

# What cigarette price is required for smokers to attempt to quit smoking? Findings from the ITC Korea Waves 2 and 3 Survey

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Received 12 January 2015

Revised 26 May 2015

Accepted 27 May 2015



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**To cite:** Park E-J, Park S, Cho S-il, et al. *Tob Control* 2015;**24**:iii48–iii55.

## ABSTRACT

**Objectives** We assess the cigarette price that would motivate smokers to quit. We also explore the factors associated with the required price, including exposures to non-tax tobacco control policies.

**Methods** Cross-sectional analysis was conducted on data from 1257 male smokers, who participated in either Wave 2 or 3 of the ITC Korea Survey. Information was obtained on what cigarette price per pack would make them try to quit ('price to quit'). Tobit regression on log-transformed price and logistic regression on non-quit attempts were conducted to identify associated factors.

**Results** The median price to quit was KRW5854 (US \$5.31)/pack, given the current price of KRW2500 (US \$2.27)/pack. Younger age, higher education, lack of concern about the health effects of smoking, lack of quit attempts and more cigarettes consumed per day were related to a higher price needed for a quit attempt. Exposures to combinations of non-tax policies were significantly associated with lower price levels to be motivated to quit.

**Conclusions** Considering the large price increase required for quit attempts, tax policy needs to be combined with other policies, particularly for certain groups, such as heavy smokers. Strengthening non-tax policies is likely to facilitate greater responsiveness to tax policy.

## INTRODUCTION

Raising cigarette taxes is an important policy tool to reduce cigarette use, as recommended in the WHO MPOWER strategy for tobacco control.<sup>1</sup> Effective tobacco tax and price policy is also a key part of the Framework Convention of Tobacco Control (FCTC), an international treaty with 180 parties as of March 2015.<sup>2</sup> Higher taxes imply increases in the sale price of tobacco, which in turn reduces the demand for tobacco, following the well-established economic relationship between price and demand for consumer goods.

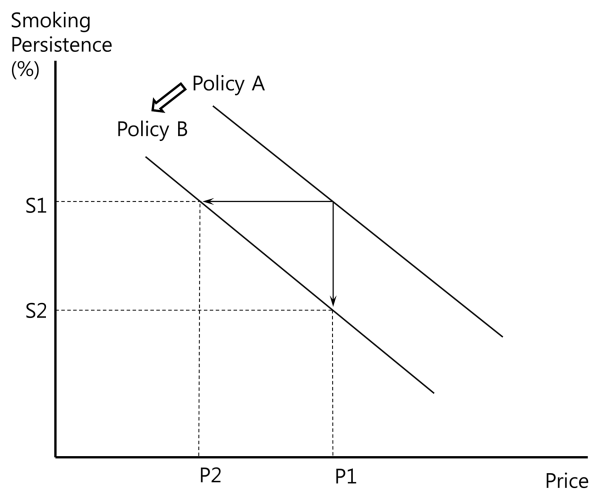
Tax policy effects on smoking behaviours can be assessed by observing actual responses after a tax increase. For example, a study based on the ITC Mexico Survey compared smoking behaviours in a cohort before and after the 2007 cigarette tax increase.<sup>3</sup> At the follow-up, light smokers were more likely to have quit for at least 30 days compared to heavy smokers (15.8% vs 9.5%). Another study in New Zealand compared the motivating factors for a quit attempt before and after a tax increase in 2010.<sup>4</sup> Smokers were 1.5 times more likely to make a quit attempt after the tax increase

than in 2009, and 3.6 times more likely to cite cost as a reason for attempting to quit.

An alternative way to estimate the response to a tax increase is to use hypothetical scenarios to assess expected responses. Ross *et al*<sup>5</sup> studied the impact of cigarette prices on young smokers' behaviour by presenting hypothetical price increases ranging from US\$0.50 to US\$4.00 per pack. The expected behavioural response was stronger with higher increase. More recently, Ross *et al* observed consistent results among adult smokers in the ITC Four Country Survey data. Smokers were asked how they would respond to a 50% increase in cigarette price. The percentage of smokers who would try to quit ranged from 58% in the UK to 73% in Canada.<sup>6</sup> Guillaumier *et al*<sup>7</sup> also obtained the price to quit among Australian socioeconomically disadvantaged smokers, finding that half of smokers would try to quit at a 20% increase in price. Among those who would not try to quit at such increase of price, the median of the price needed to quit was about 150% of the usual price.

It is usually desirable to combine diverse policies to reduce smoking prevalence, in addition to raising tax. Non-tax policies are expected to enhance the effects of tax increase, based on an assumption that smokers exposed to non-tax policies would be motivated to quit at a lower price level. However, to our knowledge, no previous studies have addressed this issue so far.

