Predictors of Health Promotion Behaviors Among Working Adults at Risk for Metabolic Syndrome

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Background: Metabolic syndrome has a high global prevalence, affecting 26% of South Koreans. Lifestyle modifications have shown benefits in studies involving health behavior enhancement, specifically through workplace eating and exercise interventions. However, workplace interventions focusing on health behaviors have been inadequately explored.

Objectives: This study examined factors affecting health promotion behaviors of workers at high risk of metabolic syndrome by applying Theory of Planned Behavior constructs (attitude, subjective norm, perceived behavioral control, and intention).

Methods: This correlational cross-sectional study collected survey data from 164 hotel workers in South Korea. The study applied factor analysis and structural equation modeling for the data analysis.

Results: Analysis revealed five health promotion behaviors: exercise, making healthy food choices, avoiding fatty foods, eating a nutritious and balanced diet, and eating regular moderate meals. Participants were grouped as total participants, those with one risk factor, and those with two risk factors. In the "total" group, four behaviors were influenced by perceived behavioral control: exercise, making healthy food choices, eating a nutritious and balanced diet, and eating regular moderate meals. In the "one risk factor" group, intention and attitude influenced the eating regular moderate meals behavior, and two other behaviors were influenced by perceived behavioral control: exercise and eating a nutritious and balanced diet; in the "two risk factor" group, only perceived behavioral control directly affected exercise.

Discussion: Perceived behavioral control was a key predictor of health behaviors, and theory constructs partially explained behaviors. Perceived behavioral control influenced four behaviors and influenced exercise in all three groups. Also, theory constructs showed a greater effect on behaviors in the one risk factor group than in the two risk factor group, indicating that participants with one risk factor more effectively managed their behaviors on their own and with healthcare providers' support. Occupational health providers should conduct early assessments of workers showing metabolic syndrome risk factors to identify their particular risks, intention, and behaviors. As the number of risk factors affects behaviors and perceived behavioral control primarily influences exercise, these findings should be incorporated in metabolic syndrome interventions.

Key Words: health behavior • health promotion • metabolic syndrome • occupational health nursing • workers

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Over the past decade, worker health research has turned its attention to metabolic syndrome, as it is found in about 30% of the world's population (de Carvalho Vidigal et al., 2013; Moore et al., 2017; Saklayen, 2018). In South Korea, 26% of the population was reported to have metabolic syndrome in 2017, and its prevalence has been increasing (Korean National Health Insurance Service, 2017). In response to the high prevalence of metabolic syndrome in South Korea and its public health costs, a municipal-level metabolic syndrome program has been conducted across the country; its goal is to prevent and manage the condition among those having risk factors for it or diagnosed with it as well as to reduce healthcare costs (K. Y. Kim & Yun, 2019; Y.-H. Lee et al., 2013).

Metabolic syndrome is known to be caused by a combination of social, economic, occupational, psychological, and genetic factors as well as unhealthy behaviors such as smoking, drinking alcohol, inappropriate diet, and lack of exercise (Johnson et al., 2015; J. A. Lee et al., 2017; Liu et al., 2017). Given the fact that work constitutes most of adults' daily lives and that many workers have been found to have or be at risk of metabolic syndrome, studies have examined the benefits of lifestyle modification efforts in enhancing workers' health behaviors, such as exercise and diet (Lucini et al., 2016). In particular, improvements in exercise and diet have been most

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effective in reducing risk of metabolic syndrome overall and in workplace settings (Choi et al., 2017; G.-H.Lee et al., 2018; Watanabe et al., 2017).

To date, however, only a limited number of studies have focused on sustainable healthy lifestyles for metabolic syndrome patients, and those studies have had difficulties such as high attrition rates (Alefishat et al., 2017; Jahangiry et al., 2014; Susin et al., 2016). In addition, many studies of metabolic syndrome in the workplace have been confined to prevalence analysis and exploration of risk factors (Johnson et al., 2015; K. Y. Kim & Yun, 2019; Park, 2020; Pietroiusti et al., 2010) or development or modification of clinical parameter criteria for interventions (Choi et al., 2017; H. J. Kim et al., 2016).

