Effects of Health Behavior Factors and Mental Health Factors in Korean Obese Adults on Their Metabolic State: Utilizing the Korea National Health and Nutrition Examination Survey Data

Jeonghee Song, Jeongwon Han
College of Nursing,
Kosin University, Busan, Korea

ABSTRACT

This is a descriptive research study that classified Korean adults with obesity into those with Metabolically Healthy Obesity and those with Metabolically Unhealthy Obesity based on the data from the fifth and sixth South Korea's National Health and Nutrition Examination Surveys, designed due to the development of information and communication technology, to examine the impacts of obese adults' health behavior factors and mental health factors on their metabolic state. With respect to data analysis, the collected data were analyzed by complex sample statistics. The results of this study can be summarized as follows: Men who were smoking at the time of the survey had a 1.29 times higher probability of inclusion in the MUO group than in the MHO group. Women who had a high stress cognition rate had a 1.02 times higher probability of inclusion in the MUO group than in the MHO group. This study is significant as it provides the basic data for establishing strategies of nursing intervention for the promotion of obese adults' health, and it suggests that it is necessary to develop a program for the promotion of obese adults' health based on these results.

Key words: Behavior, Health, Mental, Metabolism, Obesity.

1. INTRODUCTION

In modern society, obese population increases with the change in the dietary habits and lifestyle, stress and lack of exercise, which is connected to the rapid economic development [1]. According to the World Health Statistics Report, about 35% of the population of adults around the world are overweight and of these 500 million persons, 12%, are obese [2]. According to the 2012 National Health and Nutrition Survey, it was reported that one out of three adults were obese in South Korea [3], and according to the results of a study conducted by the Ministry of Health and Welfare, the medical expenses spent due to overweight increased by 41.89% from 1.8971 trillion won in 2007 to 2.6919 trillion won in 2011 [4]. Obesity is an important risk factor for the occurrence of chronic diseases, such as diabetes, dyslipidemia, hypertension, and coronary-artery diseases, which causes cardio-cerebrovascular diseases like myocardial infarction or stroke, and the mortality due to obesity, too, tends to increase consistently [5].

Generally, obesity refers to a state in which fat is excessively accumulated in the body [6]. Based on the criteria for Asian in the WHO West Pacific Branch, a person with a Body Mass Index (BMI) over 25.0kg/m² is defined as a person with obesity [7]. Obesity is classified into primary (Protopathic)

obesity and secondary obesity. The primary obesity is simple obesity, in which dietary habit and life habit of adult act as an important influence factor. The secondary obesity is caused in association with medications, diseases in nervous and endocrine system and mental diseases [8]. Recently, adults with obesity were classified into Metabolically Healthy Obesity (MHO) and Metabolically Unhealthy Obesity (MUO) according to their metabolic condition [9]. An adult with MHO refers to an adult with obesity who became obese, according to BMI, but have relatively lower visceral obesity than the common obesity, lower blood pressure or frequency of disease of lipid metabolism, and higher insulin sensitivity [10].

In the result of a cohort study conducted in Mexico, about 65.6% of adult subjects are judged to be obese and about 36.3% of them are classified as adults with MHO [11]. In the South Korean National Health and Nutrition Survey, of 2,045 adult male subjects 20.4% (417 persons) were with MHO, whereas in the female subjects (2,536 persons) 13.2% (335 persons) were with MHO [12]. An adult with MHO is defined as a person who does not meet three out of five criteria: waist line ≧102cm (man) and ≧88cm (woman); blood pressure ≧ 130/85mmHg; fasting glucose ≧ 110mg/dL; high density cholesterol ≦ 40mg/dL (man) and ≦ 50mg/dL (woman) and triglycerides ≧ 150mg/dL, applying criteria of the National Cholesterol Education Program-Adult Treatment Panel III (NCEP-ATPIII) [13].

Obesity provides a cause of metabolic diseases, but since all adults with obesity do not have the same metabolic state, it

is very important that this is considered while setting up intervention strategies for adults with obesity [14]. According to the theory of the impact of psychosocial factors on the pathogenesis of CVD (cardio-vascular disease) by Rozanski, Blumenthal, and Kaplan (1999), mental health factors such as excessive business, the sense of loss due to lack of sleep, stress, and negative health behaviors such as smoking, drinking, and decline of physical activity are emphasized as important factors causing metabolic disorder [15]. Especially, adults living in modern society experience a variety of psychological stress, and such a continuous stimulus excessively secretes into the HPA (hypothalamus-pituitary gland-adrenocortical axis) [16], lowers the sensitivity of leptin, thus making the people to look for sweet food more frequently, and it is known that it increases abdominal obesity and decline of insulin sensitivity [17]. In addition, depression and stress worsen the health behaviors such as excessive calorie intake, smoking, drinking, and lack of physical activity all of which cause obesity and metabolic syndrome [18]. In particular, abdominal obesity and reduced insulin sensitivity are characteristic symptoms of adults with MUO. Therefore, interventional strategies for adults with obesity should approach with methods that can multi-dimensionally increase mental health factors and health behaviors [10].

