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Factors Related to Efforts to Enhance Health Behavior Among Patients With Metabolic Disease

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대사성 질환자의 건강행위증진 노력관련 융합연구

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Abstract The purpose of this study was to investigate the convergence factors affecting disease management efforts of the middle-aged population who have comorbidities of all three metabolic diseases: type 2 diabetes, hypertension, and dyslipidemia. This study used raw data from the 2015 community health survey(CHS). A multiple hierarchical regression analysis was performed that the included variables explained 20.1% of the variance in weight-loss efforts, 6.8% of exercise efforts and 5.3% diet efforts respectively. This study revealed associations among gender, socioeconomic status, and behavioral habits of smoking and drinking with disease-management efforts. It is important to design a health service or supportive intervention with consideration of multiple factors for patients with multiple metabolic disease.

Key Words : Convergence, Metabolic disease, Exercise, Diet effort, Weight loss

요 약 본 연구의 목적은 제 2 형 당뇨병, 고혈압 및 이상지질혈증을 복합적으로 가지고 있는 중년 대상자의 체중조절, 운동, 식이조절을 통한 질환관리 노력에 영향을 미치는 융합적 요인을 확인하고자 시행되었다. 본 연구는 2015 년 지역사회 건강 조사 (CHS)의 원시 데이터를 사용했다. 2015년 지역사회건강조사의 총 228,558명 중 연구대상 선정기준에 부합되어 분석에 이용된 대상자는 2,990명의 데이터를 활용하였다. 다중 회귀 분석이 수행되었고 체중조절노력, 운동노력, 식이조절노력 변수의 설명력은 각각 20.1%, 6.8 %, 5.3 %였다. 본 연구의 결과는 대사성 질환이 복합적으로 있는 대상자의 성별, 사회 경제적 상태 및 흡연과 음주의 행동 습관과 체중감소, 운동, 식이조절의 질병 관리 노력의 관계를 보여 주었다. 향후 대사질환을 복합적으로 가지고 있는 환자를 위한 서비스나 중재 프로그램 개발에 요소들을 복합적으로 고려할 것을 제언한다.

주제어 : 융합, 대사성 질환, 운동, 식이노력, 체중감소

1. Introduction

Due to changing lifestyles entailing lack of exercise and overeating, metabolic syndrome has been a growing concern in Korea[1,2]. Of men over 30 years old, 31.9%, of women, 25.6%, and

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of men and women combined, 28.8% have metabolic-syndrome prevalence.

Hypertension, type 2 diabetes, and hyperlipidemia are the most prevalent metabolic diseases affecting the productive population aged 30 to 60[2]. Hypertension disease prevalence is estimated to be 26.9% in the adult population[3] and the majority of this population have comorbidities of other metabolic diseases: type 2 diabetes or dyslipidemia[4].

People with metabolic disease have a great risk of developing complications. Previous studies indicated cardiovascular disease is one of the major complications of metabolic disease and results in disease with high mortality such as heart attack and stroke[5,6]. These are the leading causes of death among the middle-aged adult population in Korea[7]. The treatment of metabolic disease is costly, comprising more than one third of the total domestic medical expenses in Korea. Moreover, the cost of treatment for cardiovascular diseases is continuously increasing[8-10]. Thus, considering the high prevalence of metabolic diseases in elders, management of the disease in the younger population is very important to prevent catastrophic outcomes.

Type 2 diabetes, hypertension, and dyslipidemia are closely related metabolic diseases that often develop as a result of excessive calorie intake and little physical inactivity[1,2]. In Korea, concerns have been raised regarding health behavior in middle aged adults with metabolic disease such as excessive intake of carbohydrates and sodium, and sedentary lifestyles[11-13]. In addition, among middle-aged women, menopause aligns with risk of overweight and obesity and developing metabolic disease[14].

Guidelines for metabolic-disease management indicate that timely interventions with proper lifestyle modification include improved health behaviors with proper weight loss, essential to preventing the development of further complications[15-17]. In addition, a meta-analysis of 13 randomized experimental studies showed that a combination of nutrition and exercise interventions are more effective in reducing metabolic-related factors such as abdominal obesity and systolic blood pressure than are nutrition and exercise interventions alone[18].

Metabolic diseases are chronic; modification in one's daily lifestyle occurs not only through medication, but also through exercise and proper diet[19]. Despite evidence suggesting continuous efforts in lifestyle modification, people in this age group are often less interested in improving their health as they age, rending it more difficult to modify their behavior patterns. The first step in interventions for lifestyle modification for patients with metabolic disease is education. However, it is unknown if education is effective at influencing sustainable disease management over time[20,21].

