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# HEALTH MEDICAL EXAMINATION AND THE PREVALENCE OF METABOLIC SYNDROME

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## ABSTRACT

### Background and Objective

Metabolic syndrome (MetS) can be effectively prevented and treated by following healthy lifestyle practices. Healthy lifestyle management not only includes regulation of drinking and smoking, and regular physical activity but also health medical examinations. However, health medical examinations at private medical facilities involve high cost, limiting continuous and regular examination. The aim of this study is to analyze the prevalence of MetS and health management behavior according to the number of health medical examinations conducted in 14 years.

### Material and Methods

According to the number of health medical examinations undertaken each year from 1999 to 2012, in 2012, 21,803 visitors (14,511 men and 7,292 women) from a health medical examination center at a private medical facility were assigned to low- (3–5 health examinations in 14 years), middle- (6–10 health examinations in 14 years), and high-frequency groups (11–14 health examinations for 14 years) and were classified by sex. Namely, they were divided into three groups: those who underwent 3–5 examinations, as low-frequency group, 6–10 examinations, as middle-frequency group, and 11-14 examinations, as high-frequency group. MetS was evaluated according to the criteria of the National Cholesterol Education Program and Adult Treatment Panel III and waist circumference was measured according to the standard for Asians by the World Health Organization. Odds ratio (OR) was calculated by logistic regression analysis.

### Results

Systolic blood pressure tended to decrease to 124.5 versus 123.9 versus 123.5 mmHg in the low-, middle-, and high-frequency groups in men, respectively. In addition, the middle- and high-frequency groups

demonstrated better total cholesterol, high-density lipoprotein, low-density lipoprotein, and systolic blood pressure compared with the low-frequency group. The prevalence of MetS demonstrated no significance before adjusting for variables in men, and high-frequency examinees demonstrated 18% low OR values (0.823, $p < 0.001$) after adjusting for age. OR was 0.868 ($p = 0.015$) when adjusted for age, other socioeconomic factors, and health behavior. In women, the prevalence of MetS demonstrated significantly high OR of 1.205 ($p = 0.007$) and 1.300 ($p = 0.008$) in the middle- and high-frequency groups, respectively, but OR value decreased by 21% (0.791, $p = 0.026$) after adjusting for age. However, OR remained significant when adjusting for socioeconomic variables, physical activity, drinking, and smoking. For income and education, high-frequency examinees belonged to the high socioeconomic status group among men and women, but there were significant differences in walking among men with regard to physical activity ($p < 0.001$). Smoking was well-managed in the high-frequency group among men and women, and drinking showed a significant difference only in women ($p < 0.001$).

**Conclusion**

The high frequency of health medical examinations demonstrated low prevalence of MetS in men and women, and high socioeconomic status was associated with healthy behavior.

Metabolic syndrome (MetS) is a common condition affecting approximately 30% of adults in Korea.[1] Although it cannot be cured, it should be carefully managed since MetS is associated with cardio-cerebrovascular disease, diabetes, and hypertension, as well as high mortality.[2,3] The risk factors of MetS are classified into unmodifiable factors such as age and sex and modifiable factors such as fitness, drinking, smoking, diet, and physical activity that are affected by an individual's interest in maintaining a healthy lifestyle. Among preventive medical management methods, health examination is effective in preventing the progress and incidence of serious diseases by detecting them at an early stage. Many studies on the preventive effects of health examination have yielded positive results.[4]

General health examination is one type of health examination that is conducted by some countries every year for adults >20 years old free of cost. However, general health examinations are expensive and cannot be conducted free of cost in Korea; therefore, specialized services, such as cancer screening (≥40 years old) and health screening for individuals at transition periods in life (40 years old and 66 years old), are conducted in Korea.[5] Similarly, workplace health screening is conducted every year, with costs borne by the company. These health examinations are advantageous, since the individual does not feel the burden of expenses, resulting in regular participation. Many health examinees at private medical facilities willingly participate and have high interest toward health; in addition, a high-income level results in a more expensive examination.[6] Therefore, Korea recognizes the need for public-directed health examinations.

Advanced studies have reported that individuals with a high socioeconomic status show good health behavior with regard to drinking, smoking, and physical activity, indicating lower disease incidence and mortality; such individuals actively participate in health examinations.[7]

This study is based on an advanced study, and we aimed to analyze the health management status and prevalence of MetS by sex according to the frequency of health examinations conducted at private medical facilities that often involve high costs. We also identified the characteristics of low- and high-frequency health examinees.

