**보건사회연구** 32(3), 2012, 429-460
Health and Social Welfare Review

# The Effect of the Increase in Tobacco Price on Adolescent Smoking in Korea:

## Smoking Reduction and Brand Switching

**Kim, Hyun-Cheol**
(Columbia University)

**Cho, Kyung-Sook***
(Ministry of Health and Welfare)

**Kwon, Soon-Man**
(Seoul National University)

**Lim, Jae-Young**
(Korea University)

This research aimed to measure the effect of the increase in tobacco price in Korea; changes in tobacco consumption patterns and the price elasticity of adolescent demand for tobacco. We investigated 14,692 teen-age students attending middle school or high school in July 2005. The increase in tobacco price in December 2004 has contributed to a reduction in adolescent smoking and a switch to cheaper tobacco brands. Of all smoking adolescents, 11.7 percent quitted smoking, 20.5 percent reduced their tobacco consumption, and 32.0 percent shifted to cheaper brands, following the price change. Even though some adolescents changed the brand after price increase, the reduction in smoking by brand changers was either bigger than or at least as big as that by non-brand changers. The estimated price elasticity of adolescent demand for tobacco was estimated to range between -1.15 and -1.56.

Keywords: Tobacco Price, Adolescent, Smoking Reduction, Brand Switching, Price Elasticity

This paper was supported by the National Health Promotion Fund in 2005.

This paper is based on the book “The status of youth smoking and the effect of tobacco price increase for the youth” by Seoul National University and the presentation “The price elasticity of tobacco demand among adolescent” at the Great Autumn Conference of the Korea Society of Health Policy and Administration in 2005.

*Corresponding Author : Cho, Kyung Sook, Ministry of Health and Welfare(gabrielle@korea.kr)

■ 투고일: 2012.7.31 ■ 수정일: 2012.8.24 ■ 게재확정일: 2012.9.4

# Ⅰ. Introduction

Tobacco use is one of the major preventable causes of mortality worldwide (WHO, 2005). Several cancers as well as numerous cardiovascular and respiratory diseases have been known to be linked to cigarette smoking (Ezzati et al., 2002). These mortalities and morbidities are closely related to total duration of smoking, and therefore prevention efforts early in life are particularly important in relieving the global burden of tobacco-related illnesses. Moreover, adolescents are more vulnerable to smoking-related diseases (USDHHS, 1994). So, smoking control in adolescents and the studies on the demand for cigarette among adolescents are very important.

In the demand for cigarette, the general economic principle applies; as a response to the increase in tobacco price, the demand decreases and vice versa. For evaluating cigarette consumption, two types of data are used: macro level data such as total revenue of tobacco and micro level data obtained from the survey. For studies on the demand for cigarette among the entire population, either macro or micro level data can be used. However, for studies on the demand for cigarette among specific groups of population, only survey-based micro level data can be used. This limitation explains why there are fewer studies on the relationship of smoking behavior with higher tobacco tax or price in adolescents than there are in adults or whole population.

Previous studies on the demand for cigarette indicate that higher cigarette prices cause adolescents to reduce smoking. The World Bank (1999) has argued that the price elasticity of cigarette demand is three times greater among youths than among adults. Also, most of studies conclude that adolescents are more sensitive to the price of the cigarette than adults (Lewit et al., 1981; Lewit & Coate, 1982; Chaloupka & Wechsler, 1997; Alexander, 2003). The Center for Disease Control and Prevention (CDC) concluded that the overall price elasticity of adolescent cigarette demand is in the range of -0.9 to -1.5 (USDHHS, 1994).

Since 1981, most of the studies on the price effect of adolescent smoking have estimated the price elasticity of adolescent demand for tobacco to be between -0.3 and -1.7 (Lewit & Coate, 1982; Grossman et al., 1983; Lewit et al., 1997; Chaloupka & Pacula, 1999; Harris & Chan, 1999; Emery & White, 2001; Gruber, 2002; Ross & Chaloupka, 2003). However, the accuracy of the estimation remains debated. Several studies argue that there is no evidence to prove that the price elasticity of cigarette demand is greater for youths than for adults (Chaloupka, 1991; Wasserman et al., 1991; Lee et al., 2004). In addition, it has been suggested that boys are more responsive to changes in the price of cigarettes than girls in the Western society (Lewit et al., 1997; Chaloupka & Pacula, 1999). However, the price elasticity of adolescent demand for cigarette and its differences by sex and age has not been evaluated in Asia.

Meanwhile, higher cigarette prices are found to have an impact on cigarette purchasing patterns. It has been shown that as a response to the increase in tobacco tax, people change the type of cigarette they consume to cheaper brands, smokeless tobacco and hand-rolled cigarettes which are regarded more harmful to health (than cigarettes) in both developed and developing countries (Thompson & McLeod, 1976; Pekurinen, 1989; Evans & Farrelly, 1998; Ohsfelt & Boyle, 1999; Chaloupka & Warner, 2000; Laxminarayan & Deolalikar, 2004; Hyland et al., 2005; Tsai et al., 2005). However, no evidence has been revealed regarding compensating behavior of adolescents in response to tobacco price increase.

This paper aims to examine the effect of the Korean tobacco pricing policy on the reduction in smoking and on tobacco purchasing patterns among adolescents. Also, the authors calculate the price elasticity of tobacco demand among adolescents based on the changes in their tobacco consumption patterns.

## Ⅱ. Smoking in Korea

Korean society is relatively forgiving toward male smoking while it is strongly unfavorable toward female smoking. Although there was a possibility of underestimation (Jung, 2004; Jung-Choi, 2011), smoking rate in 2010 was only 6.3 percent for females compared to 48.3 percent for males.

Anti-smoking campaigns in Korea were initiated in the early 1980s by non-governmental organizations. In 1995, intervention of central government began with the legislation of the National Health Promotion Act. From 1995 to 2004, the government focused heavily on non-price policy. However after signing FCTC, the Korean government raised cigarette price by 500 KRW (Korean Won, approximately 0.5 USD) for all brands uniformly in Dec 2004. It was on average a 29.0% increase in price. The smoking rate among Korean male adults dropped by 7.5 percentage points from 57.8 percent in 2004 to 50.3 percent in 2005. Given the fact that the rate had declined by only one percentage point every year over the preceding 25 years, it was a significant reduction (Cho, 2006). However, the rate of decrease has slowed down in more recent years. Male smoking rate was 48.3 percent and female smoking rate was 6.3 percent in 2010 (KCDC, 2011a). Meanwhile, youth smoking rate in Korea reached a peak with 35.3 percent for boys in 1998 and 10.7 percent for girls in 2000 (Ji, 2005). It has since decreased to 16.6 percent and 7.1 percent in 2010, respectively (KCDC, 2011b).

## Ⅲ. Data and Methods

### 1. Sample

The survey, funded by the Korean Ministry of Health and Welfare, was

conducted by Graduate School of Public Health at Seoul National University from July 1 to July 15 in 2005, six months after the tax increase. The survey was handled and managed by a health education teacher at each school. The structured-questionnaires were distributed to their students by the health education teachers and were answered anonymously.

It was cross-sectional study. We planned to survey 15,110 students in 7th to 12th grader at 38 middle and high schools nationwide. The total number of the surveyed was 14,692 with a response rate of 97.0%.

We first selected six representative cities for each province, and then randomly selected schools in each of the cities and its suburbs. The survey covered all classes at each selected school. In order to have a nationally representative sample, several ratios released by the Ministry of Education and Human Resource Development were employed, including sex ratio and the ratio of middle and high school students in large cities, small to medium cities, and town and village (Table 1).

