



■ Original Article

Association between Physical Activity and Depressive Mood among Korean Adults with Chronic Diseases

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Background: This study aimed to investigate the association between physical activity and depressive mood among Korean adults with chronic diseases.

Methods: This study analyzed the 2014 Korean National Health and Nutrition Examination Survey data. The study was restricted to participants aged ≥ 20 years who had completed the survey and were not diagnosed as having depression. After exclusion, 4,676 participants were included in the final analysis. Subjects were categorized according to their level of physical activity. Physical activity was assessed using the International Physical Activity Questionnaire. Patients were categorized into two groups according to depressive traits (normal and depressed) based on the 9-item Patient Health Questionnaire scores.

Results: In univariate analysis, significant associations were observed between the level of physical activity and depressive mood in both chronic and healthy groups. Participants with higher levels of physical activity had lower risks of depressive mood than those with lower levels of physical activity, especially patients with chronic diseases (odds ratio [OR], 0.47; 95% confidence interval [CI], 0.31–0.73). Similar trends were observed in multivariate logistic regression analysis (OR, 0.54; 95% CI, 0.34–0.88).

Conclusion: Physical activity significantly decreased the development of depressive mood among Korean adults with chronic diseases compared with their healthy counterparts. Physical activity must be emphasized in patients with chronic diseases.

Keywords: Exercise; Depression; Chronic Disease; Korean; Adult

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INTRODUCTION

Non-communicable diseases (NCDs), also known as chronic diseases, are major causes of morbidity and mortality worldwide. According to the 2014 cause-of-death statistics in Korea, 54.2% of Koreans died from cancer, cardiovascular diseases, diabetes mellitus (DM), and chronic respiratory diseases.¹⁾ The prevalence of chronic diseases is likely to continue to increase and result in increased socioeconomic burden. Moreover, this burden will continue to increase due to an increasing elderly population.^{2,3)}

According to the 2014 Korean National Health and Nutrition Examination Survey (KNHANES), 6.7% of Korean adults aged ≥ 20 years have an underlying depressive disorder. Depression is one of the most common mental illnesses and a major public health concern worldwide.⁴⁾ Furthermore, depression is often accompanied by chronic illnesses, and the burden of disease among chronic patients is known to increase with concomitant mental health disorders.⁵⁾

Physical inactivity is among the 10 leading risk factors for death worldwide and is a major risk factor for NCDs such as cardiovascular diseases, DM, and some cancers.⁶⁾ In addition, studies have discussed the relationship between physical activity and depression; it has been reported that physical inactivity increases the risk of depression, and physical activity has been reported to have a therapeutic effect on depression.^{7,8)}

In patients with chronic diseases, the chronic disease itself may increase the prevalence of depression. Furthermore, it is thought that the lack of physical activity increases the risk of depression and adversely affects the course of the chronic disease due to the functional impairment and loss of productivity that accompany depression.^{9,10)}

Therefore, physical activity is not only important in managing the chronic disease itself, but also in reducing the adverse effects of diseases when accompanied by depression. However, there is a lack of

research on the relationship between physical activity and depression in certain disease groups. Although most studies have separately analyzed the relationships between physical activity and depression, depression and chronic disease, and physical activity and chronic disease, there insufficient studies linking these aspects.

The purpose of this study was to investigate the relationship between physical activity and depressive mood among Korean adults with chronic diseases. We hypothesized that the relationship between physical activity and depressive mood is more significant in people with chronic illnesses than in their healthy counterparts.

METHODS

1. Study Population

This study was conducted among Korean adults aged ≥ 20 years who participated in the 2014 KNHANES. Of the 5,976 participants, 265 who were already diagnosed with depression were excluded. Within the limits of retrospective studies, it is best to exclude the deterioration of physical activity due to depression. Participants with missing data (e.g., no responses regarding biological, demographic, or socioeconomic status) were also excluded. In total, 4,676 participants were included in the present study (1,643 patients with chronic diseases and 3,033 in the control group) (Figure 1). Approval for the study was exempted by the Institutional Review Board of Seoul National University Bundang Hospital (IRB no., X-1703-388-901) because we analyzed publicly available data.

