

# Relationships among Physical Activity Level, Health-promoting Behavior, and Physiological Variables in Korean University Students

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**Purpose:** Many Korean college students suffer from physical inactivity and mental health problems. However, it has not been sufficiently reported how this lack of exercise and health-related behavior affect their health. The present study was performed to identify the relationships among physical activity level, health-promoting behavior, and physiological variables in Korean undergraduate and graduate students. **Methods:** Participants were 115 undergraduate and graduate students from one university in Seoul. The Pearson's correlation analysis was performed using SPSS for Windows. **Results:** Physical activity level had significant positive correlations with health-promoting behavior ( $r=.32, p=.001$ ) and exercise self-efficacy ( $r=.25, p=.008$ ), and health-promoting behavior had a significant correlation with depression ( $r=-.33, p<.001$ ) and exercise self-efficacy ( $r=.44, p<.001$ ). Additionally, physical activity level had significant correlations with triglyceride ( $r=-.20, p=.034$ ) and vitamin D ( $r=.20, p=.029$ ) levels. The high density cholesterol level had significant negative correlations with systolic blood pressure ( $r=-.33, p<.001$ ), diastolic blood pressure ( $r=-.29, p=.002$ ), and vitamin D ( $r=-.20, p=.035$ ) levels. **Conclusion:** Physical activity level or health-promoting behavior had significant relationships with the health status of college students. Strategies need to be developed to improve health-promoting behaviors among college students.

**Key Words:** Exercise, Health promotion, Depression

## INTRODUCTION

A lack of physical activity is one of the most important public health problems of the 21st century.<sup>1)</sup> It has been identified as the fourth leading risk factor for death worldwide. Globally, physical inactivity is estimated to cause about 21% to 25% of breast and colon cancer, 27% of diabetes, and about 30% of ischemic heart disease; the burden of these and other chronic diseases has rapidly increased in recent decades.<sup>2)</sup> Recent population estimates suggest that 5.3 million deaths from non-communicable disease, such as coronary heart disease, type 2 diabetes, and breast and colon cancers, could be prevented annually if physically inactive people were sufficiently active.<sup>3)</sup> Lack of physical activity is an important modifiable risk factor for cardiovascular and metabolic diseases and bone

density.<sup>3,4)</sup> With these reasons, international public health and health promotion organizations have listed physical inactivity as the most remarkable health risk factor across the lifespan. Therefore, promoting physical activity is essential for public health and health promotion strategies. Some systematic reviews have ascertained the benefits of physical activity among healthy adults.<sup>5-7)</sup>

A previous study has shown that practicing health-promoting behaviors decreases the occurrence of disease and lowers the death rate.<sup>8)</sup> If health-promoting behaviors are integrated into the lifestyle, it will bring better health, functional abilities, and overall quality of life.

The college years are an important time of transition from adolescence to adulthood.<sup>9)</sup> During this period, young adults may increase their control over their lifestyles and may engage in a variety of both protective (e.g., exercise)

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and risky (e.g., drinking) behaviors that impact their current and future health status.<sup>10</sup> Additionally, lifestyle is not firmly formed compared to adults and has larger modifiability.

According to a study on the effect of self-efficacy on physical activity among Korean college students, self-efficacy was significantly correlated with physical activity and can be considered a significant factor to help improve college students' physical activity levels.<sup>11</sup> Health-related behaviors, including physical activity and health-promoting behavior is associated with self-efficacy.<sup>9</sup> There are also several studies that reported a significant correlation between the physical activity level and depression; it was also suggested that physical activity could help reduce depressive symptoms.<sup>12,13</sup> Some studies on the effect of physical activity reported a significant decrease in systolic blood pressure (BP), body fat percentage, cholesterol, and triglycerides levels, which are indicators of metabolic syndrome in intervention group.<sup>14</sup> Another study showed a significant relationship between physical activity and vitamin D.<sup>15</sup> Consequently, physical activity was associated with body composition and some blood profiles.

As reviewed, physical activity is known to be associated with health-promoting behaviors, self-efficacy, depression, blood profiles, and body composition. However, how a lack of physical activity and health-promoting behavior in university students can affect the health is not sufficiently reported. This study was designed to identify the relationships among physical activity level, health-promoting behavior, exercise self-efficacy, depression, and physiological variables such as BP, body composition analysis, and other clinical indicators for Korean undergraduate and graduate students. This study also investigated the correlation between physiological variables of metabolic syndrome and bone density those were known to be associated with physical inactivity.

## METHODS

### 1. Study Design

This study was a descriptive correlational study to address the relationship among physical activity level, health-promoting behavior, and physiological variables.

