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Clustering Patterns and Correlates of Multiple Health Behaviors in Middle-aged Koreans with Metabolic Syndrome

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<Abstract>

Objectives: The objective of the study was to examine the clustering patterns and correlates of multiple health behaviors (MHBs) in middle-aged Koreans with metabolic syndrome (MetS). **Methods**: Data on sociodemographics, clinical characteristics, health behaviors (vegetable intake, physical activity, cigarette smoking, and alcohol consumption), and psychological characteristics were collected by a self-reported survey and medical examination from 331 individuals with MetS. Clustering of MHBs was examined by measuring 1) the ratios of observed and expected prevalence of MHBs, and 2) the prevalence odds ratios. A binomial logistic regression were conducted. **Results**: Men were more likely than women to engage in multiple unhealthy behaviors. Clustering of smoking and heavy drinking was exhibited in the participants. Women with high vegetable intake were more likely to be physically inactive, and those with inadequate vegetable intake were more likely to be physically active. Those with lower self-regulation were more likely to engage in unhealthy behaviors. **Conclusions**: The findings support the multiple health behavior approach as opposed to the individual health behavior approach. Emphasis of self-regulation is necessary in developing multiple behavior intervention for individuals with MetS.

Key words: Metabolic syndrome, Multiple health behaviors, Clustering, Self-regulation

Ⅰ. Introduction

Adverse levels of abdominal obesity, fasting blood glucose (FBG), blood pressure (BP), high-density lipoprotein cholesterol (HDLC), and triglyceride (TG) co-occur as part of the metabolic syndrome (MetS) (Johnson & Weinstock, 2006). Existing literature shows that MetS increases the risk of cardiovascular disease, type 2 diabetes mellitus (Wilson, D'Agostino, Parise, Sullivan, & Meigs, 2005), and cerebrovascular diseases (Kim, 2005). As obesity became pandemic in the world, prevalence of MetS has been increasing in South Korea (Korea hereafter) as well (Lim et al., 2005). According to the 2005 Korean National Health and Nutrition Examination Surveys (KNHANES), 32.6% of Koreans aged ≥ 30 years had MetS, showing strikingly higher rates than the rest of Asia (Korean Ministry of Health and Welfare, 2006). Accordingly, public health approach calls for lifestyle changes, including healthy diet, regular physical activity (PA), smoking cessation, and moderate alcohol consumption (AC). It has been well documented that these 'big four' health behaviors are associated with chronic diseases (World Health Organization, 2002). Desirable dietary habit score was inversely associated with risk of MetS (Yoo, Jeong, Park, Kang, & Ahn, 2009). Strong evidence of an inverse relationship between PA and risk of MetS was reported (Physical Activity Guidelines Advisory Committee, 2008). Cigarette smoking decreased HDLC and increased TG, thereby increasing risk of cardiovascular disease among Korean men (Lee, Park, & Meng, 1998). Heavy AC (HAC) was associated with higher risk of MetS in Koreans (Yoon, Oh, Baik, Park, & Kim, 2004). National Cholesterol Education Program's (NCEP) Therapeutic lifestyle change guideline emphasizes: 1) reducing intakes of saturated fat and cholesterol and increasing

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intakes of fruit and vegetable; 2) increasing PA; and 3) engaging in weight control in order to manage MetS (National Cholesterol Education Program [NCEP] Adult Treatment Panel [ATP] III, 2001). While there are many studies concerning definitions, diagnostic criteria, and prevalence rates of MetS to date, the public health community needs more studies on effective management of MetS. Although there are guidelines on individual health behaviors, little is known about multiple health behaviors, and long-term effects of multiple-behavior interventions are not yet reported in Korean studies (Joo, 2010).

Research suggests that unhealthy behaviors are not randomly distributed, but that they occur in combination with other unhealthy behaviors within individuals (Poortinga, 2007; Schuit, Van Loon, Tijhuis, & Ocke, 2002). If a combination of certain risk factors is more prevalent than can be expected based on the prevalence of individual risk factors, it is called "clustering" (Schuit et al., 2002). Studying the clustering of multiple health behaviors is important because of possible synergistic health effects (Poortinga, 2007; Schuit et al., 2002). Previous findings suggest that health effects of unhealthy behaviors are multiplicative rather than additive (Poortinga, 2007). Not only the clustering of unhealthy behaviors but also the clustering of multiple healthy behaviors is associated with favorable, and possibly synergistic, health outcomes (Li, Jiles, Ford, Giles, & Mokdad, 2007; Stampfer, Hu, Manson, Rimm, & Wilett, 2000). Stampfer and colleagues (2000) showed that accumulation of multiple healthy behaviors, such as healthy diet, nonsmoking, moderate to vigorous exercise, body mass index < 25 kg/m², and alcohol ≥ 5 g/day, was associated with a lower relative risk of coronary heart disease. Although there have been recent studies on the clustering of multiple health behaviors in the general Korean population (Kang, 2007; Kang, Sung, & Kim, 2010), information regarding the clustering of multiple health behaviors among Korean adults with MetS is scant.

