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Effects of Disease Detection on Changes in Smoking Behavior

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Purpose: This study was conducted to investigate the effect that detection of chronic disease via health screening programs has on health behaviors, particularly smoking. **Materials and Methods:** We analyzed national health insurance data from 2007 and 2009. Subjects who were 40 years of age in 2007 and eligible for the life cycle-based national health screening program were included. The total study population comprised 153518 individuals who participated in the screening program in 2007 and follow-up screening in 2009. Multiple logistic regression analyses were conducted by sex, with adjustment for health insurance type, socioeconomic status, body mass index, diabetes, hypertension, hyperlipidemia, and family history of cardiovascular and/or neurovascular disease. **Results:** Among men with smoking behavior changes, those newly diagnosed with hyperlipidemia were more likely to show a positive health behavior change, such as smoking cessation, and were less likely to have a negative behavior change (e.g., smoking initiation). Additionally, men newly diagnosed with diabetes showed lower rates of negative health behavior changes compared to those without disease. Body mass index (BMI)≥25, compared to BMI<23, showed higher rates of positive health behavior changes and lower rates of negative health behavior changes. Newly diagnosed chronic disease did not influence smoking behavior in women. **Conclusion:** Smoking behavior changes were only detected in men who participated in health screening programs. In particular, those newly diagnosed with hyperlipidemia were more likely to stop smoking and less likely to start smoking.

Key Words: Smoking, behavior change, life cycle-based, national, screening program

INTRODUCTION

The purposes of health screening programs are to decrease mortality and incidence rates, as well as increase early detection and treatment rates, for target diseases.[1]

Screening is thus considered to be a form of secondary prevention against disease.[2] Nevertheless, while screening programs are commonly offered as part of preventive health services in many countries, participation rates play a significant role in increasing the benefits thereof.[3]

In Korea, a nationwide health screening program was initiated in 1980, targeting individuals with chronic diseases working for the government or in schools.[2] In 1995, the Ministry of Health and Welfare initiated the General Health Screening Program (GHSP)[2] to include local and corporate subscribers with National Health Insurance (NHI). In 2007, a new life cycle-based national health screening program was implemented to overcome the limitations of the GHSP.[4] This program targeted participants aged 40 and 66 years to capture health transitions in their life cycle: middle age begins around the age of 40 years, at which time the incidence of chronic disease increases;[5] old age begins around 66 years, at which time geriatric approaches to health promotion are needed.[6] In contrast to the GHSP, the life cycle-based national health screening program provides follow-up consultation services after screening to modify participants' health behaviors.[1] The National Health Insurance Corporation (NHIC) reported that 69.8% of the participants were satisfied with this program, and 65% felt that it was superior to the GHSP.[7] Furthermore, the NHIC stated that participants who completed primary and secondary screening in 2009 and 2011, respectively, were more likely to change their lifestyles (41%) than were those who participated only in primary screening in 2009 (29%).[8]

Kasl and Cobb[9,10] defined health behaviors as "any activity undertaken by a person who believes himself to be healthy for the purpose of preventing disease or detecting disease in an asymptomatic stage." To explain health behavior changes, social psychologists in the US introduced the health belief model in the 1950s to evaluate "the widespread failure of people to accept disease preventives or screening tests for the early detection of asymptomatic disease."[9,11] Variables affecting health behavior, such as demographic, sociopsychological, and structural variables, were identified.[12] In addition to these variables, several dimensions affecting health behavior changes were established; these included perceived susceptibility, severity, benefits, and barriers.[12,13] Rosenstock[13] stated that the levels of perceived susceptibility and severity influence an individual's actions, and perceived benefits help to determine preferred paths of action. Some form of stimulation is needed in the decision-making process: it may be internal, such as symptoms, or external, such as mass media communications, interpersonal interactions, or reminder postcards from health care providers.[13] New detection of diseases via health screening programs could increase one's perceived susceptibility and severity, and newly diagnosed individuals who participate in a physician consultation program could gain perceived benefits of guided decisions on courses of action.

The effect of disease detection via health screening programs on health behavior changes is an important issue in health care. Regarding smoking behavior, Hsu, et al. discovered a positive effect on smoking behavior with cancer diagnosis.[14,15] Also, Neutel, et al.[16] reported that newly diagnosed hypertensive patients often quit smoking. Accordingly, the purpose of this study was to investigate the effect that detection of chronic disease via health screening programs has on health behaviors, particularly smoking.