This study was conducted to investigate workers' health promotion behaviors (HPB) with a focus on exercise and diet as well as related factors. Guided by Ajzen's (1991) Theory of Planned Behavior (TPB), this study aimed to identify factors affecting the HPB of workers at high risk of metabolic syndrome and, more specifically, investigate whether TPB constructs such as intention to promote exercise and diet in the workplace. Ajzen formulated the TPB to offer a theoretical framework for determining factors that influence decision-making about behavior as well as for predicting behavior. It has been widely applied to individual behaviors, including health behaviors such as exercise and eating habits (Brooks et al., 2017; Fishbein & Ajzen, 2010; Genrich et al., 2020; Jang & Song, 2020). Thus, this study's specific objectives were to (a) identify specific TPB constructs influencing intention and HPB in high-risk workers and (b) differentiate between intention and specific HPB exhibited by workers according to the number of metabolic syndrome risk factors present.

METHODS

Conceptual Framework

As a systematic examination of the factors affecting HPB in the workplace required a comprehensive theoretical framework, this study applied the TPB published by Ajzen (1991; see Figure 1). Widely used as a theoretical framework in the health sciences, the TPB can identify factors influencing behavior decisions and predicting behavior (Fishbein & Ajzen, 2010). Specifically, the theory constructs addressed in this study included attitude toward behavior, subjective norm, perceived behavioral control (PBC), intention, and behavior (Ajzen, 1991).

Study Design and Participants

This correlational cross-sectional study was conducted at a hotel in an urban area of South Korea where over 400 workers received annual health examinations between January and August 2014. The criteria for recruiting participants were based on the guidelines of the National Cholesterol Education Program Adult Treatment Panel-III modified for Koreans: (a) fasting blood sugar over 100 mg/dl, a history of diabetes, or taking diabetes medication; (b) blood pressure over 130/85 mm Hg; (c) fasting triglyceride level over 150 mg/dl; (d) fasting high-density lipoprotein (HDL) cholesterol level below 40 mg/dl (men) or 50 mg/dl (women); and (e) waist circumference over 90 cm (men) or over 85 cm (women). Of these five risk factors for metabolic syndrome, workers who exhibited one or two characteristics were eligible to participate as high-risk workers; those who had three or more risk factors were excluded because they were already considered to have metabolic syndrome.

A total of 168 workers at high risk for metabolic syndrome consented to participate in this study and complete survey questionnaires voluntarily. Of these, four participants were excluded from the analysis: three who did not complete all the survey items and one who withdrew during survey administration. Consequently, 164 participants were included in the study analysis.

The target sample size for the study was calculated using the G*Power 3.1 program. To demonstrate significance in multiple linear regression modeling, a significance level of .05, an effect size of .10, a power of 80%, and four expected predictors were assumed. Allowing for a 10% dropout rate, the target sample size was 138. The 164 participants whose data were analyzed exceeded the target sample size.

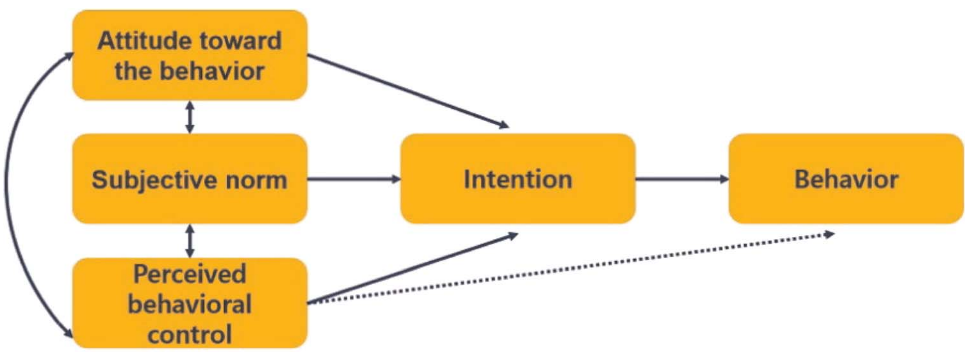

FIGURE 1. Theory of planned behavior (reproduced from Ajzen, 1991).

Data Collection

Data collection was conducted in September and October 2014. A researcher collected data using a structured survey administered in a private office. In an individual session lasting about 30 minutes, participants signed an informed consent form, completed the questionnaires by themselves, and received compensation in the form of customized information and counseling about their body mass index, exercise, and diet.

