

The effects of physical activity and sedentary time on the prevalence rate of metabolic syndrome and perceived stress in Korean adults

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This study examined adult health related factors of the Korea National Health and Nutrition Examination Survey in 2017. Metabolic syndrome prevalence and perceived stress with physical activity and sedentary time were analyzed. Subjects are 4,459 over 40 year adults. The data were analyzed odds ratio (OR) and confidence interval by logistic regression analysis. First, male, moderate intensity occupational physical activity (OPA) and high intensity leisure time physical activity (LTPA) (OR, 1.337) between metabolic syndrome prevalence tended to increase. Vigorous intensity OPA (OR, 0.847), transport physical activity (TPA) (OR, 0.968), and moderate intensity LTPA (OR, 0.927) between metabolic syndrome prevalence tends to decrease. Female, vigorous intensity OPA (OR, 1.238) between metabolic syndrome prevalence tended to increase. Moderate intensity OPA (OR, 0.878), TPA (OR, 0.875), vigorous

intensity LTPA (OR, 0.691), and moderate intensity LTPA (OR, 0.479) between metabolic syndrome prevalence tended to decrease. Male, vigorous intensity OPA (OR, 1.584), moderate intensity OPA (OR, 1.752), and vigorous intensity LTPA (OR, 1.316) between perceived stress tended to increase. TPA (OR, 0.753) and moderate intensity LTPA (OR, 0.983) between perceived stress tended to decrease. Female, moderate intensity OPA (OR, 2.331) between perceived stress tended to increase. Vigorous intensity OPA (OR, 0.732), TPA (OR, 0.836), vigorous intensity LTPA (OR, 0.990), and moderate intensity LTPA (OR, 0.837) between perceived stress tended to decrease.

Keywords: Physical activity, Metabolic syndrome, Sedentary time, Perceived stress

INTRODUCTION

Through the development of scientific and medical technology, economic growth has been achieved, and our interest in health continues to increase. To improve national health, the government institutionalized the National Health Promotion Act and has conducted the Korea National Health and Nutrition Examination Survey (KNHNES) from the 1st in 1998 to the 7th in 2016 to 2018 through Korea Centers for Disease Control and Prevention to examine Koreans' health conditions. KNHNES provides foundational materials to analyze Koreans' health conditions and the World Health Organization (WHO) and Organization for Eco-

nomics Co-operation and Development (OECD) members' health conditions comparatively and also promotes both public and global health.

According to the life cycle, adults face excessive stress within competitive society and tend to neglect their health to survive in it. In competitive environment, they indicate nutritional imbalance and exercise hardly. This affects not only hormones and the stress level (Ezzati et al., 2002) but also muscular and nervous systems badly. Bad habits do harm to mental health and physical functions through anxiety, depression, or lack of confidence and causes the attack or exacerbation of degenerative disease (Stanton and Reaburn, 2014).

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Metabolic syndrome is one of the representative lifestyle diseases (Cameron et al., 2004). It indicates the metabolic risk factors (Grundy et al., 2005) of cardiovascular disease. If three out of five factors, hypertension, high fasting blood sugar (FBG), high triglycerides, low high-density lipoprotein (HDL) cholesterol, and big waist, are detected, it is diagnosed as metabolic syndrome (Alberti et al., 2005). According to the annual report of health examination statistics (2015) announced by National Health Insurance Corporation, 24% receiving regular health examinations are patients with metabolic syndrome indicating over three metabolic risk factors. It has been proven those risk factors of metabolic syndrome are detected more in those indicating lower physical activity (Lee et al., 2012a), therefore, to manage health through physical activity is important effect factors (Neufer et al., 2015).

One of the causes of reduced physical activity is the change of living environment. Through economic growth and industrialization, work environment has changed a lot, which has increased our sedentary time (Katzmarzyk, 2010). Sedentary life reduces the amount of physical activity and works as a factor to cause diseases like obesity (Moore et al., 2013; Tremblay et al., 2010). In our life, we tend to practice long time using computer, watch TV longer, have more automated devices for housework, and use vehicles frequently. This life style environment is pointed out as a cause to change our lifestyle from being active to being inactive (Owen et al., 2010). These changes of working and living environment have reduced our physical activity level and working activity level as factors to harm our health (Church et al., 2011).

Global interest in public health to improve lifestyle diseases is not just in physical health grounded on physical activity but in mental health. The WHO (2010) defined that 'health is the condition of not only physical but also mental and social well-being.' Considering the aspects of today society, we can conclude it is needed to increase physical activity and promote mental health by managing stress at working and in ordinary life efficiently. Therefore, our sedentary life that continues even in leisure time should be more active. This will bring changes into our physical and emotional health positively.