MATERIALS AND METHODS

Subjects

The baseline age of the study subjects was 40 years in 2007 and 42 years in 2009. A total of 312480 individuals participated in the life cycle-based national health screening program in 2007, and 194238 of these participants completed follow-up screening in 2009. After excluding participants who did not participate in one of the screening sessions, as well as those for whom data for variables were missing and had unclear responses, the final study population was 153518 (77307 men and 76211 women).

The subjects were recruited from the NHIC; all were aged 40 years and were eligible for the life cycle-based national health screening program (e.g., covered by NHI or Medical aid) in 2007.[2] The NHIC and public health centers campaigned (including by mail) to increase the participation rate among the target population. Qualified clinics, hospitals, and public health centers provided the screening service. Targeted individuals were allowed to select a screening center.

Variables

Independent variables were divided into two groups: demographic factors [health insurance type (local or corporate), socioeconomic status (average monthly income in quartiles, and Q4 is the highest income), and body mass index (BMI; <23, 23 to <25, and ≥25)] and health status [family history of cardiovascular (CV) and/or neurovascular (NV) disease (heart disease and stroke; yes/no); status of diabetes, hyper-

tension, and hyperlipidemia (none, known, and newly diagnosed)]. "No disease" was defined as no history of disease and no disease in 2007. "Known disease" was defined as a history of disease and diagnosed with disease in 2007. "Newly diagnosed with disease" was defined as no history of disease and a new diagnosis.

Changes in smoking behavior (positive, none, negative) was used to characterize the dependent variable (Fig. 1). "Positive change" was defined as smoking cessation (smoker in 2007, ex-smoker in 2009). "No change" was defined as no smoking behavior change between 2007 and 2009. "Negative change" was defined as smoking initiation (ex-smoker or non-smoker in 2007, smoker in 2009).

Statistical analysis

Multiple logistic regression analyses were conducted adjusting for health insurance type, socioeconomic status, BMI, diabetes, hypertension, hyperlipidemia, and family history of CV and/or NV disease. This study conducted multiple logistic regression analyses for two groups, current smoker group and ex-smoker or non-smoker group in 2007. We analyzed the current smoker group for smoking cessation and the ex-smoker or non-smoker group for smoking initiation. The analysis was stratified by sex due to differences in smoking characteristics between men and women.[17] Statistical analyses were performed using SAS software (version 9.2; SAS Institute Inc., Cary, NC, USA).

RESULTS

Table 1 shows the baseline characteristics of the study population. A total of 153518 individuals (77307 men and 76211 women; 94193 non-smokers, 20403 ex-smokers, 38922 current smokers) participated in screening in 2007. In 2007, 3466 individuals (1443 non-smokers, 611 ex-smokers, 1412 current smokers) were newly diagnosed with diabetes; 9823 (4388 non-smokers, 1944 ex-smokers, 3491 current smokers) were newly diagnosed with hypertension; and 22023 (8863 non-smokers, 4059 ex-smokers, 9101 current smokers) were newly diagnosed with hyperlipidemia.

Changes in smoking behavior during the study period are described in Table 2. Most (97.6%) individuals who were non-smokers in 2007 remained ex-smokers or non-smokers in 2009; 2.4% were current smokers in 2009. Most (83.8%) individuals who were ex-smokers in 2007 retained this status, although 16.2% were current smokers in 2009. Similarly, most (87.0%) individuals who were current smokers in 2007 continued to smoke, although 13.0% were ex-smokers or non-smokers in 2009.

Table 3 and 4 show the results of the multiple logistic regression analyses of changes in smoking behavior. Table 3 lists the results of a positive change in smoking behavior among current smokers in 2007. The analysis revealed no significant relationship among women. In men, the risk of smoking cessation was 1.11 [95% confidence interval (CI), 1.03–1.20] times higher for men newly diagnosed with hyperlipidemia in 2007 than among those who had never had hyperlipidemia. Smoking cessation was 1.33 (95% CI, 1.05–1.68) times higher for men who had known diabetes in 2007 than among those who had never had diabetes. The risk of smoking cessation was 1.06 (95% CI, 0.95–1.19) times higher for men newly diagnosed with hypertension in 2007 than among those who had never had hypertension, al-