## METHODS

### *Participants and Procedure*

We enrolled 48,601 individuals who underwent health examinations in Seoul more than 3 times from 1999 to 2012, specifically in 2012. Men and women aged 21–80 years were included. Individuals

who underwent examinations once or twice during this period and did not consent to the use of their examination results were excluded. Finally, 21,803 (14,511 men and 7,292 women) participants who met the research criteria were included in this study. They were classified by sex and divided into three groups: those who underwent 3–5 examinations, as low-frequency group; 6–10 examinations, as middle-frequency group; and 11–14 examinations, as high-frequency group. The participants were asked to fast for more than 8 hours, with the exception of water intake through prior-official documentation, including information and agreement on health screening as well as patient consent. History of disease and drugs, drinking, smoking, and level of physical activity were surveyed using a questionnaire. On the examination day, anthropometry and blood tests were performed while participants wore light gowns and slippers to minimize the interaction effect between tests.

### *Metabolic Syndrome*

The National Cholesterol Education Program, Adult Treatment Panel III of MetS and the Asian criteria for waist circumference by the World Health Organization (WHO) were applied in this study.[8,9] Triglyceride (TG) ≥ 150 mg/dL, male high-density lipoprotein (HDL) < 40 mg/dL, female HDL < 50 mg/dL, blood pressure ≥ 130/85 mmHg, and fasting blood glucose level ≥ 110 mg/dL were the criteria applied to estimate dyslipidemia, and ≥ 90 cm and ≥ 80 cm male and female waist circumference were used to assess abdominal obesity. Presence of more than 3 of the above criteria was diagnosed as MetS. Participants who were taking drugs for dyslipidemia, hypertension, and diabetes at the time of the survey was classified as exposed individuals.

### *Questionnaire: Socioeconomic Status and Health Behavior*

Socioeconomic status was based on monthly household income by husband and wife and education was based on the highest level of education. Household income was divided into 4 groups from 5 million to 10 million won, and education was divided into middle, high school, and university education. Health behavior was restricted to physical activity, drinking, and smoking, and the physical activity questionnaire used the Korean version of the International Physical Activity Questionnaire by WHO.[10] Time, frequency, and intensity were classified into 3 groups of weekly frequency according to intensity. Exercise frequency was analyzed as 0 day, 1–2 days, and 3–7 days by applying the American College of Sports Medicine guidelines. Since non-activity is more frequent than moderate and vigorous intensity but since walking is a common physical activity in daily life, we analyzed physical activity as 0–2 days, low activity; 3–4 days, middle activity; and 5–7 days, high activity.[11] Drinking was analyzed by weekly mean days, and volume of alcohol consumed, and smoking was analyzed using history, current smoking status, and smoking volume. In this study, physical activity was analyzed only by frequency according to intensity; drinking was analyzed by number of days on which alcohol was consumed in a month (days/month); and smoking was analyzed by current smoking status, smoking cessation, and no-smoking based on when the study was conducted.

## STATISTICAL ANALYSIS

SPSS 21.0 (IBM SPSS Institute, USA) was used for data analysis. Continuous variables such as risk factors of MetS, blood samples, and anthropometry were expressed as mean and standard deviation, and categorical variables, including socioeconomic status and health behavior by questionnaires, were expressed as percentages. All data was analyzed by classification into male and female groups to examine the difference in sexes. One-way ANOVA was conducted to examine the difference in continuous variables among the groups, and a chi-square test was used for categorical variables. To determine the prevalence of MetS, odds ratio (OR) and 95% confidence interval (CI) was calculated using logistic regression analysis. Model 1 did not include adjustment of variables; model 2 adjusted for age; and model 3 adjusted for age, health behavior, and socioeconomic status. Statistical significance was set at $p < 0.05$.