### 2. Study Participants

This study was designed with a different purpose from that of an intervention study for undergraduate and graduate students. The data used in this study were pretest da-

taset of an intervention study.<sup>16</sup> Participants were recruited at one university in Seoul, South Korea. Undergraduate and graduate students were recruited via notices posted on the university homepage and sent via e-mail to students through the health service center from August to September 2014. Study participants comprised 115 students who voluntarily agreed to participate. Before the study commenced, a full explanation about the research purpose, experimental procedure, and all measured indices was provided. Informed consent was obtained from all participants. Before the study commenced, a full explanation about the research purpose, experimental procedure, and all measured indices was provided. Informed consent was obtained from all participants. This study is part of original project that has been approved by the Ethics Committee of the Seoul National University Hospital Evaluation Committee (IRB No. 1409/001-001).

### 3. Measurements

We measured participants' body composition, BP, bone density, and collected blood sample. Additionally, the physical activity level, health-promoting behavior, exercise self-efficacy, and depression were assessed using a structured self-report questionnaire.

Height and weight were measured using an automatic stadiometer (BSM 370, Inbody Co., Ltd., Seoul, Korea). Body composition was assessed using a body composition analyzer regarding the amount of body fat, percentage of body fat, body mass index (BMI), skeletal muscle mass, and amount of muscle (Inbody 570, Inbody Co., Ltd., Seoul, Korea). After 10 min of rest, BP was measured. Bone density was measured at the right calcaneus bone using broadband ultrasound attenuation (Sonost 3000, OsteoSys Co., Ltd, Seoul, Korea). In general, bone density indicates a T-score of “-1 and above” to mean normal; “-2.5 to -1” to mean osteopenia, a condition in which bone density is below normal and may lead to osteoporosis; and “-2.5 or below” to mean osteoporosis. About 5mL of blood were taken to determine serum vitamin D, fasting serum total cholesterol (TC), low-density lipoprotein cholesterol (LDL), high-density lipoprotein cholesterol (HDL), and triglyceride (TG). Participants were asked not to eat or drink for 12 hours before testing. One laboratory determined all blood biochemistry parameters (Green Cross Laboratories, Yongin, Korea). Heart rate variability (HRV) was measured using a portable electrocardiograph (LXC 3203, LAXTHA Inc., Daejeon, Korea). HRV data were obtained at various frequency bands using an HRV software tool (TeleScan, LAXTHA Inc., Daejeon, Korea). After 10

min of rest, HRV was measured. A heart rate monitor with a unipolar limb lead electrocardiography (ECG) recorder was used to collect continuous R-R intervals, which were stored on a computer for later analysis. Time taken to measure was about 5 min.

A self-report questionnaire was administered to investigate demographic data, health-promoting behavior, exercise self-efficacy, physical activity level, and depression. Health-promoting behavior was assessed using a Korean version<sup>17)</sup> of the Health-Promoting Lifestyle Profile II (HPLP-II). The HPLP-II is a 52-item 4-point Likert scale based on Pender's health promotion model, which contains six subscales. Cronbach's  $\alpha$  for this scale was .92,<sup>17)</sup> and in this study, it was .91. Exercise self-efficacy was assessed using a modified version of Marcus et al.<sup>18)</sup> tool, revised and translated into Korean by three Korean nursing college professors.<sup>19)</sup> This comprises 10 items that examine self-efficacy for physical activity in various situations using a 4-point Likert scale. Cronbach's  $\alpha$  for this scale was .84.<sup>19)</sup> In this study, it was .74. Physical activity level was measured using the International Physical Activity Questionnaire-Short form<sup>20)</sup> which measures total physical activity accrued through work and leisure in all settings combined. Participants were asked about their frequency and duration of exercise by indicating the days and time spent doing vigorous and moderate activities, walking, and sitting in the last 7 days. Metabolic equivalent (MET) is the ratio of working metabolic rate to resting metabolic rate. 1 MET is defined as 1 kcal/kg/hour and is about the same as the energy cost when sitting quietly.

- Walking MET-min/week=3.3×walking min×walking days
- Moderate MET-min/week=4.0×moderate-intensity activity min×moderate days
- Vigorous MET-min/week=8.0×vigorous-intensity activity min×vigorous-intensity days
- A combined total physical activity MET-min/week can be computed as the sum of Walking+Moderate+Vigorous MET-min/week scores.

Depression was investigated using a Korean version of the Beck Depression Inventory (BDI) questionnaire.<sup>21)</sup> It comprises 21 items and a 3-point Likert scale. The total sum of the item scores ranges from 0 to 63, with higher total scores indicating more severe depressive symptoms. Cronbach's  $\alpha$  for this scale was .85.<sup>21)</sup> In this study, it was .86.