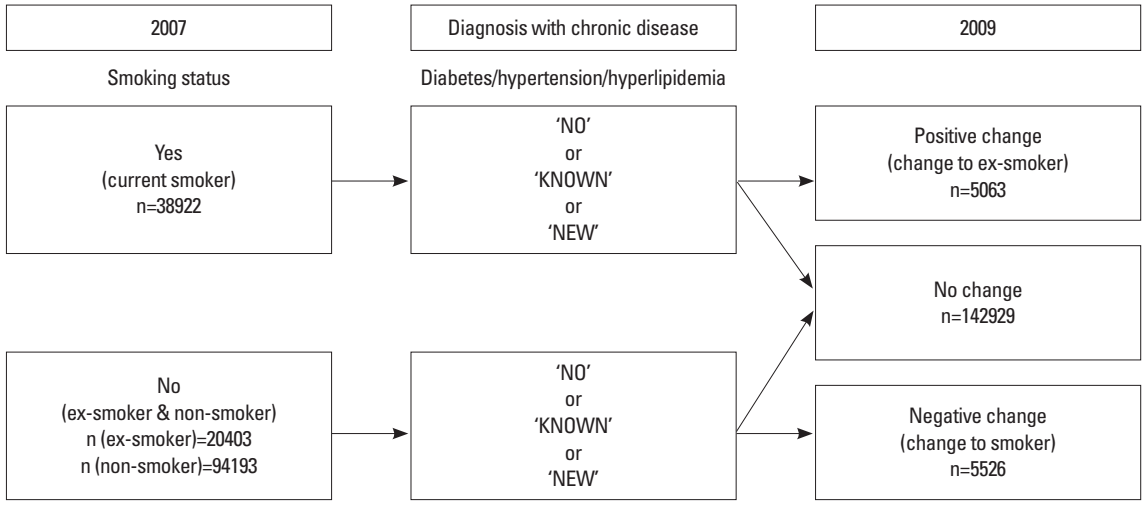

Fig. 1. Flowchart of study design.

though the result was not statistically significant. The risk of smoking cessation was 1.17 (95% CI, 1.01–1.35) times higher among men with BMI≥25, compared to men with BMI<23. Table 4 shows the results of a negative change in smoking behavior among ex-smokers or non-smokers in 2007. Among men, the risk of smoking initiation was 0.75 (95% CI, 0.64–0.88) times and 0.79 (95% CI, 0.73–0.85) times lower for those newly diagnosed with diabetes or hyperlipidemia in 2007 than among those who had never had diabetes or hyperlipidemia, respectively. The risk of smoking initiation was 1.55 (95% CI, 1.31–1.82) times higher for those with known hypertension in 2007 than among those who had never had hypertension. The risk of smoking initiation was 0.62 (95% CI, 0.55–0.69) times lower among men with BMI≥25, compared to men with BMI<23. There were no significant results in women.

DISCUSSION

In this study, to investigate the relationship between disease detection by screening programs and changes in smoking behavior, changes among women and men were analyzed with adjustment for health insurance type, socioeconomic status, BMI, diabetes, hypertension, hyperlipidemia, and family history of CV and/or NV disease.

In this study, the probability of smoking cessation among current smokers was higher among men with newly diagnosed hyperlipidemia and smoking initiation among ex-smoker or non-smoker was lower among men with newly diagnosed diabetes or hyperlipidemia, compared to those without disease, respectively. Meanwhile, studies have mentioned that hyperlipidemia patients are more likely to not know of their disease before being diagnosed by a doctor, compared to those with

Table 1. Characteristics of Subjects at Baseline (2007)