A comprehensive understanding of factors affecting efforts to manage disease is essential; thus the provision of baseline information on the middle-aged population with metabolic disease could promote healthier lifestyles in this population. Several contextual factors have been identified as determinants of metabolic disease including socio-demographic characteristics and health behavior related factors in middle aged adults[12,13,22,23]. But, previous studies only partially examined the influencing factors in small groups. Using big data and examining diverse variables could reveal a more comprehensive understanding of factors that enable health providers to develop and implement practical interventions for patients with metabolic disease.

To achieve the research objective through the analysis of big data, this study used raw data from the Community Health Survey (CHS), conducted in 2015. CHS has launched to provide population-based estimates of health indicators since 2008. The purpose of this study was to investigate the factors affecting the disease-

management efforts of the middle-aged population who have comorbidities of all three metabolic diseases: type 2 diabetes, hypertension, and dyslipidemia.

2. Method

A retrospective secondary analysis was conducted using data from 2015 CHS, national-wide survey.

2.1 Sample

The data for this study accrued from the 2015 CHS run by the Korean Center for Disease Control and Prevention with 253 community health centers and 36 universities. Trained interviewers conducted 1:1 protocols and computer-assisted personal interviews. The CHS is nationwide survey that targets the adult population, aged 19 and older, and has been conducted annually for 3 months since 2008. The survey questionnaire consists of 11 fields including factors related to demographics, behavior, comorbidities, and quality of life. The quality of survey data is ensured by the Ministry of Health and Welfare, which readministers the survey to a random 10% of participants and retrains interviewers. Of the 228,558 adults who took part in the CHS in 2015, 2,990 adults had all three metabolic diseases: type 2 diabetes, hypertension, and dyslipidemia.

2.2 Independent variables

Independent variables included demographic factors, physical and psychological factors, health-habit factors, and education factors. Demographic factors included age (40s, 50s, and 60s), gender (male/female), education level (less than elementary school, middle school graduate, high school graduate, and college graduate and above), having a spouse (yes/no), income level (less than 1 million, 1~3million and 4 million won and above) and economic activity in the past week (yes/no). Physical and psychological factors included EQ-5D from -1 to 1, perceived level of health status (poor, moderate, or good), perceived level of stress status (very high, high, low, or very low) and perceived body image (very thin, thin, normal, fat, or very fat). Health-habit factors include drinking alcohol (yes, not in the last year, or never drank alcohol) and smoking (yes, not in the last year, or never smoked). Education factors include previous experiences of education regarding disease management for hypertension (none ~ 3 times) and previous experience of education regarding disease management of type 2 diabetes (none ~ 3 times).

2.3 Dependent variables

The dependent variables were disease management efforts including weight loss, exercise, and low-salt diet. Efforts related to weight loss indicated when a person attempted no weight loss, maintained their weight, or worked to lose weight. The scores range from 0 to 2, with higher scores indicating more active efforts at losing weight. Exercise effort is a sum of the number of days in a week of flexibility exercises and the number of days of strength exercises. Score range from 0 to 10 with higher scores indicating more exercise activity. Efforts to eat a low-salt diet are the sum of three items including usual salt-intake levels, the amount of salt added when eating, and the amount of soy sauce intake when eating fried foods. Scores range from 3 to 12 with higher scores indicating a lower salt diet.

2.4 Statistical analysis

We used SPSS version 24.0 to perform data analysis; statistical significance was $p < .05$. A complex sample plan file was used that was developed to ensure representativeness of sampling in this study. We used an ANOVA or

t-test to identify group differences for scores of individual dependent variables. Finally, we performed a multiple hierarchical regression analysis, entering independent variables in four blocks.

3. Results

We used data from 2,990 individuals with multiple metabolic diseases: type 2 diabetes, hypertension, and dyslipidemia.