Table 1. Number of students by school type and by area

(Unit: Person, %)

| | Area | School Type | | | Total |
|---|---|---|---|---|---|
| | | Middle school | General High school | Vocational high school | |
| Population in 2005[a] | Metropolitan | 903,316(46.7) | 625,290(50.8) | 210,455(40.9) | 1,739,061(47.2) |
| | Urban Area | 762,214(39.4) | 455,469(37.0) | 191,309(37.2) | 1,408,992(38.3) |
| | Rural Area | 268,013(13.9) | 151,251(12.2) | 112,786(21.9) | 532,050(14.5) |
| | Total | 1,933,543(100.0) | 1,232,010(100.0) | 514,550(100.0) | 3,680,103(100.0) |
| Planned Sample | Metropolitan | 2,640(45.8) | 3,360(49.3) | 1,200(47.6) | 7,200(47.6) |
| | Urban Area | 2,230(38.6) | 2,610(38.2) | 700(27.8) | 5,540(36.7) |
| | Rural Area | 900(15.6) | 850(12.5) | 620(24.6) | 2,370(15.7) |
| | Total | 5,770(100.0) | 6,820(100.0) | 2,520(100.0) | 15,110(100.0) |
| Surveyed Sample[b] | Metropolitan | 3,060(51.4) | 3,135(50.2) | 1,513(60.3) | 7,708(52.4) |
| | Urban Area | 2,097(35.3) | 2,269(36.4) | 537(21.4) | 4,903(33.4) |
| | Rural Area | 789(13.3) | 834(13.4) | 458(18.3) | 2,081(14.2) |
| | Total | 5,946(100.0) | 6,238(100.0) | 2,508(100.0) | 14,692(100.0) |

[a] Sex-ratio was nearly same.

[b] Sex-ratio in girls to boys was 47.4% to 52.6%.

Given the large difference in smoking rate and smoking behavior between general high schools and vocational high schools, more high school students were over-sampled than were middle school students. General high schools prepare their students for universities, while most students at vocational high schools are expected to get a job after graduation. They were given different weights in the simple statistical analysis for adjusting the effect of over-sampling high school students, but weights were not applied in $X^2$-test and regression analysis.

## 2. Measurement

To measure the effects of price increase, students were requested to check smoking status and amount as of Dec 2004 and July 2005. The questionnaire used in this study was developed based on the literature review on smoking pattern and contributing factors in smoking. The survey questions included general characteristics of the surveyed, attributes considered to be related with smoking, and the change in smoking pattern after the increase in tobacco price.

The pilot survey was conducted on about 50 middle and high school students to enhance the reliability of the questionnaire. Also, another pilot survey was carried out on about 30 sixth grade students to monitor if the survey questions were clear and easy enough to be understood by middle and high school students. To reduce information bias in the survey, cooperation from participating schools was sought to make the survey environment least restrictive as possible for the students. In addition, the students were told in advance that the survey would be administered anonymously and kept confidential.

## 3. Variables

The definitions of “nonsmoker”, “ex-smoker”, and “current smoker” in this

study are based on the definitions by WHO (1997), but modified for evaluating the durability of the policy impact. “Adolescents” in this study refers to middle and high school students aged between 14 and 19. By defining “current smokers” as those who have smoked in the last one month, and “ex-smokers” as those who have not smoked for at least one month (not six months as WHO's definitions specify), it was possible to evaluate the impact of tobacco price increase for six months after price change. “Nonsmoker” is defined as a person who does not smoke at all or rarely smoke.

The average cigarette consumption per day (Q) was calculated by multiplying the average daily amount of smoking (A) and the number of days of smoking per month (B) and dividing by 30 (A*B/30). $Q_0$ is the amount of smoking in December 2004, $Q_1$ is the amount of smoking in July 2005, and $\Delta Q$ is the difference, $Q_1 - Q_0$. The average cigarette price (P) is arithmetic average of the price of the self-reported tobacco brands that students consumed. The students were allowed to choose a maximum of three brands. $P_0$ is the average cigarette price in December 2004, $P_1$ is average cigarette price in July 2005 and $\Delta P$ is the difference, $P_1 - P_0$.

The authors used three dependent variables. Smoking status was analyzed with the binary variable of current smokers and non-current smokers. Both ex-smokers and nonsmokers were categorized as non-current smokers. Reduction in smoking was evaluated with the dependent variable $\Delta Q/Q_0$. Brand change was analyzed by the binary variable of brand changers and non-brand changers.

As independent variables, demographic factors, school factors, family factors and educational factors were used. We distinguished ‘awareness about the harmful effect of smoking’ and ‘student’s attitude toward smoking’ because knowledge is not enough to change attitude. The duration of smoking in years is defined as the difference between the student’s current age and the age at which he or she began smoking on a regular basis.

## 4. Empirical Analysis

For estimating the price elasticity, two types of analyses are used: 1) Simple stratification and adjustment and 2) Multi-part model.

When the price elasticity of adolescent tobacco demand is calculated by simple stratification, the following method was applied.

$$\epsilon_{\text{tobacco}} = \frac{\frac{\Sigma \triangle Q}{\Sigma \frac{Q0+Q1}{2}}}{\frac{\Sigma \triangle P}{\Sigma \frac{P0+P1}{2}}} = (\triangle Q = Q1 - Q0, \triangle P = P1 - P0)$$

However, we used multi-part model for in-depth analysis considering the self-selectivity in smoking behavior. The statistical problem in estimating smoking behavior is how to deal with non-smokers because the amount of smoking is only observed in the person who have smoked at least once. Hence, when censoring is caused by observed zeros instead of missing data, as in the case of smoking behavior, this censoring problem due to sample selection might cause the estimation result to be biased (Maddala, 1983; Duan et al., 1984). Specifically, we can find the following two characteristics in the distribution of smoking behaviors. First a large proportion of the surveyed don't smoke at all during the sampling period. Second, the distribution of smoking amount is different between non-brand changers and brand changers.

Therefore, this study used a four-part model (Duan et al., 1983), or, more specifically, two sets of two-part model that one is to estimate the probability of smoking and changing the amount of smoking among smokers and the other is to estimate the probability of brand switching and changing the amount of smoking between brand-changers and non-brand-changers.

As Duan et al. (1984) showed, this four part model is superior to a two-part model in that it does eliminate the sources of known inconsistency in the two-part model. Hence this paper is distinguished from Tsai et al. (2005) in which a modified two-part model is employed and the possible correlations among dependent variables is investigated by using Zellner's seemingly unrelated regression method.

The four-part model is constructed as follows:

A. Decision to smoke: estimated by logistic regression for all
B. Conditional change in smoking amount: estimated by OLS (Ordinary Least squares) for smokers only
C. Decision to change brands: estimated by logistic regression for smokers only
D. Estimation of the conditional change in smoking amount: by OLS for brand switcher and brand non-switcher, respectively

# Ⅳ. Result

## 1. General characteristics and factors associated with smoking

Of the 14,692 surveyed, male respondents were 47.4% (Table 2). Rate of smoking was higher among students in higher grades. The proportion of smokers was only 1.9% in $7^{th}$ graders compared to 15.4% in $12^{th}$ graders. Students in rural areas smoked more than those in urban and metropolitan areas (p=0.000). Only 5.6% of those who had less than 10,000 KRW (=10USD) in monthly allowance were current smokers, while 22.7% of those who had more than 30,000 KRW (=30USD) were current smokers.

Family environments were closely associated with adolescents'smoking. Those who had smoker in his family, had worse relationship with their parents and had conversation for less than 1 hour per week tended to smoke more. Satisfaction with school life was inversely related to smoking. The student who were under stress smoked more than those who were not. Awareness about the harmful effect of smoking and the student's attitude to smoking were also strongly related with smoking. Only 8.5% of those who perceived the harmful effect of smoking were smokers, while 39.1% of those who were not aware of its harmful effect were smokers. Among those who regarded smoking positive, 44.2% of them smoked, while among those who regarded smoking negative, only 3.9% smoked.

