* In Press; Reeves *et al*., 2011).

Self-efficacy had the strongest relationship with weekly dog walking minutes, a finding that is consistent with SCT tenets and existing evidence on self-efficacy and physical activity in general (Bandura, 1997). The perception of social support from one's dog(s) and friends was strongly related to self-efficacy for dog walking. In addition, perceptions of dog support for dog walking were also directly related to dog walking. This finding for dog social support is consistent with previous studies which indicate that social support provided by the dog to walk is an important correlate of dog walking (Christian *et al.,* 2010; Hoerster *et al.,* 2011). The current study's mediation analysis extends previous research by highlighting the importance of social support specifically for enhancing dog walking self-efficacy. These findings indicate that a supportive social environment is positively related to both self-efficacy and dog walking behaviors and generally aligns well with The Guide to Community Preventive Services (2002) recommendations for social support interventions to increase PA. Dogs specifically can provide social support by being a companion for PA (Epping, 2011). Furthermore, results of this study indicate that dogs provide more than just social support for dog walking. Significant dog-specific reinforcements and dog-specific outcome expectancies regarding the benefits of dog walking for the dog(s) were important factors dog owners identified. Therefore, researchers should expand on the only controlled dog walking intervention conducted to date which successfully influenced dog walking behaviors by promoting the benefits of dog walking for the dog (Rhodes *et al.,* 2012).

While self-efficacy was significantly associated with outcome expectations, outcome expectations were not significantly associated with weekly minutes of dog walking. This finding is consistent with prior empirical research with SCT which has shown that self-efficacy

perceptions account for the most variance in health behaviors among SCT constructs (Bandura, 1997; Maddux, 1995). Therefore, when the effect of self-efficacy is included in the model, outcome expectations are not likely to explain a significant amount of additional variance in behavior (Maddux, 1995). Interestingly, dog-specific outcome expectancies were significantly related to being a dog walker suggesting that the value placed on dog walking outcomes for the dog(s) plays an important role in becoming a dog walker, but is not necessarily associated with the amount of dog walking adults perform.

The current study extends previous research on the positive relationship between certain attributes of the neighborhood environment and dog walking behaviors. Results indicate that access to open, grassy areas that are interesting and aesthetically pleasing was positively associated with dog walking, a finding consistent with two previous studies (Christian *et al.,* 2010; Hoerster *et al.,* 2011). In the current study, if a participant had a yard for their dog, they had lower levels of self-efficacy for dog walking. Overall, the findings from the current study along with previous research indicate that dog walking interventions should include strategies that target the neighborhood built environment.

While the results of this study are specific to dog walking, they also shed light on the role of social ecological models and social cognitive theory constructs in predicting walking behavior more broadly. Some correlates of dog walking identified in this study, such as social support, outcome expectancies, self-efficacy, and environmental attributes, have also been shown to be related to other forms of walking and PA (Sallis, 1999). But predictors such as social support from and outcome expectancies for the dog also bolster the idea that physical activity may be facilitated when people see relevance of those behaviors for something beyond themselves. By identifying the factors that motivate and encourage dog owners to walk their dog, this knowledge could be extended to help understand walking behaviors in general.

Study strengths and limitations

Strengths of this study include the use of SCT constructs specific to dog walking. Prior to this study, SCT had not been applied to an examination of dog walking correlates and in fact, the only other theory-based correlates study had used the theory of planned behavior. An additional strength of this study was the examination of individual, interpersonal, and environmental

correlates, and mediation testing of self-efficacy using a latent variable model approach that accounted for measurement error in the model (Kline, 2005).

This study has several limitations. The convenience sample of participants primarily consisted of white, female, relatively well-educated adults, and thus generalization to other dog owners in the U.S. should be made with caution. In addition, the cross-sectional design precludes making any causal inferences about SCT constructs and dog walking. Prospective assessments of these relationships are needed. While this study used reliable and valid measures, the use of self-report measures for PA and dog walking is prone to recall and social desirability bias. Objective assessments of PA during dog walking with the use of pedometers or accelerometers should be considered in future research.