Measures

The questionnaires contained a total of 64 items, including questions regarding sociodemographic characteristics, HPB (exercise and diet), and relevant TPB constructs (attitude, subjective norm, PBC, and intention). Before data collection, these questions were reviewed for content validity by five experts, including three nursing professors and two family medicine physicians.

Demographic and Health-Related Characteristics Demographic and health-related items included age; gender; educational level; marital status; occupation; cumulative years in occupation; subjective health status; current disease; smoking status; alcohol consumption; metabolic syndrome risk factors; and family history, perception, and educational experience of metabolic syndrome. In addition, a researcher obtained information on participants' risk factors, including test results for blood pressure, fasting blood sugar, triglycerides, HDL, and waist circumference from a 2014 annual medical examination.

HPB A modified version of Kang's (2010) measure was used to assess participants' HPB concerning exercise and diet. Specifically, only questions focusing on exercise and diet were extracted from Kang's original measure. The modified instrument consisted of 7 questions for exercise and 18 questions for diet. It employed a 5-point Likert scale ranging from *not at all times* (−2 points) to *sometimes* (0 point) to *always* (+2 points). The average score for the measure was calculated by dividing the summed score by the number of questions and ranged from −2 to +2. The higher the HPB score, the better the performance of health promotion activities. The measure's reliability in this study was Cronbach's α = .93.

TPB Constructs Related to HPB The questions regarding attitude toward HPB, subjective norm, PBC, and intention were extracted from Plotnikoff et al.'s (2013) measure for exercise and Payne et al.'s (2004) measure for diet. They were translated and modified for use in Korea. The average score for each construct was calculated by dividing the summed score for the construct by the number of associated questions and ranged from −3 to +3.

Attitude Toward HPB

Participants' attitudes toward HPB were measured using two questions on exercise and five questions on diet. The questions employed a 7-point Likert scale ranging from *very* (−3 points) for negative questions to *average* (0 points) to *very* (+3 points) for positive questions. The higher the attitude score, the more positive the attitude toward HPB. The reliability of these questions in this study was Cronbach's α = .92.

Subjective Norm

Participants' subjective norm for the HPB was assessed using two exercise questions and two diet questions. These questions used a 7-point Likert scale ranging from *strongly disagree* (−3 points) to *average* (0 points) to *strongly agree* (+3 points) —the higher the subjective norm score for HPB, the greater the compliance with the subjective norm. The reliability of these questions in this study was Cronbach's α = .92.

PBC

Participants' PBC concerning the HPB was evaluated using four questions for exercise and three questions for diet. The questions employed a 7-point Likert scale ranging from *very unsure* (−3 points) to *average* (0 points) to *very sure* (+3 points). The higher the PBC score, the greater the perception of the ease of performing the HPB. The reliability of these questions in this study was Cronbach's α = .95.

Intention

Participants' intention to perform HPB was measured using one question for exercise and one for diet. These questions employed a 7-point Likert scale ranging from *strongly disagree* (−3 points) to *average* (0 points) to *strongly agree* (+3 points). The higher the intention score, the greater the likelihood of performing the HPB. The reliability of these questions in this study was Cronbach's α = .87.

Data Analysis

The data were analyzed using Stata Statistical Software Release 16 (StataCorp, 2019). Descriptive statistics were performed for all study variables. Factor analysis was used to determine how many TPB constructs affected HPB. All 25 items of the HPB measure were identified as good indicators of HPB using principal components analysis, in which each item was found to have a loading above .40 (Acock, 2018). The Kaiser–Meyer–Olkin (KMO) and Bartlett's sphericity tests were conducted; the KMO test measures sampling adequacy. Bartlett's test evaluates whether correlations among variables are strong enough to support the factor model. In the KMO test, values exceeding 0.7 indicate satisfactory sampling adequacy (Kaiser, 1970), and in this study, the KMO value was 0.898. In addition, Bartlett's sphericity test produced significant values and supported the feasibility of factor analysis ($p < .001$; Bartlett, 1954). Factor analysis results revealed the presence of five components with eigenvalues exceeding 1: exercise, making healthy food choices, avoiding fatty foods, eating a nutritious and balanced diet, and eating regular moderate meals.