2. Variables and Measurement

1) Chronic disease and depressive mood

The present study included the following chronic diseases of interest: cancer, hypertension (HTN), DM, dyslipidemia, stroke, cardiovascular

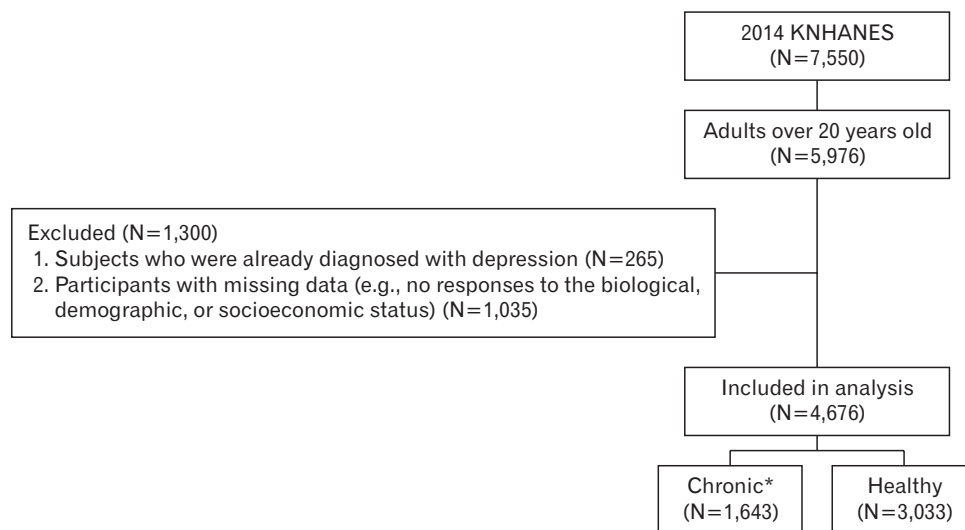


Figure 1. Flow chart of the subjects included in study. KNHANES, Korean National Health and Nutrition Examination Surveys. *Chronic diseases were limited to cancer, hypertension, diabetes, dyslipidemia, stroke, cardiovascular disease, and asthma.

diseases, and asthma. Cardiovascular diseases included myocardial infarction and angina pectoris. Each chronic disease was diagnosed by a doctor. Depressive mood was assessed using the 9-item Patient Health Questionnaire (PHQ-9) scores and defined as a PHQ-9 score of ≥ 5 .¹¹ The PHQ-9 has been recommended for depression screening and has nine questions with scores ranging from 0 (not at all) to 3 (nearly every day) for each question (maximum score=27).¹²

2) Physical activity

We used the International Physical Activity Questionnaire-Short Form (IPAQ-SF) to assess physical activity level as it is considered a cost-effective tool.¹³

The metabolic equivalent of task-minutes (MET-min) unit calculation used in the measurement of physical activity was based on the questionnaire items of the original data and IPAQ-SF. Walking, moderate activity (e.g., jogging, golf, pilates, or any other activity that causes a slight increase in breathing or heartbeat), and intense activity (e.g., running, swimming, mountain climbing, basketball, or any other activity that causes a substantial increase in breathing or heartbeat) were calculated as 3.3, 4.0, and 8.0 METs, respectively.^{14,15} We calculated the instances of walking, moderate activity, and intense activity for at least 10 minutes each during the last week. The duration of each physical activity (days, hours, and minutes) was converted to minutes and summed up (MET-min=MET level \times activity minutes \times days).

A total value of less than 600 MET-min, between 600 and 2,999 MET-min, and more than 3,000 MET-min were defined as low, moderate, and high, respectively.¹⁶

3) Biological, demographic, and socioeconomic variables

Based on previous studies,^{8,17} several variables affecting physical activity and depressive mood were assessed.¹⁸ Educational level was classified into completed elementary school or less, completed middle school/high school diploma, and completed university or higher. Income level was classified by dividing the population group income data into three groups: lowest, middle, and highest tertile. Participants' marital status was classified as married with spouse, married but without spouse, and unmarried. Residential areas were classified into three categories: capital, metropolitan, and town/city. The degree of obesity was divided into 23.0, 23.0–24.9, and 25.0 kg/m², based on body mass index (BMI). Smoking status was classified into smokers, ex-smokers, and never-smokers. Alcohol consumption status was classified into never, drinking, and risky drinking. Risky drinking was defined as drinking 2 or more times a week and drinking seven or more standard drinks per day (five drinks for women).^{19,20}