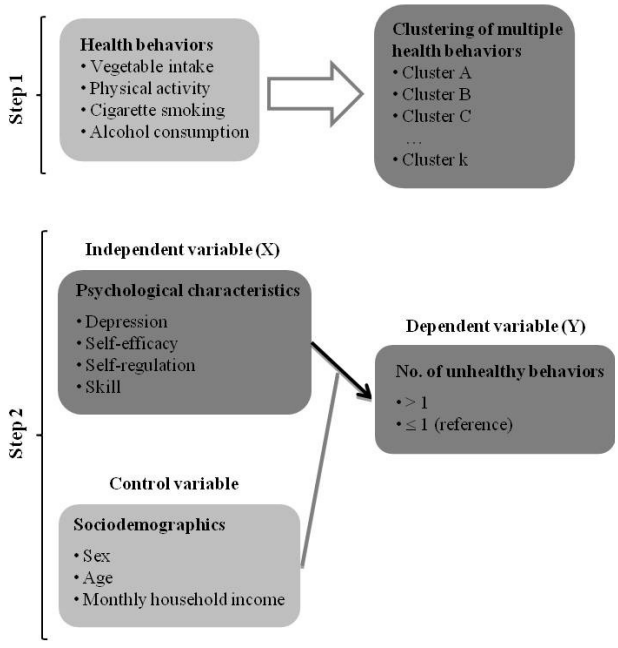
Moreover, less is known about psychological characteristics of people with MetS. Most of the past studies on MetS neglected to examine psychological characteristics, focusing mostly on clinical or behavioral characteristics. In particular, there has yet to be a Korean study that examines psychological characteristics and its association with multiple health behaviors among Koreans with MetS. Examining the psychological characteristics of the study population and investigating the relationship between such characteristics and multiple health behaviors will contribute to developing more fine-tuned intervention for individuals with MetS.

In order to manage MetS more effectively, the public health community needs better understanding of the behavioral patterns and psychological characteristics of those with MetS. Accordingly, this study was conducted with the following objectives: to examine the clustering of multiple health behaviors; and to examine the association between psychological characteristics and the number of unhealthy behaviors among middle-aged Koreans with MetS.

Ⅱ. Methods

1. Study Design

This cross-sectional study consisted of two main steps, which correspond to the aforementioned objectives. Step 1 was conducted to examine the clustering of multiple health behaviors, and step 2 was carried out to examine the association between psychological characteristics and the number of unhealthy behaviors [Figure 1].



[Figure 1] Study design

2. Study Population

The study population was derived from medical examination and self-reported health survey conducted at one of the 15 regional branches of Korea Association of Health Promotion (KAHP) between April and September, 2010, and targeted Koreans aged 40 to 59 years who had been diagnosed with MetS (i.e., as defined by NCEP ATP III, 2001). Among 3,678 eligible adults, this study selected participants by using stratified random sampling (i.e., based on age, sex, and prevalence rate for each branch). The total dataset consisted of 331 participants. All participants gave informed consent before participation. The study protocol was approved by the institutional review board of the KAHP.

3. Variables

The medical examination included following variables: systolic BP (SBP), diastolic BP (DBP), waist circumference (WC), TG, HDLC, and FBG. The questionnaire consisted of 36 items, including sociodemographics, health behaviors, and psychological characteristics. Sociodemographic variables included age, marital status, education level, employment status, and monthly household income. Behavioral variables consisted of dietary behavior, PA, cigarette smoking, and AC. To examine dietary behavior, the study measured fruit intake, vegetable intake (VI), and fat intake in descriptive analysis. In clustering and regression analyses, VI was used as a proxy measure for dietary behavior. The rationale for the use of VI was that: 1) fat intake has a high missing rate; and 2) fruit consumption is known to be associated with monthly household income among Korean adults (Kwon, Shim, Park, & Paik, 2009) due to the high fruit prices in Korea. This study used the International Physical Activity Questionnaire definition (International Physical Activity Questionnaire, 2005) of total MET-minutes/week to measure the PA, and followed the modified World Health Organization definition (Choi et al., 2008) of heavy drinking. Definitions of these behavioral variables are described in [Figure

	Variable	Definition
Behavioral	Vegetable intake	Number of days/week one eats vegetables (e.g., *na-mool*, raw vegetables, and seaweeds)
	Physical activity	Total MET-minutes/week = (3.3 METs x min x days for walking) + (4.0 METs x min x days for moderate-intensity physical activity) + (8.0 METs x min x days for vigorous-intensity physical activity)
	Current smoker	Smoking cigarettes at all nowadays
	Heavy alcohol consumption	≥ 5 glasses (men) and ≥ 4 glasses (women) on 1 occasion ≥ 1 time/week
Psychological	Knowledge	Facts, ideas, and tips that support the healthy behavior change
	Expectation	Belief about the likelihood and value of the consequences of behavioral choices
	Social norm	Belief about whether most people approve or disapprove of the behavior
	Attitude	Overall evaluation of the health behavior, based on belief that behavioral performance is associated with certain attributes or outcomes, and value attached to a behavioral outcome or attribute
	Self-efficacy	Belief about personal ability to perform behaviors that bring desired outcomes
	Self-regulation	Controlling oneself through self-monitoring, goal-setting, feedback, self-reward, self-instruction, and enlistment of social support
	Skill	Planning, making a decision, and avoiding or countering barriers