In addition, structural equation modeling was used to identify relationships among five specific HPB, intention, and other TPB constructs (attitude, subjective norm, and PBC) in three target groups: those having one risk factor for metabolic syndrome, those having two risk factors, and all study participants.

Ethical Considerations

This study was conducted after university institutional review board review and approval (IRB No. 79-22). All participants were provided with an explanation of the study purpose and procedures, the risks and benefits of participation, the right to leave the study at any time, compensation, and protection

TABLE 1. Sociodemographic Characteristics (*N* = 164)

Variable		Categories	*n* (%) or *M* (*SD*)
Gender		Male	137 (83.54%)
		Female	27 (16.46%)
Age (year)		20–29	28 (17.07%)
		30–39	56 (34.15%)
		40–49	67 (40.85%)
		50–59	13 (7.93%)
Educational level		≤ Middle school	1 (0.61%)
		High school	31 (18.90%)
		College or university	128 (78.5%)
		Graduate levels	4 (2.44%)
Marital status		Yes	116 (70.73%)
		No	48 (29.27%)
Occupation		Service staff	65 (39.63%)
		Cook	99 (60.37%)
Cumulative years in the occupation		<5	22 (13.41%)
		5–9	26 (15.85%)
		10–14	37 (22.56%)
		15–19	37 (22.56%)
		≥20	42 (25.61%)
Subjective health status		Very unhealthy	1 (0.61%)
		Unhealthy	23 (14.02%)
		Average	81 (49.39%)
		Healthy	56 (34.15%)
		Very healthy	3 (1.83%)
Disease		Yes	24 (14.63%)
		No	140 (85.37%)
Family history of metabolic syndrome		Yes	64 (39.02%)
		No	100 (60.98%)
Perception of metabolic syndrome		Yes	100 (60.98%)
		No	64 (39.02%)
Educational experience of metabolic syndrome		Yes	36 (21.95%)
		No	128 (78.05%)
Smoking status		Yes	62 (37.80%)
		No	102 (62.20%)
Alcohol consumption		Yes	96 (58.54%)
		No	68 (41.46%)
Risk factors	Blood pressure	Systolic	124.77 (9.48)
		Diastolic	79.48 (5.36)
	Fasting blood sugar		97.72 (15.54)
	Fasting triglyceride		132.45 (80.23)
	HDL	Male	55.07 (10.70)
		Female	60.07 (14.12)
	Waist circumference	Male	84.12 (7.72)
		Female	74.85 (8.27)

Note. HDL = fasting high-density lipoprotein cholesterol.

of personal information. All the participants voluntarily enrolled in the study.

RESULTS

The sociodemographic characteristics of study participants are summarized in Table 1. Most of the participants were male individuals (82%), mid-young adults (average age = 38.7 years), college graduates (76.6%), and married (71.3%). As to occupation, over 60% of the participants were cooks, and the cumulative occupation duration most commonly reported by participants (25.7%) was "over 20 years." Also, about 50% of participants stated that their subjective health condition was "average," 84.4% reported no disease, and 61.7% said they had no family history of metabolic syndrome. Although about 80% of participants said they were aware of metabolic syndrome, most (78.1%) reported having no education about metabolic