However, to examine domestic preceding studies, most of the conducted studies of adults with obesity did not consider the metabolic condition. Those which considered the metabolic condition identified the general characteristics of the subjects, including sex, occupation, income level, and education background [13], [19]-[21] or investigated only calorie intake and degree of physical activity of the subjects [22], [23] and their alcohol intake and smoking [24], so they lack intervention strategies for adults with obesity according to the metabolic condition. Moreover, in the field of nursing with frequent encounters with adults with obesity, there are only a few studies on adults with obesity according to their metabolic condition except Jo [23].

Thus, this study will provide basic materials for nursing intervention of adults with obesity by checking the characteristics of the adults with MHO or MUO and analyzing health behaviors and mental health factors affecting adults with MUO based on the theory of the impact of psychosocial factors on the pathogenesis of CVD suggested by Rozanski and his colleagues [15]. For this, data from the and 6th National Health and Nutrition Survey Data is used.

2. METHOD

2.1 Design of the study

This study is a cross-sectional descriptive research, classifying Korean adults with obesity into adults with MHO and adults with MUO to determine the characteristics of the groups and understand the risk factors.

2.2 Subjects of the study

This study aims to check the characteristics of the groups, classifying adults with obesity according to their metabolic condition based on the National Health and Nutrition Survey

Data, checking their health behavior and mental health factors according to their metabolic condition, and analyzing the difference. An adult with MHO is defined as a person who does not meet three out of five criteria: waist line ≧102cm (man) and ≧88cm (woman); blood pressure ≧ 130/85mmHg; fasting glucose ≧ 110mg/dL; high density cholesterol ≦ 40mg/dL (man) and ≦ 50mg/dL (woman), and triglycerides ≧ 150mg/dL, applying criteria of the NCEP-ATPIII. An adult with MUO is defined as a person who meet three of five criteria.

The specific purposes are as follows:
1) Check the general characteristics of the subjects
2) Classify the subjects according to metabolic condition and analyze the difference in the general characteristics of the classified groups
3) Check health behavior factors affecting adults with MUO
4) Check mental health factors affecting adults with MUO

2.3 Measurements

The measuring tools of this study are part of the items of the health survey and nutrition survey of the 5th and 6th National Health and Nutrition Survey conducted between 2007 and 2013, which were selected for the purposes of this study.

2.3.1 General characteristics of the subjects

General characteristics of the subjects were included as sex(1. man, 2. female), age(The subject directly records the age), menstruation (1. before menarche, 2. yes, 3. no, 4. not applicable, 5, non-response), personal Income (1. low, 2, low middle, 3. high middle, 4. high. The subject directly records the personal income. And then personal income is divided into four groups according to age and sex by research team of National Health and Nutrition Survey), family Income (1. low, 2, low middle, 3. high middle, 4. high. The subject directly records the family income. And then monthly household income was calculated by applying the root value to the number of households by research team of National Health and Nutrition Survey), education background (1. under elementary school, 2. middle school , 3. high school , 4. over college graduates), occupation(1. manager , 2. white collar job, 3. service sector or sales person, 4. agriculture, forestry and fishery, 5. engineer or machine fabricaters, 6. simple labor, 7. unemployed include student and housewife), marital status(1. yes, 2, no, 3. non-response), hypertension, diabetes, hyperlipidemia and hypertriglyceridemia diagnosed by doctor in the survey of health.

2.3.2 Health behavior

For health behavior, the health survey included current smoking (0. no, 1. yes), AUDIT (alcohol use disorder identification test)(It is the data calculated by the National Health and Nutrition Examination Team based on the question related the drinking), number of days for strenuous physical activity (day/week) (question: In the last week, how many days did you take 10 minutes or more of intense physical activity which is very hard or breathythan usual?), number of days for moderate physical activity (day/week) (question: In the last week, how many days did you take 10 minutes or more of

moderate physical activity which is very hard or breathythan usual?), number of days for walking (day/week)(question: How many days have you been walking for at least 10 minutes at a time in the last week?), number of days for muscle strength exercise (day/week)(question:In the last week, how many days did you perform armpits such as push-ups, sit-ups, dumbbells, weights, and iron bars?),flexibility exercises (day/week) (question: How many days did you do flexibility exercises such as stretching, bare-hand exercises, etc. for the last week?) and the amount of energy consumed per day(It is the data calculated by the National Health and Nutrition Examination Team based on the food frequency survey through individual 24-hour recall survey).

2.3.3 Mental health factors

The health survey included sleeping hours(The subject directly records on the sleeping hours), rate of stress cognition (0. I feel less stressed, 1. I feel more stressed), experience of depressive symptom for the past two weeks (0. There is no continuous depression for more than 2 weeks, 1. There is continuous depression for more than 2 weeks), suicide idea (0. I have never considered suicide, 1. I have considered suicide), which come under mental health.

.

2.4 Data analysis

The analysis of the collected material was conducted using SPSS 21.0 (IBM) as follows:

1) The general characteristics of the subjects were analyzed with complex sample descriptive statistics.The statistical significance was accepted for values of p < 0.05.

