

Original Article

Relationship between the intensity of physical activity and depressive symptoms among Korean adults: analysis of Korea Health Panel data

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Abstract. [Purpose] The aim of this study was to examine the relationship between the intensity of physical activity and symptoms of depression. [Subjects and Methods] We analyzed the influence of different intensities of physical activity on depressive symptoms using the data of 12,350 adults over the age of 20 years who had completed the 2011 Korea Health Panel. After controlling for confounding variables, a multivariable logistic regression analysis was conducted to identify the association between the intensity of physical activity and depressive symptoms. [Results] The results showed that vigorous physical activity had a significant effect on depressive symptoms. The incidence of depressive symptoms was 1.487 (95% CI 1.137, 1.943) OR higher among people who did not participate in regular activity than it was among those who took part in regular intense physical activity. [Conclusion] It appears that physical activity affects depressive symptoms, a result which is in agreement with previous studies. However, we also showed a difference in influence according to activity intensity. Thus, the intensity of physical activity should be considered when developing physical activity programs for improving depressive symptoms.

Key words: Intensity of physical activity, Depressive symptoms

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INTRODUCTION

Depression is a mood disorder characterized by mild to severe anxiety, depressive mood, and feelings of failure and worthlessness¹⁾. Due to the recent economic crisis and the rapid social changes that promote nuclear family households and excessive individualism, the prevalence of major depression in South Korea is projected to increase dramatically. Depression is strongly linked to suicide attempts, making it a significant threat to public health²⁾. The World Health Organization has estimated that, by 2020, depression will be the second most prevalent health concern worldwide after heart disease and will be the second highest contributor to societal economic burden²⁾. This steady increase in the global prevalence of depression affects individuals and society as a whole. As a result, numerous studies are being conducted to identify the causes of depression and to develop effective treatments.

The effects of physical activity on mental health are well documented. Regular physical activity has been shown to effectively decrease levels of anxiety and depressive mood; it can also enhance work performance³⁾ and improve various cognitive processes and performance by stimulating the central nervous system⁴⁾. Furthermore, studies have shown that physical activity reduces stress and decreases depressive symptoms among individuals of all ages⁵⁾. Given the evidence for the positive impact of physical activity on mental health, a lifestyle that incorporates regular exercise and continuous physical activity is recommended for individuals of all ages.

However, most previous studies of physical activity and depression have been limited by their sole focus on a specific age group and/or gender, such as adolescents, married women, or the elderly^{6–11)}. Although many studies have investigated the prevalence of depression in these particular age groups and have identified influencing factors, none has examined the depressive symptoms in the general adult population of South Korea¹²⁾. Therefore, using 2011 Korea Health Panel (KHP) data, which represents national-level data, we analyzed the relationship between the intensity of physical activity and symptoms of depression among individuals 20 years of age or older in order to establish a baseline to be used in developing physical activity programs that can improve depressive symptoms.

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SUBJECTS AND METHODS

We analyzed data from the KHP, which is conducted by the Korea Institute for Health and Social Affairs and the National Health Insurance Corporation to investigate patterns of health service use and how certain factors affect the use and cost of healthcare services. This survey also provides raw data that can be used for in-depth analyses. The survey data are collected annually via self-report questionnaires and in-person interviews, and the first survey commenced on 1 April 2008. We used and analyzed the data available from the 2011 KHP, which collected information from a total of 17,035 individuals, among who 12,946 were aged 20 years or over. We excluded individuals with missing data; therefore, a final sample population of 12,350 participants was selected for this study. This study was approved by the Institutional Review Board of the Catholic University of Korea with a waiver for informed consent because the data were obtained from a public database (MC14EIS10091).

Participants were divided into two groups based upon responses to the question, "During the past year, have you felt sad or hopeless for more than two weeks to the extent that it affected your daily activities?" We selected potential factors that could influence depressive symptoms, including physical activity, socio-demographic and economic characteristics, and health behavior. The intensity of the physical activity was categorized as vigorous, moderate, and walking. Examples of vigorous-intensity physical activities were running, hiking, playing soccer or basketball, jumping rope, playing singles tennis or squash, swimming, bicycling at a fast pace, lifting heavy objects, and walking at a very brisk pace. Moderate-intensity physical activities included playing volleyball, badminton, table tennis, doubles tennis, calisthenics, moving light objects, swimming or bicycling (at a slow pace), and brisk walking. Walking slowly or at a moderate pace for the use of public transportation and brisk walking were included in the walking category.

