

■ Original Article

The Relationship between Dog Ownership and Physical Activity in Korean Adults

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Background: Many studies have reported that dog ownership is effective in encouraging physical activity. However, the association between living with a dog and enhanced physical activity has not been clearly verified. Thus, this study aimed to investigate the effects of dog ownership on the amount of physical activity in a representative sample of Korean adults.

Methods: This cross-sectional study administered the International Physical Activity Questionnaire (IPAQ) to 1,299 individuals who visited the international healthcare center of one hospital in Seoul, Korea, between August and December in 2018. Based on responses to the IPAQ survey, the amount and duration of physical activity was calculated to analyze relationships with dog ownership.

Results: The total amount ($P=0.02$) and duration of physical activity ($P=0.02$) and the duration of vigorous-intensity physical activity ($P=0.04$) were significantly higher among dog owners than non-dog owners. The duration of daily physical activity increased with dog ownership by 18.6 minutes ($P=0.01$). A comparison of dog owners according to whether they walked with their dogs revealed that dog walking had no significant effect on the amount and duration of physical activity, inactivity, or health-enhancing physical activity status. There was a sex-specific association between dog ownership and total duration of physical activity in females.

Conclusion: The duration of physical activity increased by dog ownership. However, the higher levels of physical activity among dog owners may not necessarily be explained by dog ownership or walking with dogs. This outcome suggests that raising a dog can help promote physical activity.

Keywords: Exercise; Dogs; Walking; Health Promotion

Received: October 21, 2019, Revised: December 18, 2019, Accepted: January 8, 2020

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INTRODUCTION

In accordance with increases in the elderly population and single-person households, an increasing number of individuals are living with pet animal(s) to alleviate loneliness and/or feelings of alienation.¹⁾ Dog owners are willing to spend some time to play or take a walk with their dogs every day for their health and well-being.²⁾

There has been much research investigating whether raising a dog has beneficial effects among the elderly in terms of mental health, including improvement in depression or anxiety,³⁾ and the positive results of animal assisted activity visits are now widely known. In addition, several studies have reported positive results according to the high interest in whether living with a dog can be effective in promoting physical activity that directly affects (i.e., improves) physical health.⁴⁻⁶⁾ However, to our knowledge, no study has investigated the relationship between raising pet animal(s) and physical activity in Korea.

It has been established that exercise and regular physical activity are associated with many health benefits; however, it appears difficult for many to make time only for their currently intangible long-term health. In this regard, living with a dog could encourage physical activity among both elderly and younger adults and could be considered a less constraining and more sustainable intervention.⁷⁾

If dog owners engage in more physical activity than non-dog owners, it may be meaningful to encourage dog ownership for individuals who require higher levels of regular exercise to maintain mental and physical wellness. In the present study, we investigated the differences in the amount and duration of physical activity between dog owners and non-dog owners.

METHODS

1. Participants

A survey was performed among participants of Korean adults ≥ 20 years of age who had completed a questionnaire for general medical checkup at the international healthcare center of Hanyang University Hospital in Seoul, Korea. Participants included 3,239 Koreans (response rate, 40.1%) who visited the center between August and December in 2018. Questionnaire data and physical measurements included age, sex, marital status, dog ownership, number and size of dogs, whether they walk their dogs, changes in physical activity after raising dog(s), intensity and time of physical activity, and height and weight. After excluding seven individuals who were < 20 years of age and 1,933 with missing answers or errors in their responses, the analysis ultimately included 1,299 participants.

2. Physical Activity and Other Variables

The metabolic equivalent of task (MET) was calculated according to the International Physical Activity Questionnaire (IPAQ) guideline based on responses to questions addressing physical activity in the questionnaire.⁸⁾ Questions addressing physical activity were classified as low (walking), moderate, and vigorous activities, and the total scores

of METs of three groups for each activity were calculated. Based on this score, participants were categorized into inactive, minimally active, and health-enhancing physical activity (HEPA) groups according to the IPAQ categories. The data were truncated to 180 minutes for individuals with physical activity duration > 180 minutes and 0 minute for those with < 10 minutes at each intensity of physical activity. To determine whether the participant was a dog walker, the response to the question "Do you take the dog for a walk yourself?" in the questionnaire, was used.