2) A complex sample chi-square test was conducted on the differences in the general characteristics of the two classified groups (adults with MHO and adults with MUO). The statistical significance was accepted for values of p < 0.05.

3) To identify health behavior and mental health factors affecting adults with MUO, a complex sample logistic testwas used. The statistical significance was accepted for values of p < 0.05.

2.5 Ethical consideration

This study was conducted after getting the approval of the Institutional Review Board (IRB) of the K. University (KUB IRB 2016-0052-01). The source materials of the National Health and Nutrition Survey were provided to the researcher. Information through which the subjects of the survey and their families can be assumed has been erased. This is in accordance to the Act on the Protection of Personal Information and the Statistics Act

3. RESULTS

3.1 General participant characteristics

The general characteristics of the subjects are listed in Table 1 including 2,889 male (45.6%), and 3,449 female subjects (54.4%). By age, most of them (1,375 persons) were in their 50ties (21.7%). For personal income, 1,662 persons

(26.2%) responded that they were in the "mid-to-low" level whereas for family income 1,689 persons (26.6%) responded that they were in the "mid-to-high" level. For the educational background, a third of them (2,006 persons) were high school graduates (31.7%). For occupation, 2,396 persons were unemployed (including students and housewives) (37.8%) For marital status, 5,734 persons were married (90.5%). Regarding whether they had hypertension, 2,845 persons (44.9%) had hypertension; 1,626 persons (25.6%) had prehypertension; and 1,671 persons (26.4%) had normal blood pressure. Regarding whether they had diabetes, 3,383 persons (53.4%) were normal; 1,676 persons (26.4%) had fasting plasma glucose to prediabetes; and 958 persons (15.1%) were diabetic. Out of the subjects who responded "Yes" to the question about whether they had hyperlipidemia were 936 persons (14.8%) and those who responded "No" were 5,402 persons (85.2%). Out of the subjects who responded "Yes" to the question about whether they had hypertriglyceridemia were 1,205 persons (19.0%) and those who responded "No" were 3,964 persons (62.5%).

3.2 Comparison of the general characteristics of the subjects according to obesity type

As in Table 2, 3,537 adults (55.8%)were with MHO of the total 6,338 subjects, and 2,801 adults (44.2%) with MUO. It turned out that there were statistically significant differences in Sex (p<0.001), age (p<0.001), menstruation (p<0.001), income (personal) (p=0.044), income (family) (p<0.001), educational background (p<0.001), occupation (p=0.012), marital status (p<0.001), hypertension (p<0.001), diabetes (p<0.001), hyperlipidemia (p<0.001), and hypertriglyceridemia (p<0.001) between the two groups.

3.3 Health behavior factors affecting adults with MUO

The result of an identification of health behavior factors affecting classification as adults with MUO is listed in Table 3. In Model 3 (age, menstruation, personal income, family income, education background, occupation, marital status, hypertension, diabetes, hyperlipidemia, and hypertriglyceridemia adjusted), men's current smoking rate was 1.29 times (95% Cl=1.07-1.51, p<0.001) higher. All health behavior factors were not statistically significant in women.

3. 4 Mental health factors affecting adults with MUO

The results of an identification of mental health factors affecting classification as adults with MUO is listed in Table 4. In Model 3 (age, Menstruation, personal Income, family Income, education background, occupation, marital status, hypertension, diabetes, hyperlipidemia, and hypertriglyceridemia adjusted), women's rate of stress cognition was 1.02 times (95% Cl=1.01-1.03, p<0.001) higher. All mental health factors were not statistically significant factors in men.

Table 1. General characteristics of subjects

(N=6,338)

Variable	Category	n	%
Sex	Male	2,889	45.6
	Female	3,449	54.4
Age (yr)	< 30	462	7.3
	30-39	985	15.5
	40-49	1,222	19.3
	50-59	1,375	21.7
	60-69	1,329	21.0
	≧70	965	15.2
Menstruation	Yes	1,160	18.3
	No	2,187	34.5
	Non-response	102	1.6
	Male	2,889	45.6
Income (personal)	Low	1,560	24.6
	Low middle	1,662	26.2
	High middle	1,563	24.7
	High	1,492	23.5
	Non-response	61	1.0
Income (family)	Low	1,322	20.9
	Low middle	1,683	26.6
	High middle	1,689	26.6
	High	1,583	24.9
	Non-response	61	1.0
Education background	Under elementary school	1,781	28.1
	Middle school	797	12.6
	High school	2,006	31.7
	Over college graduates	1,568	24.7
	Non-response	186	2.9
Occupation	Manager	738	11.6
	White collar job	453	7.2
	Service sector or sales person	825	13.0
	Agriculture, forestry and fishery	519	8.2
	Engineer or machine fabricaters	641	10.1
	Simple labor	567	9.0
	Unemployed (Include student & housewife)	2,396	37.8
	Non-response	199	3.1
Marital status	Yes	5,734	90.5
	No	588	9.3
	Non-response	16	0.2
Hypertension	Normal	1,671	26.4
	Prehypertension	1,626	25.6
	Hypertension	2,845	44.9
	Non-response	196	3.1
Diabetes	Normal	3,383	53.4
	Prediabetes	1,676	26.4
	Diabetes	958	15.1
	Non-response	321	5.1
Hyperlipidemia	No	5,402	85.2
	Yes	936	14.8
Hypertriglyceridemia	No	3,964	62.5
	Yes	1,205	19.0
	Non-response	1,169	18.5