We used the guidelines suggested by Kim¹³⁾ to divide the participants into exercising and non-exercising categories based on the number of days and hours in which they took part in physical activity. The intensity of the physical activity was based on the physical activity recommendations of the Centers for Disease Control and Prevention and the American College of Sports Medicine, and these activities were categorized as follows: those who perform vigorous-intensity activity for a minimum of 20 minutes at least three days each week; those who perform moderate-intensity physical activity for a minimum of 30 minutes at least five days each week; and those who walk for a minimum of 30 minutes for at least five days weekly. Individuals who did not exercise regularly were placed into the non-exercising group. Socioeconomic characteristics used in this study included gender, age, marital status, area of residence, and education level. Age was divided into four categories: 20–34 years, 35–49 years, 50–64 years, and over 65 years. Marital status was categorized as single, married, or divorced/separated/widowed. The participant areas of residence were divided into either urban, including Seoul and other metropolitan cities, or non-metropolitan cities. Educational level was classified into four categories: completed elementary school or less, completed middle school, high school diploma, and

completed four-year college or higher.

The respondents' economic status was assessed by household income, health insurance status, and employment status. The annual household income is the combined gross income of all the members of a household. We used the 2011 average exchange rate (1 USD=1,127.4 Korean won) to convert Korean won to US dollars. Health insurance status was classified as either National Health Insurance or Medical Aid. Employment status was categorized as either employed or unemployed.

The characteristics of health behaviors, including cigarette smoking, alcohol consumption, chronic disease status, and eating habits (e.g. eating at regular times), were examined. Former cigarette smokers and non-smokers were categorized as non-smokers. Regardless of the amount of cigarette or alcohol consumption, current smokers and/or alcohol drinkers were designated as cigarette smokers and/or alcohol drinkers, respectively. Individuals with at least one chronic disease diagnosed by a physician and lasting for longer than three months were considered to have a chronic disease; if there had been no diagnosis, they were considered to be free of chronic diseases. Respondents were also asked if they ate meals at regular times in order to assess their eating habits.

We performed a frequency analysis and a descriptive statistical analysis to calculate the frequency, percentile, mean, and standard deviation of the variables, including physical activity, socio-demographic and economic characteristics and health behavior. Separate univariable logistic regression analyses for each variable and for the intensity of physical activity were performed to examine their associations with depression. After controlling for confounding variables, a multivariable logistic regression analysis was conducted to identify the association between depression and the intensity of physical activity. Statistical analysis was performed on the survey data using the IBM Statistical Package for the Social Sciences (SPSS) software (version 21; SPSS Inc., Chicago, IL, US).

RESULTS

Table 1 shows the distribution of the subjects' general characteristics and the relationships between these characteristics and depressive symptoms as analyzed by univariable logistic regression. Gender, age, marital status, education, annual household income, health insurance type, economic activity, smoking, chronic disease, eating habits, and rigorous physical activity were significantly associated with depressive symptoms. Participants were distributed as follows: 12.3% performed regular vigorous physical activity, 10.9% took part in regular moderate physical exercise, and 22.5% walked regularly. Individuals participating in vigorous physical activity were 1.90 OR less likely to be depressed ($p<0.001$) than those who were not engaged in any physical activity, while there was no significant difference between individuals participating in moderate physical activity or walking and individuals who were not engaged in any physical activity (Table 1).

We performed logistic regression analysis after adjusting for all confounding factors in order to identify the relationships between the intensity of physical activity and

Table 1. General characteristics of the study population, and results of simple logistic regression (n = 12,350)

Variables		n (%) / Mean \pm SD (min, max)	OR
Gender	Female	6,581 (53.3)	1.81***
	Male	5,769 (46.7)	ref
Age (years)	20–34	2,290 (18.5)	ref
	35–49	3,996 (32.4)	0.94
	50–64	3,250 (26.3)	0.58***
	\geq 65	2,814 (22.8)	0.59*
Marital status	Single	1,952 (15.8)	ref
	Married	8,889 (72.0)	0.88
	Divorced/Separated/Widowed	1,509 (12.2)	0.46***
Region	Rural	6,882 (55.7)	ref
	Urban	5,468 (44.3)	1.11
Education	Less than elementary school	2,697 (21.8)	ref
	Middle school	1,412 (11.4)	1.09
	High school	3,944 (31.9)	1.63***
	University	4,297 (34.8)	2.14***
Annual household income (unit: USD)		35,531 \pm 24,329 (80, 222,013)	1.00***
Health insurance	Medical Aid	604 (4.9)	ref
	National Health Insurance	11,746 (95.1)	3.68***
Economic activity	No	4,803 (38.9)	ref
	Yes	7,547 (61.1)	1.65***
Smoking	No	9,568 (77.5)	0.76**
	Yes	2,782 (22.5)	ref
Drinking	No	3,699 (30.0)	0.62***
	Yes	8,651 (70.0)	ref
Chronic disease	No	4,725 (38.3)	2.16***
	Yes	7,625 (61.7)	ref
Regular meals	No	2,651 (21.5)	ref
	Yes	9,699 (78.5)	1.65***
Vigorous physical activity	No	10,833 (87.7)	ref
	Yes	1,517 (12.3)	1.90***
Moderate physical activity	No	11,009 (89.1)	ref
	Yes	1,341 (10.9)	1.19
Walking	No	9,570 (77.5)	ref
	Yes	2,780 (22.5)	0.88