This perspective, it is meaningful to analyze the panel data of KNHNES targeting Koreans to enhance life quality through health improvement because we should know Koreans' health conditions and manage their health desirably. In study examined data about adults aged 40 or older who are the subjects of a regular adult health examination carried out by National Health Insurance Service among the results of the 7th KNHNES (2016) led by Korea Centers for Disease Control and Prevention. By un-

derstanding correlation between Koreans' behavioral patterns, prevalence rate of metabolic syndrome, and perceived stress level, this researcher will examine Koreans' health examination status, physical activity, sedentary life, prevalence rate of metabolic syndrome, and perceived stress level, heighten their recognition on health management, and provide interventions for preventing and managing metabolic syndrome and stress.

MATERIALS AND METHODS

Subjects

This study was conducted with the approval (1040782-180530-HR-07-26 ethics and bioethics) of exemption from deliberation from Sangji University Life Ethics Deliberation Committee. It utilizes the first-year data reported in the 7th Korea National Health and Nutritional Examination Survey, KNHANES VI (2016). The data used for analysis are extracted from material about 4,459 adults aged 40 or older selected from those receiving regular adult health examinations performed by Korean National Health Insurance Service among the results of KNHNES. The general characteristics of material used for analysis are shown in (Table 1).

Measurement tools

This study observed their physical activity, sedentary time, metabolic syndrome, and perceived stress level. International Physical Activity Questionnaire was used from KNHNES of physical activity. Response was 'yes' or 'no' nominal scale for items about occupation, transporting, and leisure time physical activity (LTPA). Sedentary time (min) means sitting or lying ordinarily duration except for sleeping time. Metabolic syndrome is diagnosed over three abnormal factors are found out of five, triglycerides (TG \geq 150 mg/dL), HDL cholesterol (HDL-C $<$ 50 mg/dL), FBG (\geq 100 mg/dL), blood pressure (systolic blood pressure \geq 130 mmHg, diastolic blood pressure \geq 85 mmHg), and waist size (men: over 90 cm, women: over 85 cm), according to the criteria (NCEP-ATP III, 2001).

By the data of the perceived stress is the level of stress, the response scale includes 4, 'extremely high,' 'high,' 'rather high,' and 'almost none.' For perceived stress, 'extremely high' and 'high' were categorized into a stress group and 'almost none' were classified as the low stress group. 'Rather high' was selected the most by the respondents was excluded from analysis by experts discussion for the content validity as it was ambiguous classify the groups.

Table 1. General characteristics of subjects

Characteristic	Male (n=1,933)	Female (n=2,526)
Age (yr)		
40's	566 (29.3)	695 (27.5)
50's	461 (23.8)	649 (25.7)
60's	451 (23.3)	568 (22.5)
Above 70	455 (23.5)	611 (24.2)
Education background		
Elementary or lower	382 (21.1)	865 (36.1)
Middle	246 (13.6)	318 (13.2)
High	537 (29.6)	687 (28.7)
Above university	647 (35.7)	525 (21.9)
Economic status income (personal)		
Low	475 (24.7)	625 (24.8)
Below average	481 (25)	633 (25.1)
Above average	485 (25.2)	630 (25)
High	482 (25)	628 (25)
Occupation		
Professional	255 (14.1)	173 (7.2)
Office worker	195 (10.8)	144 (6)
Service/sales	154 (8.5)	368 (15.3)
Experienced worker of agriculture, forestry, fishery	139 (7.7)	98 (4.1)
Technician manipulator/assembler	390 (21.5)	69 (2.9)
Laborer	159 (8.8)	286 (11.9)
None (housewife or student)	519 (28.7)	1,259 (52.5)
Vigorous intensity occupational physical activity		
Yes	44 (2.5)	16 (0.7)
No	1,771 (97.5)	2,391 (99.3)
Moderate intensity occupational physical activity		
Yes	142 (7.8)	116 (4.8)
No	1,673 (92.2)	2,292 (95.2)
Transport physical activity		
Yes	893 (49.2)	1,358 (56.4)
No	921 (50.8)	1,049 (43.6)
Vigorous intensity leisure time physical activity		
Yes	219 (12.1)	118 (4.9)
No	1,597 (87.9)	2,288 (95.1)
Moderate intensity leisure time physical activity		
Yes	454 (25)	419 (17.4)
No	1,362 (75)	1,988 (82.6)
Sedentary time (min)	384.59 (265.53)	381.02 (269.79)
Metabolic syndrome		
Yes	1,011 (52.3)	755 (29.9)
No	922 (47.7)	1,768 (70.1)
Perceived stress		
Extremely high	70 (3.6)	124 (4.9)
High	339 (17.5)	500 (19.8)
Rather high	1,108 (57.3)	1,383 (54.8)
Almost none	416 (21.5)	516 (20.5)

Values are presented as number (%).

