

RESEARCH ARTICLE

Health Beliefs Associated with Cancer Screening Intentions in Korean Workers

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Abstract

Background: Cancer is a leading cause of death in Korea. To prevent cancer, it is essential to facilitate and promote appropriate cancer screening behavior in the adult population. The aim of this study was to examine health beliefs related to cancer screening intentions using the Health Belief Model (HBM). **Materials and Methods:** The research participants comprised 275 male health and safety managers at commercial companies in Korea. The self-administered survey explored demographic characteristics, cancer-related factors, beliefs about cancer/cancer screening (BCCS) (vulnerability to cancer, severity of cancer, benefits of screening, and barriers to screening), and cancer screening intention. Multivariate logistic regression analyses were used to identify factors associated with an intention to be screened for cancer. **Results:** Perceived health status and need for cancer prevention education were major factors associated with BCCS. Poorer health status was associated with greater perceived vulnerability, a perception of fewer benefits, and more barriers ($p < 0.05$). A perceived greater need for cancer prevention education was associated with a higher perceived severity of cancer and more perceived barriers to screening ($p < 0.05$). Marital status, cancer screening experience, and perceived vulnerability to cancer were significant influences on the cancer screening intention ($p < 0.05$). Participants who had undergone cancer screening in the past 2 years were more likely to intend to be screened for cancer than were those who had not been screened; this was true across all degrees of intention and all types of cancer ($p < 0.01$). Hesitant people considered themselves less vulnerable to gastric, lung, and liver cancer than did the people who intended to undergo cancer screening ($p < 0.05$). **Conclusions:** Based on our findings, we recommend that workplace cancer prevention programs attempt to increase awareness about vulnerability to cancer among workers who hesitate to undergo cancer screening.

Keywords: Cancer screening intentions – health beliefs – workers - modifying factors

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Introduction

Cancer, a crucial health issue worldwide, is the principal cause of death in Korea, accounting for 28.6% of all deaths. The incidence of cancer has continually increased, from 132.6 per 100,000 in 2004 to 150.9 per 100,000 in 2014, despite rapid medical and technological advances and renewed social investment in cancer control over the last decade (Statistics Korea, 2015).

Cancer is frequently diagnosed when it is at an advanced stage, as there may be few early signs and symptoms. Cancer is associated with significant burdens in terms of pain, cost, inability to work, and family problems. Such burdens are more serious for those with a lower economic status (Jo et al., 2014). Furthermore, in Korea, men are 67% more vulnerable to die from cancer than are women (Statistics Korea, 2015). Thus, given that an inability to work imposes a heavy burden on families, male workers should be the primary target population for cancer control.

Early diagnosis is a well-known and effective approach to cancer prevention (National Cancer Information Center of Korea, 2016). The World Health Organization has reported that almost two-thirds of all cancers could be prevented or fully cured by regular cancer screening combined with desirable health behaviors and has recommended that national efforts to screen for cancer should be enhanced (World Health Organization, 2002). Specifically, it is important to reduce the prevalence of cancer while improving cancer patients' quality of life. It is also imperative to develop an understanding of attitudes toward cancer screening that is rooted in a psychosocial perspective, as the necessary psychological and economic supports should be provided (Kim et al., 2014).

The Health Belief Model (HBM) has led to important insights into cancer screening behavior and has been the basis for cancer-related behavioral research. The major constructs of the HBM are very useful for predicting whether and why subjects undergo cancer screening to prevent or control cancer. The model focuses on

the variables involved in certain behaviors, exploring perceptions about vulnerability, severity, benefits, and barriers (Skinner et al., 2015). These major HBM-related constructs and modifying factors are used to build primary theoretical and empirical frameworks that enable identification of variables significantly related to workers' behavioral intentions to undergo cancer screening. These variables are very important for targeting certain populations and developing strategies for workplace cancer control programs. It is particularly important to study male workers because they are occupationally productive but more vulnerable to cancer than women. However, most cancer screening research has been based on middle-to-elderly community residents, and less research has been restricted to those active in the workforce (Janz and Becker, 1984; Jo et al., 2014; Kim, 2015). Therefore, the purpose of this study was to use the HBM to identify the factors and beliefs significantly associated with male workers' cancer screening intentions.