Conclusion

Psychosocial and environmental factors were associated with being a dog walker and weekly minutes of dog walking. In light of these findings, it may advantageous to design dog walking interventions that focus on increasing self-efficacy for dog walking by fostering social support and providing education on the benefits of dog walking for both the dog and owner. In addition, intervention planners need to consider the influence of the neighborhood built environment on both self-efficacy and dog walking. This study's findings indicate that dog walking significantly contributed to meeting PA recommendations. Given that 21% of the participants did not walk their dog(s) and less than half of participants who did walk their dogs, walked enough to meet PA recommendations, dog owners appear to represent an important group to target for dog walking interventions. Furthermore, study findings support the continuing use of the DAWGS instrument to examine correlates of dog walking, as well as a continued focus on individual, interpersonal and environmental influences on dog walking.

References

American Pet Products Association (APPA)., 2011. *APPA National Pet Owners Survey* [online]. Source. Available from: http://www.americanpetproducts.org/pubs_survey.asp [Accessed June 2011].

Arbuckle, J., 2008. *Amos™ user's guide*. Crawfordsville, Florida: Amos Development Corporation.

Bandura, A., 1997. *Self-efficacy: the exercise of control*. New York: W.H. Freeman and Company.

Baronowski, T., Perry, C.L., Parcel, G.S. (2002). How individuals, environments, and health behavior interact: social cognitive theory. In Glanz, B., Rimer, B., Lewis, F. (Eds). *Health behavior and education: theory, research, and practice.* (pg. 165-184). San Francisco, CA: Jossey-Bass Publishers.

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 (11-12),* 632-4.

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(2), 131-6.

Cerin, E., Saelens, B.E., Sallis, J.F., Frank, L.D., 2006. Neighborhood environment walkability scale: Validity and development of a short form. *Medicine & Science in Sports & Exercise,* 38(9), 1682-91.

Christian, H., Giles-Corti, B., & Knuiman, M., 2010. I'm just a walking the dog: Correlates of regular dog walking. *Family and Community Health,* 33(1), 44-52.

Christian, H., Wesgarth, C., Bauman, A., Richards, E.A., Rhodes, R.E., Evenson, K.R., Mayer, J.A., Thorpe, R.J., (In press). Dog ownership and physical activity: A review of the evidence. *Journal of Physical Activity and Health*.

Craig, C.L., Marshall, A.L., Sjostrom, M., Bauman, A.E., Booth, M.L., Ainsworth, B.E., Pratt, M.,… Oja, P., 2003. International physical activity questionnaire: 12-country reliability and validity. *Medicine & Science in Sports & Exercise, 35*(8), 1381-95.

Cutt, H., Giles-Corti, B., Knuiman, M., 2008. Encouraging physical activity through dog walking: Why don't some dog owners walk with their dog? *Preventive Medicine,* 46(2), 120-6.

Cutt, H., Giles-Corti, B., Wood, L., Knuiman, M., Burke,V. 2008. Barriers and motivators for owners walking their dog: Results from qualitative research. *Health Promotion Journal of Australia,* 19: 118-124.

Cutt, H., Giles-Corti, B., Knuiman, M., Pikora, T.J., 2008. Physical activity behavior of dog owners: Development and reliability of the Dogs and Physical Activity (DAPA) tool. *Journal of Physical Activity and Health,* 5(Suppl 1), S73-S89.

Dzewaltowski, D., 1994. Physical activity determinants: A social cognitive approach. *Medicine & Science in Sports & Exercise,* 26(11), 1396-99.

Epping, J., 2011. Dog ownership and dog walking to promote physical activity and health in patients. *Current Sports Medicine Reports,* 10(4), 224-7.

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(1), 33-8.