Data processing

Data were analyzed by using IBM SPSS Statistics ver. 22.0 (IBM Co., Armonk, NY, USA). To examine subject general characteristics and frequency analysis and descriptive analysis were computed. To examine the effects of physical activity and sedentary time on the prevalence rate of metabolic syndrome and perceived stress level, logistic regression analysis was applied. Statistical significant level α was set 0.05 for the statistical power, and 95% confidence interval (CI) was used to determine significant critical value about the odds ratio (OR). In the OR, if 95% CI includes 1, it is determined to be insignificantly.

RESULTS

The effects of physical activity and sedentary time on the prevalence rate of metabolic syndrome

To examine the effects of physical activity and sedentary time on the prevalence rate of metabolic syndrome, logistic regression analysis was used. The results are shown in (Table 2). As shown in Table 2, in male, the group with moderate intensity occupational physical activity (OPA) and the group with high intensity LTPA indicated OR higher than 1 the critical reference value (OR, 1.337), compared to the group physical inactivity; therefore, the prevalence rate of metabolic syndrome tended to increase. The group vigorous intensity OPA (OR, 0.847), the group TPA (transport physical activity) (OR, 0.968), and the group moderate intensity LTPA (OR, 0.927) indicated OR lower than 1 the critical reference value, compared to the group physical inactivity, the prevalence rate of metabolic syndrome tends to decrease. In female, the group vigorous intensity OPA indicated OR higher

Table 2. The effects of physical activity and sedentary time on the prevalence rate of metabolic syndrome

Variable	Male		Female	
	OR	95% CI	OR	95% CI
Vigorous intensity occupational physical activity	0.847	0.431–1.665	1.238	0.412–3.724
Moderate intensity occupational physical activity	1.337	0.904–1.976	0.878	0.559–1.379
Transport physical activity	0.968	0.803–1.166	0.875	0.729–1.050
Vigorous intensity leisure time physical activity	1.053	0.776–1.427	0.691	0.408–1.171
Moderate intensity leisure time physical activity	0.927	0.738–1.166	0.479	0.359–0.638
Sedentary time	1.000	1.000–1.000	1.001	1.000–1.001

OR, odds ratio; CI, confidence interval.

Table 3. The effects of physical activity and sedentary time on the perceived stress level

Variable	Male		Female	
	OR	95% CI	OR	95% CI
Vigorous intensity occupational physical activity	1.584	0.584–4.296	0.732	0.157–3.408
Moderate intensity occupational physical activity	1.752	1.004–3.058	2.331	1.257–4.321
Transport physical activity	0.753	0.559–1.015	0.836	0.648–1.078
Vigorous intensity leisure time physical activity	1.316	0.796–2.177	0.990	0.511–1.917
Moderate intensity leisure time physical activity	0.983	0.674–1.433	0.837	0.572–1.225
Sedentary time	1.001	1.001–1.002	1.000	1.000–1.001

OR, odds ratio; CI, confidence interval.

than 1, the critical reference value (OR, 1.238), the prevalence rate of metabolic syndrome tended to increase. The group moderate intensity OPA (OR, 0.878), the group TPA (OR, 0.875), the group vigorous intensity LTPA (OR, 0.691), and the group moderate intensity LTPA (OR, 0.479) indicated OR lower than 1, the critical reference value, compared to the group physical inactivity, the prevalence rate of metabolic syndrome tended to decrease. There was no difference found in vigorous intensity LTPA in the male group and sedentary time in both males and females.

The effects of physical activity and sedentary time on the perceived stress level

To examine the effects of physical activity and sedentary time on perceived stress, logistic regression analysis was used. The results are shown in Table 3. As shown in Table 3, in male, the group vigorous intensity OPA (OR, 1.584), the group moderate intensity OPA (OR, 1.752), and the group vigorous intensity LTPA (OR, 1.316) indicated OR higher than 1, the critical reference value, compared to the group physical inactivity, perceived stress level tended to increase. The group TPA (OR, 0.753) and the group moderate intensity LTPA (OR, 0.983) indicated OR lower than 1, the critical reference value, compared to the group physical inactivity, perceived stress tended to decrease. In female, the group moderate intensity OPA (OR, 2.331) indicated OR higher than 1, the critical reference value, compared to the group physical inactivity, perceived stress level tended to increase. The group vigorous intensity OPA (OR, 0.732), the group TPA (OR, 0.836), the group vigorous intensity LTPA (OR, 0.990), and the group moderate intensity LTPA (OR, 0.837) indicated OR lower than 1, the critical reference value, compared to the group physical inactivity,

perceived stress tended to decrease. There is no difference found in sedentary time in both male and female.

