What Physical Activities Can Help You Feel Better?: Analysis Based on the 2016 Korean National Health and Nutrition Examination Survey

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Background: This study aimed to investigate the relationship between exercise and depression based on responses to 2016 Korean National Health and Nutrition Examination Survey (KNHANES) and the Patient Health Questionnaire-9 (PHQ-9). Specifically, this study examined which physical activities have the greatest effects in combating depression.

Methods: This study was based on data from 2016 KNHANES and responses to the PHQ-9 questionnaire on physical activity. We selected 2,245 people of age >19 years, who completed the surveys. Physical activity variables included number of days of walking, duration of walking, days of strength training, and aerobic physical activity. These variables subdivided into aerobic and muscle strengthening activities and their effects on depression were examined.

Results: All the variables, except duration of walking, were negatively correlated with the PHQ-9 scale scores. However, of the physical activity variables included in the hierarchical regression analysis, only the number of days of walking over 1 week had a statistically significant negative effect on the PHQ-9 scores.

Conclusion: For adults, aerobic activity (walking) had a greater effect on reducing depression than muscle strengthening activity. The frequency and consistency of walking had a greater impact than the duration of walks. These results suggest that regular walking is a better form of physical activity than strength training for its effect on mood and it assists in overcoming depression.

Keywords Depression; Walking; Strength training

INTRODUCTION

Depression goes beyond manifesting negative emotions, but also seriously impairs normal function and daily activities. Depression is more of a problem than just experiencing negative emotions, bringing about substantial functional and daily impairment of the individual and a significant proportion of the leading causes of the increasing suicide rate [1,2].

According to a 2017 survey by the Korean National Statistical Office, suicide is the fifth cause of death

among all Koreans, and the most common cause of suicide is depression. Thus, the treatment and prevention of depression is becoming more imperative [3].

Because of the importance of the prevention and treatment of depression, many studies have been conducted. Among them, there are studies on if physical activity is effective in the prevention and treatment of depression [4,5]. Physical activity refers to all the movements of the body through energy consumption of skeletal muscle, and regular physical activity has a positive effect on mental health as well as improving physical health, and

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preventing chronic diseases [6-9].

More specifically, there is a significant correlation between depression and physical activity such as walking, muscle-strengthening, and aerobic exercise, and exercising regularly is more effective in reducing depression. Corbin et al. [8] found that regular and proper aerobic exercise facilitates improvement of depression. Kim and Suh [10] reported that employees who participated in exercise more than one hour daily had lower depressive symptoms than employees who did not exercise. Additionally, Kim et al. [11] reported that the decrease in muscle mass and strength is a risk factor for depression.

The World Health Organization [12], the United States, Australia, Canada, and many other countries have announced guidelines for physical activity and recommended a level of physical activity to promote health [13-15]. Korea's Ministry of Health and Welfare established the 'Physical Activity Guidelines for Koreans' in 2013. This Korean guideline suggests physical activity by life cycle, classified into children and adolescents, young adults, and adults older than age 65. Although there are some differences in recommendations for physical activity across the life cycles, aerobic physical activity (APA) and muscle-strengthening activity (MSA) are commonly recommended. APA guidelines for adults recommend moderate intense activity (3.0-5.9 times higher than resting) for more than two hours 30 minutes weekly, or vigorous intensity activity (more than 6.0 times higher than resting) for at least one hour 15 minutes weekly, and at least two days weekly for MSA [16].

However, data released by the Korea Centers for Disease Control and Prevention (2014) showed that the APA (vigorous or moderate intensity) of the Korean people decreased 41.5% in 2008 to 30.6% in 2012, and there the ratio of complying with APA and MSA guidelines decreased slightly 12.4% in 2008 to 11.8% in 2012 [17]. In the United States, conversely, the compliance rate for APA guidelines in 2012 was 49.5% and that for APA and MSA guidelines was 20.2%. This shows that Korea has lower compliance with physical activity guidelines in APA and MSA than the United States [18].

Although we know that physical activity helps to improve depressive symptoms, it is not easy for people to do physical activity. Thus, it is desirable to assess the degree of physical activity and depression and to examine their associations with health and nutrition examination data recently surveyed in Korea. This can be a good resource for developing and encouraging future physical

activity guidelines in Korea.