Materials and Methods

The research participants consisted of 275 male supervisors or team managers of occupational health and safety units at commercial companies. They had all completed health and safety training programs provided by the Korean Occupational Safety and Health Education Center (KOSHEC). Self-administered questionnaires were distributed to all participants in 10 training classes during their break times.

The main constructs of this study were developed based on the modifying factors, four health beliefs, and behaviors of the HBM (Skinner et al., 2015). The questionnaire explored the roles of both demographic and cancer-related characteristics as modifying factors with regard to the four beliefs about cancer/cancer screening (perceived vulnerability, severity, benefits, and barriers) and the cancer screening intention. Age, type of industry, duration of work, income, marital status, education, and perceived health status were explored as demographic characteristics. Cancer-related characteristics included needs for cancer prevention education, experience with cancer screening over the past 2 years, experience of cancer education over the past year, and whether advice had been received from others (doctors, families, relatives, friends, or neighbors) to undergo cancer screening. The perceived need for cancer prevention education was explored in a single question, the answers to which were rated on a four-point scale from 1 ('not necessary') to 4 ('very necessary'). Cancer screening experience included any screening for gastric, lung, colorectal, liver, or job-induced cancer over the past 2 years, and answers to this question were dichotomous (no/yes). We also explored experiences, either at the worksite or elsewhere, with education related to cancer prevention over the past year (no/yes). All demographic and cancer-related questions as the modifying factors were drawn from previous research on cancer screening (Lee et al., 2004; Kwak et al., 2005). We developed 12 belief-related questions for the present study based on earlier studies of cancer screening behaviors employing the HBM (Champion, 1999; Kwak

et al., 2005). The 12 questions addressed the four main belief constructs included in the HBM (vulnerability, severity, benefits, and barriers); each of the four constructs was explored by three questions. All questions were rated on a four-point scale from 1 ('strongly disagree') to 4 ('strongly agree'). The Cronbach's alpha of the beliefs-related questions was 0.69, which was acceptable in the present context. The cancer screening intention was explored by four questions about participants' screening intentions over the next 2 years with regard to four main cancers (gastric, lung, colorectal, and liver). The answers were rated on a three-point scale on which 1 indicated no intention, 2 indicated hesitant, and 3 indicated a positive intend.

All survey responses were coded and analyzed using SPSS version 23. Descriptive statistics, t-tests, ANOVAs, chi-squared tests, multiple regression analysis, and multivariate logistic regression analysis were used to analyze the data.

Results

Participant characteristics

The modifying factors (including demographic and cancer-related characteristics) of the 275 participants are shown in Table 1. All participants were male, and 45.8% were 40 years of age or older. In terms of industrial jobs, 42.2% were involved in manufacturing, 31.6% in

Table 1. Characteristics of Participants (N=275)

Variables	M±SD/n(%)
Demographic characteristics	
Age (years)	
< 40	146 (53.1)
≥ 40	126 (45.8)
Type of industry	
Construction	67 (24.4)
Manufacturing	116 (42.2)
Service and others	87 (31.6)
Duration of work (years)	
< 10	67 (24.4)
≥ 10	73 (26.5)
Income (10,000 won/month)	
< 300	154 (56.0)
≥ 300	115 (41.8)
Marital status	
Unmarried	57 (20.7)
Married	215 (78.2)
Educational level	
High school or less	117 (42.5)
College or more	152 (55.3)
Perceived health status	
Poor or normal	130 (47.3)
Healthy	142 (51.6)
Cancer-related characteristics	
Need for cancer prevention education†	3.04±.83
Cancer screening in the past 2 years	85 (30.9)
Cancer prevention education in the past 1 year	84 (30.6)
Received advice to undergo cancer screening	94 (34.2)

† Rated on a four-point scale (1=strongly disagree to 4=strongly agree)
Note: The totals may not add to 100 due to missing values.

service and other occupations, and 24.4% in construction. Approximately half (56.0%) reported incomes of more than 3,000,000 won a month. Most respondents (78.2%) were married, and more than half (55.3%) had completed higher education. Nearly half (51.6%) considered themselves to be healthy.