3.1 General characteristics

Table 1 presents scores of the three efforts of weight loss, exercise, and diet, by sociodemographic,

Table 1. Descriptive of general characteristics of study participants

	Category			Efforts 1 Weight loss			Efforts 2 Exercise			Efforts 3 Diet		
		N	%	M	SD	t/F (p)	M	SD	t/F (p)	M	SD	t/F (p)
Age	40s	288	9.6	1.42	0.839	26.03 (<.001)	2.02	2.593	1.45 (.234)	8.84	1.465	2.52 (.081)
	50s	1033	34.5	1.17	0.91		2.34	2.986		8.99	1.538	
	60s	1669	55.8	1.03	0.922		2.34	3.102		9.05	1.513	
Gender	Male	1474	49.3	1.05	0.915	−3.94 (<.001)	2.67	3.356	6.52 (<.001)	8.76	1.624	−9.16 (<.001)
	Female	1516	50.7	1.18	0.915		1.96	2.598		9.26	1.362	
Education level	6<	1055	35.3	0.99	0.942	13.65 (<.001)	1.78	2.662	27.77 (<.001)	9.04	1.501	1.31 (.268)
	6~12	640	21.4	1.11	0.918		2.11	2.93		9.08	1.476	
	12~15	845	28.3	1.18	0.896		2.67	3.19		8.98	1.524	
	15>	450	15.1	1.29	0.857		3.14	3.311		8.91	1.601	
Having spouse	Yes	2292	76.7	1.12	0.914	0.82 (.411)	2.41	3.065	3.36 (<.001)	8.99	1.522	−1.10 (.273)
	No	698	23.3	1.09	0.929		1.99	2.831		9.07	1.504	
Economic activity	Yes	1713	57.3	1.08	0.924	2.04 (.042)	2.26	2.98	0.99 (.322)	8.95	1.518	2.59 (.010)
	No	1277	42.7	1.15	0.908		2.37	3.065		9.09	1.514	
Household income (10,000won/month)	< 100	847	28.3	1.01	0.936	13.38 (<.001)	1.96	2.857	19.88 (<.001)	9.04	1.568	0.30 (.743)
	100~399	1650	55.2	1.11	0.913		2.28	3.001		9.00	1.499	
	400 >	493	16.5	1.28	0.876		3.02	3.215		8.98	1.496	
Smoking	Everyday	504	16.9	0.89	0.911	14.18 (<.001)	2.21	3.077	12.38 (<.001)	8.54	1.659	32.94 (<.001)
	Sometimes	40	1.3	0.88	0.939		2.58	2.925		8.55	1.782	
	Not in last 1 yr	828	27.7	1.12	0.914		2.83	3.449		8.87	1.614	
	Never smoked	1618	54.1	1.18	0.91		2.06	2.716		9.24	1.362	
Drinking alcohol	Yes	1843	61.6	1.13	0.912	3.74 (.024)	2.52	3.139	18.06 (<.001)	8.84	1.562	31.23 (<.001)
	Not in last 1 yr	596	19.9	1.15	0.92		2.25	3.022		9.29	1.381	
	Never	551	18.4	1.02	0.93		1.65	2.445		9.28	1.424	
EQ-5D	< 0.678	261	8.7	1.06	0.953	−0.98 (.329)	1.53	2.735	−4.78 (<.001)	9.11	1.672	1.16 (.246)
	>= 0.678	2729	91.3	1.12	0.914		2.38	3.032		9.00	1.502	
Perceived level of health status	Bad	1643	54.9	1.09	0.924	1.77 (.170)	1.95	2.851	30.65 (<.001)	9.04	1.554	0.84 (.432)
	Moderate	1054	35.3	1.15	0.904		2.6	3.047		8.96	1.477	
	Good	293	9.8	1.08	0.926		3.23	3.479		9.04	1.453	
Perceived level of stress status	Very high	138	4.6	1.01	0.924	1.27 (.284)	1.68	2.75	6.83 (<.001)	8.91	1.729	2.74 (.042)
	High	761	25.5	1.12	0.935		1.99	2.77		8.89	1.584	
	Low	1421	47.5	1.14	0.906		2.46	3.057		9.04	1.471	
	Very low	670	22.4	1.08	0.919		2.49	3.206		9.1	1.487	
BMI	< 18.5	9	0.3	0.67	0.866	129.64 (<.001)	2.00	3.500	0.33 (.806)	9.33	1.732	3.83 (.009)
	18.5~22.99	563	18.8	0.57	0.764		2.42	3.097		9.16	1.527	
	23.0~24.99	810	27.1	0.97	0.906		2.29	3.027		9.07	1.485	
	>= 25.0	1608	53.8	1.37	0.874		2.28	2.982		8.93	1.526	
Perceived physical fitness of self	Very thin	34	1.1	0.15	0.359	156.07 (<.001)	0.62	1.393	7.41 (<.001)	9.18	1.623	4.14 (.002)
	Thin	178	6	0.34	0.6		1.97	3.075		8.99	1.669	
	Normal	985	32.9	0.75	0.831		2.61	3.221		9.17	1.495	
	Fat	1393	46.6	1.37	0.878		2.3	2.974		8.93	1.484	
	Very fat	400	13.4	1.55	0.809		1.91	2.591		8.92	1.586	
HTN management education	None	2252	75.3	1.08	0.923	4.82 (.002)	2.18	2.966	6.03 (<.001)	9.01	1.497	0.32 (.814)
	1	683	22.8	1.21	0.894		2.72	3.151		9.02	1.59	
	2	49	1.6	1.33	0.899		2.22	2.733		8.9	1.489	
	3	6	0.2	1	0.632		3.5	4.722		9.5	1.378	
DM management education	None	2105	70.4	1.07	0.926	7.17 (<.001)	2.15	2.951	7.81 (<.001)	8.97	1.506	1.72 (.160)
	1	829	27.7	1.21	0.893		2.69	3.151		9.11	1.538	
	2	50	1.7	1.44	0.837		2.4	2.556		8.92	1.55	
	3	6	0.2	1.5	0.548		4.67	5.164		9.33	2.251	