Several studies on the correlation between APA, such as walking, MSA and depression, exist. However, most of these previous studies were limited to the elderly or middle-age women [19,20], and APA and MSA were treated as the same physical activity without distinction [9,21,22]. Few studies have the differences between the two types of physical activity in Korean adults.

In this study, we classified physical activity into APA and MSA and further sub-classified APA into qualitative (i.e., regularity) or quantitative (i.e., amount) component to determine how it is related to depressive symptom.

MATERIALS AND METHODS

This study was conducted based on the Korean National Health and Nutrition Examination Survey (KNHANES). And, this study used raw data from the seventh year of the KNHANES conducted in 2016.

The KNHANES is a statutory investigation conducted under the National Health Promotion Act. This is a survey on the health behavior, chronic disease prevalence, food and nutrition intake of the public, and was conducted every three years from the first (1998) to the third (2005). It is held yearly from the beginning of 2007-2009. Since then, it has been reorganized into an annual survey system and has been conducted yearly since the fourth period (2007-2009).

KNHANES was conducted with the approval of the Institutional Review Board of the Korea Centers for Disease Control and Prevention (KCDC). The results of the survey are published through the distribution of press releases, publication of statistics, and the release of raw data until December of the following year. And the KCDC provide only data that has been de-identified so that no individual can be estimated. In 2016, 10,806 were surveyed, of which 8,150 were participants and the participation rate was 75.4%.

The raw data consists of three types: health survey, examination, and nutrition survey. In this study, the results of the health survey were used, conducted through interviews and self-reported surveys. This study was conducted after obtaining the approval of the Institutional Review Board of Bongsang Memorial Hospital in Busan, South Korea (No. 2020-002).

1. Subjects

The subjects of this study were older than age 19 and responded to the days of weekly walking exercise (DWWE), the total time of weekly walking exercise (TTWWE), the days of weekly muscle-strengthening exercise (DWMSE), the recommended aerobic physical activity execution status (RAPAES) and Patient Health Questionnaire-9 (PHQ-9). In the case of not responding to any item or responding 'no idea' to the PHQ-9 questionnaire, the subject was excluded. The total number of subjects was 2,245.

2. Measurements

1) Depression (PHQ-9)

In this study, the Korean standardized PHQ-9 was used to measure the degree of depression.

The PHQ-9 is a nine-item depression screening tool based on the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition. It has better sensitivity (88%) and specificity (88%) than the Self-Rating Depression Scale and the Beck Depression Inventory, the two most commonly used current depression measures. And it is a reliable and valid tool for measuring depression severity [23].

According to the existing domestic research, the cut-off value can be set to 9, but the total score of PHQ-9 was considered as the primary measure to use the continuous variable value of the raw data [24].

2) Physical activity

Using the data of KNHANES, DWWE (unit: days), TTWWE (unit: hours), and DWMSE (unit: days) were used as continuous variables. RAPAES is 'yes' or 'no' and were used as qualitative variables. Then we examined the association between them and the PHQ-9 score and the strength of the association.

3) Covariates (demographic variables)

Demographic characteristics included sex, age, income, education, marital status, job status, drinking, current smoking status, and body mass index (BMI). Ages were classified into under 30s, 30s, 40s, 50s, 60s, 70s, and 80s and above. Income levels were classified into lower, low-middle, upper-middle, and upper class according to the income quartile classification. The education level was classified into elementary school,

middle school, high school, and college.

Marital and job status were classified into two groups based on the current status. The current smoking group was classified into the smoking group, and the non-smoking group. The BMI was classified into underweight (<20), normal ($20 \leq \text{BMI} < 25$), mild obesity ($25 \leq \text{BMI} < 30$), and obesity ($\text{BMI} \geq 30$).

3. Statistical analyses

Discrete variables such as sex and disease status, were evaluated using the Chi-square test. Since the PHQ-9 score was taken as a continuous variable, covariance analysis was used to correct the confounding variable. Pearson's correlation analysis was used to correlate the variables. And hierarchical regression analysis was performed to investigate the variables affecting PHQ-9. Statistical significance of this study was defined as $p\text{-value} < 0.05$ in both directions, and all statistical analyzes were performed using IBM SPSS Statistics for Windows, Version 23.0 (IBM Co., Armonk, NY, USA).