Table 2. General characteristics

(Unit: Person, %)

| | | Nonsmoker | Ex-smoker | Current smoker | Total[a] | p-value |
|---|---|---|---|---|---|---|
| Gender | Male | 5,058(80.4) | 400(6.4) | 831(13.2) | 6,289(100.0) | 0.000 |
| | Female | 6,135(87.8) | 350(5.0) | 505(7.2) | 6,990(100.0) | |
| School Type | Middle school | 4,903(92.0) | 206(3.9) | 221(4.1) | 5,330(100.0) | 0.000 |
| | General Highschool | 4,854(83.6) | 336(5.8) | 613(10.6) | 5,803(100.0) | |
| | Vocational high school | 1,555(66.6) | 234(10.0) | 545(23.4) | 2,334(100.0) | |
| Grade | 7th grader | 1,713(94.7) | 61(3.4) | 35(1.9) | 1,809(100.0) | 0.000 |
| | 8th grader | 1,691(92.5) | 66(3.6) | 72(3.9) | 1,829(100.0) | |
| | 9th grader | 1,498(88.7) | 78(4.6) | 113(6.7) | 1,689(100.0) | |
| | 10th grader | 2,478(81.1) | 193(6.3) | 384(12.6) | 3,055(100.0) | |
| | 11th grader | 2,041(77.6) | 193(7.3) | 395(15.0) | 2,629(100.0) | |
| | 12th grader | 1,882(77.3) | 180(7.4) | 374(15.4) | 2,436(100.0) | |
| Area | Metropolitan | 5,965(84.2) | 421(5.9) | 701(9.9) | 7,087(100.0) | 0.000 |
| | Urban Area | 3,874(86.8) | 224(5.0) | 364(8.2) | 4,462(100.0) | |
| | Rural Area | 1,473(76.8) | 131(6.8) | 314(16.4) | 1,918(100.0) | |
| Religion | None | 4,644(85.3) | 278(5.1) | 525(9.6) | 5,447(100.0) | 0.000 |
| | Buddhist | 2,023(83.6) | 154(6.4) | 243(10.0) | 2,420(100.0) | |
| | Protestant Christian | 3,310(85.0) | 227(5.8) | 258(9.2) | 3,895(100.0) | |

| | | Nonsmoker | Ex-smoker | Current smoker | Total[a] | p-value |
|---|---|---|---|---|---|---|
| | Catholic | 916(84.0) | 60(5.5) | 115(10.5) | 1,091(100.0) | |
| | Others | 240(73.8) | 21(6.5) | 64(19.7) | 325(100.0) | |
| Monthly allowance | <10000won | 5,914(90.3) | 271(4.1) | 366(5.6) | 6,551(100.0) | 0.000 |
| | 10000~30000won | 2,134(77.2) | 201(7.3) | 428(15.5) | 2,763(100.0) | |
| | >30000won | 774(68.8) | 96(8.5) | 255(22.7) | 1,125(100.0) | |
| Smoker in the family | Yes | 8,191(83.7) | 577(5.9) | 1,015(10.4) | 9,783(100.0) | 0.000 |
| | No | 2,780(86.9) | 149(4.7) | 271(8.5) | 3,200(100.0) | |
| Family attitude to smoking | Against | 8,932(85.6) | 559(5.4) | 940(9.0) | 10,431(100.0) | 0.000 |
| | Permissive/Indifference | 1,508(77.6) | 139(7.2) | 296(15.2) | 1,943(100.0) | |
| Relationship with parents | Good | 8,138(86.5) | 503(5.3) | 772(8.2) | 9,413(100.0) | 0.000 |
| | So-so | 2,089(79.9) | 158(6.0) | 367(14.0) | 2,614(100.0) | |
| | Bad | 269(64.0) | 44(10.5) | 107(25.5) | 420(100.0) | |
| Time spent on conversation with family per week | <hour | 3,546(79.7) | 294(6.6) | 611(13.7) | 4,451(100.0) | 0.000 |
| | 1~3 hour | 4,065(86.3) | 248(5.3) | 399(8.5) | 4,712(100.0) | |
| | >3hours | 2,843(88.0) | 161(5.0) | 226(7.0) | 3,230(100.0) | |
| School life satisfaction | Satisfied | 4,575(85.5) | 312(5.8) | 461(8.6) | 5,348(100.0) | 0.000 |
| | So-so | 4,282(85.9) | 257(5.2) | 445(8.9) | 4,984(100.0) | |
| | Dissatisfied | 2,251(79.5) | 176(6.2) | 404(14.3) | 2,831(100.0) | |
| Subjective health status | Healthy | 9,193(86.4) | 560(5.3) | 885(8.3) | 10,638(100.0) | 0.000 |
| | Not healthy | 1,875(76.1) | 176(7.1) | 414(16.8) | 2,465(100.0) | |
| Perceived stress | Yes | 6,125(81.8) | 476(6.4) | 884(11.8) | 7,485(100.0) | 0.000 |
| | No | 4,897(88.2) | 254(4.6) | 399(7.2) | 5,550(100.0) | |
| Awareness about harmful effect of smoking | Harmful | 10,003(86.4) | 591(5.1) | 980(8.5) | 11,574(100.0) | 0.000 |
| | So-so | 341(57.4) | 87(14.6) | 166(27.9) | 594(100.0) | |
| | Not harmful | 127(51.2) | 24(9.7) | 97(39.1) | 248(100.0) | |
| Student's attitude to smoking | Negative | 8,371(92.1) | 367(4.0) | 355(3.9) | 9,093(100.0) | 0.000 |
| | So-so | 1,833(66.3) | 300(10.9) | 630(22.8) | 2,763(100.0) | |
| | Positive | 294(49.7) | 36(6.1) | 261(44.2) | 591(100.0) | |

[a] Total numbers are not consistent because of missing variables

## 2. The effect of the increase in tobacco price on adolescent smokers: By simple stratification

### A. Reduction in smoking and the price elasticity of adolescent demand for tobacco

The increase in tobacco price has led 11.7% of smokers to stop smoking and 20.5% of smokers to reduce smoking (Table 3). The reduction in smoking was more noticeable among middle school students and female students. When it comes to total smoking amount, price increase has resulted in a 27.7% reduction in tobacco consumption. Female smokers showed greater reduction rate of 31.8%, compared to 24.3% for male smokers, and middle school students showed the greatest reduction rate of more than 30% in both males and females.

In the cohort study of 700 Korean male adults conducted from 2004 to 2005, 11.0% of smokers stopped smoking and 22.2% of smokers reduced smoking in 6 months after the price increase (Kim & Lee, 2005). The proportion of smokers who quitted or reduced smoking in adult is very similar to that of adolescents.

When asked whether the price increase influenced the decision to quit, 26.5% answered ‘yes’ and 38.2% answered that it made an impact on reduction in their smoking (Table 4). In particular, male vocational high school students were more likely to respond that the price increase was the main reason for the reduction in smoking. The fact that no male students in vocational high school quitted smoking suggests that the price increase was not enough to make them quit smoking but only contributed to the reduction in the amount of smoking. Meanwhile, when asked whether an additional increase in price would decrease the smoking rate, 49.9% of the respondents answered ‘yes’ (14.9% answered ‘absolutely yes’ and the other 35.0% answered ‘yes’).

