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ORIGINAL ARTICLE

Factors influencing cigarette smoking and quantified implications for anti-smoking policy: evidence from South Korea

Woojin Chung · Hanjoong Kim · Seungji Lim · Sunmi Lee · Kyungsook Cho

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Abstract

Objectives The aim of this study was to determine the factors that are associated with adult males' smoking in South Korea and simulate the effects of a potential anti-smoking policy.

Methods We conducted a national, cross-sectional, telephone survey among males aged 20 years and older in 2006 and analyzed a dataset of 2,847 subjects by using the full information maximum likelihood sample selection model.

Results The likelihood of smoking was highest among the wealthy, employed, Christian, or people who exercise regularly. The low rate of smoking participation was associated with either low pure alcohol intake or increased awareness of lung cancer from smoking. We found that policies to reduce cigarette consumption should focus on lowering smoking participation rather than the amount of cigarettes smoked. Compared to the current state, a policy package consisting of mutually reinforcing measures could reduce the probability of smoking and the average number of cigarettes consumed among all adult males by 34 and 51%, respectively.

Conclusions Understanding the country-specific factors affecting smoking behavior and selecting an appropriate anti-smoking measure could greatly reduce smoking participation and cigarette consumption.

Keywords Smoking · Tobacco · Policy simulation · Public health · South Korea

W. Chung
Department of Health Policy and Management, Graduate School of Public Health, Institute of Health Services Research, Yonsei University, Seoul, Republic of Korea

H. Kim
Department of Preventive Medicine and Public Health, Yonsei University College of Medicine, Seoul, Republic of Korea

S. Lim (✉)
Department of Public Health, Yonsei University Graduate School, 134 Shinchon-dong, Seodaemun-gu, Seoul, 120-752, Republic of Korea
e-mail: limseungji@hotmail.com; sjlim@yuhs.ac

S. Lee
Health Insurance Policy Research Institute, Seoul, Republic of Korea

K. Cho
Office for Aging Society and Population Policy, Ministry of Health and Welfare, Gwacheon, Gyeonggi, Republic of Korea

Introduction

The percentage of smokers in South Korea is among the highest in developed nations (Organization for Economic Co-operation and Development 2005). In 2005, 50.3% of men and 3.1% of women aged 20 years and older were smokers (Korean Association of Smoking and Health 2007) (Fig. 1). Because of this high prevalence of smoking, Korea is suffering from rising health expenditures and public health problems. A study of the Korean National Health Insurance dataset revealed that the estimated total medical expenditure related to smoking increased by 27% from $324.9 million in 1999 to $413.7 million in 2003 (Lee et al. 2007). Another study including indirect costs reported that the estimated social cost attributable to smoking in 1998 in Korea ranged between $3.15 billion (0.82% of gross domestic product, GDP) and $45.80 billion (1.19% GDP). In addition, the cigarette smoking was

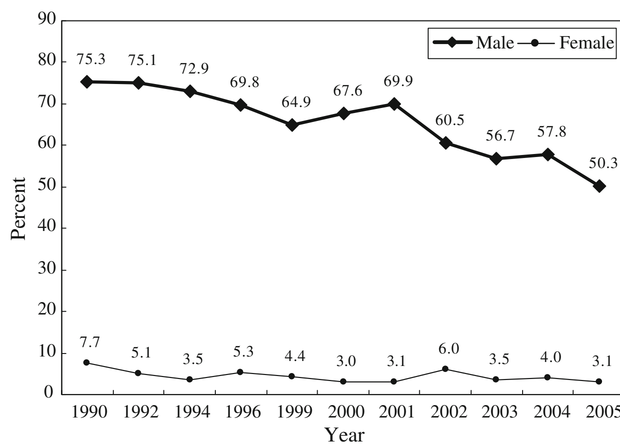


Fig. 1 Prevalence rate of current smoking among adults aged 20 years and over, Korea, 1990–2005

found to be the major risk factor of disease, including lung cancer, among Koreans (Bae et al. 2007; Lee et al. 2007; Sung et al. 2007).

Although the reduction of the smoking rate ought to be one of the central issues of public health policy, Korea lacks strong national policies to reduce smoking rate. For example, the National Health Promotion Act, which was implemented in 1995, focused mainly on such policies as the restriction on the sale of cigarettes to minors and public areas in which people are allowed to smoke. This is partly due to the special circumstance of the Korean government being the main producer of cigarettes in Korea. The government has been ineffectual in improving anti-smoking policies because of its conflicting goals to maximize revenue from cigarette sales and reduce the smoking rate to improve public health (Kang et al. 2003). Another reason for the paucity of anti-smoking policies might be that there were very few studies of the factors associated with smoking behavior in Korea (Khang and Cho 2006). The lack of such studies has made the Korean government postpone the formulation of policies to reduce smoking more strongly than those which were implemented in the present day.