Variables	Total, n (%)	Non-smoker, n (%)	Ex-smoker, n (%)	Current smoker, n (%)	*p* value
Total	153518 (100.0)	94193 (61.4)	20403 (13.3)	38922 (25.4)	
Sex					<0.0001
Men	77307 (50.4)	20116 (26.0)	19691 (25.5)	37500 (48.5)	
Women	76211 (49.6)	74077 (97.2)	712 (0.9)	1422 (1.9)	
Health insurance type					
Local	33871 (22.1)	24440 (72.2)	3242 (9.6)	6189 (18.3)	
Corporate	119647 (77.9)	69753 (58.3)	17161 (14.3)	32733 (27.4)	
Socioeconomic status					<0.0001
Q1	38364 (25.0)	27949 (72.9)	3054 (8.0)	7361 (19.2)	
Q2	38393 (25.0)	22086 (57.5)	4961 (12.9)	11346 (29.6)	
Q3	38370 (25.0)	21187 (55.2)	6124 (16.0)	11059 (28.8)	
Q4	38391 (25.0)	22971 (59.8)	6264 (16.3)	9156 (23.9)	
Body mass index					<0.0001
<23	107808 (70.2)	72433 (67.2)	11589 (10.8)	23786 (22.1)	
23≤ and <25	39489 (25.7)	18938 (48.0)	7502 (19.0)	13049 (33.0)	
25≤	6221 (4.1)	2822 (45.4)	1312 (21.1)	2087 (33.6)	
Diabetes					<0.0001
No diabetes	147504 (96.1)	91478 (62.0)	19361 (13.1)	36665 (24.9)	
Known diabetes	2548 (1.7)	1272 (49.9)	431 (16.9)	845 (33.2)	
Newly diagnosed	3466 (2.3)	1443 (41.6)	611 (17.6)	1412 (40.7)	
Hypertension					<0.0001
No hypertension	138067 (89.9)	87044 (63.0)	17277 (12.5)	33746 (24.4)	
Known hypertension	5628 (3.7)	2761 (49.1)	1182 (21.0)	1685 (29.9)	
Newly diagnosed	9823 (6.4)	4388 (44.7)	1944 (19.8)	3491 (35.5)	
Hyperlipidemia					<0.0001
No hyperlipidemia	128088 (83.4)	84022 (65.6)	15526 (12.1)	28540 (22.3)	
Known hyperlipidemia	3407 (2.2)	1308 (38.4)	818 (24.0)	1281 (37.6)	
Newly diagnosed	22023 (14.4)	8863 (40.2)	4059 (18.4)	9101 (41.3)	
Family history of cardiovascular/neurovascular disease					<0.0001
No	130643 (85.1)	80121 (61.3)	17145 (13.1)	33377 (25.6)	
Yes	22875 (14.9)	14072 (61.5)	3258 (14.2)	5545 (24.2)	

diabetes or hypertension.[18,19] In the present study, the number of people who were newly diagnosed with hyperlipidemia was greater than those newly diagnosed with diabetes or hypertension. Among 153518 individuals, 22023 (14.4%) were newly diagnosed with hyperlipidemia, while only 3466 (2.3%) and 9823 (6.4%) were newly diagnosed with diabetes

Table 2. Changes in Smoking Behavior during the Study Period

Category	2007	2009	
	n=153518 (%)	No (non-smoker & ex-smoker) n=77307 (%)	Yes (current smoker) n=76211 (%)
Non-smoker			
Total	94193 (100.0)	91964 (97.6)	2229 (2.4)
Men	20116 (21.4)	18207 (90.5)	1909 (9.5)
Women	74077 (78.6)	73757 (99.6)	320 (0.4)
Ex-smoker			
Total	20403 (100.0)	17106 (83.8)	3297 (16.2)
Men	19691 (96.5)	16550 (84.1)	3141 (16.0)
Women	712 (3.5)	556 (78.1)	156 (21.9)
Current smoker			
Total	38922 (100.0)	5063 (13.0)	33859 (87.0)
Men	37500 (96.3)	4802 (12.8)	32698 (87.2)
Women	1422 (3.7)	261 (18.4)	1161 (81.7)

Table 3. Risk of Positive Change in Smoking Behavior for Current Smokers in 2007*

Variable	Men		*p* for trend	Women		*p* for trend
	OR	95% CI		OR	95% CI	
Health insurance type						
Local	1.00		0.950	1.00		0.019
Corporate	1.00	0.92–1.09		0.72	0.55–0.95	
Socioeconomic status						
Q1	1.00			1.00		
Q2	1.00	0.91–1.11	0.389	1.24	0.88–1.74	0.320
Q3	0.83	0.75–0.91		0.92	0.62–1.37	
Q4	0.71	0.64–0.78		0.85	0.57–1.27	
Body mass index						
<23	1.00			1.00		
23≤ and <25	0.93	0.87–0.99	0.906	1.07	0.72–1.58	0.681
25≤	1.17	1.01–1.35		1.13	0.49–2.63	
Diabetes						
No diabetes	1.00			1.00		
Known diabetes	1.33	1.05–1.68	0.114	0.97	0.38–2.47	0.554
Newly diagnosed	1.08	0.91–1.27		1.77	0.40–7.93	
Hypertension						
No hypertension	1.00			1.00		
Known hypertension	1.01	0.86–1.18	0.288	1.84	0.73–4.64	0.303
Newly diagnosed	1.06	0.95–1.19		0.56	0.29–1.09	
Hyperlipidemia						
No hyperlipidemia	1.00			1.00		
Known hyperlipidemia	0.96	0.81–1.14	1.091	0.52	0.15–1.75	0.253
Newly diagnosed	1.11	1.03–1.20		1.40	0.84–2.33	
Family history of cardiovascular/neurovascular disease						
No	1.00		0.556	1.00		0.243
Yes	0.97	0.89–1.06		0.82	0.59–1.14	

OR, odds ratio; CI, confidence interval.
*Positive change: change to ex-smoker in 2009 among current smokers in 2007.