## RESULTS

General characteristics are presented in Tables 1 and 2. An increasing trend in age was noted as the frequency of health examinations increased in both men and women. In men, the average blood pressure

for low-, middle-, high-frequency groups was 124.5, 123.9, and 123.5 mmHg, respectively, showing a decreasing trend. The middle- and high-frequency groups demonstrated better values for total cholesterol, HDL, low-density lipoprotein (LDL), and systolic blood pressure (SBP) than the low-frequency group ($p < 0.002$); women did not present a clear difference between the groups except for fasting blood glucose levels. Men demonstrated a decreasing trend in the prevalence of MetS with 30.1%, 30.3%, and 28.5% in the low-, middle-, and high-frequency groups, respectively, while women demonstrated an increasing trend with 12.0%, 14.1%, and 15.1% in the low-, middle-, and high-frequency groups, respectively. However, these values were obtained before adjusting for age, which is an important variable.

**TABLE 1** Characteristics of Men

| | **Low (n = 6,759)** | **Middle (n = 5,429)** | **High (n = 2,323)** | **p** |
|---|---|---|---|---|
| Age, years | 51.2 ± 8.6 | 54.2 ± 7.9[a] | 57.3 ± 7.4[bc] | <0.001*** |
| Height, cm | 171.1 ± 6.1 | 170.7 ± 5.6 [a] | 170.3 ± 5.5 [bc] | <0.001*** |
| Weight, kg | 71.9 ± 9.4 | 71.5 ± 8.9 [a] | 70.4 ± 8.9 [bc] | <0.001*** |
| BMI, kg/cm$^2$ | 24.5 ± 2.7 | 24.5 ± 2.6 | 24.2 ± 2.6 [bc] | <0.001*** |
| SBP, mmHg | 124.5 ± 12.7 | 123.9 ± 12.6 [a] | 123.5 ± 12.6 [b] | 0.002** |
| DBP, mmHg | 80.2 ± 10.0 | 79.7 ± 9.9 [a] | 79.5 ± 9.7[b] | 0.241 |
| Waist Cir, cm | 87.0 ± 7.4 | 87.1 ± 7.1 | 86.8 ± 7.1 | <0.001*** |
| TC, mg/dl | 191.8 ± 34.4 | 189.1 ± 33.8 [a] | 186.5 ± 33.3 [bc] | <0.001*** |
| HDL, mg/dl | 51.8 ± 12.5 | 52.4 ± 12.5 [a] | 53.7 ± 12.7 [bc] | <0.001*** |
| LDL, mg/dl | 119.6 ± 30.2 | 117.1 ± 29.9 [a] | 114.3 ± 29.1 [bc] | <0.001*** |
| TG, mg/dl | 136.1 ± 84.0 | 131.8 ± 79.1 [a] | 121.5 ± 67.6 [bc] | 0.464 |
| Glucose, mg/dl | 100.2 ± 20.9 | 100.3 ± 19.5 | 99.7 ± 18.0 | 0.053 |
| HbA1c, mg/dl | 5.68 ± 0.72 | 5.71 ± 0.69 | 5.70 ± 0.62 | <0.001*** |
| MetS, % | 30.1 | 30.3 | 28.5 | 0.278 |

***p < 0.01, ***p < 0.001; tested by one-way analysis of variance*
*Low = 3–5 health examinations in 14 years; middle = 6–10 health examinations in 14 years; high = 11–14 health examinations during 14 years; a, low vs. middle; b, low vs. high; c, middle vs. high; BMI = body mass index; SBP, = systolic blood pressure; DBP = diastolic blood pressure; Waist Cir = waist circumference; TC = total cholesterol; HDL = high density lipoprotein; LDL = low density lipoprotein; TG = triglyceride; HbA1c = hemoglobin A1c; MetS = metabolic syndrome.*