Table 3. Smoking reduction after the price increase

Unit: Person, %

| | | Middle school | | General Highschool | | Vocational Highschool | | Total[a] (Weighted Average and Weighted proportion) | | | Adults[b] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Male | Female | Male | Female | Male | Female | Male | Female | Total | Male |
| Change in smoking pattern after the price increase | Never thought about behavioral change | 21 (18.9) | 15 (25.4) | 70 (21.2) | 30 (24.6) | 24 (13.3) | 27 (10.4) | 17.6 | 21.5 | 19.4 | 51.2 |
| | Thought about cut-down but never tried | 33 (29.7) | 8 (13.6) | 133 (40.3) | 33 (27.0) | 79 (43.6) | 125 (48.1) | 36.4 | 26.2 | 31.8 | |
| | Tried, but failed | 20 (18.0) | 7 (11.9) | 51 (15.5) | 22 (18.0) | 33 (18.2) | 49 (18.8) | 17.5 | 15.5 | 16.6 | 15.6 |
| | Reduced smoking | 21 (18.9) | 15 (25.4) | 60 (18.2) | 17 (13.9) | 45 (24.9) | 49 (18.8) | 20.6 | 20.2 | 20.5 | 22.2 |
| | Quit | 16 (14.4) | 14 (23.7) | 16 (4.8) | 20 (16.4) | 0 (0.0) | 10 (3.8) | 7.6 | 16.6 | 11.7 | 11.0 |
| | Total (100%) | 111 (100.0) | 59 (100.0) | 330 (100.0) | 122 (100.0) | 181 (100.0) | 260 (100.0) | 100.0 | 100.0 | 100.0 | 100.0 |
| Rate (%) of reduction in total amount of smoking | | -31.2 | -37.2 | -17.1 | -31.8 | -19.5 | -21.9 | -24.3 | -31.8 | -27.7 | -19.9 |

Note: Out of 1,456 smokers, 1,063 responded to the question regarding their changes in smoking status.

[a] Weights are applied for adjusting the effect of over-sampling high school students.

[b] Result of Kim WN. *A Study of the Effectiveness of Tobacco Control Policy*. Korea University, Seoul, Korea, 2005.

The price elasticity of adolescent tobacco demand was estimated by calculating the weighted average based on the proportion of the surveyed to the whole population of each group. The estimated elasticity was -1.56 in total (Table 5). Females had a greater elasticity than males: -1.90 vs. -1.34. Middle school students showed much greater elasticity than high school students: -1.80 vs. -1.15. The findings of this study are different from former research, which showed that boys are more responsive to changes in the price of cigarettes than girls (Lewit et al., 1981; Alexander, 2003).

Table 4. Reasons for the change in smoking pattern

Unit: Person, %

| | | Middle school | | General Highschool | | Vocational Highschool | | Total | Adult[a] |
|---|---|---|---|---|---|---|---|---|---|
| | | Male | Female | Male | Female | Male | Female | | Male |
| Did the price increase influence the decision to quit smoking? | Yes | 2 | 2 | 6 | 5 | 0 | 3 | 18 | (65.1) |
| | (%) | (12.5) | (20.0) | (46.2) | (26.3) | (0.00) | (30.0) | (26.5) | |
| | No | 14 | 8 | 7 | 14 | 0 | 7 | 50 | (34.9) |
| | (%) | (87.5) | (80.0) | (53.9) | (73.7) | (0.00) | (70.0) | (73.5) | |
| Did the price increase influence the decision to cut down smoking? | Yes | 39 | 16 | 107 | 35 | 72 | 82 | (38.2) | (59.2) |
| | (%) | (41.9) | (35.6) | (34.6) | (36.8) | (41.9) | (34.2) | | |
| | No | 54 | 29 | 202 | 60 | 100 | 158 | (61.8) | (40.8) |
| | (%) | (58.1) | (64.4) | (65.4) | (63.2) | (58.1) | (65.8) | | |

Note: Weighted average.of the reason of quitting smoking was not calculated because sample size was too small.
Decision to quit smoking is arithmetic average and reduced smoking is weighted average.
[a] Result of Kim WN and Lee JS. *A Study of the Effectiveness of Tobacco Control Policy*. Korea University, Seoul, Korea, 2005.

The impact of the price increase on tobacco demand can be estimated by counting the change in the demand of people who responded ‘yes’ to a question that asked whether their changes were caused by the price change. Changes in the demand of people who answered ‘no’ were regarded as 0 even though it is not. In that case, the elasticity of tobacco demand was estimated to be -1.23. Until now most of the researches haven’t considered the smoking reduction by reasons other than price change, such as concerns on health, anti-smoking education, family objection, social pressure, religion and so on. Therefore the price elasticity may be overestimated in those studies.

An interesting finding was that the difference in elasticity among middle school students, general high school students and vocational high school students became narrower after the above adjustment. The adjustment decreased the elasticity in middle school students, but didn’t have much effect on smoking among high school students. It indicates that the reduced smoking among some middle school students was not necessarily caused by the price change, but the fall in smoking among high school students, vocational high school students in particular, can be attributed to the price increase.

Table 5. Price elasticity of adolescent tobacco demand

| School Type | Gender | ε | ε adjusted[a] |
|---|---|---|---|
| Middle school | Male | -1.80 | -1.24 |
| | Female | -2.26 | -1.71 |
| | Total | -2.01 | -1.46 |
| General high school | Male | -0.99 | -0.91 |
| | Female | -1.94 | -1.11 |
| | Total | -1.43 | -1.01 |
| Vocational high school | Male | -1.27 | -1.31 |
| | Female | -1.33 | -1.12 |
| | Total | -1.28 | -1.24 |
| High school | Male | -1.15 | -1.15 |
| | Female | -1.67 | -1.11 |
| | Total | -1.34 | -1.13 |
| Total (Weighted average) | Male | -1.34 | -1.16 |
| | Female | -1.90 | -1.35 |
| | Total | -1.56 | -1.23 |

[a] Estimated by counting the change in the demand of people who responded 'yes' to a question that asked whether their changes were caused by the price change.

## B. Brand switch

Multiple responses were allowed on brand selection. When more than two brands were selected on the survey, the average of the prices was used. Tobacco products were categorized into deluxe brands (>2500 KRW), medium priced brands (>2200 KRW), and cheap brands (<2200 KRW) based on the market price as of July 2005. Some adolescents moved to cheaper-brand tobaccos after the price increase (Table 6). Before the price change, 96.6% of students consumed deluxe brands, but after the increase in price, only 70.1% stayed with them. Vocational high school students changed brands more than other students. Of the surveyed, 32.0% shifted to other brands after the price increase, and it was much bigger than that for adults (8.04%) (Duan et al., 1983).

Table 6. Brand(s) switching after the price increase

(Unit: Person, %)

| | | Middle school | | | | General high school | | | | Vocational high school | | | | Total (Weighted average/ Weighted proportion) | | Adults[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Male | | Female | | Male | | Female | | Male | | Female | | | | Male |
| | Year | 04’ | 05’ | 04’ | 05’ | 04’ | 05’ | 04’ | 05’ | 04’ | 05’ | 04’ | 05’ | 04’ | 05’ | |
| Brand | Cheap brands | 4.1 | 9.8 | 7.5 | 17.2 | 1.3 | 19.3 | 1.3 | 13.6 | 0.0 | 23.4 | 1.9 | 22.1 | 2.1 | 19.6 | - |
| | Medium-priced brands | 4.9 | 17.9 | 4.5 | 7.8 | 1.0 | 7.5 | 1.3 | 10.7 | 0.5 | 15.6 | 0.3 | 8.6 | 1.3 | 10.3 | - |
| | Deluxe brands | 91.1 | 72.3 | 88.1 | 75.0 | 97.7 | 73.2 | 97.4 | 75.7 | 99.5 | 61.0 | 97.8 | 69.3 | 96.6 | 70.1 | - |
| Switching brand | Yes | 33 (25.8) | | 17 (24.6) | | 108 (27.7) | | 46 (29.5) | | 93 (42.7) | | 111 (35.4) | | 408 (32.0) | | 46 (8.0) |
| | No | 95 (74.2) | | 52 (75.4) | | 282 (72.3) | | 110 (70.5) | | 125 (57.3) | | 203 (64.7) | | 867 (68.0) | | 526 (92.0) |
| | Total | 128 (100.0) | | 69 (100.0) | | 390 (100.0) | | 156 (100.0) | | 218 (100.0) | | 314 (100.0) | | 1,275 (100.0) | | 572 (100.0) |

Note : 04’ indicates 2004 Dec and 05’ indicates 2005 Aug
Out of 1,456 smokers, 1,275 responded to the question regarding their changes of brand they choose.