3. Statistical Analysis

First, a normality test was performed on the data; study participants were then classified into two groups according to dog ownership and baseline characteristics. The data were analyzed and compared. The Student t-test or Mann-Whitney test was used to compare continuous variables, and the chi-square test was used to compare categorical variables. The effect of dog ownership on total METs, the total duration of physical activity and moderate physical activity, and walking time were analyzed using linear regression analysis. The duration of physical activity was analyzed according to each intensity as the outcome variable. Model 1 addressed the relationship between age, sex, body mass index (BMI), marital status, and dog ownership and total physical activity time. Model 2 addressed the relationship between dog ownership and total physical activity time after the adjustment for variables in model 1. Univariate and multivariate logistic regression analyses were performed to assess the relationship between dog ownership and HEPA. As a subgroup analysis, dog owners were divided into "walker" and "non-walker" groups and compared with one another. Multivariate analysis was performed using a linear regression model, and logistic regression was conducted to assess the relationship between dog walking and physical activity. Differences with $P < 0.05$ were considered to be statistically significant. All statistical analyses were performed using IBM SPSS ver. 21.0 (IBM Corp., Armonk, NY, USA). The study was approved by the Institutional Review Board on Human Subjects Research and Ethics Committee, Hanyang University Hospital (IRB approval no., 2018-11-003-003). The study participants agreed to the informed consent for completing questionnaires and using their medical records for this study.

RESULTS

The basic characteristics of the participants according to dog ownership are summarized in Table 1. Approximately 16% of participants owned a dog. No significant differences in age, sex, marital status, and BMI were observed among participants who owned a dog and those who did not.

Comparing the total duration of physical activity, the result was significantly high among dog owners (1,946.6 versus 2,229.7 [MET-min/wk], $P = 0.02$), although the intensity of each physical activity was not. Moreover, dog owners engaged in significantly more exercise in total time of physical activity (121.5 versus 140.0 min/d, $P = 0.02$) and dura-

Table 1. Characteristics of study participants according to dog ownership

Characteristic	Non-dog owner (N=1,091)	Dog owner (N=208)	P-value*
Age (y)	44.2±10.5	45.5±12.2	0.14
Sex (male)	614.0 (56.3)	110.0 (52.9)	0.37
Body mass index (kg/m ²)	23.6±3.5	23.7±3.5	0.46
Marital status (married)	888 (81.4)	168 (80.8)	0.83
Amount of physical activity (MET-min/wk)			
Vigorous PA	712.1±1,198.6	817.5±1,330.7	0.15 [†]
Moderate PA	383.6±673.4	497.9±877.5	0.23 [†]
Walking PA	850.9±876.3	914.2±909.1	0.18 [†]
Total PA	1,946.6±2,158.6	2,229.7±2,362.1	0.02 [†]
Duration of physical activity (min/d)			
Vigorous PA	34.0±43.7	41.0±47.4	0.04
Moderate PA	34.8±44.9	40.5±51.0	0.78 [†]
Walking PA	52.8±43.4	58.4±46.6	0.09
Total PA	121.5±99.2	140.0±106.8	0.02
IPAQ category			
Inactive	347 (31.8)	61 (29.3)	
Minimally active	455 (41.7)	84 (40.4)	
Health enhancing physical activity	289 (26.5)	63 (30.3)	

Values are presented as mean±standard deviation or number (%).

MET, metabolic equivalent of task; PA, physical activity; IPAQ, International Physical Activity Questionnaire.

*Categorical variables were analyzed using chi-square test; continuous variables using Student t-test. [†]By Mann-Whitney test.

Table 2. Multivariate regression analysis of relationship between PA and dog ownership using a linear regression analysis

Variable	Univariate					Multivariate*				
	B	SE	β	P-value	95% CI	B	SE	β	P-value	95% CI
Total amount of PA (MET-min/wk)	283.04	165.87	0.05	0.09	-42.37 to 608.45	286.74	164.12	0.05	0.08	-35.23 to 608.71
Total PA time (min/d)	18.45	7.60	0.07	0.02	3.54 to 33.36	18.56	7.45	0.07	0.01	3.93 to 33.18
Moderate PA time and walking time (min/d)	11.45	5.42	0.06	0.04	0.81 to 22.09	10.92	5.37	0.06	0.04	0.38 to 21.45

PA, physical activity; SE, standard error; CI, confidence interval; MET, metabolic equivalent of task.