In terms of cancer-related characteristics, approximately 30% reported that they had undergone cancer screening in the past 2 years and had completed cancer prevention education in the past year (30.9% and 30.6%, respectively). Similarly, 34.2% reported that they had never received any suggestion or advice from medical professionals, family, or friends to undergo cancer screening.

Table 2 shows the BCCS and the cancer screening intention. In terms of the BCCS, the level of vulnerability to cancer was perceived to be medium (average, $M=2.03$)

Table 2. Beliefs about Cancer/Cancer Screening and Cancer Screening Intentions (N=275)

Variable	Values	$M \pm SD$ /n(%)
Beliefs about cancer/cancer screening[†]		
Perceived vulnerability to cancer		2.03±.58
Perceived severity of cancer		3.46±.57
Perceived benefits of cancer screening		3.36±.50
Perceived barriers to cancer screening		2.41±.62
Cancer screening intentions in the next 2 years*		
Gastric cancer	No	46(16.7)
	Hesitant	95(34.5)
	Yes	118(42.9)
Lung cancer	No	70(25.5)
	Hesitant	80(29.1)
	Yes	118(42.9)
Colorectal cancer	No	70(25.5)
	Hesitant	80(29.1)
	Yes	100(36.4)
Liver cancer	No	54(19.6)
	Hesitant	82(29.8)
	Yes	114(41.5)

[†] Rated on a four-point scale (1=strongly disagree to 4=strongly agree),

* The total percentages may not add to 100 due to missing values.

and the severity of cancer was perceived to be high (average, $M=3.46$). In terms of cancer screening, a high level of benefits was perceived ($M=3.36$), but a moderate barrier to cancer screening was also perceived ($M=2.41$). Overall, cancer severity and screening benefits ranked higher than did cancer vulnerability and barriers to screening. In terms of the intention to undergo cancer screening within the next 2 years, less than half the participants responded that they intended to undergo such screening: 42.9% intended to undergo screening for gastric cancer, 42.9% intended to undergo screening for lung cancer, 36.4% intended to undergo screening for colorectal cancer, and 41.5% intended to undergo screening for liver cancer. On average, 30.6% of participants reported that they were hesitant about cancer screening.

Modifying factors associated with beliefs about cancer or cancer screening

The modifying variables associated with beliefs about cancer/cancer screening are presented in Table 3. Among the demographic characteristics, age ($\beta =0.18$, $p<0.05$), monthly income ($\beta =-0.22$, $p<0.05$), educational level ($\beta =0.17$, $p<0.05$), and perceived health status ($\beta =-0.38$, $p<0.001$) were significantly related to perceived vulnerability. In terms of cancer-related characteristics, participants who had received advice to undergo cancer screening had a higher perceived vulnerability to cancer ($\beta =0.19$, $p<0.05$). In total, the five significant factors explained 20.8% of the variance in perceived vulnerability to cancer according to the multiple regression analysis ($F=6.08$, $R^2_{Adj}=0.208$). Thus, older age, a lower income, more education, poorer perceived health, and the receipt of advice to undergo cancer screening were associated with a higher perceived vulnerability to cancer. The need for cancer prevention education was the only significant factor related to the perceived severity of cancer ($\beta =0.20$, $p<0.05$). A greater need for cancer prevention education was associated with a perception that cancer is more severe.

Table 3. Factors Associated with Beliefs about Cancer/Cancer Screening

Variables	Perceived vulnerability		Perceived severity		Perceived benefits		Perceived barriers	
	β	t	β	t	β	T	β	t
Demographic characteristics								
Age (years/continuous)	0.18*	2.08	0.02	0.2	-0.1	-1.18	0.05	0.57
Type of industry (others vs. construction industry)	0.07	0.97	-†	-†	-†	-†	0.17*	2.19
Income (10,000 Won/continuous)	-0.22*	-2.74	0.13	1.45	0.08	0.92	-0.09	-1.02
Educational level (high school vs. college)	0.17*	2.28	-	-	-	-	-	-
Perceived health status	-0.38**	-5.23	0.03	0.34	0.18*	2.36	-0.19*	-2.50
Cancer-related characteristics								
Need for cancer prevention education	0.11	1.47	0.20*	2.61	0.13	1.78	0.18*	2.33
Cancer screening in the past 2 years	0.02	0.30	-0.01	-0.18	0.06	0.82	-0.18*	-2.32
Cancer prevention education in the past 1 year	-0.03	-0.35	-0.08	-1.02	-0.16*	-2.06	-0.08	-1.09
Received advice to undergo cancer screening	0.19*	2.61	0.09	1.12	0.11	1.43	0.13	1.65
F	6.08**		2.08*		2.41*		3.57**	
Adjusted R ²	0.208		0.041		0.053		0.106	