SD: standard deviation; OR: odds ratio; ref: reference

*p<0.05; **p<0.01; ***p<0.001

depressive symptoms. There were significant associations between depressive symptoms and gender (p<0.001), annual household income (p<0.001), health insurance type (p<0.001), employment status (p=0.016), chronic disease (p<0.001), regular eating pattern (p<0.001), and vigorous physical activity (p=0.004). Men tended to be 1.57 OR less depressed than women. Participants who had higher household incomes were 1.00 OR more likely to have less depressive symptoms. Respondents who were insured by the National Health Insurance were 2.34 OR more likely to not have depressive symptoms than those with Medical Aid. The unemployed had a 1.21 OR greater risk of being depressed

than those who held jobs. Respondents with chronic disease were 1.75 OR more likely to report depressive symptoms. Individuals with irregular eating habits were 1.73 OR more likely to be depressed than those with regular eating patterns. Furthermore, only vigorous physical activity had a significant association with depressive symptoms, which is consistent with the results of the unadjusted univariable analysis, which showed a 1.49 OR higher incidence of being depressed among individuals who did not participate in vigorous physical activity than those who did (Table 2).

Table 2. Relationships between physical activity intensity and depressive symptoms according to multiple logistic regression (n = 12,350)

	Variables	OR	95% CI
Gender	Female (ref)		
	Male	1.57***	1.312–1.889
Age (years)	20–34 (ref)		
	35–49	0.90	0.673–1.189
	50–64	0.74	0.536–1.027
	≥ 65	1.12	0.781–1.617
Marital status	Single (ref)		
	Married	1.20	0.903–1.586
	Divorced/Separated/Widowed	1.05	0.752–1.473
Region	Rural (ref)		
	Urban	1.03	0.897–1.187
Education	Elementary school or less (ref)		
	Middle school	0.94	0.749–1.184
	High school	1.07	0.857–1.339
	University	1.11	0.848–1.451
Annual household income		1.00***	1.000–1.001
Health insurance	Medical Aid (ref)		
	National Health Insurance	2.34***	1.857–2.941
Economic activity	No (ref)		
	Yes	1.21*	1.035–1.404
Smoking	Yes (ref)		
	No	1.12	0.903–1.376
Drinking	Yes (ref)		
	No	0.88	0.750–1.020
Chronic disease	Yes (ref)		
	No	1.75***	1.453–2.108
Regular meals	No (ref)		
	Yes	1.73***	1.482–2.028
Vigorous physical activity	No (ref)		
	Yes	1.49**	1.137–1.943
Moderate physical activity	No (ref)		
	Yes	1.02	0.805–1.300
Walking	No (ref)		
	Yes	0.88	0.753–1.039

OR: odds ratio; CI: confidence interval; ref: reference

*p<0.05; **p<0.01; ***p<0.001

DISCUSSION

In this study, we analyzed the four characteristics of physical activity level, socio-demographic and economic characteristics, and health behavior in order to investigate the relation between physical activity level and depressive symptoms. Of all the variables we examined, gender, annual household income, health insurance type, employment status, chronic disease status, regular eating habits, and vigorous physical activity showed significant associations with depressive symptoms.

We found that vigorous physical activity was strongly associated with a decrease in depressive symptoms, while moderate physical activity and walking had no significant relationship with depressive symptoms. Previous studies

have demonstrated that physical activity can decrease stress by impacting hormone levels, improving mood, and increasing energy, as well as reducing anxiety and anger^{14–18}); our findings are consistent with these reports, which suggests that a lack of physical activity is strongly associated with depressive symptoms.