**TABLE 2.** Characteristics of Women

| | Low (n = 4,123) | Middle (n = 2,344) | High (n = 825) | p |
|---|---|---|---|---|
| Age, years | 50.5 ± 8.7 | 53.5 ± 7.7 a | 56.2 ± 8.2 bc | <0.001*** |
| Height, cm | 159.1 ± 5.2 | 158.7 ± 5.0 a | 158.4 ± 4.6 bc | <0.001*** |
| Weight, kg | 56.4 ± 7.5 | 56.2 ± 7.2 | 56.1 ± 7.1 | 0.213 |
| BMI, kg/cm2 | 22.3 ± 2.8 | 22.3 ± 2.8 | 22.4 ± 2.7 | 0.823 |
| SBP, mmHg | 114.8 ± 13.4 | 115.4 ± 13.3 | 115.1 ± 13.4 | 0.167 |
| DBP, mmHg | 71.6 ± 10.1 | 71.9 ± 9.8 | 71.0 ± 9.4c | 0.030* |
| Waist Cir, cm | 77.2 ± 7.9 | 77.5 ± 8.0 | 77.8 ± 7.7 | 0.048* |
| TC, mg/dl | 195.3 ± 34.1 | 197.2 ± 34.0 | 196.1 ± 33.2 | 0.065 |
| HDL-C, mg/dl | 62.5 ± 14.4 | 63.0 ± 14.7 | 63.2 ± 14.7 | 0.198 |
| LDL-C, mg/dl | 117.7 ± 30.0 | 119.1 ± 29.6 | 118.1 ± 28.9 | 0.130 |
| TG, mg/dl | 96.9 ± 54.7 | 97.6 ± 49.7 | 96.2 ± 47.8 | 0.750 |
| Glucose, mg/dl | 92.3 ± 15.4 | 92.9 ± 15.5 | 91.5 ± 13.0 c | 0.036* |
| HbA1c, mg/dl | 5.53 ± 0.56 | 5.60 ± 0.60 a | 5.61 ± 0.51 b | <0.001*** |
| MetS, % | 12.0 | 14.1 | 15.1 | 0.004** |

**p < 0.05, **p < 0.01, ***p < 0.001; tested by one-way analysis of variance.*
*Low = 3–5 health examinations in 14 years; middle = 6–10 health examinations in 14 years; high = 11–14 health examinations during 14 years; a, low vs. middle; b, low vs. high; c, middle vs. high; BMI = body mass index; SBP = systolic blood pressure; DBP = diastolic blood pressure; Waist Cir = waist circumference; TC = total cholesterol; HDL = high density lipoprotein; LDL = low density lipoprotein; TG = triglyceride; HbA1c = hemoglobin A1c; MetS = Metabolic syndrome.*

The prevalence of MetS was not significantly different among groups before adjusting for variables in men. The high-frequency group showed an OR value of ≤ 18% (0.823, p < 0.001) with respect to the low-frequency group when adjusting for age. A similar OR value (0.868, p = 0.015) was obtained when adjusting for age and other socioeconomic statuses as well as health behavior. In women, as mentioned earlier, middle- (OR = 1.205) and high-frequency (OR = 1.300) groups demonstrated significantly high MetS prevalence before adjusting for age, but OR decreased by approximately 21% (0.791, p = 0.026) when adjusting for age (Table 5). However, OR was not significant when adjusting for socioeconomic variables and physical activity, drinking, and smoking (Table 3).

**TABLE 3** Socioeconomic Status and Health or Men

| | **Low (n = 6,759)** | **Middle (n = 5,429)** | **High (n = 2,323)** | **p** |
|---|---|---|---|---|
| Monthly family income | | | | |
| < 5,000 dollar | 17.6% | 13.4% | 12.1% | <0.001*** |
| < 7,000 dollar | 20.4% | 18.9% | 17.2% | |
| < 10,000 dollar | 23.9% | 22.3% | 22.7% | |
| ≥ 10,000 dollar | 38.2% | 45.3% | 48.1% | |
| Education | | | | |
| To middle school | 23.6% | 19.7% | 14.2% | <0.001*** |
| To high school | 53.4% | 54.0% | 53.2% | |
| Above College | 22.9% | 26.3% | 32.6% | |
| Vigorous activity, week | | | | |
| 0 day | 67.5% | 66.9% | 68.2% | 0.295 |
| 1-2 day | 21.0% | 21.1% | 19.9% | |
| 3-7 days | 11.6% | 12.0% | 11.9% | |
| Moderate activity, week | | | | |
| 0 day | 48.9% | 48.2% | 44.9% | 0.064 |
| 1-2 day | 32.2% | 31.7% | 33.0% | |
| 3-7 day | 18.9% | 20.1% | 22.1% | |
| Walking, week | | | | |
| 0-2 day | 55.8% | 53.8% | 51.7% | <0.001*** |
| 3-4 day | 23.1% | 24.0% | 26.2% | |
| 5-7 day | 21.2% | 22.3% | 22.1% | |
| Smoking | | | | |
| Never | 20.6% | 22.2% | 22.7% | <0.001*** |
| Quit | 45.8% | 51.0% | 56.2% | |
| Present | 33.6% | 26.8% | 21.1% | |
| Alcohol | | | | |
| No | 9.1% | 9.4% | 9.4% | 0.966 |
| ≤ 1 time / month | 10.5% | 10.9% | 9.9% | |