† Not included in multiple regression analyses due to lack of significance in simple difference analyses, * $p<0.05$, ** $p<0.01$

Table 4. Health Beliefs Associated with Cancer Screening Intentions

Variables	Gastric cancer screening		Lung cancer screening		Colorectal cancer screening		Liver cancer screening	
	OR(95%CI) †		OR(95%CI) †		OR(95%CI) †		OR(95%CI) †	
	No	Hesitant	No	Hesitant	No	Hesitant	No	Hesitant
Modifying factors								
Age (less than 40 vs. 40 years or older)	0.38 (0.13-1.18)	0.79 (0.33-1.93)	0.55 (0.21-1.44)	0.77 (0.29-2.01)	1.04 (0.40-2.75)	1.76 (0.68-4.54)	0.49 (0.16-1.45)	0.99 (0.39-2.52)
Income (less than 300 vs 300 or more/10,000 Won)	-	-	-	-	1.95 (0.73-5.14)	1.3 (0.51-3.29)	2.01 (0.68-5.91)	0.91 (0.35-2.34)
Marital status (unmarried vs. married)	5.62** (1.52-20.76)	2.21 (0.71-6.86)	3.13* (0.97-10.05)	1.36 (0.41-4.51)	-	-	2.63 (0.77-8.94)	1.31 (0.41-4.16)
Educational level (high school vs. college)	-	-	-	-	1.35 (0.50-3.60)	3.09* (1.23-7.78)	-	-
Cancer screening in past 2 years (no vs. yes)	34.70** (7.08-170.02)	12.34** (4.74-32.14)	14.89** (5.02-44.14)	13.79** (4.71-40.33)	8.99** (3.06-26.40)	5.66** (2.15-14.91)	28.17** (5.78-137.15)	11.76** (4.14-33.38)
Cancer prevention education in past 1 year (no vs. yes)	1.80 (0.68-4.81)	1.20 (0.53-2.71)	0.98 (0.41-2.33)	1.15 (0.48-2.76)	1.86 (0.76-4.56)	2.04 (0.86-4.81)	2.08 (0.83-5.20)	2.31* (1.00-5.31)
Beliefs								
Vulnerability (continuous)	1.33 (0.51-3.52)	2.32* (1.00-5.36)	1.63 (0.64-4.14)	5.76** (2.12-15.62)	1.37 (0.56-3.33)	2.07 (0.86-5.01)	1.02 (0.39-2.71)	2.67* (1.08-6.59)
Severity (continuous)	1.48 (0.59-3.74)	1.58 (0.72-3.44)	1.49 (0.65-3.43)	0.96 (0.39-2.09)	1.07 (0.43-2.66)	0.87 (0.36-2.06)	1.66 (0.69-3.99)	1.65 (0.72-3.77)
Benefits (continuous)	1.16 (0.40-3.36)	0.63 (0.26-1.52)	1.19 (0.47-3.04)	1.36 (0.53-3.48)	1.24 (0.46-3.34)	0.58 (0.22-1.49)	1.33 (0.49-3.60)	1.56 (0.63-3.86)
Barriers (continuous)	1.02 (0.41-2.54)	1.04 (0.48-2.27)	0.91 (0.40-2.06)	0.68 (0.29-1.59)	0.82 (0.36-1.86)	1.24 (0.55-2.77)	0.66 (0.27-1.62)	0.74 (0.33-1.67)

† (Reference group: Intention to undergo cancer screening) -: Not included in multivariate logistic regression analyses due to lack of significance in simple difference analyses; * p<0.05, ** p<0.01