physical, psychological, health-habit, and education-related factors of individuals with metabolic diseases. More than half of study participants (55.8%) were in their 60s and the proportion of men was slightly higher than women. Most participants were not involved in economic activity (57.3%) and the majority had income between 1,000,000 and 3,990,000 won. Nine of ten study participants (90.2%) reported health status of moderate to poor. At present, 19.9% were drinking alcohol and 16.9% were smoking. About two thirds reported being fat or very fat (60.0%) and a large proportion of study participants reported experiencing no education on managing hypertension or type 2 diabetes (75.3% and 70.4%, respectively).

3.2 Correlation analysis

The correlation analysis among continuous variables appears in Table 2; all correlations were weak. Statistically significant correlations emerged between weight loss and exercise (r = .145, p < .001), and exercise and diet (r = .053, p < .001).

3.3 Hierarchical regression analysis

We entered study variables into a four-block model grouping sociodemographic factors in Block 1, physical and psychological factors in Block 2, health-habit factors in Block 3, and education factors in Block 4 (Table 3). The multi-collinearity was examined using variance of the inflation factor (VIF). A VIF greater than 10 indicate serious multi-collinearity problem. Figures ranged between 1.143 and 2.193. The results of Durbin-Watson test indicate no residual correlation of models with 1.927, 1.971 and 1.871 respectfully. The variables included explained 20.1% of the variance on weight-loss effort. The explanatory power for exercise and diet efforts were 6.8% and 5.3%, respectively. Of the four blocks entered, the largest contributor to weight-loss efforts were the physical and psychological factors in Block 2 (F = 32.022, p = .000) and for exercise, demographical factors in Block 1 (F = 22.891, p = .000). Examining the beta scores for individual variables, self-perceived physical fitness was the greatest contributor to the variance for weight-loss effort (β = .294, SE =

Table 2 Pearson's correlation analysis

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Age	1												
2. Education level	−.353**	1											
3. Household income	−.305**	.380**	1										
4. Perceived physical fitness of self	−.146**	.063**	.038*	1									
5. BMI	−.155**	0.035	0.016	.667**	1								
6. Perceived level of health status	−.077**	.210**	.205**	−.039*	−0.031	1							
7. Perceived level of stress status	.171**	−.006	.015	−.029	−.042*	.170**	1						
8. EQ_5D	−.184**	.241**	.270**	−0.021	−.047*	.343**	.253**	1					
9. HTN management education	−0.027	.077**	.069**	0.024	0.000	0.018	−0.026	−0.002	1				
10. DM management education	−0.032	.087**	.062**	0.026	−0.014	−0.022	−0.012	−0.021	.733**	1			
11. Weight loss efforts	−.123**	.116**	.098**	.401**	.326**	0.012	−0.001	0.030	.066**	.084**	1		
12. Exercise efforts	0.015	.164**	.118**	−.021	−0.036	.142**	.074**	.120**	.067**	.081**	.145**	1	
13. Diet efforts	.037*	−.029	−.017	−.053**	−.066**	−.010	.049**	−.028	.003	.034	.020	.053**	1

*p < 0.05, **p < 0.01

Table 3 Hierarchical regression analysis of factors determining disease management efforts

