



Original Article

Effects of Physical Activity on Depression in Adults with Diabetes

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ABSTRACT

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Objectives: The purpose of this study was to identify the current state of physical activity in adults with diabetes and to investigate the effect of physical activity on depression.

Methods: The present study was conducted using data from the 2nd year of the 6th Korea National Health and Nutritional Examination Survey. From the total of 7,550 individuals, 418 adults diagnosed with diabetes were selected as participants, and their physical activity and depression levels were examined.

Results: The physical activity status of the participants showed that they did not usually engage in physical activities at work, and only a few participants were involved in moderate intensity physical leisure activity. Apart from walking for 10 minutes each day, which accounted for 1/3 of the participants, most of the participants did not engage in specific forms of exercise. An examination of the effects of physical activity on depression revealed that moderate intensity physical activity at work and leisure influenced depression. In terms of demographic characteristics, gender, occupation, income quintile, and subjective health status were all found to affect depression.

Conclusion: For elderly (60 years or older) patients with diabetes, which accounted for the majority of the diabetic population, a systematic leisure program and professional education are necessary to help them to manage stress and depression in daily life. Additionally, provision of community and family support should encourage regular, moderate intensity exercise and promote lifestyle changes to encourage increased physical activity.

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Introduction

Diabetes mellitus is a rapidly growing chronic metabolic disease worldwide. In 2010, 1 in 10 adults in Korea was diagnosed with diabetes mellitus, and this number is estimated to increase to 6 million by 2050 [1]. According to the Korea Institute for Health and Social Affairs statistics, the domestic mortality rate due to diabetes was 32.3 per 100,000 population in 2012, which is higher than the average mortality rate of all the countries belonging to the Organisation for Economic Co-operation and Development which was 22.8 per 100,000 population [2].

The cost of medical treatment for patients with diabetes in Korea accounts for 20% of the total medical expenses of the

national health insurance scheme, and the average medical cost per patient with diabetes is about 3 times higher than that for patients without diabetes [3]. As a result, the national cost of health insurance expenditure is also increasing. Therefore, efforts should be made to promote and maintain the health of diabetic patients to reduce the cost of medical care and reduce the mortality rate of patients with diabetes.

In previous studies on the healthcare of patients with diabetes, the psychological state of the patient was identified as 1 of the factors having a negative effect on treatment, of which, depression was the main factor [4]. Diabetes and depression are known to be closely related, and patients with diabetes have twice the prevalence of depression than those who do not have diabetes [5]. Depression is a condition that ranges from

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mild depressive to abnormal [6]. As individuals with depression have a negative self-image and experience negative thoughts about their future [7], increased levels of depression often lead to sleep deprivation, tiredness, inadequacy, decreased self-esteem, decreased attention, anxiety, death, or suicide due to repeated suicidal ideations [6]. In particular, as depression in chronic illnesses such as diabetes aggravates health problems and is a major risk factor linked to suicide [8], patients with diabetes require active intervention for depression.

Regular exercise is known to have various effects such as the prevention of chronic diseases, reduction in the likelihood of depression, improvement of physical strength, and alleviation of mental stress [9]. Regular physical activity helps to regulate normal glucose uptake into peripheral tissues, and increases insulin receptors and insulin sensitivity, thus contributing to blood glucose control [10].

In contrast, the lack of physical activity is likely to lead to obesity. The incidence of obesity is reported to be higher in Korea as compared to the World Health Organization's average of 35.2% for males and 28.3% for females worldwide. In addition, more than 80% of these patients have diabetes mellitus and the greater the degree of obesity, the greater the risk of diabetes [11]. Therefore, for the healthcare of adults with diabetes in Korea, it is critical to understand the state of physical activity and to examine the effect of physical activity on depression, which could reduce patients' motivation for treatment.

To this end, the purpose of this study was to investigate the current status of physical activity and its effect on depression in adults with diabetes using data from the 2nd year of the nationally representative 6th Korea National Health and Nutritional Examination Survey (KNHANES). We aimed to provide a guide for future health management of diabetes in adults.

Materials and Methods

1. Participants

This study used data from the 2nd year of the 6th KNHANES. These data were reviewed and approved by the Research Ethics Review Committee of the Disease Control Division. To ensure that the data were representative of the entire population of Korea, a weighted sample was drawn from each region. In this study, amongst the 7,550 individuals who participated in the 6th KNHANES, 418 participants aged 19 years or older, and diagnosed with diabetes were selected.

2. Measurements

2.1. Depression

In the present study, depression was assessed using the

scores on the Patient Health Questionnaire 9 (PHQ-9). This 9-item tool is a self-report test that measures the severity of depression. The scores on each item are summed, and a total score of 0 to 4 points is classified as "normal," 5 to 9 points as "mild depression," and 10 points as "mild to moderate" depression.