RESULTS

1. Demographic characteristics

Table 1 shows the results of the frequency analysis on the general characteristics of the subjects for each major demographic variable. There were 1,891 males (84.2%) and 354 females (15.8%). A total of 446 people (19.9%) were in their 40s, the largest percentage, and 81 patients (3.6%) were older than age, the smallest percentage. The frequency of income level was highest at 635 people (28.3%) in the upper-middle level, and lowest at 400 people (17.8%) in the lower level. The frequency of education level was highest at 866 people (38.6%) in the university education level. In this study, 1,687 people (74.7%) were married and 1,573 people (70.1%) were employed.

Based on drinking more than one glass per month in the last year, there were 1,632 (72.7%) responded that they drank alcohol. Additionally, 899 people (40.0%) responded that they smoked daily, 153 people (6.8%) responded that they smoked occasionally, and 1,193 people (53.1%) responded that they did not ever smoke.

In the BMI, normal comprised 878 (47.9%), and obesity comprised 88 (4.4%). Looking at the aerobic

Table 1. Demographic characteristics of the subjects

Variable	Frequency	%	Mean	SD
Sex				
Male	1,891	84.2		
Female	354	15.8		
Age			50.73	16.20
30s under	229	10.2		
30s	435	19.4		
40s	446	19.9		
50s	412	18.4		
60s	368	16.4		
70s	274	12.2		
80s more than	81	3.6		
Income				
Low	400	17.8		
Medium	581	25.9		
Moderate	635	28.3		
High	629	28.0		
Education				
Elementary	363	16.2		
Middle	255	11.4		
High	761	33.9		
University	866	38.6		
Marital status				
Married	1,678	74.7		
Single	567	25.3		
Job status				
Occupation	1,573	70.1		
Inoccupation	672	29.9		
Alcohol drinking				
Non-drinker	613	27.3		
Drinker	1,632	72.7		
Current smoking				
Everyday	899	40.0		
Sometimes	153	6.8		
None	1,193	53.1		
BMI			24.37	3.48
Low weight (<20)	112	6.1		
Normal (20≤, <25)	878	47.9		
Mild obesity (25≤, <30)	754	41.2		
Obesity (≥30)	88	4.8		
Aerobic physical activity				
No	1,235	55.0		
Yes	1,010	45.0		

SD, standard deviation; BMI, body mass index.

exercise rate, 1,235 people (55.0%) responded ‘No’ and 1,010 people (45.0%) were ‘Yes’, with more non-aerobic groups.

2. Physical activity and PHQ-9 score

Descriptive statistical analysis was performed to de-

termine the descriptive statistics of physical activity variables and PHQ-9 scores. The results are shown in Table 2. The first DDWE was 4.67 days, and the TTWWE was 0.76 hours. The DWMSE was 1.87 days and the mean score of PHQ-9 was 2.72.

3. Comparative analysis of PHQ-9 scores according to sex, marital status, current job status, and drinking status (one glass or more monthly for the last year)

Table 3 shows the difference in physical activity and PHQ-9 scores according to sex. And, it also shows the differences in PHQ-9 scores according to marital status, occupational status, and drinking status using the t-test.

The differences in physical activity according to sex showed that DDWE, TTWWE, and DWMSE were higher for males than for females. In contrast, the mean

scores of PHQ-9 were lower for males than for females (2.22 vs. 5.35). The mean PHQ-9 scores according to the current marital status was higher in those who were married than those who were not married. For the PHQ-9 scores based on current job status, the mean PHQ-9 score was higher if there were unemployed. Conversely, the group who drank more than one drink monthly in the last year had a lower PHQ-9 mean score than the group who did not drink. All results are statistically significant differences.

4. Differences in PHQ-9 scores by age, income, education, current smoking status and BMI

Table 4 shows the differences in PHQ-9 scores according to age, income level, final education, current smoking status, and BMI. The differences in PHQ-9 scores by age, income level, educational attainment, and smoking were all statistically significant, except by BMI. In terms of age, the mean PHQ-9 score for those younger than age 30 was the highest with 3.58, and the average score for those in their 60s was the lowest with 2.28.

In the case of income levels, the lower the income level, the higher the PHQ-9 scores. For education, the mean PHQ-9 scores in the group below elementary school (3.36) was the highest. The higher the education level, the lower the average PHQ-9 scores. The mean PHQ-9 scores according to smoking status were lower in the non-smoking group, and the difference in PHQ-9 scores by BMI was not statistically significant, but the average

Table 2. Descriptive statistical analysis of major variables

Variable	Number	Range	Mean	SD
DWWE (d)	2,245	0–7	4.67	2.677
TTWWE (h)	1,782	0–10	0.76	1.178
DWMSE (d)	2,245	0–6	1.87	1.629
PHQ-9 score	2,245	0–27	2.72	3.953

SD, standard deviation; DWWE, the days of weekly walking exercise; TTWWE, total time of weekly walking exercise; DWMSE, the days of weekly muscle-strengthening exercise; PHQ-9, Patient Health Questionnaire-9.