		Efforts 1. Weight loss				Efforts 2. Exercise				Efforts 3. Diet			
		Beta/SE				Beta/SE				Beta/SE			
Block 1 Demographical factors	Age	−.096** .003	−.035 .003	−.042* .003	−.040** .003	.083** .009	.073** .009	.075** .009	.077** .009	.034 .004	.008 .005	−.013 .005	−.012 .005
	Gender	.124** .037	.076** .035	.032 .043	.035 .043	−.076** .121	−.070** .123	−.069** .154	−.066* .153	.185** .062	.195** .062	.100** .078	.101** .078
	Education level	.115** .013	.089** .013	.089** .012	.084** .012	.134** .044	.113** .044	.113** .044	.107** .044	.056* .022	.061** .023	.060** .022	.058** .022
	Having spouse	−.001 .041	.004 .038	.010 .038	.009 .038	−.008 .136	.003 .136	.003 .136	.002 .136	−.001 .069	−.001 .069	.010 .069	.010 .069
	Household income	.059** .001	.060** .001	.054* .001	.051* .001	.087** .003	.068** .003	.066** .003	.063** .003	.003 .002	.003 .002	−.005 .002	−.005 .002
	Economic activity	−.057** .036	−.064** .034	−.069** .034	−.064** .034	−.057** .118	−.080** .120	−.085** .120	−.079** .121	.003 .060	.007 .061	.008 .061	.009 .061
Block 2 Physical & psychological factors	EQ−5D		.023 .111	.016 .111	.017 .111		.058** .392	.050* .393	.051* .393		−.025 .199	−.017 .199	−.017 .199
	Perceived level of health status		.008 .025	.001 .025	.003 .025		.090** .088	.084** .088	.086** .088		.001 .045	.001 .044	.003 .045
	Perceived level of stress status		.012 .020	.008 .020	.008 .020		.026 .071	.026 .071	.027 .071		.058** .036	.048* .036	.047* .036
	Perceived physical fitness of self		.302** .025	.296** .025	.294** .025		.012 .089	.008 .089	.005 .089		−.057* .045	−.059* .045	−.060* .045
	BMI		.118** .007	.118** .007	.121** .007		−.027 .023	−.026 .023	−.023 .023		−.029 .012	−.032 .012	−.030 .012
Block 3 Health habit factors	Drinking alcohol			−.058** .021	−.059* .021			−.068** .076	−.069** .076			.071** .039	.070** .039
	Smoking			.102** .018	.098** .018			.037 .063	.031 .063			.112** .032	.110** .032
Block 4 Education factors	HTN management education				−.005 .045				−.002 .161				−.035 .081
	DM management education				.061 .044				.069** .154				.048 .078
	F(p)	21.75 (.000)	63.02 (.000)	56.29 (.000)	49.74 (.000)	22.89 (.000)	17.10 (.000)	15.59 (.000)	14.49 (.000)	15.48 (.000)	11.03 (.000)	12.43 (.000)	10.99 (.000)
	R^2	.042	.189	.197	.201	.044	.059	.064	.068	.030	.039	.051	.053
	Durbin−Watson	1.927				1.971				1.871			

$*p < 0.05$, $**p < 0.01$

.025), followed by BMI (β = .121, SE = .007) and smoking (β = .098, SE = .018). Education level was the biggest contributor to exercise (β = .107, SE = .044) as was smoking for diet effort (β = .110, SE = .032).

4. Discussion

Middle−aged adults with metabolic disease have a tremendous risk for complications leading to high mortality; thus, continuous health care as well as self−management promise a healthier old age. Little is known about the factors affecting efforts for disease management. Accordingly, the current study examined multidimensional factors using big data from CHS that may influence the three disease−management efforts of weight loss, exercise, and diet among the middle−aged population with all three metabolic diseases of type 2 diabetes, hypertension, and dyslipidemia in Korea.

Study findings indicates a few common factors influencing the three efforts of weight loss, exercise, and diet. Gender and alcohol consumption were variables showing statistically significant differences in all three efforts. This pattern also emerged in the correlation analysis, showing weak and no statistically significant correlation among scores of the three efforts. Although these three efforts are essential for disease management, high barriers exist to

maintaining all three efforts in people's daily lives.

Researchers in a previous review concluded that it was more effective to promote single interventions targeting exercise or diet as a behavior change[24]. In addition, it is unlikely these three metabolic diseases occur at the same time; thus, people may focus on the most concerning disease. Future researchers should to use multiple-health-behavior-change interventions for patients from the onset of metabolic disease[25]. These multiple-health-behavior-change interventions are designed to intervene in physical activity and diet and would eventually reduce the risk of developing complications.