3. Statistical Analysis

To determine the baseline characteristics according to physical activity level, numbers (%) or mean values were calculated. Logistic regression analysis was used to determine the relationship between physical activity and depressive mood, according to the presence or absence of chronic diseases. Model A was adjusted for age and sex. Model B was

adjusted for socioeconomic factors (education, residence, household income, spouse status), and model C was adjusted for health behavior factors (smoking, alcohol use, BMI) in addition to all variables in model A. Model D was adjusted for age, sex, socioeconomic factors, and health behavior factors. $P < 0.05$ was considered statistically significant. All statistical analyses were performed using Stata ver. 14.0 for Windows (Stata Corp., College Station, TX, USA). Because we only used data for 1 year, raw data were analyzed without additional weighting.

Table 1. General characteristics of the study population (N=4,676)

| Characteristic | Healthy (n=3,033) | Chronic* (n=1,643) | P-value [†] |
|-------------------------------------|-------------------|--------------------|----------------------|
| Age (y) | 44.3 \pm 15.2 | 62.8 \pm 12.9 | <0.001 |
| Sex | | | 0.949 |
| Male | 1,297 (42.8) | 701 (42.7) | |
| Female | 1,736 (57.2) | 942 (57.3) | |
| Education | | | <0.001 |
| Elementary | 365 (12.0) | 708 (43.1) | |
| Middle/high school | 1,400 (46.2) | 654 (39.9) | |
| University | 1,266 (41.8) | 279 (17.0) | |
| Household income | | | <0.001 |
| Lowest | 331 (10.9) | 506 (30.9) | |
| Middle | 1,734 (57.3) | 804 (49.1) | |
| Highest | 961 (31.8) | 327 (20.0) | |
| Residence | | | 0.032 |
| Capital | 634 (20.9) | 292 (17.8) | |
| Metropolitan | 821 (27.1) | 451 (27.4) | |
| Town/city | 1,578 (52.0) | 900 (54.8) | |
| Spouse status | | | <0.001 |
| With spouse | 2,151 (71.0) | 1,222 (74.4) | |
| Married but without spouse | 216 (7.1) | 362 (22.1) | |
| Unmarried | 664 (21.9) | 58 (3.5) | |
| Body mass index | | | <0.001 |
| Under/normal | 1,575 (51.9) | 563 (34.3) | |
| Overweight | 679 (22.4) | 402 (24.5) | |
| Obesity | 778 (25.7) | 677 (41.2) | |
| Smoking | | | <0.001 |
| Never-smoker | 1,856 (61.7) | 972 (60.3) | |
| Ex-smoker | 503 (16.7) | 393 (24.4) | |
| Smoker | 649 (21.6) | 246 (15.3) | |
| Alcohol use | | | <0.001 |
| Never | 267 (8.9) | 315 (19.5) | |
| Drinking | 2,380 (79.1) | 1,164 (72.0) | |
| Risky drinking | 362 (12.0) | 137 (8.5) | |
| Physical activity level | | | 0.011 |
| Low | 1,287 (42.4) | 772 (47.0) | |
| Moderate | 1,390 (45.8) | 689 (41.9) | |
| High | 356 (11.8) | 182 (11.1) | |
| 9-Item Patient Health Questionnaire | | | <0.001 |
| Normal (<5) | 2,442 (80.5) | 1,279 (77.8) | |
| Depressed (≥ 5) | 591 (19.5) | 364 (22.2) | |

Values are presented as mean \pm standard deviation or number (%), unless otherwise stated.

*Chronic diseases were limited to cancer, hypertension, diabetes, dyslipidemia, stroke, cardiovascular disease, and asthma. [†]Calculated by one-way analysis of variance or chi-square analyses.

RESULTS

1. Baseline Characteristics of the Study Participants

The general characteristics of the study population according to health status are shown in Table 1. Of the 4,676 participants, 1,643 were diagnosed with chronic disease, while 3,033 were without chronic disease. The mean age of the patients with chronic diseases was slightly higher.