#### 4. Statistical Analysis

Demographic information was analyzed using mean, standard deviation (SD), frequency, and percentage. The

relationships between variables were analyzed using Pearson product-moment correlation coefficients, depending on the normality of the distribution of the variables. All statistical tests were two-tailed and the acceptance level of statistical significance ( $p$  value) in the overall analysis was 0.05 or less. All statistical analyses were undertaken using IBM SPSS 22.0 for Windows (Chicago, IL, USA).

## RESULTS

This study was conducted with healthy university students, and we evaluated the relationships among physical activity level, health-promoting behavior, depression, and physiological variables. The total participants included 115 university students (mean age  $24.4 \pm 4.2$ ; age range: 18~36 years; 54 men [47.0%] and 61 women [53.0%]).

Pearson product-moment correlation coefficients are shown in Table 1. The physical activity level showed significant correlations with health-promoting behaviors ( $r = .32, p = .001$ ) and exercise self-efficacy ( $r = .25, p = .008$ ). Health-promoting behaviors showed a significant negative correlation with depression ( $r = -.33, p < .001$ ). Additionally, the physical activity level showed significant correlations with TG ( $r = -.20, p = .034$ ), vitamin D ( $r = .20, p = .029$ ).

The systolic and diastolic BP showed significant correlations with TG, LDL, and HDL. The systolic BP showed significant positive correlations with TG ( $r = .32, p = .001$ ), LDL ( $r = .25, p = .007$ ), and the diastolic BP showed significant positive correlations with TG ( $r = .27, p = .004$ ), LDL ( $r = .24, p = .011$ ). Also, HDL has significant negative correlation with systolic BP ( $r = -.33, p < .001$ ), and diastolic BP ( $r = -.29, p = .002$ ). Vitamin D levels showed significant negative correlations with total cholesterol ( $r = -.19, p = .047$ ) and HDL ( $r = -.20, p = .035$ ) (Table 2).

## DISCUSSION

This study was performed to ascertain the relationships among physical activity level, health-promoting behavior, and physiological variables and to explore the association between physiological variables. The study demonstrated a significant relationship between health-promoting behavior and physical activity levels. Health-promoting behaviors help alleviate physical and psychological stresses, and strengthen the positive aspects of life.<sup>22)</sup> This finding was consistent with previous study.<sup>8)</sup> Health-promoting behavior is one of the most important factors in caring for one's health. This direct relationship between health-promoting behaviors and physical activity levels shows us that increased health-promoting behaviors would improve

**Table 1.** Correlations among Physical Activity Levels, Health-promoting Behaviors, Subjective and Physiological Data (N=115)

Domain	Parameter	Physical activity level	Health-promoting behavior
		r (p)	r (p)
Subjective data	Physical activity level	1	
	Health-promoting behavior	.32 (.001)	1
	Exercise self-efficacy	.25 (.008)	.44 (< .001)
	Depression	-.09 (.350)	-.33 (< .001)
Physiological data	Systolic blood pressure	.08 (.399)	-.02 (.947)
	Diastolic blood pressure	-.08 (.423)	-.01 (.911)
	LF/HF	-.01 (.957)	.04 (.641)
	Total cholesterol	-.14 (.134)	.02 (.821)
	Triglycerin	-.20 (.034)	-.20 (.044)
	HDL	.05 (.594)	.08 (.411)
	LDL	-.11 (.224)	.04 (.638)
	Vitamin D	.20 (.029)	.18 (.053)
	Body mass index	.05 (.630)	.08 (.406)
	Amount of muscle	.13 (.162)	.10 (.285)
	Skeletal muscle mass	.13 (.164)	.10 (.297)
	Percent body fat	-.13 (.179)	-.02 (.829)
	Amount of body fat	-.07 (.491)	.05 (.570)
	Bone density	-.03 (.766)	-.05 (.603)

HDL=High density lipid; HF=High frequency; LDL=Low density lipid; LF=Low frequency.

**Table 2.** Correlations among Physiological Variables

(N=115)

Variables	SBP	DBP	T. Cho	TG	LDL	HDL	Vit. D	Bone density
	r (p)	r (p)	r (p)	r (p)	r (p)	r (p)	r (p)	r (p)
SBP	1							
DBP	.71 (< .001)	1						
T. Cho	.12 (.211)	.13 (.152)	1					
TG	.32 (.001)	.27 (.004)	.50 (< .001)	1				
LDL	.25 (.007)	.24 (.011)	.83 (< .001)	.47 (< .001)	1			
HDL	-.33 (< .001)	-.29 (.002)	.30 (.001)	-.24 (.009)	-.13 (.166)	1		
Vit. D	.21 (.025)	.16 (.098)	-.19 (.047)	-.12 (.195)	-.11 (.236)	-.20 (.035)	1	
Bone density	.18 (.055)	.13 (.163)	-.01 (.946)	.07 (.439)	.06 (.519)	-.08 (.384)	.09 (.329)	1

DBP=Diastolic blood pressure; HDL=High density lipid; LDL=Low density lipid; SBP=Systolic blood pressure; T. Cho=Total cholesterol; TG=Triglycerin; Vit. D=Vitamin D.

university students' attitudes to health care and their physical activity. Therefore, healthcare programs are to be focused on, encouraging health-promoting behaviors in order to increase physical activity levels.