†unweighted; ‡weighted

Table 2. Comparison of subject's characteristics by obesity type

(N=6,338)

Variable	Category	MHO	MUO	p
		n†(%)‡	n†(%)‡	
Sex	Male	1,624(56.2)	1,265(43.8)	<0.001
	Female	1,913(55.5)	1,536(44.5)	
Age (yr)	< 30	370(80.1)	92(19.9)	<0.001
	30-39	664(67.4)	321(32.6)	
	40-49	697(57.0)	525(43.0)	
	50-59	708(51.5)	667(48.5)	
	60-69	640(48.2)	689(51.8)	
	≧70	458(47.5)	507(52.5)	
Menstruation (exclusion male)	Yes	795(68.5)	365(31.5)	<0.001
	No	1,069(48.9)	1,118(51.1)	
Income (personal)	Low	827(53.0)	733(47.0)	0.044
	Low middle	939(56.5)	723(43.5)	
	High middle	866(55.4)	697(44.6)	
	High	879(58.9)	613(41.1)	
Income (family)	Low	612(46.3)	710(53.7)	<0.001
	Low middle	974(57.9)	709(42.1)	
	High middle	967(57.3)	722(42.7)	
	High	958(60.5)	625(39.5)	
Education background	Under elementary school	833(46.8)	948(53.2)	<0.001
	Middle school	399(50.1)	398(49.9)	
	High school	1,210(60.3)	796(39.7)	
	Over college graduates	1,004(64.0)	564(36.0)	
Occupation	Employed	2,156(57.6)	1,587(42.4)	0.012
	Unemployed	1,283(53.5)	1,113(46.5)	
Marital status	Yes	3,085(53.8)	2,649(46.2)	<0.001
	No	447(76.0)	141(24.0)	
Hypertension	Normal	1,237(74.0)	434(26.0)	<0.001
	Prehypertension	1,007(61.9)	619(38.1)	
	Hypertension	1,196(42.0)	1,649(58.0)	
Diabetes	Normal	2,615(77.3)	768(22.7)	<0.001
	Prediabetes	514(30.7)	1,162(69.3)	
	Diabetes	252(26.3)	706(73.7)	
Hyperlipidemia	No	3,131(49.4)	2,271(35.8)	<0.001
	Yes	406(43.4)	530(56.6)	
Hypertriglyceridemia	No	2,644(66.7)	1,320(33.3)	<0.001
	Yes	243(20.2)	962(79.8)	

* Non-response value: menstruation=102; Income (personal)=61; Income(family)=61; Education background=186; Occupation=199; Marital status=16; Hypertension=196; Diabetes=321; Hypertriglyceridemia=1,169
* MHO=Metabolically healthy obesity; MUHO= Metabolicallyunhealthy obesity
†unweighted; ‡weighted
.The statistical significance was accepted for values of p < 0.05(complex sample chi-square test).

Table 3. Logistic regression of health behaviors by group

(N=6,338)

Variables	Model 1			Model 2			Model 3		
	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Male									
Current non-smoking	1.00			1.00			1.00		
Current smoking	1.57	1.27-1.93	<0.001	1.55	1.26-1.92	<0.001	1.29	1.07-1.51	<0.001
AUDIT	1.02	1.01-1.03	<0.001	1.02	1.01-1.03	<0.001	1.01	0.99-1.02	0.171
Strenuous physical activity (day/week)	0.98	0.93-1.04	0.237	0.98	0.93-1.04	0.298	0.98	0.91-1.07	0.380
Moderate physical activity (day/week)	0.96	0.91-1.02	0.374	0.96	0.91-1.02	0.388	0.97	0.90-1.04	0.407
Walking (day/week)	0.96	0.93-1.01	0.336	0.97	0.93-1.01	0.311	0.97	0.94-1.01	0.481
Muscle strength exercise (day/week)	0.96	0.90-1.03	0.318	0.96	0.96-1.03	0.312	0.95	0.86-1.04	0.468
Flexibility exercises (day/week)	0.94	0.89-0.99	0.018	0.94	0.89-0.99	0.019	0.97	0.92-1.01	0.101
The amount of energy consumed per day	1.01	0.99-1.02	0.128	0.99	0.98-1.01	0.228	0.99	0.98-1.01	0.356
Female									
Current non-smoking	1.00			1.00			1.00		
Current smoking	1.19	0.77-1.83	0.257	1.12	0.77-1.75	0.250	1.20	0.60-2.40	0.244
AUDIT	1.01	0.98-1.03	0.165	1.01	0.98-1.03	0.168	1.01	0.98-1.03	0.188
Strenuous physical activity (day/week)	0.97	0.91-1.04	0.361	0.97	0.88-1.07	0.364	0.97	0.88-1.07	0.367
Moderate physical activity (day/week)	1.01	0.95-1.05	0.368	0.99	0.92-1.07	0.375	0.99	0.92-1.07	0.380
Walking (day/week)	0.99	0.96-1.02	0.144	0.97	0.93-1.02	0.201	0.98	0.93-1.02	0.211
Muscle strength exercise (day/week)	1.01	0.94-1.10	0.282	0.99	0.96-1.02	0.378	0.92	0.85-1.01	0.463
Flexibility exercises (day/week)	0.91	0.87-0.97	<0.001	0.92	0.85-0.99	<0.001	0.92	0.86-1.01	0.177
The amount of energy consumed per day	1.01	0.99-1.02	0.235	1.01	0.99-1.02	0.265	1.01	0.99-1.02	0.356