[a] Result of Kim WN. *A Study of the Effectiveness of Tobacco Control Policy*. Korea University, Seoul, Korea, 2005.

## 3. The effect of the increase in tobacco price on adolescent smokers: Four-part model

Firstly, we analyzed the determinant of participating smoking, so the respondents were divided into two groups, smokers and nonsmokers (ex-smokers are included in nonsmokers). And then we calculated the conditional change in smoking amount by those who currently smoke. In the next stage, we analyzed the determinant of changing brands, so current smokers were divided into two groups, brand switcher and brand non-switcher. Conditional changes in the amount of smoking by the two groups were calculated.

## A. Decision to smoke: Regression 1

The model to analyze the decision to smoke is as follows.

Y (smoking 0 or 1) = $\alpha 1$ + $\alpha 2$ * Gender + $\alpha 3$ * Height + $\alpha 4$ * BMI + $\alpha 5$ * Grade +$\alpha 6$ * School type + $\alpha 7$ * Religion + $\alpha 8$ * Academic performance + $\alpha 9$ * Monthly allowance + $\alpha 10$ * Perceived stress + $\alpha 11$ * Family smoking + $\alpha 12$ * Family communication + $\alpha 13$ * Relationship with parents + $\alpha 14$ * Awareness on health risk of smoking + u

Additional regression analysis was done without monthly allowance variable due to prevailing missing data, but the result was almost the same. Males are 1.5 times more likely to smoke than females (p=0.000) (Table 7). Height, age and school type are strongly related with the adolescent smoking (p=0.000). Religion did not seem to be a powerful determinant, but smoking rate in Catholics was 1.3 times higher than their peers (p=0.036). School performance and monthly allowances also inversely associated with smoking. Students who perceive more stress were 1.6 times more likely to smoke than those who don't (p=0.000). Smoking behavior is also affected by family environment. Those who didn't have smokers in family and talk for more than three hours a week with their family were less likely to smoke. Awareness about the physiological effect of cigarette smoking proved to be an important factor in adolescent smoking (p=0.000).

Table 7. Decision to smoke: Result of the logistic model for the determinants of smoking behavior

| | | Model 1 | | | Model 2 | | |
|---|---|---|---|---|---|---|---|
| | | B[a] | P value[b] | Exp(B)[c] | B | P value | Exp(B) |
| Gender | Females<br>Males | 0.403 | 0.000 | 1.497 | 0.359 | 0.000 | 1.432 |
| Height | Cm | 0.037 | 0.000 | 1.037 | 0.038 | 0.000 | 1.039 |
| BMI | Kg/M2 | -0.016 | 0.176 | 0.984 | -0.016 | 0.134 | 0.984 |
| Age | | 0.190 | 0.000 | 1.209 | 0.240 | 0.000 | 1.271 |
| School type | Middle schools | | 0.000 | | | 0.000 | |
| | General high schools | 0.086 | 0.615 | 1.090 | 0.197 | 0.205 | 1.217 |
| | Vocational high schools | 1.080 | 0.000 | 2.945 | 1.240 | 0.000 | 3.457 |
| Religion | None | | 0.215 | | | 0.013 | |
| | Buddhism | 0.079 | 0.451 | 1.083 | 0.115 | 0.223 | 1.122 |
| | Protestant Christianity | 0.039 | 0.675 | 1.040 | 0.088 | 0.291 | 1.092 |
| | Catholic | 0.293 | 0.036 | 1.341 | 0.358 | 0.004 | 1.430 |
| | Others | 0.320 | 0.187 | 1.377 | 0.477 | 0.014 | 1.611 |
| Academic performance | Upper third | | 0.000 | | | 0.000 | |
| | Middle third | 0.593 | 0.000 | 1.809 | 0.524 | 0.000 | 1.689 |
| | Lower third | 1.407 | 0.000 | 4.084 | 1.320 | 0.000 | 3.744 |
| Monthly allowance | < 10000 won | | 0.000 | | | | |
| | 10000won~30000won | 0.747 | 0.000 | 2.111 | | | |
| | > 30000 won | 1.083 | 0.000 | 2.952 | | | |
| Perceived stress | Not much/Not at all | | | | | | |
| | Much | 0.465 | 0.000 | 1.592 | 0.414 | 0.000 | 1.514 |
| Smokers in the family | No | | | | | | |
| | Yes | 0.270 | 0.005 | 1.310 | 0.281 | 0.001 | 1.324 |
| Time spent on conversation with family(week) | Less than 1 hour | | 0.018 | | | 0.062 | |
| | 1 hour to 3 hours | -0.133 | 0.135 | 0.876 | -0.148 | 0.065 | 0.862 |
| | More than 3 hours | -0.315 | 0.005 | 0.730 | -0.208 | 0.035 | 0.812 |
| Relationship with parents | Good | | 0.001 | | | 0.000 | |
| | So-so | 0.259 | 0.004 | 1.296 | 0.266 | 0.001 | 1.305 |
| | Bad | 0.556 | 0.002 | 1.744 | 0.685 | 0.000 | 1.983 |
| Awareness about harmful effect of smoking | Harmful | | 0.000 | | | 0.000 | |
| | So-so | 1.131 | 0.000 | 3.100 | 1.121 | 0.000 | 3.067 |
| | Not harmful | 1.674 | 0.000 | 5.334 | 1.765 | 0.000 | 5.839 |
| Constant | | -11.005 | 0.000 | | -11.067 | 0.000 | |
| | N | 8,696 | | | 10,686 | | |
| | Predictability | 89.3 | | | 89.2 | | |
| | -2LL | 4819.623 | | | 6027.730 | | |
| | Cox-snell R2 | 0.129 | | | 0.111 | | |
| | Nagelkerke R2 | 0.258 | | | 0.225 | | |

[a] B is regression coefficient of the variable
[b] P is p-value of the regression coefficient
[c] Exp(B) is exponential of regression coefficient

## B. Conditional change in smoking amount: Regression 2

Regression analysis to examine the changes in smoking pattern among smokers was conducted on the students who were smokers in December 2004. The regression equation is shown below, denoting $\Delta$P the change in the price of cigarette brand (unit: KRW) and $Q_0$ the amount of smoking as of December 2004. In model 1, all possible variables related to conditional change in smoking amount are used. To improve the robustness of the regression model, monthly allowance, family attitudes to smoking and the awareness about harmful effect of smoking are excluded from model 2.

Model 1

$\Delta Q/Q_0 = \beta 1 + \beta 2 * \Delta P + \beta 3 * \text{School Type} + \beta 4 * \text{Monthly allowance} + \beta 5 * \text{Family attitude} + \beta 6 * \text{Attitude to smoking} + \beta 7 * \text{Perception on health risk of smoking} + \beta 8 * Q_0 + \beta 9 * \text{Duration} + u$

Model 2

$\Delta Q/Q_0 = \beta 1 + \beta 2 * \Delta P + \beta 3 * \text{School Type} + \beta 6 * \text{Attitude to smoking} + \beta 8 * Q_0 + u$

The regression coefficient for $\Delta$P ($\beta 2$) was estimated to be 0.000107 which is marginally significant (p=0.097) (Table 8). For those who did not change cigarette brands, the price change $\Delta$P is 500 KRW uniformly. However, for those who did change cigarette brands, $\Delta$P gets smaller than 500 KRW and sometimes even below zero if they switch to a much cheaper brand. Therefore positive $\beta 2$ does not mean that the elasticity of tobacco demand has a positive value, but smokers would cut down their smoking more significantly when they switch to cheaper brands.