Currently, Korean male smoking prevalence is among the highest in Organisation for Economic Co-operation and Development (OECD) countries, being 43.7% in 2012.<sup>8</sup> Cigarette taxes have not increased since 2005, resulting in a continuous decline in real (inflation adjusted) consumer price for a decade. With increasing calls for a cigarette tax increase, the Korean government recently announced a comprehensive tobacco control plan including a tax raise by KRW2000 (US\$1.9) per pack, effective from 1 January 2015.<sup>9</sup> Despite the lag of tax policy, there has been gradual progress in other approaches, such as cessation clinic services, expansion of smoke-free areas, package warnings and media campaigns. Therefore, it would be informative to assess whether the exposure to non-tax policies motivated Korean smokers to quit at a lower level of cigarette price. Waves 2 (2008) and 3 (2010) of the ITC Korea Survey included relevant variables to address these questions. Thus, using these data, the aim of this paper is, first, to assess the distribution of cigarette price that would motivate smokers to quit ('price to quit'), and



**Figure 1** Hypothetical plots of smoking persistence versus cigarette price in two non-tax policy contexts. Smoking persistence (proportion of smokers who do not quit at or below a specific price) declines with higher cigarette price. Compared to a weaker policy A, a stronger policy B moves the line downward, and consequently reduces the price from P1 to P2 for a given level of smoking persistence, S1, and reduces the smoking persistence from S1 to S2 for a given level of price, P1.

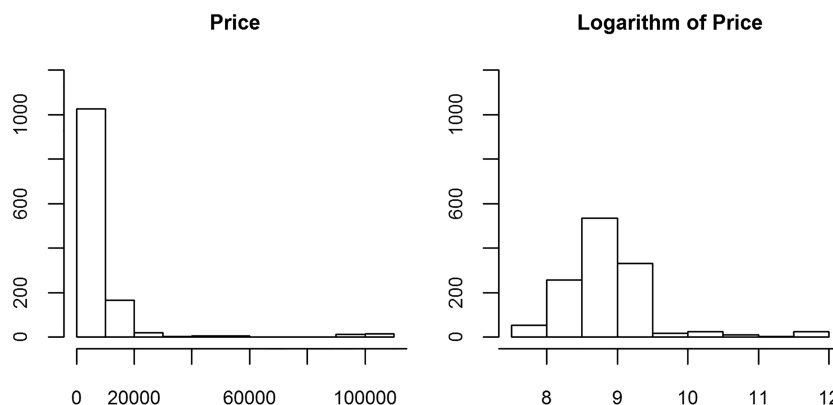
second, to identify the factors associated with levels of price to quit. Finally, we assess the effects of non-tax policies on the levels of price to quit. Since smoking prevalence is low (less than 10%) among Korean women, we focus our study on male smokers.

## METHODS

### Data and participants

We used the combined data of the 2008 Wave 2 and 2010 Wave 3 ITC Korea Survey. The ITC Korea Survey examined the cigarette price needed to attempt to quit, smoking behaviours, experience with various tobacco control policies and sociodemographic characteristics. For the ITC Korea Survey, 1818 persons participated in Wave 2 (October–November 2008), and 1753 persons in Wave 3 (October–December 2010). We used data from 972 male smokers in Wave 2 with valid responses, plus data on 285 male smokers who were newly enrolled in Wave 3. For those who participated in both waves, only the data from Wave 2 were used. Together, the final data for cross-sectional analysis in this study included 1257 male smokers. Since each of the study participants contributed information only once to our data, we used cross-sectional sampling weights for their respective wave.

**Figure 2** Distribution of cigarette price (KRW/pack) to motivate smokers to quit, in original (left) and log-transformed scale (right). KRW, Korean Won.



## Measures

### Price to quit

Two questions were used from the survey: “How much of a cigarette price increase would it take to make you try to quit smoking?”, “Would that be an increase in the cost per carton, per pack, or per single cigarette?”. The survey protocol included the following clarification to avoid respondents’ confusion: “We want to know how much the DIFFERENCE in price would be, not how much the higher price would be.” The cigarette price that would motivate a smoker to quit (‘price to quit’) was calculated as the sum of the needed price increase and usual price for purchased cigarettes, normalised per pack of 20 cigarettes. Survey questions used the Korean Won (KRW) as the currency unit. For the purpose of comparison with other studies, amounts are also shown where appropriate in this paper in US dollar units (USD), using the official World Bank exchange rate for 2008 (USD1=KRW1102.05).

### Smoking behaviours

Attempts at smoking cessation were defined by answering “Yes” to the question: “Have you ever tried to quit smoking?”. The number of smoked cigarettes per day (CPD) was ascertained to examine cigarette consumption, and the purchased cigarette price per pack of 20 cigarettes was self-reported.