The PHQ-9 questionnaire consists of questions related to depression such as "no interest or fun in working," "difficult to sleep or waking up frequently, or sleeping too much," "fatigue and decline of energy," "nervous or anxious" and "desire to die." Cronbach α showed that this questionnaire was highly reliable (0.89) [12].

2.2. Physical activity

Data on participation in various physical activities during a typical week and the amount of time spent on each physical activity was analysed. The data included the number of activity days per week and the presence of high- and moderate-intensity physical activity at work, travelling from 1 place to another, during leisure, during walking, and whilst muscle training.

"High-intensity activity" refers to activities in which a person breathes heavily or has a very rapid heartbeat due to intense physical activity. "Moderate-intensity activity" refers to activities in which a person is slightly out of breath or has a slightly faster heartbeat due to moderate physical activity.

The questionnaire assigned physical activities such as lifting or moving heavy objects (over 20 kg), digging, labor at construction sites and carrying objects up the stairs as "high intensity activity." Whereas, walking fast, carrying light objects, cleaning and child care (giving a bath, holding a baby) were assigned to the "medium intensity activity" category.

3. Statistical analysis

The collected data were analysed using the SPSS 21.0 program. The socio-demographic characteristics and physical activity status of adults with diabetes were analysed using descriptive statistics. The effects of physical activity on depression and the general characteristics of depression were analysed using multiple regression analysis. Statistical significance was set at $p < 0.05$.

Results

1. Participant demographics and characteristics

The general demographics of the participants showed no significant differences in gender, with 49.3% males and 50.7% females. The most common age group was those aged over 70 years (39.5%), followed by those aged 60 years to 69 years (35.6%) and those aged 50 years to 59 years (17.5%). In

terms of educational level, elementary school graduate or below accounted for the highest proportion of participants (48.3%). Based on employment, those individuals not in paid employment (including housewives) accounted for the highest proportion of participants (60.3%). The employed participants were simple manual labourers (10.5%), functional and machine operators (8.1%), and service and sales workers (7.4%). More than half the participants fell in the middle-level or below average income category, with 36.1% in the low-income group and 30.6% in the medium-low income group. Living with a

spouse was the most common marital status (70.8%). The subjective health status provided by the participants showed that 85.2% of the population reported feeling either normal (43.3%), bad (27.3%), or very bad (14.6%) (Table 1).

2. Physical activity status of adults with diabetes

In working adults with diabetes who typically exercised for 3 or 4 days per week at work, only 3 (0.7%) participants engaged in high-intensity physical activities, whilst 32 (7.7%)

Table 1. General characteristics of participants ($n = 418$).

Characteristics	Categories	<i>n</i>	%
Gender	Male	206	49.3
	Female	212	50.7
Age (y)	19 - 29	1	0.2
	30 - 39	8	1.9
	40 - 49	22	5.3
	50 - 59	73	17.5
	60 - 69	149	35.6
	70 or older	165	39.5
Education level	Primary school diploma or lower	202	48.3
	Middle school diploma	55	13.2
	High school diploma	105	25.1
	Bachelor's degree or lower	51	12.2
	Not answered	5	1.2
Occupation	Manager and specialist	23	5.5
	Office worker	7	1.7
	Service and sales worker	31	7.4
	Agriculture and fishery worker	22	5.3
	Functional worker and machine operator	34	8.1
	Simple labour	44	10.5
	Unemployed including housewife)	252	60.3
Income quartile (household)	Not answered	5	1.2
	Low	151	36.1
	Medium low	128	30.6
	Medium high	70	16.7
	High	66	15.9
Marital status	Not answered	3	0.7
	I have a spouse and live together.	296	70.8
	I have a spouse but I live separately.	3	0.7
	Bereaved	79	18.9
	Divorced	25	6.0
Subjective health status	Not answered	15	3.6
	Very good	15	3.6
	Good	47	11.2
	Normal	181	43.3
	Bad	114	27.3
	Very bad	61	14.6

engaged in moderate-intensity physical activity. The majority of the participants reported that they walked for more than 10 minutes when travelling from 1 place to another (52.2%), and most of them engaged in this activity every day. High-intensity activity associated with leisure accounted for 27 (6.5%) participants, whilst 74 (17.7%) participants engaged

in moderate-intensity activity. Furthermore, 127 (30.3%) participants typically walked for more than 10 minutes every day during the week, but 109 (26.1%) participants did not walk at all. Most participants (80.4%) did not engage in any muscle training exercise during the week (Table 2).

Table 2. Overview of physical activity in the adults with diabetes ($n = 418$).