The main purpose of this paper was to determine which factors are associated with adult males' smoking in Korea and to simulate the effects of potential policies to reduce smoking prevalence and cigarette consumption. While the impact of smoking on public health in Korea has been well documented (Bae et al. 2007; Lee et al. 2007; Sung et al. 2007), there have not been any in-depth empirical studies on cigarette consumption that separate the decision to smoke from the decision about how much to smoke. Also, there have not been any attempts to simulate the effects of a potential policy package based on the obtained data, as we did in this study. Thus, our study may help establish an effectual anti-smoking policy in Korea and provide valuable information to policymakers in other countries.

Methods

Data

To assess the behavioral risk factors of smoking among adult males, a national telephone survey using quota sampling methods (Korea Health Behavior Survey), which was supported by Korea Ministry of Health and Welfare, was conducted between 14 April 2006, and 3 May 2006. A random sample of adult males aged 20 years and older were generated from the target population by a stratified approach based on 25 administrative districts and 6 age categories based on the 2004 National Registry data. A total of 17,840 telephone numbers were chosen randomly by a computer and trained interviewers asked to speak with a male aged 20 years or older in the household. Unanswered phone numbers were called back three times before they were classified as invalid. In the survey, 3,000 adult males answered and 2,847 respondents provided the information used in this study. A sample size of 3,000 subjects resulted in a 95% confidence interval with 1.79% margin of error. Regarding an ethics committee approval, the system for non-clinical research involving human subjects has not yet been well established in Korea. Therefore, we informed participants that all of the information provided was confidential, and the only people who would see their responses would be the research team checking the questionnaires upon completion. Detailed information on the sampling method and contents of the survey are described elsewhere (Management Center for Health Promotion of Korea 2006).

Variables

This study had two dependent variables: current smoking status and the number of cigarettes smoked per month among current smokers. Questions about these variables were constructed based on the behavioral risk factors survey (BRFS) in the US in 2005. First, the surveyed males were asked if they had smoked a total of 100 cigarettes during their entire lifetime. For those who answered "yes", they were asked if they currently smoked "every day", "occasionally", or "not at all".

The explanatory variables included socio-demographic data such as age, education, occupation, location of residence, religion, and marital status. We also asked about behavioral risk factors such as regular physical exercise, body mass index, and subjective health status. Pure alcohol consumption per day was calculated by the methods suggested by the WHO (World Health Organization 2000). To find out about an individual's awareness of lung cancer from smoking, we asked the respondents, "Out of 100 chronic smokers, how many of them do you think will get

lung cancer?" and classified them according to their answers. Additionally, parents' and friends' smoking habits were included as a dichotomous variable. For current smokers, the price of cigarettes was calculated by asking which brand of cigarettes they usually smoked. Smoking regularity and the age at which they started smoking regularly were also categorized.

Statistical analysis

Our analysis consisted of three steps. The first step involved univariate analyses. The second step was made up of the multivariate analyses, and we took into account that many people do not smoke and that the number of cigarettes smoked is observed only among those who smoke. If this is ignored, the model studying the number of cigarettes smoked might suffer from a sample selection bias (Heckman 1976). To correct this, we employed the full information maximum likelihood (FIML) estimator (Greene 2003; Nawata 1994; Nawata and Nagase 1996). This is because Heckman's estimator can be affected by multicollinearity between the estimated Mill's ratio and explanatory variables (Nawata 1993, 1994). In the multivariate analyses, the characteristics found to be associated with at least one univariate analysis at a 10% significance level were selected. Then, the potential multicollinearity and endogeneity were checked by using the variance inflation factor and Hausman endogeneity test (Greene 2003).

In the third step, we predicted three corresponding series of values, which were (1) the probability of current smoking among all adult males, (2) the average number of cigarettes smoked per month among adult male smokers and (3) the average number of cigarettes consumed per month among all adult males, depending on respondents' characteristics. After defining the base case in which all adult males had mean value characteristics of the sample, we predicted percentage changes in each series of values compared to the base case. For comparison purposes, we also applied the two-part model (Hu et al. 1995).

Results

Table 1 shows the proportion of smokers among all adult males and the mean number of cigarettes smoked per month among current smokers according to the explanatory variables. Out of 2,847 respondents, 1,109 (38.9%) adult males were smokers and 1,781 (61.1%) were non-smokers. According to the univariate analyses for smoking participation, there was an inverse U-shaped relationship with age whereas a bimodal shape was found with either educational level or family income. Higher rates of smoking were found among those who had blue-collar jobs, no religious affiliation, exercised regularly, or had friends or parents who smoked. People who reported a fair or poor health status had higher rates of smoking, as did individuals with a higher level of alcohol intake and a lower perception of lung cancer risk. Among smokers, the level of smoking tended to increase among smokers who had blue-collar jobs, were married, exercised regularly, or had parents who smoked. Among smokers, cigarette prices were not significantly associated with consumption.