### Non-tax policies

Non-tax policy-related variables included awareness of cigarette warning labels, noticing antismoking advertising or information, use of local stop-smoking services and a total smoking ban in indoor areas of workplaces and restaurants. Awareness of cigarette warning labels was assessed by asking “How often, if at all, have you noticed the warning labels on cigarette packages during the last month?”. We grouped those who answered that they have noticed these labels ‘often’ or ‘very often’ and compared them with the rest. Notice of antismoking advertising or information was measured by asking “In the last 6 months, how often, if at all, have you noticed advertising or information that talks about the dangers of smoking, or encourages quitting?”. As with the previous question, we grouped those who answered “often” or “very often”. Use of local stop-smoking services was also questioned: “In the last 12 months, have you received advice or information about quitting smoking from local stop-smoking services (such as clinics or specialists)?”. Response options were “Yes” and “No”. A non-smoking environment was defined by responses that smoking was not allowed in any indoor area in restaurants or cafes where the respondent lived, or where he or she worked.

### Other variables

Age at the time of survey, marital status, education and yearly household income were included in the survey.

Self-rated health and worries about the health effects of smoking were asked in five-point Likert scale. Because ITC Korea Survey was composed of three waves, and new participants were replenished in Wave 2 or 3, a time-in-sample variable was categorised into three groups according to the number of times respondents participated in the ITC Korea Survey.

### Data analysis

Descriptive statistics of study participants' characteristics and other variables were examined. The main outcome variable in this study was 'price to quit', as described above. Our hypothesis was that smokers' exposure to tobacco policies would lower the price to quit. This hypothesis could be tested in two ways: first, by comparing the average (mean and median) price to quit among different exposure groups; second, by comparing the proportion of non-quitters (defined as 'smoking persistence') at a given price among different exposure groups.

For detailed analyses, the analytical framework is shown in figure 1 as conceptual plots of the relationship between smoking persistence and cigarette price. In general, smoking persistence is expected to decline with higher cigarette price because of increase in the proportion of quitters. Effective non-tax tobacco control policies should move the line downward and reduce smoking persistence at any price level. The effect of policy B relative to policy A on price to quit can be conceptualised as the difference P1–P2, and the effect on smoking persistence as the difference S1–S2. We implemented the analysis of the former by Tobit regression and the latter by logistic regression.

Initial assessment of the unweighted data showed that the distribution of the cigarette price to quit was highly skewed, with a prolonged tail towards the higher prices, with range from KRW2000 to 102 800 (US\$1.81–93.3). Log-transformation resulted in a reduction in skewness (from 5.3 to 1.4 in skewness coefficient) (figure 2). Excluding the highest 5% of values, KRW20 000 (US\$18.1) or higher, markedly reduced the skewness coefficient to 0.06.

Weighted data were used for subsequent analyses. The outlier responses likely represent strong unwillingness to quit, even if the price becomes extremely high. Since such responses may not carry information about the specific price beyond a certain level, they were regarded as censored in order to avoid their influence on the mean. The Tobit model is a censored regression model used for a continuous dependent variable that is not observed beyond a certain cut-off value. This model is often used in econometrics, for the censored variables other than the time variable.<sup>10</sup>

For the Tobit model, we set the cut-off value for censoring at the 95th centile of the dependent variable, KRW22 400 (US \$20.3), excluding the highest 5% of the weighted data. Since the distribution of price to quit was still skewed even with the censoring, the natural logarithm of the price to quit was used for the Tobit analysis. Even if the dependent variable was censored, the observations were still included in the analysis to utilise the information on the other covariates, with the price value taken as the censoring cut-off. We conducted sensitivity analyses using different cut-offs (1%, 3%, 7%, 10%). Estimates showed only very small changes, and there were no changes in statistical significance for any of the non-tax policy variables. Since the Tobit model may be vulnerable to violating the assumption about the distribution of the error term, we