TABLE 2. Confirmation of Five Health Promotion Behaviors

Health promotion behavior item	Exercise	Making healthy food choices	Avoiding fatty foods	Eating a nutritious and balanced diet	Eating regular moderate meals
21 Exercise so hard to sweat two or three times a week.	.922				
20 Perform aerobic exercises such as running, swimming, and cycling more than three times a week.	.899				
22 Exercise to strengthen his muscles, including push-ups, dumbbells, and sit-ups, two to three times a week.	.887				
23 Exercise to improve my flexibility, such as stretching and gymnastics, more than three times a week.	.825				
19 Do regular exercise more than 30 minutes a day more than five times a week.	.815				
24 Increase the amount of physical activity in our daily lives intentionally such as using the elevator rather than stairs.	.707				
25 Perform to control the actual weight of meals, such as regular exercise and control of what you eat.	.687				
17 Choose food with low calorie content in case of the food of the same ingredients.		.742			
18 Reduce going out to have meals.		.701			
16 When you choose food, buy it by looking at the ingredients of the food.		.669			
11 Reduce the intake of white sugar or flour.		.645			
8 Drink only low-fat milk or nonfat milk.		.617			
13 Avoid salty food.		.612			
12 Avoid instant food, chemical condiments, or foods that contain preservatives.		.608			
15 Reduce coffee or tea containing caffeine.		.579			
5 Reduce the consumption of fried foods.			.738		
7 Avoid trans fatty foods such as hamburgers, pizza, French fries, and donuts.			.731		
6 When you choose meat, choose low-fat meat.			.683		
3 Take evenly balanced foods every day.				.701	
9 Eat enough beans and fish.				.582	
14 Reduce snacks other than meals.				.523	
10 Eat multigrain rice such as brown rice rather than white rice.				.500	
4 Eat enough fresh fruits and vegetables every day.				.485	
1 Eat regular meals three times a day.					.674
2 No overeating at meals.					.658

syndrome. Over 60% of the participants were nonsmokers, and about 40% reported no alcohol consumption. In terms of metabolic syndrome risk factors, the average value for each risk factor was within the normal range. However, each risk factor showed a large variation in minimum and maximum values across participants; fasting triglyceride showed the largest variation in values among the factors. The average risk factor value for systolic blood pressure was 124.77 mm Hg (SD = 9.48), diastolic blood pressure was 79.48 mm Hg (SD = 5.36), fasting blood sugar was 97.72 mg/dl (SD = 15.54), and fasting triglyceride was 132.45 mg/dl (SD = 80.23). Male individuals' average HDL value was 55.07 mg/dl (SD = 10.70), and female individuals' average HDL value was 60.07 mg/dl (SD = 14.12). Also, male individuals' average waist circumference was 84.12 cm (SD = 7.72), and female individuals' average waist circumference was 74.85 cm (SD = 8.27).

Five HPB

In the factor analysis, five components—exercise, making healthy food choices, avoiding fatty foods, eating a nutritious and balanced diet, and eating regular moderate meals—explained 39.11%, 10.34%, 7.62%, 4.88%, and 4.73% of the variance, respectively; together, the five components explained 66.67% of the variance in the items. A scree plot showed a clear break after these five components. Each of the five components represented a subgroup of items on the HPB measure (see Table 2). Specifically, "exercise" involved items for exercise duration and type, regularity, willingness, and weight control, and "making healthy food choices" involved items for selection of healthy foods (e.g., low calorie), reducing seasoning (e.g., salt, sugar) and caffeine, and reducing eating out. "Avoiding fatty foods" involved items for consumption of high-fat foods. "Eating a nutritious and balanced diet" involved items for consumption of foods with various ingredients (e.g., multigrain rice, vegetables) and balancing eating (e.g., eating evenly balanced foods every day, reducing snacks). Last, "eating regular moderate meals" involved eating three meals per day and avoiding overeating.

Three TPB Constructs' Effects on Intention

Based on structural equation modeling, Table 3 shows the effects of three TPB constructs—attitude, subjective norm, and PBC—on intention to perform the five HPB. The total participant group, the group having one risk factor, and the group having two risk factors all showed the same result—that intention was significantly influenced only by PBC ($p < .05$; see Table 3). Attitude and subjective norm showed no significant effect on intention.

TABLE 3. Estimates for Effects of Attitude, Subjective Norm, and Perceived Behavioral Control on Intention Among Five Behaviors