Participants in the healthy group were more likely to be younger and more educated and to have a higher income and lower BMI. The healthy group included a higher proportion of unmarried participants, who were also more likely to be smokers and risky drinkers. The chronic disease group had a higher proportion of participants with low physical activity and depressive mood. However, there was no significant difference in the proportion of subjects belonging to either sex.

2. Association between Physical Activity and Depressive Mood

Table 2 shows the results of the logistic regression analysis of the risk of depressive mood according to physical activity levels. In univariate analysis, significant associations were observed between levels of physical activity and depressive mood in both chronic disease and healthy groups. Participants with higher levels of physical activity had lower risks of depressive mood than those with lower levels of physical activity (odds ratio [OR], 0.62; 95% confidence interval [CI], 0.45–0.85), especially among chronic disease patients (OR, 0.47; 95% CI, 0.31–0.73). Similar trends were observed in multivariate logistic regression

analysis (chronic disease group: OR, 0.54; 95% CI, 0.34–0.88; healthy group: OR, 0.73; 95% CI, 0.59–0.89).

According to sex, the risk of depressive mood decreased as the degree of physical activity increased in women without chronic diseases (OR, 0.51; 95% CI, 0.33–0.80); however, there was no significant difference in men before and after adjustment for covariates. In the chronic disease group, moderate levels of physical activity reduced the risk of depressive mood in both men and women compared with those with lower levels (men: OR, 0.57; 95% CI, 0.37–0.89; women: OR, 0.56; 95% CI, 0.41–0.77). As demonstrated earlier, the decrease in the risk of depressive mood according to physical activity was greater in patients with chronic illnesses. However, the dose-response association is not clear (Table 2).

DISCUSSION

This study analyzed the association between physical activity and depressive mood among Korean adults aged ≥ 20 years who participated in the 2014 KNHANES. We found that the higher the amount of physical activity, the lower the risk of depressive mood. In particular, when differences according to the presence or absence of chronic diseases were compared, the decrease in the risk of depressive mood was greater among patients with chronic diseases. The reason for the greater association of physical activity in chronically ill individuals is thought to be that the psychological effect (mentioned below) is greater than the physiological effects of exercise. Regular exercise will increase aware-

Table 2. Odds ratios for the development of depressive mood according to physical activity level

| Variable | Level of physical activity | | | | | |
|--------------|----------------------------|-------------------------|-------------------------|-------------------|-------------------------|-------------------------|
| | Healthy (n=3,033) | | | Chronic (n=1,643) | | |
| | Low | Moderate | High | Low | Moderate | High |
| Total | | | | | | |
| Unadjusted | 1 | 0.69 (0.57–0.83) | 0.62 (0.45–0.85) | 1 | 0.55 (0.43–0.71) | 0.47 (0.31–0.73) |
| Model A | 1 | 0.70 (0.58–0.85) | 0.67 (0.49–0.92) | 1 | 0.57 (0.44–0.74) | 0.54 (0.35–0.84) |
| Model B | 1 | 0.72 (0.59–0.88) | 0.68 (0.49–0.94) | 1 | 0.59 (0.45–0.77) | 0.57 (0.37–0.90) |
| Model C | 1 | 0.71 (0.58–0.86) | 0.72 (0.52–0.99) | 1 | 0.58 (0.45–0.76) | 0.53 (0.33–0.84) |
| Model D | 1 | 0.73 (0.59–0.89) | 0.73 (0.53–1.01) | 1 | 0.59 (0.45–0.78) | 0.54 (0.34–0.88) |
| Men | | | | | | |
| Unadjusted | 1 | 0.77 (0.55–1.09) | 0.96 (0.61–1.52) | 1 | 0.57 (0.37–0.89) | 0.50 (0.26–0.95) |
| Model A | 1 | 0.77 (0.55–1.09) | 0.92 (0.58–1.47) | 1 | 0.58 (0.37–0.90) | 0.51 (0.27–0.97) |
| Model B | 1 | 0.78 (0.55–1.11) | 0.95 (0.59–1.50) | 1 | 0.58 (0.37–0.93) | 0.53 (0.27–1.02) |
| Model C | 1 | 0.80 (0.56–1.12) | 1.00 (0.63–1.60) | 1 | 0.63 (0.40–0.99) | 0.53 (0.26–1.05) |
| Model D | 1 | 0.80 (0.56–1.14) | 1.00 (0.63–1.62) | 1 | 0.61 (0.38–0.99) | 0.52 (0.26–1.05) |
| Women | | | | | | |
| Unadjusted | 1 | 0.68 (0.54–0.86) | 0.51 (0.33–0.80) | 1 | 0.56 (0.41–0.77) | 0.57 (0.32–1.05) |
| Model A | 1 | 0.67 (0.53–0.85) | 0.50 (0.32–0.79) | 1 | 0.56 (0.41–0.77) | 0.57 (0.32–1.05) |
| Model B | 1 | 0.69 (0.54–0.88) | 0.51 (0.32–0.81) | 1 | 0.59 (0.43–0.82) | 0.63 (0.34–1.18) |
| Model C | 1 | 0.67 (0.53–0.85) | 0.53 (0.34–0.84) | 1 | 0.56 (0.41–0.78) | 0.54 (0.29–1.02) |
| Model D | 1 | 0.68 (0.53–0.87) | 0.54 (0.34–0.86) | 1 | 0.59 (0.42–0.82) | 0.60 (0.32–1.14) |