*Adjusted for age, sex, marital status, and body mass index.

Table 3. Multivariate regression analysis of relationship between PA and dog ownership using logistic regression analysis

Variable	Univariate		Multivariate*	
	OR (95% CI)	P-value	OR (95% CI)	P-value
Health-enhancing PA	1.21 (0.87–1.67)	0.26	1.22 (0.88–1.70)	0.24

PA, physical activity; OR, odds ratio; CI, confidence interval.

*Adjusted for age, sex, marital status, and body mass index.

tion of vigorous intensity physical activity (34.0 versus 41.0 min/d, $P=0.04$). In addition, categorical scores of the IPAQ classification tended to be high in inactive and minimally active groups, although the difference was not statistically significant.

Results of the effects of dog ownership on total METs, total duration of physical activity, moderate and walking physical activity time, and HEPA states are summarized in Tables 2 and 3. Model 1 demonstrates the relationship between age, sex, BMI, marital status, and dog ownership and total duration of physical activity. Model 2 demonstrates the adjusted result of variables in model 1. Sex, marital status, and dog ownership were significantly correlated with all outcome variables after adjustment. Outcomes related to dog ownership included total du-

ration of physical activity and moderate and walking physical activity. Total duration of physical activity was increased by 18.6 minutes ($P=0.01$), and moderate and walking physical activity time was increased by 10.9 minutes per day ($P=0.04$) in those with dogs. In males, total METs were higher by 632.5 ($P<0.001$), total physical activity time was greater by 34.3 minutes per day ($P<0.001$), moderate and walking physical activity time was greater by 14.8 minutes per day ($P=0.001$), and 1.9 times more likely to be in a HEPA state than females. Among married individuals, total METs were lower by 595.2 ($P=0.001$), total physical activity time was 30.1 minutes less per day ($P<0.001$), moderate and walking physical activity time was 21.1 minutes less per day ($P<0.001$), and had a probability of 0.6 of being in a HEPA state than

Table 4. Subgroup analysis for dog owners according to whether walking with dog or not (N=208)

Variable	Dog owner non-walker (N=84)	Dog walker (N=124)	P-value*
Age (y)	48.0±12.5	43.8±11.7	0.01
Sex (male)	53 (63.1)	57 (46.0)	0.02
Body mass index (kg/m ²)	24.1±3.5	23.5±3.5	0.19
Marital status (married)	69 (82.1)	99 (79.8)	0.68
Amount of PA (MET-min/wk)			
Vigorous PA	895.8±1,588.0	764.5±1,127.5	0.49
Moderate PA	601.9±998.7	427.4±781.3	0.16
Walking PA	954.1±1,062.7	887.3±791.7	0.60
Total PA	2,451.8±2,872.6	2,079.2±1,940.4	0.27
Duration of PA (min/d)			
Vigorous PA	37.4±48.9	43.5±46.5	0.37
Moderate PA	47.1±57.8	36.0±45.4	0.12
Walking PA	62.2±52.2	55.9±42.5	0.34
Total PA	146.7±118.2	135.4±98.6	0.45
IPAQ category			0.44
Inactive	26 (31.0)	35 (28.2)	
Minimally active	27 (32.1)	57 (46.0)	
Health-enhancing PA	31 (36.9)	32 (25.8)	
No. of dogs			0.67
1	69 (82.1)	99 (79.8)	
2	14 (16.7)	21 (16.9)	
≥3	1 (1.2)	4 (3.2)	
Dog size			0.07
Small	44 (52.4)	72 (58.1)	
Medium	25 (29.8)	43 (37.7)	
Large	15 (17.9)	9 (7.3)	
Increased PA with dog (self-evaluated)			<0.001
Yes	79 (94.0)	76 (61.3)	
No	5 (6.0)	48 (38.7)	

Values are presented as mean±standard deviation or number (%).