* OR=Odds ratio 95% CI=95% Confidence interval
* AUDIT=Alcohol Use Disorder Identification Test
* Model 1=Adjusted Age
  Model 2=Model 1+Adjusted income (personal, family), education background, occupation, marital status
  Model 3=Model 2+ Adjusted hypertension, diabetes, hyperlipidemia, hypertriglyceridemia (Female=Including menstruation whether)
* Reference Group : Metabolically healthy obesity

Table 4. Logistic regression of mental health factors by group

(N=6,338)

Variables	Model 1			Model 2			Model 3		
	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Male									
Sleeping hours	0.99	0.98-1.01	0.481	0.93	0.98-1.01	0.403	0.97	0.94-1.01	0.494
Rate of stress cognition: low	1.00			1.00			1.00		
Rate of stress cognition: high	1.03	1.02-1.04	<0.001	1.02	1.01-1.03	<0.001	0.99	0.97-1.01	0.110
Depress symptom: no	1.00			1.00			1.00		
Depress symptom: yes	1.15	0.76-1.61	0.194	1.13	0.79-1.69	0.184	1.11	0.66-1.85	0.147
Suicide idea: no	1.00			1.00			1.00		
Suicide idea: yes	0.93	0.42-2.05	0.438	1.02	0.48-2.65	0.393	1.16	0.47-2.84	0.343
Female									
Sleeping hours	1.01	0.98-1.04	0.263	1.01	0.99-1.03	0.265	1.01	0.99-1.03	0.271
Rate of stress cognition: low	1.00			1.00			1.00		
Rate of stress cognition: high	1.03	1.02-1.04	<0.001	1.02	1.01-1.04	<0.001	1.02	1.01-1.03	<0.001
Depress symptom: no	1.00			1.00			1.00		
Depress symptom: yes	1.14	0.87-1.49	0.409	0.95	0.65-1.37	0.615	0.94	0.64-1.39	0.715
Suicide idea: no	1.00			1.00			1.00		
Suicide idea: yes	1.06	0.50-1.91	0.244	1.27	0.66-2.45	0.358	1.34	0.66-2.17	0.250

* OR=Odds ratio 95% CI=95% Confidence interval

* Model 1=Adjusted Age

  Model 2=Model 1+Adjusted income (personal, family), education background, occupation, marital status

  Model 3=Model 2+ Adjusted hypertension, diabetes, hyperlipidemia, hypertriglyceridemia (Female=Including menstruation whether)

* Reference Group : Metabolically healthy obesity

4. DISCUSSION

This study is a research conducted to analyze health behavior and mental health factors affecting adults with MUO, classifying research subjects into adults with MHO and adults with MUO based on the Korean 5th and 6th National Health and Nutrition Survey Data.

In this study, it was noted that men with MUO had 1.29 times higher current smoking rate than those with MHO, and this finding is similar to the resultsfrom a preceding study conducted with Korean people that analyzed health behavior of metabolic syndrome [25]. The more the cigarette nicotine intake, the more the cortisol secretion in the body becomes. It is judged that the increased cortisol lowers the sensitivity of leptin that suppresses the appetite, and this physiological change reduces the insulin sensitivity of adults with obesity and causes metabolic syndrome [17]. However, in the preceding studies with men in Ireland [26] and men in the U.S. [27], unlike in this study, smoking did not have any impact on the metabolic condition of adults with obesity. This finding shows that, since there are insufficient smoking regulations or non-smoking policies and measures in South Korea as compared to the U.S. or Ireland and the price of cigarettes is lower, the smoking rate of all men is relatively higher [28], which may explain thediscrepancy in the results. Since currently smoking rate in Korea increases continuously and smoking reduces insulin

sensitivity and increases total cholesterol and neutral fats, this becomes a cause for the increase of the risk of metabolic syndrome [29]. Thus, it is necessary to educate men with obesity and promote active management of smoking, so that they maintain a metabolically healthy condition.