[Figure 2] Definition of select behavioral and psychological variables

2]. All four health behaviors were dichotomized to examine clustering patterns. Median split[1] was used to dichotomize VI and PA. Smoking status was dichotomized into current smoker (CS) versus never- or ex- smoker (NS). Likewise, AC was dichotomized into HAC versus moderate or no AC (MAC). Depression and other psychological variables, such as knowledge, expectation, social norm, attitude, self-efficacy, self-regulation, and skill, were included. Depression was measured by using the Patient Health Questionnaire-9 Score (Kroenke, Spitzer, & Williams, 2001), and it was dichotomized into minimal (i.e., 0-4) versus ≥ mild (i.e., 5-27). [Figure 2] shows definitions of other psychological variables. Definition of "consciousness raising" in Transtheoretical Model (Glanz, Rimer, & Viswanath, 2008) was used to define knowledge. Definitions of expectation, self-efficacy, and self-regulation were based on the Social Cognitive Theory (Bandura, 1998). Definitions of social norm and attitude were based on the Integrated Behavioral Model (Glanz et al., 2008). All of these psychological variables, except for depression, were categorized into tertiles[2] based on the distribution. After the data collection, internal consistency for the newly created psychological items was assessed. Cronbach's alpha was 0.92 for knowledge, 0.80 for expectation, 0.74 for social norm, 0.71 for attitude, 0.43 for self-efficacy, 0.81 for self-regulation, and 0.69 for skill.

4. Statistical Analyses

To examine sex differences, chi-square tests and t-tests were conducted. Besides the descriptive analysis, all the analyses in the two main steps (step 1: n=177, step 2: n=151) were performed with a complete set, excluding cases with missing values in at least one of the behavioral or psychological variables. Clustering of multiple health behaviors was examined based on the ratios of observed and expected prevalence of simultaneously occurring health behaviors (Kang et al., 2010; Schuit et al., 2002). A combination of multiple health behaviors was considered as a cluster if the ratio of observed and expected prevalence (O/E) was ≥ 1.50. In order to measure the degree of clustering, the prevalence odds ratio (POR) for each combination of two simultaneously occurring health behaviors was calculated as suggested by Schuit et al. (2002):

$$\frac{\text{(No. of respondents without both factors) x (No. of respondents with both factors)}}{\text{(No. of respondents with one factor) x (No. of respondents with the other factor)}}$$

A binomial logistic regression was conducted to examine the association between psychological characteristics and the number of unhealthy behaviors. All statistical analyses were performed using SAS software, version 9.2 (SAS Institute, Inc., Cary, North Carolina).

Ⅲ. Results

1. Baseline Characteristics

<Table 1> shows sociodemographic characteristics of the study population. All the sociodemographic characteristics showed a significant sex difference ($P < 0.01$). The majority of men were married and living with a spouse (92.37%), was employed (80.00%), and reported monthly income of least 2 million Korean won (87.12%). Also, 34.59% of men had completed at least a bachelor's degree. In comparison, women were more likely to be single (15.30%), and had a lower education level and lower monthly household income than men. Almost half of women were housewives (47.89%).

Clinical characteristics are shown in <Table 2>. A significant sex difference was shown in most of the clinical factors, except for SBP and HDLC ($p < .05$). Given that the cutoff point for high BP is 130/85 mmHg, mean values of SBP and DBP were quite close to this cutoff point. Bearing in mind that 150 mg/dL is the cutoff point for high TG, mean values of 238.23 mg/dL in men and 182.64 mg/dL in women seem strikingly high.

1) Values < median (i.e., 50.00th percentile) was categorized as low and those ≥ median as high.

2) Values < 33.33% (i.e., 33.33th percentile) was categorized as lowest, those between 33.33-66.65% as middle, and those ≥ 66.66% as highest.

<Table 1> Sociodemographic characteristics in men and women

	Men (n=133)		Women (n=198)	
	n	%	n	%
Age (years)**				
40-49	67	50.38	73	36.87
50-59	66	49.62	125	63.13
Marital status***				
Married and living with a spouse	121	92.37	160	81.63
Married but living without a spouse	4	3.05	6	3.06
Single	6	4.58	30	15.31
Education level***				
< High school	15	11.28	76	38.78
High school	48	36.09	80	40.82
Some college	24	18.05	14	7.14
≥ Undergraduate	46	34.59	26	13.26
Employment status***				
Employed	104	80.00	84	44.21
Homemaking	2	1.54	91	47.89
Retired	7	5.38	1	0.53
Etc	17	13.08	14	7.37
Monthly household income (10^4 Korean won)***				
< 100	3	2.27	28	14.29
100-199	11	8.33	44	22.45
200-299	41	31.06	41	20.92
300-499	43	32.58	47	23.98
≥ 500	31	23.48	24	12.24
Don't know	3	2.27	12	6.12