In contrast, participants who considered themselves to be healthy ($\beta = 0.18, p < 0.05$) and who had not received any cancer prevention education in the past year ($\beta = -0.16, p < 0.05$) were more likely to perceive benefits associated with cancer screening. Those who were engaged in the construction industry ($\beta = 0.17, p < 0.05$) and perceived themselves as unhealthy-to-normal ($\beta = -0.19, p < 0.05$) were more likely to perceive barriers to cancer screening. Cancer screening experience ($\beta = -0.18, p < 0.05$) and the perceived need for cancer prevention education ($\beta = 0.18, p < 0.05$) were significantly associated with perceived barriers to screening. Workers who were employed in construction companies, who perceived their health as poor, who had not undergone cancer screening in the past 2 years, and who perceived a greater need for cancer prevention education were more likely to perceive barriers to cancer screening. These four significant factors explained 10.6% of the variance in the perceived barriers to cancer screening ($F = 3.57, R^2_{Adj} = 0.106$).

Beliefs associated with cancer screening intentions

The results regarding the beliefs associated with the screening intention for different types of cancer are presented in Table 4. Among the HBM-derived modifying variables, marital status, educational level, experience of cancer screening, and experience of cancer prevention education were significantly associated with the cancer screening intention. Specifically, a cancer screening experience in the past 2 years strongly predicted the intention to undergo screening for all four types of cancer. Those who were unmarried were less likely to intend to undergo gastric and lung cancer screening than were those who were married (OR=5.62, 95% CI: 1.52-20.76, p<0.01; OR=3.13, 95% CI:0.97-10.05, p<0.05 respectively).

However, there was no significant difference between the hesitant group and those with a positive intention. High school or less education was associated with more hesitation than with college or more education in terms of colorectal cancer screening (OR=3.09, 95% CI:1.23-7.78, p<0.01). Experience of cancer screening was significantly associated with the intention to (vs. hesitation about or not intending to) undergo screening for gastric cancer (OR=34.70, 95% CI:7.08-170.02, p<0.01), lung cancer (OR=14.89, 95% CI:5.02-44.14, p<0.01), colorectal cancer (OR=8.99, 95% CI:3.06-26.40, p<0.01), and liver cancer (OR=28.17, 95% CI:5.78-137.15, p<0.01). In terms of cancer prevention education, those who had no experience of such education were more likely to hesitate undergoing liver cancer screening (OR=2.31, 95% CI: 1.00-5.31, p<0.05).

Of the four HBM beliefs, perceived vulnerability was significantly associated with the cancer screening intention. Those who hesitated undergoing screening perceived greater vulnerability to cancer than those having intentions to undergo screening for gastric cancer (OR=2.32, 95% CI: 1.00-5.36, p<0.05), lung cancer (OR=5.76, 95% CI: 2.12-15.62, p<0.01), and liver cancer (OR=2.67, 95% CI: 1.08-6.59, p<0.05). No other belief (severity, benefits, or barriers) was significantly associated with the intention to undergo cancer screening.

Discussion

In this study, we identified significant HBM-related modifying factors associated with health beliefs about cancer/cancer screening and elucidated relationships between health beliefs and the cancer screening intentions among male workers in Korea.

The distributions of demographic characteristics were generally acceptable. According to a recent study of manufacturing workers' attitudes toward cancer screening and related factors (Park et al., 2013), 82.4% of this population were married and 58.2% were educated to the college level or higher, which is similar to our results. However, the participants in our study were younger and earned more than did those in the study conducted by Park et al. (2013), in which all participants were 40 years of age or older. Our data were from management-level employees who generally earned more than average. Additionally, our participants were mostly younger, less likely to be married, and healthier than were those of previous cancer-related studies, because most people in earlier studies were community-dwelling middle-aged or elderly adults (Jo et al., 2014; Kim et al., 2014; Kim, 2015).