The results from the two-part model and the FIML sample selection model are displayed in Table 2. During the process to reduce multicollinearity and endogeneity problems, some variables were not included in the analyses. The correlation coefficient between the errors in the two equations was −0.89 at a 0.1% significance level. The FIML sample selection model confirmed that the unaccounted factors in one equation related to smoking participation were significantly correlated with those in the other equation related to the level of smoking among smokers.

For most variables, the results from the two-part model differed from the FIML sample selection model. In the latter, there was an increased likelihood to smoke among adult males who had a job, were not Christian, exercised regularly, or consumed more alcohol. The likelihood of smoking was highest among the wealthy. Increased awareness of the risk of lung cancer from smoking seemed to encourage men not to smoke. Among smokers, people who consumed the largest amount of cigarettes were those between the ages of 50–59, did not have a blue-collar job, have friends who smoked, smoked everyday, or started smoking at the age of 19 or earlier. Among smokers, cigarette consumption increased with awareness of the risk of lung cancer from smoking.

The percentage change in the probability of smoking compared to the base case was predicted to vary according to individual characteristics, with other things being unchanged (Fig. 2). For example, if all adult males had a high income, the probability of smoking would increase by 11% compared to the base case. Likewise, if all adult males were Christian, the probability would fall by about 16%. Unlike the probability of smoking, the percentage changes in the amount of cigarette consumption among smokers do not depend largely on individual characteristics (Fig. 3). However, it is noted that occasional smoking considerably reduces the level of smoking.

Discussion

Smoking prevalence

The smoking prevalence among adult males aged 20 years or older in 2006 in this study was 38.9%. This is lower than

Table 1 Relation of selective socio-demographics to (1) smoking status among adult males and (2) the number of cigarettes consumed among adult male smokers

Characteristic	All adult males		Adult male smokers	
	Current smokers (%)	%	Cigarettes smoked per month (mean)	%
Age (years)	($p < 0.0001$)[b]		($p < 0.0001$)[c]	
20–29	37.5	24.1	417.0	23.2
30–39	46.9	25.0	503.6	30.1
40–49	39.7	23.1	554.8	23.5
50–59	35.6	13.4	567.0	12.3
≥60	29.5	14.4	433.3	10.9
Education	($p < 0.0001$)		($p < 0.0001$)	
<Sr. high school completion	35.9	15.3	535.5	14.1
Sr. high school completion	44.8	33.0	526.0	37.9
Some college	25.0	12.6	371.2	8.1
College completion	39.8	39.1	478.0	39.9
Occupation	($p < 0.0001$)		($p < 0.0001$)	100.0
No job	29.6	31.2	433.9	23.7
White-collar job	40.5	43.2	514.4	44.9
Blue-collar job	47.8	25.6	515.3	31.4
Family income per month (USD)[a]	($p < 0.0001$)		($p = 0.6010$)	
<1,600	36.6	27.3	485.7	25.6
1,600–2,590	46.7	22.1	484.9	26.5
2,600–3,590	34.0	27.0	498.6	23.6
≥3,600	44.2	15.4	507.9	17.4
Missing	32.6	8.2	532.3	6.9
Location of residence	($p = 0.5735$)		($p = 0.3879$)	
Metropolis	38.2	47.3	491.9	46.4
Small city	40.1	42.6	492.0	43.8
Rural area	37.9	10.1	529.0	9.8
Religion	($p < 0.0001$)		($p = 0.1012$)	
None/others	44.8	55.4	495.5	63.7
Buddhism	39.8	17.2	525.0	17.6
Christianity	26.5	27.4	468.0	18.7
Marriage	($p = 0.3243$)		($p < 0.0001$)	
Unmarried	40.4	31.0	446.9	32.1
Married	38.3	69.0	518.6	67.9
Regular, physical exercise	($p < 0.0001$)		($p = 0.0251$)	
No	33.8	46.6	473.8	40.5
Yes	43.4	53.4	510.4	59.5
Body mass index	($p = 0.5618$)		($p = 0.0403$)	
<23	39.9	45.9	475.3	46.9
23–24	37.5	30.0	522.1	28.9
≥25	39.0	24.1	503.3	24.2
Subjective health status	($p < 0.0001$)		($p = 0.4990$)	
Excellent/good	34.0	42.9	498.4	37.4
Fair	41.1	42.9	489.3	45.4
Poor	49.7	11.9	515.4	15.1
Very poor	35.4	2.3	437.0	2.1