*Continued*

| | Low (n = 6,759) | Middle (n = 5,429) | High (n = 2,323) | p |
|---|---|---|---|---|
| 2-4 times / month | 35.4% | 35.3% | 35.8% | |
| 2-3 times / week | 33.3% | 33.3% | 33.5% | |
| ≥ 4 times / week | 11.6% | 11.2% | 11.3% | |

****p < 0.001; tested by chi-square test*
*Exchange rate 1 dollar = estimated 1,000 won; low = 3–5 health examinations in 14 years; middle = 6–10 health examinations in 14 years; high = 11–14 health examinations during 14 years.*

**TABLE 4** Socioeconomic Status and Health of Women

| | Low (n = 4,123) | Middle (n = 2,344) | High (n = 825) | p |
|---|---|---|---|---|
| Monthly family income | | | | |
| < 5,000 dollar | 21.5% | 19.3% | 16.2% | <0.001*** |
| < 7,000 dollar | 19.2% | 16.0% | 19.4% | |
| < 10,000 dollar | 21.3% | 21.2% | 22.9% | |
| ≥ 10,000 dollar | 37.9% | 43.4% | 41.5% | |
| Education | | | | |
| To middle school | 36.7% | 34.5% | 28.2% | <0.001*** |
| To high school | 51.8% | 51.6% | 48.6% | |
| Above College | 11.5% | 13.9% | 23.2% | |
| Vigorous activity, week | | | | |
| 0 day | 74.8% | 76.4% | 77.6% | 0.234 |
| 1-2 day | 13.7% | 11.4% | 11.3% | |
| 3-7 days | 11.4% | 12.2% | 11.2% | |
| Moderate activity, week | | | | |
| 0 day | 53.7% | 53.5% | 56.5% | 0.679 |
| 1-2 day | 25.4% | 25.4% | 23.0% | |
| 3-7 day | 20.9% | 21.0% | 20.5% | |
| Walking, week | | | | |
| 0-2 day | 45.9% | 46.4% | 47.0% | 0.888 |
| 3-4 day | 30.0% | 30.9% | 30.1% | |

*Continued*

| | Low (n = 4,123) | Middle (n = 2,344) | High (n = 825) | p |
|---|---|---|---|---|
| 5-7 day | 24.1% | 22.7% | 22.9% | |
| Smoking | | | | |
| Never | 94.5% | 96.3% | 98.1% | <0.001*** |
| Quit | 2.8% | 2.3% | 1.2% | |
| Present | 2.6% | 1.4% | 0.7% | |
| Alcohol | | | | |
| No | 42.1% | 45.8% | 45.5% | <0.001*** |
| ≤ 1 time / month | 29.3% | 28.8% | 31.4% | |
| 2-4 times / month | 22.0% | 18.2% | 20.7% | |
| 2-3 times / week | 5.6% | 5.9% | 2.1% | |
| ≥ 4 times / week | 1.1% | 1.2% | 0.4% | |

****p < 0.001; tested by chi-square test*
*Exchange rate 1 dollar = estimated 1,000 won; low = 3–5 health examinations in 14 years; middle = 6–10 health examinations in 14 years; high = 11–14 health examinations during 14 years.*

**TABLE 5** MetS Odds Ratio According to Repetition of Health Screening

| | Model 1 | | Model 2 | | Model 3 | |
|---|---|---|---|---|---|---|
| | OR (95% CI) | p | OR (95% CI) | p | OR (95% CI) | p |
| Men | | | | | | |
| Low | 1.000 | | 1.000 | | 1.000 | |
| Middle | 1.008(0.933-1.090) | 0.835 | 0.951(0.879-1.030) | 0.217 | 0.974(0.896-1.059) | 0.535 |
| High | 0.927(0.836-1.029) | 0.927 | 0.823(0.740-0.917) | <0.001*** | 0.868(0.775-0.973) | 0.015* |
| Women | | | | | | |
| Low | 1.000 | | 1.000 | | 1.000 | |
| Middle | 1.205(1.052-1.380) | 0.007** | 0.961(0.834-1.106) | 0.577 | 1.063(0.903-1.251) | 0.464 |
| High | 1.300(1.071-1.578) | 0.008** | 0.791(0.643-0.972) | 0.026* | 0.960(0.758-1.216) | 0.734 |