PA, physical activity; MET, metabolic equivalent of task; IPAQ, International Physical Activity Questionnaire.

*Categorical variables were analyzed using chi-square test; continuous variables using ANOVA or Kruskal-Wallis test.

Table 5. Multivariate regression analysis of relationship between PA and walking with dog using a linear regression analysis

Variable	Univariate					Multivariate*				
	B	SE	β	P-value	95% CI	B	SE	β	P-value	95% CI
Total amount of PA (MET-min/wk)	-372.56	333.59	-0.08	0.27	-1,030.25 to 285.14	-222.58	331.42	-0.05	0.50	-876.06 to 430.90

PA, physical activity; SE, standard error; CI, confidence interval; MET, metabolic equivalent of task.

*Adjusted for age, sex, marital status, and body mass index.

Table 6. Multivariate regression analysis of relationship between PA and walking with dog using a logistic regression analysis

Variable	Univariate		Multivariate*	
	OR (95% CI)	P-value	OR (95% CI)	P-value
Physical inactivity	0.88 (0.48–1.61)	0.67	0.79 (0.42–1.49)	0.46
Health-enhancing PA	0.60 (0.33–1.08)	0.09	0.61 (0.32–1.14)	0.12

PA, physical activity; OR, odds ratio; CI, confidence interval.

*Adjusted for age, sex, marital status, and body mass index.

others (P=0.003).

Table 4 reports the results of comparing dog owners according to whether they walk with their dog. The amount and time of physical activity, the number of dogs, and dog size were not associated with

dog walking. The response that physical activity was increased after raising a dog was high in the dog owner but non-walker group (P<0.001).

Tables 5 and 6 demonstrate the effect of dog walking in terms of total

Table 7. Subgroup analysis for relationship between PA and dog ownership according to sex

Variable	Univariate					Multivariate*				
	B	SE	β	P-value	95% CI	B	SE	β	P-value	95% CI
Women (N=575)										
Total amount of PA (MET-min/wk)	225.44	211.93	0.04	0.29	-190.82 to 641.70	211.44	212.47	0.04	0.32	-205.87 to 628.75
Total PA time (min/d)	18.48	9.30	0.08	0.047	0.21 to 36.75	18.54	9.33	0.08	0.05	0.23 to 36.86
Amount of walking activity (MET-min/wk)	82.82	97.04	0.04	0.39	-107.79 to 273.42	90.06	97.31	0.04	0.36	-101.07 to 281.19
Walking activity time (min/d)	8.17	4.87	0.07	0.09	-1.40 to 17.74	8.66	4.87	0.07	0.08	-0.90 to 18.23
Men (N=724)										
Total amount of PA (MET-min/wk)	372.30	244.29	0.06	0.13	-107.31 to 851.91	303.82	244.06	0.05	0.21	-175.34 to 782.97
Total PA time (min/d)	20.74	11.32	0.07	0.07	-1.48 to 42.96	16.06	11.31	0.05	0.16	-6.14 to 38.26
Amount of walking activity (MET-min/wk)	51.16	91.80	0.02	0.58	-129.07 to 231.38	40.38	92.19	0.02	0.66	-140.61 to 221.36
Walking activity time (min/d)	3.79	4.54	0.03	0.40	-5.13 to 12.70	2.10	4.55	0.02	0.65	-6.84 to 11.04

P-value by linear regression analysis.

PA, physical activity; SE, standard error; CI, confidence interval; MET, metabolic equivalent of task.

*Adjusted for age, marital status, and body mass index.

METs, inactivity, and HEPA state. Among participants who were married, total METs decreased by 1,833.7 ($P < 0.001$) and decreased to 29% in HEPA state than the others ($P = 0.01$) after adjustment. Dog walking had no significant impact on the amount of physical activity, inactivity, or HEPA state.

Table 7 reports the results of analysis of the relationship between dog ownership and physical activity by dividing all participants according to sex. Multiple regression analysis revealed a significant association between dog ownership and total duration of physical activity in females, although there was no sex-specific association in males.