Table 3. Differences in physical activity by sex and PHQ-9 scores by sex, marriage status, job status and alcohol drinking

Variable	Male		Female		t	p-value
	Mean	SD	Mean	SD		
DWWE (d)	4.72	2.688	4.41	2.610	2.000	0.046*
TTWWE (h)	0.77	1.178	0.70	1.173	0.936	0.349
DWMSE (d)	1.95	1.688	1.44	1.182	5.507	<0.001**
PHQ-9 score	2.22	3.411	5.35	5.365	14.259	<0.001**
PHQ-9 score	Married		Single		-9.232	<0.001**
	2.28	3.480	4.02	4.881		
	Occupation		Inoccupation		-7.764	<0.001**
	2.30	3.301	3.69	5.037		
	Non-drinker		Drinker		2.768	0.006**
	3.09	4.357	2.58	3.782		

PHQ-9, Patient Health Questionnaire-9; SD, standard deviation; DWWE, the days of weekly walking exercise; TTWWE, total time of weekly walking exercise; DWMSE, the days of weekly muscle-strengthening exercise.

*p<0.05, **p<0.01.

Table 4. Differences in PHQ-9 scores by age, income, education, and current smoking

Variable	PHQ-9 Score		F	p-value	Scheffe
	Mean	SD			
Age			5.614	<0.001**	
30s under	3.58	4.168			
30s	3.35	4.195			
40s	2.37	3.465			
50s	2.38	3.745			
60s	2.28	4.129			
70s	2.62	3.923			
80s more than	2.83	4.165			
Total	2.72	3.953			
Income			19.313	<0.001**	
Low	3.78	5.161			
Medium	3.09	4.252			
Moderate	2.33	3.410			
High	2.09	3.014			
Total	2.72	3.953			
Education			6.531	<0.001**	
Elementary	3.36	4.896			
Middle	2.75	4.299			
High	2.85	3.980			
University	2.32	3.290			
Total	2.72	3.953			
Current smoking			14.678	<0.001**	
Everyday	3.18	4.454			
Sometimes	3.25	4.175			
None	2.30	3.446			
Total	2.72	3.953			
BMI			2.557	0.054	n/a
Low weight (<20)	3.55	4.360			
Normal (20≤, <25)	2.83	4.213			
Mild obesity (25≤, <30)	2.55	3.665			
Obesity (≥30)	3.17	4.437			
Total	2.77	4.023			

PHQ-9, Patient Health Questionnaire-9; SD, standard deviation; BMI, body mass index; n/a, not available.

**p<0.01.

Table 5. Correlation between variables

Variable	DWWE	TTWWE	DWMSE	RAPAES	PHQ-9 score
DWWE (d)	1				
TTWWE (h)	0.140**	1			
DWMSE (d)	0.228**	0.046	1		
RAPAES	0.379**	0.110**	0.212**	1	
PHQ-9 score	-0.073**	0.005	-0.094**	-0.045*	1

DWWE, the days of weekly walking exercise; TTWWE, total time of weekly walking exercise; DWMSE, the days of weekly muscle-strengthening exercise; RAPAES, recommended aerobic physical activity execution status; PHQ-9, Patient Health Questionnaire-9.

*p<0.05, **p<0.01.

PHQ-9 scores tended to be higher in the underweight and obesity groups compared to the normal and mild obesity groups.

5. Correlation between physical activities and PHQ-9 scores

Pearson's correlation analysis was used to observe

the correlation between physical activities and the mean PHQ-9 scores and the results are shown in Table 5. DWWE, DWMSE and RAPAES are a statistically significant correlation with the PHQ-9 Scores. The correlation coefficients with PHQ-9 scores were -0.073 for DWWE (unit: days), -0.094 for DWMSE, and -0.045 for RAPAES. DWNSE and PHQ-9 scores have the largest negative correlation.