**p < .01, ***p < .001 by chi-square test

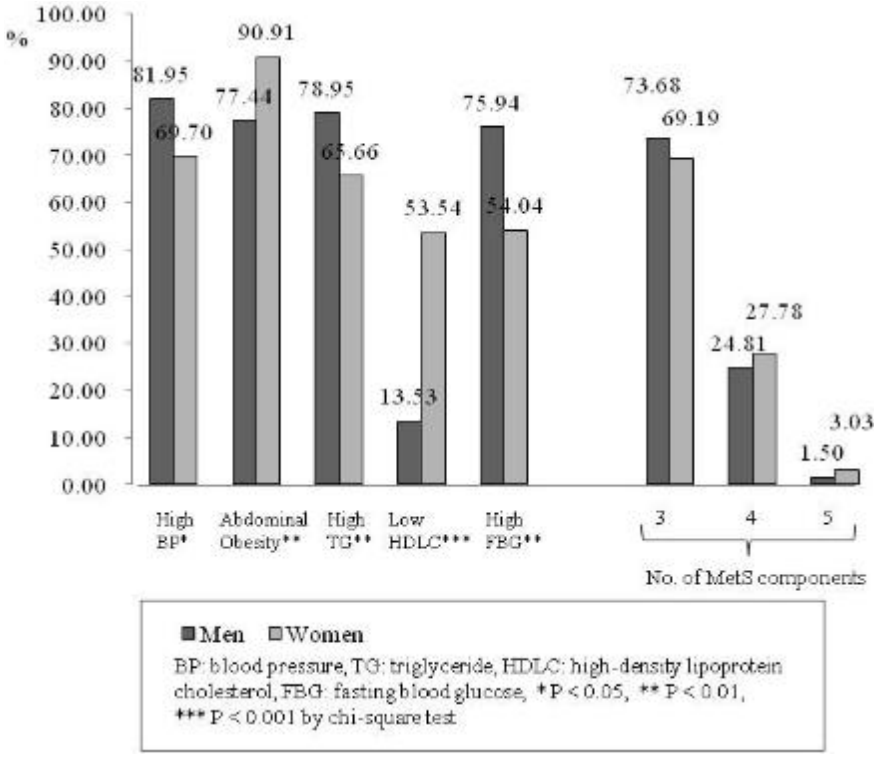
<Table 2> Clinical characteristics in men and women

(means ± SD)

	Men (n=133)	Women (n=198)
SBP (mmHg)	131.55 ± 11.83	129.37 ± 13.42
DBP (mmHg)*	85.50 ± 8.65	81.10 ± 8.86
WC (cm)*	93.51 ± 6.75	86.56 ± 6.67
TG (mg/dL)*	238.23 ± 112.72	182.64 ± 87.81
HDLC (mg/dL)	50.70 ± 9.23	52.10 ± 10.08
FBG (mg/dL)*	117.10 ± 30.17	106.49 ± 30.02

Note: SBP: systolic blood pressure, DBP: diastolic blood pressure, WC: waist circumference, TG: triglyceride, HDLC: high-density lipoprotein cholesterol, FBG: fasting blood glucose

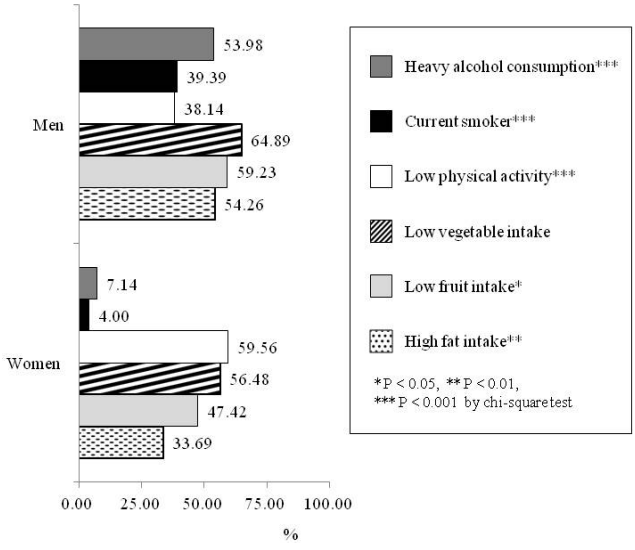
*p < .05 by t-test



[Figure 3] Prevalence of metabolic syndrome components in men and women

[Figure 3] summarizes the prevalence of MetS components. Higher proportion of men (81.95%) had high BP compared to women (69.70%, p < .05). Prevalence of abdominal obesity was higher in women (men: 77.44%, women: 90.91%, p < .01). Prevalence of high TG was 78.95% and 65.66% for men and women respectively (p < .01). About 70% of the participants (men: 73.68%, women: 69.19%) was diagnosed with three MetS components, and 26.31% of men and 30.81% of women had four or five MetS components.

