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Original Article

Lifestyle-related factors and their association with metabolic syndrome in Korean adults: a population-based study

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Abstract. [Purpose] The aim of this study was to investigate whether lifestyle-related factors are associated with metabolic syndrome (MetS) in community-dwelling Korean adults. [Subjects and Methods] The subjects comprised 590 men and 1,138 women aged 20 years and above. The subjects visited a public health promotion center in Seoul, Republic of Korea to participate in a survey regarding sleep duration, mental stress, educational level, economic status, and frequency of alcohol consumption and smoking. MetS was defined according to the standard definition of the National Cholesterol Education Program's Adult Treatment Panel III report. The relationship between lifestyle-related factors and MetS was assessed using multivariate logistic regression analysis after adjustments for age and sex. [Results] Sleep duration, educational level, economic status, and frequency of alcohol consumption and smoking were not associated with MetS. Mental stress was the only lifestyle-related factor associated with MetS. [Conclusion] Well-designed studies will be necessary in order to establish the lifestyle-related factors of MetS.
Key words: Korean, Lifestyle-related factors, Metabolic syndrome

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INTRODUCTION

In 2009, the United States (US) Department of Health and Human Services estimated the prevalence of metabolic syndrome (MetS) to be 35.1% for men and 32.6% for women aged 20 years or older[1]. Likewise, in 2012, the Korea National Health Insurance Corporation reported that the prevalence of MetS in Korean adults aged over 30 years was 31.4% and 18.4% for men and women, respectively, and it continues to increase each year[2]. These numbers indicate that MetS is becoming a serious public health issue in both the US and Korea.

MetS is strongly associated with unhealthy lifestyle patterns[3, 4]. Furthermore, MetS is associated with an increased risk of cardiovascular disease and type 2 diabetes owing to the clustering of metabolic risk factors, including abdominal obesity, hypertension, hyperglycemia, and dyslipidemia[5, 6].

The prevention and management of MetS is centered on weight reduction via lifestyle changes such as diet modification and increasing levels of physical activity[7–9]. Moreover, most previous studies have reported that weight reduction affects all the individual components of MetS[10, 11]. For example, Muzio et al. (2005) showed that subjects who lost >10% of their initial body weight showed greater reductions in MetS components than subjects who lost <10% of their initial body weight[12].

However, although weight reduction via lifestyle modifications is important for the prevention and management of MetS, little evidence has been accumulated regarding other lifestyle-related factors such as sleep duration, mental stress, educational level, economic status, and frequency of alcohol consumption and smoking, or their effectiveness in preventing or managing MetS in Koreans. Therefore, the purpose of this study was to examine whether lifestyle-related factors are related to MetS in community-dwelling Korean adults.

SUBJECTS AND METHODS

Participants: The subjects include 590 men and 1,138 women aged over 20 years who visited a health center in Seoul, Republic of Korea to participate in a survey regarding sleep duration, mental stress, educational level, economic status, and frequency of alcohol consumption and smoking.

Each subject was assessed using the following MetS components: waist circumference (WC), high-density lipoprotein cholesterol (HDL-C) level, blood pressure, triglyceride (TG) level, and fasting blood glucose level. All the subjects provided their written consent before participating in this study. The characteristics of the subjects are shown in Table 1.

Covariate variables: Age (the self-reported ages of the participants were used without any modifications). Sex (the

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Table 1. The characteristics of the subjects

Variable		Men (n = 590)	Women (n = 1,138)	Total (n = 1,728)
Age (years)		51.0 ± 11.9	51.3 ± 10.6	51.2 ± 11.1
Height (cm)		170.0 ± 5.7	157.5 ± 5.3	161.5 ± 8.0
Weight (kg)		71.4 ± 9.3	57.2 ± 7.6	61.8 ± 10.5
Body mass index (kg/m^2)		24.7 ± 2.8	23.1 ± 3.0	23.6 ± 3.0
Metabolic syndrome components	Waist circumference (cm)	84.9 ± 7.3	76.9 ± 8.0	79.6 ± 8.6
	HDL-C (mg/dl)	42.8 ± 13.0	49.5 ± 14.9	47.2 ± 14.6
	SBP (mmHg)	136.3 ± 17.4	126.2 ± 18.1	129.7 ± 18.5
	DBP (mmHg)	84.8 ± 12.6	81.1 ± 12.8	82.4 ± 12.8
	Triglyceride (mg/dl)	188.2 ± 128.1	152.6 ± 93.6	164.6 ± 107.8
	Fasting blood glucose (mg/dl)	111.7 ± 38.0	110.3 ± 34.6	110.8 ± 35.8