Second, there were significant correlations between the physical activity level and exercise self-efficacy as well as between health-promoting behaviors and exercise self-efficacy. As in previous studies, physical activity has been positively related to self-efficacy,<sup>23)</sup> and self-efficacy is a vital factor affecting health-promoting behavior.<sup>24)</sup> Increasing self-efficacy is generally considered an important me-

diator of the effects of physical activity interventions.

Additionally, there was a significant negative correlation between health-promoting behaviors and depression. Meanwhile, a relationship between depression and physical activity level was not found. A longitudinal study to examine the relationships between physical activity and depression showed lower levels of physical activity associated with depression.<sup>25)</sup> Similarly, the physical activity level was significantly related to depressive symptoms and they argued the possibility of the role of physical activity in preventing depressive symptoms.<sup>12)</sup> These find-

ings are not consistent with this study's result. Therefore, further research is needed to examine the relationship between depression and physical activity.

Higher health-promoting behaviors showed lower levels of depression, which was consistent with other study findings.<sup>13,26)</sup> A negative correlation between the geriatric depression score and health-promoting behavior was found. The Geriatric Depression Scale score was negatively associated with health-promoting behaviors. Social participation, health responsibility, self-protection, an active lifestyle, and the total health promotion for seniors score all reached statistical significance. Previous studies have also shown that any level of physical activity, including low levels (e.g., walking < 150 min/week) can prevent future depression. From a population health perspective, promoting physical activity may serve as a valuable mental health promotion strategy in reducing the risk of developing depression.

Physical activity level showed significant correlations with TG and vitamin D among physiological variables. High levels of physical activity showed reduced TG, increased vitamin D. Previous study performed to determine the effect of an intensive exercise program reported that increased physical activity through the exercise program significantly decreased serum triglycerides.<sup>27)</sup> Also, the result indicated a significant positive relationship between physical activity level and vitamin D. There is evidence that vitamin D status is associated with physical activity. A positive correlation between vitamin D and physical activity has been reported and, potentially, intensive physical activity might contribute to increase vitamin D levels.<sup>15)</sup> Another study also showed that vitamin D is related to high-impact physical activity.<sup>28)</sup> These findings are supported by our study results.

Moreover, BP showed a significant positive correlation with level of triglyceride and LDL, and negative correlation with the level of HDL. Hypertension, high TG, and low HDL are the main indicators of the metabolic syndrome with the central circumference.<sup>29)</sup> In this study, HDL and vitamin D showed a negative correlation. However, in many recent studies, a positive correlation between HDL and vitamin D has been reported.<sup>29)</sup> A recent review included that there is implicit evidence for the association among higher vitamin D level and low risk of cardiovascular disease and type 2 diabetes, and low BP.<sup>30)</sup>

Some study limitations are as follows. First, study participants were restricted to only undergraduate and graduate students at one university; therefore, caution is needed regarding the generalization of the results to other population groups. Second, the data used in this study are

secondary data collected for intervention studies for undergraduate and graduate students. Since the data was not collected for the purpose of this study, there may be problems such as missing important information. Therefore, further studies are needed, including other variables those affect health. In addition, Pearson's product-moment correlation coefficient was used to analyze the simple relationship among variables in this study. Comprehensive follow-up studies using advanced statistics such as multiple regression, multivariable analysis considering gender and age should be conducted to analyze factors directly or indirectly affecting physical activity level, health-promoting behavior, and physiological variables. Further studies undertaken in diverse settings with larger sample will be needed to generalize the study findings. Here, we discuss the results compared with previous studies, which will contribute to the establishment of strategies to improve the physical activity and mental health of Korean university students.

## CONCLUSION

University students represent one of the largest student groups in the Korean higher education system. Understanding the relationships among their physical activity, health-promoting behavior, and physiological variables are important steps to help advance the application of physical activity intervention programs for the university student population. This study result provides us with some empirical suggestions for health educators in colleges and universities who are interested in promoting physical and mental health. For example, the physical activity level was correlated with health-promoting behavior, and self-efficacy affected both physical activity and health-promoting behaviors positively. Meanwhile, healthpromoting behaviors seemed to reduce depression. In addition, physical activity can lead to a positive change in the serum lipid profile, especially outdoor activity increases the vitamin D level. Finally, health educators should recognize and address the relationships among those variables in the design and implementation of health-promoting programs to provide Korean university students with the best opportunity to engage in greater physical activity.

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