Table 1 continued

Characteristic	All adult males		Adult male smokers	
	Current smokers (%)	%	Cigarettes smoked per month (mean)	%
Pure alcohol intake per day (g)	($p < 0.0001$)		($p = 0.4211$)	
None	30.2	31.1	487.5	24.1
<63.2	28.7	19.2	487.2	14.2
63.2–74.0	43.2	26.4	484.9	29.3
≥74.1	54.4	23.3	514.9	32.4
Awareness of the risk of lung cancer (persons)	($p < 0.0001$)		($p = 0.6720$)	
<5	46.4	17.4	511.1	20.7
5–19	45.1	20.8	479.1	24.1
20–49	35.1	16.9	502.6	15.2
≥50	31.8	21.4	485.3	17.5
Missing	37.4	23.5	502.2	22.5
Parents smoking	($p = 0.0675$)		($p = 0.0067$)	
No	35.7	21.7	452.1	19.9
Yes	39.9	78.3	506.4	80.1
Friends smoking	($p < 0.0001$)		($p = 0.0003$)	
No	25.4	37.1	444.0	24.3
Yes	46.9	62.9	512.1	75.7
Cigarette price per pack (USD)			($p = 0.3405$)	
<2.64			506.0	35.0
≥2.64			490.0	65.0
Occasional smoking			($p < 0.0001$)	
No			524.4	93.1
Yes			103.3	6.9
Age at which one started regular smoking (years)			($p = 0.0735$)	
<19			512.2	42.6
≥19			483.3	57.4
Sample size	2,847		1,109	

Source: 2006 Korea Health Behavior Survey

[a] USD 1 = KRW 948.80 (June 2006)

[b] p values are based on Chi-squared test statistic

[c] p values are based on t or ANOVA test statistic

the smoking rate of 44.1% determined by the Korean Association of Smoking and Health (KASH). There is a reason for the small difference in smoking rates between KASH and our survey. With respect to the sampling methodology, our study selected male adults who had smoked at some point in their lives and then asked if they currently smoked, whereas, KASH only selected current male adult smokers. Thus, the KASH survey must have an upward bias that may have led to the increased smoking rate.

Income

Smoking is known to be closely related to income level. Previous findings showed that people in lower-income brackets were more likely to smoke than those in higher-income brackets (Reijneveld 1998; US Department of Health and Human Services 2001). However, our results were not consistent with these findings. There was no monotonic, negative association of smoking participation with the level of income; for example, after controlling for all other socio-demographic factors, a group with a high family income showed a high rate of smoking. One possible reason for this difference is that previous studies did not control for possible multicollinearity among the level of education, occupation, and family income. Another reason might be that other things being equal, adult males with a high family income in Korea were more likely than those with a low family income to be exposed to work-related stress (Cha et al. 1997), thereby increasing their tendency to smoke.