Holmbeck, G.N., 1997. Toward terminological, conceptual, and statistical clarity in the study of mediators and moderators: examples from the child-clinical and pediatric psychology literatures. *Journal of Consulting and Clinical Psychology, 65*(4), 599-610.

Johnson, R., 2010. Dog-walking: motivation for adherence to a walking program. *Clinical Nursing Research, 19*, 387-402.

Kline, R., 2005. *Principles and practice of structural equation modeling*. New York: Guilford Press.

Laflamme, D., 1997. Development and validation of a body condition score system for dogs. *Canine Practice,* 22(4), 10-15.

Lentino, C., Visek, A., McDonnell, K., DiPietro, L., 2012. Dog-walking is associated with a favorable risk profile independent of moderate to high volume of physical activity. *Journal of Physical Activity and Health,* 9(3), 414-20.

Maddux, J., 1995. *Self-efficacy, adaptation, and adjustment: Theory, research and application.* New York: Plenum Press.

McLeroy, K.R., Bibeau, D., Steckler, A., Glanz, K., 1988. An ecological perspective on health promotion programs. *Health Education Quarterly*, 15(4), 15:351-77.

Moudon, A.V., Lee, C., Cheadle, A.C., Garvin, C., Rd, D., Schmid, T., Weathers, R. 2007. Attributes of environments supporting walking. *American Journal of Health Promotion,* 21(5), 448-59.

Physical Activity Guidelines Advisory Committee., 2008. Physical Activity Guidelines Advisory Committee Report. U.S. Department of Health and Human Services. http://www.health.gov/PAGuidelines/Report/

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, 436-44.

Rhodes, R.E., Murray, H., Temple, V.A., Tuokko, H., Higgins, J.W., 2012. Pilot study of a dog walking randomized intervention: effects of a focus on canine exercise. *Preventive Medicine,54*, 309-312.

Richards, E., McDonough, M., Edwards, N., Lyle, R., Troped, P., Development and psychometric testing of the Dogs and Walking Survey (DAWGS). *Research Quarterly for Exercise and Sport.* (In Press)

Sallis, J.F. & Owen, N., 1999. *Physical activity and behavioral medicine.* Thousand Oaks, California: Sage.

SAS Institute Inc., 2009. *SAS/STAT ® 9.2 User's Guide*, Second Edition. Cary, North Carolina: SAS Institute Inc.

Schofield, G., Mummery, K., Steele, R., 2005. Dog ownership and human health-related physical activity: an epidemiological study. *Health Promotion Journal of Australia, 16*(1), 15-19.

Task Force on Community Preventive Services., 2002. Recommendations to increase physical activity in communities. *American Journal of Preventive Medicine, 22*(4S), 67-72.

Williams, D.M., Anderson, E.S., Winett, R.A., 2005. A review of the outcome expectancy construct in physical activity research. *Annals of Behavioral Medicine, 29*, 70-79.

Table 1. Sociodemographic and physical activity characteristics of participants

Characteristic	All respondents *n*=391		Dog walkers[a] *n*=312		Non-dog walkers *n*=79		p^b
Age (mean years ±SD)	43.6± 12.3		42.4±12.4		48.4±10.5		<0.01
Minutes of walking per week	255.5 ± 259.3		265.9 ± 250.4		214.6 ± 289.6		0.12
Minutes of MPA per week	139.4 ± 159.8		145.3 ± 168.7		116.1 ± 115.8		0.09
Minutes of VPA per week	142.6± 162.4		149.4 ± 158.9		116.0 ± 174.0		0.12
	n	%	*N*	%	*n*	%	p^c
Meeting PA recommendations based on walking							
Yes	218	55.8	189	60.6	29	36.7	<0.01
No	173	44.3	123	39.4	50	63.3	
Gender							
Female	323	82.2	259	86.1	68	92.9	0.38
Male	56	14.8	42	14.0	14	17.1	
Marital status							
Married	249	65.7	194	64.5	55	70.5	0.72
Single	60	15.8	49	16.3	11	14.1	
Widowed	9	2.4	7	2.3	2	2.6	
Divorced/separated	33	8.7	28	9.3	5	6.4	
Living as married	28	7.4	23	7.6	5	6.4	
Income							
<$50,000	96	26.1	80	27.3	17	21.5	0.57
$50-89,999	131	35.6	102	34.8	30	38.0	
$90,000+	141	38.3	111	37.9	32	40.5	
Education level							
High school/ GED	38	9.7	25	8.0	13	16.5	0.05
Some college/ technical school	73	18.7	54	17.3	19	24.1	
2 or 4 year college degree	135	34.5	115	36.9	20	25.3	
Masters or professional degree	86	22.0	68	21.8	18	22.8	
Doctoral degree	59	15.1	50	16.0	9	10.8	