Table 4. Risk of Negative Change in Smoking Behavior for Ex- or Non-Smokers in 2007*

Variable	Men		*p* for trend	Women		*p* for trend
	OR	95% CI		OR	95% CI	
Health insurance type						
Local	1.00		<0.0001	1.00		<0.0001
Corporate	0.85	0.78–0.93		3.16	2.63–3.80	
Socioeconomic status						
Q1	1.00			1.00		
Q2	1.02	0.93–1.12	0.030	1.12	0.89–1.39	<0.0001
Q3	1.26	1.15–1.38		1.64	1.26–2.13	
Q4	1.06	0.97–1.16		2.81	2.10–3.75	
Body mass index						
<23	1.00			1.00		
23≤ and <25	0.98	0.92–1.05	<0.0001	0.98	0.77–1.25	0.960
25≤	0.62	0.55–0.69		1.02	0.58–1.80	
Diabetes						
No diabetes	1.00			1.00		
Known diabetes	1.04	0.83–1.31	<0.0001	0.64	0.32–1.26	0.954
Newly diagnosed	0.75	0.64–0.88		0.70	0.36–1.37	
Hypertension						
No hypertension	1.00			1.00		
Known hypertension	1.55	1.31–1.82	0.094	1.00	0.56–1.76	0.683
Newly diagnosed	1.02	0.92–1.13		0.90	0.57–1.43	
Hyperlipidemia						
No hyperlipidemia	1.00			1.00		
Known hyperlipidemia	1.20	0.99–1.46	<0.0001	2.71	0.66–11.08	0.099
Newly diagnosed	0.79	0.73–0.85		0.74	0.55–1.01	
Family history of cardiovascular/neurovascular disease						
No	1.00		<0.0001	1.00		0.070
Yes	1.32	1.21–1.45		1.29	0.98–1.69	

OR, odds ratio; CI, confidence interval.
*Negative change: change to current smoker in 2009 among ex-smokers or non-smokers in 2007.

and hypertension, respectively. According to Omboni, et al.,[19] awareness of the presence of CV risk factors among individuals newly diagnosed with hypertension, diabetes, or hyperlipidemia differs significantly: in their study, 44.5% of people diagnosed with hyperlipidemia, 22.7% with hypertension, and 3.5% with diabetes were not aware of their condition. Therefore, differences in a lack of awareness of existing disease may influence rates of change in smoking behaviors for individual conditions. Additionally, according to BMI, the risk of smoking initiation was lower and the risk of cessation was higher among men with a BMI≥25, compared to those with BMI<23, similar to results reported by Lee, et al.;[20] in their study, among individuals who successfully quit smoking, 72.4% had a BMI≥23.

In 2010, smoking rates among men and women in Korea were 48.3% and 6.3%, respectively.[21] According to the Organization for Economic Co-operation and Development (OECD), the average smoking rates among men and women were 27.5% and 17.5%, respectively, in 2011.[22] According to the OECD Factbook 2011–2012: Economic, Environmental and Social Statistics, the difference in smoking rates between men and women was larger in Korea than in other OECD country.[22] The sex-based difference in smoking behavior for Korea is related to many variables, including gender roles, social norms,[17] and other cultural and economic factors.[23] For instance, marriage status affects this difference in Asian, but not European, countries.[1,17] In addition, cigarette use is acceptable under cultural norms for men in social and business settings.[24] However, in women, smoking is considered to be against cultural norms.[24] Previously, according to a transtheoretical model, Audrain, et al.[25] noted gender differences in smoking behavior changes: gender differences were discovered for several stages of smoking behavior change, such as ready to quit smoking, perceived benefits and cost of smoking, and self-efficacy. For these reasons, our analysis of changes in smoking behavior was stratified by sex.

This study has several limitations. A lot of data were missing from responses, which may have impacted the statistical power of the analysis. In addition, the multiple logistic regression analysis did not allow for the determination of causal relationships. Furthermore, we had no information about the number of cigarettes smoked, smoking duration, or experiences with smoking cessation attempts. Despite these limitations, this study is the first to focus on behavioral changes induced by the life cycle-based national health screening program in Korea. Future studies should be conducted using advanced statistical methods and data obtained with high response rates, as well as adjustment for additional smoking-related variables.

In conclusion, smoking behavior changes after participation in a health screening program were detected only in Korean men. In particular, among men newly diagnosed with hyperlipidemia, current smokers were more likely to stop smoking, while non-smokers or ex-smokers were less likely to start smoking.

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