The cancer screening rate within the past 2 years of this study was similar to those of studies conducted relatively recently (Kye et al., 2006; Kang and Lee, 2011). However, the rate differed from that reported by the study conducted by Park et al. (2013), which found that cancer screening rates by cancer type ranged from about 40% to 70%, higher than the 30.9% of the present study. The differences in the age and sex distributions between the two studies partially explain the differences in cancer screening rates. However, the different times at which the two studies were conducted may be more important, which is related to a weakness of our study. The data analyzed in the present study were collected at least 5 years before those analyzed in the study conducted by Park et al. (2013), and cancer screening rates improved greatly over this period due to national campaigns and support for cancer screening in Korea.

Table 2 shows that almost half the participants were hesitant about undergoing or had no intention of undergoing cancer screening. Among these participants, more were hesitant about undergoing cancer screening expressed no intention of undergoing cancer screening. The hesitant group seemed to still be considering undergoing cancer screening, although they had not yet decided to do so. Compared with subjects who had no intention of undergoing screening, members of the hesitant group were more likely to develop the intention to undergo screening and exhibited considerable interest in behavioral change. Indeed, previous studies on cancer screening using theories of behavioral change have shown that such change occurs in stages or steps (Champion, 1999; Kang and Lee, 2011; Prochaska et al., 2015). In other words, before taking action, people seriously consider embracing certain desirable behaviors, and their attitudes toward and perceptions about such behaviors change in many different ways. One such stage is contemplation, which is similar to the hesitation noted in the present study.

Perceived health status was a significant modifying factor with respect to participants' beliefs about cancer/cancer screening in the present study. In terms of perceived health status, Kim et al. (2010) reported that elderly participants who perceived themselves as healthy had a stronger intention to undergo cancer screening than did unhealthy ones. Another significant modifying variable was working in construction companies, as employees of these companies were more likely to perceive barriers

to cancer screening in the present study. This may be associated with job issues and socioeconomic status. Part-time or temporary employment is common in this industry, and work schedules and sites change often due to weather or company timelines (Woo and Oh, 2014). Such a job structure (unstable work status and low control over the work schedule) is linked to lower socioeconomic status; all these factors may significantly increase the perceived barriers to desirable health behaviors (such as cancer screening) among those who work in construction. Previous studies found that unemployed, self-employed, and low-income subjects were significantly less likely to actually undergo cancer screening or have an intention to be screened (Kim et al., 2010; Gregory et al., 2011; Kim et al., 2014).

In terms of the effect sizes, the modifying factors of this study were more strongly associated with perceived vulnerability ($R^2=0.208$) and barriers ($R^2=0.106$) than severity or benefits. The modifying factors of HBM are meaningful in the sense that health beliefs are forms of perceptual assets with regard to behavioral change; thus, these factors moderate the strength and direction of personal beliefs, which may culminate in action. In terms of perceived vulnerability to cancer, being younger than 40 years of age, earning a low income, being less educated, holding a self-perception of good health, and having never heard about cancer screening may all be major contributors to a perceived low vulnerability to cancer. Including perceived health status and the need for cancer prevention education, the significant modifying variables affecting perceived barriers were working at construction companies and no experience of cancer screening in the past 2 years. Therefore, different approaches are required to modify the two beliefs. When planning cancer screening promotions, targeting may be more important for dealing with a perceived low vulnerability to cancer, whereas strategy development (provision of education or a screening experience) might be more effective for modifying perceived barriers to screening.

The factors significantly associated with the cancer screening intention were experience of cancer screening within the past 2 years and perceived vulnerability to cancer. Cancer screening experience had a significant effect with regard to all types of cancer among both the hesitant and the no-intention groups. Consistent with this result, cancer screening experience has been reported to strongly affect screening behavior or intention in many previous studies (Kwak et al., 2005; Kim et al., 2010; Kim et al., 2014; Kim, 2015). A nationwide survey of more than 2,500 community residents in Korea conducted by Kwak et al. (2005) found that subjects who had ever undergone a health examination underwent stomach cancer screening more than others ($OR=3.05$). Previous studies conducted with elderly populations also reported that cancer screening experience was significantly related to an intention to undergo cancer screening (Kim et al., 2014; Kim, 2015).