**Table 1** Characteristics of study population and cigarette price to quit† (N=1257)

	Per cent	Cigarette price to quit (KRW/pack)	
		Mean (SE)	Median
Total	100.0	9747 (468)	5854
Survey year		p=0.72	p<0.01
2008	75.9	9821 (583)	4996
2010	24.1	9512 (628)	7387
Time-in-sample		p=0.21	p<0.01
Once	50.8	9692 (593)	7219
Twice	37.9	10 339 (897)	5444
Three times	11.3	8002 (990)	4785
Age		p=0.15	p=0.05
18–29	26.4	8404 (668)	5122
30–39	32.9	11 241 (1113)	7312
40–49	23.1	10 006 (837)	5937
50–59	11.4	8742 (984)	4990
60+	6.2	8448 (910)	4884
Marital status		p=0.01	p=0.14
With partner	58.2	10 751 (719)	6000
Without partner	41.8	8350 (485)	5212
Education		p=0.22	p<0.01
High school or less	57.9	9253 (599)	4997
College or more	42.1	10 426 (750)	7352
Household income (KRW/year)		p=0.52	p<0.01
<30 million	37.2	9349 (788)	5090
30 million+	62.8	9983 (582)	7030
Good self-rated health		p=0.48	p=1.00
No	30.4	9275 (764)	5714
Yes	69.6	9953 (584)	5851
Worries about health effect of smoking		p=0.04	p<0.01
No	47.4	10 779 (789)	7073
Yes	52.6	8819 (535)	5350
Attempting smoking cessation		p=0.74	p<0.01
Never	18.4	9496 (762)	7407
Ever	81.6	9804 (548)	5456
Smoked cigarettes per day		p=0.02	p<0.01
≤10	33.3	8737 (792)	5301
11–20	54.5	9238 (532)	5492
≥21	12.2	14 803 (2071)	7453
Purchased cigarette price (won/per pack)		p=0.43	p<0.01
<2500	17.0	9104 (1067)	4977
2500	78.3	9738 (534)	6156
>2500	4.7	12 242 (2224)	6061
Awareness of cigarette warning labels		p=0.10	p=0.28
No	59.2	10 342 (681)	5877
Yes	40.8	8883 (584)	5500
Notice antismoking advertising or information		p=0.69	p=0.05
No	76.6	9861 (511)	5945
Yes	23.4	9374 (1090)	4982
Local stop-smoking services use		p=0.03	p=0.03
No	90.2	9957 (511)	5935
Yes	9.8	7806 (819)	4985
Smoke-free workplace and restaurants		p=0.24	p=0.34
No	74.1	10 048 (562)	5946
Yes	25.9	8886 (823)	5423

\*p Values for difference among categories.

†Cigarette price that would motivate smokers to quit. See Methods section for details.

KRW, Korean Won.

**Table 2** Percentage distribution (%) of participants (A), mean cigarette price to quit in KRW (and USD) per pack and prevalence (%) of high smoking persistence (B)<sup>†</sup> according to policy exposures

	Total (N=1257)			Younger men (18–39) (N=512)			Older men (40+) (N=745)		
	A (%)	Mean KRW (USD)	B (%)	A (%)	Mean KRW (USD)	B (%)	A (%)	Mean KRW (USD)	B (%)
All	100	9747 (8.84)	50.5	100	9976 (9.05)	52.3	100	9413 (8.54)	47.8
Warning									
No	59.2	10 342 (9.38)	50.8	56.6	10 778 (9.78)	53.2	63.0	9771 (8.86)	47.6
Yes	40.8	8882 (8.06)	50.0	43.4	8929 (8.10)	51.0	37.0	8804 (7.98)	48.3
Campaign									*p=0.03
No	76.6	9860 (8.94)	51.6	72.3	10 080 (9.14)	52.9	82.9	9582 (8.69)	49.8
Yes	23.4	9374 (8.50)	46.8	27.7	9705 (8.80)	50.5	17.1	8595 (7.80)	38.1
Advice		*p=0.03			*p=0.00				*p=0.06
No	90.2	9958 (9.03)	51.3	92.0	10 243 (9.29)	52.6	87.5	9522 (8.64)	49.2
Yes	9.8	7806 (7.08)	43.1	8.0	6893 (6.25)	48.6	12.5	8653 (7.85)	38.0
Non-smoking environment									
No	74.1	10 048 (9.11)	51.1	73.8	10 161 (9.22)	52.7	74.5	9885 (8.97)	48.9
Yes	25.9	8886 (8.06)	48.5	26.2	9454 (8.57)	51.1	25.5	8036 (7.29)	44.6
Combination		*p=0.05							*p=0.06
0	32.5	10 674 (9.68)	52.8	29.8	10 443 (9.47)	51.7	36.4	10 950 (9.93)	54.2
1	41.5	9976 (9.05)	50.7	42.7	10 789 (9.79)	54.7	39.7	8700 (7.89)	44.3
2+	26.0	8225 (7.46)	47.1	27.5	8205 (7.44)	49.0	23.9	8257 (7.49)	44.0

\*p Values are shown if  $p < 0.10$  for difference by levels in the means or prevalence.

<sup>†</sup>Defined by the individual's price to quit being greater than the overall median (5854KRW). See text for details. KRW, Korean Won; USD, US dollar units.

performed tests for heteroskedacity. We also compared the results from the Tobit models with those from logistic regression models.