DISCUSSION

Recently, national open resource panel data analysis has been carried out in various academic fields and countries belonging to improve national and international public health promotion. Public health promotion and improvement being spotlighted globally, this research has verified Korea national data survey of the KNHNES (Korea Centers for Disease Control and Prevention, 2018) to extend the necessity and importance of Korean physical activity participation, enhance the awareness of health management, and provide interventions for the prevention and management of metabolic syndrome and mental stress. Data selected and analyzed in this study were extracted from 4,459 adults aged 40 or older adult national health examination and survey by National Health Insurance Service among the results of KNHNES.

According to the results of panel data analysis on the prevalence rate of metabolic syndrome in relation to physical activity, men's prevalence rate of metabolic syndrome decreases when they practice vigorous intensity OPA, transport physical activity, or moderate intensity LTPA, and it increases when they are involved in moderate intensity OPA or vigorous intensity LTPA (Jeon et al., 2007). Women's prevalence rate of metabolic syndrome decreases when they practice moderate intensity OPA, transport physical activity, or vigorous · moderate intensity LTPA, but it increases when they are involved in vigorous intensity OPA. Regarding the changes of prevalence rate in metabolic syndrome according to sex, most of the physical activities reduce the prevalence rate of metabolic syndrome positively.

These results are supported as correspond to the results of Ohkawara et al. (2007) research that physical activity reduces body fat and lowers the risk of metabolic syndrome research of the therapeutic lifestyle modification (2010) targeting obese patients in Taiwan did improve participants' metabolic syndrome (Jou et al., 2010). For health improvement, the WHO (2010) recommends to participate in moderate intensity physical activity 3 times a week for over 150 min. This suggestion, health can be improved as occupational, leisure time, and transport physical activities are changed more actively. However, according to the prevalence rate of metabolic syndrome by sex, it seems to change differently by the intensity. This result presents the necessity of follow-up research on the intensity of physical activities with regard to sex characteristics (Hallal et al., 2012).

Reporting major risk factors for death, the WHO pointed out physical inactivity as the 4th high risk factor of the death (Salonen et al., 2015; WHO, 2010). Sedentary behavior, one of the typical physical inactivity, forms a large part in spending leisure time (Salonen et al., 2015). This study, however, has found no difference in the prevalence rate of metabolic syndrome according to sedentary behavior. It is known that low physical activity hinders metabolism and physical functions and increases the risk of obesity, metabolic syndrome, diabetes, and cardiovascular disease (Pradhan et al., 2002). It is also known that lack of physical activity works as a death risk factor for adult diseases including metabolic syndrome (Normandin, 2017) and reduces life expectancy and increases the risk of cardiovascular disease and metabolic disease (Archer and Blair, 2011; Chomistek et al., 2013; Lee et al., 2012b). These results were not showed expected prediction for the data. This is because considering Korean sedentary time is about 380 min, therefore, sedentary time is not too much long to cause or worsen metabolic syndrome. For the health promotion and improvement, further research with analytic related sedentary time should be studied, and follow-up of the research is needed to lead changing sedentary time deduction with physical activity for health initiatively.

According to the data analysis on mental health in relation to physical activity, men's perceived stress decreases when they practice transport physical activity or moderate intensity LTPA while it increases when they are involved in vigorous · moderate intensity OPA or vigorous intensity LTPA (Sisson et al., 2009).

In a report, Korean has long working time among the OECD nations. OPA or vigorous intensity leisure time activity increases perceived stress because they regard it not as physical activity but as labor. Women's perceived stress decreases when they participate in vigorous intensity OPA, transport physical activity, or vigorous · moderate intensity physical activity (Healy et al., 2008), but it increases when they practice moderate intensity OPA. This implies that when women participate in physical activity as well, their resistance to perceive stress increases and perceived stress is relieved (Schuch et al., 2017). In moderate intensity OPA, the results are showed oppositely. This may be because from Korean life style behavior, vigorous intensity OPA is normally demanded from men. Therefore, if women also are involved in moderate intensity OPA perceived stress gets more highly.

All results of the analysis, as a mental health factors perceived stress appeared no difference with sedentary time. Regarding physical activity and mental health (Sampasa-Kanyinga and Chapat, 2017), it is known depression is influenced by sedentary behavior (Nam et al., 2017) and it is also known that the increase of

sedentary behavior elevates the prevalence rate of mental disease (Hoare et al., 2014). By the report, sedentary behavior is closely associated with mental health and over 2 to 3 hr of physical activity per day improves mental health (Hoare et al., 2014; Koloverou et al., 2018). These findings of advanced research are showed different from the results of this study, and Korean sedentary time is relatively short and there is no negative reinforcement on mental health observed for the reduction of physical activity. Therefore, particular analysis on sedentary life style is required (Guardino et al., 2018) to be spontaneously. However, excessive physical activity and training lead to psychological problems (Paluska and Schwenk, 2000), therefore, further researchers should study to find out effective methods to decrease perceived stress with intensity of physical activity (Awick et al., 2017) and resting leisure time and provide additional suggestions for health promotion.

CONFLICT OF INTEREST

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

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