Regression coefficient estimated for school types ($\beta 3$) is positive and statistically significant. This means that high school students were more reluctant to cut down smoking than middle school students were. Regression coefficient

for the attitude toward smoking behavior ($\beta$6) is statistically significant and positive. Monthly allowance ($\beta$4), family attitudes toward smoking ($\beta$5) and awareness of the health risk of smoking ($\beta$7) were not statistically significant.

Statistical significance of daily smoking amount ($\beta$8) differed among the groups. In comparison with light smokers (< 5 cigarettes per day), moderate smokers (>5 and <10 cigarettes per day) were more likely to cut down and the coefficient was statistically significant (coefficient = -0.65). For heavy smokers (>10 cigarettes per day), the coefficient was smaller (-0.036) and not statistically significant either (t=-1.436 and p=0.151). Thus, moderate smokers were most likely to cut down smoking, whereas heavy smokers were less likely to do so. Total duration of smoking ($\beta$9) was found to inhibit cutting down smoking, which can be attributed to addictive effects.

The regression coefficient for $\Delta$P ($\beta$2) was estimated to be 0.000107 which is marginally significant (p=0.097) (Table 8). For those who did not change cigarette brands, the price change $\Delta$P is 500 KRW uniformly. However, for those who did change cigarette brands, $\Delta$P gets smaller than 500 KRW and sometimes even below zero if they switch to a much cheaper brand. Therefore positive $\beta$2 does not mean that the elasticity of tobacco demand has a positive value, but smokers would cut down their smoking more significantly when they switch to cheaper brands.

Regression coefficient estimated for school types ($\beta$3) is positive and statistically significant. This means that high school students were more reluctant to cut down smoking than middle school students were. Regression coefficient for the attitude toward smoking behavior ($\beta$6) is statistically significant and positive. Monthly allowance ($\beta$4), family attitudes toward smoking ($\beta$5) and awareness of the health risk of smoking ($\beta$7) were not statistically significant.

Statistical significance of daily smoking amount($\beta$8) differed among the groups. In comparison with light smokers ( < 5 cigarettes per day), moderate smokers (>5 and <10 cigarettes per day) were more likely to cut down and the

coefficient was statistically significant (coefficient = -0.65). For heavy smokers (>10 cigarettes per day), the coefficient was smaller (-0.036) and not statistically significant either (t = -1.436 and p = 0.151). Thus, moderate smokers were most likely to cut down smoking, whereas heavy smokers were less likely to do so. Total duration of smoking ($\beta$9) was found to inhibit cutting down smoking, which can be attributed to addictive effects.

Table 8. Conditional change in smoking amount: The result of the logistic model for the determinants of smoking pattern change

| | | Model 1 | | | Model 2 | | |
|---|---|---|---|---|---|---|---|
| | | B | t-value | P value | B | t-value | P value |
| ⊿P | | 0.000107 | 1.663 | 0.097 | 0.000092 | 1.559 | 0.119 |
| School type | Middle school | | Reference | | | Reference | |
| | General high school | 0.068 | 2.031 | 0.043 | 0.086 | 2.712 | 0.007 |
| | Vocational high school | 0.066 | 1.963 | 0.050 | 0.077 | 2.440 | 0.015 |
| Monthly allowance | < 10000 won | | Reference | | | | |
| | 10000won~30000won | 0.010 | 0.404 | 0.687 | | | |
| | > 30000 won | 0.012 | 0.396 | 0.692 | | | |
| Family attitude to smoking | Permissive or indifferent | | Reference | | | | |
| | Opposed | -0.019 | -0.732 | 0.483 | | | |
| Attitude toward smoking | Positive | | Reference | | | Reference | |
| | So-so | -0.085 | -2.999 | 0.003 | -0.086 | -3.370 | 0.001 |
| | Negative | -0.106 | -3.291 | 0.001 | -0.119 | -4.158 | 0.000 |
| Awareness about harmful effect of smoking | Not harmful | | Reference | | | | |
| | So-so | | 1.109 | 0.268 | | | |
| | Harmful | 0.026 | 0.495 | 0.621 | | | |
| Average consumed cigarettes per day | Less than 5 | | Reference | | | Reference | |
| | 5 to 10 | -0.056 | -2.143 | 0.033 | -0.065 | -2.729 | 0.007 |
| | More than 10 | -0.031 | -1.124 | 0.262 | -0.036 | -1.436 | 0.151 |
| Smoking duration | | 0.005 | 0.792 | 0.429 | 0.010 | 1.701 | 0.089 |
| Constants | | -0.180 | -2.521 | 0.012 | -0.190 | -4.230 | 0.000 |
| R-square | | 0.048 | | | 0.053 | | |
| Durbin-Watson | | 1.336 | | | 1.308 | | |
| F | | 2.265(p=0.007) | | | 4.948(p=0.000) | | |
| N | | 594 | | | 716 | | |

### C. Decision to change brand: Regression 3

Decision to switch brands was analyzed using the following logistic regression.

Brand change (0 or 1) = $\gamma 1 + \gamma 2 * \text{Gender} + \gamma 3 * \text{School type} + \gamma 4 * \text{Monthly allowance} + \gamma 5 * \text{Attitude to smoking} + \gamma 6 * Q_0 + u$

First of all, gender was not significantly associated with brand switch, however vocational high school students were more likely to change brands compared to middle school students ($\gamma 3 = 0.898$, $p = 0.002$), but this was not significant in general high school students (Table 9). The more they smoke, the more likely they are to change brands ($\gamma 6 = 0.035$, $p = 0.002$). Having negative attitude to smoking behavior turned out not to be associated with brand switching behavior. Although the decision to switch brands can imply an increase in financial burden due to the rise in tobacco price, monthly allowance was not related with brand switch.

Table 9. Decision to switch brands: The result of the logistic model for the determinants of brand switching

| Variables | | B | p | Exp(B) |
|---|---|---|---|---|
| Constants | | -1.309 | 0.001 | 0.270 |
| Gender | Male | | | |
| | Female | -0.277 | 0.150 | 0.758 |
| School type | Middle school | | Reference | |
| | General high school | 0.123 | 0.675 | 1.130 |
| | Vocational high school | 0.898 | 0.002 | 2.454 |
| Monthly allowance (Income) | < 10,000 won | | Reference | |
| | 10000won~30000won | 0.334 | 0.120 | 0.396 |
| | >30,000 won | 0.344 | 0.154 | 0.410 |
| Family attitude toward smoking | Permissive | | Reference | |
| | Not concerned | -0.290 | 0.142 | 0.748 |
| | Opposed | -0.590 | 0.554 | 0.027 |
| Q0 | Average amount of smoking as of Dec 2004 | 0.035 | 0.012 | 1.036 |
| | N | | 708 | |
| | Predictability | | 71.8% | |
| | -2LL | | 788.435 | |
| | Cox-Snell R2 | | 0.059 | |
| | Nagelkerke R2 | | 0.085 | |

## D. Estimation of the conditional change in smoking amount

People who did not change the brand consumed 7.41 cigarettes per day in December 2004 (before the increase in price), and reduced the amount of smoking by 1.71 cigarettes per day, while people who changed the brand as a result of the price change consumed 9.23 cigarettes per day in December 2004, and reduced it by 1.77 cigarettes per day (23.08% and 19.18% reduction for the brand non-switchers and brand switchers, respectively). For brand non-switchers the price elasticity of tobacco demand was -1.15. Meanwhile, from the result of regression for the conditional change in smoking amount (Table 8), smokers would cut down their smoking more when they switch to cheaper brands and hence $\Delta P$ is smaller. Therefore the price elasticity of brand-switchers may be marginally bigger than that of brand non-switchers.