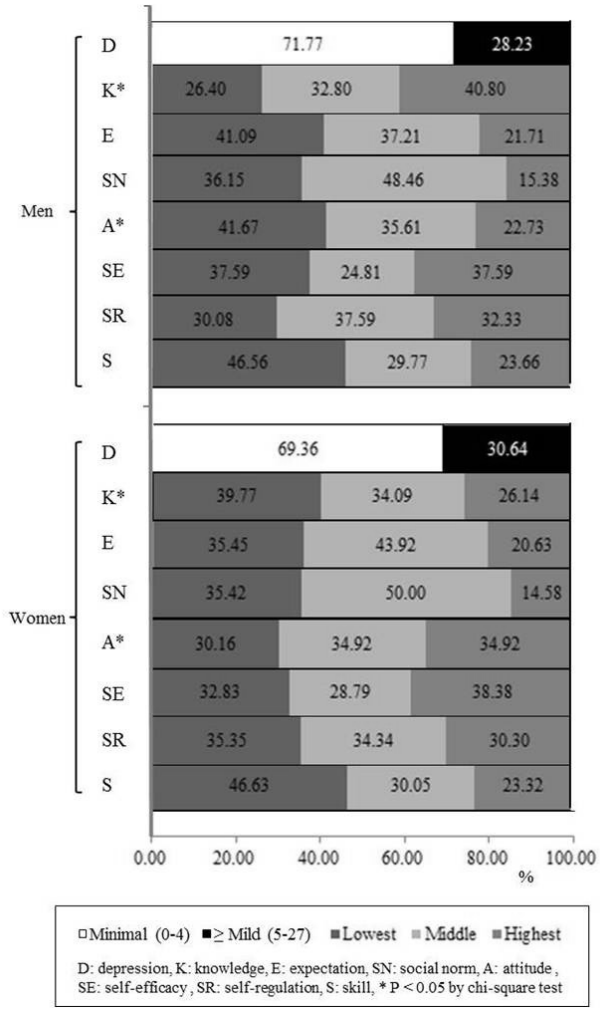
[Figure 4] shows the behavioral characteristics. Except for VI, there was a significant sex difference in the behavioral characteristics (p < .05). With respect to fat consumption, 54.26% of men and 33.69% of women reported high fat intake (p < .01). Low fruit intake was reported as 59.23% in men and 47.42% in women (p < .05), and low VI64.89% in men and 56.48% in women. Regarding PA, 38.14% of men and 59.56% of women were physically inactive (p < .001). Strikingly higher proportion of men (39.39%) smoked compared to women (4.00%, p < .001). Likewise, 53.98% of men drank heavily at least once per week, whereas 7.14% of women reported HAC (p < .001).



[Figure 4] Behavioral characteristics in men and women

[Figure 5] describes depression and other psychological characteristics. Significantly higher percentage of men was in the

highest tertile of knowledge regarding MetS compared to women (men: 40.80%, women: 26.14%, $p < .05$). Also, 22.73% of men and 34.92% of women had the highest tertile of attitude, suggesting that women are more likely to have positive attitudes concerning MetS management than men ($p < .05$). About one third was in the highest tertile of self-regulation (men: 32.33%, women: 30.30%). Concerning MetS management skill, 23.66% of men and 23.32% of women were in the highest tertile.



[Figure 5] Depression and psychological characteristics regarding metabolic syndrome in men and women

2. Clustering of Multiple Health Behaviors

The clustering of multiple health behaviors is depicted in <Table 3>. Men and women showed markedly different behavioral patterns. In men, 56.12% engaged in at least two unhealthy behaviors. Among women, 27.37% had two or more behavioral risk factors. The combination of all four unhealthy behaviors in men showed the O/E of 2.05, suggesting that four unhealthy behaviors tend to cluster among men. The combination of low PA (LPA), CS, HAC, and high VI (HVI) exhibited clustering in men (O/E: 1.50). In women, there were three combinations that showed high O/E ratios (i.e., the combination of LVI, HPA, CS, & MAC: 2.00, the combination of HVI, HPA, CS, & HAC: 1.72, and the combination of HVI, HPA, NS, & HAC: 2.04). However, given the low expected and observed prevalence for each of these combinations, these high O/E ratios may not be meaningful in a practical sense. Instead, high observed prevalence of other combinations appear to be more meaningful regarding the behavioral pattern of women. About one out of five women engaged in LVI, LPA, NS, and MAC (22.11%), and similar proportion took part in LVI and three other healthy behaviors (21.05%), while 36.84% had LPA and three healthy behaviors.

<Table 4> summarizes the prevalence (P) and POR of two simultaneously occurring health behaviors. In men, even though there was no statistically significant clustering in any of the combinations, marginal clustering was shown in the combination of CS and HAC (POR=2.33, 95% CI=0.92-5.94). Among women, strong clustering was found in the combination of HVI and LPA, and the combination of LVI and HPA (POR=2.64, 95% CI=1.13-6.20 for both combinations). In the total subgroup, the combination of CS and HAC showed strong clustering (POR=6.10, 95% CI= 2.72-13.69), and the combination of HAC and HPA exhibited marginal clustering (POR=1.56, 95% CI=0.80-3.03).