Regression analysis showed that education for disease management was not a powerful predictor of patients making effort to manage their diseases. Some degree of influence of type 2 diabetes education was identified for weight control and exercise, but not for diet. This finding implies that educational interventions are ineffective for patients with metabolic diseases. Clearly, self-management education is a critical element; however, incorporating personal needs and targeting personal preferences is essential and has been emphasized[26]. In Korea, most public health care centers provide education on disease management at a very low cost[27] as a nationwide health-promotion strategy. However, most educational programs are uniform, which could hinder the effectiveness of an intervention.

The most significant predictor of weight-loss effort was perceived self-body image. Clearly, recognition of one's own body plays an important role in determining a person's weight control as a motivator. However, compared to young people, middle-aged adults rarely accurately identify their body as overweight or obese[28-30]. This study identified that perceived physical fitness was a stronger predictor of weight-loss effort than body-mass index, implying an underrecognition or lack of interest in self-perceptions of body image. A recent review suggested application of behavior-change-techniques and persuasive-system-design principles to stimulate motivation[31]. Knowing the significant influence of motivation on efforts to manage disease, future interventions should consider using these strategies.

Examining with EQ-5D, the finding of this study identified that quality of life (QoL) was only statistically significant variables for exercise efforts. It can be explained the attribute of concept QoL. The contents of EQ-5D tool were mainly regarding individuals capability to lead daily life without assistant from others. Regular exercise is an important components of disease management in metabolic disease which has close relationship with quality of life[32]. In other words, when exercise is integrated into health habits with adequate physical function, the quality of life of the subject could be improved.

Interestingly, metabolic patients with previous and current experiences of smoking and drinking alcohol showed better effort for weight loss and exercise. Moreover, smoking was a statistically significant factor affecting weight loss and diet effort and drinking alcohol influenced all three efforts. Diet, in particular, those health-habit variables, were of secondary significance in that metabolic-disease patients who have never experienced drinking alcohol and smoking were more likely to work to eat a healthy diet. These findings indicate an association between disease-management behavior and the poor health habits of smoking and drinking alcohol.

In addition, previous research identified relationships of smoking and alcohol to deterioration of metabolic disease, increasing the risk of developing cardiovascular complications[33,34]. Therefore, metabolic-disease patients with poor behavioral habits of drinking and smoking should be classified as a group urgently in need of intervention. Education was the most significant factor influencing exercise effort, followed by

perceived level of physical health and current economic activity. This outcome aligns with findings from a previous study in Chine that showed that those with low socioeconomic status had poor disease control and were more likely to develop complications among diabetes patients[35]. Possible explanations are that one's level of interest in a healthy life and accessibility to health care services focused on health and healthy behaviors increased as the level of socioeconomic status increased[30].

People engaged in current economic activity would have a greater chance to be exposed to information regarding the importance of physical activity while participating in social activities. In addition to public health education, a disease-management program based on socioeconomic status is encouraged.

Hierarchical regression analysis indicated that gender was the second strongest factor affecting diet effort. One possible explanation is the culture surrounding gender roles in Korea. Middle-aged men mostly depend on women to prepare meals[36]. Hence, it is less likely for men to consider healthy diet as something they can modify. The provision of simple recipes for low-salt meals could induce their interest. Further studies are needed to develop special strategies to encourage men to make efforts to modify their diet habits.

Unlike other efforts, income level and economic activities were not significant predictors for diet efforts. It may reflect the stronger motivation required for diet efforts for individuals with metabolic disease. Previous studies, on the other hand, have reported that subjects with low level of socio-economic status poor economic would have poor eating habits with cheap and restricted choice of foods which lead to unhealthy diet[37]. Thus, further research will be needed to confirm these different results.

5. Conclusion

This study was conducted to provide comprehensive understanding of factors affecting disease management efforts in patients with multiple metabolic diseases. Using data from national-wide survey, evidences for future implication for metabolic disease were produced. The findings of this study revealed relations of gender, socio-economic status and behavioral habits of smoking and drinking to disease management efforts in patients with multiple metabolic diseases. Future intervention needs to consider these components in its implication.

This study aimed at identifying determinants affecting the three most important efforts for disease prevention and management in middle aged adults. Middle age is the period of transition to old age, and it is judged to be more accessible and effective group than old age, which is more difficult to improve lifestyle. Therefore, it is meaningful to provide fundamental and comprehensive information as various interventions should design to provide individualized and to target multiple life style behaviors for patients with metabolic diseases.

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