Employment							
Full-time	297	78.0	234	77.2	63	80.8	0.50
Not employed full-time	84	22.1	69	22.8	15	19.2	
Weight status							
Normal BMI	148	39.7	128	43.0	21	26.6	0.03
Overweight	113	30.3	87	29.2	28	35.4	
Obese	112	30.0	83	27.9	30	38.0	
Indiana resident							
Yes	315	83.1	254	84.1	63	81.8	
No	64	16.9	48	17.9	14	18.2	0.50

[a] A participant was classified as a dog walker if they reported any minutes of dog walking in the past week.
[b] T-test *p-value;* [c] χ^2 *p*-value
[d] Chi-square not computed due to small group sample sizes
MPA= moderate physical activity; PA= physical activity; VPA= vigorous physical activity

Table 2. Variable correlations, means, standard deviations, skewness, and kurtosis[a]

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Making time[b]													
2. Resisting relapse[b]	0.79												
3. Owner expectations	0.37	0.41											
4. Dog expectations	0.31	0.37	0.69										
5. Owner expectancies	0.22	0.28	0.68	0.43									
6. Dog expectancies	0.32	0.40	0.49	0.60	0.56								
7. Dog support	0.35	0.40	0.43	0.45	0.24	0.35							
8. Family support	0.24	0.21	0.21	0.26	0.08	0.14	0.29						
9. Friend support	0.27	0.29	0.25	0.25	0.16	0.21	0.28	0.19					
10. Walking features	0.12	0.04	0.12	0.10	0.08	0.02	0.03	0.19	0.12				
11. Dog-specific environment	0.15	0.13	-0.05	0.03	-0.06	0.01	0.02	0.12	0.26	0.28			
12. Weekly walking minutes	0.26	0.25	0.11	0.08	0.08	0.13	0.08	0.02	0.11	0.01	0.10		
13. Weekly dog walking minutes	0.48	0.50	0.26	0.31	0.10	0.28	0.42	0.30	0.32	0.22	0.22	0.32	
M±*SD*	3.8±0.8	3.7±0.9	4.3±0.7	4.3±0.7	4.2±0.6	4.4±0.7	4.0±1.0	2.5±1.3	1.6±0.8	3.7±0.8	2.2±1.1	256±259	186±164
Skewness	-0.7	-0.5	-1.3	-1.0	-1.1	1.5	-1.2	0.4	1.7	-0.5	0.6	2.2	1.8
Kurtosis	0.6	-0.1	3.6	1.8	3.5	4.4	1.1	-0.7	3.1	-0.3	-0.7	6.0	4.2

[a]All correlations with an absolute value of 0.11 or greater are significant at $p<0.05$; [b]One of two self-efficacy factors

Table 3. Associations between psychosocial and environmental variables and dog walking status: odds ratios (95% CI) (n=391)