<Table 3> Clustering of multiple health behaviors

No. of unhealthy behaviors	Low vegetable intake	Low physical activity	Current smoker	Heavy alcohol consumption		Men (n=82)			Women (n=95)			Total (n=177)		
						O (%)	E (%)	O/E	O (%)	E (%)	O/E	O (%)	E (%)	O/E
> 1	+	+	+	+		8.54	4.16	**2.05**	0.00	0.05	0.00	3.95	1.33	**2.97**
	+	+	+	−		2.44	3.60	0.68	1.05	0.86	1.22	1.69	3.49	0.48
	+	+	−	+		7.32	7.22	1.01	0.00	1.47	0.00	3.39	5.82	0.58
	+	−	+	+		6.10	6.85	0.89	0.00	0.03	0.00	2.82	1.30	**2.17**
	−	+	+	+		4.88	3.26	**1.50**	0.00	0.06	0.00	2.26	1.30	**1.74**
	+	+	−	−		4.88	6.23	0.78	22.11	26.39	0.84	14.12	15.21	0.93
	+	−	+	−		4.88	5.92	0.82	1.05	0.53	**2.00**	2.82	3.37	0.84
	+	−	−	+		9.76	11.87	0.82	1.05	0.89	1.17	5.08	5.63	0.90
	−	+	+	−		0.00	2.81	0.00	0.00	1.00	0.00	0.00	3.37	0.00
	−	+	−	+		2.44	5.65	0.43	2.11	1.70	1.24	2.26	5.63	0.40
	−	−	+	+		4.88	5.36	0.91	0.00	0.03	0.00	2.26	1.25	**1.81**
					Total	56.12			27.37			40.65		
≤ 1	+	−	−	−		12.2	10.25	1.19	21.05	16.10	1.31	16.95	14.71	1.15
	−	+	−	−		7.32	4.88	**1.50**	36.84	30.59	1.20	23.16	14.71	**1.57**
	−	−	+	−		4.88	4.63	1.05	1.05	0.61	**1.72**	2.82	3.26	0.87
	−	−	−	+		9.76	9.29	1.05	2.11	1.04	**2.04**	5.65	5.44	1.04
	−	−	−	−		9.76	8.02	1.22	11.58	18.66	0.62	10.73	14.21	0.76
					Total	43.92			72.63			59.31		

Note: O: observed frequency of (the combination of) health behaviors, E: expected frequency calculated on the assumption of independence of the individual health behavior, based on their occurrence in the study population

+: unhealthy behavior present, −: unhealthy behavior not present

<Table 4> Prevalence and prevalence odds ratio of simultaneous occurrence of two health behaviors

Combination of health behaviors	Men (n=82)			Women (n=95)			Total (n=177)		
	P (%)	POR	95% CI	P (%)	POR	95% CI	P (%)	POR	95% CI
CS x HAC	24.39	2.33	0.92-5.94	0.00	0.00	N/A	11.30	6.10***	2.72-13.69
NS x MAC	34.15	2.33	0.92-5.94	91.58	0.00	N/A	64.97	6.10***	2.72-13.69
NS x HAC	29.27	0.43	0.17-1.09	5.26	N/A	N/A	16.38	0.16***	0.07-0.37
CS x MAC	12.20	0.43	0.17-1.09	3.16	N/A	N/A	7.34	0.16***	0.07-0.37
CS x LVI	21.95	1.29	0.52-3.20	2.11	2.38	0.21-27.19	11.30	1.63	0.75-3.52
NS x HVI	29.27	1.29	0.52-3.20	52.63	2.38	0.21-27.19	41.81	1.63	0.75-3.52
NS x LVI	34.15	0.78	0.31-1.94	44.21	0.42	0.04-4.80	39.55	0.61	0.28-1.33
CS x HVI	14.63	0.78	0.31-1.94	1.05	0.42	0.04-4.80	7.34	0.61	0.28-1.33
CS x LPA	15.85	1.44	0.58-3.63	1.05	0.29	0.03-3.35	7.91	0.66	0.31-1.42
NS x HPA	41.46	1.44	0.58-3.63	35.79	0.29	0.03-3.35	38.42	0.66	0.31-1.42
NS x LPA	21.95	0.69	0.28-1.74	61.05	3.41	0.30-39.05	42.94	1.52	0.71-3.26
CS x HPA	20.73	0.69	0.28-1.74	2.11	3.41	0.30-39.05	10.73	1.52	0.71-3.26
HAC x LVI	31.71	1.30	0.54-3.12	1.05	0.27	0.03-2.54	15.25	1.27	0.65-2.45
MAC x HVI	21.95	1.30	0.54-3.12	49.47	0.27	0.03-2.54	36.72	1.27	0.65-2.45
MAC x LVI	24.39	0.77	0.32-1.85	45.26	3.66	0.39-34.03	35.59	0.79	0.41-1.53
HAC x HVI	21.95	0.77	0.32-1.85	4.21	3.66	0.39-34.03	12.43	0.79	0.41-1.53
HAC x LPA	23.17	1.65	0.66-4.08	2.11	0.39	0.06-2.43	11.86	0.64	0.33-1.25
MAC x HPA	31.71	1.65	0.66-4.08	34.74	0.39	0.06-2.43	33.33	0.64	0.33-1.25
MAC x LPA	14.63	0.61	0.25-1.51	60.00	2.59	0.41-16.31	38.98	1.56	0.80-3.03
HAC x HPA	30.49	0.61	0.25-1.51	3.16	2.59	0.41-16.31	15.82	1.56	0.80-3.03
LVI x LPA	23.17	1.41	0.57-3.49	23.16	0.38*	0.16-0.89	23.16	0.65	0.36-1.17
HVI x HPA	29.27	1.41	0.57-3.49	14.74	0.38*	0.16-0.89	21.47	0.65	0.36-1.17
HVI x LPA	14.63	0.71	0.29-1.76	38.95	2.64*	1.13-6.20	27.68	1.54	0.85-2.79
LVI x HPA	32.93	0.71	0.29-1.76	23.16	2.64*	1.13-6.20	27.68	1.54	0.85-2.79