		Subjects											
		Total (N = 164)				Those who have one risk factor (n = 98)				Those who have two risk factors (n = 66)			
HPB		b	SE	95% CI		b	SE	95% CI		b	SE	95% CI	
EX	Direct/total												
	Attitude	.061	.058	−.052	.174	.021	.082	−.139	.181	.095	.086	−.074	.264
	Subjective norm	.056	.055	−.051	.163	.152	.091	−.026	.331	−.046	.069	−.180	.089
	PBC	.780	.062	.658	.901	.795	.059	.680	.910	.742	.112	.522	.962
HE	Direct/total												
	Attitude	.061	.059	−.051	.172	.021	.082	−.139	.181	.095	.086	−.073	.264
	Subjective norm	.056	.056	−.054	.166	.152	.091	−.025	.330	−.046	.071	−.185	.094
	PBC	.780	.063	.656	.904	.795	.060	.677	.913	.742	.117	.513	.971
AV	Direct/total												
	Attitude	.061	.058	−.053	.175	.021	.083	−.142	.184	.095	.084	−.070	.260
	Subjective norm	.056	.056	−.055	.167	.152	.094	−.032	.336	−.046	.071	−.184	.093
	PBC	.780	.063	.656	.904	.795	.061	.675	.915	.742	.117	.512	.972
EA	Direct/total												
	Attitude	.061	.056	−.049	.170	.021	.081	−.137	.180	.095	.083	−.067	.257
	Subjective norm	.056	.055	−.053	.165	.152	.089	−.023	.327	−.046	.068	−.180	.088
	PBC	.780	.065	.653	.906	.795	.060	.677	.913	.742	.116	.515	.969
RE	Direct/total												
	Attitude	.061	.057	−.052	.173	.021	.077	−.130	.172	.095	.084	−.069	.260
	Subjective norm	.056	.056	−.054	.165	.152	.089	−.023	.328	−.046	.069	−.182	.090
	PBC	.780	.063	.657	.903	.795	.061	.675	.914	.742	.115	.516	.968

Note. Bold numbers indicate $p < .05$. SE = standard error; CI = confidence interval; HPB = health promotion behavior; EX = exercise; HE = making healthy food choices; AV = avoiding fatty foods; EA = eating a nutritious and balanced diet; RE = eating regular moderate meals; PBC = perceived behavioral control.

Four TPB Constructs' Effects on HPB

Unlike the results for intention, the results for HPB varied depending on the participant group (see Table 4). Intention was not a reliable predictor of engagement in HPB, as only the influence of intention on "eating regular moderate meals" in the group having one risk factor was found to be statistically significant ($p < .05$). Also, no TPB constructs significantly influenced "avoiding fatty foods" regardless of participant group (Table 4).

For the total participant group, only PBC significantly influenced four HPB: exercise, making healthy food choices, eating a nutritious and balanced diet, and eating regular moderate meals. In addition, the influence of attitude on eating regular moderate meals was statistically significant ($p < .05$). Among the three participant groups, the group having one risk factor showed significant influences of three TPB constructs on three HPB (Table 4). The effects of PBC on two HPB (exercise and eating a nutritious and balanced diet) and of intention and attitude on one HPB (eating regular moderate meals) were significant. Also, the indirect effect of PBC on eating regular moderate meals was significant ($p < .05$). As opposed to the group having one risk factor, the group having two risk factors showed only one significant result: the significant influence of PBC on exercise.

DISCUSSION

The study's results showed that the TPB partially explained HPB in hotel workers. For both occupational healthcare providers and researchers, our findings provide insights into the importance of identifying the number of metabolic syndrome risk factors and the types of HPB exhibited by workers. Of the TPB constructs (Figure 1), PBC showed a significant association with four HPB, excluding only avoiding fatty foods. In addition, PBC significantly influenced exercise in all three risk factor groups, and eating regular moderate meals was influenced by both attitude and PBC in the total participant group.

Based on these findings, PBC should be emphasized in future metabolic syndrome interventions research to improve health behaviors. Notably, PBC influenced intention for all five HPB, whereas attitude and subjective norm showed no

TABLE 4. Estimates for Effects of Attitude, Subjective Norm, Perceived Behavioral Control, and Intention on Five Behaviors