In terms of the relationship between perceived vulnerability to cancer and cancer screening intention, the hesitant group perceived a significantly lower vulnerability to cancer than did the intention group. In previous studies

using the HBM, perceived vulnerability was reported to significantly affect both screening behavior and intention (Kang and Lee, 2011; Kim et al., 2014; Shiryazdi et al., 2014; Abuadas et al., 2015; Taheri-Kharameh, 2015; Chaowawanit et al., 2016). Taheri-Kharameh et al. (2015) reported that perceived vulnerability to cancer and barriers to screening significantly affected adherence to colorectal cancer screening guidelines; the odds ratio for vulnerability was 1.29 among community residents in Iran. In this context, it is useful to define the stages of development of a screening-related intention. The hesitant group perceived themselves as significantly less vulnerable to cancer than the intention group, and the perceived vulnerability of the no-intention group did not significantly differ from the intention group.

Although we do not report the detailed figures, we found that perceived barriers was a more significant predictor of hesitation with regard to the cancer screening intention than was perceived vulnerability when only the four personal beliefs were included as independent variables in the logistic regression analysis. However, perceived vulnerability to cancer was the only factor significantly associated with an intention to undergo cancer screening when all modifying variables were included in the multivariate logistic regression analysis. Of course, many previous studies have shown that perceived barriers to screening significantly affected the cancer screening behaviors even more so than perceived vulnerability (Jans and Becker, 1984; Tung et al., 2010; Jung and Jo, 2014). Tung et al. (2010) reported similar results: women in the pre-contemplation stage perceived stronger barriers than did those at a more advanced stage of readiness to undergo screening. In a comprehensive review of studies using the HBM, Jans and Becker (1984) reported that perceived barriers (93%) was a stronger predictor than perceived vulnerability (86%) in terms of effects on preventative health behaviors. Additionally, perceptions about vulnerability and about barriers among the no-intention group were little different from those among the intention group in all analyses. It was also shown that those who decided not to undergo cancer screening were probably unconcerned about such screening and thus perceived relatively weak barriers and vulnerability (Kang and Lee, 2011). Therefore, it may be efficient to first target the hesitant group when designing interventions to decrease the perceived barriers to cancer screening.

Thus, our results differ somewhat from those of the most important previous studies with regard to the primary types of belief associated with the cancer screening intention. We would like to discuss this by reference to the HBM framework, which formed the theoretical basis of our study. In simple terms, perceived barriers was the major contributor to decisions to not undergo cancer screening. However, perceived vulnerability to cancer may, in fact, be more important in this context, and this should be carefully considered, along with the HBM-related modifying variables, when examining complex environments.

In conclusion, we found that modifying variables played important roles in moderating beliefs about cancer/cancer screening and cancer screening intentions.

Demographic factors were more likely to be associated with health beliefs than were cancer-related factors. One significant demographic factor was perceived health status, which was associated with perceived vulnerability, benefits, and barriers. However, cancer-related factors were more likely than demographic factors to be associated with the cancer screening intention. One significant cancer-related factor was cancer screening experience in the past 2 years. Indeed, demographic factors may be useful for targeting populations that require interventions to increase cancer screening rates, whereas cancer-related factors may be more helpful in the design of content and methods. Furthermore, we found that the most significant contributor to the cancer screening intention changed from perception of barriers to perception of vulnerability when modifying variables were included in analysis. Thus, certain variables may moderate the effects of beliefs on intentions as well as the direct relationships between beliefs about cancer/cancer screening and the intention to undergo screening.

Finally, two limitations of this study should be acknowledged to facilitate the interpretation of the results. The first limitation is that the data are relatively old and obtained from men. The data analyzed in this study were collected at least 5 years before those used in other recently published studies, and our study participants were limited to management-level male workers. Thus, it is necessary to use caution when interpreting our results. The other limitation concerns variations in the modifying variables, which were very important in our analyses and in terms of the results obtained. However, the data would have been more reliable if several other factors had also been included among the those examined in this study (e.g., family history of cancer, private insurance status, and health behaviors), because these variables have been used to predict cancer screening in previous studies (Kim et al., 2010; Kang and Lee, 2011; Kim et al., 2014; Kim, 2015). We recommend that future research applying the HBM model carefully choose the modifying variables that are examined.

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