Note: P: prevalence, POR: prevalence odds ratio, CI: confidence interval, CS: current smoker, HAC: heavy alcohol consumption, NS: never or ex smoker, MAC: moderate or no alcohol consumption, LVI: low vegetable intake, HVI: high vegetable intake, LPA: low physical activity, HPA: high physical activity

* $p < .05$, *** $p < .001$

<Table 5> Adjusted odds ratio† and 95% confidence interval of psychological characteristics on the number of unhealthy behaviors

Psychological characteristic	Reference of independent variable	Number of unhealthy behaviors (reference: ≤ 1)	
		OR	95% CI
Depression			
≥ Mild	Minimal	1.98	0.87-4.51
Self-efficacy			
Lowest	Highest tertile	1.86	0.65-5.34
Middle		0.91	0.35-2.39
Self-regulation			
Lowest	Highest tertile	4.05*	1.24-13.17
Middle		1.54	0.53-4.43
Skill			
Lowest	Highest tertile	0.91	0.31-2.66
Middle		1.08	0.39-2.98

Note: OR: odds ratio, CI: confidence interval
† Adjusted for sex, age (unit: 1.00 year), and monthly household income
* $p < .05$

3. Psychological Characteristics and the Number of Unhealthy Behaviors

In <Table 5>, odds ratio (OR) and 95% confidence interval (CI) of psychological characteristics on the number of unhealthy behaviors are presented. Participants in the lowest tertile of self-regulationwere more likely than those in the highest tertile to take part in several unhealthy behaviors simultaneously (OR=4.05, 95% CI=1.24-13.17).

Ⅳ. Discussion

These results on the prevalence of high BP, abdominal obesity, and high TG, as well as the number of MetS components support the earlier reports on Korean adults with MetS (Lee et al., 2007). The findings on the number of MetS components suggest that majority of the participants (men: 73.68%, women: 69.19%) would not have MetS anymore if they can manage to improve at least one of the MetS components.

Men tended to smoke and drink heavily, supporting existing literature (Kang et al., 2010). Women tended to have low vegetable intake and low physical activity. The results suggest that women are likely to be passive in terms of health behaviors in that they do not engage in smoking, heavy drinking, physical activity, and vegetable intake. In some way, this finding is consistent with the earlier reports that high percentage of Korean women do not partake in smoking, drinking, and physical activity at the same time (Kang, 2007). Men with MetS were more likely than their female counterparts to partake in multiple unhealthy behaviors, confirming previous findings (Kang et al., 2010; Poortinga, 2007). Clustering of smoking and heavy drinking is also consistent with existing literature (Kang et al., 2010; Lee, Yang, & Hwang, 2005; Schuit et al., 2002). On the other hand, the results were not in line with previous studies regarding stronger behavioral clustering in women (Kang et al., 2010; Poortinga, 2007), and clustering at both ends of the behavioral spectrum (Poortinga, 2007). Additionally, women with high vegetable intake were likely to be physically inactive, and those with inadequate vegetable intake were likely to be physically active. Assuming vegetable intake is a proxy for healthy eating, one can hypothesize that women with healthy diet may neglect exercising, and those with poor diet may exercise more regularly. However, such findings are not in line with earlier reports (Poortinga, 2007), which showed strong clustering of low fruit and vegetable intake and

low physical activity among English women. Furthermore, this study found marginal clustering of heavy drinking and high physical activity in the total subgroup, supporting earlier reports which showed clustering of heavy drinking and high physical activity (Poortinga, 2007; Schuit et al., 2002). These previous studies hypothesized that such phenomenon may be due to drinking in canteens at sporting clubs. Considering the Korean drinking culture, this hypothesis is plausible. It seems common for middle-aged Koreans to participate in organized sports, such as golfing and hiking, with friends or co-workers and end up drinking afterwards. These hypotheses regarding physical activity and other behaviors, including dietary behavior and drinking, should be investigated further in future studies. From an intervention developer's perspective, this phenomenon may be associated with social norm or other social factors, suggesting that one may need to utilize societal-level intervention, such as social marketing, to improve such health behaviors more effectively.