Table 6. Hierarchical regression analysis results of variables influencing PHQ-9 score

(A)

M	Dependent variable	Unstandardized coefficients		Stand coefficients	t	Sig.	Collinearity statistics		F
		B	SE	Beta			Tolerance	VIF	
1	(Constant)	8.009	0.832		9.627	0.000			27.965** (<0.001)
	Sex	-2.399	0.253	-0.227	-9.470	0.000**	0.849	1.178	
	Age	-0.015	0.007	-0.062	-1.995	0.046	0.506	1.976	
	Income	-0.407	0.092	-0.113	-4.416	0.000*	0.740	1.352	
	Education	-0.102	0.104	-0.028	-0.982	0.326	0.614	1.629	
	Marriage	-0.921	0.217	-0.106	-4.237	0.000**	0.779	1.284	
	Occupation	-0.647	0.204	-0.078	-3.169	0.002**	0.811	1.233	
	Alcohol drinking	-0.194	0.202	-0.022	-0.960	0.337	0.922	1.085	
	Everyday smoking	0.759	0.186	0.097	4.080	0.000**	0.859	1.165	
	Sometimes smoking	0.560	0.340	0.038	1.649	0.099	0.897	1.115	
	BMI	-0.011	0.024	-0.010	-0.467	0.640	0.972	1.028	
2	(Constant)	8.636	0.862		10.024	0.000			20.845** (<0.001)
	Sex	-2.331	0.255	-0.221	9.158	0.000**	0.837	1.194	
	Age	-0.013	0.007	-0.057	1.820	0.069	0.501	1.996	
	Income	-0.397	0.092	-0.111	-4.309	0.000**	0.737	1.357	
	Education	-0.091	0.104	-0.025	-0.871	0.384	0.609	1.643	
	Marriage	-1.004	0.219	-0.116	4.591	0.000**	0.765	1.307	
	Occupation	-0.684	0.205	-0.082	3.344	0.001**	0.806	1.241	
	Alcohol drinking	-0.170	0.202	-0.019	-0.840	0.401	0.918	1.089	
	Everyday smoking	0.720	0.186	0.092	3.863	0.000**	0.851	1.175	
	Sometimes smoking	0.541	0.339	0.037	1.596	0.111	0.895	1.117	
	BMI	-0.016	0.024	-0.014	-0.646	0.518	0.968	1.033	
	DWWE	-0.102	0.042	-0.057	-2.416	0.016*	0.858	1.165	
	TTWWE	0.095	0.072	0.030	1.316	0.188	0.964	1.037	
	DWMSE	-0.090	0.051	-0.040	-1.763	0.078	0.921	1.085	
	RAPAES	0.124	0.182	0.016	0.680	0.496	0.849	1.179	

(B)

M	R	R ²	Adjusted R square	SE of the estimate	R Square change	F change	Sig. F change	Durbin-watson
1	0.369	0.136	0.131	3.544	0.136	27.965	0.000	1.973
2	0.376	0.142	0.135	3.537	0.005	2.767	0.026	

PHQ-9, Patient Health Questionnaire-9; M, model; SE, standard error; Sig., significance; VIF, variation inflation factor; BMI, body mass index; DWWE, the days of weekly walking exercise; TTWWE, total time of weekly walking exercise; DWMSE, the days of weekly muscle-strengthening exercise; RAPAES, recommended aerobic physical activity execution status.

6. Hierarchical regression analysis results of variables influencing PHQ-9 score (hierarchical regression results)

The results are shown in Table 6. The independent variables were DWWE, TTWWE, DWNSE, PARAES, and the dependent variable was the total score of PHQ-9. Covariates included sex, age, income, education, marital status, job status, drinking, smoking status, and BMI. The final model's F-value was 20.845 and the regression model was statistically significant.

The R^2 was 14.2% and it is the same as the coefficient of determination, which is the percentage of total variation in the dependent variable that can be explained by the variable factor. When the confounding variables were corrected, DWSME, TTWWE and RAPAES did not have a statistically significant effect on the PHQ-9 scores. Conversely, DWWE was the only physical activity variable that had a statistically significant negative effect even when the confounding variable was controlled. That is, since the value of the non-standardized beta (B) was -0.102 , the PHQ-9 scores decreased by -0.102 as DWWE increased during the week.

DISCUSSION

This study used data of adults older than age 19 from the 2016 KNHANES. The purpose of this study was to examine the association between DWWE, TTWWE, DWMSE, RAPAES, and the degree of depression measured by PHQ-9.