In this study, we realized that drinking and smoking did not have any impact on the metabolic condition in women with obesity, which different to the results from a study with American women with obesity [27]. Since there are negative perceptions of stigma on women's drinking and smoking in South Korea due to the Confucian culture unlike the American open culture [30], the actual drinking and smoking rate of women are lower than those of men. Therefore, the difference in health behavior according to the cultural difference between American and Korean women explains the different result. Yet, since drinking and smoking are important factors of metabolic syndrome and obesity [31], it is recommended that a continuous preventive education for women is needed. In addition, physical activity and diet, too, did not have any impact on the metabolic condition of women with obesity, which is similar to the resultsof a preceding study with Korean women with the metabolic syndrome [27]. In women, as hormonal changes occur throughout their life, in their 50ties, the blood pressure increases and the metabolism changes resulting in an increase of the waist line and appearance of insulin resistance, which causes dyslipidemia [32]. Therefore, so it is concluded that physical activity and diet do not have a big impact on women with obesity. However, in studies

conducted in Ireland [26] and the U.S. [33], factors important for the metabolic syndrome of women with obesity are high sodium, carbohydrate, and crude fiber intake were reported. Therefore, it is necessary to carry out additional education and management for physical activity and diet for Korean women with high sodium and carbohydrate intake.

Resultsto identify mental health factors affecting adults with MUO in this study, sleeping hours did not have any impact on the metabolic condition of men.This result contrasts to the study that analyzed health behavior of metabolic syndrome in American men [34] and in Japanese men [35]. This indicates that the lack of sleep related to metabolic syndrome, including regularity of sleep, the depth of sleep, the number of times of waking up at night, bedtime and wake-up time as well as sleep time should be reflected [35].Unfortunately, the National Health and Nutrition Survey materials utilized in this study included only sleeping hours, which explains the different resultsto studies in other countries. Thus, future studies on adults with obesity and metabolic syndromeshould also analyze the interrelation of quality and quantity of sleep. In addition, in this study, stress cognition, depression, and suicide idea did not have any impact on adults with MUO, and this finding is similar to the results of the studies with men in Finland [35] and the U.K. [36]. Concerning stress and depression, ACTH (AdrenocorticotropesHormone) and cortisol hormone are directly and indirectly involved in obesity, diabetes, and hypertension in metabolic syndrome through HPA axis stimulus. Also, catecholamine becomes a risk factor of metabolic syndrome, such as vasoconstriction and blood pressure increase related to sympathetic nervous system acceleration [37].However, since men are active in coping with stress and very likely to solve problems through interactions with others [38], even by stress with the same intensity, they have a lower rate of stress cognition than women. Thus, we conclude that mental health factors have less impact on their health condition.

In contrast, stress cognition was affecting women with MUO, which is a similar result to a study with American women with obesity[39]. Therefore, since women have a higher sensitivity to stress than men, their perceived stress lowers the sensitivity of leptin in the body, which makes them look more frequently for sweet food and subsequently increases abdominal obesity and insulin resistance, which becomes the direct cause for metabolic syndrome [17]. In addition, since women are very likely to tend to have avoidance- and emotion-centered coping strategies for stress, stress lowers their physical activity [38], which affects the metabolic state of women with obesity. Thus, to promote the metabolic state of women with obesity, it is necessary to develop and provide an intervention program and education in which they can acquire various methods for coping with stress. However, like in men, sleeping hours, depression, and suicide idea did not have any impact on metabolic condition in women.But since mental-related factors are emphasized as important factors of metabolic syndrome, it is recommended to conduct a replication study related to this.

5. CONCLUSION

This study is descriptive research, dividing subjects into a group of adults with MHO and a group of adults with MUO based on the Korean 6th National Health and Nutrition Survey Data to identify characteristics within the groups and analyze health behaviors and mental health factors affecting adults with MUO. As a result of the study, current smoking rate was 1.29 times higher than metabolically healthy men than those with MUO and the factor of stress cognition was 1.02 times higher than metabolically healthy women than those with MUO. The data of this study were limited to the fact that it was not possible to additionally select various variables that affect the metabolic status of obese adults. Therefore, future studies would be necessary to conduct including various factors affecting the metabolic condition of adults with obesity.

ACKNOWLEDGEMENT

REFERENCES

[1] S. K. Park and Y. C. Choi, "Relationships between Alcohol Intake and Blood Pressure, Serum Lipids, Liver Function Tests and Obesity Indices in Middle-Aged Male Workers," Journal of the Korea Academia-Industrial Cooperation Society, vol. 16, no. 5, May. 2015, pp. 3323-3332.

[2] World Health Organization, "Global Status Report on Non-Communicable Diseases 2010," Apr. 2011.pp. 1-31.

[3] I. Hwang and K. S. Bang, "Factors Affecting Obesity and Overweight in Korean Preschool Children: Based on the Korea National Health and Nutrition Examination Survey 2013-2014," Child Health Nursing Research, vol. 22, no. 4, Oct. 2016, pp. 237-246.

[4] N. E. Adler and K. Newman, "Socioeconomic Disparities in Health: Pathways and Policies," Health Affairs, vol. 21, no. 2, Feb. 2002, pp. 60-76.

[5] J. H. Lee and B. J. Ku, "The Management of Metabolically Unhealthy Obesity," Journal of Korean Diabetes, vol. 15, no. 1, Mar. 2014, pp. 24-29.

[6] G. A. Bray, "Overweight is Risking Fate," Annals of the New York Academy of Sciences, vol. 499, no. 1, Jun. 1987, pp. 14-28.