Table 2 Factors influencing cigarette smoking among adult males

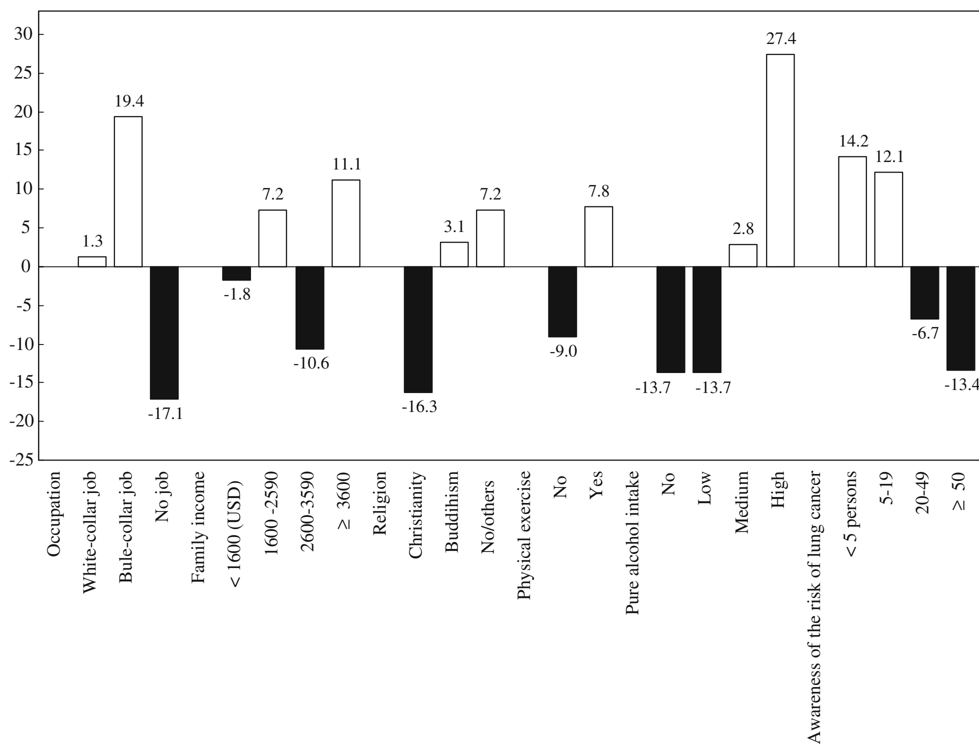
Characteristic	Two-part model		FIML sample selection model	
	Smoke	Cigarettes smoked (log)	Smoke	Cigarettes smoked (log)
Age (Ref: 20–29 years)				
30–39		0.12		0.14*
40–49	–	0.24**	–	0.25***
50–59		0.23*		0.27**
≥60		0.09		0.10
Education (Ref: <Sr. high school completion)				
Sr. high school completion		−0.09		−0.08
Some college	–	−0.14	–	−0.19
College completion		−0.15*		−0.13
Occupation (Ref: no job)				
White-collar job	0.18**	0.14*	0.19***	−0.02
Blue-collar job	0.37***	0.12*	0.37***	−0.14*
Family income per month[a] (Ref: <1,600) (in USD)				
USD 1,600–2,590	0.17*		0.09	
2,600–3,590	−0.16*	–	−0.09	–
≥3,600	0.10		0.13*	
Missing	−0.12		0.02	
Religion (Ref: none/others)				
Buddhism	−0.12	–	−0.04	–
Christianity	−0.40***		−0.24***	
Married (Ref: unmarried)	–	−0.03	–	−0.02
Regular, physical exercise (Ref: none)	0.18***	0.05	0.17***	−0.07
Body mass index (Ref: <23) (in kg/m^2)				
23–24	–	0.06	–	0.05
≥25		0.02		0.04
Pure alcohol intake per day (Ref: none) (in g)				
<63.2	−0.09	–	0.00	–
63.2–74	0.26***		0.17**	
≥74.1	0.54***		0.41***	
Awareness the risk of lung cancer (Ref: <5) (persons)				
5–19	−0.01	−0.03	−0.02	−0.03
20–49	−0.23**	−0.03	−0.21**	0.16*
≥50	−0.31***	0.00	−0.28***	0.17*
Missing	−0.16*	−0.02	−0.18*	0.07
Parents smoking (Ref: no)	0.04	0.05	0.04	0.01
Friends smoking (Ref: no)	–	0.15**	–	0.13***
Occasional smoking (Ref: no)	–	−1.95***	–	−1.67***
Started smoking at the age of 19 or older (Ref: <19 years)	–	−0.11**	–	−0.09**
Constant	−0.51***	5.90***	−0.53***	6.70***
Correlation coefficient		–		−0.89***
Log likelihood/adjusted R^2	−1,758.6	0.45		−2,688.7
Sample size	2,847	1,109		2,847

Source: 2006 Korea Health Behavior Survey

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

[a] USD 1 = KRW 948.80 (June 2006)