DISCUSSION

Regular physical activity is essential for health and increasing life expectancy, reducing the incidence of chronic disease(s), and maintaining physical function.⁹ It has been emphasized that reducing sedentary time and promoting physical activity enables a longer and healthier life in aging societies.¹⁰ Recently, the emphasis on health care, such as a healthy diet and regular physical activity in younger adults with obesity or other adult-onset diseases, has been increasing due to poor lifestyle habits.¹¹ In particular, work is often performed in the sitting position for prolonged periods, and many individuals sit or lie down to watch television or use their cellphones or even simply rest in our country.¹² However, it may be difficult to set aside time for regular exercise every day, despite the necessity of physical activity for fitness and well-being.

Therefore, we were curious whether the intervention of raising a dog could have a positive effect on encouraging regular physical activity. There has been much interest regarding the effects of living with companion pets on health. Accordingly, many studies have been conducted, and some have reported positive results. Research has also indicated positive effects, not only on improvement of depression and anxiety

but also on physical health, such as lowering blood pressure, simply by raising companion pets.¹³

Recently, studies that investigated the hypothesis that walking with or simply playing with dogs can more directly encourage physical activity and in turn provide beneficial effects on health have been performed in many countries.⁴⁻⁶ According to a research from the United Kingdom, among the elderly population, dog-owners were 12% more physically active than those without a dog.⁴ Another study reported that dog-walkers were 2.5 times more likely to achieve the recommended minimum of moderate-intensity physical activity.¹⁴ Even in Japan, which is similar to Korea in terms of environmental factors, a study showed that the dog owner group performed physical activity 54% more than the non-dog owner group.¹⁵ A recent research by Westgarth et al.¹⁶ suggested that the odds of dog-owners achieving physical activity benchmarks proposed in guidelines was 4 times greater than non-dog owners.

In a large-scale study from the United States, there was a positive correlation between walking with a dog and total duration of walking activity.¹⁷ Previous studies have reported that walking with a dog is also a major factor in encouraging physical activity.^{18,19} In addition, a study investigated the psychological mechanisms involved in motivating and encouraging walking with dogs under the assumption that walking is a key factor to promote physical activity.²

However, to our knowledge, no studies have investigated whether raising a dog affects physical activity levels in Korea. In the present study, we found that total amount and time of physical activity were significantly higher in the dog-owner group, and that total physical activity time was increased by 18.6 minutes per day and moderate and walking physical activity time was increased by 10.9 minutes per day. This outcome was consistent with previous studies, and as such, we can conclude that raising a dog in Korea can help promote physical activity.

According to the results of comparing the dog walker group versus the dog-owner non-walker group, the relationship between dog walking and the amount and time of physical activity, inactivity, or HEPA state was not significant, which is contrary to the findings of previous studies.⁷⁾ We speculate that there are some reasons for this outcome. First, in our country, we have a relatively large proportion of small dogs; therefore, there may be a lower sense of obligation to take a walk with the dog. Small dogs in our country account for 55.6% of the dog population compared to 27.6% in Canada, as reported by Lim and Rhodes.²⁾ In addition, the above study indicated that large dogs and those with high energy—regardless of breed—were walked more than small- or low-energy dogs. Another study reported that individuals with medium or large dogs performed significantly more minutes of recreational walking per week than those with small dogs or no dog at all.²⁰⁾ This means that walking is not necessarily the only reason why dog owners are more physically active in Korea. Second, dog owners are physically active not necessarily because of any activity with their dog but owing to the alleviation of depression or anxiety and emerging from helplessness that comes from raising a dog itself; as such, their life becomes more active.⁴⁾

We further performed a subgroup analysis to determine whether the relationship between dog ownership and physical activity differed according to sex and found that a significant relationship was present only in females. This result may be interpreted as simply the difference between owning a dog and taking care of it. Even if a couple raise a dog together, females performed more activities with the dog that helped in increasing their movement than male counterparts. Further research, however, may be needed to confirm this hypothesis.

There were limitations to this study. First, our results were not necessarily generalizable to the population who do not seek medical check-ups, given that our analysis applied only to those who visited the health care center for screening. Second, there may have been errors in measuring physical activity because it was self-reported, and because physical activity measurements were dependent on participant recall, recall bias may have been introduced. Finally, due to the lack of data and cross-sectional design of the study, we could not analyze the difference in physical activity of the study subjects before and after raising dogs, as it requires further investigation in the future.