[7] Y. N. Kim, H. H. Lee, E. J. Kang, K. J. Kang, and G. H. Kim, "Obesity Rate and Nutrient Intakes of 20-to 69-year-old Women Living in Rural Kampong Spue Province in Cambodia," Journal of The Korean Society of Food Culture, vol. 29, no. 6, Dec. 2014, pp. 668-676.

[8] Korean Society for the Study of Obesity, and Korean Society for the Study of Obesity, "Management of Obesity, 2010 Recommendation," Journal of Korean Society of Endocrinology, vol. 25, no. 4, Dec. 2010, pp. 301-304.

[9] A. D. Karelis and R. Rabasa-Lhoret, "Inclusion of C-Reactive Proteinin The Identificationof Metabolically

Healthy but Obese(MHO) Individuals," Diabetes & Metabolism, vol. 34, no. 2, Mar. 2008, pp. 183-184.

[10] S. W. Oh, J. W. Im, J. W. Lee, K. W. Kim, J. K. Choi, M. S. Park, and T. W Yoo, "What are the Characteristics of Obese Adults without Metabolic Complications?," Journal of the Korean Academy of Family Medicine, vol. 27, no. 9, Sep. 2006, pp. 733-740.

[11] C. A. Aguilar-Salinas, E. G. García, L. Robles, D. Riano, D. G. Ruiz-Gomez, A. C. García-Ulloa, and S. Canizales-Quinteros, "High Adiponectin Concentrations are Associated with the Metabolically Healthy Obese Phenotype," The Journal of Clinical Endocrinology & Metabolism, vol. 93, no. 10, Aug. 2008, pp. 4075-4079.

[12] S. Kim, E. H. Nah, and H. I. Cho, "Association between Smoking, Metabolic Syndrome, and Arteriosclerosis in Korean Men," Journal of Health Informatics and Statistics, vol. 41, no. 1, Feb. 2016, pp. 18-26.

[13] E. Expert Panel on Detection, "Executive summary of the Third Report of the National Cholesterol Education Program (NCEP) expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III)," JAMA, vol. 285, no. 19, 2001, p. 2486.

[14] J. M. Choi and C. B. Kim, "Obesity Management andScientific Evidence," Journal of the Korean Medical Association/Taehan Uisa Hyophoe Chi, vol. 54, no. 3, Mar. 2011, pp. 250-265.

[15] A. Rozanski, J. A. Blumenthal, and J. Kaplan, "Impact of Psychological Factors on the Pathogenesis of Cardiovascular Disease and Implications for Therapy," Circulation, vol. 99, no. 16, Apr. 1999, pp. 2192-2217.

[16] M. E. Holmes, P. Ekkekakis, and J. C. Eisenmann, "The Physical Activity, Stress and Metabolic Syndrome Triangle: A Guide to Unfamiliar Territory for the Obesity Researcher," Obesity Reviews, vol. 11, no. 7, Nov. 2010, pp. 492-507.

[17] J. W. Newcomer, G. Selke, A. K. Melson, J. Gross, G. P. Vogler, and S. Dagogo-Jack, "Dose-dependent Cortisol-Induced Increases In Plasma Leptin Concentration In Healthy Humans," Archives of General Psychiatry, vol. 55, no. 11, Nov. 1998, pp. 995-1000.

[18] A. Kouvonen, M. Kivimäki, S. J. Cox, T. Cox, and J. Vahtera, "Relationship between Work Stress and Body Mass Index Among 45,810 Female and Male Employees," Psychosomatic Medicine, vol. 67, no. 4, Aug. 2005, pp. 577-583.

[19] A. D. Ma, "Associations between Subjective Stress Level, Health-Related Habits, and Obesity According to Gender," The Korean Journal of Obesity, vol. 24, no. 3, Sep. 2015, pp. 156-165.

[20] G. N. Lee, Development of the Healthy Behavior Model with Metabolic Syndrome: An Information-Motivation-Behavioral Skills and Stress Analysis, doctoral dissertation, University of Ewha Womans University, 2015.

[21] S. J. Park, H. T. Kang, C. M. Nam, B. J. Park, J. A. Linton, and Y. J. Lee, "Sex Differences in the Relationship between Socioeconomic Status and Metabolic Syndrome: The Korean National Health And Nutrition Examination Survey," Diabetes Research And Clinical Practice, vol. 96, no. 3, Jun. 2012, pp. 400-406.

[22] J. M. Seo, N. K. Lim, J. Y. Lim, and H. Y. Park, "Gender Difference in Association with Socioeconomic Status and Incidence of Metabolic Syndrome in Korean Adults," The Korean Journal of Obesity, vol. 25, no. 4, Dec. 2016, pp. 247-254.

[23] N. H. Jo, A Structural model for the risk factors of metabolic syndrome in rural women, doctoral dissertation, University of Kyung pook National University, 2014.

[24] F. Conus, R. Rabasa-Lhoret, and F. Peronnet, "Characteristics of Metabolically Obese Normal-weight (MONW) Subjects," Applied Physiology, Nutrition, & Metabolism, vol. 32, no. 1, Sep. 2007, pp. 4-12.