While comparing these results with previous reports about behavioral clustering, one should note that current study population is, specifically, middle-aged Koreans with MetS, whereas earlier studies examined general adult population of various ethnic origins. Also, previous Korean studies (Kang, 2007; Kang et al., 2010) were based on the 2005 KNHANES data, and targeted general adult population (i.e., not necessarily at-risk group, and those aged $\geq$ 20 years). It is possible that inconsistency between current findings and earlier reports may be due to difference in characteristics of respective participants.

Regarding psychological characteristics, higher percentage of respondents had high level of self-efficacy or self-regulation, whereas lower percentage had high level of skill. Hence, one can hypothesize that more people feel confident in their ability to perform healthy behaviors and perceive they can regulate themselves, while less people actually have the concrete management skills. Also, participants with lower self-regulation were more likely to engage in higher number of unhealthy behaviors. Given that information about the association between psychological factors and multiple health behaviors is lacking, the current results are, to some extent, in line with a U.S. study on the social-cognitive correlates of an individual health behavior. According to Anderson et al. (2006), self-efficacy and self-regulation contributed to physical activity level, and self-regulation, among various psychosocial variables, showed the strongest effect on physical activity. Thus, it appears that improving self-regulation is essential in modifying health behaviors, whether it is on individual or multiple levels.

This study has a number of important implications for health promotion research and practice. First, the findings show that middle-aged Korean men with MetS tend to smoke and drink heavily, while their female counterpart tends to have inadequate vegetable intake and low physical activity. Future studies and intervention programs ought to take into consideration these behavioral patterns. In contrast to many of the past studies that examined individual health behaviors with a fragmented and cross-sectional view, the present study took a more holistic multiple health behavior approach and investigated patterns and contexts of four major health behaviors. The results support the multiple health behavior approach as opposed to the individual health behavior approach, and the findings can be used as evidence to corroborate multiple health behavior intervention program and policy in the future (Kang, 2007). Instead of focusing exclusively on unhealthy behaviors, this study investigated all possible combinations, including those with all four healthy behaviors and others with both healthy and unhealthy behaviors. The findings suggest that sometimes healthy behaviors and unhealthy behaviors may occur simultaneously (Kang, 2007), and future research can investigate further the association between physical activity and other behaviors, such as dietary behavior and alcohol consumption. Furthermore, the results indicate that relatively low proportion of the study population have the concrete management skills. Based on the low level of skill among participants, the study suggests that intervention developers focus more on management skills, such as planning, decision-making, maintenance, and adherence. The findings show that emphasis of self-regulation is necessary in developing multiple behavior intervention for Korean adults with MetS. An intervention developer should provide specific guidelines on different components of self-regulation, including but not limited to monitoring, goal-setting, feedback, positive reinforcement, and enlistment of social support. Improving self-regulation will be helpful in not only modifying health

behaviors but also maintaining the desirable behaviors (Lee et al., 2007). National Institutes of Health (1998) advises that "regular self-monitoring of weight is critical for long-term maintenance." In order to maintain healthy behaviors, one needs to monitor his or her behaviors, reward oneself appropriately, and continue to regulate oneself in the long run. One ought to take into account that current findings can be applied to middle-aged Koreans with MetS.

The present study has several limitations, such as a cross-sectional design, self-reporting, and small sample size. Given the small sample size, one should be cautious in interpreting the present findings, and it is recommended to focus more on the direction and magnitude of PORs and ORs than on the statistical significance. It may be difficult to compare the current findings with existing literature because past studies examined different combinations of health behaviors, or used different definitions or cut-off points (Poortinga, 2007). Lastly, from the social ecological perspective, this study is limited to individual behaviors and psychological factors, neglecting to examine environmental factors. Nevertheless, the current study contributes to health promotion research and practice in that it investigated behavioral patterns and psychological characteristics of an at-risk group, shedding light on oftentimes overlooked factors. One can utilize the results on behavior clusters and psychological factors, such as self-regulation, to develop more effective intervention strategies in an attempt to facilitate behavior modification, and, ultimately, disease prevention and health promotion.

Ⅴ. Conclusion

The findings support the multiple health behavior approach as opposed to the individual health behavior approach. The results suggest that smoking and heavy drinking cluster among middle-aged Korean males with MetS. In female counterpart, those with high vegetable intake tend to be physically inactive, and those with inadequate vegetable intake tend to be physically active. This study suggests that clustering patterns of exercise and other health behaviors, including dietary behavior and drinking, in individuals with MetS should be further investigated in future studies. Emphasis of self-regulation is necessary in developing multiple behavior intervention for those with MetS.

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