Values are presented as odds ratio (95% confidence interval). Model A: adjusted for age and sex; model B: adjusted for age, sex, and socioeconomic factors (education, residence, household income, and spouse status); model C: adjusted for age, sex, and health behavior factors (smoking, alcohol use, and BMI); and model D: adjusted for age, sex, socioeconomic factors (education, residence, household income, and spouse status), and health behavior factors (smoking, alcohol use, and BMI). Statistically significant results are written in bold ($P < 0.05$).

BMI, body mass index.

ness of self-efficacy or confidence in the body, and the self-esteem resulting from regular exercise is more important in those with chronic disease than in healthy people.⁹⁾

A previous study have reported a tendency for a dose-response association;¹⁷⁾ we propose that the lack of clarity of the dose-response in our study was because of the fact that we separated the degree of physical activity into only three groups.

Physical activity, the main focus of this study, is widely known to reduce the risk of coronary heart disease, stroke, DM, and other chronic diseases.²¹⁻²³⁾ While studies have described the association between physical activity and depression, the mechanism behind this association remains unclear. Exercise has been shown to alter norepinephrine activity, decrease hypothalamic-pituitary-adrenal axis activity, and increase beta-endorphin secretion, resulting in improved mood.²⁴⁾ In addition to these physiological responses, psychological mechanisms are also known to be involved. These factors might explain why the OR for depressive mood was significant for women, but not for men, in the context of high levels of physical activity in our study.²⁵⁾

With regard to the role of depression in increasing the burden of disease among patients with chronic diseases, it can be inferred from our findings that physical activity reduces the risk of depressive mood and influences disease outcomes.¹⁰⁾ In addition, a previous study found that the level of physical activity was low among Korean adults with chronic diseases such as HTN and DM.²⁶⁾ Therefore, the importance of physical activity among patients with chronic illnesses should be strongly emphasized.

The study limitations are as follows. First, because this was a cross-sectional study, it was difficult to determine the causal relationship between depressive mood and physical activity. Second, there is a possibility of recall bias as the classification of depressive mood and physical activity was based on a retrospective self-report questionnaire. Third, we identified an association between depressive mood and physical activity in chronic illnesses, but we have not yet identified any differences in disease outcomes due to decreased depressive symptoms. Fourth, although the KNHANES data are representative, we only analyzed data from 2014, when the PHQ-9 was newly introduced. In addition, because only the amount of leisure-time physical activity was included, the correlation with occupational physical activity was not reflected. Further validation is required through prospective studies involving a larger sample size to substantiate the recommendation of increased physical activity among people with chronic diseases.

In conclusion, higher levels of physical activity significantly decreased the development of depressive mood among Korean adults with chronic diseases, compared to their healthy counterparts. Thus, by recommending appropriate physical activity in patients with chronic illnesses, we can reduce the risk of depressive mood and expect an improvement in the course of the disease, although follow-up studies are necessary to evaluate chronic disease outcomes. Overall, the importance of physical activity must be emphasized in chronic disease patients.

CONFLICT OF INTEREST

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

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