	Subjects											
	Total (*N* = 164)				Those who have one risk factor (*n* = 98)				Those who have two risk factors (*n* = 66)			
HPB	*b*	*SE*	95% CI		*b*	*SE*	95% CI		*b*	*SE*	95% CI	
EX Total												
Intention	.062	.083	–.101	.224	.058	.119	–.176	.292	.106	.134	–.157	.370
Attitude	.006	.078	–.147	.159	.040	.101	–.157	.238	–.011	.126	–.259	.237
Subjective norm	–.045	.077	–.197	.106	–.144	.109	–.357	.070	.041	.102	–.158	.240
PBC	.436	.057	.324	.548	.477	.072	.336	.617	.412	.083	.250	.576
HE Total												
Intention	–.070	.083	–.233	.092	–.213	.112	–.432	.006	.130	.100	–.066	.326
Attitude	–.020	.056	–.130	.090	–.015	.083	–.178	.147	.012	.085	–.155	.179
Subjective norm	.019	.061	–.100	.138	–.064	.089	–.238	.110	.095	.082	–.066	.255
PBC	.125	.055	.017	.234	.143	.076	–.007	.293	.127	.078	–.026	.281
AV Total												
Intention	.031	.088	–.142	.204	–.036	.140	–.310	.237	.138	.100	–.057	.334
Attitude	–.015	.068	–.150	.119	.038	.090	–.137	.214	–.059	.099	–.253	.135
Subjective norm	–.006	.062	–.128	.116	–.083	.106	–.292	.125	.059	.065	–.068	.186
PBC	.075	.059	–.041	.191	.120	.086	–.048	.288	.040	.088	–.132	.212
EA Total												
Intention	.068	.103	–.133	.270	.056	.106	–.151	.264	.093	.194	–.287	.473
Attitude	–.003	.068	–.137	.132	.036	.091	–.143	.214	–.049	.120	–.283	.186
Subjective norm	.007	.070	–.131	.144	–.022	.098	–.215	.169	.031	.104	–.173	.234
PBC	.147	.062	.025	.270	.170	.083	.007	.334	.126	.103	–.077	.326
RE Total												
Intention	.137	.080	–.021	.294	.227	.103	.026	.428	.059	.133	–.202	.320
Attitude	–.127	.057	–.239	–.016	–.161	.078	–.313	–.009	–.056	.090	–.233	.121
Subjective norm	.090	.049	–.006	.186	.080	.079	–.074	.234	.103	.060	–.014	.220
PBC	.129	.054	.023	.235	.100	.069	–.035	.236	.168	.092	–.012	.348

Note. Bold numbers indicate $p < .05$. SE = standard error; CI = confidence interval; HPB = health promotion behavior; EX = exercise; HE = healthy eating habits; AV = avoiding fatty foods; EA = eating a nutritious and balanced diet; RE = eating regular moderate meals; PBC = perceived behavioral control.

significant results. Findings reported in the literature were partially supported by our study results and somewhat inconsistent. For example, in using the TPB to investigate intention and health behaviors among those at high risk of or having metabolic syndrome, Jang and Song (2020) reported that attitude, subjective norm, and PBC all influenced intention regarding health behaviors. In a similar assessment of individuals with obesity (body mass index > 30 kg/m^2), Chevance et al. (2017) reported that, although attitude, subjective norm, and PBC influenced intention for both physical activity and eating behaviors, the actual health behaviors were affected by different TPB constructs; specifically, attitude, PBC, and intention influenced physical activity, whereas subjective norm and intention influenced eating behaviors. Furthermore, Ferreira and Pereira (2017) reported that among Type 2 diabetes patients, intention to exercise was influenced by attitude and PBC. That study also found that intention, attitude, and PBC influenced health behaviors (Ferreira & Pereira, 2017). Overall, the relatively few metabolic syndrome studies that have applied the TPB to physical activity and exercise have produced inconsistent findings.

In our study, data analysis revealed that TPB constructs—particularly PBC—showed a more pronounced effect on HPB in participants with one metabolic syndrome risk factor than in those with two risk factors. This finding indicates that those in the one risk factor group were more effectively managing their HPB independently and with the support of healthcare providers. The results suggest that individuals in the early stage of metabolic syndrome could more readily benefit from engaging in HPB. Moreover, they indicate the need for intervention strategies customized according to the number of risk factors present. As interventions for preventing and managing metabolic syndrome, potentially effective options include a peer-led support program emphasizing advisement on both diet and physical activity (Sanee et al., 2017) and a community-wide therapeutic intervention focused on lifestyle modification concerning health screening, exercise, low-calorie diet, and health education (Choo et al., 2016).