For logistic regression, we defined a dichotomised dependent variable to be 1 if price to quit was greater than the weighted overall median, KRW5854 (US\$5.31), and 0 otherwise. This variable was constructed to indicate those expected to be relatively persistent smokers among the population, who would not quit at or below the overall median. Tentatively, we call this variable “high smoking persistence”. Analyses were performed for all study participants as well as for younger (below 40) and older (40 or higher) age strata separately. The age cut-off of 40 was based on previous surveys, which showed that smoking prevalence declined with age 40–49 years for Korean males.<sup>8</sup> The sampling weight was used to represent the population of smokers in Korea. Data were analysed using SAS V9.3 (SAS Institute Inc, Cary, North Carolina, USA). We used the procedures SURVEYMEANS, SURVEYFREQ for descriptive analyses, SURVEYREG and QUANTREG for hypothesis testing of the weighted means and medians, and QLIM and SURVEYLOGISTIC for modelling. A p value  $< 0.05$  was considered statistically significant.

## RESULTS

The median price to quit per pack, KRW 5854 (US\$5.31), was 2.3 times higher than the typical current price of KRW2500 (US\$2.27), the price at which cigarettes were sold most frequently, over 70% in Korea (table 1). Mean prices to quit were higher than medians reflecting the skewness, and there were differences in prices to quit according with the characteristics of the study population. Not having worries about health effects of smoking and the number of cigarettes smoked per day were associated with higher price to quit, both in the means and medians. Perceived exposures to non-tax policies tended to be

associated with lower prices in both median and mean values, but only the exposures to local cessation advice service and anti-smoking campaigns reached a statistical significance level in the medians and/or means.

Table 2 shows the differences across policy exposure categories in the mean price to quit as well as the prevalence of “high smoking persistence” (see Methods section for definition). Results are shown for total and age-stratified groups of study participants. Categories were first constructed dichotomously for each of the four policies, and a combined category as exposure to 0, 1 and 2 or more.

Generally, mean price to quit and prevalence of high smoking persistence were generally lower among those exposed to non-tax tobacco control policies than among those who were not. Statistical significance was reached for local cessation advice service (Advice) for all men, and for younger men. The prevalence of high smoking persistence approached statistical significance only among older men for exposure to antismoking campaigns (Campaign) and local cessation advice service (Advice).

Policy combinations showed dose–response patterns among all men. Statistical significance was approached for all men in the mean price to quit, and for older men in the prevalence of high smoking persistence.

Table 3 shows the results of the Tobit regression models, which explain cigarette price to quit in association with covariates. Younger age, married status, high education, no worries about health effect of smoking, higher CPD and higher purchased cigarette price were related to a higher price to quit. Among policy exposures, the use of local stop-smoking services showed statistically significant association. There was a significant interaction ( $p < 0.05$ ) between age and “Ever attempting smoking cessation”, so we additionally conducted analyses separately for younger and older age groups. In these stratified analyses, education, worries about health effect of smoking and