**p < 0.05, **p < 0.01, ***p < 0.001; tested by logistic regression analysis*
*OR = odds ratio; CI = confidence interval; Model 1 = Crude; Model 2 = Adjusted age; Model 3 = Adjusted age, education, income, alcohol, smoking, physical activity; low = 3–5 health examinations in 14 years; middle = 6–10 health examinations in 14 years; high = 11–14 health examinations during 14 years.*

On evaluating the differences in socioeconomic status and health behavior according to group, men demonstrated significant differences in income, education, walking, and smoking, and women demonstrated significant differences in income, education, smoking. The differences in physical activity among groups were not significant for women but were significant for men (Tables 3 and 4). Among men, the proportion of examinees with high income of > 10 million won per month (low-frequency group 38.2%, middle-frequency group 45.3%, high-frequency group 48.1%), education above university level (low-frequency group 22.9%, middle-frequency group 26.3%, high-frequency group 32.6%), and low smoking status (low-frequency group 33.6%, middle-frequency group 26.8%, high-frequency group 21.1%) increased with increase in examination frequency.

Among women, the middle- and high-frequency groups tended to have monthly salaries of > 10 million won 37.9% vs. 43.4%, 41.5% ($p < 0.001$), as well as significantly high education above university level 11.5% vs. 13.9%, 23.2% ($p < 0.001$). However, no significant differences were observed among groups in vigorous physical activity ($p = 0.234$), moderate physical activity ($p = 0.679$), and walking ($p = 0.888$). The proportion of examinees with current smoking status was low in the middle- and high-frequency groups (low-frequency group 2.6%, middle-frequency group 1.4%, high-frequency group 0.7%) ($p < 0.001$). Although there were no significant differences with regard to drinking in men, there were significant differences in women. The frequency of no drinking was low in the high-frequency group and that of drinking more than 4 times a week was 1.1% in the low-frequency group and 0.4% in the high-frequency group ($p < 0.001$).

## DISCUSSION

The proportion of obese and elderly population has rapidly increased along with economic development in Korea.[12,13] This study investigated the number of health examinations and prevalence of MetS, to identify the disease prevention benefits and cost-effectiveness of health examinations.

Advanced studies have reported that health status was affected by several variables such as socioeconomic status and the possibility of developing disease, mortality, accessibility to medical services, and health management behavior.[14] A disadvantage of economic development is that development of a country and economy leads to neglect of small income earners, a situation that is also observed in Korea.[15] Some studies reported that high prevalence of obesity with the risk of cardiocerebral vascular disease, is closely related to low socioeconomic status.[16]

Hospitals are not only places to visit during an illness, but they can also be visited in order to prevent diseases; health examinations in Korea and several countries have shown positive results. The national health examination is conducted every 2 years for free, since the country recognizes the importance of regular medical examinations for the general well-being of the people. National health examinations have been shown to help in reducing the prevalence of the most common causes of death, and thereby, influencing the common causes of death in a country.[17] The major cause of mortality in advanced countries is cardiovascular disease, but it is cancer in Korea.[18,19] Cardiovascular disease has specific risk factors such as dyslipidemia, blood pressure, and diabetes but cancer does not have specific risk factors. Thus, in Korea with high mortality due to cancer, preventive health examination by prompt and early radiographic and endoscopic tests is the only way to increase the rate of detection and cure, since detection in many cases is usually after the symptoms appear.[5]

Although health examinations by public organizations are free, access to computed tomography scanning and magnetic resonance imaging at public venues is limited. On the other hand, health examination services by private medical facilities are dependent on the cost; therefore, people visit private medical facilities for the best services, despite the high cost. Those who regularly visit expensive private medical facilities are considered to have high economic capacity as well as high interest toward health. A survey conducted revealed that people undergoing health examinations at private medical facilities have high socioeconomic statuses[6]; the results of this survey aided in the design of our study.