Characteristics	Categories	<i>n</i>	%
Work: High-intensity physical activity	Yes	3	0.7
	No	415	99.3
Work: Number of days of engaging in high-intensity physical activity ($n = 3$)	1 to 2 d	0	0.0
	3 to 4 d	3	100.0
	5 to 6 d	0	0.0
	7 d	0	0.0
Work: Moderate-intensity physical activity	Yes	32	7.7
	No	386	92.3
Work: Number of days of engaging in moderate-intensity physical activity ($n = 32$)	1 to 2 d	10	31.3
	3 to 4 d	12	37.5
	5 to 6 d	5	15.6
	7 d	5	15.6
Travelling: Physical activity	Yes	218	52.2
	No	197	47.1
Travelling: Number of activity days ($n = 218$)	1 to 2 d	39	17.8
	3 to 4 d	60	27.5
	5 to 6 d	47	21.5
	7 d	72	33.2
Leisure: High-intensity physical activity	Yes	27	6.5
	No	388	92.8
Leisure: Number of days of engaging in high-intensity physical activity ($n = 27$)	1 to 2 d	7	25.9
	3 to 4 d	8	29.7
	5 to 6 d	6	22.2
	7 d	6	22.2
Leisure: Moderate-intensity physical activity	Yes	74	17.7
	No	341	81.6
Leisure: Number of days of engaging in moderate-intensity physical activity ($n = 74$)	1 to 2 d	16	21.6
	3 to 4 d	23	31.1
	5 to 6 d	17	22.9
	7 d	18	24.4
Number of days of walking per week	I do not walk at all	109	26.1
	1 to 2 d	51	12.2
	3 to 4 d	64	15.3
	5 to 6 d	67	16.1
	7 d	127	30.3
Number of days of engaging in muscle training exercise per week	I do not engage in muscle training at all	336	80.4
	1 to 2 d	20	4.8
	3 to 4 d	19	4.6
	5 to 6 d	43	10.2
	7 d	0	0.0

3. Effects of physical activity and socio-demographic characteristics on depression

Multiple regression analysis was performed on demographic characteristics to investigate their effect on depression.

Analysis of physical activity showed that the presence of work-related moderate-intensity physical activity ($\beta = 0.004$, $p < 0.01$), number of work-related moderate-intensity physical activity days ($\beta = -0.216$, $p < 0.001$), and number of leisure-related moderate-intensity physical activity days ($\beta = 0.103$, $p < 0.05$) were all found to affect depression.

Among the socio-demographic characteristics examined in the present study, gender ($\beta = 0.154$, $p < 0.01$), occupation ($\beta = 0.128$, $p < 0.05$), income quintile ($\beta = -0.159$, $p < 0.01$), and subjective health status ($\beta = 0.387$, $p < 0.001$) were all found to affect depression (Table 3).

Discussion

The present study analysed the effects of physical activity on depression in adults with diabetes using data from the 2nd year of the 6th KNHANES (2014). The sample comprised of a similar number of male and female participants. Compared with the percentage of patients with diabetes 10 years ago (12.6% for men and 7.9% for women), the present study suggests that the percentage of women with diabetes (50.7%) is now equivalent to men (49.3%). The incidence of diabetes was most prevalent amongst those aged 70 years and above, which suggests that the risk for diabetes increases with old age.

Regarding education level, elementary school graduate or lower, accounted for the highest proportion of participants in this study, whilst the unemployed and simple manual labourers accounted for the highest proportion of participants. In terms

Table 3. Effects of physical activity and socio-demographic characteristics on depression.

Categories	Depression				
	Unstandardized Coefficients		Standardized Coefficients	<i>p</i>	
	β	SE	β		
Physical Activity	Work: High-intensity physical activity	-0.967	0.635	-0.076	0.128
	Work: Number of days of engaging in high-intensity physical activity	-4.544	1.310	-0.171	0.001 **
	Work: Moderate-intensity physical activity	-1.462	0.510	-0.142	0.004**
	Work: Number of days of engaging in moderate-intensity physical activity	-1.708	0.387	-0.216	< 0.001 ***
	Travelling: Physical activity	0.094	0.459	0.010	0.838
	Travelling: Number of days of engaging in physical activity	0.012	0.220	0.003	0.955
	Leisure: High-intensity physical activity	0.462	0.476	0.048	0.332
	Leisure: Number of days of engaging in high-intensity physical activity	0.993	0.929	0.053	0.286
	Leisure: Moderate-intensity physical activity	0.756	0.589	0.065	0.195
	Leisure: Number of days of engaging in moderate-intensity physical activity	0.633	0.306	0.103	0.039*
	Number of days of walking per week	-0.041	0.032	-0.065	0.197
	Number days of engaging in muscle training exercise per week	-0.128	0.138	-0.046	0.357
Socio-demographic Characteristics	Gender	1.413	0.452	0.154	0.002**
	Age	-0.156	0.228	-0.034	0.494
	Marital status	0.003	0.014	0.012	0.812
	Education level	-0.359	0.205	-0.807	0.080
	Occupation	0.324	0.126	0.128	0.010*
	Income quartile	-0.677	0.211	-0.159	0.001**
	Subjective health status	1.822	0.217	0.387	< 0.001 ***

Dependent variables: Depression.