## Ⅴ. Summary and Concluding Remarks

The most noticeable impact of the increase in tobacco price on adolescent smoking pattern were 'cut down' and 'brand switching'. After the price change 11.7% of smokers stopped smoking and 20.5% of smokers reduced smoking. The proportion of smokers who quitted or reduced smoking in adult is very similar to that of adolescents. In our study, total cigarette consumption of adolescents decreased by 27.7%, following 29.0% increase in price, which is much bigger than 19.9% decrease in consumption in the case of adults. Among adolescents, tobacco price policy is more effective to younger adolescents, moderate smokers with short duration of smoking.

The results also show that 32.0% of smoking adolescents moved to more affordable brands. Adolescents are more sensitive to brand changes after the price increase. Vocational high school students were the most prominent group associated with brand switching, and heavy smokers were more likely to switch tobacco brands. Even though some adolescents are likely to change the brand after price increase, the reduction in the amount of smoking of brand changers is either bigger than or at least as big as that of brand non-changers. These impacts of tobacco price policy continued for at least six months.

The price elasticity of adolescent demand for tobacco is calculated to be -1.56. When smokers who changed the smoking pattern not because of price increase were excluded, the elasticity is estimated to -1.23. Meanwhile, the estimated elasticity of brand non-switchers was -1.15. The reason why the elasticity of brand switchers is bigger than that of brand non-switchers may be that the price change ($\Delta$P) of those who did change cigarette brands is smaller than 500 KRW, while the price change ($\Delta$P) of those who did not change cigarette brands is 500 KRW uniformly when there is no significant difference in the amount of cigarette consumption between brand switchers and brand non-switchers.

Considering that the elasticity of brand-switchers may be marginally bigger than that of brand non-switchers, the price elasticity of tobacco demand by Korean adolescents is estimated to be in the range of -1.15 and -1.56 (-1.34 for male and -1.90 for female). They are two to three times greater than that of Korean male adults, -0.55, which was calculated from a cohort study conducted after the price increase (Kim & Lee, 2005). These results are consistent with previous studies which concluded that the demand for tobacco by adolescents is more responsive to the price increase than that of adults (Lewit et al., 1981; Lewit & Coate, 1982; Chaloupka & Wechsler, 1997; World Bank 1999, 2000; Alexander, 2003). Considering that the percentage of adult smokers who quitted or reduced smoking is very similar to that of adolescents, the difference in elasticity between adults and adolescents originates from the difference in the average amount of daily smoking.

From the four-part model in our study, the following results were obtained; Firstly, we can conclude that adolescents'attitude toward smoking behavior is significant for reducing smoking after price increase (Table 8). It means that students who have regarded smoking as bad behavior are more likely to quit when the price was raised. Moreover its coefficient is greater than those of other variables. From this result, we can expect that combining anti-smoking campaign/education and price policy is likely to have a synergic effect because anti-smoking campaign and education lead students to have negative attitude toward smoking, and students who have negative attitude toward smoking are more sensitive to the increase in price. As in the research of Lisa et al. (2005) that introduces the multiplier effects of peer smoking and tobacco price control policy (Powell et al., 2005), there is a potential for a multiplier effect with respect to anti-smoking campaign/education and tobacco price policy. However awareness about the harmful effect of smoking was not significant. Therefore for this synergic effect to be realized, anti-smoking campaign/education has to be effective enough to change students' attitude toward smoking behavior rather

simply deliver knowledge. Secondly, even though some adolescents changed the brand after price increase, the reduction in smoking by brand changers was either bigger than or at least as big as that by non-brand changers is remarkable.

In conclusion, this study showed that increasing tobacco price is very effective tobacco control policy in not only reducing smoking rate but also preventing adolescents from smoking. Since the effect of price policy is higher than that of non-price policy on tobacco control (World Bank, 2000; Kam, 2006) and adolescents are more sensitive than adults in the tobacco price (World Bank 1999, 2000; Lewit et al., 1981; Lewit & Coate, 1982; Chaloupka & Wechsler, 1997; Alexander, 2003), the Korean Government needs to increase the tobacco price regularly and over 20% at once.

This research has some limitations. First, recall bias might be a limitation for this study because the survey respondents answered questions six months later after the tax increase. This retrospective study can cause under-reporting of smoking rates. Further studies need to attempt to avoid recall bias by obtaining data on smoking prospectively.

Secondly, even though the students were informed of the confidentiality of the survey, some of smokers may have pretended not to smoke, potentially resulting in an underestimation of smoking rate. According to a research (West R et al., 2007), cotinine-verified smoking rates were higher than self-reported smoking rates by an estimated 2.8% point in England, 0.6% point in the United States, and 4.4% point in Poland. In Korea, cotinine-verified smoking rates were 5.3% point for men and 8.0% for women higher than self-reported smoking rates in 2008 (Jung-Choi et al., 2011). However, several studies have shown that self-reported data are reliable when the confidentiality is assured and can be accepted as valid (Needle et al., 1983; O'Malley et al., 1983; Barnea et al., 1987). Moreover, when it comes to the daily amount of smoking and their smoking behavioral change, there is no incentive for the students to answer incorrectly. Even though there is still the probability of underestimated smoking

rate in this study, it is a less likely to influence the price elasticity of demand for cigarette since the smoking rate in this study (male 13.2%, female 7.2%) was higher than other survey result (male 9.9%, female 4.7%, Ji, 2005) in the same year.

Third, those who began smoking after price increase were not considered. However it is expected that not many students began smoking during the six months after the increase in tobacco price. Lastly, strictly speaking, the price elasticity has to be calculated from the multiple regressions, but we couldn't induce it from the multiple regressions because of the limitation of our data. We tried to overcome the limitation through the stratification by age and sex.

김현철은 미국 컬럼비아대학교 경제학 박사과정에 있으며, 주요 관심분야는 개발경제학 분야이다.
(E-mail: hk2405@gmail.com)

조경숙은 연세대학교에서 보건학 박사학위를 받았으며, 현재 보건복지부 국립제주검역소 소장으로 재직 중이다. 주요 관심분야는 금연정책, 건강증진, 국제보건 등이다.
(E-mail: gabrielle@korea.kr)

권순만은 미국 펜실베니아대학교에서 경영학 박사학위를 받았으며, 현재 서울대학교 보건대학원 교수로 재직 중이다. 주요 관심분야는 건강보험, 진료비지불제도 등이다.
(E-mail: kwons@snu.ac.kr)

임재영은 미국 노스캐롤라이나대학교에서 경제학 박사학위를 받았으며, 현재 고려대학교 식품자원경제학과 교수로 재직 중이다. 주요 관심분야는 보건경제, 노인정책 등이다.
(E-mail: jylimecon@korea.ac.kr)

## References

Alexander, D.(2003). Youth are more sensitive to price changes in cigarette than adults. *Yale j Biology and Medicine, 76*, pp.115-124.

Barnea, Z., Rahav, G., Teichman, M.(1987). The reliability and consistency of self-reports of substance use in a longitudinal study. *Br J Addict, 88,* pp.891-898.

Chaloupka, F. J.(1991). Rational additive behavior and cigarette smoking, *J Pol Econ, 99*, pp.722-742.

Chaloupka, F. J., Pacula, R. L.(1999). Sex and race differences in young people's responsiveness to price and tobacco control policies. *Tob Control, 8*, pp.373-377.

Chaloupka, F. J., Wechsler, H.(1997). Price, tobacco control policies and smoking among young adults. *J Health Econ, 16*, pp.359-373.

Chaloupka, F. J., Warner, K. E.(2000). *The Economics of Smoking*. New York: Elsevier.

Cho, K. S.(2006). *Tobacco Control Policy of the Republic of Korea 2005*. Seoul: Ministry of Health & Welfare.

Duan N., Manning, W. G., Morris, C. N., Mewhouse J. P.(1983). A Compaison of Alternative models for the demand of Medical Care. *J Business and Econ Stat, 1*, pp.115-126.

_____, _____, _____, _____(1984). Choosing between the Sample-Selection Model and the Multi-Part Model. *J Business and Econ Stat, 3*, pp.283-289.