This study contradicts a previous study that concluded that vigorous exercise is negatively associated with depression, while mild to moderate exercise decreases depressive symptoms⁷). However, other studies are consistent with our findings, indicating that vigorous exercise reduces the symptoms of depression. Chu et al. suggest that only vigorous exercise is significantly associated with depression¹⁹); similarly, Ledwidge found that perform aerobic exercise, which was considered a vigorous physical activity in the

present study, is effective at alleviating the symptoms of depression^{20, 21}). Moreover, Morgan²²), Sime²³), and Folkins and Sime⁴) suggested that vigorous exercise, including jogging, swimming and cycling, reduces depressive symptoms or anxiety, but mild physical activity, such as walking, is not effective at improving mental health. The differences in basic physical strength and exercise intensity preference based on age group may explain these findings²⁴). Furthermore, a personal preference either for individual or group exercise can affect a person's psychological mood after exercise, such as depression.

In addition to the intensity of the physical activity, this study also showed statistically significant associations between depressive symptoms and other variables, including gender, annual household income, health insurance status, employment status, chronic disease status, and a regular eating pattern, which are consistent with most previous studies²⁵⁻³⁴). Among these variables, annual household income, health insurance type, and employment status are income-related variables. They indicate that depressive symptoms are reported less often by those with a higher income. According to Ho et al., quality of life influences depression, suggesting that income is closely associated with perceived quality of life²⁶). Also, individuals with a chronic disease are more likely to be depressed than those without chronic disease³¹⁻³⁸), implying a strong association between depression and health-related quality of life³⁹).

While most previous studies of physical activity and depression have focused on certain age groups, we analyzed nationally representative KHP data of adults aged 20 years and over. Our findings are significant in that they indicate there are different correlations between physical activity and depression depending on the intensity of the exercise. Further studies will be needed to build upon our findings and analyze the relationship between physical activity and depression in an adult population. Future studies should also include those diagnosed with depression secondary to a physical illness, which would help identify the individual factors that influence related variables.