* $R^2 = 0.127$, **Adjusted $R^2 = 0.086$, *** $F(p) = 3.075 (< 0.001)$.

SE = standard error.

of income quintiles, "below average" was the most common. A meta-analysis revealed that diabetes was more prevalent amongst participants with lower social class occupations, and this trend was observed in both high-income and low-income countries [13]. More patients with diabetes were simple manual labourers, functional workers, and machine operators as compared to office workers or specialists, which contradicts results obtained from previous studies which reported that the prevalence of diabetes is higher amongst office workers and specialists [14]. Studies have shown that the risk of diabetes is higher among office workers because white-collar workers engage in less physical activity during work than production workers [10]. However, the results of the present study suggest that the risk of diabetes may be affected by lifestyle outside of work.

Furthermore, the current findings revealed that the participants did not engage in high-intensity physical activity at work, and less than 10% of them engaged in moderate-intensity physical activity. However, 1/3 of the participants walked for more than 10 minutes each day, indicating that the participants walked when they needed to travel from one place to another, rather than engaging in any particular form of physical activity however, 1/3 responded that they did not walk, even to travel. More than 80% of the participants did not engage in muscle training exercise, indicating that most diabetics do not actively engage in physical activity. A study by Park and Kim [15] revealed that the reason for the low level of physical activity of middle-aged Korean adults is that they tend to sit for long periods of time even when they are at work, and their leisure activities mainly involve sedentary activities such as watching TV or sleeping. Accordingly, Cho et al [16] reported the urgent need to develop a program to increase the physical activity level of adults in Korea.

In this study the effects of physical activity on depression were examined and the presence of work-related moderate-intensity physical activity, the number of work-related activity days, and the number of leisure-related moderate-intensity physical activity days influenced the levels of depression experienced by participants. Simple walking to travel to a destination did not affect depression in this study. The results of previous studies on patients with diabetes and their physical activity showed that high-intensity physical activity and insulin resistance are not related to each other. However, moderate-intensity physical activity and exercise are known to improve metabolism, including blood sugar metabolism [17,18]. In fact, the World Health Organization recommends engaging in regular moderate-intensity exercise for at least 5 days a week, for at least 30 minutes a day [19]. Excessive, tough, high-intensity physical activity can lead to fatigue and it can increase depression. Furthermore, it is believed that moderate-intensity physical activity, which is suitable for the

improvement of health conditions, may help relieve stress and depression. It would be beneficial for health professionals such as occupational therapists and exercise instructors, to develop exercise programs of appropriate intensity, duration and frequency for patients with diabetes that is age appropriate, and to implement such programs in community health centres and welfare centres.

Furthermore, in the present study an examination of the effect of demographic characteristics on depression revealed that gender, occupation, income quintile, and subjective health status affect depression, while marital status does not. However, in a study by Lee et al [20] that examined patients with diabetes mellitus, women were found to be more likely to be depressed than men, and unemployed adults with diabetes were found to be twice more likely to experience depression than their employed counterparts [14]. Results of studies conducted in the early and mid-2000s, showed that unmarried individuals with diabetes were more depressed than married individuals with diabetes [21,22]. These results contradict the results in this study. Further studies are needed to confirm the relationship between marital status and depression in adults with diabetes.

Pompili et al [23] suggested that the subjective assessment of health status is related to depression in patients with diabetes, and that the likelihood of depression is 3.2 times higher when the subjective health status is worse, corroborating the results of the present study.

In conclusion, elderly individuals aged 60 years or older with diabetes, need systematic active leisure programs and professional education to manage stress and depression in daily life. Support in the community and encouragement by family members could result in meaningful exercise programs to encourage moderate-intensity exercise and to bring about lifestyle changes that promote healthy activity.

In many diabetes studies, elderly patients have been shown to benefit from muscular endurance exercises [24,25]. Endurance exercises reduce age-related problems by increasing muscle mass and allowing increased bone density, reducing the effects of osteoporosis. Walking regularly for 30 minutes every day improves muscular endurance, and also enhances concentration. Dance programs for the elderly have similar physical and psychological effects enabling moderate joint movement as well as being a popular social activity [26].

The limitation of this study is that the data was collected in 2014 and may not reflect the current national demographics. Furthermore, this study could not identify various types of physical activity because the 6th KNHANES did not include this information. However, since the current state of physical activity of patients with diabetes and its effects on depression were examined, the results of this study could be of great value for the development of national and community level

strategies for the care of patients with diabetes.

Conflicts of Interest

The author has no conflicts of interest to declare.

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