**Table 3** Tobit regression models for predictors of price to quit

	Total β (95% CI)	Younger men (18–39) β (95% CI)	Older men (40+) β (95% CI)
Survey year			
2010 (vs 2008)	0.15 (0.05 to 0.25)*	0.19 (0.06 to 0.32)*	0.11 (−0.05 to 0.27)
Time-in-sample (vs once)			
Twice	0.04 (−0.05 to 0.13)	0.11 (−0.01 to 0.22)	−0.05 (−0.20 to 0.10)
Three times	−0.17 (−0.30 to −0.04)*	−0.22 (−0.38 to −0.05)*	−0.13 (−0.33 to 0.07)
Age (vs referent)			
18–29	0.21 (0.02 to 0.40)*	0.02 (−0.14 to 0.10)	
30–39	0.23 (0.06 to 0.39)*	Referent	
40–49	0.06 (−0.11 to 0.23)		0.08 (−0.11 to 0.27)
50–59	0.01 (−0.18 to 0.18)		0.02 (−0.17 to 0.20)
60+	Referent		Referent
Marital status			
Without partner (vs with partner)	−0.14 (−0.24 to −0.04)*	−0.16 (−0.27 to −0.04)*	−0.09 (−0.27 to 0.10)
Education			
College or more (vs high school or less)	0.14 (0.06 to 0.21)*	0.11 (0.02 to 0.21)*	0.19 (0.07 to 0.32)*
Household income, KRW/year			
30 million+ (vs below 30 million)	0.02 (−0.06 to 0.10)	0.05 (−0.05 to 0.15)	−0.04 (−0.17 to 0.09)
Good self-rated health			
Yes (vs no)	−0.04 (−0.12 to 0.04)	−0.03 (−0.13 to 0.07)	−0.04 (−0.17 to 0.09)
Worries about health effect of smoking			
Yes (vs no)	−0.13 (−0.20 to −0.05)*	−0.13 (−0.22 to −0.03)*	−0.13 (−0.25 to −0.01)*
Attempting smoking cessation			
Ever (vs never)	−0.01 (−0.10 to 0.09)	0.09 (−0.02 to 0.20)	−0.18 (−0.34 to −0.03)*
Smoked cigarettes per day (vs ≤10)			
11–20	0.05 (−0.03 to 0.13)	0.04 (−0.06 to 0.13)	0.07 (−0.07 to 0.21)
≥21	0.35 (0.22 to 0.47)*	0.41 (0.23 to 0.59)*	0.32 (0.13 to 0.50)*
Purchased cigarette price, KRW/per pack†			
Higher vs 2500 vs lower	0.13 (0.05 to 0.21)*	0.24 (0.12 to 0.35)*	0.04 (−0.07 to 0.15)
Awareness of cigarette warning labels			
Yes (vs no)	−0.04 (−0.11 to 0.03)	−0.07 (−0.16 to 0.03)	0.01 (−0.11 to 0.13)
Notice antismoking advertising or information			
Yes (vs no)	−0.00 (−0.09 to 0.08)	0.05 (−0.06 to 0.15)	−0.08 (−0.25 to 0.07)
Local stop-smoking services use			
Yes (vs no)	−0.14 (−0.26 to −0.02)*	−0.18 (−0.35 to −0.01)*	−0.09 (−0.26 to 0.08)
Smoke-free workplace and restaurants			
Yes (vs no)	−0.07 (−0.16 to 0.01)	−0.03 (−0.14 to 0.07)	−0.12 (−0.26 to 0.01)

\*p&lt;0.05.

†Coded as ordinal levels of 2 (Higher), 1 (2500) and 0 (Lower), respectively. KRW, Korean Won.

higher CPD were significantly associated with price to quit in both age groups. Local stop-smoking services use was significantly associated only in the younger age group. However, this variable did not show a significant interaction with age. Heteroskedasticity was not statistically significant for the stratified models in both age groups, respectively.

According to logistic regression analyses, the odds of high smoking persistence was significantly associated with married status, high education, no worries about health effect of smoking and higher CPD (table 4). Some variables had a significant interaction by age group in the models (p<0.05); “Attempting smoking cessation” and two non-tax policy variables, “Notice of anti-smoking advertising or information” and “Local stop-smoking services use”, were associated with lower smoking persistence in older men. These effects were not detected among younger men by logistic regression analysis.

Although a policy variable may not show statistically significant association individually with the dependent variable, it

may still contribute to the effects of policy combinations. Table 5 shows the effects of exposure to any single non-tax policy and exposure to 2 or more non-tax policies, compared to no exposure. Results from the Tobit model were also presented as exponential of coefficients (exp(β)) in order to compare with ORs from logit models. Logit model results were stratified by age group, because of significant interactions by age. There was a significantly increasing trend of the effects by the number of policy exposures for all men according to the Tobit model, and for older men according to the logit model. We could not find a significant effect of policy exposures among younger men by the logit model. The Tobit and logit models may reflect slightly different aspects of the policy effects. In addition, the logit model dichotomises the information at a fixed level of price to create a dependent variable. This might have resulted in a lower power to detect an effect in younger men, of whom the sample size was smaller in our study.