In conclusion, our study demonstrated that physical activity could be promoted by raising a dog, even if dog-owners do not necessarily walk their own dogs. We can consider encouraging individuals to raise a dog in those who need to engage in more physical activity. This, of course, applies only to those who can raise a dog with responsibility and affection and not merely for their own needs. Individuals will be able to live a more active and healthy life by raising and caring for a dog.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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REFERENCES

1. The Seoul Institute. Introduction of animal welfare support facilities in Seoul. Seoul: The Seoul Institute; 2016.
2. Lim C, Rhodes RE. Sizing up physical activity: the relationships between dog characteristics, dog owners' motivations, and dog walking. *Psychol Sport Exerc* 2016;24:65-71.
3. Le Roux MC, Kemp R. Effect of a companion dog on depression and anxiety levels of elderly residents in a long-term care facility. *Psychogeriatrics* 2009;9:23-6.
4. Feng Z, Dibben C, Witham MD, Donnan PT, Vadiveloo T, Sniehotta E, et al. Dog ownership and physical activity in later life: a cross-sectional observational study. *Prev Med* 2014;66:101-6.
5. Garcia DO, Wertheim BC, Manson JE, Chlebowski RT, Volpe SL, Howard BV, et al. Relationships between dog ownership and physical activity in postmenopausal women. *Prev Med* 2015;70:33-8.
6. Cutt HE, Knuiman MW, Giles-Corti B. Does getting a dog increase recreational walking? *Int J Behav Nutr Phys Act* 2008;5:17.
7. Hoerster KD, Mayer JA, Sallis JE, Pizzi N, Talley S, Pichon LC, et al. Dog walking: its association with physical activity guideline adherence and its correlates. *Prev Med* 2011;52:33-8.
8. IPAQ Research Committee. Guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ): short and long forms [Internet]. [place unknown]: IPAQ Research Committee; 2005 [cited 2019 Aug 15]. Available from: <http://www.ipaq.ki.se>.
9. Paterson DH, Jones GR, Rice CL. Ageing and physical activity: evidence to develop exercise recommendations for older adults. *Can J Public Health* 2007;98 Suppl 2:S69-108.
10. de Rezende LF, Rey-Lopez JP, Matsudo VK, do Carmo Luiz O. Sedentary behavior and health outcomes among older adults: a systematic review. *BMC Public Health* 2014;14:333.
11. Ministry of Culture, Sports and Tourism. 2018 Public leisure activity survey report. Sejong: Ministry of Culture, Sports and Tourism; 2018.
12. Anderson WP, Reid CM, Jennings GL. Pet ownership and risk factors for cardiovascular disease. *Med J Aust* 1992;157:298-301.
13. Soares J, Epping JN, Owens CJ, Brown DR, Lankford TJ, Simoes EJ, et al. Odds of getting adequate physical activity by dog walking. *J Phys Act Health* 2015;12 Suppl 1:S102-9.
14. Oka K, Shibata A. Dog ownership and health-related physical activity among Japanese adults. *J Phys Act Health* 2009;6:412-8.
15. Westgarth C, Christley RM, Jewell C, German AJ, Boddy LM, Christian HE. Dog owners are more likely to meet physical activity guidelines

- than people without a dog: an investigation of the association between dog ownership and physical activity levels in a UK community. *Sci Rep* 2019;9:5704.
16. Reeves MJ, Rafferty AP, Miller CE, Lyon-Callo SK. The impact of dog walking on leisure-time physical activity: results from a population-based survey of Michigan adults. *J Phys Act Health* 2011;8:436-44.
 17. Brown SG, Rhodes RE. Relationships among dog ownership and leisure-time walking in Western Canadian adults. *Am J Prev Med* 2006; 30:131-6.
 18. Yabroff KR, Troiano RP, Berrigan D. Walking the dog: is pet ownership associated with physical activity in California? *J Phys Act Health* 2008;5:216-28.
 19. Schofield G, Mummery K, Steele R. Dog ownership and human health-related physical activity: an epidemiological study. *Health Promot J Austr* 2005;16:15-9.