Variable	Model 1[a]	Model 2[b]	Model 3[b,c]
Self-efficacy			
Making time	2.68 (2.03, 3.53)	2.58 (1.90, 3.49)	1.34 (1.03, 2.78)
Resisting relapse	2.67 (2.02, 3.51)	2.67 (1.97, 3.64)	
Outcome expectations			
Owner expectations	2.22 (1.57, 3.14)	2.53 (1.71, 3.75)	
Dog expectations	3.11 (2.13, 4.51)	3601 (2.34, 5.55)	
Outcome expectancies			
Owner expectancies	1.61 (1.13, 2.28)	2.01 (1.36, 2.97)	
Dog expectancies	2.82 (1.92, 4.15)	3.40 (2.20, 5.24)	2.88 (1.56, 5.29)
Social support			
Dog support	3.31 (2.50, 4.39)	5.13 (3.48, 7.56)	4.11 (2.52, 6.72)
Family support	4.87 (3.05, 7.78)	5.45 (3.22, 9.23)	5.66 (2.74, 11.70)
Friend support	10.57 (3.93, 28.43)	11.52 (3.75, 32.35)	
Neighborhood environment			
Walking environment	1.48 (1.11, 1.99)	1.70 (1.23, 2.37)	1.87 (1.23, 3.12)
Dog-specific environment	1.32 (1.03, 1.71)	1.15 (0.87, 1.51)	
Presence of maintained	1.25 (1.04, 1.48)	1.12 (0.92, 1.36)	

sidewalks		
Presence of heavy traffic	0.79 (0.64, 0.99)	0.79 (0.62, 1.00)
Presence of day crime	0.82 (0.58, 1.15)	0.69 (0.48, 1.01)
Presence of night crime	1.00 (0.77, 1.28)	0.87 (0.67, 1.48)
Presence of other dogs	1.06 (0.86, 1.31)	0.97 (0.77, 1.22)
Presence of a yard	0.12 (0.02, 0.90)	0.16 (0.02, 1.28)
Presence of a fence in yard	0.81 (0.47, 1.41)	0.63 (0.34, 1.16)

[a] Unadjusted model; [b] Adjusted for age, gender, weight, education, income, employment status, and marital status; [c] Adjusted for all significant independent variables

Table 4. Associations between reinforcements and barriers and dog walking status: odds ratios (95% CI) (*n*=391)

Variable	Model 1[a]	Model 2[b]
Takes away from exercise time	0.53 (0.21, 1.35)	0.38 (0.14, 1.05)
Reinforcements		
Personal health	1.89 (1.12, 3.21)	2.47 (1.38, 4.42)
Dog health	5.02 (2.60, 9.70)	5.38 (2.59, 11.18)
Maintain weight	2.05 (1.12, 3.74)	2.00 (1.05, 3.80)
Lose weight	0.91 (0.54, 1.54)	1.01 (0.55, 1.84)
Good weather	1.46 (0.85, 2.50)	1.55 (0.86, 2.79)
Dog enjoyment	12.61 (6.53, 24.37)	12.57 (3.02, 26.26)
Maintain dog weight	3.12 (1.81, 5.36)	2.37 (1.32, 4.26)
Reduce dog weight	1.04 (0.56, 1.96)	1.07 (0.55, 2.11)
Large dog	2.12 (0.97, 4.65)	2.06 (0.87, 4.88)
Energetic dog	3.37 (1.92, 5.92)	3.11 (1.71, 5.68)
Barriers		
Cold weather	0.89 (0.53, 1.49)	0.81 (0.46, 1.42)
Hot weather	0.73 (0.44, 1.20)	0.94 (0.53, 1.65)
Rain	1.76 (0.99, 3.13)	1.97 (1.07, 3.62)
Snow	0.73 (0.44, 1.22)	0.76 (0.44, 1.30)
Lack of time	0.86 (0.53, 1.42)	0.82 (0.48, 1.41)
Difficult for me to walk	0.81 (0.31, 2.09)	1.10 (0.37, 3.28)
Personal health	0.93 (0.33, 2.58)	2.12 (0.53, 8.42)
Old dog	0.48 (0.23,0.99)	0.30 (0.13, 0.67)
Dog health	0.34 (0.15, 0.77)	0.35 (0.14, 0.86)
Small dog	0.38 (0.10, 1.36)	0.40 (0.10, 1.58)
Untrained dog	0.76 (0.29, 1.99)	0.41 (0.15, 1.10)
Wild dog	1.04 (0.34, 3.19)	0.52 (0.15, 1.73)
Dog difficult to control	0.66 (0.34, 1.29)	0.42 (0.20, 0.91)
More than 1 dog to walk	0.49 (0.26, 0.90)	0.40 (0.21, 0.79)