Data are presented as mean ± SD.
HDL-C: high density lipoprotein cholesterol, SBP: systolic blood pressure, DBP: diastolic blood pressure

2 responses respondents answered man, or woman).

Independent variables: The participants were evaluated on the basis of their responses to 6 questions regarding lifestyle-related factors. The lifestyle-related factors and possible responses were as follows. Sleep duration: <5 hours, 6 hours, 7 hours, and >8 hours; mental stress: very low mental stress, low mental stress, high mental stress, and very high mental stress; Educational level: elementary school or lower, middle school, high school, and college or higher; economic status: very poor, poor, rich, and very rich; frequency of alcohol consumption: teetotaller, once a month, 2 or 3 times a month, and >4 times a month; frequency of smoking: non-smoker, ex-smoker, and current smoker.

Dependent variables: According to the National Cholesterol Education Program's Adult Treatment Panel III, the risk factors for MetS are high WC (≥88 cm for women and ≥102 cm for men), low HDL-C levels (<50 mg/dl for women and <40 mg/dl for men), high blood pressure (≥130/80 mm Hg), high TG levels (≥150 mg/dl), and high fasting blood glucose levels (≥100 mg/dl). According to these criteria, subjects with <2 of these MetS risk factors are defined as not having MetS and those with ≥3 of these MetS risk factors are defined as having MetS[13].

Blood was collected from each patient and analyzed for TG, HDL-C, and glucose concentrations using an ADVIA 1650 automated analyzer (Bayer HealthCare Ltd. Tarrytown, NY, USA) with the Pureauto S TG-N, Cholestest N-HDL, and Hexokinase kits (Daiichi, Japan), respectively.

WC measurements were taken at the patients' midriff, midway between the lower costal margin (below the lower rib) and the iliac crest (above the pelvic bone), during which the subjects stood with their feet approximately 25–30 cm apart. The measurer fitted the tape around the subject's midriff, while exercising caution so as to not compress the underlying soft tissues. Measurements were taken to the nearest 0.5 cm at the end of normal expiration.

After the participants had rested in a sitting position for >10 minutes, systolic and diastolic blood pressure at the right brachial artery was measured using a mercury sphygmomanometer by a specialist nurse. Two separate blood pressure measurements were taken at 2-min intervals and the mean value was determined.

Statistical analysis: All the results are presented as mean ± standard deviation. Multivariate logistic regression analyses were conducted to determine whether lifestyle-related factors were related to MetS after adjustments for age and sex. Statistical significance was accepted for values of $p < 0.05$. All the analyses were performed using SPSS ver. 18.0 (Chicago, IL, USA).

RESULTS

The results of the multivariate logistic regression analyses of the lifestyle-related factors of the healthy and MetS groups are shown in Table 2.