**Table 4** Logistic regression models for predictors of high smoking persistence†

	Total OR (95% CI)	Younger men (18–39) OR (95% CI)	Older men (40+) OR (95% CI)
Survey year			
2010 (vs 2008)	1.77 (1.29 to 2.41)*	2.22 (1.46 to 3.37)*	1.46 (0.89 to 2.39)
Time-in-sample (vs once)			
Twice	1.02 (0.77 to 1.33)	1.21 (0.85 to 1.72)	0.82 (0.52 to 1.28)
Three times	0.41 (0.27 to 0.61)*	0.32 (0.18 to 0.56)*	0.49 (0.26 to 0.92)*
Age (vs referent)			
18–29	1.71 (0.95 to 3.08)	1.11 (0.76 to 1.62)	
30–39	1.57 (0.94 to 2.63)	Referent	
40–49	1.17 (0.69 to 1.99)		1.24 (0.69 to 2.20)
50–59	0.97 (0.55 to 1.70)		1.01 (0.57 to 1.81)
60+	Referent		Referent
Marital status			
Without partner (vs with partner)	0.68 (0.50 to 0.93)*	0.66 (0.45 to 0.96)*	0.77 (0.44 to 1.35)
Education			
College or more (vs high school or less)	1.58 (1.25 to 2.00)*	1.42 (1.05 to 1.93)*	1.95 (1.32 to 2.88)*
Household income, KRW/year			
30 million+ (vs below 30 million)	1.01 (0.80 to 1.29)	1.18 (0.87 to 1.61)	0.77 (0.51 to 1.17)
Good self-rated health			
Yes (vs no)	0.95 (0.75 to 1.21)	0.94 (0.69 to 1.29)	0.97 (0.65 to 1.46)
Worries about health effect of smoking			
Yes (vs no)	0.80 (0.64 to 1.00)*	0.83 (0.62 to 1.12)	0.72 (0.51 to 1.03)
Attempting smoking cessation			
Ever (vs never)	0.78 (0.59 to 1.04)	1.02 (0.71 to 1.46)	0.49 (0.30 to 0.81)*
Smoked cigarettes per day (vs ≤10)			
11–20	1.18 (0.92 to 1.51)	1.14 (0.84 to 1.56)	1.28 (0.83 to 1.99)
≥21	2.40 (1.62 to 3.57)*	3.57 (1.91 to 6.68)*	2.09 (1.17 to 3.71)*
Purchased cigarette price, KRW/per pack‡			
Higher vs 2500 vs lower	1.18 (0.92 to 1.52)	1.41 (0.96 to 2.06)	1.03 (0.73 to 1.46)
Awareness of cigarette warning labels			
Yes (vs no)	1.01 (0.81 to 1.27)	0.91 (0.68 to 1.22)	1.19 (0.82 to 1.72)
Notice antismoking advertising or information			
Yes (vs no)	0.90 (0.69 to 1.17)	1.10 (0.79 to 1.54)	0.61 (0.38 to 0.98)*
Local stop-smoking services use			
Yes (vs no)	0.73 (0.50 to 1.06)	0.94 (0.55 to 1.62)	0.58 (0.34 to 1.00)*
Smoke-free workplace and restaurants			
Yes (vs no)	0.90 (0.70 to 1.16)	1.02 (0.73 to 1.43)	0.74 (0.49 to 1.12)

\*p&lt;0.05.

†Defined by the individual's price to quit being greater than the overall median (5854KRW).

‡Coded as ordinal levels of 2 (higher), 1 (2500) and 0 (lower), respectively.  
KRW, Korean Won.**DISCUSSION**

This study analysed smokers' assessment of the cigarette price required to motivate them to quit, and explored the effects of

non-tax tobacco control policies and their combinations on the price to quit. Overall, the median price to quit was KRW5854 (US\$5.31), an increase to more than 2.3 times the typical

**Table 5** Effects of single and combined policy exposures on price to quit (Tobit model) and high smoking persistence† (logit model) (N=1257)

Combined exposure to non-tax policies	Tobit model‡		Logit model†			
	All β	exp(β) (95% CI)	Younger men (18–39) β	exp(β) (95% CI)	Older men (40+) β,	exp(β) (95% CI)
None	(ref)	p for trend=0.038	(ref)	p for trend>0.05	(ref)	p for trend=0.046
1	−0.04	0.96 (0.88 to 1.04)	0.12	0.49 (0.80 to 1.60)	−0.45*	0.64 (0.43 to 0.94)
2 or more	−0.11*	0.89 (0.81 to 0.98)	0.05	1.05 (0.71 to 1.55)	−0.42	0.66 (0.41 to 1.04)

\*p&lt;0.05.

†Defined by the individual's price to quit being greater than the overall median (5854KRW).

‡Adjusted for the covariates in tables 3 and 4 plus interaction between age group and quit attempt.

current price of KRW2500 (US\$2.27). We found that policy combinations were associated with stronger effects than single policies in dose–response fashions. Among variables other than tobacco control policies, smoking more than 20 CPD had the strongest association with higher price to quit and high smoking persistence.

Population studies with hypothetical price increases have investigated the price that would motivate smokers to quit.<sup>7–11</sup> These studies utilise methods corresponding to contingent valuation (CV). Generally, CV methods use surveys to obtain people's willingness to pay (WTP) for a specified offer. With regard to smoking, CV methods have been applied for two different purposes: to assess WTP for cessation treatment (WTPt), and to assess the WTP for smoking (WTPs). Methods in the first category of studies are similar to those applied to medical or surgical treatments for specific health problems.<sup>12</sup> The second category of studies typically ask about the tobacco price at which a smoker would be motivated to quit. It may appear contradictory that WTP is measured not only for cessation treatment but also for persistent smoking. This is because tobacco is an addictive good, characterised by withdrawal difficulty. If a smoker wishes to continue to smoke, he or she needs to pay for cigarettes. When the price is higher than WTPs, the smoker may be motivated to quit. However, if a smoker wishes to stop smoking, he or she faces the difficulty of withdrawal symptoms. This difficulty is positively correlated with WTPt. The smoker's perception of the health risks of smoking, or the benefits of quitting, is also involved in the motivation to quit.