As a result, when the demographic and clinical characteristics were corrected, the more days people walked weekly, the lower their total score on PHQ-9. This result is consistent with the results of previous studies on the association between walking and depressive symptom. Walking exercise has been shown to both reduce depressive symptoms and prevent depression. In study of the preventive effect, regular walking among middle-age females, conducted more than three times weekly, had a positive effect on stress perception and depression [20]. Walking can be performed without limitations of equipment, places, and facilities, and it is an easy and effective exercise for reducing stress [25], increasing energy consumption and the fat oxidation rate, and improving muscle mobilization. Thus, it prevents obesity and chronic diseases [26]. And, Katon [27] reported that

chronically ill patients had a higher prevalence of major depression than the general population because of decreased physical activity.

In addition, studies showing that walking helps to alleviate depressive symptoms include studies showing depression on older people, 13 weeks of walking exercise [28] and 12 weeks of Nordic walking [29]. Recently, many studies have been conducted to investigate the relationship between depression, obesity, aging, immune response, and stress hormones. Depressed females age 18-20 were instructed to run five times weekly. After eight weeks, their degree of depression was reduced, as well as the stress hormones such as cortisol, epinephrine [9], and ACTH levels [30]. Additionally, increased high-sensitivity C-reactive protein and the development of insulin-resistant Type 1 diabetes, associated with depression, were prevented with regular aerobic exercise [8,31,32]. Thus, walking to improve depression alleviates the symptoms of depression, as well as improves the risk factors of chronic diseases affecting depression, so the effect of depression treatment is expected to be considerable. Another interesting result of this study was that the correlation with PHQ-9 score was greater in DWNSE than DWWE before the covariate was corrected. However, after adjusting for the covariates, DWMSE was not correlated with PHQ-9.

The relationship between DWMSE and depression can be explained by a report that muscle-strengthening is more likely to be beneficial for depression than daily physical activity or flexibility exercise [33]. And this can be explained by the study that lowering muscle mass and strength are risk factors for depression [34]. But there was no independent correlation of DWMSE with PHQ-9 when the covariates were corrected in our study.

It may be speculated that the decrease in muscle mass does not affect depression directly, but leads to decrease in physical activities such as aerobic exercise and finally leads to depression [19]. Previous studies have recommended muscle-strengthening for improving depression, but this supports the fact that it works only in conjunction with aerobic exercise [33].

Meanwhile, when the covariates were corrected, there was a significant correlation between depression and walking days rather than the duration of walking. This result may be evidence for suggesting specific and feasible ways of physical exercise for preventing depression.

This study has limitations. First, this study is a cross-sectional study. It can reveal the association between

physical activities and depression, but not a causal relationship. Thus, follow-up studies such as a time series analysis to identify causality between physical activities and depression should be conducted in the future. Second, the KNHANES data are not a survey conducted for professional psychiatric evaluations and the assessment of depression depends on the PHQ-9 self-report scale, indicating that the accuracy of the depression assessment is low. So, further research is needed by using the latest advanced information communication technology and physical activity measurement method.

However, this study has some significant advantages. First, we applied reliable data that can represent the entire population of Korea by reflecting weights in the 2016 KNHANES data, led by the state. Second, the size of the sample is large, and it has strength in that several moderator variables can be used. Third, unlike previous studies, we compared walking and muscle strengthening, and suggested a specific method of walking that is more related to depression. Even walking had a positive effect on depression. Its antidepressant effect works when walking is regular and consistent, but it is not crucial to walk for a lengthy time.

Based on the results of this study, studies on the causal relationship between physical activities and depression, as well as studies on the association of physical activities with other mental health problems are needed. If such research is undertaken, the impact of walking on mental health could be further elucidated. And then, this will significantly facilitate improving the quality of life for people globally.

CONCLUSION

In this study, the more weekly walking was in the Korean general population, the lower the score of the depression scale, PHQ-9. This supports the fact that walking and symptoms of depression are related. Also, when the variables were corrected, PHQ-9 had a significant correlation with the number of days of walking exercise rather than the duration of walking exercise. And, the number of days for muscle-strengthening exercise for one week were not significant. In other words, for adults older than age 19, aerobic physical activity such as walking exercise especially not by duration but by regular and steady engagement had more impact on depressive symptoms than muscle strengthening. Based on these

results, it may be beneficial to suggest the appropriate direction to practice regarding physical activity to facilitate the improvement of mood.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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