Emery, S., White, M. M., Pierce, J. P.(2001). Does cigarette price influence adolescent experimentation?. *J Health Econ, 20*(2), pp.261-270.

Evans, W. N., Farrelly, M. C.(1998). The compensating behavior of smokers: Taxes, tar and nicotine. *RAND J Econ , 29*(3), pp.578–595.

Ezzati, M., Lopez, A. D., Rodgers, A., Vander, H. S., Murray, C. L., and the

Comparative Risk Assessment Collaborating Group.(2002). Selected major risk factors and global and regional burden of disease. *Lancet, 360*, pp.1347-1360.

Grossman, M., Coate, D., Lewit, E. M., Shakotko, R. A.(1983). *Economics and other factors in youth smoking: Final report*. Arlington: *National Science Foundation*.

Gruber, J.(2002). The economics of tobacco regulation. *Health Aff(Millwood), 21*(2), pp.146-162.

Harris, J. E., Chan S. W.(1999). The continuum-of-addiction: cigarette smoking in relation to price among Americans aged 15-29. *Health Econ, 8*(1), pp.81-86.

Hyland, A., Bauer, J. E., Li, Q., Abrams, S. M., Higbee, C., Peppone, L., Cummings, K. M.(2005). Higher cigarette prices influence cigarette purchase patterns. *Tob Control, 14*, pp.86-92.

Ji, S. H. (2005). *The annual survey for smoking status of middle and high school students in Korea*. Seoul: Yonsei University. (In Korean)

Jung-Choi, K. H., Khang, Y. H., Cho, H. J.(2011). Hidden female smokers in Asia : A comparison of self-reported with cotinine-verified smoking prevalence rates in representative national data from an Asian population. *Tob Control* DOI:10.1136/tobaccocontrol-2011-050012.

Jung, I. S., Park, N. R., Ham, J.(2004). Agreement between Smoking Self-report and Urine Cotinine among Adolescents. *Journal of Preventive Medicine and Public Health, 37*(2), pp.127-132. (In Korean)

Kam, S.(2006). The effect of price policy and policy aim in anti-tobacco policies. *Health and Welfare Forum, 116*, pp.24-36. (In Korean)

KCDC(2011a). *2010 Korean National Health and Nutrition Examination Survey*. Osong: Korea Centers for Disease Control and Prevention. (In Korean)

_____(2011b). *2010 Korean Youth Health Risk Behavior Web-based Survey*. Osong: Korea Centers for Disease Control and Prevention. (In Korean)

Kim, W. N., Lee, J. S.(2005). *A Study of the effectiveness of tobacco control policy*. Seoul: Korea University. (In Korean)

Laxminarayan, R., Deolalikar, A.(2004). Tobacco initiation, cessation, and change: evidence from Vietnam. *Health Econ, 13*, pp.1191-1201.

Lee, J. M., Hwang, T. C., Ye, C. Y., Chen, S. H.(2004). The effect of cigarette price increase on the cigarette consumption in Taiwan: evidence from the National Health Interview Surveys on cigarette consumption. *BMC Public Health, 4*, doi:10.1186/1471-2458-4-61.

Lewit, E. M., Coate, D., Grossman, M.(1981). The effects of government regulations on teenage smoking. *Health Econ, 24*(3), pp.545-569.

Lewit, E. M., Hyland, A., Kerrebrock, N., Cummings, K. M.(1997). Price, Public Policy, and smoking in young people. *Tob Control, 6,* pp.17-24.

Lewit, E. M., Coate, D.(1982). The potential for using excise taxes to reduce smoking. *J Health Econ, 1*, pp.121-145.

Maddala G. S.(1983). A Survey of the Literature on Selectivity Bias as it Pertains to Health Care Markets. *Advances in Health Economics and Health Services Research, 6*, pp.3-18.

Needle, R., McCubbin, H., Lorence, J., Hochhauser, M.(1983). Reliability and validity of adolescent self-reported drug use in a family based study: a methodological report. *Int J Addict, 18*, pp.901-912.

O'Malley, P. M., Bachman, J. G., Johnston, L. D.(1983). Reliability and consistency in self-reports of drug use. *Int J Addict, 18*, pp.805-824.

Ohsfeldt, R., Boyle, R. G., Capilouto, E. I.(1999). Effects of tobacco excise taxes on the use of smokeless tobacco products. *Health Econ, 6*(5), pp.525–532.

Pekurinen, M.(1989). The demand for tobacco products in Finland. *British J Addiction, 84*, pp.1183–1192.

Powell, L. M., Tauras, J. A., Ross, H.(2005). The importance of peer effect, cigarette prices and tobacco control policies for youth smoking behavior. *J*

*Health Econ, 24*(5), pp.950-968.

Ross, H., Chaloupka, F. J.(2003). The effect of cigarette prices on youth smoking. *Health Econ, 12*(3), pp.217-230.

Thompson, M. E., McLeod, I.(1976). The effects of economic variables upon the demand for cigarettes in Canada. *Math Sci, 1*, pp.121-132.

Tsai, Y. W., Yang, C. L., Chen, C. S., Liu, T. C., Chen, P. F.(2005). The effect of Taiwan's tax-induced increases in cigarette prices on brand-switching and the consumption of cigarettes. *Health Econ, 14*(6), pp.627-641.

USDHHS(U.S. Department of Health and Human Services)(1994). *Preventing Tobacco Use Among Young People: A Report of the Surgeon General,* Atlanta, Georgia: U.S. Department of Health and Human Services, CDC.

Wasserman, J., Manning, W. G., Newhouse, J. P., Winkler, J. D.(1991). The effect of excise taxes and regulations on cigarette smoking. *J Health Econ, 10*(1), pp.43-64.

West, R., Zatonski, W., Przewozniak, K., Jarvis, M. J.(2007). Can We Trust National Smoking Prevalence Figures? Discrepancies Between Biochemically Assessed and Self-Reported Smoking Rates in Three Countries. *Cancer Epidemiol Biomarkers Prev, 16*, pp.820-822.

WHO(1997). *Tobacco or Health: a global status report*. Geneva: World Health Organization.

_____(2005). *The millennium development goals and tobacco control*, Geneva: World Health Organization.

World Bank(1999). *Cubing the Epidemic: Governments and the Economics of Tobacco Control*. Washington DC: World Bank.

_____(2000). *The economic rationale for intervention in the tobacco market: Tobacco control in developing countries*. Washington DC: World Bank.

**보건사회연구** 32(3), 2012, 429-460
Health and Social Welfare Review

# 담배가격 인상이 청소년 흡연에 미치는 영향: 흡연 감소 및 브랜드 스위칭

**김 현 철**
(컬럼비아대학교)

**조 경 숙**
(보건복지부)

**권 순 만**
(서울대학교)

**임 재 영**
(고려대학교)

본 연구는 우리나라 중·고등학생 14,692명을 대상으로 2005년 7월에 실시한 설문조사 자료를 이용하여, 2004년 말 담배가격 인상이 청소년 흡연에 어떠한 영향을 미쳤는지를 분석한 것이다. 연구결과, 담배가격 인상 후 청소년 흡연자 중 11.7%가 흡연을 중단했고, 20.5%가 담배 소비를 감소시켰으며, 32.0%가 더 값이 싼 담배로 브랜드를 바꾸었다. 비록 일부 청소년 흡연자들이 담배가격 인상 후에도 금연하지 않고 값이 싼 담배로 브랜드를 바꾸었다 할지라도, 브랜드를 바꾸지 않은 청소년 흡연자들보다 브랜드를 바꾼 청소년 흡연자들의 흡연감소 폭이 더 컸다. 또한 청소년의 담배소비에 대한 가격탄력성은 -1.15에서 -1.56으로 측정되었다.

주요용어: 담배가격, 청소년 흡연, 금연, 브랜드 스위칭, 가격탄력성