[a] Unadjusted model; [b] Adjusted for age, gender, weight, education, income, employment status, and marital status

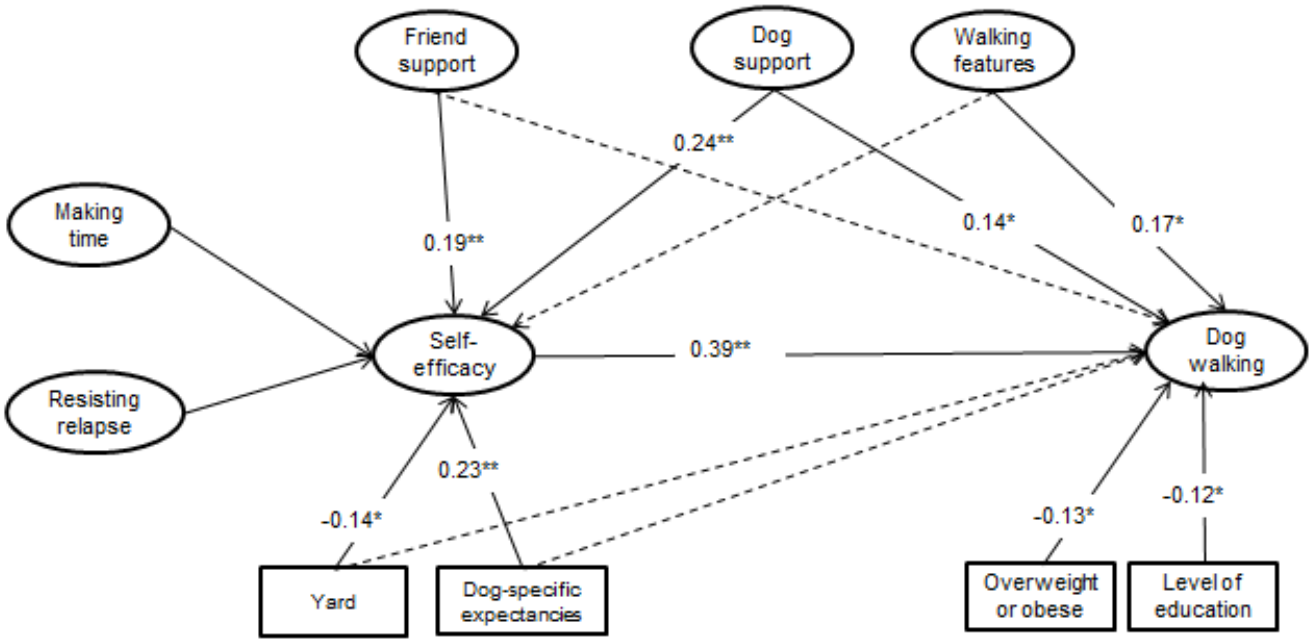

Figure 1. Final structural model with standardized estimates and fit statistics[a]

χ^2=777.5, *df*= 516, RMSEA= 0.04(90% CI= 0.03, 0.05) CFI=0.95

*p<0.05 **p<0.01; [a]Non-significant paths are indicated by dashed lines

Covariates controlled for include: age, gender, education, household income, employment status, marital status, and weight status