The odds ratios (ORs) (95% confidence intervals [CIs]) for the association between MetS and sleep duration (compared with <5 hours' sleep) were 1.756 (0.537–5.742, p=0.352) for 6 hours, 1.590 (0.461–5.483, p=0.463) for 7 hours, and 2.523 (0.828–7.693, p=0.104) for >8 hours. The ORs (95% CIs) for the association between MetS and mental stress (compared with very low mental stress) were 0.952 (0.406–2.236, p=0.911) for low mental stress, 1.300 (0.319–5.294, p=0.714) for high mental stress, and 2.394 (1.021–5.614, p=0.045) for very high mental stress. The ORs (95% CI) for the association between MetS and educational level (compared with elementary school or lower) were 0.810 (0.447–1.467, p=0.487) for middle school, 0.963 (0.586–1.581, p = 0.880) for high school, and 1.030 (0.588–1.803, p=0.918) for college or higher. The ORs (95% CIs) for the association between MetS and economic status (compared with very poor status) were 0.872 (0.552–1.377, p=0.557) for poor, 1.100 (0.737–1.640, p=0.641) for rich, and 2.099 (0.945–4.661, p=0.069) for very rich. The ORs (95% CIs) for the association between MetS and frequency of alcohol consumption (compared to teetotaller) were 0.662 (0.319–1.373, p=0.268) for once a month, 0.860 (0.365–2.027, p=0.731) for 2 or 3 times a month, and 1.275 (0.440–3.696, p=0.654) for >4 times a month. The ORs (95% CIs) for the association between MetS and frequency of smoking (compared with non-smokers) were 0.394 (0.136–1.142, p=0.086) for ex-smokers and 0.636 (0.215–1.885, p=0.415)

Table 2. The results of the multivariate logistic regression analyses of the lifestyle-related factors of the healthy and metabolic syndrome groups of Korean adults

Prevalence of metabolic syndrome as compared to healthy-individual		Odds ratio	95% CI
Sleep duration	<5 hours' sleep	1.000	
	6 hours	1.756	0.537–5.742
	7 hours	1.590	0.461–5.483
	>8 hours	2.523	0.828–7.693
Mental stress	Very low	1.000	
	Low	0.952	0.406–2.236
	High	1.300	0.319–5.294
	Very high	2.394*	1.021–5.614
Educational level	Elementary school or lower	1.000	
	Middle school	0.810	0.447–1.467
	High school	0.963	0.586–1.581
	College or higher	1.030	0.588–1.803
Economic status	Very poor	1.000	
	Poor	0.872	0.552–1.377
	Rich	1.100	0.737–1.640
	Very rich	2.099	0.945–4.661
Frequency of alcohol consumption	Teetotaller	1.000	
	Once a month	0.662	0.319–1.373
	2 or 3 times a month	0.860	0.365–2.027
	>4 times a month	1.275	0.440–3.696
Frequency of smoking	Non-smoker	1.000	
	Ex-smokers	0.394	0.136–1.142
	Current smokers	0.636	0.215–1.885

*$p<0.05$, tested by multivariate logistic regression analysis after adjustment for age and sex

for current smokers.

DISCUSSION

The purpose of present study was to examine the relationship between lifestyle-related factors and MetS in community-dwelling Korean adults. The results of this study show that MetS was associated only with mental stress.

Although many previous studies have demonstrated that sleep duration is associated with MetS[14], the present study did not demonstrate this trend in Korean adults. This finding could be related to the fact that this study did not investigate sleep quality parameters such as the sleep-wake cycle or the influence of disorders such as sleep apnea. Therefore, further well-designed studies should be performed to determine the effects of sleep quality on MetS.

Sygnowska et al. reported that although higher educational level was associated with MetS, economic status did not affect the severity of MetS. In the case of Korean adults in this study, there was no association between socioeconomic status and MetS[15]. Moreover, unlike several other studies[16, 17], our results show that alcohol consumption and smoking are not associated with MetS in Korean adults. This finding might be attributable to the fact that this study did not delineate the duration, amount, type, or form of alcohol consumption or smoking. Therefore, further well-designed studies will be necessary.

Notably, the OR for the association between MetS and very high mental stress (compared with very low mental stress) was 2.394, indicating that mental stress levels are associated with MetS. Pervanidou and Chrousos reported that some psychological and physical diseases, such as obesity, depression, anxiety disorder, and MetS, may be caused or exacerbated by physical or emotional stress, regardless of whether they had acute or chronic origins[18]. Furthermore, occupational mental stress also affects MetS[19]. The results of our study are in agreement with those of other studies in showing that individuals with MetS had higher mental stress levels than healthy individuals.

In summary, sleep duration, educational level, economic status, and frequency of alcohol consumption and smoking were found not to be associated with MetS. Mental stress was the only lifestyle-related factor found to be associated with MetS regardless of age or sex in Korean adults.

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