Although lifestyle intervention programs targeting individuals at high risk of or having metabolic syndrome have proven their effectiveness in reducing the risk factors for the condition, most studies have focused only on the differences between intervention and control groups (Choi et al., 2017; Lo et al., 2017; Watanabe et al., 2017). The differences within target groups, such as variations in the number of risk factors, have been little examined, and such examination is key to optimizing the success of interventions. Some previous studies, such as Alefishat et al. (2017) and Lo et al. (2017), have concluded that many metabolic syndrome risk factors were not significantly related to health behaviors. However, the preliminary data assessment performed by Alefishat et al. indicated that the number of risk factors could be significant. In addition, in their study evaluating lifestyle interventions for people at risk for metabolic syndrome, Lo et al. (2017) found that data for their control group showed an association between the number of risk factors and health behavior modification. Based on these findings of partial effects of the number of risk factors on health behaviors, future researchers should investigate differences among study participants according to the number of risk factors to support development of more effective interventions for people at risk of or having metabolic syndrome.

Similar to previous research, our study found that PBC is a key predictor of both intention to engage in health behavior and engaging in the behavior. However, because of inconsistent findings, the relationships of the TPB constructs to the health behaviors of those at high risk of or having metabolic syndrome remain uncertain. Furthermore, the literature lacks replicated studies targeting the same participants using the same approach. These limitations of previous studies complicate the application of TPB constructs to HPB research, as it is unclear which constructs should be emphasized in future interventions to improve health behaviors efficiently.

Strengths and Limitations

One strength of our study is that it examined the TPB constructs' influences on HPB in three distinct participant groups. This approach revealed that PBC and other TPB constructs showed stronger effects on HPB in individuals with one risk factor for metabolic syndrome than those with two risk factors. Considering that those in the one risk factor group were in the early stage of metabolic syndrome, this appears to be the period when TPB constructs can be most effectively applied to motivate individuals to engage in HPB. Another strength of the study was its use of factor analysis to identify effective HPB—for example, "strengthening PBC for exercise," "making healthy food choices," "eating a nutritious and balanced diet," and "eating regular moderate meals."

The study has a few limitations deriving from the study methodology. First, this cross-sectional study lacked comparisons of the same participants' data over time. Thus, causal relationships could not be determined. Second, this study involved a group of workers employed by a single company in one large urban area of South Korea. Thus, our results may be limited in their generalizability. Third, the questionnaire used to measure HPB among the study participants had not been validated, specifically for the hotel workers who comprised the study sample. Finally, the study found the "avoiding fatty foods" TPB constructs did not significantly influence HPB. This insignificance could have been due to a limited number of items to measure this behavior. The questionnaire we used included only three items pertaining to this behavior. Future research should consider adding more relevant items about eating fatty foods to the questionnaire. Readers should bear this in mind when considering our findings regarding TPB construct influences on HPB.

Implications for Theory, Policy, and/or Practice

Our study findings partially support the existing literature indicating that TPB constructs influence HPB. Four of five HPB were significantly influenced by PBC for the total participant group. These findings suggest that occupational health providers should strengthen workers' PBC for HPB.

In addition, differences in TPB construct influences between those with one risk factor or two risk factors for metabolic syndrome indicate that HPB can be more effectively promoted among those in the early stage of the condition. In particular, we found that the relationships between the TPB constructs and the five HPB varied and influenced the number of risk factors for metabolic syndrome. For participants with one risk factor, TPB constructs had a stronger influence on HPB than for those with two risk factors. Therefore, we suggest that occupational health providers seeking to educate patients on management of the condition intervene as early as possible with those at risk of metabolic syndrome.

Finally, we recommend that occupational health researchers develop early health interventions for those with metabolic syndrome risk factors. Also, future studies should further investigate barriers and facilitators influencing the relationship between intention and workplace HPB.

Conclusion

In summary, this study demonstrates the importance of both workers' PBC for most HPB and early intervention for managing metabolic syndrome. Addressing metabolic syndrome management in the early stage would reduce risk factors and potentially prevent this chronic condition. In addition, in efforts to strengthen attitude, PBC, or intention concerning HPB, occupational health researchers should consider the differences in engagement observed for four HPB between those with one risk factor or two risk factors. In addition, more research attention should be given to development of early metabolic syndrome management interventions that can be implemented in clinical practice. Finally, longitudinal investigations of TPB constructs' influences on health behaviors of workers at high risk of metabolic syndrome should be performed.

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