Economic models of addiction have been proposed to address these issues.<sup>13</sup> A smoker's utility from smoking includes the immediate pleasure and the perceived additional benefits such as socialising. The cost or disutility of smoking includes health risks as well as the price of cigarettes. In contrast, withdrawal symptoms are experienced as a disutility of quitting attempts. If the perceived overall disutility of smoking is greater than the utility, the smoker will be motivated to quit. While tax and price policies are directed to increase the immediate cost of smoking, various non-tax policies are directed either to increase perceived disutility of smoking, or to lessen disutility of quitting. These non-tax policies should eventually reduce the net utility of smoking, resulting in a lower WTPs, that is, a lower price to quit.

Compared with the various approaches to study the effects of individual policies, there has been less attention paid to assessing the effects of policy combinations. A previous study showed that more than 30% of former smokers cited smoke-free policies and warning labels as a motivation to quit.<sup>14</sup> Levy *et al*<sup>15</sup> suggested that implementation of multiple policies appeared to be more successful in tobacco control, presumably by way of synergistic or complementary effects on smoking behaviours. However, the effects of policy combinations, particularly those including tax and non-tax policies, have not been discussed to a great extent. The analytical framework we adopted corresponds to a unified model that can be used to conceptualise the combined effects of tax and non-tax policies for tobacco control. Our study should not be taken as suggesting that lower tobacco tax is desirable. Rather, given the political reality that often plays a role in determining the level of tobacco tax increase, comprehensive policy combination is important to maximise the potential of tobacco tax to reduce smoking prevalence.

There are several methodological issues to consider in interpreting the current study findings. First, there can be some measurement issues. The self-assessed price that would motivate a smoker to quit may not be the same as the actual price at which the smoker indeed quits. Generally, intention to quit is known to

be associated with successful cessation. If the association is weak, the self-reported price to quit would be an underestimation, since failure to quit at the expected price would imply a need for a higher price to quit. In addition, some respondents of our study might have interpreted the question wrongly, and reported the price itself instead of the 'increase' in price.

A second issue is the direction of causality in the association between non-tax policy exposures and lower price to quit. For example, use of local quit-smoking services will increase a smoker's motivation to quit. On the other hand, a smoker who already has a strong intention to quit may seek out local quit-smoking services. Causality in both directions may lead to an overestimation of the effects of non-tax policies. Lastly, smokers' responses to an increase in cigarette price may include not only quitting, but also reducing the amount of smoking, switching to cheaper brands and seeking promotional products.<sup>16</sup> Availability of options other than quitting would increase price to quit, and thus persistence of smoking.

## CONCLUSION

Considering the large price increase required for quit attempts, tax policy needs to be combined with other policies, particularly for heavy smokers. The dose-response effects of combined policies suggest that comprehensive policies can reduce smoking prevalence more effectively by enhancing the sensitivity to tobacco tax policy.

### What this paper adds

- ▶ Exposures to non-tax policies may significantly enhance smokers' sensitivity to tax policy.
- ▶ A combination of non-tax policies with tax policy is associated with greater effects on the intention to quit in a dose–response fashion, suggesting the importance of comprehensive tobacco control policies.

**Contributors** E-JP, SP and S-iC conceived the study, analysed the data, interpreted the results and drafted the manuscript. YK and HGS designed ITC Korea Survey and collected data. PD and ACKQ supervised data analysis and manuscript drafting. GTF is the Chief Principal Investigator of the ITC Project and designed the ITC Korea Project. All authors reviewed and approved the final version of the manuscript. As the corresponding author, S-iC had final responsibility for this publication.

**Funding** The ITC Korea Project was supported by grants from the US National Cancer Institute (R01 CA125116), the Roswell Park Transdisciplinary Tobacco Use Research Center (P50 CA111236), Canadian Institutes of Health Research (57897, 79551 and 115016), the Korean Ministry of Health and Welfare and Korean National Cancer Center (0731040-1). Additional support was provided to Geoffrey T. Fong from a Senior Investigator Award from the Ontario Institute for Cancer Research and a Prevention Scientist Award from the Canadian Cancer Society Research Institute.

**Competing interests** None declared.

**Ethics approval** The ITC Korea Survey was cleared for ethics by the Office of Research Ethics, University of Waterloo, Ontario, Canada, and the ethics board of National Cancer Center, Republic of Korea.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data sharing statement** The data used for this study are available on request from the ITC Project at the University of Waterloo, Ontario, Canada.

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