Fig. 2 Percentage change in probability of smoking



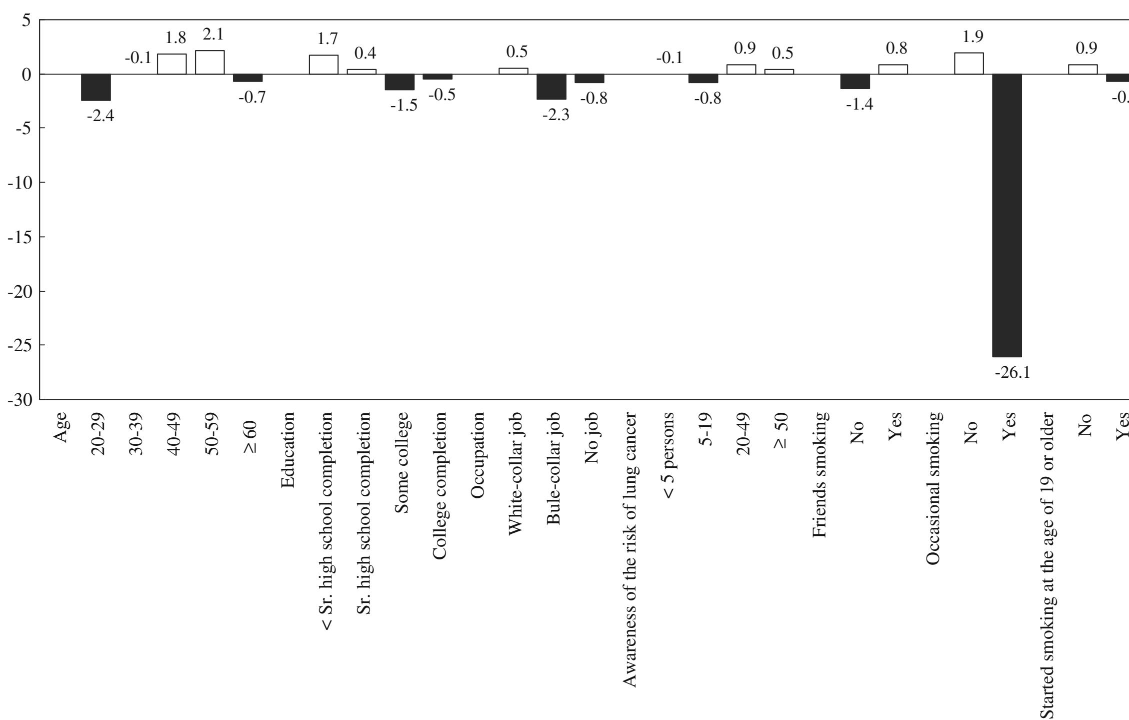


Fig. 3 Percentage change in the number of cigarettes smoked per month (log) by smokers

Physical exercise

Physical exercise has been proposed for smoking cessation by moderating the effects of nicotine withdrawal (Ussher et al. 2000). It has also been shown to have a positive effect on the factors against smoking relapse, including perceived coping ability and self-esteem (McAuley et al. 1997). Evidence from a survey indicates that levels of physical activity are inversely related to smoking (Wankel and Sefton 1994). Becoming more active has been positively

associated with both confidence in maintaining smoking abstinence and success in smoking cessation (Derby et al. 1994; King et al. 1996; Sedgwick et al. 1988). However, according to our results, adult males in Korea who exercised regularly were more likely than others to smoke. This implies that an erroneous belief is prevalent in Korea that the health risks from smoking could be reduced by regular physical exercise. Further investigation into this issue is necessary.

Religious affiliation

A study conducted in Scotland revealed significant differences in smoking behavior according to religious affiliation in adulthood (Mullen et al. 1996). Similarly, our results showed a significant difference in smoking status among religious affiliations. Christian adult males were less likely to smoke than Buddhists, those who had no religious affiliation, or adherents of other religions. Protestants (18% of the total population in 2005), the majority of Korean Christians, were influenced by Presbyterian and Methodist missionaries from Britain, Canada, and the US. Inspired by puritan ethics, Korean churches encourage their congregations to abstain from smoking and drinking (Palmer 1967). This suggests that similar efforts made by Buddhist monks may reduce the smoking prevalence among Buddhists (23% of the total population). Using religion or enlisting religious authorities in public health campaigns may cause controversy (Jabbour and Fouad 2004).

Occasional smoking

Our study showed that compared to everyday smokers, occasional smokers consumed fewer cigarettes per month. Some evidence showed that occasional smokers were more likely to quit smoking than everyday smokers (Gilpin et al. 1997; Zhu et al. 2003). Considering that everyday smokers are very likely to quit smoking via an occasional smoking status, policy measures to encourage everyday smokers to become occasional smokers may be the second-best strategy to reduce smoking prevalence and cigarette consumption. According to data from the BRFS in the US, nearly 24.0% of current smokers were occasional smokers in 2001, an increase from 17.2% in 1996 (Centers for Disease Control and Prevention 2003). However, the percentage of occasional smokers to current smokers in Korea was found to be only 6.9% in 2006, which is lower than one-fourth of the percentage in the US. Higher cigarette prices and limiting smoking areas at the workplace are two public policies that have been suggested to change everyday smokers into occasional smokers. Since higher cigarette prices have been shown to decrease consumption among those who continue to smoke (Chaloupka et al. 2002), price-sensitive people among everyday smokers are likely to cut back to occasional smoking. Occasional smokers tended to be observed in a completely smoke-free worksite (Evans et al. 1992). A study reported that workplace smoking restrictions reduced cigarette consumption by 50% or more (Hyland et al. 2005).