[25] D. W. Na, E. Jeng, J. S. Chung, C. H. Choi, and J. Park, "Dietary Factors and Metabolic Syndrome in Middle-Aged Men," Korean Journal of Health Education and Promotion, vol. 35, no. 4, Dec. 2010, pp. 383-394.

[26] K. L. Young, M. Graff, K. E. North, A. S. Richardson, K. L. Mohlke, L. A. Lange, and P. Gordon-Larsen, "Interaction of Smoking and Obesity Susceptibility Loci on Adolescent BMI: The National Longitudinal Study of Adolescent to Adult Health," BMC Genetics, vol. 16, no. 1, Nov. 2015, p. 131.

[27] Y. W. Park, S. Zhu, L. Palaniappan, S. Heshka, M. R. Carnethon, and S. B. Heymsfield, "The Metabolic Syndrome: Prevalence and Associated Risk Factor Findings in the US Population From the Third National Health and Nutrition Examination Survey, 1988-1994," Archives of Internal Medicine, vol. 163, no. 4, Feb. 2003, pp. 427-436.

[28] H. G. Seo, Y. S. Cheong, S. K. Myung, and Y. Kim, "International Tobacco Control Policy Evaluation Survey-Korea," The Journal of the Korean Academy of Family Medicine, vol. 29, no. 11,Oct. 2008, pp. 844-853.

[29] F. S. Facchini, C. B. Hollenbeck, J. Jeppesen, Y. D. I. Chen, and G. M. Reaven, "Insulin Resistance and Cigarette Smoking," The Lancet, vol. 339, no. 8802, May. 1992, pp. 1128-1130.

[30] H. D. Vries, E. Backbier, G. Kok, and M, Dijkstra, "The Impact of Social Influences in the Context of Attitude, Self-Efficacy, Intention, and Previous Behavior as Predictors of Smoking Onset1," Journal of Applied Social Psychology, vol. 25, no. 3, Feb. 1995, pp. 237-257.

[31] M. Monti, A. Monti, G. Murdolo, P. Di Renzi, M. R. Pirro, F. Borgognoni, and G. M. Vincentelli, "Correlation between Epicardial Fat and Cigarette Smoking: CT Imaging in Patients with Metabolic Syndrome," Scandinavian Cardiovascular Journal, vol. 48, no. 5, Agu. 2014, pp. 317-322.

[32] M. C. Carr, "The Emergence of the Metabolic Syndrome with Menopause," The Journal of Clinical Endocrinology & Metabolism, vol. 88, no. 6, Jun. 2003, pp. 2404-2411.

[33] P. M. Janiszewski and R. Ross, "Effects of Weight Loss among Metabolically Healthy Obese Men and Women," Diabetes Care, vol. 33, no. 9, Sep. 2010, pp. 1957-1959.

[34] J. Jennings, M. Muldoon, and M. Hall, "Self-Reported Sleep Quality is Associated with the Metabolic Syndrome," Sleep,vol. 30, no. 2, Oct. 2007, pp. 19-23.

[35] N. Okubo, M. Matsuzaka, I. Takahashi, K. Sawada, S. Sato, N. Akimoto, and S Nakaji, "Relationship between

Self-Reported Sleep Quality and Metabolic Syndrome in General Population," BMC Public Health, vol. 14, no. 1, Jun. 2014, p. 1.

[36] D. J. Buysse, C. F. Reynolds, T. H. Monk, S. R. Berman, and D. J. Kupfer, "The Pittsburgh Sleep Quality Index: A New Instrument for Psychiatric Practice and Research," Psychiatry Research, vol. 28, no. 2, Jun. 1989, pp. 193-213.

[37] J. Miettola, L. K. Niskanen, H. Viinamäki, and E. Kumpusalo, "Metabolic Syndrome is Associated with Self-Perceived Depression," Scandinavian Journal of Primary Health Care, vol. 26, no. 4, Jul. 2008, pp. 203-210.

[38] L. S. Kinder, M. R. Carnethon, L. P. Palaniappan, A. C. King, and S. P. Fortmann, "Depression and the Metabolic Syndrome in Young Adults: Findings from the Third National Health and Nutrition Examination Survey," Psychosomatic Medicine, vol. 66, no. 3, Jun. 2004, pp. 316-322.

[39] E. J. Brunner, H. Hemingway, B. R. Walker, M. Page, P. Clarke, M. Juneja, and A. Apadopoulos, "Adrenocortical, Autonomic, and Inflammatory Causes of the Metabolic Syndrome Nested Case-Control Stud," Circulation, vol. 106, no. 21, Oct. 2002, pp. 2659-2665.

Jeonghee Song
She received M.S degrees in Nursing from the Kosin University. Her main research interests include obese and diabetes.

Jeongwon Han
She received M.S. degrees and Ph.D. in Nursing from the Kyunghee University, South Korea and is currently a professor in the College of Nursing, Kosin University. She is currently published in Marquis Who's Who in the world (33rd) and 2000 Outstanding Intellectuals of the 21st Century. Her main research interests include symptom management of cancer and nurses' motivation.