We observed that the number of health examinations, increased with age, with the youngest belonging

to the low-frequency group and the oldest (elderly) belonging to the high-frequency group. Although high health examination numbers involved high age, SBP, diastolic blood pressure, total cholesterol, LDL, TG, and glucose, which are risk factors for cardiovascular disease and MetS, remarkably decreased in men. This result may be influenced by drug use, although this was not analyzed in our study. Furthermore, weight, body mass index, and waist circumference that are not related to drug use, but socioeconomic status also demonstrated remarkably low values. However, in women, there was almost no change with age with few significant values. These results indicate that individuals who regularly undergo health examinations have high levels of health management, which is consistent with other studies on cardiovascular risk factors and socioeconomic status.[20] The prevalence of MetS by aging should instead be increased; however, no such phenomenon was observed in men, and there was significant difference in women: 12.0%, 14.1%, and 15.1% ($p = 0.004$).

From the analysis of socioeconomic status in men, 32.6% and 22.9% of the high- and low-frequency groups had education higher than university level, respectively, and the tendency of earning an income of > 10 000 dollars per month was 48.1% and 38.2% in the high- and low-frequency groups, respectively. In addition, women demonstrated significant differences in socioeconomic status with 11.5% versus 23.2% and 37.9% versus 41.5% having education higher than university level and income of > 10 000 dollars per month. The reason for the lower proportion of women receiving education than men is a result of the social environment at that time; this has been also noted in other studies in Korea.[21] Household income was based on the total income of a family; therefore, there was no difference between men and women.

This study only analyzed health behavior based on the frequency of physical activity. Men demonstrated significant differences for walking, but women showed no difference. Moderate and vigorous activity were considered to decrease with age, and the reason for this discrepancy among men and women is because our study considered only middle-aged to elderly individuals. We observed that > 50% women walked more than 3 times a week, resulting in no significance among the three groups. These results were different to the advanced studies that reported that high socioeconomic status is proportional to participation of physical activity.[22] One of the reasons for this difference is that our study did not analyze the entire data of the country but only visitors at an organization. More than 50% of the participants had monthly income of more than 10,000 dollars, although they belonged to the low-frequency group, and overall exercise participation rate was high, resulting in a small difference.

There was a clear difference between groups with regard to smoking. High-frequency examinees showed 21.1% rate of smoking, but low-frequency examinees demonstrated a rate of 33.6%; women showed smoking rates of 2.6% and 0.7% in low- and high-frequency groups, respectively. No smoking and non-smoker rates in men were high ($p < 0.001$). The drinking rate in Korean men was high but not significant between groups, as it demonstrates strong correlation between socializing and business. In women, more number of examinations revealed lower drinking rates ($p < 0.001$). Advanced studies reported that health behaviors, such as smoking and drinking, were inversely related to socioeconomic status, and our study showed similar results.[23]

In men, the prevalence of MetS in the high-frequency group decreased by 0.823 and 0.868 when adjusting for age as well as health behavior and socioeconomic status, respectively. In women, each age-adjusted OR was 0.791 (95% CI 0.643–0.972), and there were no significant results in model 3. Socioeconomic status showed a significant result; however, this is considered to result from physical activity, indicating that prevalence of MetS is more affected by physical activity than socioeconomic status.

Many domestic and foreign studies have evaluated the relationship between socioeconomic status and MetS.[24,25] The reason why socioeconomic status is important in healthcare is that it could be passed down to the next generations, and inducing rapid change is difficult. The term, "status syndrome," which means that the health of the people is not affected by famine, hygiene problems, and poverty but by the household income gap, is well established.[26] It is not only difficult to induce change in the outlook of people from the lower income group toward health, but it is also challenging to improve their economic status rapidly,

since socioeconomic differences increase the economic and social burden of the nation. Considering these factors, countries should prepare policies that focus on the development of vulnerable social groups than entrusting complete control of preventive health care to the individual.

The limitation of this study is that other health examination records included public organization-directed health examination results from every 2 years. Socioeconomic status involves income, education, occupation, and race, but our study interpreted it based on education and economic status. Although there are people with high income and high education in the low- and middle-frequency groups, health concerns lead to undergoing health examinations; however, we did not conduct a survey on this aspect.

## CONCLUSION

This study evaluated the prevalence of MetS according to number of health examinations conducted over 14 years. Men and women with high frequency of health examinations demonstrated approximately 18% and 21% low prevalence of MetS, respectively. For health behavior, men and women in the high-frequency group demonstrated low current smoking rate. Furthermore, men and women in the high-frequency group demonstrated high education and household income level. Thus, we observed that high education and income were related to high frequency of health examinations as well as good health management behavior, resulting in remarkably low prevalence of MetS.

## CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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