Occupation

In Japan, employed men were more likely to smoke than unemployed men (Fukuda et al. 2005). Similarly, our results showed that employment had a positive association with smoking participation in adult males. Meanwhile, occupation is considered to be the conventional measure of one's position in the socioeconomic hierarchy, and it is more closely connected to working conditions than other socio-demographic indicators (Gregorio et al. 1997). According to our study, adult males with blue-collar jobs had an increased likelihood of smoking, compared to those with white-collar jobs or those without jobs. This suggests that adult males with blue-collar jobs are exposed to more stressful environments and anti-smoking measures should be targeted at them. These results are consistent with the findings from a previous study in Korea which reported that more prestigious jobs generally related to lower smoking rates (Cho et al. 2006; Khang and Cho 2006). In Korea, blue-collar workers have more freedom to smoke than white-collar workers, because smoking is prohibited in most office buildings where white-collar workers are employed. Overall, with regard to the political priority setting, this suggests that employed men should be targeted by political measures to reduce smoking behavior. In particular, the government should impose legal control on smoking, and create a type of social climate that strongly discourages smoking.

Subjective lung cancer risk perception

Previous research showed that an individual's perception of risk regarding a particular health behavior is associated with behavioral change (McKee et al. 2005). Our results are similar to previous findings in that the decision to smoke is related to a person's perception of lung cancer risk but the amount of smoking was not (McCoy et al. 1992). However, we found two intriguing results: one was that there might be a "threshold level of risk perception" above which the probability of smoking starts to decrease with the degree of risk perception (in our study, around 20 out of 100 persons). This suggests that up to a threshold level, efforts to inform the general public about the risk of lung cancer from smoking may be evaluated as ineffective to reduce smoking. The other intriguing result was that although the difference is not very large, more cigarettes

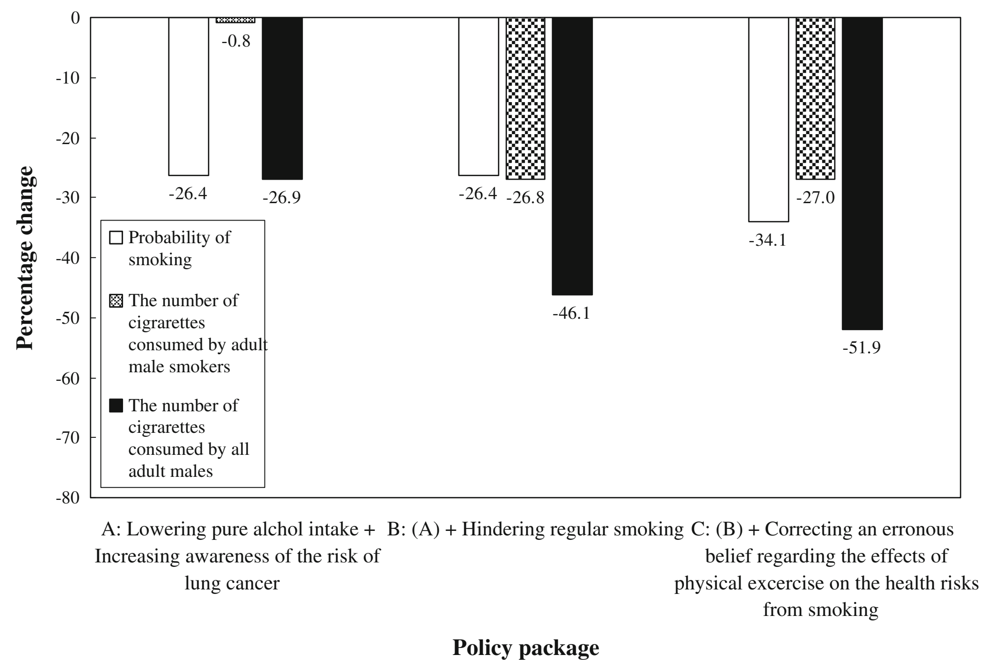


Fig. 4 Simulation of the effects of potential policy packages on cigarette smoking

were smoked by those who were aware of the high risk of lung cancer. The reason might be that heavy smokers are more likely to hear from their acquaintances about the incidence of lung cancer due to chronic smoking than light smokers but they cannot reduce their cigarette consumption because of severe addiction. Also, heavy smokers in Korea might have a self-exempting "optimistic bias" with regard to perceptions of their own risks (Baker et al. 2001). This issue needs further investigation.