REFERENCES

- Battle J: Relationship between self-esteem and depression. *Psychol Rep*, 1978, 42: 745-746. [Medline] [CrossRef]
- Heo DS: Depression and suicide in Korean society. *J Korean Med Assoc*, 2011, 54: 356-357. [CrossRef]
- Shin JG, Park SJ, Yang DJ, et al.: Improvement of work ability by exercise program. *J Phys Ther Sci*, 2012, 24: 1111-1113. [CrossRef]
- Folkins CH, Sime WE: Physical fitness training and mental health. *Am Psychol*, 1981, 36: 373-389. [Medline] [CrossRef]
- McCann IL, Holmes DS: Influence of aerobic exercise on depression. *J Pers Soc Psychol*, 1984, 46: 1142-1147. [Medline] [CrossRef]
- Kim SW: Influence of exercise on brain activity and emotion in female depression. *Korean J Phys Educ*, 2006, 45: 193-205.
- Kwon SM: Effects of low-density exercise in the frail elderly. *J Digit Converg*, 2013, 11: 643-650. [CrossRef]
- Cho KO, Nam SN: Relationship between physical activity and health-related life quality according to gender in Korean elderly people. *Korean Gerontol Soc*, 2013, 33: 775-785.
- Lampinen P, Heikkinen RL, Ruoppila I: Changes in intensity of physical exercise as predictors of depressive symptoms among older adults: an eight-year follow-up. *Prev Med*, 2000, 30: 371-380. [Medline] [CrossRef]
- Nicklas BJ, Wang X, You T, et al.: Effect of exercise intensity on abdominal fat loss during calorie restriction in overweight and obese postmenopausal women: a randomized, controlled trial. *Am J Clin Nutr*, 2009, 89: 1043-1052. [Medline] [CrossRef]
- Hansen D, Dendale P, Jonkers RA, et al.: Continuous low- to moderate-intensity exercise training is as effective as moderate- to high-intensity exercise training at lowering blood HbA(1c) in obese type 2 diabetes patients. *Diabetologia*, 2009, 52: 1789-1797. [Medline] [CrossRef]
- Kim JY: Age and depression in Korean adults. *Korean Assoc Health Med Sociol*, 2009, 26: 89-113.
- Kim JE: A study on the mental health and regular exercise of the aged; based on the secondary data of 2007 Korea National Health and Nutrition. University of Seoul, 2009, pp 3-4.
- Carek PJ, Laibstein SE, Carek SM: Exercise for the treatment of depression and anxiety. *Int J Psychiatry Med*, 2011, 41: 15-28. [Medline] [CrossRef]
- Lee BH, Park JS, Kim NR: The effect of physical activity program on cognitive function, physical performance, gait, quality of life and depression in the elderly with dementia. *J Spec Educ Rehabil Sci*, 2011, 50: 307-328.
- Oh KH, Kim JS, Yu YC: Effect of the cytokines and IgE in middle school with a type 1 allergy and depression affect the exercise medium strength. *Exerc Sci*, 2013, 22: 329-341.
- Csikszentmihalyi M: *Finding flow; The psychology of engagement with everyday life*. New York: Basic Books, 1997, pp 9-13.
- Hunter M: The south-east England longitudinal study of the climacteric and postmenopause. *Maturitas*, 1992, 14: 117-126. [Medline] [CrossRef]
- Chu JE, Lee HJ, Yoon CH, et al.: Relationships between depressed mood and life style patterns in Koreans aged 40 years. *J Korean Soc Food Sci Nutr*, 2014, 43: 772-783. [CrossRef]
- Ledwidge B: Run for your mind: aerobic exercise as a means of alleviating anxiety and depression. *Can J Behav Sci*, 1980, 12: 126-140. [CrossRef]
- Hur S, Cho BJ, Kim SR: Comparison of the effects of exercise participation on psychosocial risk factors and cardiovascular disease in women. *J Phys Ther Sci*, 2014, 26: 1795-1798. [Medline] [CrossRef]
- Morgan WP: Psychological benefits of physical activity. In: *Exercise in Health and Disease*. Springfield: Charles C Thomas, 1981, pp 299-314.
- Sime WE: Psychological benefits of exercise training in the healthy individual. In: *Behavioral Health: a Handbook of Health Enhancement and Disease Prevention*. New York: John Wiley & Sons, 1984, pp 488-508.
- Koo YK: The correlations between the preferences of exercise and mood changes after exercise in adolescences. Dissertation, Ewha Womans University, 2007, pp 36-39.
- Kessler RC: Epidemiology of women and depression. *J Affect Disord*, 2003, 74: 5-13. [Medline] [CrossRef]
- Ho KY, Li WH, Chan SS: The effect of poverty and income disparity on the psychological well-being of Hong Kong children. *Public Health Nurs*, 2014, Epub ahead of print: [CrossRef]. [Medline]
- Cyranowski JM, Frank E, Young E, et al.: Adolescent onset of the gender difference in lifetime rates of major depression: a theoretical model. *Arch Gen Psychiatry*, 2000, 57: 21-27. [Medline] [CrossRef]
- Piccinelli M, Wilkinson G: Gender differences in depression. *Critical review. Br J Psychiatry*, 2000, 177: 486-492. [Medline] [CrossRef]
- Heo JS, Yu SH: Determinants of depression among elderly persons. *Ment Health Soc Work*, 2002, 13: 7-22.
- Lorant V, Deliège D, Eaton W, et al.: Socioeconomic inequalities in depression: a meta-analysis. *Am J Epidemiol*, 2003, 157: 98-112. [Medline] [CrossRef]
- Sohn SJ, Shin JH, Shin HY, et al.: Assessment of depression and relates in rural elderly. *Korean J Community Nutr*, 2000, 25: 85-98.
- Murray E, Burns J, See TS, et al.: Interactive Health Communication Applications for people with chronic disease. *Cochrane Database Syst Rev*, 2005, 19: CD004274. [Medline]
- Sanna L, Stuart AL, Pasco JA, et al.: Physical comorbidities in men with mood and anxiety disorders: a population-based study. *BMC Med*, 2013, 11: 110. [Medline] [CrossRef]
- Park JE, Kim SJ, Choue RW: Study on stress, depression binge eating, and food behavior of high school girls based on their BMI. *Korean J Community Nutr*, 2000, 14: 175-181.
- van Manen JG, Bindels PJ, Dekker FW, et al.: Risk of depression in patients with chronic obstructive pulmonary disease and its determinants. *Thorax*, 2002, 57: 412-416. [Medline] [CrossRef]
- Anderson RJ, Freedland KE, Clouse RE, et al.: The prevalence of comorbid depression in adults with diabetes: a meta-analysis. *Diabetes Care*, 2001, 24: 1069-1078. [Medline] [CrossRef]
- Kaneda R, Senjyu H, Iguchi A, et al.: Factors that impact anxiety and depression in patients with chronic obstructive pulmonary disease. *J Phys Ther Sci*, 2011, 23: 927-931. [CrossRef]
- Iwai S, Senjyu H, Kaneda R, et al.: Personality traits of patients with chronic obstructive pulmonary disease who exhibit depression. *J Phys Ther Sci*, 2010, 22: 93-99. [CrossRef]
- Omachi TA, Katz PP, Yelin EH, et al.: Depression and health-related quality of life in chronic obstructive pulmonary disease. *Am J Med*, 2009, 122: 778.e9-778.e15. [Medline] [CrossRef]