Policy implications

With the enactment of the 1995 Health Promotion Act, the Korean government has developed numerous anti-smoking policies, including smoke-free buildings and zones, a public media campaign, and tobacco taxation. By 1999, 96.7% of all public buildings in South Korea had divided smoking and nonsmoking areas. The act also restricted the sale of tobacco via vending machines and prohibited selling cigarettes to juveniles. With financial support from the National Health Promotion Fund, which is based on the tax for a package of cigarettes, anti-smoking campaigns featuring television stars were initiated in 2000. Also in 2002, major TV channels in South Korea stopped showing smoking scenes. Simultaneously, the South Korean government mandated labeling of tar and nicotine content on cigarette packs and privatized the leading tobacco company of South Korea, KT&G. However, these efforts were restricted to the sale of cigarettes to minors and in public areas where people are allowed to smoke, with the obvious conflicting role of government as the tobacco industry. As a result, despite reducing overall cigarette smoking rates in males (Fig. 1), the smoking prevalence rate is still among the highest of the developed nations, and it has remained stable or even increased in women (Organization for Economic Co-operation and Development 2005). Moreover, the governmental anti-smoking policies of South Korea did not reduce the socioeconomic inequalities in smoking in either gender (Khang et al. 2009). Therefore, an effective mechanism to convince people of the negative impact of smoking on our society must be established to provide persuasive support for the need of anti-smoking policies in Korea.

We assumed that each of the three types of potential policy packages should be implemented for all adult males and simulated the effect of each policy package in Fig. 4: (A) "Lowering pure alcohol intake to a very low level and increasing awareness of the risk of lung cancer from smoking to a very high level;" (B) policy package A plus "Hindering regular smoking;" (C) policy package B plus "Correcting an erroneous belief that regular physical exercise will reduce the health risks from smoking."

If policy package A were implemented compared to the base case, the probability of smoking among all adult males, the average number of cigarettes consumed per month among adult male smokers, and the average number of cigarettes consumed per month among all adult males would be expected to decrease by 26, 1, and 27%, respectively. Meanwhile, if policy package C were carried out, the probability of smoking would fall by as much as 34%, whereas the average number of cigarettes consumed

per month among all adult males would decrease by more than 51%.

Limitations

Although our study examined the factors affecting adult male smoking in Korea by using an advanced analytical method, it has its limitations. First, this was a cross-sectional study, which is why a definite causal relationship between smoking and related factors could not be established. In Korea, unfortunately, there are neither national cross-sectional nor longitudinal surveys focusing on smoking behavior. Second, interviewees are more likely to give socially desirable answers during a telephone interview (Holbrook et al. 2003). This social desirability bias may have resulted in an underestimation of the smoking prevalence and consumption, leading to an underestimation of exposure and outcome status. Third, the telephone survey had a somewhat low response rate, which may have led to some bias. However, this analysis included the missing variables in income to prevent any risk of the misclassification of income. Fourth, this study was restricted to adult males of the age of 20 or older. Some studies have shown that smoking behavior among females differs from that of adult males. However, compared to adult males, the prevalence rate of smoking adult females is not so high in Korea (Fig. 1). There is a very Korean-specific reason for the gender differences in smoking rates. Smoking behavior, especially in women, is heavily influenced by gender roles and social norms. In Korea, for example, married women are forced to quit or are strongly discouraged from smoking (Cho et al. 2008). This is related to the Korea-specific patrilineal kinship system, which is strongly influenced by Confucianism (Deuchler 1992, 2003). Under this system, smoking is not considered acceptable behavior for women who have a crucial role in rearing children (Chun et al. 2006). Fifth, the cigarette price variable was not included in the multivariate analyses. One reason is that it was not statistically significant in the univariate analyses for the decision on the amount of cigarettes consumed. Another reason is that because Korea has implemented one cigarette tax policy throughout the country, there is no difference in the price of a brand of cigarette across regions and the difference in the price cannot be included as an exogenous factor in the analyses regarding one's decision on smoking participation. A study of the effect of cigarette price on smoking in Korea did not take this into account (Chung et al. 2007). Sixth, we did not standardize family income because family size was not asked in the survey. Lastly, we tried to employ recent analytical methods, such as a zero-inflated negative binomial model (Sheu et al. 2004), but decided against it because the model was unstable and showed poor goodness to fit.

Conclusion

This is the first study to conduct an in-depth empirical analysis and to quantify policy implications from the available data. This study demonstrates that adult males who earn higher incomes or who exercise regularly tend to smoke more frequently than do those with lower incomes and less frequent exercise habits. Christians are less likely to smoke than are Buddhists, but the difference in cigarette consumption among smokers was not significant across religions. Lowering pure alcohol intake and increasing the risk perception of lung cancer from smoking reduced smoking participation. Whether a smoker consumed cigarettes occasionally or regularly was closely related to cigarette consumption. A policy package consisting of mutually reinforcing measures could reduce smoking and cigarette consumption among adult males by 34 and 51%, respectively. This study revealed factors that are associated with smoking in adult Korean males and simulated the effects of potential policies to reduce smoking prevalence and cigarette consumption. However, factors affecting smoking behavior may differ across countries. Understanding the country-specific factors that affect smoking behavior and selecting appropriate anti-smoking measures could greatly reduce smoking and cigarette consumption.

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